

## Demonstration that power line communication turns electrical lines into antennas

Any type of signal that runs along an electrical wire will generate an electromagnetic field that radiates outwards. The wire is turned into a de facto antenna.

This can cause problems of various kinds, such as interfering with radio reception and sometimes even making electronic equipment malfunction. It can also be a problem for people who are particularly sensitive to these kinds of radiation.

The invention of systems for sending communication signals along electrical wires has been met with complaints from radio amateurs and broadcasters. Their concerns were that these power line communication or power line carrier (PLC) systems would turn out to cause a lot of interference as the electrical wires radiate the signals unintentionally.

The industry building the PLC systems responded that “there is no problem”.

One of the objectors was the British Broadcasting Corporation (BBC), which saw the PLC systems as a threat to the reception of the BBC World Service programs. The BBC World Service is broadcast worldwide, especially to countries which have censored media. These transmitters use the same frequencies as some of the PLC operators, frequencies that are particularly useful for long-distance radio broadcasts.

BBC research engineer Jonathan Stott stated in his White Paper:

there is the difficulty for radio-system users that the signals PLT [PLC] injects do not simply travel from point to point along the wiring, they also escape as *radiated emissions* [emphasis in original]

Met with refusal by the PLC-industry to take the problem seriously, the BBC engineer Jonathan Stott and his German colleague Dr. Markus Wehr came up with a simple demonstration of the problem.

They used an off-the-shelf home-networking PLC system called HomePlug. This system can be used to let computers, printers, etc. be networked in a home, using the household wiring to transfer the signals.

## 2 *PLC antenna effect demo*

A HomePlug modem is connected to a computer's USB port and also plugged into a wall outlet. Each computer or printer has its own HomePlug modem.

The HomePlug modems used in this demonstration are powered by the USB port. They only use the wall outlet to communicate through, not to power the modem. They do not check whether or not there is any power available in the outlet, they just send out their signals and listen for incoming signals. In other words, these HomePlug modems can work even if there is no electricity in the outlets they are plugged into.

Instead of plugging the HomePlug modem into a wall socket, Mr. Stott plugged it into a power strip. He also inserted the plug for a string of Christmas tree lights into the power strip. The power strip was not plugged into the wall, so it had no power and the lights on the Christmas tree were not on. There was no connection between the HomePlug modem and the household wiring.

And yet, the HomePlug network could freely communicate with another computer using another HomePlug modem, which was plugged into a wall outlet.

The electrical wires in the walls worked as a transmitting and receiving antenna for the one computer. The wires for the Christmas tree worked as transmitting and receiving antenna for the other computer. There was no physical connection. The communication was wireless, even though it was not intended to be. This is an elegant way to visually demonstrate that the wires are turned into unintentional antennas.

This demonstration is described more briefly in: British Broadcasting Corporation R&D White Paper WHP 099: *PLT and broadcasting – can they co-exist?* by J. H. Stott, November 2004. It is available on <http://www.bbc.co.uk/rd/pubs/whp/whp099.shtml>.

The BBC produced a brief video with this demonstration, which is available on: <http://downloads.bbc.co.uk/rd/pubs/whp/whp-pdf-files/whp099-downloads/whp099-videofile/1.rm>

Note that PLC is called PLT (Power Line Transmission) in British terminology.

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