

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554
17 August 2003**

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

REPLY COMMENTS OF CORTLAND E. RICHMOND, Jr.
to
Comments of the United Power Line Council, dated July 7, 2003

These are Reply Comments of Cortland E. Richmond, Jr., to Comments of the United Power Line Council, in this document referred to as the UPLC, in the matter above, dated 7 July 2003.

The writer has been involved in EMC and EMI engineering since 1983, spent 21 years in the United States Army working with airborne and ground communications equipment, and has been an Amateur Radio operator since 1958.

These replies take the form of excerpts from the UPLC's original comment, noted as Comment, followed by reply remarks, noted as Reply. A Roman numeral annotates each Comment and Reply. Replies commence below.

I

Comment:

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.

Reply:

The UPLC summary ignores already known or readily signal levels used by service who operate on frequencies it wishes its systems to use, and dismisses out of hand easily calculable interference levels that from emissions permitted by the existing part 15 rules.

Part 15 in no way foresaw carrier current systems occupying the whole HF spectrum (and perhaps part of the VHF spectrum), and geographically omnipresent to boot;. limits appropriate to a geographically scattered and narrowband carrier current technology are inappropriate to BPL. The Commission should consider BPL *de novo*.

II

Comment:

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. The results 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.

Reply:

Speeds in a sparsely populated test system should not to be expected to adequately predict those available to users of a mature system. This is reflected in performance of similarly constrained services delivered by Cable Television providers. In addition, and as the UPLC admits in its further remarks, BPL will require a substantial investment in equipment such as repeaters, couplers and transformer bypasses. Moreover, the UPLC errs in assuming no home rewiring will be required, since the state of home wiring varies from post and beam, to loose wire, to ROMEX or EMT conduit in dwellings across the country.

III

Comment:

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.

Reply:

The technological hurdles yet to be overcome should not be slighted. High frequency radio signals placed on the power distribution network may be expected to undergo attenuation due to losses in couplers and protective and switching hardware, radiation at the connection to the distribution line, common-mode conversion caused by imbalance at the high frequencies employed, and crossovers which uncontrollably create, at high frequencies, conditions favoring radiation of RF on power lines.

A transmission line of two wires spaced just one sixth of a wavelength from each other is equivalent, at the injection point, to a dipole which radiates one percent of the applied RF. While this seems very little, it is more than enough to cause interference to nearby radio users, even at levels permitted by Part 15. Lowering signal levels to those not able to create harmful interference would indeed pose an insuperable obstacle to economical deployment of BPL as it presently exists. Compliance with the limits presently imposed by Part 15 is economically and practically problematical, and, as will be shown later, with present BPL technologies even this level cannot sufficiently protect existing radio services.

* Bingeman. Transmission Lines as Antennas, www.rfdesign.com

IV

Comment:

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 must meet specific radiated and conducted emission limits under the existing Part 15 limits. 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. There are three possible radiated emission limits that could apply to BPL operations. BPL operations below 30 MHz must not produce radiated emissions that exceed 30 microvolts per meter measured at a distance of 30 meters. Above 30 MHz, either the limits for Class A or Class B digital devices would apply to BPL. 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. 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.

Reply:

These levels may be shown insufficient to protect over-the air radio spectrum users in the frequency range under discussion. For example the permitted field strength permitted for Class A equipment of (at 30-88 MHz) 90 microvolts per meter, ten meters from equipment under test (EUT), at a dipole just above 30 MHz, a signal of 90 microvolts. which far exceeds both the usual full-quieting sensitivity of narrowband FM communication equipment used in this spectrum, and the amplitude of signals over-the-air users must receive. And while the antenna factor of a victim installing may be expected to decrease with frequency, the efficiency of the equivalent dipole at the power line pair used to carry BPL increases, so the level of interference may not be expected to decrease with frequency. In any case, such a decrease would be modest between 30 and 50 or 80 MHz (some foresee using up to 80 MHz) .

V

Comment:

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. The rules further provide that .to the extent practicable. the measurements must be taken at .the distance specified in the appropriate rule section,. but alternative measurement distances may be used for frequencies at or above 30 MHz, as well as below 30 MHz. 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).

Reply:

Most of the radiated interference from BPL installations may be expected to occur as a result of dipole radiation at injection points and imbalance, with resulting common-mode conversion, on the power line pairs upon which BPL is placed. Even without repeaters, these conductors are sufficiently long as to bring into question both the assumptions on which the usual near-field/far field restrictions are made, the propriety of using 20 dB and 40 dB per decade scaling with distance, and reliance upon far field conditions assumed when converting signals received with a magnetic field antenna (loop) to the E-field equivalent.

VI

Comment:

In this proceeding, the FCC inquires concerning the potential for interference from BPL systems under the existing Part 15 emission limits, and it inquires whether the existing measurement procedures are appropriate. 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 measurement procedures. 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.

Reply:

It appears that the UPLC, or at least some of its members, are less than forthcoming, in that it, or they, have not let the potential victims of interference know when and where trials will be carried out, or to whom they should complain, and in not soliciting interference complaints from spectrum users known to exist in the target trial areas. Under the circumstances, it is not a surprise no complaints were received.

This writer has found a great deal of difficulty in identifying, from on-line documents on file with the Commission, the location and duration of trials the UPLC asserts result in no interference complaints. In addition the American Radio Relay League has reported that (in at least one instance) upon notifying a BPL trial provider of dispatch of a mobile radio station to the trials area, the trial system was unexpectedly shut down "for maintenance." The Commission, should it notify a service provider of intent to measure emissions, would not suffer such an evasion.

In any case, unequivocally harmful interference has been noted in areas the American Radio Relay League has been able to dispatch a mobile station to check, as well as reported on Internet discussion forums (such as www.qrz.com) by some few Amateurs who were not aware it was BPL they had been hearing.

VII

Comment:

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. 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. 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

Reply:

This is unclear. What does the UPLC expect would be interfered with? Access BPL devices? In-House BPL? Nearby radios? Who would report interference, if it did occur? How would they know to report it -- and where?

VIII

Comment:

The FCC inquires about the implications on radiated emissions from the use of various methods for injecting the signal onto the medium voltage lines. 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.

Reply:

This assumes that the equipment itself is the sole interference radiator, and that the line to which it is attached do not radiate at all. These are unwarranted assumptions. Moreover, interference is not the only concern to which the Commission should address itself. The Commission may well need to specify a parameters of coupling mechanisms in order to reduce common mode radiation from power lines and also to protect BPL equipment and service from transients and surges generated during normal operation of power utility equipment such as interrupters and reclosers.

IX

Comment:

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. 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, 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.

Reply:

Having shown that Class A and Class B limits are *prima facie* inadequate to protect radio spectrum users, the writer cannot agree with the UPLC's conclusions. Even if he did agree, the distinction to be made is not one which can be maintained when a system intrudes upon residential environs along conductors offering a resident no choice whether interference will be allowed inside or not. High frequency currents will not be stopped transformers entirely adequate to the purpose at 50, 60 or even 400 Hz; there is sufficient capacitive coupling across such to make isolation at radio frequencies problematical. In any case, the presence of a coupler designed to overcome that isolation makes its putative utility as a filter moot.

X

Comment:

The FCC raises a number of questions concerning the potential for interference and mitigation techniques. The UPLC reiterates its general response that BPL systems have not caused interference. Nor is there any indication from the trials that BPL systems would cause interference. 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.

Reply:

The writer is minded of Charles Dickens' Mr. Bumble: " 'If the law supposes that,' said Mr. Bumble, 'the law is a ass, a idiot.' "(Oliver Twist) The writer does not regard the UPLC, its members, or its personnel either as asses or idiots. But the writer finds it hard to believe that the technically competent organization the UPLC and its members undoubtedly are could utter the statements above. Could it be that UPLC or its members have abstained from asking if the levels being discussed could cause interference?

XI

Comment:

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. 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.

Reply:

This writer at one time believed that a simple radiated emissions limit -- though a lower one than Part 15 at present requires -- would suffice, as it is likely most victim devices would receive interference through their antenna ports. However, upon further thought, it appears that many radio receivers will be subject to radio interference coupled in common-mode on AC power, and thence to the radio and antenna. For this reason as well as the multitude of wiring configurations from which interference may be radiated, the writer now believes it best not only to impose a radiated emissions limit but to add, where it does not now exist, one for conducted current.

XII

Comment:

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. 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.

Reply:

The writer, as noted above, disagrees with the UPLC in this, and recommends retaining a conducted emission limit not as a proxy, but as a supplement to a radiated emission limit.

XIII

Comment:

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. 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 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. 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.

Reply:

The UPLC here ignores the point of testing. The object of Part 15 testing is to discover likely sources of harmful interference so they may be prevented from causing it. The more difficult the procedure, the less likely such a test is to be carried out, or be carried out with the diligence required. Thus, an adequate surrogate should be available for testing BPL equipment before it is placed on the market or deployed.. It is to be noted that economic and competitive equity requires BPL not be treated in this respect more favorably than other technologies now in use or under development. For these reasons, the writer urges the Commission not to proceed in this matter before until an effective and acceptable test method can be adopted.

XIV

Comment:

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. 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. More stringent forms of equipment authorization are unnecessary to assure compliance and will only impede innovation.

Reply:

BPL is a □gweapon of mass destruction□h for radio spectrum users, and should, because of its much greater potential for harmful interference and number of over-the-air users affected, be much more strictly regulated than Part 15 has in the past required for carrier current unintentional radiators. Electric utilities not at present being sufficiently diligent to forestall harmful interference from their existing physical plant, the manufacturers of BPL equipment are the best party to hold responsible for interference their equipment causes; manufacturers should be required to declare compliance with such regulations as the Commission shall see fit to apply to BPL.

Comment:

(footnote) 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.

Reply:

Differing modulation schemes also have greater or lesser potential for harmful interference and, as recent field surveys by the ARRL have revealed, they do in fact interfere at different (and so far, all objectionable) levels. A Rulemaking based only on one technology may and probably will not be suitable for all. For this reason, the Commission should be conservative in adopting emission and conducted current limits for BPL, as they must apply to systems with greatly different impact on radio users.

--0--

The writer desiring that the Commission examine the UPLC' s comments with the above in mind, these replies are respectfully submitted,

Cortland E. Richmond, Jr., KA5S

17 August 2003