Before the
Federal Communications Commission
Washington, D.C. 20554

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

COMMENTS OF UPLC

Brett Kilbourne
United Power Line Council
1901 Pennsylvania Avenue, N.W.
Fifth Floor
Washington, D.C. 20006

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SUMMARY

Broadband over Power Line (BPL) systems use the existing electric distribution grid to provide last-mile high-speed access and home networking, and enable advanced utility applications that promote energy efficiency and critical infrastructure reliability and security. BPL would promote the Commission's policy goals of broadband access and competition by encouraging utilities to provide retail and wholesale services in urban, suburban, and rural communities that they currently serve.

Already, utilities have engaged in several significant trials producing encouraging results. Speeds are competitive with DSL and cable modem. The service is relatively inexpensive to deploy and easy for customers to use. Many of the technical hurdles to BPL deployment in the U.S. have been overcome, but the range of BPL is limited to substantially less than a mile. As a result, utilities are interested in commercial deployment of BPL systems, which will be determined in large part by the technical rules that the FCC ultimately adopts.

The UPLC believes that Class A standards should apply to Access BPL equipment on medium voltage lines, and that the Commission should continue to use uniform radiated emission limits for both Access and In-home BPL systems as the primary means of preventing interference. The UPLC believes that the existing Part 15 rules for carrier current systems adequately protect against interference, and that the existing measurement methods and Verification process for equipment authorization should be retained at this time.

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Pursuant to Section 1.415 of the Federal Communications Commission ("FCC") Rules, the United Power Line Council ("UPLC") hereby submits its comments in response to the *Notice of Inquiry* in the above referenced proceeding.[1] The UPLC applauds the FCC for initiating this NOI and provides the following information on Broadband over Power Line (BPL) and suggestions for encouraging its development.

I. Introduction

The UPLC is an alliance of utilities and their technology partners that are developing BPL in America. Its mission is to drive the development of business, technical and regulatory solutions for BPL in a manner that enables all its members to succeed. The UPLC was created in recognition that significant trials are underway in various parts of North and South America. It was formed by the United Telecom Council (UTC) as a separate organization to carry on and expand on the efforts of the UTC's Power Line Telecommunications Forum (UTC PLTF) that has been the primary resource for advocacy and information on BPL in North America since 1998.

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[1] *Inquiry Regarding Carrier Current Systems, including Broadband over Power Line Systems*, Notice of Inquiry, *ET Docket No. 03-104* (April 28, 2003) *("FCC NOI")*.

II. Access BPL Systems

A. Background

The history of BPL in America is a story of technological achievement verging on widespread success and public benefit. In 1999, the UTC PLTF was skeptical towards the future of BPL in North America, and outlined five principal obstacles to its deployment here.[2] At that time, the electric noise on the lines, the high number of transformers on the electric grid, insufficient capacity, interference and safety issues all led to the conclusion that BPL could not compete technically or economically with incumbent broadband technologies, such as cable modem, DSL and satellite.[3] Since then, the UTC PLTF has published reports in 2001 and 2002 that concluded that the technology had improved to the extent that utilities might wish to seriously investigate the economic feasibility of deploying BPL using a variety of business models.[4]

The breakthrough in BPL between 1999 and 2001 was brought about by a few relatively unknown companies, many of which are based here in the United States. These companies persisted when others gave up, and have developed solutions for the obstacles to the deployment of BPL in the U.S., such that there are presently nine trials that are underway with utilities under experimental authority from the FCC.[5] The results

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[2] *See* Initial Report of the UTC Power Line Telecommunications Forum, June 1999, at http://www.utc.org/file_depot/0-10000000/0-10000/1013/conman/initial_report.pdf (visited June 24,2003).

[3] *Id.*

[4] *See* Revised Report of the UTC Power Line Telecommunications Forum, June 2001, at http://www.uplc.utc.org/file_depot/0-10000000/0-10000/7966/folder/15676/Revised+Report+of+the+UTC+Power+Line+Telecommunications+Forum.pdf (visited June 24, 2003).

[5] *See generally* Applications for Experimental Radio Station Construction Permit and License by Progress Energy; Current Technologies, LLC; Ambient Corporation; Ameren Energy Communications, Inc.; City of

of these trials are encouraging. Speeds are competitive with DSL and cable modem. The service is relatively inexpensive to deploy and easy for customers to use. BPL offers advantages over conventional technologies by enabling home networking without additional wiring or rewiring and by supporting internal utility applications, in addition to high-speed Internet access and other commercial services.

B. Market Considerations

While BPL is a late arrival in the broadband marketplace, it has arrived at a critical time. Based upon the most recent statistics from the FCC, there is no choice of broadband providers in thirty-four percent of the zip codes in the country, and sixteen percent of the country has no access at all.[6] Investment in further terrestrial broadband deployment has slowed, as capital markets demand that providers demonstrate a return on the investment that has already been made.[7] Meanwhile, customer adoption of broadband where it is available has struggled to reach fifteen percent of all U.S. households.[8] Perhaps customers are discouraged by the price, the quality of service, the applications, or all of the above.[9] Whatever the reason, broadband deployment is at an impasse that requires a disruptive technology.

Manassas; Hawaiian Electric Company, Inc.; PPL Electric Utilities DBA PPL Utilities; and Southern Telecom, Inc.

[6] Federal Communications Commission Releases Data on High-Speed Services for Internet Access, FCC News, 2002 WL 1610969 (F.C.C.), at Table 9 (released Dec. 17, 2002).

[7] *See* Broadband Services in the United States: An Analysis of Availability and Demand, The Federal-State Joint Conference on Advanced Services, at http://www.fcc.gov/jointconference/services_study-oct2002.pdf (visited June 24, 2003).

[8] *Id* at 24.

[9] *Id.* at 5.

Enter BPL. BPL offers a unique opportunity to break the duopoly in the broadband marketplace by providing utilities with a feasible option of offering retail as well as wholesale services. Utilities can also use BPL to extend the reach of their fiber optic backbone networks, which have untapped capacity that can be used to aggregate and route traffic to the Internet and provide such access to areas where it does not now exist. As such, BPL may succeed in encouraging utilities to invest in broadband to provide retail services, where other technologies have failed.[10]

C. Technical Considerations

BPL works by amplifying a communications signal over the electric noise on existing electric lines. As the signal travels over the electric lines, the primary hurdle between the customer and the Internet is the transformer, which filters much of the signal. Different technologies are employed at the transformer to carry the signal to and from the customer. Some physically bypass the transformer by routing the signal from the medium to the low voltage lines. Some are able to send the signal through the transformer using discrete frequencies. Others use Wi-Fi to deliver the signal from the pole to the customer premise. Although different BPL systems deliver the signal in different ways, BPL is inherently a shared medium, so the capacity on the medium voltage lines will be shared between the customers that subscribe and are using the system at the same time.

There are other differences in the technologies that bear consideration. One key component is the coupler that is used to inject and extract the signal. Some use

[10] In addition, utilities are also interested in BPL for internal utility and homeland security applications. *See* Section II.E *infra*.

capacitive couplers and some use inductive couplers. The coupling technique and the technology used are important factors in the level of radiated emissions that may be measured from BPL systems.[11] However, the modulation technique employed by different BPL systems is a negligible factor in regards to emission measurements.[12] Finally, different BPL systems use different frequencies of operation.[13] Generally, they all use frequencies in the 1.7 – 30 MHz range, but some are using frequencies above 30 MHz, as well.[14] Both Access and In-House BPL systems will likely share a portion of the same spectrum.[15]

D. Performance Characteristics

A number of trials of BPL have been conducted under experimental authority from the FCC. Initially, these trials assessed the technical performance of BPL, and now many have moved into marketing trials to gauge customer response. The results from the technical phase of the trials have been encouraging.

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[11] *See* Comments of UPLC *infra.*

[12] *See* FCC NOI at ¶ 15 (inquiring concerning the modulation techniques and the contention resolution between Access and various In-House BPL devices.) Different technologies employ different modulation schemes. Some use OFDM and others use spread spectrum. These modulation schemes improve throughput and reliability of BPL systems by overcoming the noise on the lines and making more efficient use of capacity available on the spectrum that is used.

[13] *See* FCC NOI at ¶ 15 (inquiring concerning the spectrum and bandwidth for Access BPL systems, and noting that experimental authority has been granted for BPL systems to operate from 1.7 MHz to 80 MHz).

[14] *See generally* Applications for Experimental Radio Station Construction Permit and License by Progress Energy; Current Technologies, LLC; Ambient Corporation; Ameren Energy Communications, Inc.; City of Manassas, Hawaiian Electric Company, Inc.; PPL Electric Utilities DBA PPL Utilities; and Southern Telecom, Inc. Although experimental authorization has been granted to some parties to operate from 1.7 to 80 MHz, as a practical matter BPL operations have been confined below 50 MHz.

[15] For example, HomePlug states that it uses the 4-21 MHz band. *See* HomePlug Standard Brings Networking to the Home. At http://www.commsdesign.com/main/2000/12/0012feat5.htm (visited May 20, 2003).

Technology companies report that customers have received symmetric speeds between 500 kbps up to multiple megabits per second. Moreover, throughput only tells half the story. The technology is scalable and capacity can be increased to meet demand. The symmetric speeds and scalability of BPL are attractive features for applications such as interactive gaming and file sharing that are reportedly driving Internet growth.

Although many of the technology hurdles have been overcome, the principal obstacle that remains is the range of BPL. Typically the BPL signal travels substantially less than a mile from the point where the signal is injected. This is particularly frustrating because BPL systems are not otherwise limited to a particular area, unlike other broadband architectures that are predicated upon massive head-ends or central offices. Technically, BPL can be deployed in rural as well as suburban communities, but economically present FCC rules constrain such deployment. Repeating the signal will increase the range, but it increases the costs and the latency of the service and constrains the bandwidth due to frequency use limitations.

E. Commercialization of BPL

Utilities are interested in deploying BPL systems for a number of reasons. First, BPL supports internal applications, such as load management, outage reporting and automated meter reading that improve the efficiency, security and quality of electric services to utility customers. Moreover, BPL affords a unique and exciting potential to promote homeland security and critical infrastructure reliability. From a utility perspective, these benefits may actually be more important than the new businesses that could be supported by BPL. Second, BPL utilizes existing infrastructure with minimal risk of stranded investment. Third, BPL enables utilities to provide their customers with

an alternative or, in many cases, the only source for broadband Internet access and associated applications, such as voice, video-on-demand, home security, and smart-home appliances.

Conversely, there are many reasons that might discourage utilities from deploying BPL. First, this is a difficult time for utilities to be starting a new business -- any business, let alone a communications business. Second, there is an added level of risk inherent in any new technology such as BPL. Third, and probably most important, electric utilities which are regulated by the state utility commissions and by the Federal Energy Commission tend to be conservative in their investments, have unique operating concerns and must be very careful about equipment that attaches to live electric wires.

Whether utilities offer commercial services will be determined in large part by the technical rules that the FCC adopts for BPL. The UPLC appreciates the support that the FCC has shown for BPL, and urges it to continue to pursue regulatory policies that encourage the development of current and next generation BPL systems. Technology has brought BPL to the verge of commercial deployment. This proceeding sets the stage toward making BPL a commercial reality.

III. Access BPL Systems and the Part 15 Rules

A. Background

Access BPL systems do not intentionally emit radio frequency energy in order to communicate, and as such are appropriately classified as an unintentional radiator for purposes of Part 15.[16] Access BPL systems are treated as carrier current systems that

[16] *See* 47 C.F.R. § 15.3(z) (defining an unintentional radiator as a device that intentionally generates radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction).

must meet specific radiated and conducted emission limits under the existing Part 15 limits.[17] As Access BPL systems operate above 1.705 MHz (where there is no conducted emissions limit), as a practical matter only the radiated emissions limits apply to BPL operations.[18] There are three possible radiated emission limits that could apply to BPL operations.[19] BPL operations below 30 MHz must not produce radiated emissions that exceed 30 microvolts per meter measured at a distance of 30 meters.[20] Above 30 MHz, either the limits for Class A or Class B digital devices would apply to BPL.[21] Class A limits that generally apply to digital devices that are designed for use in non-residential environments are set at 90 microvolts per meter at a measurement distance of 10 meters.[22] Class B limits that generally apply to digital devices that are designed for use in residential environments are set at 100 microvolts per meter at a measurement distance of 3 meters.[23]

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[17] *See 1998 Biennial Regulatory Review – Conducted Emission Limits Below 30 MHz for Equipment Regulated under Parts 15 and 18 of the Commission's Rules*, Report and Order, ET Docket No. 98-80, 17 FCC Rcd. 10,806 at ¶ 10 (2002) (clarifying that BPL systems are a type of carrier current system for purposes of Part 15 of the Commission's rules).

[18] *See* FCC NOI at ¶11 (explaining that the primary means for controlling interference from carrier current systems operating from 9 kHz to 30 MHz is a limit on the radiated emissions from any part of the wiring or power network connected to the RF power source).

[19] *See* 47 C.F.R. § 15.109(e).

[20] 47 C.F.R. § 15.209(a).

[21] 47 C.F.R. § 15.109(e) (specifying that at frequencies above 30 MHz, the limits in subparagraphs (a), (b) or (g) as appropriate would apply).

[22] 47 C.F.R. § 15.109(b).

[23] 47 C.F.R. § 15.109(a).

The measurement standards that apply to BPL operations are provided at Section 15.31.[24] Field strength measurements for carrier current systems must be performed at a minimum of three installations that can be demonstrated to be representative of typical installation sites.[25] The rules further provide that "to the extent practicable" the measurements must be taken at "the distance specified in the appropriate rule section,"[26] but alternative measurement distances may be used for frequencies at or above 30 MHz, as well as below 30 MHz.[27] In either case, an attempt should be made to avoid making the measurements in the near field. If the measurements are conducted at distances closer than that specified in the appropriate rule section, the results must be extrapolated to the specified distance using an extrapolation factor of either 20 dB/decade (at or above 30 MHz) or 40 dB/decade (below 30 MHz).[28]

B. Interference

In this proceeding, the FCC inquires concerning the potential for interference from BPL systems under the existing Part 15 emission limits,[29] and it inquires whether the existing measurement procedures are appropriate.[30] The UPLC is pleased to respond that there has been no interference reported in any of the field trials by its members. These trials have been conducted in accordance with the existing Part 15 limits and

[24] 47 C.F.R. § 15.31.

[25] *See* 47 C.F.R. § 15.31(d).

[26] 47 C.F.R. § 15.31(f).

[27] *See* 47 C.F.R. §§15.31(f)(1)-(2).

[28] *Id.*

[29] *See* FCC NOI at ¶¶18-21.

[30] *See* FCC NOI at ¶¶ 21-23.

measurement procedures.[31] In many cases, the FCC has assisted in the test measurements that have been taken. The experience gained from this process indicates that BPL systems comply with the Part 15 limits, and that the existing rules protect licensed users against interference from BPL systems. If anything, the existing rules may be too stringent and unnecessarily limit the range of BPL, but certainly the emission limits do not need to be reduced to prevent interference. As such, the UPLC provides its responses to certain issues raised by the FCC with respect to interference and the measurement standards for emissions from BPL systems.

The FCC inquires whether the devices that bypass the transformer could conversely permit signals from In-House devices to migrate past the transformer onto the medium voltage lines.[32] Some trials of Access BPL systems do in fact use devices designed for In-House BPL use, and any unintended migration of the signal would be so faint that there would be no potential for interference.[33] Indeed, to date there has not been any interference reported. Nor is the UPLC aware of the existence of any potential interference from other "in-premises technologies that may rely on the low-voltage

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[31] The trials are being conducted under authorization from the FCC to operate an experimental radio station. Each ERS authorization requires that licensees file a progress report every 6 months from the date of the grant of the license. The ERS authorization specifies that the progress report should include, but is not limited to a description of the measurements and results demonstrating compliance with Part 15.109.

[32] *See* FCC NOI at ¶ 20 (noting that Access BPL systems use high-pass filter circuits to bypass the transformer, and inquiring what the effect of these high-pass filters might be with respect to high-frequency signals used inside the house *e.g.* from In-House BPL equipment or other in-premises technologies that may rely on the low-voltage transformer as a natural barrier to avoid causing interference at higher frequencies).

[33] Current Technologies uses In-House BPL equipment designed to the HomePlug specification in its trials. As the Commission recognized, there are several operational standards for In-House power line applications, including HomePlug.

transformer as a natural barrier to avoid causing interference at higher frequencies."[34] Therefore, even though it may be theoretically possible for In-House signals to migrate onto the medium voltage lines through the bypass device, the UPLC does not believe that this raises any significant potential for interference.

The FCC inquires about the implications on radiated emissions from the use of various methods for injecting the signal onto the medium voltage lines.[35] The method of injecting the signal onto the medium voltage lines is an important factor in the radiated emissions that are measured from BPL systems. Actually, most of the signal loss tends to occur at the coupler, so the more efficient the technique, the lower the emission measurements will tend to be, if other things are equal. However, the Commission need not adopt rules with respect to specific coupling technologies. Rather, it should continue simply to set technology-neutral emissions limits and enable manufacturers to utilize the most efficient coupling techniques consistent with such limits.

The FCC inquires whether BPL equipment that is installed on medium voltage lines that supply electricity to a residential neighborhood should be treated as Class A (commercial) or Class B (residential) equipment.[36] Access BPL systems should be treated as Class A equipment for purposes of radiated emission limits. First, the distinction between radiated emission limits for Class A and Class B equipment only applies under the rules for operations of carrier current systems above 30 MHz. Second,

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[34] *Id.*

[35] *See* FCC NOI at ¶ 20.

[36] *See* FCC NOI at ¶20 (inquiring whether BPL equipment that is installed on medium voltage lines that supply electricity to a residential neighborhood should be treated as operating in a residential (Class B) or commercial (Class A) environment).

at frequencies above 30 MHz, the transformer very effectively blocks signals from reaching the customer premise. Third, all BPL Access equipment would be professionally installed, away from the customer premises and consumer devices. Therefore, it would be entirely appropriate to treat BPL equipment that operates on medium voltage lines as Class A devices.

The FCC raises a number of questions concerning the potential for interference and mitigation techniques.[37] The UPLC reiterates its general response that BPL systems have not caused interference.[38] Nor is there any indication from the trials that BPL systems would cause interference.[39] Therefore, it would not be appropriate to require notching or other mitigation techniques to avoid interference to licensed operations, cable TV or DSL services that operate in proximity with BPL systems. The UPLC believes that the existing Part 15 rules for low speed carrier current systems do adequately protect authorized users of the spectrum that are in the bands used by BPL systems.

The FCC further inquires whether different emission limits should apply to Access and In-House BPL systems, and whether it would be appropriate to rely on a single conducted emissions limit in order to protect authorized users from interference.[40]

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[37] *See* FCC NOI at ¶ 20 (inquiring whether there is a need to define frequency bands that must be avoided in order to protect the licensed users on the same frequencies as those used by Access BPL systems; and whether the close proximity of Access BPL equipment to cable television and telecommunications equipment from third party providers co-located on the same pole could impact these services or BPL itself).

[38] *See* Comments of UPLC, at Section III. B., *supra.*

[39] *See* FCC NOI at ¶ 20 (inquiring concerning the probable interference and propagation patterns of Access BPL and In-House BPL systems; whether there are specific issues such as an increase in the noise floor and what models are available for predicting radiated emissions from Access BPL systems).

[40] *See* FCC NOI at ¶ 20 (inquiring whether there is a need to specify different limits for Access and In-House systems, assuming that In-House systems would principally affect the user of the system and that interference from Access systems would affect a wider area and therefore be more problematic to mitigate).

The same limits should apply to BPL Access and In-House systems, because each effectively produces a signal that travels outside the home to the pole- or pad-mounted transformer and hence neither system is inherently more or less likely to cause interference than the other.

Moreover, the FCC should not eliminate the radiated emissions limit, and to the extent that only one set of limits should apply, the UPLC would support eliminating the conducted limit, instead of the radiated limit as suggested by the FCC.[41] Radiated emissions provide a true indication of the potential for interference. Moreover, taking conducted measurements from the medium-voltage lines would be problematic. Therefore, Access and In-House BPL systems should be subject to the same rules and limits that the FCC ultimately decides to adopt. The UPLC recommends retaining the radiated emission limits, rather than relying on conducted emission limits as a proxy.

C. Measurement Methods

The FCC has expressed concern that the present measurement procedures are time consuming and difficult to make, and it suggests developing a standard measurement procedure that is consistent and repeatable.[42] Although measurements may be difficult, the UPLC would prefer that the FCC retain the existing measurement procedures, rather than shifting to a new scheme. The current process is familiar and accurate, and a new regime may cause unnecessary delays and additional costs that

[41] *See* FCC NOI at ¶ 20 (inquiring whether one type of limits would be sufficient to control interference from both low speed and high speed BPL, instead of both radiated and conducted emission limits as currently applies).

[42] *See* FCC NOI at ¶ 23 (inquiring how the measurement procedures for testing existing low-speed carrier current systems be developed in order to avoid the burden of selecting representative installations and to promote consistency and repeatability).

cannot be afforded. To alter the measurement standards now without sufficient evidence that new measurement procedures reflect the real potential for interference, could discourage the development of BPL by adopting emission limits that are more stringent than necessary to protect licensed users.[43] In general, the UPLC urges the Commission to allow providers to continue to demonstrate compliance with radiated emissions and the rest of the existing Part 15 rules.

D. Equipment Authorization

The FCC inquires whether BPL equipment should continue to be authorized through the equipment *Verification* process, or whether the *Certification* or *Declaration of Conformity* process should apply.[44] The UPLC recommends that the FCC retain the equipment *Verification* process. Access BPL equipment will be marketed only to utilities and third-party service providers, never to consumers. Because it connects to the electric distribution lines, it must – and will – always be professionally installed by qualified linemen.[45] More stringent forms of equipment authorization are unnecessary to assure compliance and will only impede innovation.[46]

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[43] *Cf* FCC NOI at ¶23 (inquiring how a single conducted emissions measurement procedure should be specified, if it is determined that conducted emissions alone are sufficient to control harmful interference from BPL systems).

[44] *See* FCC NOI at ¶ 26. *See also* 47 C.F.R. 15.101(a).

[45] *Compare* 47 C.F.R. § 15.113 (c) (No equipment authorization is required for power line carrier equipment).

[46] *See* Amendment of Parts 2, 15, 18, and other Parts of the Commission's Rules to Simplify and Streamline the Equipment Authorization Process for Radio Frequency Equipment, Report & Order, ET Docket No. 97-94, 13 FCC Rcd. 11,415, at ¶ 15 (1998) (stating that the public interest is best served by eliminating the unnecessary delays and higher costs of marketing equipment caused by overly burdensome regulations and that manufacturers' self-approval for certain equipment is an appropriate way of controlling interference without overly burdening manufacturers).

E. Power Line Carrier Systems

It should be recognized that power line carrier (PLC) systems currently used by electric utilities are and will continue to be significantly different in both usage and technology.[47] While BPL systems offer advantages for high bandwidth last mile access, traditional PLC systems lend themselves to long distance, low bandwidth applications (such as in the protection of transmission assets). Although BPL is an important emerging technology that will enable efficiencies to utility operations that are currently too costly to implement, it is not considered a replacement for existing PLC systems due to the distances achievable through legacy PLC systems.

Not only would they operate on separate parts of the electric network, BPL and PLC systems would operate on entirely different frequencies. PLC systems operate between 9-490 kHz, whereas BPL systems operate above 1.705 MHz. Due to the physical and spectral separation between these two systems, it is expected that they will coexist with one another.[48] Given these functional and operational differences between BPL and PLC systems, the Commission should refrain from arbitrarily applying rules for PLC systems to BPL systems.

F. Other Matters

The UPLC looks forward to working with the FCC to craft rules that are appropriate for current generation BPL systems, and which also provide for the growth of BPL systems in the future. Although BPL is poised to promote real competition among broadband services and to provide high-speed access in areas where none exists, its

[47] *See* FCC NOI at ¶ 28 (inquiring whether power line carrier systems currently deployed by the utility companies to control and monitor the electrical system would be replaced in the future with the new high speed BPL equipment).

immediate future depends on its long-term prospects as well. The FCC has encouraged utilities to deploy BPL commercially under the existing rules, but this proceeding provides an opportunity for the Commission to develop rules that would further encourage utilities to invest and deploy theses systems. The UPLC looks forward to working with the Commission to develop rules that are appropriate for the systems today and tomorrow.

WHEREFORE, THE PREMISES CONSIDERED, the UPLC is pleased to provide these comments on the NOI.

Respectfully submitted,

UPLC

By: _____
Brett Kilbourne
Director of Regulatory Services and
Associate Counsel

UPLC
1901 Pennsylvania Avenue, N.W.
Fifth Floor
Washington, D.C. 20006

(202) 872-0030

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[48] *See* FCC NOI at ¶ 28 (inquiring how BPL systems would coexist with PLC systems).