

Wireless interference from Power Line Communication in Japan

How a controlled test demonstrated that Power Line Communication (PLC) turns the power lines along the streets into unintended antennas. This test was instrumental in keeping restrictions on PLC in Japan.

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Power line communication (PLC) is a method to transmit data using the existing electrical grid instead of fiber optic cables, telephone lines, dedicated lines or wireless communications. PLC can be used to bring internet services to households, for communication with smart electrical meters, or other uses.

The various PLC systems all work by injecting signals onto the electrical wires, which are then picked up elsewhere. The concern is that these added signals turn the electrical wires into unintentional antennas.

With many miles of power lines turned into antennas, even weak signals can have a substantial reach.

Early on, the authorities in Japan limited PLC systems to frequencies below 450 kHz. This limit was set as higher frequencies are used for civilian and military telecommunications, as well as by radio astronomy. These uses are not disturbed by radio noise below the 450 kHz. However, this limit was set as a precaution; it was originally not known whether there really would be a problem.

In the early 2000s, the PLC industry applied for permission to use frequencies up to 30 MHz, i.e. just below the VHF band. The ministry responsible for the wireless spectrum (Ministry of Public Management, Home Affairs, Post and Telecommunications) created a study group to look into the issue.

Testing PLC radio interference

An experiment was conducted by eight scientists from two universities, a space research center and the Japanese National Astronomical Observatory.

They created a test site on Mt. Akagi in a rural area of Japan. They had three power poles erected in a straight line, to simulate a small section of a residential power line.

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Then they set up a small PLC network, using two laptop computers and PLC modems. One computer was connected to the middle pole on the simulated power line. The other computer was placed inside a shielded shed to simulate a house.

Five different PLC modems were used, covering the frequencies from 3.8 MHz to 20.9 MHz. To receive the signals radiating from the simulated power line, antennas, receivers and spectrum analyzers were used. The receiving antennas were placed from 35 meters (110 ft) to 180 meters (560 ft) from the power line.

Results

The scientists could clearly detect the PLC radiation from the simulated power line. The report states:

many broadcasting signals were interfered [with] and some of them completely masked by the PLC noise.

They also noted that the PLC emissions were at least 30 dB above the cosmic radiation throughout the 4–30 MHz band.

As radio astronomy is very interested in the UHF band (300 MHz – 3 GHz), the study also looked at possible interference above 300 MHz. Even though the PLC systems all operated at frequencies below 21 MHz, they had a demonstrated spillover effect (harmonics) that clearly showed up at much higher frequencies.

The report concluded that a radio observatory must be located at least 4 km (2.5 miles) from the test site in order not to be disturbed. If PLC systems came into general use, using miles of power lines, a radio observatory must be located much further from populated areas. This would be impossible in densely populated Japan.

Conclusion

The conclusion was that PLC systems should not be allowed to use the requested frequencies, as it would interfere with telecommunication and science. The Ministry did not grant the permission.

Sources:

Measurements of Harmful Interference in the HF-UHF Bands Caused by Extension of Power Line Communication Bandwidth, Fuminori Tsuchiya et al, IVS CRL-TDC News, No. 21, November 2002.

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