

*BPL—Broadband over Power Lines—is the talk of ham radio. But how many of us would recognize it if we heard it on the air? CQ VHF columnist Gary Pearce, KN4AQ, has been involved with one of the BPL tests now under way, and offers this beginner’s guide to BPL interference.*

## BPL Primer: How Do I Know What I’m Hearing?

BY GARY PEARCE,\* KN4AQ

**E**verybody’s talking about BPL—Broadband over Power Lines—but few hams have actually heard it in person because there are still only a few active trial areas in operation. Thus, there are a lot of questions. Here in the Raleigh, North Carolina area, we’ve been “fortunate” enough to have a BPL trial nearby, courtesy of Progress Energy, and several of us have become intimately familiar with what one system sounds like and how it operates.

BPL is a means of delivering broadband internet data to homes and businesses using the power lines as the transmission medium. The other methods of delivery are the telephone lines (DSL, or Digital Subscriber Line service), cable TV, and wide-area microwave. BPL will be carried on the “local” power lines, feeding neighborhoods and business districts, not the big “high-tension” lines that carry power across a region. To be really specific, I’ll call this “Access BPL.” There are two other flavors of BPL—“in-house,” where BPL is used to distribute data inside a home or office using the AC power wires, and PLC (Power Line Carrier), which uses very low-frequency signals (below 200 kHz) to send low-speed data across the power lines. Energy companies use PLC to control their networks. I’ll mostly be talking about Access BPL here, but some of the same problems occur with in-house BPL.

DSL, cable, and BPL all use radio-frequency energy to carry their data, and they have a variety of modulation schemes. DSL and cable haven’t come



*The box on this power pole is called an “injector” and it injects the BPL signals onto the overhead power line. The small white box on the left of the bigger gray box is a Wi-Fi antenna, which receives data from a substation a few blocks away. It is then inductively coupled to one phase of the power line with the two big clamps seen on the wire. (Photos by the author)*

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Inside the BPL “extractor,” the broadband signals are taken off the power line and fed to a “Wi-Fi” antenna for final transmission into subscribers’ homes. Amperion uses Wi-Fi for this last leg; other companies take the signal all the way into each house on the power line.

under fire for causing interference because they generally use lower frequencies (below 4 MHz), and because they don’t radiate much signal. The TV cable is shielded, and the phone lines are balanced. If you go looking for signals with an antenna close to the lines, you’ll probably hear something.

BPL is causing bigger problems because it uses more of the HF spectrum (from 2 to 80 MHz is the common description), and because the RF is placed on unshielded power lines, where it can radiate like any other antenna—and it *does* radiate.

There are four principal vendors offering BPL equipment, and each uses a somewhat different technical scheme. I’ll describe in detail the one with which I’m most familiar, and then tell you a little about the others.

Progress Energy is using a system manufactured by Amperion ([www.amperion.com](http://www.amperion.com)). It places a series of close-spaced carriers, about one kHz apart, on the power line. Most of the time they are just clean, unmodulated carriers, although I hear a clock signal, a little tick-tick-tick at about 2 Hz, on many of them. Occasionally I’ll also hear what sounds like a burst of data “ring” across the carriers. The trial system I’ve observed has few subscribers. The carriers are always present, but would carry the sound of more data if they were more heavily used.

The carriers are placed on the power line in two “blocks”

of spectrum. One block, used for downloading data, is 3.5 MHz wide. The other, for upstream data, is a bit smaller, 2.5 MHz wide. These two blocks carry the BPL signal for about 2000 feet, where it is picked up by a “repeater” and converted to two new spectrum blocks for the next 2000-foot run. The two blocks on one wire can be anywhere in the available spectrum, which for Amperion is from 2 to 50 MHz, and they can be as close as 100 kHz apart. A block of spectrum can’t be reused for several 2000-foot legs of power line so that one repeater is sure to hear data only from its adjacent neighbor.

A BPL system can bring the data on the power line right into your building. In that case, you plug a BPL modem into any AC outlet, and connect an Ethernet cable between the modem and your computer. Amperion and Progress Energy don’t bring the BPL that far. They have standard wireless networking (802.11b “Wi-Fi”) nodes scattered about their trial neighborhoods, and users receive the internet via this 2.4-GHz connection.

### How Much Interference is There?

Once again, the BPL RF placed on the power lines *does* radiate. The Progress Energy trial uses a half-mile of overhead power line along the main highway to bring BPL to a neighborhood. Then the signal goes onto buried lines for distribution to the homes, with repeaters in ground-mounted pedestals. They have been using spectrum near 25 and 29 MHz for the overhead line, and many blocks of spectrum from 6 to 31 MHz on the buried segments. Most of those spectrum blocks cross ham bands.

My mobile, driving along the road directly under the line, receives a signal strong enough to obliterate all but the loudest ham signals on 10 meters, in this case. When I turn and drive away from the line, the signal fades quickly and is barely audible at about 400 feet. There are no hams living in our trial sites, but hams a half-mile to three-quarters of a mile away, using dipole antennas, are receiving weak but audible signals from the overhead line.

Inside the neighborhood, I can hear signals from the buried line when I’m within a hundred or so feet of one of the pedestals. The signal is audible, but never very strong. Our hams living a half mile away do not hear the signals from the buried lines, and again there are no hams living in the trial neighborhoods, so we can’t test how well a home station in the immediate vicinity of buried lines would hear those signals. *(It’s important to note that underground electric lines and feeders that come up from the ground have much less interference potential than overhead lines with “drops” to each building. A BPL system in an area fed by overhead lines would be much noisier.—ed.)*

### The Other Systems

Ed Hare, W1RFI, the ARRL’s lab manager, is probably the ham most familiar with BPL, and he filled me in on the other systems. Ambient Corporation ([www.ambientcorp.com](http://www.ambientcorp.com)) uses the same technology as Amperion, but it brings the BPL signal into the building on the power line, so its system uses more spectrum.

Main.net is different, using a spread-spectrum system that sounds like a clicking Geiger counter. Ed observed a Main.net system using 3 to 25 MHz continuously. Duke Power, which serves western North Carolina, is about to test a Main.net system in Charlotte, and an engineer told me it would use from 2 to about 9 MHz.

Current Technologies ([www.currenttechnologies.com](http://www.currenttechnologies.com))

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uses HomePlug equipment (HomePlug is an in-house BPL system), with RF from 4 to 20 MHz, and notches or RF “masks” to reduce radiation on the ham bands.

### Interference Mitigation

The FCC’s recent Notice of Proposed Rule Making (NPRM) on BPL (see this month’s “Washington Readout” column for details) proposes that BPL operators must be able to reduce power, move in frequency, or turn off their systems by remote control in response to complaints of interference. Amperion’s engineers claim to be able to do that now, although they were unable to demonstrate that during our visit. The 12- and 10-meter signals have remained on the overhead lines for more than 60 days, despite calls to the power company’s customer-service center to complain (it’s possible, since this is just a test, that the customer-service reps haven’t yet been trained on how to deal with BPL interference complaints). We have begun filing more formal complaints with Progress Energy lawyers and the FCC. Promptness and effectiveness of response to interference complaints is as great a cause for concern as the technology itself.

Another problem is a lack of understanding by the utilities of how hams operate—that we don’t use just a few discrete frequencies that can easily be notched out, and that we often tune the bands, searching for weak signals, signals that would be covered over by an increase in the noise floor.

### The Biggest Unknown

One area of great concern for hams (as well as other HF spectrum users) is also the one about which the least is known: skywave, or “BPL skip.” The BPL signals are essentially QRP (low power) radio transmissions. We hams know from broad experience that QRP signals are capable of being propagated over very long distances. Any HF signal strong enough to be heard a half mile away on a simple dipole antenna is also strong enough to travel up to the ionosphere and be bent back to Earth hundreds or thousands of miles away.

As of yet, there have been no studies of BPL skywave. What will happen when QRP signals from a BPL system in North Carolina bounce off the ionosphere and come back to Earth in New York, causing interference to an HF signal from an aircraft over the Atlantic Ocean? What happens when a shortwave listener in Texas can’t tune in Deutsche Welle (Germany’s shortwave broadcast service) because of interference from a BPL system in Pennsylvania? And when multiple systems are active, will it be possible to identify individual signals in order to determine their source and file a complaint? Or will there just be that much more noise on the bands—a higher noise floor—making it impossible to hear weaker shortwave signals, ham signals, aircraft, or military signals, and equally impossible to identify the source of the interference?

Hams everywhere need to start listening to the HF bands for the telltale sounds of BPL signals (as described here and heard on W1RFI’s tape on the

ARRL website, [www.arrl.org](http://www.arrl.org)) even if there are no test sites nearby, and reporting suspicious signals to the ARRL, which hopefully will be able to track down the source and pass along any interference complaints.

### To Learn More...

For more detail on BPL, including my very brief meeting in February with FCC Chairman Michael Powell, see “The BPL Dilemma” in the upcoming Spring 2004 issue of *CQ VHF* magazine and on the *CQ VHF* website at <http://www.cq-vhf.com>. There is also a link to the article from the May highlights page on the *CQ* website at <http://www.cq-amateur-radio.com>. Plus, we have an MP3 file with a sample of what Amperion’s BPL signals sound like on the air, narrated by yours truly. It’s on the web at <http://www.cq-vhf.com/BPL.html>. In addition, see W5YI’s “Washington Readout” column this month (on page 34) and N6CL’s “VHF-Plus” column in the April issue of *CQ*, on page 62. ■

#### BPL Comment Deadline May 3

The FCC Notice of Proposed Rule Making on BPL, ET Docket 03-104, was published in the Federal Register on March 17. Comments are due by May 3, with reply comments due by June 1. We urge you to learn all you can from articles here and elsewhere, read the NPRM, and file comments via the FCC’s Electronic Comment Filing System, or ECFS, at <http://gulfoss2.fcc.gov/ecfs/Upload/>.