Comments on NPRM of ET Dockets No. 03-104 and 04-37

Thomas D. Cox, KT9OM
Advanced Class Radio Amateur
Certified Wireless Network Administrator
Certified Amateur Radio Emergency Communicator, Level I
4920 W. Caleb Ct.
Muncie, IN 47302

This document contains comments on the NPRM regarding ET Docket 03-104 (BPL).

The NPRM is a proposal for the implementation of BPL. The comments are listed below with a number referring to the applicable paragraph as it appears in the portable document format of the document, with a brief excerpt of the text to which the comment applies, *in Italics*. Comments appear in the numerical order of the paragraph to which they apply. A section of conclusions appears at the end of this document.

21. *HomePlug contends that joint testing by the ARRL and HomePlug has demonstrated a very low probability of interference between its devices and amateur radio use.*

While this contention may well be accurate, it is not applicable to the potential for interference between Amateur Radio and Access BPL. HomePlug uses household wiring within a residence or building, with the power wiring relatively well shielded against radiation to the exterior by structural materials, and commonly located at or below the roof of a one- or two-story residential building. The residential step-down transformer that connects the residence's power wiring to the medium-voltage distribution system does not couple the HomePlug RF across the connection, keeping the currents in the house wiring.

In contrast, Access BPL is distributed over miles of medium voltage power lines, many of which are aerial lines 10M or more above ground. The significant increase in height of medium voltage power lines, compared to residential wiring, will result in a much-improved “view” of the RF horizon, and reduced absorption by ground-level features, resulting in much more efficient radiation – and absorption – of RF in the HF and low-VHF spectrum as used by Access BPL. Power company injectors and repeaters, as well as BPL client (customer) devices, will all have access to transmit signals over the medium voltage line.

22. *Southern states that there is a high degree of variability in the ability of power lines to radiate BPL signals and that signals on power lines will tend to cancel each other out.*

The signals originating in arcing and sparking from power line hardware have been found to couple laterally and longitudinally into the power distribution system and travel for hundreds of yards, or several miles. Power line noise is broadband electromagnetic radiation, with the bulk of its spectral energy in the 1 MHz to 60 MHz range. Anyone

who has tried to listen to an AM broadcast station in the 500 – 1700 KHz range, has heard this interference in the vicinity of a power line noise source.

There is no reason to believe the laws of physics governing the radiation of power line noise do not also apply to Access BPL signals. There may indeed be "variability" in the ability of power lines to radiate, but at the high end of that variability, the radiation can be quite strong. Coupling of the BPL signal into nearby conductors, and subsequent re-radiation from those conductors, is outside the control of the electrical utility.

There is, likewise, no scientific foundation for the belief that such signals would "cancel each other out." Power line noise signals certainly do not cancel each other out, and, as stated above, there is no rational argument for BPL signals behaving differently.

23. *Current Technologies submits that its data indicate that BPL emissions drop off very rapidly away from the BPL source and that emissions fall off in point-source fashion.*

BPL signals are not exempt from the physical laws that govern radio frequency propagation. Electromagnetic radiation follows the inverse-square law, and free-space path loss applies to BPL signals just as it does to power line noise and other RF signals. Coupling and re-radiation will occur. What begins as a "point source" signal will not remain so.

AEC asserts that because of impedance mismatch in real-world power lines, a single power line is expected to be a rather inefficient radiator.

Radio amateurs routinely use antennas that have inherent impedance mismatches, as in the use of random-wire or long-wire antennas for HF communications. This often involves the application to an antenna of a signal at other than the resonant frequency of the antenna, with an expected impedance mismatch. Communication over thousands of miles with such antenna systems and very modest power is commonplace.

There is a great deal of difference between what the BPL proponents routinely claim to be a self-contained communication system, and what they also claim to be a "rather inefficient radiator." If BPL proponents were to be honest about their proposals, they would admit that power lines, being of random length and characteristic impedance, will be random in their efficiency as radiators.

Unfortunately, even "rather inefficient radiators" are still radiators, and can reasonably be expected to cause interference to other users of that spectrum, even at considerable distances.

27. *Ambient states that if a sub-band is being used by a nearby transceiver, the BPL modem transmitter can be programmed to avoid transmitting on that sub-band, or "notch" it out.*

Automatically and immediately “notching out” a particular frequency in response to a nearby transceiver is an absolute requirement for a responsibly managed BPL system. However, this remedy does nothing to relieve the interference to anyone only receiving off-the-air signals in the spectrum occupied by BPL, since the BPL system cannot be aware of the reception.

People still listen to AM-broadcast radio from a station that is not in the immediate vicinity, such as a “clear channel” station in a distant city, which happens to carry a listener’s favorite baseball team’s home games. Tens of thousands of Americans are short-wave listeners, perhaps seeking out news from the unique perspective of an overseas broadcaster. These listeners will not be able to transmit a signal legally on the frequency on which they are listening, in order to cause the automatic notching process to occur. What relief does the Commission offer to these people, who are conducting a legal activity in their own homes?

All BPL providers should be required to provide a 24-hour telephone and e-mail contact point with which consumers can register a need for BPL notching. The notching ability should be required of all BPL devices, and a policy should be in place to implement notching in a very timely manner. Failure to remediate the interference in the allowed time span should result in enforcement action by the Commission.

However closely the BPL distributors adhere to such a standard, what relief does the Commission propose to mobile listeners of short wave or AM broadcasting from non-local sources? Since the advent of "talk radio," listenership to AM broadcast in the United States has grown immensely. AM stations which were slated for closing have become income generators for their owners, and valuable information sources for their listeners, as a result of the proliferation of talk radio.

All BPL devices should be required to identify themselves in some way that is accessible to persons in their vicinity, such as a looping synthesized voice message carrying a unique identifier over a Part 15 transmitter in the FM broadcast band. An individual who is affected by the BPL signal should be able to recover this identifier and, either via a toll-free telephone call, or by access to an online database maintained by the power utility, discover the exact location of the device, and have the affected frequencies notched out immediately on that device.

The author of these comments makes a 15-mile commute from Muncie, Indiana to Anderson, Indiana, and often listens to non-local AM stations, such as WLS in Chicago, IL, and WOWO, in Fort Wayne, IN. There are already places along the commuting route that have so much power line noise that these stations are all but inaudible. Adding BPL systems to that environment could preclude receiving those stations altogether, unless the BPL systems notch out the entire AM band. What relief does the Commission propose in this scenario?

Small, efficient amateur radio equipment has been on the market for several years that allows HF communication from an automobile -- a licensed activity that also is likely to

take place over extended distances of public roadway near power lines. Such communication may occur on any amateur frequency between 1.8 MHz and 29.7 MHz, as well as in the 50 MHz to 54 MHz low VHF band. Choice of frequency, direction of the communication path, signal strength and propagation conditions are uniquely unpredictable in these circumstances. What means does the Commission propose to BPL providers to protect these Commission-licensed activities?

24. *Current Technologies states that aggregation of BPL signals is unlikely since in its system only two BPL devices in the same area can operate simultaneously, and even those two devices would operate on different frequencies, so they cannot affect the same receiver. Main.Net Communications Ltd. (Main.Net) similarly indicates that in its technology only one unit is transmitting on any given frequency at any given time in any given area.*

How does the limit of one device per operating area square with the providers' promise of "broadband" service? If users in a neighborhood happen to be concentrated in an area that can only be served by one BPL device, they must share the available bandwidth of that device. Will the customers consider such service to be competitive against cable modem or DSL Internet service?

26. *Finally, Ambient Corporation (Ambient) states that it is possible to avoid interference to nearby transceivers using the inherent frequency agile characteristics of advanced Orthogonal Frequency Division Multiplexing (OFDM) technology. Ambient states that if a sub-band is being used by a nearby transceiver, the BPL modem transmitter can be programmed to avoid transmitting on that sub-band, or "notch" it out.*

Adaptive notching is a known strategy for dealing with interference in this technology -- it is already part of the OFDM scheme often used in DSL over phone lines. However, the fact that notching is technically possible does not assure us that it will be used. And, as noted earlier, the notching strategy accommodates "nearby transceivers," but does not protect nearby *receivers*. Receiver users will have to rely on the willingness and technical ability of the power company to perform the notching. Further, notching will address interference on a specific range of frequencies, but does not protect a spectrum user who merely wishes to "tune around" for interesting signals to listen to over the 30 MHz-plus operating range of the typical short wave receiver. Will the Commission require a power company to accommodate a short wave listener who wants unencumbered access to the whole HF spectrum, if the only way to do so is to discontinue service to its BPL customer(s) in the neighborhood? The Commission should require such an accommodation if a short wave listener requests it.

Further, the nature of modern amateur radio equipment is to be frequency-agile, and not channelized. Amateur radio operators are not assigned to specific frequencies in any of the bands proposed to be used by BPL but one, the 60M band. Rather, amateur radio operators roam through a range of frequencies in several bands, examining propagation conditions, noting activity, or looking for stations in a specific area or using a particular operating mode. This activity may be random, or associated with expected propagation

conditions, which vary hourly, daily, seasonally, and over the 11-year sunspot cycle. It may also relate to competitive activities in which certain operators attempt to contact a maximum number of distant stations in a certain location, on a certain frequency, or who operate in a specific modulation mode. In any of these activities, an operator working well within the regulations of the Commission, and following good operator practice, may move from one frequency to another in a very short time, covering the entire HF band and low VHF band used by BPL. A BPL device in the vicinity of such a typical operator would have to notch out the entire HF band to avoid interfering with the licensed activity in this common set of circumstances. The effective bandwidth delivered by the BPL device to the consumer(s) who are then paying for the service.

How long should a notch remain in effect? How does notching protect the legal operation of a radio amateur who is searching the HF bands from one end to the other in search of a particular set of communication conditions? If he transmits on the 80 Meter band, activating an automatic notch feature, and later moves to the 60 Meter band, he will have to transmit to cause the BPL device to notch that band, if the BPL device is transmitting there. If he then moves back to the 80 Meter band, and the notch has "expired," he has to transmit again to have it restored. If he remains on the 80Meter band listening for traffic, the notch may expire, causing interference again.

In this scenario, an amateur radio operator, an operator in a licensed service, is required to intervene with the operator of an unlicensed, Part 15 device, to gain "permission" to use a part of the spectrum for which, not only is the operator licensed by the Commission, but, on which frequency, he is classified by the Commission as a primary user. This is contrary to the Commission's established practice of placing the burden of dealing with harmful interference by a Part 15 device on the owner/operator of the device. The responsibility for acting to relieve the interference, in the case of BPL, is being, de facto, shifted to the licensed operator. This is an inappropriate shift of responsibility, and should not be permitted by the Commission.

Any BPL device close enough to a licensed HF or low band VHF station to cause interference should be required by the Commission to be disabled and removed if it is required to notch out frequencies covered by the licensed station more than twice in any 30-day period.

30. *Because power lines reach virtually every home, school, and business in the United States, Access BPL technology could play an important role in providing high-speed Internet and broadband services to rural and remote areas of the country.*

The Commission is repeating here an argument made by the entities which stand to profit from installing BPL hardware, but without justification. Broadband service rollouts to rural areas have been limited by the low projected income, due to low customer density, and the high infrastructure investment costs, due to the distances involved. Although the power lines may already be in place to these remote areas, the electronics required to couple to them with data still have to be installed, and additional repeaters, amplifiers, etc., will be required to pass data over the greater distances to reach remote home sites.

Much of the existing electrical infrastructure is of significant age. The author of these comments has seen electrical service poles in his neighborhood that are dated from the 1950s and before, with hardware that appears to be original, or not much newer than the poles. The poles have shrunk and cracked with age, loosening bolts and brackets that produce significant line noise due to arcing. The existing line noise background level will certainly require either extensive repair and replacement of pole line hardware, or increased input power from the BPL devices, to reach the minimum acceptable signal to noise ratio for such equipment. Either measure will entail costs which are not foreseeable in detail until deployment has already begun. Increased power from the BPL devices will certainly complicate the interference issues, probably entailing remediation and attendant expense.

Power companies do not typically maintain the staff and equipment required to troubleshoot data network problems, but they will have to hire or train employees and buy equipment if they are to support an acceptable quality of service that is comparable to, and competitive with, telephone and cable TV services. Further, connection to the Internet backbone, as is required of an Internet Service Provider, is not free, and is a recurring expense that can increase at any time.

If the telephone and cable companies have determined that a remote area is not a cost-effective market for Internet access service, what causes the Commission to believe the power industry will be able to afford to branch out into that business? Has the Commission seen objective business models that show a profit potential to power companies that justifies the initial investment and continuing expense? If the attempt by a power company fails, how is it permitted to recover the costs? Will the Commission permit power companies to force ratepayers to help recoup their losses, even if the rate payers never had BPL service?

The Commission keeps a very close eye on the business practices of telecommunication service providers, such as telephone and cable companies. Is the Commission prepared to subject power companies to similar scrutiny, once they enter into the telecommunication sphere? What would be the additional operating cost of such scrutiny to the taxpayers?

35. *In considering this interference potential, we note that ARRL acknowledges that noise from power lines, absent any Access BPL signals, already presents a significant problem for amateur communications. We therefore would expect that, in practice, many amateurs already orient their antennas to minimize the reception of emissions from nearby electric power lines.*

This radio amateur orients his rotatable antennas for maximum performance in relation to the direction of the desired signal first, and to avoid interference only second. Another factor in antenna orientation is the physical limitation imposed by antenna size versus lot size. As the Commission knows, an antenna of a given design grows larger as the design frequency decreases. The author of these comments has a 1.8 - 2 MHz wire antenna approximately 130 feet long, attached to a tower. The wire is oriented in the only way

that it fits safely on the property, which, unfortunately, causes it to be pointed in the vicinity of a power line that traverses one side of the property. The author has no options for moving this antenna that would reduce BPL interference while keeping the antenna safely and legally located within the property lines. What remediation does the Commission suggest for licensed operation in this situation?

Further, antenna orientation at higher frequencies covered by BPL tends to direct the most sensitive reception and highest radiated power of the antenna toward the remote station, whose compass bearing is not subject to the control of the antenna's owner, but is dictated by geography and electromagnetic propagation phenomena, and is subject to change without notice. What protection will the Commission afford the licensed radio amateur against BPL interference under these conditions? The only realistic protective measure is to require any BPL device causing such interference to a licensed operator to discontinue its operation permanently.

45. *Thus, rather than finding the maximum emissions across a number of radials, - as currently performed for other Part 15 emitters - the receive antenna is moved down-line, parallel to the power line, starting from the Access BPL equipment location, to find the maximum emissions. Down-line distances used in this sequence of measurements are specified in terms of wavelength of the Access BPL mid-band frequency. We seek comment on these guidelines.*

Current Part 15 emission measurement standards are completely inappropriate as tools for the evaluation of RF environmental impact on HF and low VHF users, as they assume limited antenna system dimensions and point sources. I strongly recommend that the field measurement for BPL radiation should conform to the most widely accepted practice for antenna installation of licensed users of this spectrum, including that of stations in the amateur radio service. Measurements taken in vertical polarization from one meter above ground level will not produce representative results as to the BPL radiation’s effect on licensed users and listeners in the affected spectrum.

Further, measurements should include not only the peak power of radiated BPL signals in a narrow-band receiver, but any elevation of the broadband noise floor in the HF and low VHF spectrum from BPL radiation should also be measured, with appropriate limits set on such radiation. All measurements should be made with data flowing both upstream and downstream on the BPL circuit, at the maximum rated capacity of the BPL circuit. Measurement should also include the frequencies surrounding BPL operation, so as to capture any spurious radiation, such as mixing products or other emissions resulting from improper operation of the equipment.

Measurements should include radiation in horizontal polarization, as most amateur radio station HF antennas, as well as low-VHF, weak-signal antennas, are horizontally polarized.

Measurements should be made at heights representative of antenna heights at HF and low VHF licensed stations. Typical HF and low VHF antenna heights in the amateur service

fall in a range of 10 to 30 meters. Measurements should take place at least at these two heights above ground.

Distances from emitters for such measurements should also be representative of the typical separation distance between a BPL-loaded power line and a licensed stations antenna system, which should be from 10 to 30 meters.

If the operator of a licensed station requests it, measurements should be made at the feed point(s) of any antenna system operated by a licensee claiming to suffer harmful interference.

In any of the above cases, if measured BPL radiation exceeds legal limits, or if a licensed operator or unlicensed listener can demonstrate harmful interference, the power utility should be required to (1) notch out emissions in the bands available to the licensee, or bands used by the listener to the extent that such interference is no longer produced, or (2), the power utility should cease to operate such radiators until it can demonstrate that such operation can be resumed without harmful interference.

Conclusions

The Commission's enthusiasm for BPL needs to be moderated by its responsibility for stewardship of the finite electromagnetic spectrum, which is a vital national resource. If real-world results of BPL deployments indicate that it pollutes the electromagnetic environment, the Commission must provide for explicit, immediate and thorough remediation. If the Commission does not have much more compelling evidence (*evidence*, not optimistic claims) than has been provided by the BPL proponents and the Commission so far, that BPL can be deployed without such pollution, then the Commission should not allow deployment to continue until such evidence has been provided.

It is the position of this commentator that the laws of physics and economics preclude the deployment of BPL from being anything other than a serious environmental problem for other spectrum users, and a model for business failure, at the expense of power utility ratepayers and taxpayers.

BPL radiation measurements used by the Commission should reflect realistically the effect such measurements will have on licensed user and legal listeners in the affected spectrum. Current part 15 measurement methods and standards are not adequate to this task.

In any environment in which BPL is deployed, the Commission must assume the responsibility for establishing and enforcing timely and effective measures against harmful interference of any kind from such operations, including the application of

monetary fines and forfeitures, against power utilities and their business partners involved in BPL service.

The BPL providers must be required to provide immediate and convenient public access to the identity and location of BPL emitters, and all such emitters must be equipped to notch out interfering emissions both manually and automatically.

Given the uncertainty of the current geopolitical situation, and the continuing risk of natural disaster, putting existing radio communication systems in jeopardy to accommodate an unlicensed user of the spectrum would be an irresponsible act, and should be subjected to much more critical review than the Commission has evidenced so far. Interference mitigation measures in deployed systems should reflect the urgency and importance of protecting the radio communication resources in the BPL environment, such that they are available unencumbered by any interference from BPL emissions. Such measures must be applied from the outset, as emergencies, by their very nature, do not provide notice or time for preparation.

Respectfully Submitted,

Thomas D. Cox, KT9OM
Certified Wireless Network Administrator
Certified, Level I Amateur Radio Emergency Communications Course
4920 W. Caleb Ct.
Muncie, IN 47302