In the Matter of

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| Carrier Current Systems, including Broadband over Power Line Systems | ET Docket No. 03-104 |
| Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems | ET Docket No. 04-37 |

## I. ASSUMPTIONS AND STATEMENTS

1. The assumption, made by the equipment manufacturers, that BPL will not cause harmful interference is not supported by any evidence acquired in an environment encompassing licensed users such as Amateur Radio, Military Affiliate Radio Systems, and FEMA to mention a few. I urge the Commission to insist upon public, documented field-testing of a sampling from the various manufacturers to validate their claims. Furthermore, the BPL community and the Commission make statements such as "may provide……last mile" indicating the early stage of technology development. This seems to enhance my call for further "real world" testing prior to unleashing an immature technology with the capacity to inflict widespread and unpredictable harm.
2. I urge the Commission to insist upon good engineering and science practices per 15.14&15, and not be swayed by marketing or unsupportable promises.
3. Wireless technologies exist that are far more powerful and easily deployed. The Commission should similarly allow for more market place competition to exist for microwave providers by loosening the regulations and speeding the implementation in the areas of 802.16, and LMDS.
4. Statements to the effect that BPL will serve the rural areas are suspicious and should be further scrutinized. Rural areas are the most overlooked in the deployment of broadband services. Economics is the reason. Since the FCC has declared that broadband, such as cable, is an entertainment service and not subject to the same government scrutiny as traditional telephone providers, the likelihood of broadband deployment into rural areas has decreased. Although BPL could provide rural service, the economics of maintaining the quality of service will also retard rural deployment. Rural deployment was one of the prime drivers for the Commission's interest in BPL, but as proposed, without regulation, such deployment fails the test of economics. In other words it will never happen if BPL companies are left to themselves. They have no more incentive to serve rural areas than cable or DSL. They will serve the "low hanging fruit" found in dense urban and slightly less dense suburban areas, which are already served by DSL and Cable. They will attempt to do this by being the low priced provider, a strategy that may, or may not be successful.
5. There is no evidence provided in recent experience that the power industry can be self-regulating either in price or performance. Deregulation proved itself unworkable and highlighted the new levels of greed possible when left without oversight. I suggest that this lack of such evidence will flow through to BPL without more Commission oversight. A major challenge will be the separation of

BPL from the regulated business.

## II. INTERFERENCE MATTERS

6. The Commission is to be commended for including language on protecting licensed users from interference. How will the Commission enforce this protection? How long will it take to rectify BPL interference to licensed services? Experience with utilities and power system generated noise indicates that the delay may be excessive and the cooperative spirit of the utility may be lacking. This would require formal FCC action, which it appears, will quickly overwhelm the Commission with interference complaints. I urge the Commission to add language and formality to the disposition of interference matters so that they may be resolved quickly. Further the definition of "quickly" needs to be addressed. For instance, an amateur radio operator talking to another amateur radio operator across the country or the world may not require the highest level of urgency. However, neither the Commission nor the BPL industry can predict when that same amateur radio operator may be handling emergency traffic from a strife torn Haiti, or priority traffic from overseas via the Military Affiliate Radio System.

7. On this argument alone it is reasonable that the Commission add some wording as to the timeliness of correction and or the remedies available to licensed users when interfered with.

8. The utilities, and indeed the manufacturers, have little incentive to correct Part 15 violations that interfere with licensed users. As it is presently written the utilities are generally responsible, but with their limited knowledge of licensed user's operational needs I question the usefulness of the Commission's strategy in this regard. I urge the Commission to add language toughening the non-interference requirements for BPL because of its possible wide deployment.

9. BPL proponents speak to the successful and interference free implementation in various locations. I ask of the Commission, which of those locations have included a representative mix of licensed users? I ask the Commission, which of those locations have been witnessed by representatives of various licensed users? The Commission should clarify these statements, or require further public and documented testing under "real world" scenarios as opposed to the likely "cheery picked" sites demonstrated.

10. Interference mitigation is important to the success of BPL implementation. Some manufacturers speak of their frequency agility. How will they know where to move within the spectrum? It seems that unless they themselves receive interference they have no reason to use this capability in real time. If a manufacturer is making statements such as this the Commission should insist

upon more details being made public for review by licensed users. To this commenter the frequency agility capability is for their benefit alone and is of little use to reduce real time interference to licensed users. At least that is the observation based on the very limited information made public.

11. Paragraphs 41 and 42 imply that various manufacturers have promised the ability to control power and individual frequencies. Again, I urge the Commission to be more descriptive of just how is this too be accomplished in the operational environment. Frankly, I fail to see, despite the BPL advocates statements, any incentive for them expend funds in interference mitigation if they can get away with simply stalling or ignoring interference complaints from licensed users. The assignment of fault and the assignment of correction are too complicated under the Commission's present description leaving a wide door open to numerous contentious interpretations.

12. The Commission makes note of the lack of interference from the HomePlug system. The reality is that the manufacturers of this equipment and the amateur radio community, through the ARRL, worked together to resolve the interference issue. The resolution was to notch the amateur radio bands. So yes, the Commission is correct in its statement about HomePlug. This success should indicate to the Commission how to proceed with BPL implementation. Working together it has been demonstrated that these potentially disruptive technologies can coexist (ARRL RFI Task Group Semi Annual Report July 2001). I urge the Commission to insist upon cooperation between all concerned to both meet the growing potential for BPL and minimize or eliminate disruption to licensed services.

13. The Commission in Paragraph 33 seems to imply that those users such as Amateur Radio Operators will be secondary to BPL in Part 15 requirements for non-interference to licensed services. This seems to open the door for all sorts of utility interpretation as to the "importance" of their BPL system. I urge the Commission not to make exceptions in the Part 15 rules based on "perceived" benefit. Interference from Part 15 devices, and BPL, should all be treated the same, with the operator or owner of the unlicensed device either correcting the problem or shutting down. To do otherwise both retards technology development and creates the potential for havoc to licensed users.

14. According to the Commission's words in Paragraph 35 the Commission fails to appreciate the nature of operations on the high frequency bands in general and the Amateur Radio Service in particular. The reason for using directive antennas is to improve the signal strength of the received signal at both ends of the path. If a BPL radiator is located in one quadrant then any attempt at communications in

that direction will be impossible. Further if the directional antenna were pointed in that direction to enhance the received signal strength the increased transmitted ERP could be greatly increased and will be aimed directly at the BPL system, and then everyone losses. The scenario proposed by the Commission in this paragraph is unrealistic. The Commission's assertion in this paragraph is simply wrong. I urge the Commission to reconsider the data that led to this paragraph being included.

15. The Commission makes assertions about the interference history of low speed carrier systems in Paragraph 34. These systems have been operating without interference because these systems operate at very low to very low frequencies. The proposed BPL technology operates in a portion of the spectrum with high occupancy and having far different propagation characteristics over power lines.
    - **Existing Low Speed Carrier Systems <500 KHz**
    - **Proposed BPL Systems > 3,000 KHz**
16. For this reason, the complete difference in technology and spectrum employed, the Commission should maintain tight control over the application of BPL equipment. This may require type acceptance initially to insure that the early entry manufacturers do in fact adhere to the letter and intent of Part 15.
17. The Commission is no doubt aware of the testing and results of deployment tests in Japan, Austria and Sweden. In each case it was found that BPL caused unexpected levels of interference to licensed services. In each case deployment was either halted or slowed pending other technical developments. There is no public evidence that the proposed BPL systems in the United States will perform any better in this regard. The Commission and indeed the public, such as this commenter, have only the words of the manufacturers, which is questionable given their economic motives.
18. I urge the Commission to comment on and address the issues giving rise to halts in deployment in other countries. Specifically, what evidence exists that the proposed deployment will fare any better in the United States. Maxwell's equations apply universally to the best of my knowledge.
19. While setting aside the discussion on aggregation and the subsequent rise in noise floor, Southern's comments in Paragraph 22 regarding the "inefficiency" of a power line as an antenna lacks both substance and technical justification However, empirical data regarding inefficient antennas has shown that even with an inefficient antenna high frequency communications is possible at very low power levels. I suggest to the Commission that at this point no one can

accurately answer the question of the radiation characteristics of a randomly selected stretch of active power line, hence the need for in-situ testing. BPL is supposed to be an unintentional radiator, so discussion of power lines as antennas should be meaningless if BPL providers comply with Part 15 rules.

20. The BPL proponents have stated that the power lines act as very inefficient antenna, or as a waveguide. An antenna is an intentional radiator; a waveguide is a transmission line. If the power line is an antenna it will radiate, regardless of its efficiency. If 15.209 field strength limits are met, the antenna efficiency is moot. If 15.209 limits are being met then clearly the power line is an antenna. Hence the statements by BPL proponents are without merit. The real issue, the one being avoided, is whether the 15.209 limits will result in harmful interference. And if the 15.209 limits do result in widespread harmful interference, what will the Commission do to correct the matter? Any conductor, of any length, with energy efficiently coupled into it between the conductor and ground will radiate. If the coupling is very efficient, all that remains are the losses in a long run of copper power line (or aluminum), which will be minimal. If the energy is fed into two power lines separated by feet, they will radiate since with this conductor spacing the power lines will act as an antenna rather than as a transmission line. And in each case there will be ground reflections that are dependent on frequency, height above ground and the conductivity of the ground in the near field of the radiator. BPL proponents make an argument against radiating power lines that simply flies in the face of reality and 15.209. I would suggest to BPL proponents a study of the single conductor fed Windom antenna of 50-60 years ago. The conductor radiated then, and the power line conductors will radiate now. The fundamental principles of electromagnetism have not changed. Regulations, laws, economics will not change them either and it's preposterous to suggest that BPL proponents have somehow found a way around Maxwell.

21. The fact is, the power lines will radiate if excited in the 3-30 MHz range. The fact is that the Commission proposes to allow 15.209 field strength limits to apply, thereby acknowledging the radiating attribute of power lines. The Commission has stated its willingness to accept interference to accomplish its goal of BPL deployment. I propose that the Commission clarify that interference from a Part 15 device or system requires that such Part 15 devices or systems be corrected or shutdown.

## III. DEFINITIONS AND TERMS

24. The Commission asserts the need for non-interference by Part 15 operations including BPL in Paragraph 39. This is appropriate. However, I urge the Commission to include additional wording in paragraph 15.3(m) to further clarify

the meaning of "harmful interference" I propose that the following wording be added:

> "Harmful interference is such as to preclude the normal use and intended purpose of the licensed user."

25. The definition of "administrative requirements" (Paragraph 1) should be clarified. The Commission suggests an industry-operated entity in Paragraph 43 be the administrator. This implication needs further discussion and clarification given the potential widespread installation and interference matters.

26. The Commission should require definition "frequency agility" as it applies to OFDM systems and "on the fly" as it pertains to manufacturers claims of interference mitigation. Further, the Commission should add definition to paragraph 15.3 for any proposed technology that will operate under part 15 rules. Concepts such as frequency agility and notching (PowerWAN) are excellent technical proposals for interference mitigation, but clear definition is needed. Perhaps the Commission should engage of panel of experts.

27. The Commission proposes that 15.3(ff) be added. Although it is defined as a "carrier current system", the use of the words "unintentional radiator" should be included to clarify that BPL is not intended to be a wireless service.

28. The Commission should clarify paragraph 15.113 insofar as its relationship to new rules for BPL, again reinforcing that BPL is an unintentional radiator. Also BPL should operate with minimum required coupled energy into the power conductor to achieve its purpose, so long as the limits of 15.209 are maintained.

## IV. TESTING AND VERIFICATION

29. I am concerned that the measurements may not capture the maximum field strength either due to the selection of measurement frequency, measurement band, or correction factors. The measurements are noted to be at the "midband" frequency of the emissions. Under what circumstances does the Commission believe that the by design wideband nature of BPL will present its maximum field strength at this frequency.

30. I suggest that Part 15 sets limits on emissions for unintentional radiation based on discrete frequencies, or at least relatively narrow bands. BPL operating within the band of 3 to 30 MHz may or may not be radiating at the midland (13.5 MHz) during the test. The high frequency power input to a power line at a discrete frequency, resulting in 15.209 limits being met, is lower than the broadband power input that will be used for BPL.

31. The Commission should require that a standard test procedure be developed to be

representative of the wideband nature of BPL transmissions. This may include a standard transmission of data on known frequencies that are then sampled for field strength in addition to the midband.

32. Will the antennas used for the testing be frequency dependent in the high frequency range? How does the Commission propose to calibrate these devices to be accurate at potentially many discreet frequencies? In other words, the field strength results at one frequency compared to that measured at another frequency should not be a function of the test antenna bandwidth.

33. I propose a calibration standard for the test equipment, including the attached antenna that provides frequency dependent (sensitivity) correction for the measurements taken.

34. Further, the testing should be done at the high and low limits of the systems normal operating range as well as the midpoint and several frequencies in between. There is no public evidence that the BPL emissions will have constant amplitude versus frequency over the wide transmission bandwidth. Further, different manufactures may use very different methods of modulation to achieve the data rates required. I ask the Commission to comment on this matter and provide to the public such information as needed for evaluation by 3rd parties.

35. Further research must be done to validate assumption about correction factors when applied in the "real world" and not the laboratory or within a computer model.

36. At best the data gathered by any method will not be absolute. The measurement process is attempting to make field results absolute with a measuring instrument that may or may not be calibrated and in the hands of minimally trained personnel. How will the Commission handle the inevitable controversy?

37. The Commission proposes Verification in lieu of more burdensome requirements for BPL devices. Clearly this is a cost savings to the manufacturers. The Commission suggests BPL will rapidly grow, but the pressure on manufacturers and operators may cause significant deviations from both the intent and letter of Part 15.

38. I propose that the Commission require a higher standard to avoid the long run probability of electromagnetic chaos, which will render BPL useless. In the long run all manufacturers benefit from tighter technical controls. One bad operator deploying will in reality smear the name of all BPL operators. This is an area where the Commission could provide a valuable service to maintain technical standards for the manufacturers. I pose another scenario. Surely the Commission

realizes that foreign manufactured electronic equipment, such as cordless telephones, entered the country with technical specifications violating the Commission's rules. BPL equipment entering without any oversight whatsoever will make the cordless telephone issue minor by comparison.

39. The Commission states that because of the lack of interference from low frequency carrier devices operated under Verification the same rules are adequate for the proposed BPL equipment. Low frequency carrier equipment is totally different from BPL in terms of spectrum used and the potential for propagation from power conductors. The analogy between these two services is completely without merit insofar as potential interference is concerned.

## V. ELECTRIC POWER RELIABILITY

39. The Commission and the Chairman make frequent mention of the ability of BPL to enhance the electric power system. The proposed BPL systems lack both security and reliability. They lack data and physical security. Frequently during a crisis the electric power system is the first infrastructure component to fail. It is commonly known by power engineers that the U.S. power grid is vulnerable to a wide variety of disruptive events. Using BPL in any way to either monitor or control the electric power system is adding another potential disruptive event. Using BPL for any monitoring and control of the electric power system is not the best engineering America is capable of producing

40. Furthermore, if BPL interfaces with the monitoring and control of the electric power system, a single clever hacker could disrupt the entire command and control of the grid. The Commission surely can not deny that such hackers exist.

41. Citing electric power reliability as a benefit of BPL deployment is simply nonsense not supported by any public evidence, but only the statements of the manufacturers.

## VI. HOMELAND DEFENSE

42. The Commission cites in its summary that BPL will advance Homeland Defense. I suggest that cable, DSL, and dial up all contribute to Homeland Defense under this assertion at least to the same degree as BPL. The further deployment of broadband, in any form, is helpful to many functions including Homeland Defense but to imply that BPL is the sole provider to Homeland Defense is inappropriate and misleading.

43. Amateur radio stations also provide trained manpower to the Military Affiliate Radio System. Military frequencies in the high frequency spectrum are used. Immediately following 9/11 amateur radio operators operating under their

military licenses handled vital priority traffic for rapidly redeploying military units and aircraft. The Commission must insure that BPL does not render such vital activities ineffective.

## VII. IMPLEMENTATION

44. The industry-operated entity noted in Paragraph 43 should be composed of BPL operators and representatives from each licensed user organization that may be impacted. This would include organizations such as APCO, MARS, FEMA, ARRL, etc. Nevertheless this entity will be costly and complicated to maintain if the wide deployment of BPL occurs as the Commission implies. There is no evidence to support a belief that a BPL industry only entity would be responsive to interference issues from licensed users or other technical issues. In this matter I would ask the Commission to carefully consider how to "entice" such an industry entity to respond in a positive and effective manner to interference and technical matters.

45. Of course the Commission must make it a requirement that BPL providers coordinate and cooperate with all users of the high frequency spectrum. The Commission should note that Amateur Radio operators provide needed services to the Military Affiliate Radio System, the National Weather Service, FEMA through SHARES, and numerous hurricane and natural and manmade disaster scenarios. Without coordination these services will be generally at risk of being unavailable during the most critical times. I urge the Commission to require coordination for the licensed users of the high frequency spectrum.

46. I would suggest to the Commission that portion of the cost of operation could be borne by fees collected from BPL providers, who long with licensed operators are best served by an effective entity operating under public scrutiny.

47. The requirement for BPL providers to populate a public database is a necessary component until such time as technology reduces BPL interference to acceptable levels. The BPL provider mechanism for notification and populating the database could be done:

    ⇒ By using the FCC database to locate all licensed facilities in a given geographic area, including Amateur Radio.

    ⇒ By notification to the industry-operated entity of the nature and location of the BPL facility.

    ⇒ By notification to the industry-operated body of possible sites of interference based on the knowledge of the licensed users in the geographic area surrounding the proposed BPL site.

⇒ By notification to all licensed users in the geographic area of interest by the industry-operated entity of the proposed BPL installation. This is to allow certain licensed users to prepare for potential interference that may disrupt potentially vital high frequency communications.

48. The deployment of BPL, like the deployment of cable and DSL, will require the creation of call centers and help desks. The Cable industry required decades to finally develop customer friendly and effective centers. There is no evidence that existing power company infrastructures have the capability to service BPL installations. Contrary evidence exists that they focus on major power outage issues only and defer or ignore completely other matters such as power line interference. I ask the Commission, what evidence is in there possession indicating that BPL will be handled any better?

49. Poor or no maintenance, natural causes, trees and animals seem to cause most radio frequency interference from power lines. If BPL is to succeed it must reach several important goals including maintainability and customer service. If the early entry providers earn a reputation for bad performance continued deployment and the Commission's objectives will be in jeopardy. Interference from any cause, given the high susceptibility of BPL will achieve the later, unwanted goal. Even the existing line noise problems are potential sources for BPL performance failure. In this case the Commission is promising more than can be delivered and foisting upon the public what may become another failed technology if testing is incomplete or haphazard. I urge the Commission to insist upon "real world" testing before wide deployment. I further urge the Commission to insist upon a higher degree of responsibility to the public who will be buying the service.

## VIII. SUMMARY

50. BPL will add broadband access and competition. That is the simple reply to the Commission's statement. However, the statement that it will add to the "quality and reliability of electric power delivery" is incorrect. There is no evidence to support claims that BPL, as it exists today, can provide either the security or reliability needed in the power industry. If a 15 year old can hack into Bank of America's computers, and they have, it is folly of the highest order to assume that the same will not happen to the power grid control systems. As far as Homeland Defense is concerned there is no evidence to suggest that BPL is any different than Cable, DSL, or dial up in this regard. Additional broadband users may serve this goal, but that would seem to be the only way it may add to Homeland Defense. On the other hand, if the power industry were to use BPL for their control and monitoring systems, BPL disruption, interference, and hacking would be a prime objective of any early moves against the United States. So instead of

enhancing homeland security, under certain circumstances it may actually reduce security, providing another unguarded point of entry.

51. Additionally, it is presumed that the requirements of Part 15 are such that an interfering device must be shutdown whether its field strength measurements fall within the guidelines or not. Any other interpretation exacerbates the likely finger pointing and litigation resulting from interference issues. The Commission must be clear on this issue and how the shutdown if required will be implemented.
52. The real issue, the one being avoided by the Commission and the manufacturers, is whether the 15.209 limits will result in harmful interference. And if the 15.209 limits do result in widespread harmful interference, what will the Commission do to correct the matter?
53. In this matter the Commission seems to be taking a very "hands off" attitude and planning to allow the marketplace to sort out the best technologies for BPL. I do not categorically oppose BPL; I am opposed to bad engineering and science. I do urge the Commission to be specific in its requirements insofar as disruption of other entities and licensed users are concerned.
54. BPL may well prove to be a valuable communications asset that could add much to our technical superiority. Other technologies will be discovered and BPL itself will hopefully continue to evolve. BPL must be regulated in some way to avoid an uncaring marketplace creating an interference issue and PR nightmare, while also capturing as much as possible of the potential.

Respectfully Submitted Before the Federal Communications Commission March 16, 2004

Lionel S. Booth PE

N5LB

AR6IP MARS