Comment on ET Docket 03-104

FCC May 27, 2003

Dear Commissioners,

BPL technology is such a bold new step that I feel compelled to address some of the questions you asked and issues you raised. First, should you set limits on the radiated field itself or on the easier-to-measure conducted signal? Well, if we follow the reasoning of commissioner Jonathan Adelstein who said in the notice, "I believe that while we must be mindful of harmful interference, we cannot let unsupported claims stand in the way of such an innovation as BPL systems," we wouldn't want to hinder the suppliers of this service by making it unnecessarily hard on them to do their job. However, judging from the ARRL web site, there seems to be adequate foundation for being wary of interference:

> Power Line Communications (PLC) and Amateur Radio[1], Ed Hare, W1RFI, ARRL Laboratory Manager
>
> Studies done by amateurs in Europe, Japan and the US leave little doubt that access PLC poses an interference risk to HF.
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> This collection of information was prepared as a public service by ARRL, the National Organization for Amateur Radio in the US. Copyright 2003, ARRL. All rights are reserved. Please contact ARRL if you wish additional copies, to ensure that the latest and most complete information will be distributed. Manufacturers and organizations are encouraged to contact ARRL to discuss PLC and potential interference problems.
>
> **PLC Tutorial:**
>
> Power Line Communications (PLC) also goes by a few other names and acronyms. Power Line Telecommunications (PLT), Power Line Broadband (PLB) and Broadband Over Power Line (BPL) are terms also used. Most of these papers and links use the term "PLC." There are a number of types of PLC systems, using different approaches and architecture. All are "carrier-current" systems, a term used to describe systems that intentionally conduct signals over electrical wiring or power lines.
>
> **There are three major categories of PLC:**
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> Access PLC uses electrical distribution lines, overhead or underground, to provide broadband Internet access to homes and businesses. Because their wiring is physically large, often overhead and extends across entire communities, access PLC systems pose a significant interference potential to over-the-air radio services. Amateur Radio is not the only potentially affected service from these types of systems. There are a number of different techniques used in access PLC, from spread spectrum to OFDM (multi-carrier signals). Studies done by amateurs in

[1]ARRL: The National Organization for Amateur Radio in the United States, 225 Main St, Newington, CT USA 06111, Telephone: 860-594-0200, Internet: http://www.arrl.org

Europe, Japan and the US leave little doubt that access PLC that uses overhead electrical distribution wiring poses an interference risk to HF.

In-building PLC systems are designed to use the electrical wiring within a building to network computers. Most operate under the HomePlug specification. HomePlug systems used within a building have notches in their product specifications, to protect over-the-air Amateur Radio operation. To date, with hundreds of thousands HomePlug systems sold, ARRL does not have any complaints of interference.

Control PLC operates below 500 kHz, and is used by electric-utility companies to control their equipment using the power-lines as transmission lines. This type of PLC does not pose any significant interference risk to HF operation.

Summary:

This is the presentation that Ed Hare, W1RFI, ARRL Laboratory Manager, gave at the November 2002 meeting of the IEEE C63 EMC standards committee. It contains a tutorial on PLC, calculations on the interference potential from access PLC and a summary of what ARRL believes is necessary to prevent interference from carrier-current devices. ARRL's calculations estimate that the ambient noise level near PLC systems could increase as much as 70 dB. Author: ARRL, Ed Hare, W1RFI@arrl.org

HomePlug and ARRL Joint Test Report
Internet:
http://www.arrl.org/tis/info/HTML/plc/files/HomePlug_ARRL_Dec_2000.pdf

Summary: HomePlug (Internet: http://www.homeplug.org/) is an industry of manufacturers of in-building PLC systems designed to network computers within a building. This describes the testing that ARRL did in late 2000 with HomePlug to help establish the spectral masks (notches) that HomePlug included in its product specification to help protect Amateur Radio from harmful interference.
Author: ARRL, Ed Hare, W1RFI@arrl.org

PLC measurements in Japan: (Japan Amateur Radio League, JARL) JARL home page: Internet: http://www.jarl.or.jp/

JH5ESM, a member of JARL Technical Board on EMC: Internet: http://www.qsl.net/jh5esm/

JARL PLC Information Page (Japanese): Internet:
http://www.jarl.or.jp/Japanese/2_Joho/2-7_plc/powerline.htm Official press release on PLC issue in Japan, from Ministry of Public Management, Home Affairs, Posts and Telecommunications (English) Internet:
http://www.soumu.go.jp/joho_tsusin/eng/Releases/Telecommunications/news020809_3.html

Summary: English summary of statement from the Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications. Japanese original text is available from the Internet URL above.
Author: MPHPT

Japan's Government Concluded That It is not suitable to allow HF band for PLC

(English)
Internet: http://www.jarl.or.jp/English/4_Library/A-4-1_News/jn0208.htm)
Summary: On April 30, 2002, the Ministry's study group on PLC held its first public hearing with JARL, Association of Radio Industries and Business, and others. At the meeting, the results of collaborated field tests, which were held in January, 2002, were reported. The tests included monitoring leakage of electric waves from power lines -- specifically in cases of providing Internet access via power lines to homes. In this way, JARL actively cooperated with the group. As a result, MPHPT's study group officially announced in its fifth meeting on July 31 that it is too early to allow PLC between 2 MHz and 30 MHz due to hazardous effects on HF users. This news was reported by major newspapers including Yomiuri, Asahi and Mainichi, as well as the major financial daily, Nihon Keizai Shimbun.
Author: JARL
Campaign Against Power Line Communications Operating in the HF Bands (English) Internet: http://www.qsl.net/jh5esm/PLC/JARLcampaignPLCe.pdf
Summary: This paper gives a tutorial of PLC and presents summaries of the interference level from measurements made of several access PLC field tests in Japan. Japan has chosen not to allow access PLC at this time.
Author: JARL, Cosy MUTO, JH5ESM
Campaign Against Power Line Communications Operating in the HF Bands (Japanese) Internet: http://www.qsl.net/jh5esm/PLC/JARLcampaignPLCj.pdf
Summary: This paper gives a tutorial of PLC and presents summaries of the interference level from measurements made of several access PLC field tests in Japan. Japan has chosen not to allow access PLC at this time. Author: JARL, Cosy MUTO, JH5ESM
7th International Symposium on Power Line Communications and Its Applications (ISPLC2003) (English)
Internet: http://www.darc.de/referate/evm/plc/isplc2003.html Summary: This is a short summary of the symposium written by Cosy MUTO, JH5ESM.
Author: JARL, Cosy MUTO, JH5ESM
On Radio Interference Assessments of Access PLC System
Internet: http://www.qsl.net/jh5esm/PLC/isplc2003/isplc2003a2-3.pdf Summary: Access PLC system is considered one of the "last mile" solutions. However, HF PLCs using overhead distribution would be an interference source to radio communications services and scientific observations in this band. This paper describes assessment test results in Japan. One of them is carried out as a part of government's investigation. Bad LCL characteristics of mains results large amount of radio interference, and thus the deregulation in Japan is shelved.
Authors: Cosy MUTO, Norikazu MORI and Toshiyuki KONDOH
Note: Presented at the ISPLC2003 Symposium.
On Radio Interference Assessments of Access PLC System -- Presentation Material
Internet:
http://www.qsl.net/jh5esm/PLC/isplc2003/isplc2003a2-3presentation.pdf
Summary: This file is the presentation material from the above paper.
Authors: Cosy MUTO, Norikazu MORI and Toshiyuki KONDOH

The following 2 papers were also presented at the ISPLC2003 Symposium:
Interference measurements in HF and UHF bands caused by extension of power line communication bandwidth for astronomical purpose
Internet: http://www.qsl.net/jh5esm/PLC/isplc2003/isplc2003a7-1.pdf Summary: Power line communication (PLC) system which extends the available frequency bandwidth up to 30 MHz has been proposed in Japan. The electromagnetic interference problems on PLC had been investigated by the PLC study group organized by the Ministry of Public Management Home Affaires, Post and Telecommunications (MPHPT). The study group held collaborated field experiments of the PLC facility and we measured interferences caused by the PLC facility in the HF and UHF bands in order to evaluate the inflences of the expansion of PLC bandwidth on radio astronomical observations. In the field experiment, two sets of PLC modems (SS and OFDM) were tested as an access system. During the PLC modems were on, the HF spectra observed showed strong increase of the noise-floor level, and it was found that the PLC noise exceeded the level of galactic noise by more than 30 dB. In UHF band, spurious emission around 327 MHz was identified. In both HF and UHF band, the interferences exceeded the limit of harmful interference level for radiop astronomical observation which is given in Recommendation ITU-R TA769-1. Safety distances where the Recommendation was satisfied are estimated to be 219 km and 12 km at 9.2 MHz and 327 MHz, respectively. PLC seems to be a harmful interference source for the radio astronomical observation in both HF and UHF bands.
Authors: F.Tsuchiya, H.Misawa, T.Nakajo, I.Tomizawa, J.Nakajima, M.Ohishi, M.Tokumaru, T.Ono and A.Morioka
Sharing studies between the radio astronomy telescopes and the power line communication systems in the HF region
Internet: http://www.qsl.net/jh5esm/PLC/isplc2003/isplc2003a7-4.pdf Summary: Radio Astronomy has frequency allocations in 13.36-13.41 MHz and 25.55-25.67 MHz on a primary basis worldwide. These bands are extensively used by radio astronomers to observe electromagnetic waves emitted by the Sun, Jupiter and other large, gaseous planets in the solar system. The powers from a single PLC system in the above radio astronomy bands are --33 dBW and --29.2 dBW respectively and therefore the PLC sytems seem to be a harmful interference source for the radio astronomical observation in the HF band. It is necessary to keep an adequate separation distance to avoid harmful inteference to the radio astronomy telescope, and we calculated the separation distance based on the free-propagation method. We obtained a value of 424 km. If the PLC system is widely deployed, it is sure that the interference level increase greatly and the separation distance will become much larger. Thus it was recognized that it is quite difficult to share frequencies with the PLC systems and radio astronomy telescopes, at least, in Japan, and that a new technology to dramatically reduce leaked emissions from the power lines are crucial for the PLC systems to coexist with other radiocommunications services.
Authors: by M.Ohishi, J.Nakajima and M.Tokumaru
Other JARL PLC Web Pages (Japanese)

http://www.jarl.or.jp/Japanese/2_Joho/2-7_plc/powerline.htm
http://www.geocities.co.jp/Technopolis-Mars/7270/index.html
http://www.watch.impress.co.jp/internet/www/article/2001/1219/jarl.htm
http://www.geocities.co.jp/Technopolis-Mars/7270/geobook.html
http://www.jarl.gr.jp/plc/report1/
PLC Measurements in the Netherlands (Vereniging voor Experimenteel Radio Onderzoek in Nederland) (VERON)
VERON Home Page Internet: http://www.veron.nl/maine.htm
The Radio Amateur and the Effects of the Use of the 230-Volt Power Line for Broadband Data Communications
Internet: http://www.darc.de/referate/emv/plc/VERON_PLC_Report.pdf
Summary: This 38-page technical paper starts with a PLC tutorial, then outlines the test methods and results of PLC testing by Dutch amateurs. At the turn of the year 2002 a series of measurements was conducted to evaluate the risks of interference by PLC for the amateur station PA0KDF. Both in-house and outside field strength measurements were taken and compared with the CEPT proposed radiation limits (NB 30, Norwegian Limit and BBC limit). In addition the coupling between the mains wiring and the antennas of the amateur station was determined. In an audio test, where use was made of amateur antennas and receiver, the level of interference in the HF amateur bands was evaluated. Only in the case of the strictest limit, the BBC limit, adequate protection was provided against mains injected interference signals. In addition measurements were performed to find the "normal" interference levels on the mains wiring. Firstly it became apparent that the present interference levels in a quiet rural area are far below the CISPR 22 limits and secondly, injection of interference signals with a level equal to the CISPR 22 limit level causes harmful interference to the reception of signals in the amateur bands.
Author: Koos Fockens, PA0KDF
HF radio reception compatibility test of an in-house PLC system using two brands of modems.
Internet:
http://www.arrl.org/tis/info/HTML/plc/files/ModemRPRTVeron11-04-03.pdf
Summary: Tests have been performed on the EMC of two types of in-house PLC modems, developed according the HomePlug« standard, that recently appeared on the European market. Some measurements were done in a laboratory set-up (mains disturbance voltage, field strength, background noise), other were performed in the house of the author (interference on amateur radio receiving antenna, background signals and noise on mains). One type PLC modem seems just to meet the mains disturbance limit in EN55022 for residential environment, the second type showed a level which was approximately 20 dB higher. Under the condition that the in-house PLC modem complies with the current EN55022 B standard, and that the modem additionally uses notches for the bands of the amateur services according to the Homeplug« standard, the general conclusions drawn were: Only when when a reasonable well constructed outdoor antenna is used the interference from the modems is probably not a threat to the radio amateur service; Outside the notches harmful interference may be caused to the broadcasting services; In the

laboratory environment with many PCs running, as well as in the author's home environment, the background mains disturbance level was 30 or more dB's below the EN55022 B limit.
Author: VERON EMC Committee, Koos Fockens, PA0KDF
PLC Measurements in Great Britain (Radio Society of Great Britian) (RSGB) RSGB Home Page - http://www.rsgb.org/
RSGB EMC Committee Page Internet: http://www.rsgb.org/society/emcc.htm
RSGB EMC Committee Information Pages Internet: http://www.qsl.net/rsgb_emc/ Notes on the Final Report of the RA's TWG on the Compatibility of DSL and PLT with Radio Services 1.6 to 30MHz Compiled by the RSGB for the benefit of Radio Amateurs
Internet:
http://www.qsl.net/rsgb_emc/Notes%20on%20Fin%20Rpt%20Ver%201.pdf
Summary: This Radio Society of Great Britain summary of the work of the British government's RadioCommunications Agency Technical Working Group on DSL and PLC the WG's position on PLC, the extent of the interference problems reported and expected with PLC and lists a number of papers that have been produced by companies and organizations that support this conclusion.
Author: RSGB
The DSLPLC WG Final Report - UK Technical Working Group (TWG) on Compatibility Between Radio Services and VDSL + PLT Systems Operating between 1.6 and 30 MHz Internet: http://www.radio.gov.uk/topics/interference/documents/dslplt.htm Summary: This summary report of the British Radiocommunications Agency (RA) TWG concludes, "Field tests were undertaken by Agency officials to determine the possible levels of emissions from VDSL and PLT access systems respectively. The scope of this practical work was, by agreement, necessarily limited due to constraints on time and available facilities. It is accepted therefore that the significance of the results is correspondingly limited insofar as neither the VDSL or PLT access test arrangement was truly representative of likely practical commercial deployments. Nevertheless, sufficient data was gathered which enabled TWG to conclude that there is a finite possibility of interference to radio systems when operated within a few metres of cables or wires associated with VDSL or PLT systems. The propagation characteristics of the HF bands are unique in that it is possible, under certain conditions, to provide extended communications over exceptionally long distances, several thousand kilometres being a reasonable expectation under ideal conditions. This means that the bands are particularly valuable for international broadcasting; military applications; long distance maritime and aeronautical communication & navigation, and as a challenging recreational pursuit for amateur radio enthusiasts looking to develop techniques to establish contact over increasingly long distances taking account of prevailing conditions. But such extended propagation is variable, depending very much on seasonal conditions and natural changes in the ionosphere. This means that planning HF systems requires quite different techniques and assumptions to those used in higher order bands, where the limit of expected service area can be

predicted with a high level of confidence." This committee report does not represent the official position of the British government.
Author: UK Technical Working Group
RSGB EMC PLT Position Paper
Internet: http://www.qsl.net/rsgb_emc/emcplc.pdf
Summary: The Radio Society of Great Britain raises a very robust objection to the current commercial proposals for PLT in the High Frequency spectrum with the currently suggested radiation levels. The Society will take all measures open to it to oppose the introduction of such mains HF signalling. The Society supports the introduction of broadband technologies provided they do not exceed a level allowing radio and telecommunications apparatus to operate as intended. The Radio Society of Great Britain recommends that all proposals for standards that would allow PLT to operate in the High Frequency spectrum be firmly rejected unless the signal levels are within the existing standards for mains conducted emissions or unless a specific frequency allocation is made for PLT that is compatible with radio services in the HF band.
Author: RSGB
PLT Test Information Including Sound Bites
Internet: http://www.qsl.net/rsgb_emc/PLTREP.pdf
Summary: This report summarizes field tests of PLC made by the Radio Society of Great Britain. As already reported elsewhere, it is difficult or almost impossible to capture and present the emissions from new broadband-communication systems using spread-spectrum-technologies at low or unknown data-rates (stand-by) by simple use of a spectrum analyser. Nevertheless even at these very low data rates, the harmful effect of these emissions on radio systems all over the spectrum used for radio communication is at once evident, as soon as emissions exceed the conventional limits.
Author: RSGB
Notes on RSGB Observations of HF Ambient Noise Floor
Internet: http://www.qsl.net/rsgb_emc/RSGBMeasurements_1b.pdf Summary: A summary of the RSGB HF ambient noise measurements. Author: RSGB
Background Noise on HF Bands
Internet: http://www.qsl.net/rsgb_emc/emcslides.html
Summary: Slide presentation on PLC made an an RSGB Amateur Radio convention.
Author: RSGB, Robin Page-Jones (G3JWI)
Notes on the RSGB Investigation of PLT Systems in Crieff
Internet: http://www.qsl.net/rsgb_emc/CRIEFF%20Notes%20Version_1.html
Summary: A summary of the RSGB field measurements made of the Crieff field trials. The report noted interference, but felt that more study was needed to quantify it more precisely.
Author: RSGB, Robin Page-Jones (G3JWI)
PLT and the Future of the HF Spectrum - from RadCom Feb. 2003 Internet: http://www.qsl.net/rsgb_emc/RadCom02PLT.pdf
Summary: Op Ed
Author: RSGB

See also RSGB files in PLC Audio section of this page.
PLC Measurements in Germany (Deutscher Amateur-Radio-Club) (DARC) DARC Home Page - http://www.darc.de/
DARC PLC Web Page - Internet: http://www.darc.de/referate/emv/plc/ DARC Press Release and Position Paper on PLC
Internet:
http://www.darc.de/referate/emv/plc/PLC-in-Germany-3-2001-Press-release.pdf
Summary: PLC in Germany, update March, 2001.
Author: DARC
PLT - A Risky Undertaking
Internet: http://www.darc.de/referate/emv/plc/PLT-Market-version.pdf
Summary: This paper outlines some of the reasons that PLT may present problems, including EMC.
Author: Gaston Bertels, EUROCOM Chairman
PLC in Germany - Strategic Discussion Paper
Internet:
http://www.darc.de/referate/emv/plc/plt-strategic-paper-june%202001.pdf
Summary: This paper gives the background for strategic activities with the purpose of achieving compatibility between the radio amateur service and networks communication (including power lines communication). Author: DARC
PLC in Germany 1
Internet: http://www.darc.de/referate/emv/plc/DARC-PLC-paper-1.pdf
Summary: RTA and DARC e.V. present this document as a contribution to inform the amateur radio community on the issue of PLC and as discussion material to be used in public relations efforts. Latest developments are taken into account. The overall conclusion is that PLC is not recommended.
Author: The paper is a common effort of DF7VX, DJ6AN, DJ1ZB, Mrs Volmer, DL2CH, DJ8CY, DF5DP, DF4JI, DL9MH and DF9IC and of the member societies of the RTA. Translation by ON4WF.
PLC in Germany 2
Internet: http://www.darc.de/referate/emv/plc/DARC-PLC-paper-2.pdf
Summary: PLC and xDSL situation in Germany, March 2001.
Author: DARC Standards Group March 26, 2001 Hans-Joachim Brandt, DJ1ZB PLC in Germany Report 11/2001
Internet: http://www.darc.de/referate/emv/plc/DARC-PLC4xRPRT.pdf
Summary:
Author: DARC
PLC and xDSL Situation in Germany (with a look over the border) Internet: http://www.darc.de/referate/emv/plc/c3.4-rev1-PLC5RPRT.pdf Summary: PLC and xDSL situation in Germany, June 2002.
Author: DARC
PLC - DARC HQ Info (in German)
Internet: http://www.darc.de/referate/emv/plc/darc-plcinfo.pdf Summary: A six-page DARC overview of PLC, including some technical data and info about NB-30, the European version of FCC Part 15. PLC has the potential to impact HF,

including HF broadcasting and amateur. This file contains a summary of what DARC has been doing to combat PLC; and provides a list of articles in *CQ DL* on the topic.
Author: DARC
PR Information on SE 35 (in German)
Internet: http://www.darc.de/referate/emv/plc/pubrel2.html Summary: IARU-EUROCOM and DARC Take Position on HF Limits on PLC Radiation Author: DARC
See also DARC files in PLC Audio section.
PLC in Other Countries
PLC in Finland
Internet: http://www.darc.de/referate/emv/plc/plc-oh.pdf
Summary: PLC for the present rejected by Finnish Telecommunication Minister. In the Finnish Amateur Radio League's monthly magazine "Radioamateuri" 06/2001 on pages 12 to 17, there is an article about a session held on PLC in the Finnish Telecommunication Administration Center (Telehallintokeskus, THK) on May 16th, 2001. The Finnish Minister of Transport and Telecommunication, Mr. Olli-Pekka Heinonen, had answered to the question of a Member of Parliament regarding the introduction of PLC in Finland: For the present, because of the technical problems encountered, introduction of PLC technology is not possible. Author:
PLC in Norway (German only)
Internet: http://www.darc.de/referate/emv/plc/PLT-in-Norwegen.pdf
Summary: The Power Grid as Telecommunications Grid -- Investigation by Telecommunications Authorities Concerning the Prevention of Radiocommunication Interference to Electronic Equipment
Author: PLC in Poland
Internet: http://www.darc.de/referate/emv/plc/plc-in-poland.html Summary: Translation of newspaper article.
Author: Daily Warsaw Newspaper "SUPER-EXPRESS" - 12.11.2001 PLC -- European General Information
PLC Amendment - Proposal to the European Commission
Internet: http://www.darc.de/referate/emv/plc/eu-amendment-plc.pdf PLC Action - IARU Region 1
Internet: http://www.darc.de/referate/emv/plc/PLC-WGs-1.pdf PLC EU - AMENDMENTS 21-85 (draft)
Internet: http://www.darc.de/referate/emv/plc/454136PA.pdf Status on EMC requirements for PLC equipment and networks 20-6-02 Internet: http://www.darc.de/referate/emv/plc/status-plc_iaru-r1.pdf PLT Symposium Friedrichshafen 2002
Internet: http://www.darc.de/referate/emv/plc/plt-symposium.pdf Summary: MINUTES OF THE PLT SYMPOSIUM. Held on Saturday 29 th June 2002 at the Friedrichshafen, Hamradio 2002.
Authors: Chairman: Karl Vogel, DK9HU. DARC, Secretary: Peter Kirby, G0TWW. RSGB Return to "Quick Links" Section of This Document
Amateur Radio Interference Studies -- Other Broadband Technologies Home Phone

Networking Alliance Testing -- Version 1 (ARRL) Internet: http://www.arrl.org/tis/info/HTML/plc/files/hpnatests.html Summary: These are the test results from testing of the Home Phone Networking Alliance (HPNA) Version 1 product. The tests were performed by Ed Hare, W1RFI, at his home station. This product meets FCC limits, but the tests indicate that it had a significant interference potential to nearby amateur radio operation. Version 1 HNPA devices are no longer in production. Version 2 includes a spectral mask to protect sensitive Amateur Radio HF reception. Author: ARRL, Ed Hare, W1RFI@arrl.org

VDSL Testing (ARRL)

Internet: http://www.arrl.org/tis/info/HTML/plc/files/vdsl-phoenix.html

Summary: This paper describes testing done by Ed Hare, W1RFI, in Phoenix, AZ. He used a mobile HF receiver on 80 and 40 meters to drive through areas in Phoenix where VDSL was installed. These areas were all served by underground utility wiring. No significant RFI potential from this system was detected. Author: ARRL, Ed Hare, W1RFI@arrl.org

VDSL-TIA Presentation -- 1999 - Operating Parameters of Typical HF US Amateur Stations - (ARRL)

Internet: http://www.arrl.org/tis/info/HTML/plc/files/vdsl-tia.html Summary: This is a two-part presentation on VDSL given by Ed Hare, W1RFI, ARRL Laboratory Manager, at a 1999 meeting of the TIA T1E1.4 VDSL standards committee. It outlined the operating characteristics of Amateur Radio stations and the expected impact of VDSL systems on Amateur operation. Author: ARRL, Ed Hare, W1RFI@arrl.org

VDSL-TIA Presentation -- 2002 -- "Possible Impact of VDSL on Stations Operating In the Amateur Radio Service" (ARRL)

Internet: http://www.arrl.org/tis/info/HTML/plc/files/vdsl-tia.ppt Summary: This is a PowerPoint file of a presentation given by Ed Hare, W1RFI, ARRL Laboratory Manager, at a 2002 meeting of the TIA T1E1.4 VDSL standards committee. It reiterated some of the interference issues under consideration and presented calculations of the interference potential of VDSL systems. Author: ARRL, Ed Hare, W1RFI@arrl.org

Operating Parameters of Amateur Radio Stations:

These files describe the technical parameters for Amateur stations operating on the HF Amateur bands. They were authored by Zack Lau, W1VT, ARRL Senior Laboratory Engineer.

Reference Circuit Information for the MF and HF Amateur Bands:
± 10 KHz for MARS operation

1.8 - 2.0 MHz
3.5 - 4.0 MHz
5.25 - 5.4 MHz (proposed)
7.0 - 7.3 MHz (possibly 6.9 - 7.2 MHz if realligned)
10.1 - 10.15 MHz
14.0 - 14.35 MHz
18.068 -18.168 MHz
21.0 - 21.45 MHz
24.89 - 24.99 MHz
28.0 - 29.70 MHz

Estimated Field Strength from Amateur Radio Stations -- ARRL #1 Internet: http://www.arrl.org/tis/info/HTML/plc/files/vdsl-tia.html Summary: This paper, presented at a 1999 meeting of the T1E1.4 VDSL standards committee, outlines the expected field strength and ambient noise level of typical HF amateur stations. Amateur stations operate with very sensitive systems that can be degraded by local noise sources. They also can radiate some relatively strong fields at heights typical of telephone-wiring installations. These factors must be considered when evaluating the compatibility of high-speed digital systems that may be installed in residential areas. Several papers previously presented indicate that VDSL technology may be compatible with the Amateur Radio Service, but just compatible. These additional data indicate that those conclusions need to be reconsidered and additional calculations made. Author: ARRL, Ed Hare, W1RFI@arrl.org

Estimated Field Strength from Amateur Radio Stations -- EPA, Overbeck Internet: http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/reports/asd9601/asd9601.pdf

Summary: This paper outlines measurements of the field strength from typical HF and VHF amateur stations.

Author: Bob Cleveland, rclevela@fcc.gov, Ed Mantiply, emantipl@fcc.gov FCC RF-Exposure Regulations -- the Station Evaluation

Internet: http://www.arrl.org/news/rfsafety/eval/index.html Summary: This article describes FCC OET Bulletin 65 Supplement B and tells hams how to use it to estimate the field strength near their stations to comply with the FCC regulations on RF exposure.

Author: ARRL, Ed Hare, W1RFI@arrl.org

FCC OET Bulletin 65 -- estimating RF exposure from radio transmitters (Internet)

Internet: http://www.fcc.gov/oet/info/documents/bulletins/#65 Summary: This paper outlines the ways that amateurs can calculate or measure the field strength from their stations. Typical field-strength levels are described.

Author: FCC

Case History of Widespread Interference From Part-15 Carrier-Current Device: Interference Case History from Wireless Modem Jacks Internet: http://www.arrl.org/tis/info/rfiteljx.html

Summary: This is a case history of severe interference to Amateur Radio from a

device that had been Verified under FCC Part 15 to be in compliance with the rules. The manufacturer was very responsive and corrected the interference by redesigning the product not to use Amateur frequencies. The devices were deployed widely and the end user ultimately had to do a system-wide recall in the field. ARRL appreciates that those involved acted appropriately, but this serves as a good case history about the level and degree of interference that can come from devices that are at the current FCC limits, and of the costs to industry that can result if interference is not mitigated at a product's initial design. The model under discussion has not been in production for several years and the company's present products are not known to present any significant interference potential.

Author: ARRL, Ed Hare, W1RFI@arrl.org

Interference TO PLC from Amateur Radio Operation:

Analysis by Ed Hare, W1RFI -- estimate

Internet: http://www.arrl.org/tis/info/HTML/plc/files/Interference_to_PLC.htm

Summary: A free-space calculation the expected field strength from HF amateur stations.

Author: ARRL, Ed Hare, W1RFI@arrl.org

Links to operating parameters of Amateur Radio Stations

Industry/Other Interference Studies:

To date, none of the numerous industry studies on PLC have contained any published information on harmful interference. The following studies and presentations are being used by the PLC industry to promote the technology.

UPLC/ PLCA Joint Report to the FCC:

Internet:

http://www.uplc.utc.org/file_depot/0-10000000/0-10000/7966/conman/Joint+Report+on+PLC.pdf

Summary: On Monday, March 4, 2003, the United PowerLine Council and the Power Line Communications Association filed a Joint Report to the Federal Communications Commission on the present state of the PLC industry as well as appropriate next steps for the Commission to encourage the technology's commercial deployment.

Authors: United Power Line Council and the Power Lines Communications Association

PALAS - Powerline as an Alternative Local AcceSs project reports: Internet: http://palas.regiocom.net/reports.html

Summary: Multiple reports, including some discussion of field trials. Authors: Multiple

NUON discontinues PLC test (Dutch)

Internet:

http://www.webwereld.nl/nieuws/14920.phtmlhttp://www.webwereld.nl/nieuws/14920.phtml

Summary: NUON in the Netherlands is not going to offer its digital services through the power lines any longer. It will stop its services in the beginning of July. They have determined that the technology is too limited and that it is still not commercially attractive to offer internet services through the power lines. NUON

claims that the test they performed shows that it is possible to offer internet services on a small scale. However, the technology is not ready yet for a large scale applications. One of the biggest problems is that it is very susceptible to interference. The Telecom Agency of the Dutch Government has determined through measurements that signals are too strong and cause interference to radio communications.
Author: Webwereld
Current Situation on the Field Trials and Other Tests Performed in the Netherlands
Internet:
http://www.agentschap-telecom.nl/informatie/plc/Position_NL_PLC_C..pdf
Summary: This is a letter sent by the Dutch Telecom Agency to the European Committee containing the test report/results of the NUON PLC test in Arnhem. This small field trial resulted in a specific complaint of harmful interference by an Amateur Radio operator. The levels measured at 3 meters distance from the radiating source are listed in table format. They concluded that estimates based on the balance of the lines are not a reliable way to predict field strength. Author: Dutch Telecom Agency
Information on radiating properties of mains networks
Internet: http://www.agentschap-telecom.nl/informatie/plc/NL_versie 6_final.pdf Summary: This paper describes measurments made of the radiating characteristics of a number of houses in Holland. In Europe, it is common to have 100 or more houses connected to transformer, with each house fed with close-spaced or twisted-pair electrical wiring. Under these circumstances, the wiring radiation effectiveness was measured at about a -30 dBi average. In the US, access PLC signals would have to be coupled past the transformers onto the medium-voltage distribution lines, which will radiate more efficiently than twisted pairs and house wiring. The report also describes the cumulative effects of multiple emitters propagated by skywave. According to this study, a PLC system with 4 emitters per square kilometer will have a skywave propagated signal of -23 to -52 dBuV/m to distant areas.
Author: Radio Communications Agency, Netherlands.
Information on radiating properties of mains networks
Internet: http://www.agentschap-telecom.nl/informatie/plc/JWG_input.pdf
Summary: This paper describes measurments made of the radiating characteristics of a number of houses in Holland. In Europe, it is common to have 100 or more houses connected to transformer, with each house fed with close-spaced or twisted-pair electrical wiring. Under these circumstances, the wiring radiation effectiveness was measured at about a -30 dBi average. In the US, access PLC signals would have to be coupled past the transformers onto the medium-voltage distribution lines, which will radiate more efficiently than twisted pairs and house wiring. The report also describes the cumulative effects of multiple emitters propagated by skywave. According to this study, a PLC system with 4 emitters per square kilometer will have a skywave propagated signal of -23 to -52 dBuV/m to distant areas.
Video:
Video Showing Effect of PLC on Over-the-Air Reception In Fulmpes, Austria

Internet: http://www.darc.de/referate/emv/plc/030103-PLC_Video_Fulpmes.wmv Summary: This video with sound shows the strong levels of interference experienced to an HF receiver brought to Fulmpes, Tirol, Austria during PLC field trials.
Author: OVSV, Austrian Amateur Radio Society
Video Showing Effect of PLC in Linz, Austria
Internet: http://www.darc.de/referate/emv/plc/plc_video_linz.rm Summary: This video with sound shows the strong levels of interference experienced to an HF receiver brought to Linz, Austria during PLC field trials. Author: OVSV, Austrian Amateur Radio Society
Video Showing Effect of PLC in Tirol, Austria
Internet: http://www.darc.de/referate/emv/plc/plc_video_tirol.rm Summary: This video with sound shows the strong levels of interference experienced to an HF receiver brought to Tirol, Austria during PLC field trials.
Author: OVSV, Austrian Amateur Radio Society
Broadband Over Power Lines
Internet:
http://www.uplc.utc.org/file_depot/0-10000000/0-10000/7966/folder/23284/UPLC_broadband.ram - high-speed access
Internet:
http://www.uplc.utc.org/file_depot/0-10000000/0-10000/7966/folder/23284/UPLC56k.ram - dial-up access
Summary: The UPLC has created a video that demonstrates how powerline works and how easy it is to install and use. It does not contain any information about possible interference.
Author: United Powerline Council
Audio:
The following sounds are provided courtesy of the Japan Amateur Radio League (JARL):
They are digests of official recorded data for The Power Line Communication Study Group, Ministry of Public Management, Home Affairs, Posts and Telecommunications. These files are located on JARL Web. For detail of JARL measurement configurations, see the above presentation materials. Apartment house:
261015SS10_6055.mpga
Internet: http://www.qsl.net/jh5esm/PLC/MPHPTsounds/261015SS10_6055.mp3 Summary: Nihon Short-wave Broadcasting, Co. (NSB), 6.055MHz, recorded at 1015JST on 26 June, 2000. Receiving point was 3m from the substaion wall of the apartment house. Field strength of NSB signal was 36dBuV/m (average rated). Spread Spectrum (SS) modems.
Author: JARL
261024SS10_9595.mpga
Internet: http://www.qsl.net/jh5esm/PLC/MPHPTsounds/261024SS10_9595.mp3 Summary: NSB 9.595MHz, 34dBuV/m, at 1024JST on 26 June, 2002. SS modems, 3m from the substation.

Author: JARL
261506OFDM10_6055.mpga
Internet:
http://www.qsl.net/jh5esm/PLC/MPHPTsounds/261506OFDM10_6055.mp3
Summary: NSB 6.055MHz, 35dBuV/m, at 1506JST on 26 June, 2002. OFDM modems, 3m from the substation. NSB signal was fully jammed at its fading bottom. Author: JARL
261527OFDM10_6060.mpga
Internet:
http://www.qsl.net/jh5esm/PLC/MPHPTsounds/261527OFDM10_6060.mp3
Summary: No signal, 6.060MHz at 1527JST on 26 June, 2002. OFDM modems, 3m from the substation. Field strength of the modem carrier was 17dBuV/m. Note: In the measurements at the apartment house, monitoring couplers were insterted in the power line for current measurement. Since couplers had 16dB loss totally, actual noise would be 10dB louder than these recordings.
Author: JARL
Detached house:
021150ss01_6055.mpga
Internet: http://www.qsl.net/jh5esm/PLC/MPHPTsounds/021150ss01_6055.mp3
Summary: NSB 6.055MHz, 28dBuV/m, at 1150JST on 2 July, 2002. Recorded at 10m from the power line (No.1). SS modems, the monitoring couplers were inserted.
Author: JARL
021311ss03_6055.mpga
Internet: http://www.qsl.net/jh5esm/PLC/MPHPTsounds/021311ss03_6055.mp3
Summary: NSB 6.055MHz, 30dBuV/m, at 1311JST on 2 July, 2002. Recorded at 3m from the power line (No.3). SS modems, the monitoring couplers were inserted.
Author: JARL
031009OFDMcarr03_1504.mpga
Internet:
http://www.qsl.net/jh5esm/PLC/MPHPTsounds/031009OFDMcarr03_15040.mp3
Summary: OFDM modem carrier, 15.040MHz, 35dBuV/m at 1009JST on 3 July 2002. Recorded at 3m from the power line (No.3). OFDM modems, no monitoring couplers. Author: JARL
031111OFDM03_6055.mpga
Internet:
http://www.qsl.net/jh5esm/PLC/MPHPTsounds/031111OFDM03_6055.mp3
Summary: NSB 6.055MHz, 19dBuV/m, at 1111JST on 3 July 2002. Recorded at No.3 receiving point. SS modems, no monitoring couplers.
Author: JARL
031609OFDMSG03_15040.mpga
Internet:
http://www.qsl.net/jh5esm/PLC/MPHPTsounds/031609OFDMSG03_15040.mp3
Summary: Standard AM (1kHz, 30% modulation) signal on 15.040MHz, 40dBuV/m at 1609JST on 3 July, 2002. Recorded at No.3 receiving point. OFDM

modems, no monitoring couplers.
Author: JARL
031701SSSG03_15050.mpga
Internet:
http://www.qsl.net/jh5esm/PLC/MPHPTsounds/031701SSSG03_15050.mp3
Summary: Standard AM signal on 15.050MHz, 40dBuV/m, at 1701JST on 3 July, 2002. Recorded at No.3 receiving point. SS modems, no monitoring couplers.
Author: JARL
Temporary accommodations:
231503NON12000.mpga
Internet:
http://www.qsl.net/jh5esm/PLC/MPHPTsounds/231503NON12000.mp3
Summary: No signal, 12.000MHz, at 1503JST on 23 July 2002. Modem OFF --> ON sequence. SS modems, 156m from the accommodation. No couplers inserted.
Author: JARL
231136ALL6055.mpga
Internet: http://www.qsl.net/jh5esm/PLC/MPHPTsounds/231136ALL6055.mp3
Summary: NSB 6.055MHz at 1136JST on 23 July, 2002. OFDM and SS modems (totally 6 modems) OFF-->ON sequence. 156m from the accommodation, no couplers inserted. Author: JARL
The following files are provided courtesy of the Radio Society of Great Britain:
PLT Test Information Including Sound Bites
Internet: http://www.qsl.net/rsgb_emc/PLTREP.pdf
Summary: This report summarizes field tests of PLC made by the Radio Society of Great Britain. As already reported elsewhere, it is difficult or almost impossible to capture and present the emissions from new broadband-communication systems using spread-spectrum-technologies at low or unknown data-rates (stand-by) by simple use of a spectrum analyser. Nevertheless even at these very low data rates, the harmful effect of these emissions on radio systems all over the spectrum used for radio communication is at once evident, as soon as emissions exceed the conventional limits. Author: RSGB The Mainnet system
Internet: http://www.qsl.net/rsgb_emc/MN_1.wav
Summary: Recorded about 3m from the house on the 7MHz amateur band. This is described as a spread spectrum system. Interference depends on the density of traffic. Recording starts with light traffic increasing as the recording proceeds.
Author: RSGB
The Ascom system #1
Internet: http://www.qsl.net/rsgb_emc/delivery.wav
Summary: Recorded about 4m from the house in one of the "delivery" frequency bands. This system uses three discrete frequency bands, below 10MHz, to deliver signals to the house. The bands are about 1MHz wide.
Author: RSGB
The Ascom system #2
Internet: http://www.qsl.net/rsgb_emc/inhouse.wav
Summary: Recorded about 4m from the house, in one of the "in-house frequency"

bands. This system uses three discrete frequency bands above 10MHz to distribute signals in the house.
Author: RSGB
The following files are provided courtesy of DARC:
A PLC Audio Signal
Internet: http://www.darc.de/referate/emv/iaru/eurocom/plc.ra Summary: A PLC audio signal.
Author: DARC
Return to "Quick Links" Section of This Document
PLC Deployment and Field Trials:
These are links to various industry pages announcing PLC deployment and field trials worldwide.
United Powerline Council / Powerlines Communications Association joint report to the FCC
Internet:
http://www.uplc.utc.org/file_depot/0-10000000/0-10000/7966/conman/Joint+Report+on+PLC.pdf
Summary: This UPLC/PLCA joint paper reports that "successful" field trials have taken place in the US in AL; MD; MO; NY; OH; PA and VA. Although the studies were not well publicized and did not include any direct participation by the Amateur Radio Service, this report concludes that "none of these field trials have caused any interference to home entertainment equipment, licensed wireless services and other spectrum users." ARRL believes that this conclusion is premature because none of these studies included any Amateur Radio involvment and no specific mention of measurements or tests to quantify interference levels appear to have been included. Author: UPLC/PCLA
Megabits per Second on 50 Hz Power Lines?
Internet:
http://www.ieee.org/organizations/pubs/newsletters/emcs/winter01/hansen.htm Summary: The reason for the removal of the RegTP field trial license, based on numerous protests, is that Digital Power Line Communications (PLC) is trying to increase the speed of data rates into the Megabits per seconds range. Therefore the short wave band of up to 30 MHz will be transmitted over the low voltage distribution network. The recent history of PLC in Germany together with the standardization and measurement procedures used are given. Public opinion in Germany and technological alternatives to PLC like ADSL and wireless communications with low power are discussed and explained. The present approach of the remaining PLC consortia and their attempt to introduce the PLC technology nation wide is questionable.
Author: Diethard Hansen, EURO EMC SERVICE (EES)
Southern Electric Broadband Over Powerline Trial in Winchester, England Internet: http://www.theregister.co.uk/content/22/30567.html Internet: http://www.theregister.co.uk/content/22/29992.html Summary: Over 200 homes involved in this field trial
Author: Tim Richardson, The Register

Besides ham radio and radio astronomy, there are SWLers:

Medium Wave Interference, by Steve Whitt, ©2002

Interference is a topic that affects not just the MW DXer but just about every radio listener. In fact it is usually the level of interference rather than any other factor that limits the reception of weak and distant stations on the MW band.

Interference is usually taken to mean any unwanted signal (or noise) that, by adding to the desired signal, degrades reception of the wanted information. It is usually the case that the interference most often encountered on MW is man-made in origin. Whereas there is very little one can do about naturally occurring interference, it is possible, theoretically at least, to eliminate man-made sources of interference. The first step to suppressing interference is in fact recognising it and identifying its origin. Having identified a source of interference it is an unfortunate fact of life that it may prove impossible to do anything about it. The following are the most common forms of man-made interference to affect MW reception:

Co-channel interference: ...

Heterodyne Interference: ...

Electrical Interference: ...

This title covers a multitude of interference sources which will tend to affect listeners living in built up areas, particularly near industrial zones. Man-made electrical interference comes in all shapes and sizes but can be classified as intermittent or long term. It can be difficult to track down intermittent sources of interference but fortunately their nuisance value is not long lasting.

Common examples are engine interference from the poorly suppressed spark plugs of passing cars, and arcing of electrical contacts in thermostats and switches. If the source is identified it is generally not too difficult to suppress this sort of interference. Other examples are caused by faulty street lights and faulty insulators on overhead power lines and in both these cases the solution is to inform the relevant authority. ... Generally as more and more electrical equipment enters the home and office the greater the level of interference and the less chance there is of suppressing it.

Among the more recent sources of (very potent) interference are computers and electronic telephones and office exchanges. Regrettably there is usually little a DXer can do cure this affliction unless they own the offending piece of equipment. Jamming: ...

Powerline Communications:

A new threat has emerged that could affect all radio reception between 9kHz and 30MHz. Tests began in Germany in early 2001 of a system called Powerline Communications. The system uses data communications to control various devices commonly used in the home, with the signals being conducted through existing power cables. But the use of radio frequencies with a proposed range of up to 300 metres, means that milllions of people in urban areas are theatened by radio pollution from these devices. Imagine trying to DX in an apartment block where dozens of different devices are operating simultaneously. There's still hope that the intereference levels, even to reception of strong domestic signals, will be so high that the whole concept will have to be re-thought. Otherwise for many urban dwellers of the future, a trip to a remote spot may be the only chance to enjoy the sort of reception that has made mediumwave DXing such a fascinating hobby for so long.

Other Sources of Noise: ...

I am sure, though, that the companies providing BPL services would nevertheless prefer the easier method of measuring conducted signal to the more telling but difficult-to-measure field strength. May I suggest a lesson from Shakespeare's *King Henry the Sixth*

Act Two, Scene 1.

GLOUCESTER What,
Cardinal, is your priesthood grown peremptory?
Tantaene animus coelestibus irae?
Churchmen so hot? Good uncle, hide such malice;
With such holiness can you do it?
SUFFOLK No malice, sir; no more than well becomes
So good a quarrel and so bad a peer.
GLOUCESTER As who, my lord?
SUFFOLK Why, as you, my lord,
An't like your lordly Lord's Protectorship.
GLOUCESTER Why, Suffolk, England knows thine insolence.
QUEEN And thy ambition, Gloucester
KING I prithee, peace,
Good Queen, and whet not on these furious peers;
For blessed are the peacemakers on earth.

Ah, ambition and insolence: the ambition of companies who want to capitalize on a new internet technology irrespective of interference generated versus the insolence of those who would stand in the way of "such an innovation as BPL systems" on account of "unsupported claims." The King said, "Good Queen, whet not on these furious peers; for blessed are the peacemakers on earth." Any decision on a *conducted* signal standard would undoubtedly be political. A radiated field strength, though, is technological; one can determine the levels a signal needs to be below for the satisfactory operation of various receivers, and the BPL providers need to verify they meet that standard. We have enough politics without trying to set a *conduction* standard.

You know, these BPL systems remind of a time I was moving into a six month leased apartment and the landlady seeing the big wires on my homemade power supply said she was glad I had agreed not to set up my ham station during that time (when I was temporarily too busy) as she thought those wires looked dangerous. I had merely overengineered a 13.5 volt, 15 amp power supply by doubling up some surplus monster cables designed for speakers in order to reduce the voltage drop under load. Nothing dangerous about it. Uneconomical, yes, if one wanted to mass produce it, but these were just spare wires used for my rig.

Connecting the internet to the power line might look dangerous too, but it doesn't have to be. Those "medium voltage" power lines are actually overengineered as a transmission line. Work it out. Light travels at 186,000 miles per second. A 60 cps wave will travel 1/60 that distance which is 3,100 miles in a second. That's the wavelength of an ac line signal. A balanced transmission line is supposed to be spaced close in comparison to a wavelength. Those transmission lines at ten or twenty feet spacing are close *compared to the 3000 mile wavelength of the signal.* Even overengineered but that's okay.

It's a different story at HF. The BPL signals will be between 2 MHz and 30 MHz. That's up to 30,000,000 cycles per second which is half a million times more cycles per second, and divided by half a million shorter wavelength. We are not overengineered any more.

Parallel-Conductor Lines[2]

A type of parallel-conductor line sometimes used in amateur installations is one in which two wires (ordinarily No. 12 or No. 14) are supported a fixed distance apart by means of insulating rods called "spacers." The spacings used vary from two to six inches, the smaller spacings being necessary at frequencies of the order of 28 Mc. and higher so that radiation will be minimized.

Even if BPL signals enter the power lines balanced, the

[2]American Radio Relay League, The Radio Amateur's Handbook (44th Edition, 1967) p. 354.

opposite phase sides will *not* cancel out the radiation because *they are too far apart.*

Unbalance in Parallel-Conductor Lines[3]

When installing parallel-conductor lines care should be taken to avoid introducing electrical unbalance into the system. If for some reason the current in one conductor is higher than the other, or if the currents in the two wires are not exactly out of phase with each other, the electromagnetic fields will not cancel completely and a considerable amount of power may be radiated by the line.

Ordinary house wiring will have the effect of unbalancing the line, especially as one side connects to a switch, the other is routed to ground, or whatever. The power lines will not be the effective transmission lines they are at a.c. line frequency, but *will radiate a sizable part of the signal with the overhead power lines acting as effective antennas.*

Radiating wires used as transmission lines. Seems hams have experimented with that very concept:

"Windom" or Off-Center-Fed Antenna[4]

A multiband antenna that enjoyed considerable popularity in the 1930's is the "off-center feed" of "Windom," named after the amateur who wrote a comprehensive article about it. ... It consists of a half wavelength antenna on the lowest-frequency band to be used, with a *single wire* feeder connected 14% off center. The antenna will operate satisfactorily on the even-harmonic frequencies, and thus a single antenna can be made to serve on the 80-, 40-, 20-, and 10-meter bands. The single-wire feeder shows an impedance of approximately 600 ohms to ground, and consequently the antenna coupling system must be capable of matching this value to the transmitter. A tapped parallel-tuned circuit or a properly-proportioned pi-network coupler is generally used. Where TVI is a problem, the antenna coupler is required, so that a low-pass filter can be used in the connecting link of coaxial line.

Although theoretically the feed line can be of any length, some lengths will tend to give trouble with "too much r.f. in the shack," with the consequence that r.f. sparks can be drawn from the transmitter's metal cabinet and/or v.f.o. notes will develop serious modulation. If such is found to be the case, the feeder length should be changed.

Actually, I've experimented with it myself, and the results are applicable to this inquiry. See, I was renting a room at a place with the landlord's permission to erect a ham antenna in the

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[3] ibid., p. 355.

[4] American Radio Relay League, The Radio Amateur's Handbook (44th Edition, 1967) pp. 376f

yard. The trees were spaced right for a 40 meter dipole, but if I put it high enough, the limbs would not support its weight, *not with a center insulator in the middle with coax hanging from it.* But I noticed the Windom off center position was a direct shot from the roof where I could support the feedline, I wouldn't need any center insulator for a Windom, and 14 gauge wire is lighter than coax. So went a Windom.

I got favorable results, working neighboring states with ¾ of a watt on 40 meters, such stations as one on Snake Island in the Black Sea on 20 meters with 6 watts, and Japan easily from my Oregon station with 2 watts on 10 meters. In fact, one Japanese ham was wondering how I got such excellent results with such an antenna. But it was high off the ground, the band was open, and he was in the direction of one of the major lobes. As for the feedline radiating before it got to the antenna, well, the impulse impedance of a 14 gauge wire $\approx$ 500 Ω is close to the impedance of a dipole at the point 14% off center, and of all its even harmonics. That means very little standing waves, and as the length of my feedline was not much more than a wavelength at 10 meters, not much was radiated, and even some that was would go towards Japan anyway.

Well, I was enjoying my antenna until the neighborhood decided they wanted us to become a historic district commemorating the industry there in the 1920's and 30's. There is a bit of red tape one has to go through with the FCC to get a ham antenna approved for a historic district, and I wasn't sure if I could assume mine would be grandfathered in or not. As it turned the boundary of the historic district was on the *outside* of the property I was on, so only the far tree supporting the antenna was on the boundary and the antenna came out away from it, so it was a moot point my antenna being a major action as it was outside the skirt of the historic district. But I didn't know at the time where the boundary would be drawn, so I investigated and found that my Windom antenna "enjoyed considerable popularity in the 1930's" as mentioned above (page 19).

So if you were driving around this historic district[5] and you knew where to look, you would see my Windom antenna a kind popular in the 30's using a single wire to feed it. It was a good antenna, and the reason it lost its popularity was the advent of television with the resulting TVI (television interference) mentioned earlier (page 19). Television broadcasts at VHF, at which frequencies that feedline was multiple wavelengths long, and any VHF signal on it would also encounter impedance lumps resulting in reflections and standing waves. Therefore the feedline would effectively radiate any VHF signal on it, and the wire coming right into the house, it would get into peoples' TV's. So hams went to using coax feed, coaxial cable becoming readily

[5] I realize we don't have as much history on the west coast as you do on the east, but it is our history and we are proud of it, be it only the 20's & 30's.

available after WW2. This new technology (coax) was something the FCC is supposed to encourage, as your public notice reminds us you are supposed to do such things.

Applying that lesson to BPL, the power lines are effective transmission lines below say 500 Hz but up at HF they will radiate effectively and beings the wires come right into the homes and communities, radiate right into HF receivers of various kinds, so to fulfill your purpose of promoting new technologies, a case can be made that you should be promoting coaxial cable as the new way to carry signals at HF rather than unbalanced wires--except perhaps in historic districts of periods before WW2 but after electric distribution.

That being the case, we need to take a closer look at the historical context of BPL:

1.1.1 Early Years of Radio[6]

The world's first digital radio system was actually the world's first radio system. Guglielmo Marconi's first wireless transmission in 1897 used Morse code (a digital representation of text) to communicate from ship to shore. He soon commercialized his technology by installing wireless systems in transatlantic ocean vessels. These Marconi wireless systems were first used to send distress calls to other nearby boats or shoreline stations, even in the famous luxury liner Titanic. This first wireless system used a spark-gap transmitter, a glorified spark plug that sprayed electromagnetic waves in all directions at all frequencies. The spark-gap transmitter could be wired to send simple Morse code sequences, but the real challenge of the system was to receive the radio signal. For that, Marconi used a coherer, a device that could only detect the presence or absence of strong radio waves. This form of detection--coupled with the fact that only mechanical switching forms of signal amplification existed--meant that Marconi's wireless was only capable of digital transmission.

The Marconi wireless was heavily limited in range and data speed by the power required to send and receive signals. However, radio communications--as well as every other electronic technology--changed in 1906 when Lee de Forest invented the first vacuum tube. The vacuum tube amplifies analog waveforms, so radio communication was liberated from its low-rate, on-and-off keying. It was now possible to transmit high-fidelity analog signals, such as voice and music, over amplitude modulation (AM). Commercial AM radio stations proliferated across the world in the 1920s.

The next great milestone in radio came in 1933, when E. H. Armstrong invented frequency modulation (FM). FM radio was the first example of signal-processing used to overcome the noisy, deleterious radio channel. In this case, the

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[6] *Wireless Channel Modeling*, DEC 27, 2002 By Gregory Durgin.

> nonlinear modulation scheme of FM was capable of trading usable bandwidth for signal fidelity. For once, engineers could design radio links with a degree of freedom other than transmit power.
>
> Many other wireless devices followed (television, military radios, radar, etc.), but perhaps the most important and sublime milestone occurred in 1948 with Claude E. Shannon's publication of his famous "A Mathematical Theory of Communications." There are two extremely important principles outlined in this paper that revolutionized the design of communication links: All analog signals can be represented by sets of discrete digital symbols to a controllable degree of precision. The fundamental rate at which digital symbols may be sent through any channel is a function of bandwidth, signal power, and noise power. In essence, Shannon's theory predicted that digital communications, rather than analog communications, was the best way to send data through any link. It was only a matter of time before most radio communications would use digital modulation. It turned out to be a long time, however.

One of the "new" technological advances the FCC would be required to promote "follow[ing] television, military radios, radar, etc., is perhaps the most important and sublime milestone occurr[ing] in 1948 with Claude E. Shannon's publication of his famous A Mathematical Theory of Communications." Pertinent to BPL is the "extremely important principle [that] the fundamental rate at which digital symbols may be sent through any channel is a function of bandwidth, signal power, and noise power." Power line control signals because they are really slow can be sent down the line using low bandwidth at say <500 Hz where they won't bother anybody. You don't need the internet to flip a switch. But computer talk over the internet is fast and would necessitate blanketing HF between 2-30 MHz at power levels easily strong enough to cause massive radio interference when they are piped into power lines, effective antennas at HF. That is because the only remaining factor among "bandwidth, signal power, and noise power" is the noise power which since internet operation was not envisioned in the past when power lines were strung up and electrical devices turned on, is rather high. If somebody had thought ahead when wiring the country for electricity, and *buried* the outside electric lines, *balanced* the in-the-house wiring, and *suppressed* electrical devices, then the noise level would be low and the wire would not be an effective radiator, and we could proceed full speed ahead, but they didn't and we can't--not without sacrificing much usable rf spectrum. If we proceed as planned, we will regress to problems of an earlier era:

> efficiency of spark gaps vs tubes[7]

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[7] To: tesla@pupman.com Subject: efficiency of spark gaps vs tubes From: Tesla List <mod1@pupman.com>/ Date: Fri, 3 Oct 1997 20:24:58 -0600 (MDT) / Approved: mod1@poodle.pupman.com

The problem with the very broadband emissions from spark gap transmitters became intolerable as the world became more dependent on radio for both messaging and entertainment. SG transmitters were in use in the US until the 1930's. By that time, the good folks at RCA, EiMac and the various other tube manufacturing concerns had advanced the art far enough to permit the construction of vacuum tubes capable of many kilowatts of (coherent) power output at really useful shortwave communication freqs (2-30MHz).

And yet I see such an impetus to move forward with BPL that one wonders if the FCC even understands the cost:

Power-Line Internet Inches Closer[8]
By Yuki Noguchi
Washington Post Staff Writer
Thursday, April 10, 2003; Page E05

Current Technologies' demonstration showed transmission speeds four times as fast as cable Internet or digital-subscriber-line service. An estimated 80 percent of the U.S. population is in areas that offer at least one of those services. Nearly all homes are wired for electricity, which means the technology can be used even in rural areas.

"This is within striking distance of becoming the third major pipe in the home," Powell said.

FCC to study broadband over power lines, by Glenn Bischoff[9]

The FCC today approved a notice of inquiry to study whether and how broadband services over power lines should be regulated. FCC Chairman Michael Powell, long a proponent of the technology as a means of accelerating broadband deployments nationwide, particularly to high-cost areas, said such services could be available to U.S. customers later this year.

Power & Communication Contractor, February, 2003[10]

State Of Deployment

...

So when can we expect to see PLC in our neighborhood? The

[8] (washingtonpost.com) ©2003 The Washington Post Company

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answer is soon, but no definite date has been announced. Even once these trials do go commercial, it is not clear just how wide the rollout will be. Utilities pride themselves on providing quality service, so the rollout is expected to proceed cautiously. ¶At the same time, PLC will need to comply with FCC rules that apply to unlicensed operations, and utilities may need to obtain approval from state regulators to provide service to customers. These issues are being addressed but will nonetheless affect the timetable to rollout commercial PLC services.
Power & Communication Contractor, February, 2003[11]

Regulatory Issues: The Last Hurdle

The remaining question is how regulators will treat PLC. Currently, PLC is a type of "unlicensed operation" (like Wi-Fi) that must not interfere with and must accept interference from other licensed operations. As an added measure to prevent interference, unlicensed operations must comply with restrictions on the RF energy that is conducted onto electric lines and radiated outside the immediate surrounding area. These restrictions were written decades ago, primarily for digital devices, but also for a type of unlicensed operation called a "carrier current system." Although PLC meets the definition of a carrier current system, the question is whether the regulations that apply to carrier current systems should apply to PLC, and if not, whether they should be made stricter or relaxed. These regulations have the practical effect of limiting the bandwidth and the range of PLC, so this issue will significantly impact the quality and cost of PLC service.

What makes for a big push is that BPL looks so beneficial.

Power & Communication Contractor, February, 2003[12]

"Powerline Communicaitons: Making the Broadband Jump", Brett Kilbourne, Director of Regulatory Services, United Telecom Council **PLC And The Big Picture**

So why PLC and why now? It's no secret that the telecommunications market has been hit hard by the general downturn in the economy. The sector that

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rode sky-high stock prices to finance the largest infrastructure build-out since the railroad era a century ago is now slowing deployment while it seeks a return on the infrastructure that it has already built.

In the meantime, the telecommunications revolution envisioned by Congress when it passed the Telecommunications Act of 1996 has been put on hold. Competition in the local and long distance telecommunications market has diminished with incumbent providers increasing their market share and merging with one another. Policymakers are now searching for a white knight to rescue telecommunications competition, and broadband may be its salvation.

Broadband Internet access is key to telecommunications and economic recovery because it enables innovative and cost-effective services and unleashes the potential for e-commerce. All those home entertainment services that we currently run out to buy or rent can be delivered to your doorstep more easily, inexpensively, and with more features via broadband. Plus, a broadband connection makes surfing the Internet faster and more enjoyable, saving you more time and money.

The problem is that there is limited broadband access and only a few options for consumers. Cable modem and DSL comprise 98 percent of the broadband market, but they cost upwards of $40 per month and are not available in many parts of the country. Satellite is an option for many homes that can't otherwise get broadband, but it's relatively expensive with installation costs of $400 and monthly fees of $70 or more. WiFi also suffers from limitations that do not make it available or appropriate for certain customers. No wonder that many customers that could get broadband choose not to. That's unfortunate because the subscribers that do switch to broadband don't go back because the service is so much better than dial-up. Even though there was massive build-out of backbone facilities for broadband during the telecom boom, there is comparatively little infrastructure that runs from the backbone to the residential or small to medium-size business customers. As a result, an enormous amount of capacity is available to deliver broadband to these customers. The build-out just didn't reach the homes before the telecom boom went bust. And that doesn't seem to be changing anytime soon because the market will no longer reward companies that believe in the "build it and they will come" philosophy that so many followed during the telecom boom. So broadband is left hanging, waiting for someone to come along to build the last mile (or even less) to connect customers to the widely touted Information Superhighway.

Now more than ever, utilities are positioned to make that connection, thanks to powerline communications. This technology allows their customers to get broadband access to the Internet using the existing powerlines to and through the home or business. This equates to less expensive broadband service that can be deployed more quickly and is scalable and more versatile and flexible than alternative technologies. In addition, the technology improves the quality of the electric services that utilities provide as their core business. It's a win-win for telecommunications and electric customers.

But the problems BPL will cause cannot be ignored either.

"Radio Smog"[13] --*David Sumner, K1ZZ*

Much in the news in mid-August were reports of a major scientific study of an "Asian brown cloud" of toxic haze hovering over the most densely populated portion of that continent and threatening other parts of the world. The harmful effects of the haze on health and weather appear to be substantial: respiratory disease, drought in some areas and flooding in others, acid rain, and reductions in crop yields to name but a few. On a more encouraging note, scientists also know how to reduce the pollution and its effects: the use of cleaner energy sources and better stoves, and reduced burning to clear fields and forests.

The issue, which is really one of economics, is how to get hundreds of millions of individuals, families, and businesses to make these changes in how they live when the cost is far more immediate and tangible than the benefit. For an impoverished family, cooking its meal as cheaply as possible is a matter of survival. If cow dung is available as a "free" fuel it's a rational decision for the family to use it — but when multiplied by one hundred million, one family's tiny stove becomes an environmental calamity.

There is an obvious parallel between pollution of the Earth's atmosphere and pollution of the radio spectrum. Like the atmosphere, the radio spectrum is a precious natural resource shared by all. Like pollution, radio waves respect no political boundaries. Like the smog that fouls the air in many cities, electronic smog fouls the radio spectrum as a consequence of human activity — and like toxic haze, radio smog is an economic rather than a technical issue. We know how to control it; the debate is over whether it's worth the price to do so, and who should pay.

We're used to hearing public policy debates about air and water pollution. While people may disagree on costs vs. benefits in some instances, no one can possibly dispute that, for example, the quality of life in London improved dramatically after Parliament curtailed coal-burning in 1956. If someone were to suggest today that Londoners could save money by switching back, he would not be taken seriously — to put it mildly. The same would be true if someone were to suggest that his community could save money by dumping its raw sewage into the river. Such thoughts might have been acceptable 100 years ago, but not today. We've made too much progress, at too great a cost, to go back.

Unfortunately, the same cannot be said of spectrum policy. In some ways we do indeed seem to be going backwards, or having to fight against pressures in that direction. Many sources of radio smog are unintentional. Switch-mode power supplies are not designed to generate radio interference. Unfortunately, in some cases they are not designed not to. They could be, and if either consumers or governments insist on it, they will be.

Line noise is a big problem for many amateurs and other radio users. Power

[13] From IT SEEMS TO US, October 2002 *QST* © ARRL

lines are not supposed to emit RF energy, and if they do it's a sign something's wrong. Some power companies care, and know what to do. Others either don't know or don't care (executive bonuses being more important than overtime pay for linemen, perhaps). The FCC can make them care, and in several recent cases has done exactly that by threatening enforcement action.

Radio smog also results from putting RF where it doesn't belong. RF has this wonderful property: it wants to radiate. And it will radiate from any conductor you introduce it to, unless the conductor is either shielded or balanced. So, why would anyone deliberately put RF on a conductor that is neither shielded nor balanced if they didn't want it to radiate? For the same reason that the destitute Asian family uses cow dung to heat its dinner: economics.

What we're talking about here are plans to use power lines to distribute broadband digital signals to homes and offices. The wires are already there, the reasoning goes, so why not use them? Utilizing existing infrastructure in new and creative ways is good for business and good for society. Offering competitive choices to consumers lowers prices and improves service. How can anyone be opposed to that?

Here's how. A broadband signal is RF. Sent down an unshielded or imperfectly balanced line, it will radiate. Putting security concerns aside as someone else's problem, this creates a new and pervasive source of interference to radio reception. In other words, this competitive choice would transfer to all of society a cost — –in the form of reduced utility of the radio spectrum — –that is not imposed by other, more environmentally friendly ways of providing broadband service. Our poor Asian family may not have any choice but to pollute. We do.

Is it possible to do power line communications without causing interference to over-the-air communications? Count us among the skeptics. What may be a fine transmission line at 60 Hz looks more like an antenna at HF. And that's a matter of physics, not economics.

Writing in the Summer 1994 issue of EPA Journal about London's historic "pea-soup" fogs that gave rise to the term "smog" in 1905, David Urbinato said: "At the turn of the century, cries to reduce the smoke faced a tough opponent. Coal was fueling the industrial revolution. To be against coal burning was to be against progress. 'Progress' won out. Not until the 1950s, when a four-day fog in 1952 killed roughly 4000 Londoners was any real reform passed."

New sources of radio smog are no more acceptable than are new sources of the visible kind. At the turn of the new century our policymakers should — –no, must — –be able to distinguish real progress from cow dung.

We can use such an analogy to caution us:

Three Cautionary Tales: Union Carbide and Vienna, West

Virginia[14]

West Virginia, never one of the more prosperous areas of the United States, went into rapid economic decline in the late twenties as the coal industry, long the state's mainstay, began to shrink. The decline of the coal industry was hastened by rising concern with mine accidents and miners' diseases. For many of the coal mines of West Virginia were small and marginal and could not afford modern safety precautions or adequate health protection.

By the late 1940s the leading industrial company in the state became alarmed over the steady economic shrinkage of the region. Union Carbide, one of America's major chemical companies, had its headquarters in New York. But the original plants of the company had been based on West Virginia coal, and the company was still the largest employer in the state, other than a few large coal mines. Accordingly, the company's top management asked a group of young engineers and economists in its employ to prepare a plan for the creation of employment opportunities in West Virginia, and especially for the location of the company's new plant facilities in areas of major unemployment in the state. For the worst afflicted area, however, the westernmost corner of the state on the border of Ohio, the planners could not come up with an attractive project. Yet this area needed jobs the most. In and around the little town of Vienna, West Virginia, there was total unemployment, and no prospects for new industries. The only plant that could possibly be put in the Vienna area was a ferroalloy plant using a process that had already become obsolete and had heavy cost disadvantages compared to more modern processes such as Union Carbide's competitors were already using.

Even for the old process, Vienna was basically an uneconomical location. The process required very large amounts of coal of fair quality. But the only coal available within the area was coal of such high sulfur content that it could not be used without expensive treatment and scrubbing. Even then--that is, after heavy capital investment--the process was inherently noisy and dirty, releasing large amounts of fly ash and of noxious gases.

In addition, the only transportation facilities, both rail and road, were not in West Virginia but across the river, on the Ohio side. Putting the plant there, however, meant that the prevailing westerly winds would blow the soot from the smokestacks and the sulfur released by the power plants directly into the town of Vienna, on the other bank of the river.

Yet the Vienna plant would provide 1,500 jobs in Vienna itself and another 500 to 1,000 jobs in a new coal field not too far distant. In addition, the new coal field would be capable of being strip-mined, so the new mining jobs would be free from the accident and health hazards that had become increasingly serious in the old and worked-out coal mines of the area. Union Carbide top management came to the conclusion that social responsibility demanded building the new plant,

[14]Peter F. Drucker, Management (London: Heinemann, 1974) pp. 320-22.

despite its marginal economics.

The plant was built with the most up-to-date antipollution equipment known at the time. Whereas even big-city power stations were then content to trap half the fly ash escaping their smokestacks, the Vienna plant installed scrubbers to catch 75 percent--though there was little anyone could do about the sulfur dioxide fumes emitted by the high-sulfur coal.

When the plant opened in 1951, Union Carbide was the hero. Politicians, public figures, educators, all praised the company for its social responsibility. But ten years later the former savior was fast becoming the public enemy. As the nation became pollution-conscious, the citizens of Vienna began to complain more and more bitterly about the ash, the soot, and the fumes that floated across the river into their town and homes. About 1961 a new mayor was elected on the platform "fight pollution," which meant "fight union Carbide." Ten years later the plant had become a "national scandal." Even *Business Week*--hardly a publication hostile to business--chastised Union Carbide (in February, 1971) in an article entitled "A Corporate Polluter Learns the Hard Way."

There is little doubt that Union Carbide's management did not behave very intelligently. They should have realized in the early sixties that they were in trouble, rather than delay and procrastinate, make and then break promises--until the citizens, the state government, the press, the environmentalists, and the federal government all were aiming their biggest guns at the company. It was not very smart to protest for years that there was nothing wrong with the plant and then, when governmental authorities began to get nasty, announce that the plant would have to be closed as it could not be brought up to environmental standards.

Yet this is not the basic lesson of this cautionary tale. Once the decision had been made to employ an obsolescent process and to build an economically marginal plant in order to alleviate unemployment in a bitterly depressed area, the rest followed more or less automatically.

Would BPL bring many benefits? Undoubtedly, but so did Union Carbide provide *lots* of jobs in Vienna, W. Va. Would it help out those without easy access to the internet? Yes, but so did Union Carbide help out a forgotten corner of the state. Would the FCC be considered a good guy for pressing forward with BPL? Of course, but so was Union Carbide a hero *at first.* Later when people's lives were becoming intolerable because of the pollution, it was a different story. Union Carbide's plant near Vienna, W. Va., and BPL have this in common: "the process was inherently noisy and dirty, releasing large amounts of fly ash and of noxious gases [or their equivalent in radio pollution]," this because they were using an obsolescent process--radiating wire transmission lines.

Basically BPL is not the *ipso facto* introduction of some new technology but the merging of old and new, the old being unshielded/unbalanced transmission lines and the new being ways to send information through this noisy medium--ways that necessarily use a strong enough signal over a broad enough spectrum to cause

considerable over-the-air interference! To understand what Congress most likely meant, for situations such as these, when telling the FCC to encourage new technology, it helps to actually look at the history:

"U.S. radio's summer of anarchy,"[15] Bill Continelli, W2XOY The Wayback Machine

The Radio Act of 1912 was hopelessly obsolete by the early 1920's. Conceived in an era of long & medium wave spark telegraphy, the Act was totally inadequate when it came to broadcasting & shortwaves. Commerce Dept gamely tried to stretch the Act to meet new requirements; 1922 & 1924 "regulations" that banned broadcasting by amateurs, set up the broadcast band, and carved out the 160, 80, 40, 20, and 5 meter bands, were really nothing more than "gentlemen's agreements", valid as long as they weren't challenged.

For a time, they worked. Amateurs enthusiastically settled in on their new bands and began working the world, while the number of broadcasters in the new 550 to 1500 kc region jumped from 30 to almost 600 in just 3 years. Technical advances had not kept up with this growth, however, and there were problems.

Crystal control of transmitters was still a couple of years away, and the unstable broadcasting stations drifted from their assigned frequencies, sometimes to the point of interfering with adjacent channels. Even stations off frequency by 400-600 cycles could cause ear splitting heterodynes.

Most receivers of the 1920's were either regenerative or TRF (Tuned Radio Frequency), good on sensitivity, poor on selectivity. As a result, the 1920's broadcast band was saturated with only 600 stations. (Compare that to today's medium wave where tight frequency control of 20 hz, coupled with directional antennas and selective superheterodyne receivers, allows over 4000 stations to occupy the AM broadcast band without undue interference).

Commerce Dept therefore issued regulations mandating such solutions as time sharing (where 2 or more stations occupied the same frequency at different times of the day), and daytime only operations. Stations were constantly moved to another frequency, or told to decrease power, in order to minimize interference.

The Dept also went after stations whose transmitters drifted onto adjacent channels. An interesting example of this was the Los Angeles station of "Sister" Aimee Semple McPherson, evangelist leader of Intl Church of the Foursquare Gospel. Her station was notorious for drifting up & down the broadcast band. When Federal Radio Inspectors tried to keep her on frequency, she imperiously wrote to Secretary Hoover, demanding his "Minions of Satan" stay away from her transmitter. The Almighty would choose her Wavelength, she wrote, not the Commerce Dept.

Many stations that had been moved, told to reduce power, or share their frequency, did what any patriotic American would do, hire a lawyer. Once the legal

[15] SOCIAL JUSTICE, D2K Defense L.A., http://webnetarts.com/socialjustice/media/html

bloodhounds began digging, certain things came to light. Article I, Section 8, of the Constitution allows the Federal Govt to regulate INTERSTATE commerce.

Furthermore, it is accepted fact that a Federal Agency cannot issue any regulations unless it was given the power to do so by Congress. Lawyers for disgruntled stations challenged the Secretary's "regulations" on 2 fronts, first, that the Radio Act of 1912 gave the Dept no authority to regulate broadcasting stations, and second, that since many stations could not be heard across state lines, there was no "interstate commerce" and therefore no Federal jurisdiction. (This is the argument used by "Radio Free Berkley" and other low power pirate stations).

Day of reckoning arrived in 1926 when an Illinois Dist. Court held there was no Federal Law to permit Commerce Secretary to assign broadcasting licenses or frequencies. The Atty General admitted Federal Govt had no control over radio, except what was specifically authorized in the 1912 Act.

Pandemonium broke out. Stations, liberated from all Federal control, upped their power, jumped frequency, and/or began full time operations on daytime or time shared frequencies. Smaller stations were jammed off the air. Unlicensed transmitters appeared out of nowhere, dropped down on any convenient (or inconvenient) frequency, and began broadcasting. Anarchy was King.

Amateurs, of course, could have legally joined in this RF Orgy. There was nothing preventing them from going back to broadcasting, moving to new frequencies, exceeding the 1 kw limit, or anything else they desired. To their credit, they did nothing of the sort. One reason was the immense respect they felt for Secretary Hoover, a man who over & over publicly supported amateur radio in any way possible. They would abide by their "gentleman's agreement" with him.

The other reason was common sense. They knew that Congress would soon rectify the problem by passing appropriate legislation. The broadcasters were "big boys" with a lot of money, powerful corporate backers, and 6 million listeners; they could afford to violate the spirit of the law and get away with it. Amateurs did not have this luxury. They realized that any violations of 1922 & 1924 agreements, even if they were legally unenforceable, would cost them dearly in political support.

While the 550 to 1500 kc segment was a free for all, the amateur bands were disciplined & orderly, as hams mastered the art of crystal control, and improved their operating skills.

One area in which those skills were honed was expeditions. From the Arctic to the Antarctic, from MacMillan to Byrd, amateurs provided the necessary communications of almost every major explorer. Also, in the area of emergencies, amateurs provided communications during snow & ice storms, hurricanes, earthquakes, and floods.

Federal Govt quickly moved to end the chaotic mess on the broadcast band. On 2/23/27, the Radio Act of 1927 was approved. This law defined "amateur radio" for the first time in a Federal statute, and created the Federal Radio Commission, which was given the power to classify & regulate all aspects of all radio stations for "the public interest, convenience or necessity". Criminal penalties were written into the 1927 Act for violations of the Act, or any regulation thereunder.

The Commission immediately went to work. "Minions of Satan" got Sister

Aimee's station back on frequency, and shut down the transmitter of KFKB, the station of "Dr." John Brinkley, graduate of the Eclectic Medical School and proponent of prostate operations and (get this) goat gland transplants to cure all medical ills. Patients by the thousands listened to KFKB's broadcasts, and flocked to Kansas to have the operations, picking out their goat from the pens next to the hospital as they went in. After the Commission shut him down, "Dr." Brinkley went to Mexico by the Texas border, set up a 150,000 watt station, and continued operations.

In regard to amateur radio, the Commission, in effect, kept the status quo for the 15,000 hams. All agreements & regulations enacted by Commerce Dept were maintained & incorporated into current regulations. About the only change that hams noticed was the addition of a prefix on their calls, thus 1AW became W1AW, 1JS became W1JS etc.

GOVERNMENT REGULATION[16]

...

At first, the electronic media were not controlled either. But unlike newspapers and other print media, airwaves are limited by the available frequencies. Before multiband cable broadcasting, relatively few broadcast channels were available. The enormous cost of radio and television broadcasting still limits access even in this age of cable and satellite transmission. Abuses by early broadcasters, especially stations with massive power that drowned out others and wavered across the dial, led to the establishment of the Federal Communications Commission.

Television and radio are now "regulated" by the FCC. This agency [was] established by the Federal Communications Act in 1934.

The way I read history, "Abuses by early broadcasters, especially stations with massive power that drowned out others and wavered across the dial, led to the establishment of the Federal Communications Commission," so "The Commission immediately went to work; 'Minions of Satan' got Sister Aimee's station back on frequency." Nobody has any kind of divine right to the frequencies, especially not the overbearing presence of the internet by BPL.

Congress telling the FCC to encourage new technology, in this case like using crystal control to prevent "unstable broadcasting stations drifting from their assigned frequencies, sometimes to the point of interfering with adjacent channels," would seem to me to mean telling the internet services to use coaxial cable so their signals don't interfere with radio uses. That's how it seems to me.

You know, Aimee Semple McPherson was quite a charmer, which is probably why she thought she could get away with so much. There was the time, so I've heard, when she disappeared from

[16]Anita Taylor et al, Communicating (Englewood Cliffs: Prentice Hall, 1986) pp. 391f.

public view for several days and nobody knew where she was, but somebody spotted her at an out-of-the-way motel staying there with a married man from her church. When she got back, she had a tale of having been kidnapped by Mexican bandits, although there was never any proof of this or any explanation of how she got away. In our day we remember the escapade of Jimmy Bakker with his church secretary in the motel, so we would probably conclude the obvious, but she got away with it back then. I've seen newsreels from that time, where she just bats her eyes at the camera, tells us to disregard the report, prays a holy sincere prayer, and the audience just eats it right up.

Forgive me for not buying into the optimism surrounding BPL, but if internet providers are going to be sharing the same airwaves (whether they mean to or not) with radio users, there is one thing that is going to happen, the same thing that happens when the good "sister" shares a motel room with a married man: hams (and other spectrum users) are going to get screwed. Any talk of keeping radiated signals below harmful interference levels by means of a *conduction* standard sounds to me like talk of Mexican bandits; whom are they trying to kid? They're not going to nullify the laws of physics.

Now, let's get down to brass tacks and take an example. I have before me a paper garnished from the internet titled *Intellon High Speed Power Line Communications* by Elliott Newcombe, Intellon Corp. (I'm not trying to single out this particular company; it's just a convenient example.) It says, on the first page, "Intellon's OFDM meets FCC Part 15 regulations." How impressive!

Power & Communication Contractor, February, 2003[17]

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The allowable field strength at 30 meters is limited to a level that can still cause substantial interference to radio reception. In fact, the ARRL has worked with Homeplug to put 30 dB notches in their equipment that met the Part 15 limit but still caused harmful interference.

The rules specify the measurement be made at 30 meters but if that is impractical, then it can be made at a closer distance and then extrapolated at 40 dB/decade more loss as one moves away to the 30 meter standard. Well, that is theoretically fine for very small sources, but unfortunately it does not hold up with physically large systems which have been shown[18] to diminish by 20 dB/decade. It has become *standard* industry practice to measure the signal strength at 3 meters, then extrapolate to 30 meters using the 40 dB/decade method in order to arrive at a passing figure, because they couldn't get it to pass the regular way. Add to that the directive gain of a long power line, say > 10 dB, and multiply it by, say 1000 potential simultaneous users in a neighborhood, another +30 dB, and you can see why Intellon's statement leaves me unimpressed. Again, I am not singling out this company; it's just an example of lack of confidence.

Part 15 also states that incidental radiation that causes harmful interference to licensed users must be remedied or the interfering operation must cease. Now, when sister Aimee was (according to legend) staying with her lover at the motel, I doubt if she hung out a sign reading: SISTER AIMEE STAYING HERE TONIGHT. Likewise, these companies doing their tests that "comply" with part 15 are not inviting the hams along to observe. I wouldn't mind so much just me not being invited, but the ARRL wasn't invited either, the national organization of radio amateurs. So if there was nobody in the area to hear interference in the small tests they did, it's not surprising nobody reported any.

What I think should happen is that the acceptable radiation limits under part 15 should be *lowered*, made stricter, harder to pass--to reduce the burgeoning radio smog--,and then BPL should be made to adhere to this stricter standard using legitimate measurements and a 20 dB/decade model if they can't measure at the designated place.

Continuing to read the Intellon document:

> Most in the industry agree that useful data rates for consumer home networking start around 1 M bits/second. At that data rate, the power line provides an inhospitable communications channel. ...
>
> The power line as a communications channel has specific characteristics that must be considered. These include the dominant and widely varying noise sources, impedance changes, and multipath effects. Noise sources are electronic, electro-mechanical, and even induced by the power lines themselves. Some noise is harmonically related to the 50 or 60 Hz power. Light dimmers and related products that use triacs create impulse noise on every cycle of power. Some power supplies, especially poorly

[18] EZNEC model: -22 dB/decade; VERON study: ≈20 dB/decade; C63 PLC working group 20 dB/decade.

designed switching supplies, conduct quite a bit of noise onto the power line. This noise may have high harmonic content related to the switching frequency of the supply. One of the worst offenders is the brush motor with its rotating spark-gap generators that create broadband noise. Intellon has even noted cases where corroded junctions in the building wiring have a semiconductor effect whose nonlinearity induces noise on every power half cycle. Even if every device were unplugged, there would still be noise present, coupled onto the power line from outside RF sources.

That is both theoretically and practically correct.

1.3 The Transmission Medium-Interference Constraints[19]

Have a Transmitter launch a disturbance into a Transmission Medium. Provide an input data signal to a Transmission Medium. As it propagates down the Transmission Medium it will encounter all sorts of deleterious effects which are termed noise or interference. ...

What is noise/interference? It is some extraneous signal that is usually generated outside of the Transmission Medium. Somehow it gets inside of the Transmission Medium. It realizes its effect usually by adding itself to the propagating signal. Though, sometimes it may multiply the propagating signal. The term *noise* is generally used when this extraneous signal appears to have random amplitude parameters--like background static in AM radio. The term *interference* is used when this extraneous signal has a more deterministic structure--like 60-cycle hum on a TV set.

In any case, when the Receiver obtains the output signal it must make its decision about what Information it represents in the presence of this noise/interference. It must demodulate the output signal in the presence of noise/interference.

Noise/interference may originate from a variety of sources. Noise/interference may come from the signals generated by equipment located near the transmitter/transmission medium/receiver. This may be equipment that has nothing at all to do with the data link. Such equipment may be motors or air conditioners or automated tools. Noise/interference may come from atmospheric effects. It may arise from using multiple electrical grounds. ... It may come from the operation of other data links. In obtaining the design solution noise/interference makes its effect best known through the Bit Error Rate (BER). The level of noise/interference drives the BER. Of course, this can be countered by having the Transmitter inject a stronger input signal. ...

The susceptibility to noise/interference varies from Transmission Medium to Transmission Medium. Consequently, during the design process attention has to be paid to the Source-User pair. Attention has to be directed to the application underlying the communication needed by this pair and to the BER required by this application.

The Transmission Medium must then be picked that has a noise/interference level capable of delivering the required BER.

[19] www.telebyteusa.com

It is good engineering practice to pick a workable medium even had Congress not told the FCC to go for modern technology, the coaxial cable. Note that Intellon states that, "Even if every device were unplugged, there would still be noise present, coupled onto the power line from outside RF sources," which is confirmed by the latter passage, "What is noise/interference? It is some extraneous signal that is usually generated outside of the Transmission Medium. Somehow it gets inside of the Transmission Medium." If the transmission medium is the power lines acting as antennas at HF, then it is easy as pie for rf interference to get in. Checking the web site I listed earlier on page 10 for some calculations:

Interference to PLC systems from Amateur Radio Operation[20]

Interference is a two-way street, and PLC systems are at significant risk from amateur HF operation. In the US, amateurs are limited to 1500 watts PEP RF output, but there is no limit to the antenna gain. As a practical matter, few amateur antennas exceed 13 dBi on HF. This means, however, that the EIRP from amateur stations can exceed 20,000 watts. These stations can have antennas that are as close as about 10 meters or so the the electrical distribution systems.

Here is an estimate of the interference potential of a more modest HF station on 7.15 MHz:

Those unshielded overhead power lines are not great antennas, but they can and will pick up our signals. Here is a quick calculation:

Transmit power: +26 dBW (400 watts)
Transmit frequency: 7.15 MHz
Distance between antenna and power line: 20 meters
Path loss: -15.6 dB
Transmit antenna gain (with ground reflection): 6 dBi
Power-line antenna gain: -10 dBi (estimate)
Power picked up on power line:

+26 dBW
-15.6 dB
+6 dBi
-10 dBi

+6.4 dBW (4.4 watts)

The total power of their signal inside the line is going to be about 10 milliwatts, and when we transmit, PLC wiring may pick up 4 watts of our power right inside the frequencies PLC is using. It is unlikely that PLC systems will continue to function in the presence of these signal levels.

[20] From a post to the amwindow.org discussion forum by Ed Hare, W1RFI

I have an amateur station capable of producing up to 400 watts out on HF, and the power lines both above and below my lot are closer than 20 meters, with a feeder above the public access stairs cutting through the lot bringing the power line still closer. I imagine my ham radio signal is one that can find its way into the transmission medium of BPL.

Intellon's material I'm looking at is for in-home BPL, but in principle house wiring itself can be within 20 meters of a ham antenna, so this material still serves to illustrate the process.

Intellon has a Figure 1. that plots typical maximum noise level on a power line versus frequency. It looks just like what I have to put up with, noise coupled from the power line to my antenna, very typical. Intellon goes on to say: "Power line does not represent a controlled impedance to the transmitter [and] has its own multipath effects just like an RF channel." It goes on to illustrate multipath producing a signal that appears to be a phase modulated square wave. Finally they illustrate an adapted frequency domain where they employ a string of carrier frequencies and shut down any that fail to maintain a good BER on account of either noise, interference, or poor transfer. But its only what one would expect from the milestone publication of Claude Shannon, A Mathematical Theory of Communications, 1948. They use a signal strong enough to compete with most of the typical noise, and in places where the noise is too strong, they don't go there but spread out on more frequencies, as if they owned the HF spectrum and nobody could hear all these signals. Now we get down to the two way communication with hams--quoting from Intellon:

> This principle is equally useful for avoiding in-band continuous wave jammers. A very real example of this kind of interference is the coupling of amateur radio signals to the power line. These narrowband jammers can have substantially greater amplitude than the OFDM information signal. The subcarrier overlapped by the jammer is simply turned off to improve BER. ... Tone allocation provides an important regulatory benefit. Frequencies can be masked to meet current and future international regulations for power line communication systems.

Let's look at that paragraph one piece at a time. Amateur radio.

PUBLIC LAW 103-408 [S.J. Res. 90]; October 22, 1994

ACHIEVEMENTS OF RADIO AMATEURS

Whereas Congress has expressed its determination in section 1 of the Communications Act of 1934 (47 U.S.C. 151) to promote safety of life and property through the use of radio communications;

Whereas Congress, in section 7 of the Communications Act of 1934 (47

U.S.C. 157) established a policy to encourage the provision of new technologies and services;

Whereas Congress, in section 3 of the Communications Act of 1934, defined radio stations to include amateur stations operated by persons interested in radio technique without pecuniary interest;

Whereas the Federal Communicatins Commission has created an effective regulatory framework through which the amateur radio service has been able to achieve the goals of the service;

Whereas these regulations[21], set forth in part 97 of title 47 of the Code of Federal Rgulationss clairfy and extend the purposes of the amateur radio service as a--

(1) voluntary noncommercial communication service, particularly with respect to providing emergency communications;
(2) contributing service to the advancement of the telecommunications infrastructure;
(3) service which encourages improvement of an individual's technical and operating skills;
(4) service providing a national reservior of trained operators, technicians and electronics experts; and
(5) service enhancing international good will;

Whereas Contress finds that members of the amateur radio service community has provided invaluable emergency communcations services following such disasters as Hurricane Hugo, Andrew, and Iniki, the Mt. St. Helens eruption, the Loma Prieta earthquake, tornadoes, floods,

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[21] 97.1. Basis and purpose. The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

(a) Recognition and enhancement of the value of the amateur service to the public as a voluntary noncommercial communication service, particulary with respect to providing emergency communications.
(b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
(c) Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communcation and technical phases of the art.
(d) Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.
(e) Continuation and extension of the amateur's unique ability to enhance international goodwill.

wild fires, and industrial accidents in great number and variety across the Nation; and

Whereas Congress finds that the amateur radio service, has make a contributuion to our Nation's communciations by its crafting, in 1961, of the first Earth satellite licensed by the Federal communciations commission, by its proof-of-concept for search and rescue satellites, by its continued exploration of the low Earth orbit in particular pointing the way to commercial use thereof in the 1990's by its pioneering of communications using reflections from meter trails, a technique now used for certain government and commercial communications, and by its leading role in development of low-cost, practical data transmission by radio which increasingly is being put to extensive use in, for instance, the land mobile service; Now, therefore be it

Resolved by the Senate and House of Representatives of the United Sates of America in Congress assembled,

SECTION 1 FINDINGS AND DECLARATIONS OF CONGRESS.

Congress finds and declares that--

(1) radio amateurs are hereby commended for their contributions to technical progress in electronics, and for their emergency radio communications in times of disaster;

(2) the Federal Communications Commission is urged to continue and enhance the develpment of the amateur radio service as a public benefit by adopting rules and regulations which encourage the use of new technologies within the amateur radio service; and

(3) reasonable accommodation should be made for the effective operation of amateur radio from residences, private vehicles and public areas, and that regulation at all levels of government should facilitate and encourage amateur radio operation as a public benefit.

Approved October 22, 1994

Amateur radio is among other things a "voluntary noncommercial communication service, particularly with respect to providing emergency communications." Public Law 103-408 says that, "reasonable accommodation should be made for the effective operation of amateur radio from residences, private vehicles and public areas, and that regulation at all levels of government should facilitate and encourage amateur radio operation as a public benefit." In-house BPL in the case of a renter or near neighbor has every potential for reducing the effectiveness of amateur radio operation. Private vehicles equipped with amateur

radio could easily lose their effectiveness passing under BPL lines, and as for public areas, that is where power lines run, over streets and sidewalks which often enough abut a radio ham's shack. P.L. 103-408 says that "reasonable accommodation" is to be made "for the effective operation of amateur radio from" those places. Intellon has the ability to turn off the carrier operating at amateur frequency, so that is a reasonable accommodation." And if "regulation at all levels of government should facilitate ... amateur radio operation as a public benefit," then the FCC rules regarding BPL should specify that BPL make that reasonable accommodation not to use amateur frequencies (listed earlier on page 10).

Furthermore, as Intellon's research discovered, corroded junctions in the power system can cause nonlinear passage of current. That means where several BPL carrier frequencies are being sent through simultaneously, they will mix in those nonlinear junctions to produce new frequencies at the sum and difference of the carriers. Also besides the harmonics inherent in their square data waves, more will be generated through the nonlinear junctions. Therefore to the extent possible with what they are allotted, BPL providers should not use carrier combinations whose sums or differences or whose subharmonics fall within amateur bands.

There's more. I've been looking at various diagrams of the operation of access BPL, and see they have been going with high pass filters to get around distribution transformers leading to the house or the big line. No, no, no ,no no. BPL signals have harmonic components extending past the 30 MHz limit of their use. Therefore the companies should be using *bandpass* filters instead of highpass filters, to cut off signal components above 30 MHz.

Furthermore, consider the lists of electro-mechanical and electronic noise sources, what the radio listener must combat. If BPL signals need some way to bypass the transformers, then all that other noise is going to find itself blocked there too. Putting a bandpass or highpass filter at the transformers will only send all that other interference/noise down the (radiating) line, whether BPL is using ham frequencies or not. There should therefore be a requirement for *notches* in the bypass filters at ham radio frequencies. HomePlug put 30 dB notches in its equipment, so that should be reasonable.

As for stressing the emergency uses of amateur radio, we should look at how Intellon proceeded to plan operations. They would be using amateur frequencies even if they didn't need to. They have equipment that sends digital signals down the line at a fair clip, and they can also monitor signals on the line (otherwise, how would they know they had competition?) Digital providers are well aware of the shared nature of the medium, that sometimes it is necessary to take turns. What is ordinary courtesy--and should be law--is that they would have enquired what the protocol was to transmit into an antenna at radio frequencies that somebody else might be using. They would have been told to transmit *QRL?* in international morse, say at 15 wpm. Its

international meaning is, Are you busy? and it's used to see if a channel is in use before transmitting on it. The affirmative reply is *YES* in morse code, often abbreviated *C* for yes in Spanish, or commonly just an *R* is sent, Roger, which technically means solid copy but is often used for an affirmative reply. Trying that three times with pauses in between should be standard practice when coming on line at every frequency. I mean, sure, they can't change the laws of physics, and it's impractical to bury the power lines and cure all the competing noise sources, but this is one thing they can do, should do, and is standard operating procedure for interfacing with other sources in other media.

Suppose a ham were listening to some emergency traffic being handled where he himself might be needed but he's just waiting to be called for rather than disrupting what's happening. It's a real emergency. Some guy down the street from him decides to view some pornography on the internet, and Intellon's system not hearing an overwhelming signal on the ham's frequency uses it for its own data. That's what Congress wants us to avoid despite its wish to encourage new technology.

James Chiles in his book, Inviting Disaster--Lessons From the Edge of Technology, writes, "In our new world, surrounded by machines occasionally gone savage, we need to acknowledge the extraordinary damage that ordinary mistakes can now cause." The journal *Science* in its review of that book wrote, "The extraordinary, accelerating advance of science and technology over the past few hundred years has been intoxicating. It fills us with a sense of nearly unlimited possibility for understanding and manipulating the physical world. [However] there is no reason to suspect that we are now any less fallible than before." We can still get caught reading dirty books, only now with BPL over the internet it could have disastrous results if precautions are not taken.

Science goes on to say, "Even a tiny risk is intolerably high. For those technologies, we must insist on perfection." How high of a standard is Intellon using to avoid any possibility of disrupting emergency communications? In their literature they referred to "amateur radio signals" as "these narrowband jammers." A "jammer" has a specific meaning.

Medium Wave Interference, by Steve Whitt, ©2002

Jamming:

> This is a deliberate attempt to interfere with reception and is usually a transmission of man-made noise intended to blanket another programme to make it unintelligible. The amount of jamming present tends to reflect the degree of political unrest in the world and today there is relatively little to bother the MW listener. The extensive jamming associated with Eastern Europe and the former USSR is now consigned to history, but jammers are still active in the Middle East and Korea.

What he probably meant to say was *interference*, as explained earlier (page 34), "The term *noise* is generally used when this extraneous signal appears to have random amplitude parameters--

like background static in AM radio. The term *interference* is used when this extraneous signal has a more deterministic structure--like 60-cycle hum on a TV set." He is talking about interference as opposed to noise, but used the term *jammer*, possibly through ignorance, but still it doesn't inspire confidence in the industry to read it in their literature where presumably they are putting their best foot forward.

Continuing down Intellon's page, we read, "A baseline OFDM system was field tested in more houses and several geographic locations. One purpose of this round of testing was to make radiated measurements against known FCC limits. Through these real world measurements Intellon has demonstrated that its OFDM system is within the rules for Part 15 devices." As mentioned earlier there is the standard industry practice of taking a measurement at 3 meters and extrapolating by the 40 dB per decade formula to show it within bounds at 30 meters where the measurement is supposed to be taken if at all possible. Then that particular formula gives a result that is 20 dB too low. Their literature doesn't give specifics, nor is there any mention of seeing how loud their signal was on an HF receiver where it is not allowed to interfere, but they can get away with signals that would as long as there is nobody to either hear or know how to make a complaint. It's not very meaningful to leave out this information on a system they want to market far and wide. Are they Intellon or Intelloff?

Now comes the issue of how we are to locate the offending BPL devices causing harmful interference to licensed radio operators, or SWLers for that matter. This would be difficult.

> While locating and correcting RFI emanating from the many devices in the neighborhood can be done by the amateur operator or the CBer, locating and pinpointing power line RFI is a different matter. The efficient antenna system made up of overhead wires conducts and radiates a spot source of RFI very efficiently. Standing waves of RFI develop on a power line and produce spurious noise sources at intervals along the line that are exceedingly difficult to differentiate from the main noise source.[22]

If it's exceedingly difficult for one noise source, it could be well nigh impossible when there are several BPL users on the line. That is why I want to propose that individual devices be registered, each with a unique number that is sent as a tone modulated international morse code identification on each carrier frequency used (after the device determined the frequency was clear) whenever it comes on line and at ten minute intervals thereafter. The ten minute space should be keyed to when it came on line, not synchronized with all the others making it impossible to separate them out. That way anyone with an A.M. shortwave receiver can figure out where the interference is coming from. Again, we cannot blame the manufacturer for not being able to circumvent the laws of physics, or the power company for not

[22]William Orr & William nelson, Interference Handbook (Lakewood, NJ: Radio Amateur Callbook, 1993) p. 103.

having buried its lines, or all the junky noise sources BPL has to compete with, but we can get them to i.d. themselves, because that is what they do, send out digital information. And spread spectrum schemes should also i.d. with slow morse, 5 wpm, and broadband noise over their frequency range. And there should be an accessible register with a listing of the numbers, their locations, and whom to contact.

Then there's the issue of what to do once the offender(s) has been identified. The user is not required to understand electronics well enough to understand an explanation of the problem his device is causing.

Power & Communication Contractor, February, 2003[23]

What To Look For

Once commercial access services are provided, PLC will ideally be plug-and-play. Customers will be able to purchase the equipment off the shelf or from the utility and subscribe for service with only a few hours of setup time required. Once customers receive service, not only will they get synchronous (same upload and download speed) high-speed Internet access, but the entire premise can be networked through the electrical jacks in each room. That means no new wires, no drilling, and easy installation.

In fact, a number of various PLC devices that enable home networking can be purchased at your local retail electronics store for less than $100, and prices are coming down.

My neighbor across the street is friendly as can be but can't understand why she should allow her "privacy" to be violated so that I can remedy her touch control lamps that interfere with my ham radio reception, so I just have to make the best of it. With these BPL devices connected up through their providers, we shouldn't have to confront an ignorant user about its harmful interference; the company itself can disconnect it. Furthermore, we shouldn't have to go through an overworked and understaffed FCC to get it done. We amateurs in the U.S. have a cadre of ARRL "official observers" with the equipment and skill to spot problems. If one of them reports an offender, it should be disconnected automatically. And there should be other designated individuals in other services who could do the same for theirs. This should be acceptable to the would-be BPL companies who tell us their devices will not interfere, so none would ever get disconnected in that case.

As for different interference standards for devices at ones

[23]Power & Communication Contractors Association, 103 Oronoco Street, Suite 200 ò Alexandria, VA 22314, (800) 542-7222 * (703) 212-7734 * Fax (703) 548-3733 * info@pccaweb.org * © 2002 Power & Communication Contractors Association. All Rights Reserved.

own residence, hey, I'm a renter. I remember the time I approached a fellow renter about the interference from his touch control lamp. He made a fist and wanted o beat me up. When one is living close to people, tensions can get out of hand. Just because they share the same house wiring doesn't mean they share the same views. If you want to make a different standard for ones dwelling, make it stricter, otherwise leave it the same.

As for right of ways, I really didn't want the power lines cutting through the property I'm on, but they had to do it. That doesn't mean BPL has to put their crud in my yard too. They should go around if they must set up their network, using only poles on public grounds. Otherwise I'd feel about as kindly to them as I feel towards that dog who did its thing in my yard and I had to chase it off.

With massive numbers of BPL users in a city operating at the same time, skywave propagation of interference could would be a problem. And since BPL would use long stretches of power lines acting as antennas with huge directivity in its directions of orientation, and since the power grid is usually laid out at right angles, say N-S & E-W, its distribution should be duplicated in both orientations so that if skywave interference becomes a problem in one direction, they can switch orientation at the offending time.

They should be made to move their frequencies up and down at different times of the day to avoid propagated interference as the MUF changes and D level absorption varies by frequency and time of day. Something like the A.M. stations changing power or antenna pattern depending on time of day.

And finally there are the quiet hours. Part 15 requires hams to observe quiet hours if there is interference that cannot be rectified through more engineering and the FCC determines that step. Since BPL cannot be engineered free of interference problems, it should automatically observe quiet hours of no operation between 5 p.m. to 11 p.m. on weekdays, and from 8 a.m. to 12 noon on Sundays. There would still be many benefits from BPL even with quiet hours, and that quiet time would be necessary.

The best solution would be to do what the Japanese did and ban BPL altogether, and Japan is not without engineers to try to work it out; it just couldn't be done without unacceptable interference to many HF users. I'm following here the philosophy in a sci fi book[24]:

> With a flourish, Sullivan waved his arm at *Apogee II,* which looked less like a rocket plane and more like a fat fireplug with windows.
>
> "I know she may not look like much," he said, "but what we've built here is the most cost-effective and practical launch vehicle now in existence. She uses an assisted SSTO launch system. After vertical takeoff, upon climbing to twelve

[24]Tess Gerritsen, Gravity (New York: Pocket Books, 1999) pp. 83f.

kilometers, pressure-fed rockets accelerate the vehicle to a Mach four staging point at low-dynamic pressures. This orbiter is fully reusable, and weighs only eight and a half tons. It fulfills the principles we believe are the future of commercial space travel. Smaller. Faster. Cheaper."

"What sort of lift engine do you use?" asked Rashad.

"Rybinsk RD-38 air-breathing engines imported from Russia."

"Why Russian?"

"Because, Mr. Rashad--between you, me, and the wall--the Russians know more about rocketry than anyone else on earth. They've developed dozens of liquid-fueled rocket motors, using advanced materials which can operate at higher pressures. Our country, I'm sorry to say, has developed only one new liquid fueled rocket motor since Apollo. This is now an international industry. We believe in choosing the best components for our product--wherever those components may come from."

"And how does this ... *thing* land?" asked Mr. Lucas, looking dubiously at the fireplug orbiter.

"Well, that's the beauty of *Apogee II*. As you'll notice, she has no wings. She doesn't need a runway. Instead she drops straight down, using parachutes to slow her descent and air bags to cushion touchdown. She can land anywhere, even in the ocean. Again, we have to tip our hats to the Russians, because we've borrowed features from their old *Soyuz* capsule. It was their reliable workhorse for decades."

"You like that old Russki technology, huh?" said Lucas.

Sullivan stiffened. "I like technology that works. Say what you want about the Russians, they knew what they were doing.

It seems to me that the Japanese know what they are doing in going with a technology that works: coaxial cable. And I believe we'd be much better off to swallow our pride and follow their lead.

Sincerely Yours,
Earl S. Gosnell III