

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

<b>In the Matter of</b>	)	
	)	
<b>AMENDMENT OF PART 15 REGARDING</b>	)	<b>ET Docket No. 04-37</b>
<b>NEW REQUIREMENTS AND</b>	)	
<b>MEASUREMENT GUIDELINES FOR</b>	)	
<b>ACCESS BROADBAND OVER POWER LINE</b>	)	
<b>SYSTEMS</b>	)	
	)	
<b>CARRIER CURRENT SYSTEMS</b>	)	<b>ET Docket No. 03-104</b>
<b>INCLUDING BROADBAND OVER POWER</b>	)	
<b>LINE SYSTEMS</b>	)	

**To: The Commission**

**EX PARTE SUBMISSION OF ARRL,  
THE NATIONAL ASSOCIATION FOR AMATEUR RADIO**

ARRL, the national association for Amateur Radio, formally known as the American Radio Relay League, Incorporated (ARRL), by counsel, hereby respectfully submits *ex parte* the attached materials, with respect to the Commission's reconsideration of the rules governing unlicensed radio frequency (RF) devices to accommodate Broadband over Power Line (BPL) technology. In the interest of the Amateur Radio Service in avoiding harmful interference from BPL systems, and in establishing rules that are appropriate for unlicensed BPL systems and which minimize the interference potential thereof, ARRL states as follows:

**I. Introduction**

1. Since the issuance by the Commission of the Further Notice of Proposed Rule Making in this proceeding, *Request for Further Comment and Further Notice of Proposed Rule Making*, FCC 09-60, 24 FCC Rcd. 9669, 74 Fed. Reg. 42631, released

July 17, 2009 (the Further Notice), ARRL has filed comments and reply comments and has made oral and written *ex parte* filings, urging the adoption of Part 15 Rules which reflect both the capabilities and practices of the bulk of the BPL industry, and which are sufficient to protect licensed radio services in the high frequency (HF) and very high frequency (VHF) bands.

2. It has been painfully apparent that the present rules permit the deployment of BPL in configurations which cause severe, ongoing harmful interference if operated on radio spectrum that is in use locally. There is ample, voluminous evidence of that in the record in this proceeding and in the Commission's files, including the conclusions of the Commission's own technical staff. The rules are inadequate as they stand to preclude harmful BPL interference to Amateur stations *ex ante*. ARRL has in this docket proceeding strenuously urged changes to the rules so as to require full time, mandatory notching of all Amateur allocations to at least 35 dB notch depths. This level of notching is both achievable by present BPL systems and is typically, but not universally, implemented by the BPL industry.

3. Among ARRL's conclusions with respect to the mandatory, full time, 35 dB notch depth requirements for Amateur bands is that this provision can be implemented in the rules without adverse impact on the BPL industry. This is because it is already a standard that is voluntarily in effect in most (but not all) BPL system architecture and deployments now. Although that conclusion is unrebutted in the record in this proceeding, it may be useful to provide documentation of this *de facto* industry standard. This *ex parte* filing contains that documentation.

4. With many tens of millions of broadband lines available in the United States, BPL has never enjoyed more than 0.011% of market penetration. At each release by the Commission of an updated Broadband Report, that percentage has been smaller. BPL is not even mentioned substantively<sup>1</sup> in the National Broadband Plan. The interference potential of BPL is an issue which most assuredly is and has been one of the major handicaps to the deployment of the technology. Reduction of the interference potential of BPL to licensed radio services to manageable levels cannot but help salvage whatever potential BPL may have in the future for broadband access, or for Smart Grid applications. If there are Smart Grid applications for BPL, the interference potential must be addressed soon, so as to avoid the fundamental incompatibility between BPL and the Amateur Radio Service that exists as the result of the present BPL rules.

5. It is now almost a year and a half since the Commission released its *Further Notice* in this proceeding; more than two and a half years since the Court of Appeals remanded the case to the Commission for further proceedings; and more than six years since the Commission first adopted the inadequate and insufficient Part 15 Rules governing BPL systems. There is no reason why the BPL rules should not be amended immediately to impose a mandatory, full-time, 35 dB notching requirement for all BPL equipment in all Amateur allocations. If that is done, the fundamental incompatibility is effectively eliminated, and BPL can, going forward, avoid the stigma of the Amateur Radio spectrum polluter that it has been shown to be in deployments throughout the United States and elsewhere in the world.

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<sup>1</sup> The only mention of BPL in the National Broadband Plan is a passing reference at page 337 to its having been classified as an information service.

## **II. Full-Time, 35 dB Notching of Amateur Allocations is the *De Facto* Industry Standard for BPL Systems, and the Rules Should Incorporate That Standard**

6. The Study attached hereto as Exhibit A is a Technical Statement of ARRL Laboratory Manager, and expert on BPL, Mr. Ed Hare. Mr. Hare's paper thoroughly reviews cooperative industry efforts to design broadband systems in such a way as to, where necessary, utilize notching or spectral masks in order to avoid fundamental incompatibility in the use of the radio spectrum allocated to the Amateur Service. In some cases, to the present time, these efforts are not adhered to on a voluntary basis, and the regulations must therefore mandate the industry "best practices". Mr. Hare cites experiences with Home Phone Networking Alliance (HPNA) standards, Very High Speed Digital Subscriber Lines (VDSL) systems, and Home Plug in-Premise BPL<sup>2</sup> as evidence that full time notching of Amateur Radio allocations is a standard procedure that has worked well on a cooperative basis. Mr. Hare concludes at Page 7 of *Exhibit A* that "Spectral masking to protect specific radio services is a mature and proven technology that, if made part of regulations for broadband emitters, would serve to ensure that the rules that govern unlicensed devices have a strong foundation written into the rules on which other industries can build a similar success."

7. Cooperative efforts in 2006 at ARRL's Laboratory between ARRL and DS2, a major manufacturer of BPL-protocol chipsets, resulted in documentation of improvements that DS2 had made to its BPL technology. The changes DS2 made to its products significantly improved the notching capability of the generation-2 DS2 chipsets

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<sup>2</sup> *Exhibit B* hereto is a complete copy of the joint report issued in 2001 by HomePlug Power Line Alliance and ARRL with respect to the cooperative tests and development of the HomePlug standard which incorporated 30 dB notches in Amateur allocations. The 30 dB notch depth was state of the art at the time.

which are capable of notch depths of 40 dB. *Exhibit C* hereto is a copy of the ARRL article that appeared at the time. Mr. Hare's paper discusses as well the efforts of Main.net to improve the notching performance of its BPL product.

8. Although the Commission's BPL database (which is mandatory for deployment of BPL systems) is and has been substantially and consistently inaccurate, it does establish, as discussed at pages 10 through 14 of *Exhibit A* that existing BPL systems in the United States are almost universally notching the entirety of the HF Amateur allocations, using equipment that is capable of notch depths of at least 35 dB. More importantly, *Exhibit A* cites the IEEE standard on BPL protocols and specifications. *See, IEEE P1901, Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications*. This standard establishes the need for BPL systems to completely avoid the use of spectrum allocated to the Amateur Radio Service. Using OFDM<sup>3</sup> emissions with notches for Amateur spectrum, the standard reveals maximum transmission rates of 220 Mb/s, with 440 Mb/s optional, demonstrating that notching the Amateur bands does *not* have a major deleterious effect on BPL-system performance. Notch depth under this standard is equivalent to minus 35 dB. However, in practice, the notch depth achievable is on the order of minus 45 dB. *See, Exhibit A, page 16.*

9. At pages 17 through 24 of Mr. Hare's Paper there appears a discussion of a new report by the United Kingdom's Office of Communications (OFCOM) dated June 21, 2010. OFCOM's commissioned report, attached hereto as *Exhibit G* is entitled *The Likelihood and Extent of Radio Frequency Interference from In-Home PLT Devices*.

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<sup>3</sup> Orthogonal Frequency Division Multiplexing.

The report concludes that BPL systems will result in widespread harmful interference to Amateur, international broadcast, FM narrowband and FM broadcast operations *unless existing practices of notching and adaptive power control are incorporated in formal regulations*. Specifically, the report concludes that “*Our results show that users of sensitive radio systems may increasingly suffer interference from PLT devices.*” OFCOM recommends that notching of, *inter alia*, Amateur allocations is “formalized” in regulations “to ensure that their introduction can be relied upon.” The Report specifies the notch depth of the UPA specification, the BPL technology most common in the UK, as 40 dB.

10. At page 25 of Exhibit A, Mr. Hare cites an ITU-R report from September 2009, Report ITU-R SM-2158, “*Impact of power line telecommunications systems on radiocommunication systems operating in the LF, MF, HF and VHF bands below 80 MHz.*” This relatively recent report concludes that, because electrical power lines are not designed for the transmission of high data rate signals, PLT signals on electrical power lines have the potential of causing interference to radiocommunication services. It concludes that a noise level increase (BPL plus ambient noise) of no more than 0.5 dB is necessary for stations in the Amateur Service, because Amateurs frequently operate at or near the minimum signal-to-noise ratio for effective communication. Limits of communication are generally determined by the received signal strength in relation to the background noise. Amateurs, the report states, communicate effectively with a signal-to-noise ratio of 6 dB for voice communications in a nominal 2.4 kHz bandwidth and as low as minus 6 dB (relative to the same bandwidth) for Morse code or spectrum-efficient data modes. *Exhibit A* also discusses ITU Recommendation P.372 which specifies median

levels of man-made noise in different environments, including “quiet rural areas.” This category describes the noise levels in residential areas where Amateur Radio operators typically operate fixed stations. Mr. Hare concludes that the levels of man-made noise described in ITU Recommendation P.372-10 provide a reasonable estimate of the current levels of man-made noise and a reasonable basis to use in setting limits and protection levels, which have not changed substantially during the past 30 years. The ITU-R Report SM-2158 report provides a good basis on which to set BPL limits. BPL emits at a relatively uniform level across a wide frequency range. Some BPL systems operate on a near-continuous basis. For access BPL deployed on overhead power lines, BPL emits at or near the emissions limits for long distances down lines on which it is deployed. Therefore, it is clear that the ubiquitous deployment of BPL, especially access BPL on medium-voltage distribution lines, would result in interference levels that exceed the protection criteria anywhere that BPL is deployed. Amateur stations are common in residential environments. Those stations are licensed to operate from unpredictable mobile and portable locations ubiquitously, and do so on a regular basis. Thus, the only practical way to implement required interference protection is to have spectral masks applied to BPL for the spectrum allocated to the Amateur Radio Service. Depending on the distance extrapolation figure utilized, Mr. Hare concludes at page 29 of *Exhibit A* that, based on the median values of man-made noise described in ITU-R P.372-1 and the protection level of 0.5 dB (as described in ITU-R SM-2158) the notch depth in protected spectrum must be 35 dB (assuming the correct 20 dB/decade distance extrapolation factor).<sup>4</sup> Finally on this topic, Mr. Hare cites at pages 29 and 30 of *Exhibit A* the ITU-T

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<sup>4</sup> The notch depth would have to be 44 dB if the (erroneous) 40 dB/decade of distance extrapolation factor for signal decay is utilized, as per the present Commission rules.

document, G.9960, “*Unified high-speed wire-line based home networking transceivers – Foundation*” which addresses notch depth. That report recommends for BPL systems a notch depth of 30 dB.

11. The remainder of *Exhibit A* (and *Exhibits E* and *F* attached hereto) discusses testing of BPL systems *in situ* and the success of notched systems versus those that attempted to notch Amateur bands based on interference complaints. While anecdotal, these studies clearly illustrate both the adequacy of full-time notching of Amateur allocations (with notch depths of 35 dB) and the *inadequacy* of *post hoc* interference mitigation through partial notching. They also reveal that there are current interference problems where BPL is deployed unless the industry standard full-time 35 dB notching of all Amateur allocations is utilized. Because adherence to industry norms is not uniformly adhered to; because BPL interference, once it arises, has proven difficult or impossible to remedy; because limited Commission enforcement resources are typically not deployed to Amateur Radio interference cases; and because the Commission’s rules should reflect sufficient technical limits available from current technology to avoid interference to licensed radio services from unlicensed BPL systems *ex ante*, the BPL rules should be modified without further delay.

### **III. Conclusions**

12. Mr. Hare’s paper concludes that testing with the BPL industry and by independent entities; statements by the BPL industry; BPL-industry specifications such as HomePlug; the Commission’s own staff measurements and findings; and international and BPL industry consensus standards uniformly result in the same inescapable conclusion: it is both practical and necessary to avoid the use of the Amateur bands in the



design and specification of BPL systems. Those systems that have followed the industry's standards have from an EMC perspective been successful. The Commission's Rules should be modified to incorporate this necessary regulatory restriction, in order to protect licensed services.

13. Notch depth at or near 35 dB is easily achievable, with 40 dB or more being typical in the most robust designs. Most of the present Access BPL deployments in the United States, though not all, are using the improved technology of 40 dB notching developed by DS2 or are using HomePlug technology, with fixed notches in the Amateur bands. Studies of measured field strength and notch depth of BPL devices conducted by a number of authoritative sources show that a combination of a correct extrapolation factor based on 20 dB/decade in the region beyond wavelength/2pi from radiating BPL systems and a mandated notch depth of 35 to 40 dB provide the required protection criteria shown to be necessary in the ITU-R in its SM-2158 report.

Therefore, for all of the above reasons, ARRL, the national association for Amateur Radio, respectfully again requests that the Commission, without further delay, amend the

rules governing Access Broadband over Power Line systems in accordance with the foregoing.

Respectfully submitted,

**ARRL, THE NATIONAL ASSOCIATION FOR  
AMATEUR RADIO**

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