Before the Federal Communications Commission
Washington, DC 20554

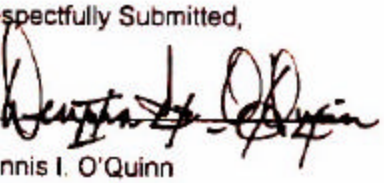
In the Matter of	)	
	)	ET Docket No. 03-104
Inquiry Regarding Carrier Current	)	
Systems, including	)	
Broadband Power Line Systems	)	

REQUEST TO ACCEPT LATE-FILED REPLY COMMENTS

The below signed individual, a qualified engineer and former military communications officer with decades of radio telecommunications experience, respectfully requests the Federal Communications Commission to accept and consider the attached reply comments to the Notice of Inquiry published in the Federal Register on May 23, 2003 (68 FR 28182-28186) despite its lateness. While the FCC gave the Public and other interested parties legally sufficient notice in this matter, many parties, including the undersigned, initially underestimated the seriousness with which the Commission's staff and others would consider this proposal which threatens established communications protocols with a ubiquitous electromagnetic smog that, once in place, would be nigh impossible to eradicate. The below signed engineer regrets assuming that the Commission's staff would necessarily recognize the invalidity of the presented extrapolations from experiences fifty years ago by the proponents to bolster the strength of this proposal. The extrapolation from those experiences are not valid, the power line distribution environment at the higher frequencies necessary to support the higher data rates is markedly different, the increased amount of spectrum (at higher frequencies, into the shortwave bands, which possibly can have all signals reflected from the ionosphere over a large area) will adversely affect more unrelated and licensed users, and the impact of an unwise decision will leave a legacy that has been rejected by at least six other countries which have considered this system; all of these issues compel one to regard this as a matter completely unsuitable for any "fast track" processing and as a matter deserving very, very close and critical technical scrutiny.

The matters being considered by the Commission and comments regarding them are of such importance with immediate and long term consequences to human safety and the national quality of life that consideration of these late comments is warranted in the public interest despite their being filed after the Commission's announced deadline for reply comments.

Respectfully Submitted,



February 4, 2004

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Inquiry Regarding Carrier Current	)	
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COMMENTS OF AN INDIVIDUAL REGARDING THE INADVISABILITY OF PURSUING THE CURRENT PROPOSAL ON BROADBAND OVER POWER LINES IMPLEMENTATION

QUALIFICATIONS AND PREVIEW

1. The below-identified individual is a Registered Professional Engineer, a former Viet Nam era U. S. Army Signal Corps officer, a successful examinee for a Federal Communications Commission First Class Commercial Radiotelephone License with a Ship Radar Endorsement initially issued in 1961, a current holder of a Federal Communications Commission General Radiotelephone License with Ship Radar Endorsement, an engineer with past professional employment as an Electromagnetic Compatibility Engineer, and an amateur radio licensee since 1958, who respectfully submits comments below that relate to proposed Broadband over Power Line (BPL) implementation by way of modification to Part 15 of the Federal Communications Commission rules (47 CFR Part 15). The proposed modification to Part 15 would facilitate implementation of a non-conforming series of data modem devices for computers in the proposed spectrum of 2 MegaHertz to 80 MegaHertz by raising the limits on the allowable conducted and radiated emissions. Based on his research of current literature, his own personal communications experimentation conducted over power lines about 1960, and his experience in diverse communications applications, he has concluded that unacceptable interference to frequencies for various radio services (some of them critical and essential to national defense, and all of them in active use for other needs) would result from a decision to pursue this technology in any forseeable future; he further believes that suitable near-term alternatives exist to attain ubiquitous broadband service without pursuing this disadvantageous avenue.

2. He has examined the filings by the Federal Emergency Management Agency of the U. S. Department of Homeland Security[1] and the Disaster Emergency Response Association[2], and concurs with those assessments of the situation, which will not be repeated here. (For ethics purposes, it should be noted that the latter has been the beneficiary of some other pro bono engineering efforts in the past.) He has also found a filing by Mr. John Robert McAlpine, IV[3], with whom he has not been in contact for over 30 years, but who, in his usual way, wastes few words in assailing the proposal; Mr. McAlpine's filing is notable in that he is very knowledgeable of the power industry, and he brings to the discussion a compelling dismissal of the currently structured proposal. These three filings are worth the time taken to read them.

[1] FEMA Office of the Chief Information Officer, signed by Barry C. West, "Comments of the Federal Emergency Management Agency on Broadband over Powerline Implementation." Posted as FCC/CO ET Docket 03-104, 16 December 2003. FCC Comment Database Online Document Locator: http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6515292045

[2] Disaster Emergency Response Association (DERA), Inc., signed by Bascombe J. Wilson, CEM, "Comments of the Disaster Emergency Response Association on Broadband over Powerline Implementation." Posted as FCC/RC ET Docket 03-104, 22 December 2003. FCC Comment Database Online Document Locator: http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6515382841

[3] John Robert McAlpine, IV, "Comments on Broadband over Powerline." Posted as FCC/CO ET Docket 03-104, 4 November 2003. FCC Comment Database Online Document Locator: http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6515288997

BROADBAND OVER POWER LINE (BPL) SYSTEMS

3. Power Line Communications (PLC) Systems have been present for over fifty years. In their original use, they were used to provide communications for switching to remote power company equipment. That function has now been replaced in many applications by point-to-point terrestrial microwave systems, which provide a broader bandwidth than was available with the PLC systems so that an extensive, computer-aided capability now exists to monitor and control the power grid. In their heyday, during the middle of the last century, PLC systems provided point-to-point control information in a time when telephone service was not nearly as widely available, and certainly there were no cellular telephones. Today, we have a host of communications services available to supplement the needs of the power companies without the vulnerabilities that PLC possessed, as in the case of downed lines.

4. One significant attribute of these systems was their low bandwidth and their low operating frequency. When one's only interest is reading switch positions or commanding switch positions, it is likely that the typical command or read back data rate might never approach more than several items per second, several times hourly.

5. Additionally, the operating frequencies were below 490 KiloHertz, beneath the AM broadcast band frequencies, where very long antennas (corresponding to the longer wavelengths) are required for effective propagation over long distances. Thus, the line to line physical separation of a few feet was a very small fraction of the wavelength; this circumstance of the communications path being on two closely located wires, in terms of wavelength, represents an electronic component called a transmission line. A transmission line is used in efficiently transferring radio frequency (RF) energy from one location to another.

6. Representative values for a PLC system, without application to any specific situation, might be an operating frequency of 175 KiloHertz, where the wavelength would be 5,623 feet (i.e., over 1.06 miles). With a line to line separation of even as much as ten feet, the ratio of separation distance to the wavelength would be 0.00178 wavelengths. (There are other factors in the suppression of RF radiation from these lines into the atmosphere, but this is a very significant one. In fact, it is this consideration that leads to the use of microwave waveguide to suppress the loss in signals between microwave equipment

and antennas, since any radiation is a loss of signal from one end to the other of the transmission line or waveguide.)

7. The Broadband over Power Line (BPL) systems are relatively new. One of the first data transfer applications was for in-house data transfers, with an operating frequency in the range of the PLC systems, below 490 KiloHertz. These supported data transfer rates of up to about 19,200 bits per second and depended on integrated circuits made by manufacturers such as National Semiconductor. As such, they were not broadband systems, and were not envisioned to be long range communications devices. Their closest similar application was a wireless baby monitor, and both of these applications were regulated by Part 15 of the FCC's rules. This implies, as in the case of all Part 15 devices, that their use was subject to not causing interference to licensed services, and to accepting any interference received from licensed services.

8. The currently proposed BPL systems differ vastly from the PLC systems described earlier. The proposed data rates are in the megabits per second range. This implies that the frequency range around the operating frequency must be one or more MegaHertz wide, an obvious impossibility in the PLC spectrum area where the high end frequency limit is only 490 KiloHertz.

9. While the lowest BPL frequencies could go down to the lower end of the PLC spectrum, there are two very probable reasons why the proposed lower frequency is only 2.0 MegaHertz (i.e., 2,000 KiloHertz): International regulations require that 500 KiloHertz be maintained as an international distress frequency, and overlaying it with BPL could cause a problem to distress communications, and operating in the 540 KiloHertz to 1,700 KiloHertz range would interfere with the AM broadcast band industry. In other words, there is no technical reason not to start the spectrum for this proposed service at 510 KiloHertz.

10. Empirical data personally collected in a small town setting about 1960 indicated that signals of even modest power levels (injected line-to-line at 1415 KiloHertz) were capable of being conducted over two miles and radiated onto the street to be picked up by a car radio before the experiment was concluded. It is this tendency to radiate that allows "carrier current" radio stations to operate on college campuses. Most are on the low frequency end of the broadcast band (e.g., less than maybe 800 KiloHertz) to discourage radiation. Significantly, the general avoidance of the upper end of the broadcast band to restrain the radiation clearly indicates that experienced personnel recognize this problem, and it is

therefore obvious that utilization of even higher frequencies (beginning at 2,000 KiloHertz) will produce a more noticeable effect. (It is purely conjecture, but the exclusion of the broadcast band from this BPL proposal is seen as an effort to avoid a confrontation with the AM broadcast industry over interference to their broadcasting services, and a tacit admission that the interference could be a problem of a magnitude that the AM broadcasters are unwilling to tolerate.)

11. The proposed upper frequency range of 80.0 MegaHertz is within the VHF portion of the spectrum. In this vicinity, radio waves mostly propagate as line of sight, with only occasional reflections off the ionosphere, which is the predominant method of covering large distances up to about 30.0 MegaHertz.

12. Thus, the proposed frequency spectrum is from 2.0 MegaHertz to 80.0 MegaHertz, which spans the upper end of the Medium Wave (MW) spectrum (to 3.0 MegaHertz) where much of the propagation is along the surface of the earth in the daytime with additional coverage by reflection off the ionosphere at night, all of the (shortwave) High Frequency (HF) spectrum (from 3.0 to 30.0 MegaHertz) where most of the long distance communication is from reflections off the ionosphere, and the lower portion of the Very High Frequency (VHF) Spectrum (starting at 30.0 MegaHertz) where the communications begin to rely on direct signal paths.

13. Obviously, it would be ideal for bandwidth considerations to move the entire BPL concept to the larger spectrum available in the VHF bands where BPL could not reflect off the ionosphere and BPL could not spread electromagnetic pollution to other services, but there is a major drawback to this alteration. At the upper end frequency of 80.0 MegaHertz, a wavelength is 12.3 feet. Now, a ten foot separation of the power lines becomes 0.813 wavelengths. Without running a numerical analysis, let it be simply said that that this fraction of a wavelength separation indisputably creates an antenna system. (In fact, there are directional AM broadcast antenna arrays where the towers are separated by less than this fraction of a wavelength in order to enhance the signal coverage in a desired direction.)

14. It should also be emphasized that this discussion of BPL is pertinent to only those proposed systems whose frequencies would be spanning the 2.0 to 80.0 MegaHertz frequency range. There are several other proposed BPL or BPL-similar systems whose operating frequencies are in the Ultra High Frequency (UHF, starting at 300.0 MegaHertz) and microwave range; very obviously they are of no concern for

interference to the users in the 2.0 to 80.0 MegaHertz frequency range. The significance of these systems operating at UHF and above is addressed later.

DIFFERENCES BETWEEN POWER LINE COMMUNCATIONS (PLC) AND BROADBAND OVER POWER LINE (BPL) SYSTEMS

15. As an interim summary, PLC relies on frequencies below the broadcast band to provide low usage, low data rates suitable for providing switch actuation or read back of switch positions. The signals are on the professionally maintained facilities of a power company whose livelihood depends on good upkeep and reliable operation. Through this environment and the presence of wiring separated by a small fraction of a wavelength, there have been relatively few complaints about the operation of this system or signal leakage from it.

16. BPL, as proposed in the MW, HF, and VHF bands, does not benefit from the circumstances surrounding PLC. Its service requires a high data rate, implying an operating frequency with several MegaHertz bandwidth surrounding it. Its transmission path is subject to radiation like an antenna in a portion of the electromagnetic spectrum where radio waves also reflect off the ionosphere, and the enticement to move higher in frequency (to avoid the short wave bands) exacerbates the radiation problem from the proposed transmission path where the cables are not only unshielded, but they are also unbalanced. (This latter attribute means that the currents are not equal and opposing, and it leads to even higher levels of radiation.) If it is not operated into the HF or perhaps the VHF spectrum, it cannot attain, with present modulation techniques, the necessary bandwidth to be a viable alternative to other means of delivering broadband data service to the public.

17. There is no simple, practical solution to this intricate and difficult conflict, and perhaps none at all. The lack of ease in fielding a universal solution to the above described conflict (where actual line-to-line physical separation may vary) assures that the foundation for continuing problems will be laid if this version of BPL is adopted, and that no simple test of the equipment will assure universal compliance with any type of existing or future standards similar to Part 15.

ADVANTAGES AND DISADVANTAGES OF THIS

BROADBAND OVER POWER LINE (BPL) SYSTEM

18. The power lines are ubiquitous, which is advantageous as far as market penetration goes, but they were not built to a specific installation standard to assure RF radiation suppression. It is suspected that many BPL installations could become a custom installation with rewiring to meet the radiation suppression requirements, thereby decreasing the economic attractiveness of this medium. Since BPL generates interference to other communications services which rely on radiated radio waves for communications, one could reasonably infer that BPL should not be located onto power lines.

19. It has been suggested that a solution to this problem is to alter Part 15 to allow the higher radiation levels. This is simply not practical since Part 15 and the Electromagnetic Compatibility (EMC) standards are predicated on a defined balance between the emission levels of the emitters and the susceptibility of the receptors. As a hypothetical example, consider a Part 15 device operating in the proximity to a television receiver receiving Channel 2, 3, 4, or 5 (on 54 through 72 MegaHertz, and 76 through 82 MegaHertz, with six MegaHertz per channel). The present balance between a near-by Part 15 device and the television receiver is that the Part 15 device should not interfere with TV reception. If the BPL devices are allowed a higher power, then the television stations would be required to raise their power to offset the increased level of this new interfering signal to maintain their quality of service. Notwithstanding the obligation of the Part 15 device operator to cease operation if there is interference to a licensed service, the existing EMC balance would capsized, resulting in upheaval in areas that are not even anticipated.

20. The 1970's Citizens Band fiasco is a case in point of good intentions gone awry. Back in the 1950's, Citizens Band existed in the 465 MegaHertz frequency range; there was little that the users could do at UHF which could adversely affect other services. When the 27 MegaHertz band was created for Citizens Band usage, and users began to add (illegal) power amplifers and equipment modifications for (illegal) out-of-band operation, the FCC was powerless to do more than collar the most egregious criminals, while thousands, if not tens of thousands, of others ran free to interfere with telephones, stereos, and television sets. (The most frequent scapegoat was the local amateur radio operator. It should not be surprising that

this technically astute community, recognizing through experience the result of bad telecommunications and spectrum policy decisions, is proactively attempting to avoid another scenario in which they will again be likely negatively affected.)

21. Imagine two similar developments if BPL is approved: Some enterprising individuals decide they can get better data service by adding "range extension" or "error reduction" power amplifiers to their BPL transmitters, and some others decide to use modified equipment directly into HF antennas to bypass some sort of service restraint or service fees. Either or both of these developments would be devastating to all legitimate users of the affected spectrum portions, and, with no disrespect intended to the FCC, the FCC would be unlikely to have the resources to do much of anything about eliminating the problem.

22. An economic aspect is that this service would need to penetrate a market with existing competitors in the form of Cable Television (CATV) service and Digital Subscriber Line (DSL) service from the CATV and telephone companies. Neither of these competitors is likely to yield market share to a BPL newcomer, and the BPL newcomer would be hard pressed to offer anything surpassing the service from these two service providers. An extension of this would be that the BPL provider (perhaps a leasee of the power lines from the power company), after a period of time, might not be financially capable to continue to maintain the equipment, particularly with respect to radiation suppression, and that the BPL provider, without bonding and in face of FCC-imposed fines, might simply walk away from the problem. It is significant that the CATV network is almost as ubiquitous as the power grid, and equipment already exists to fill in those areas might support the power lines but not CATV.

23. It is worth noting that the CATV industry did not get established without its share of interference problems[4]. Only after vigorous protests from airline operators whose navigation systems were impaired by signals leaking from CATV systems did the FCC take decisive action to avoid endangering the flying public. The difference is that the problems of CATV signal suppression were not challenges to the laws of physics and electromagnetic theory as they are with BPL.

[4] D. I. O'Quinn, "Consumer Cable Distribution System Interference in the Next Quarter Century," *Proceedings of the 1984 IEEE National Symposium on Electromagnetic Compatibility* (San Antonio, TX: Institute of Electrical and Electronic Engineers; April, 1984), pp. 299-309.

OTHER BROADBAND OPPORTUNITIES FOR UBIQUITOUS COVERAGE

AS ALTERNATIVES TO THIS PROPOSED BROADBAND OVER POWER LINE (BPL) SYSTEM

24. It is easy to overlook, in the context of the discussion of BPL's merits and shortcomings, that there are viable opportunities and alternatives in other directions. None of these has the disadvantageous EMC attributes associated with the BPL proposal, and at least one offers the opportunity to spur economic and scientific development. This list is not all-inclusive (e.g., there is no discussion of satellite-based services), but it does prove that BPL is not the only answer to offering ubiquitous broadband service.

25. The most readily available communications service is the use of the cellular telephone network. If it were subsidized, then even school children in isolated areas could have moderately priced access to the Internet. Obviously the bandwidth would be limited, but it certainly would be an improvement, as well as providing an economic incentive to the cellular telephone network providers to extend into some previously unserved or underserved areas.

26. There are already FCC-allocated Industrial, Scientific, and Medical Band (ISM) frequencies available within which the use of data networks is allowed on a secondary basis by Part 15 (i.e., starting at 902 MHz; 2,400 MHz; and 5,725 MHz). Also, the National Information Infrastructure included in Part 15 offers other alternatives. Manufacturers already build data communications equipment for some of these bands, and the demand for more of this equipment, as an alternative to BPL, would spur economic and scientific development.

27. This pursuit would accomplish several objectives in the national interest. It would stimulate interest in the UHF and microwave regions, and promote the research and manufacture of UHF and microwave equipment, thereby adding to our scientific and manufacturing base. No new frequency allocations would be required, since these frequency allocations already exist. There would be very little likelihood of interference to or from existing services, or conflict with existing services, but a change to another frequency range (perhaps through a manufacturer's exchange program in the first month) would usually solve the problem. Directional antennas, typically used in these frequency ranges, would help promote efficient use the frequency allocations and lower user-to-user interference. The equipment might be a

little more costly initially, but it could offer even greater bandwidths than BPL could ever offer without any of the identified drawbacks. An upsurge in microwave manufacturing demand would be expected to make these microwave solutions competitive to the other services.

28. Although fiber optics do not offer the flexibility that wireless links do, they are relatively easy to install. It is imaginable that some forward looking power companies could set up a neighborhood data network hub attached to a microwave transceiver on its pole, fed by fiber optic links from each of a half dozen houses in a neighborhood whose paths are through physical attachments to the power lines already running to the houses. Each house could have an in-house network for the computers in the house, but they all would connect to the Internet through the described fiber optic link.

29. Certainly alternatives exist to the proposed BPL. The advantages and disadvantages of each needs to be evaluated in light of the strong societal disadvantages of BPL.

OTHER CONSIDERATIONS IN THE DEVELOPMENT OF BROADBAND OVER POWER LINE (BPL)

30. One of the items receiving little attention in the current discussions is the bypass network slated for attachment to the transformers to provide a path for the BPL signals to travel between the drop line, running from the house to the pole and carrying the signals leaving and entering the house, and the access line, which couples the individual house signals onto a medium voltage line running between neighborhoods. Without this network, which prevents the signal from being attenuated at the transformer, the signals would not travel either from the house wiring side of the transformer to the distribution line coming to the transformer, or in the other direction.

31. This network needs to be examined more closely, for its presence will incur a liability for the leasor and the leasee of the power system that neither will want. This network is needed to isolate the 2,400 volt distribution line from the two 110 volt outputs going to the residences, while providing a path for the BPL signals.

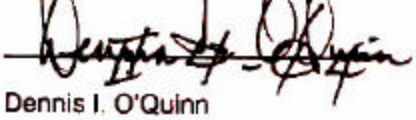
32. The prevailing power distribution designs anticipate that in the case of a lightning strike, transformers may occasionally be sacrificially destroyed by a power surge from a lightning strike. This allows part of the surge to be absorbed before it reaches a customer's home.

33. If this network is installed, two detrimental situations can occur: The lightning strike can more readily travel from the higher voltage distribution line through the network to the house drop line, and the power customer will lose more equipment than he would have without the network's presence since it becomes a conduit for the surge to the customer's home. The other event that can occur is that the network can fail, and since any protective circuitry is not instantaneous, a surge of 2,400 volts can be applied to a 110 volt line and everything attached to it in the house. Overloading a residential 110 volt line with a surge twenty times its normal voltage will probably lead to catastrophic failure of numerous solid state devices such as clock radios, television sets, electronic control panels for stoves and ovens, and even lighting devices; it might possibly initiate fires through insulation breakdown. Since these network devices will have been installed by the power company, and these devices will have reduced the protection from the lightning surge, it will not be hard to predict whose deep pockets will be sought for reimbursement.

CONCLUSION

34. This BPL proposal is not suitable for fast tracking due to the high number of serious issues it raises. While this evaluation is not all-inclusive, the experience behind the evaluation indicates that this BPL proposal definitely is detrimental to other, necessary services. Until ways of satisfactorily addressing the issues are found, this BPL proposal should not be approved, and under no circumstances should substantial changes be made to the balance between emissions and susceptibility underlying Part 15.

Respectfully Submitted,



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