DOCKET FILE COPY ORIGINAL

220 Lenox Avenue
Albany NY 12208-1408
July 8, 2003

Ms Marlene Dortch, Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Room TW-B204
Washington, DC 20554

Re: ET Docket No 03-104

MOTION TO ACCEPT THE FILING AS TIMELY FILED

Dear Ms. Dortch:

I, Gerald W. Murray, WA2IWW, respectfully request that the enclosed comments and attachments for Docket 03-104 docket be accepted as timely filed.

On the evening of Monday July 7, 2003, between 11:00 PM and 12:00 PM (midnight) EDT, I attempted to submit a comment and three attachments using the Electronic Comment Filing System (ECFS) I was able to complete the cover information and transmit four files. However, after I executed the final step to close out the submission, I received a long wait followed by a failure message. This event occurred three times.

On the morning of July 8, I checked the ECFS system on-line. Although I did find several recent comments, I did not find my own comments.

I called the Office of the Secretary. The staff reviewed the recent on-line comments, and could find no sign of my filing.

The staff advised that I could send a paper "motion to accept the filing as timely filed" along with a paper copy of the comments and attachment. They advised that I should send a signed original and at least four (4) copies.

I am providing a signed original and nine (9) copies of the motion, comments, and attachments. I am also enclosing ten (10) IBM-formatted 3-½" floppy diskettes. Because many of the documents contain graphics, I request that the electronic files be incorporated into ECFS instead of scanning the paper documents.

Under the rules for ECFS, comments submitted before midnight on the due date are considered to have been timely filed. If not for the failure, the comments would have been timely filed.

I would like to request a reasonable extension of time to prepare the motion and to print the original and nine copies of all documents (Tuesday, July 8), and to mail the complete package (Wednesday, July 9)

Thank you for your time and attention in this matter.

Respectfully submitted,

Gerald W Murray, WA2IWW
wa2iww@arrl.net

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

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

To: The Commission

July 7, 2003

COMMENTS OF GERALD W. MURRAY, WA2IWW

I BACKGROUND

My name is Gerald W. Murray. I have held Amateur Radio license WA2IWW since 1976, and have held the Amateur Extra class license since 1992. I also hold the following FCC commercial radio operator licenses:

- General Radiotelephone Operator License (GROL) with Ship Radar Endorsement
- Second Class Radiotelegraph Operator's Certificate with Ship Radar Endorsement
- GMDSS Radio Operator/Maintainer License with Ship Radar Endorsement

I am currently employed as a Data Communications Specialist II by the New York State Workers' Compensation Board (NYSWCB). I had previously been employed as a broadcast operator by AM and FM broadcast stations in Upstate New York's Capital District Area

II. AFFECTED HF/VHF USERS

To date, numerous comments have been filed in this proceeding by amateur radio operators who are very concerned about the inevitable impact of the proposed BPL systems However, amateur radio is not the only radio service which will be impacted by

the proposal A quick review of the attached chart, "United States Frequency Allocations", (prepared by the National Telecommunications Information Administration (NTIA)) provides a partial listing of the radio services which presently occupy spectrum space between 2 MHz and 80 MHz

- Aeronautical Mobile
- Aeronautical Radionavigation
- Amateur
- Amateur Satellite
- Broadcasting
- Fixed
- Land Mobile
- Mobile
- Maritime Mobile
- Radioastronomy
- Radiolocation
- Space Research
- Standard Frequency and Time Stations

III THE FEDERAL GOVERNMENT INTEREST

The Federal government has a strong interest in promoting and protecting the amateur radio service, as well as the protection of its own radio systems. The NTIA's interest in protecting the amateur radio service can be inferred from comments dated August 21, 2002 which the NTIA submitted in FCC Docket 02-98. In these comments, the NTIA states:

"The amateur radio service has been important to this nation for many years, and the National Telecommunications Information Administration (NTIA) welcomes the Commission's efforts to provide new allocations to support amateur radio services. Amateur services currently share spectrum with federal users in several bands and have been good spectrum neighbors."

In the same comment letter, the NTIA also outlines the need for protection of government HF radio systems

"HF bands are currently used extensively by federal agencies for emergency services, including communications support for the Department of Defense, Coast Guard operations, Department of Justice law enforcement, and back-up or emergency uses by twelve other federal agencies."

"Federal agencies need immediate access to these HF frequencies in times of emergency."

"Some federal agencies utilizing this portion of the HF band have automatic link establish (ALE) systems that sample channels periodically to determine channel availability."

IV HIERARCHY OF PROTECTION

The present rules define a hierarchy of protection for various spectrum users. Users of the primary licensed services enjoy the highest level of protection. Below this, users of secondary licensed services enjoy the second-highest level of protection. The third-highest level of protection is accorded to the operators of unlicensed (Part 15) devices. The operators of incidental radiators enjoy little or no protection.

To summarize, the list of radio services (in order of most protection to least protection) is.

- Primary licensed service
- Secondary licensed service
- Unlicensed devices (Part 15, etc.)
- Incidental radiators

Since incidental radiators have the lowest level of protection, they may not cause harmful interference to unlicensed Part 15 devices, secondary users, or primary users. The operators of the incidental radiators are required to take whatever steps are necessary (including the discontinuance of operation) to eliminate harmful interference, as defined by the FCC:

> *Harmful interference. Any emission, radiation or induction that endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunications service operating in accordance with the Radio Regulations.*

V. ARRL STUDIES AND COMMENTS

The ARRL has raised several questions regarding the feasibility of access BPL systems, and the potential for harmful interference. It references some of it's own research, as well as studies performed in other countries, such as the Netherlands and Japan. A copy of the ARRL white paper, "Calculated Impact of PLC on Stations Operating in the Amateur Radio Service" is included as an attachment.

The filings and studies presented or cited by the American Radio Relay League (ARRL) should be given serious consideration. There are several recent examples which validate the work of the ARRL laboratory:

1. The FCC has recognized the qualifications of the ARRL laboratory, and actually references the lab in the standard letters it sends to utilities, owners of electric fences, and operators of Part 15 devices which are believed to be causing harmful interference.

   For example, in a letter dated May 23, 2003, from the FCC to Mr. John W. Rowe,

Chairman, President and Chief Executive Officer of Exelon Corporation of Chicago, IL, the FCC states.

> *"While the FCC has confidence that most utility companies are able to resolve these issues voluntarily, the FCC wants to make your office aware that this unresolved problem may be a violation of FCC rules and could result in a monetary forfeiture for each occurrence At this stage, the FCC encourages the parties to resolve this problem without FCC intervention, but if necessary to facilitate resolution, the FCC may investigate possible rules violations and address appropriate remedies*
>
> *The American Radio Relay League, a national organization of Amateur Radio operators, may be able to offer help and guidance about radio interference that involves Amateur Radio operators.*
>
> *American Radio Relay League*
> *Radio Frequency Interference Desk*
> *225 Main Street*
> *Newington, CT 06111*
> *860-594-0200*
> *E-mail rfi@arrl.org"*

The full text of this letter is included as an attachment. The FCC has used this same language in several recent letters to utility companies and owners of electric fences (incidental radiators), as well as operators of unlicensed Part 15 devices.

2 The FCC has also accepted and acknowledged input from the ARRL in the preparation of OET Bulletin 65 Supplement B. entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields – Additional Information for Amateur Radio Stations"

20 contributors from ARRL (headquarters staff and outside advisors) reviewed an early draft of this document, and provided comments and suggestions. The 20 contributors are listed by name.

3 The ARRL hosted a workshop on power line interference on August 22 and 23, 2002. The approximately 20 attendees included two members of the U.S.

armed forces, a communications specialist, several members of the ARRL headquarters staff, several power company employees, and Riley Hollingsworth, (K4ZDH), the FCC's Special Counsel for Amateur Radio Enforcement. An article on this has been included as an attachment.

VI. EXISTING PLC SYSTEMS

The ARRL has worked with the the HomePlug Powerline Alliance in the development of the HomePlug standard for in-home PLC systems. As part of the HomePlug specification, spectral masks are utilized to protect amateur the bands.

However, this step does have some drawbacks, in that it does not provide relief in the following situations.

- The spectral masks may not be sufficient to prevent all cases of interference to stations in the amateur radio service.
- The spectral masks will not benefit amateur stations operating in the Military Affiliate Radio Service (MARS), government HF users, or other users of the HF spectrum.
- The use of spectral masks does nothing to protect the five new channels which were recently allocated to the amateur radio service on a secondary basis in the 60 meter band (5 MHz). It also does nothing to protect the pre-existing federal government radio systems which are the primary users of this band.
- The implementation of the spectral masks to protect the then-current amateur bands does nothing to protect any new HF or low VHF allocations for the amateur radio service, or for other radio services This would limit the Commission's ability to reallocate HF spectrum among licensed services when needed. This would place the Commission in an untenable position, as it would not be able to change domestic allocations when needed, or be able to respond to changes in the International HF allocations from the International Telecommunications Union (ITU).

VII UTILITY DEPLOYMENT OF ACCESS BPL SYSTEMS

Utility companies wishing to deploy access BPL systems would have to accommodate any existing radio services which are located in or near the area to be served. Even if the

situation involving pre-existing stations is completely resolved at the time of the initial installation, future events could cause interference problems which would have to be resolved by the utility which is utilizing access BPL technology. Some of these events would include.

- Deterioration of electrical wiring through normal wear and tear which unbalances (or further unbalances) the power lines with respect to data transmission. The threshold level for the deterioration which would unbalance an access BPL transmission system would be less than the threshold level for deterioration which would cause standard power line interference, and far less than the threshold for causing problems with the actual delivery of electrical power.

- One or more individuals living in or near the served area may choose to take up amateur radio

- An inactive amateur radio operator living in or near the served area may become active

- An amateur radio operator who holds a codeless Technician class license could suddenly gain HF privileges by passing examinations for upgrade to Technician HF Class (Code Element 1), or to the General Class (Code Element 1 and written Element 3).

- An amateur radio operator could move from an unserved area into a house or apartment in or near the served area

- A new radio installation may be established in or near the served area for a service other than the amateur radio service.

Although any business venture is a calculated risk, the need to protect licensed radio services may require the utility to withdraw the access BPL service, or take remedial steps which are so expensive as to offset any revenues which the utility would hope to receive from the operation of the access BPL service

The ARRL white paper cites a case study in which Phonex model PX-421 wireless modem jacks used by TCI cable (now AT&T/Comcast) had to be redesigned and recalled

IX METHODS OF PROVIDING INTERNET ACCESS

There are several different methods currently available for the provision of Internet access All of the current methods have one or more desirable features which act to prevent or limit radiation in the HF and low VHF spectrum. These features include use of balanced lines, use of shielded or fiber optic cable, or non-use of broadband spectrum. Even though each of the pre-existing delivery methods have at least one undesirable feature, the presence of one or more desirable features acts to limit harmful interference. Table I lists the features matrix for most of the currently available delivery systems, plus the proposed BPL systems.

Table I. Delivery methods for Internet Access (commercial and residential service)

Service Type	Media Type	Balanced Line	Shielding	Fiber	Broadband	Remarks
Standard telephone line/modem	Twisted Pair Cable	yes	**NO**	**NO**	no	The use of balanced lines and the lack of spectral components in HF and low VHF bands tends to limit radiation
ISDN BRI	Twisted Pair Cable	yes	**NO**	**NO**	no	The use of balanced lines and the lack of spectral components in HF and low VHF bands tends to limit radiation
ISDN PRI	Twisted Pair Cable	yes	**NO**	**NO**	no	The use of balanced lines and the lack of spectral components in HF and low VHF bands tends to limit radiation
DS-1 (T1)	Twisted Pair Cable	yes	**NO**	**NO**	no	The use of balanced lines and the lack of spectral components in HF and low VHF bands tends to limit radiation
DS-3	Coaxial Cable	**NO**	Yes	**NO**	**YES**	The shielding of the coaxial cable tends to limit radiation if properly installed and properly maintained.
DS-3	Fiber Optic Cable	N/A	N/A	yes	**YES**	Since fiber optic cable uses light, there is no radiation of RF frequencies
Cable modems	Coaxial Cable	**NO**	Yes	**NO**	**YES**	The shielding of the coaxial cable tends to limit radiation if properly installed and properly maintained. The FCC promulgates rules limiting leakage from cable systems
Cable modems	Fiber Optic Cable	N/A	N/A	yes	**YES**	Since fiber optic cable uses light, there is no radiation of RF frequencies.

Service Type	Media Type	Balanced Line	Shielding	Fiber	Broadband	Remarks
Unlicensed Microwave	Microwave	N/A	N/A	N/A	YES	Interference potential limited by Part 15 restrictions on power levels and antenna gain.
Licensed Microwave/ Satellite	Microwave/ Satellite	N/A	N/A	N/A	YES	Interference potential limited by use of directional antennas, stringent FCC technical requirements, and a complex licensing and siting process.
BPL Systems	Power Lines	NO	NO	NO	YES	**BPL SYSTEMS USE BROADBAND SIGNALS WHICH ARE RICH IN HF AND LOW VHF SPECTRAL COMPONENTS.** **THE BPL SYSTEMS ARE NOT POINT SOURCES, AND WILL RADIATE OVER WHOLE NEIGHBORHOODS AND COMMUNITIES.** **POWER LINES ARE NOT DESIGNED TO BE BALANCED FOR RF. IN PRACTICE, IT IS VERY DIFFICULT TO GET POWER LINES TO BE BALANCED (OR KEEP THEM BALANCED) FOR RF.** **POWER LINES ALSO LACK SHIELDING.**

NOTES:

1. Desirable features which tend to prevent or limit harmful interference are indicated in lower case in black print
2. Undesirable features which cause or contribute to harmful interference are indicated in **UPPER CASE IN RED PRINT**.
3. None of the features of BPL over power lines act to prevent or limit harmful interference

In evaluating the potential for access BPL systems to cause harmful interference to the amateur radio service (and other licensed services), the following real-world factors need to be considered:g

- Commercial power lines represent a very large radiating surface, which can represent an efficient high-gain antenna.
- Signals from the power lines do not constitute a point source, but instead radiate over the entire BPL service area (such as a neighborhood or a whole community)
- Utilities using access BPL and each individual subscriber will be placing signals on the power lines
- Open light switches and other electrical devices will act to unbalance the power line with respect to RF
- Power companies have shown widely varying levels of expertise and compliance with respect to their current obligations under Part 15 to correct harmful interference from incidental radiators. The FCC has written numerous letters over the past few years to utilities after amateur radio operators were unable to obtain a resolution via Customer Service In one case, the utility proposed to bill the amateur radio operator for the necessary repairs, even though the rules require the utility to correct such problems at its own expense.
- The assumption that the interference at 30 meters distance may be estimated by measuring at 3 meters and extrapolating using an attenuation of 40 dB/decade is seriously flawed. For BPL systems, measurements at both 3 meters and 30 meters would be in the near field
- FCC rules Sec. 15.31(f)(2) require that "an attempt should be made to avoid making measurements in the near field"
- In some cases, use of the 40 dB/decade attenuation figure may be the only way that some proposed systems may appear to meet the current FCC requirements
- Skywave propagation may cause signals from access BPL systems to travel hundreds or even thousands of miles to cause interference throughout the United States, and even into foreign countries
- Problems with Part 15 devices have caused manufacturers to conduct extensive (or even total) recall of equipment

IX. CONCLUSION

The adoption of BPL technology would have a serious negative impact on the amateur radio service, and on other services which use the HF and low VHF spectrum. Commercial power lines represent large and efficient radiators which often exhibit high gain. This would cause mutual interference between BPL systems and the various radio services.

Part 15 requires that incidental radiators not cause harmful interference to licensed users. The operators of the incidental radiators are required to take whatever steps are necessary to stop the interference, up to and including discontinuing use of devices which cause harmful interference. In past interference cases, individual homeowners have been asked to stop using cordless phones or other devices which cause interference. Manufacturers have had to redesign and recall such devices as television RF amplifiers, and wireless modem devices

However, in a BPL system, the whole system would cause harmful interference. If the current protection requirements for licensed radio services are maintained, utilities and subscribers would have to take whatever steps are necessary to prevent the interference. Despite the requirements of Part 15, utilities and subscribers would resist requests to discontinue use. The impact on subscribers who lose Internet access or utilities which have to scrap BPL delivery systems would be much more severe than the impact on persons who may have had to trade in cordless phones.

If the current protection requirements are changed, and radio stations in the amateur radio service or other radio services are asked to curtail or discontinue operation to protect the BPL system, this would represent a total reversal of the long-standing practice of

regulating unlicensed systems to protect licensed systems. This would be, in effect, "having the tail wagging the dog".

The irreconcilable conflicts between existing licensed radio services and proposed access BPL systems would cause harmful interference to the radio services, and may also impair the operations of the BPL systems. The proposed implementation of BPL services would not be in the public interest, convenience and necessity, and the Commission should not proceed in this matter.

Respectfully submitted,

Gerald W Murray, WA2IWW

wa2iww@arrl.net

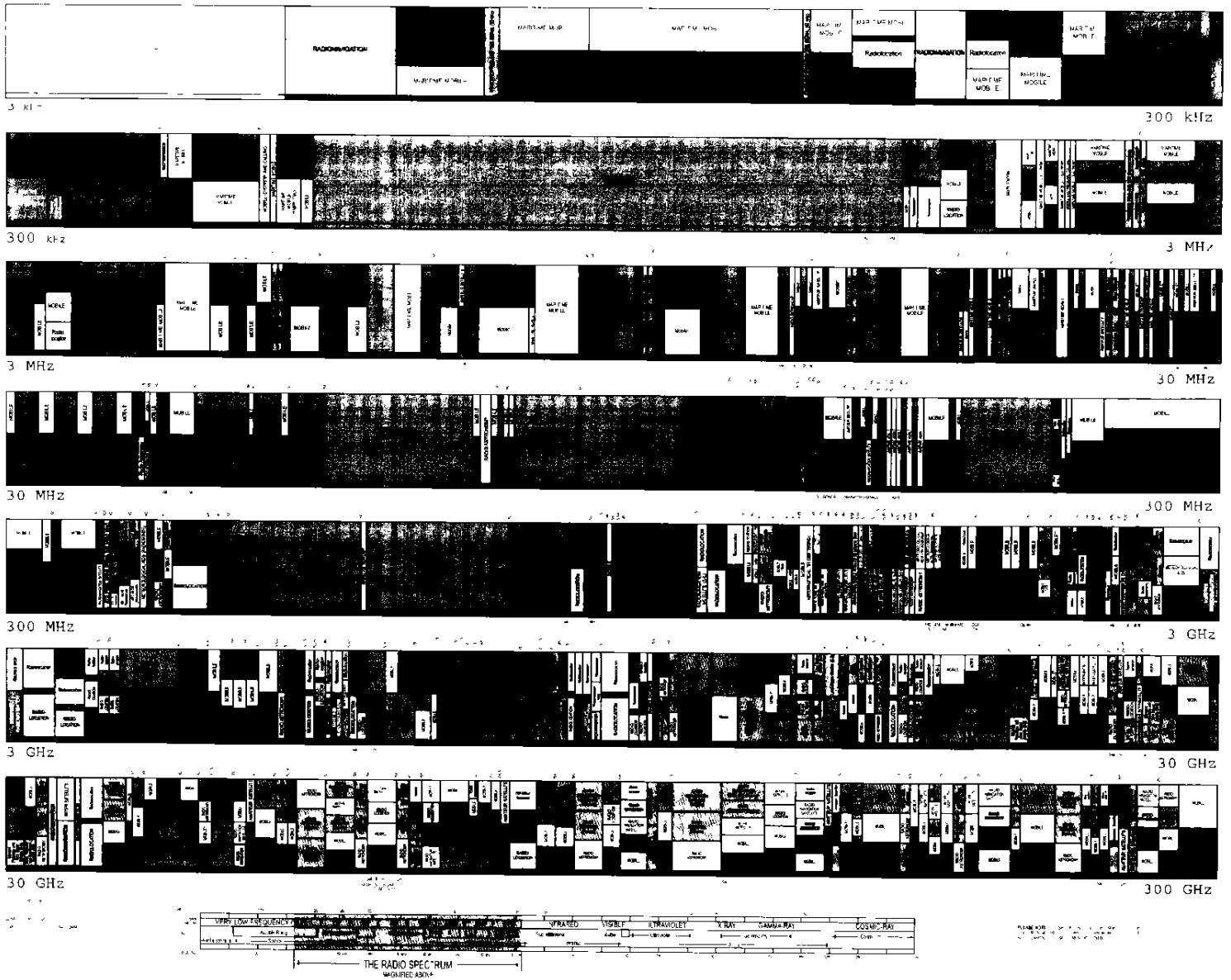
UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

ACTIVITY CODE

ALLOCATION USAGE DESIGNATION



U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management

Calculated Impact of PLC on Stations Operating in the Amateur Radio Service

Presented at the November 15, 2002 C63 Committee meeting
Rockville, MD

Ed Hare, W1RFI
ARRL Laboratory Manager
225 Main St
Newington,CT 06111
w1rfi@arrl.org
860-594-0318

In the US, PLC is operated as an unlicensed device, regulated by FCC Part 15 rules Just as they do for licensed service, the FCC rules set absolute maximum limits for emissions. PLC is a "carrier-current" device, using electrical wiring to conduct signals. Carrier-current devices are subject to the maximum radiated emissions limits for intentional emitters. Like all other Part-15 regulated devices, they also must be operated in a way that does not cause harmful interference to radio services.

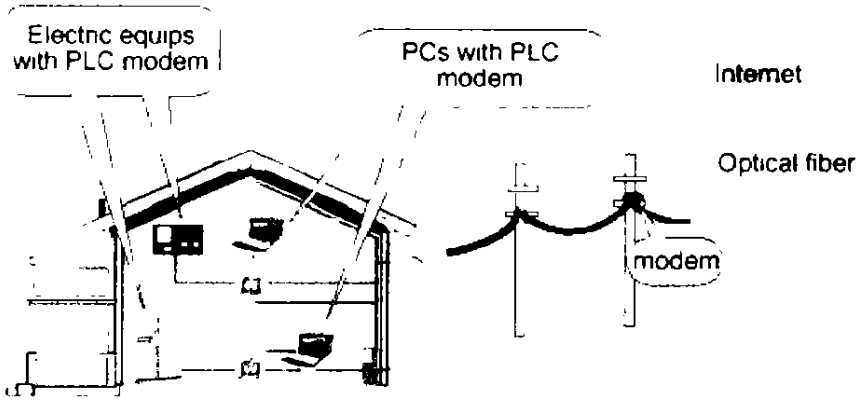
Carrier-current devices must be Verified, as described in the Part 15 equipment-authorization rules. Verification requires that the manufacturer test the product for compliance with the rules and keep the results on file, available to representatives of the Commission on request Part 15 also requires that devices generally must be manufactured using good engineering practices.

Equipment manufacturers are responsible for meeting and verifying the emissions limits of their equipment. This is their sole FCC regulatory responsibility. The operator of that equipment is responsible for operating the device in a way that doesn't cause harmful interference. In many cases, this is a responsibility assumed to some degree by manufacturers on behalf of their customers.

Both aspects of the rules are important to mitigate harmful interference.

What is HF PLC? (1)

Broadband Network Realization using Existing Power Line



There are three types of PLC The first is specifically authorized by Part 15 rules to permit electric utilities to use signals below 2 MHz to control utility equipment. These typically operate on LF at very low duty cycles These systems will probably not cause interference to amateur radio, although that could change if amateur radio is given operating privileges on LF.

Another form of PLC is described in the HomePlug industry specification This type of PLC connects computer devices within a building, using the building's existing ac electrical wiring. HomePlug is a multiple-carrier system that occupies from 4 to 21 MHz The radiating potential of residential electrical wiring is substantial

The third type of PLC is known as access PLC This provides high-speed Internet access to homes and businesses, using the overhead electric utility lines to conduct signals for up to a kilometer. The connection then goes to a neighborhood hub, which then conducts the signals to the central office over fiber At this time, there are no industry standards of specifications for access PLC, although some use the HomePlug specification This type of PLC has a high risk of causing widespread harmful interference to Amateur Radio because the overhead wiring is spaced far enough apart to make a fair antenna on HF

Access PLC is just now in field testing in a number of US cities. It has been deployed in some countries, such as Germany

This slide provided courtesy of Cosy MUTO, JH5ESM See last slide for link to ARRL page that links to the entire JARL report

In the US, Regulated by FCC Part 15

- **Absolute-maximum limits defined in Part 15**
- **Carrier-current must meet limits for intentional emitters**
- **Non-interference stipulated in Part 15**
- **Verified as described in Part 15**
- **Must use good engineering practice as required by Part 15**
- **Manufacturer responsible for FCC authorization and maximum limits**
- **Operator responsible for harmful interference**
- **Both are important to mitigate possible harmful interference**

In the US, PLC is operated as an unlicensed device, regulated by FCC Part 15 rules. Just as they do for licensed service, the FCC rules set absolute maximum limits for emissions. PLC is a "carrier-current" device, using electrical wiring to conduct signals. Carrier-current devices are subject to the maximum radiated emissions limits for intentional emitters Like all other Part-15 regulated devices, they also must be operated in a way that does not cause harmful interference to radio services

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Equipment manufacturers are responsible for meeting and verifying the emissions limits of their equipment This is their sole FCC regulatory responsibility. The operator of that equipment is responsible for operating the device in a way that doesn't cause harmful interference In many cases, this is a responsibility assumed to some degree by manufacturers on behalf of their customers

Both aspects of the rules are important to mitigate harmful interference

Emissions

- **Carrier-current devices must meet intentional emissions limits, tested at 3 typical installations**
- **Manufacturers generally would prefer conducted emissions testing**
- **If conducted emissions are to be specified, ARRL does not believe that they should be any different than the present conducted emissions limits, which already occasionally result in harmful interference**

Part 15 requires that carrier-current systems be tested in 3 typical installations. This rule is only of marginal use, as the rules offer no guidance as to what represents a typical installation. It is also not possible to ensure that any 3 installations really are "typical" and representative of the wide range of real-world installations This is also a difficult rule for manufacturers, who would much rather make conducted-emissions measurements Unfortunately, the conducted-emissions measurement limits are not high enough to permit most PLC operation

If the FCC were to use a conducted-emission limit for PLCs, manufacturers of other unintentional emitters would rightfully ask why one type of emitter is permitted greater emissions than another Considering that the present conducted emissions limits are high enough that harmful interference does occasionally occur from otherwise legal devices, ARRL does not believe that PLCs should be permitted limits greater than any other device authorized by Part 15

Intentional Emitter Radiated Emissions Limits - HF

- **Sec 15.209**
- **1.705-30.0 MHz -- 30 μV/m at 30 meters**
- **Peak signal, 9 kHz bandwidth for measurements made below 30 MHz**
- **These limits should protect users of the spectrum against interference, yes?**

PLC systems are generally operated below 30 MHz, although some access PLC systems are being considered at frequencies of up to 60 MHz Below 30 MHz, intentional emitters are limited to a peak field strength of 30 microvolts/meter at a distance of 30 meters from the source This is tested at a bandwidth of 9 kHz for HF signals.

The FCC limits should protect users of the spectrum against interference, yes?

No!

- **If the absolute emissions limits were set to offer unconditional protection to all radio services, the permitted levels would be unworkably low**
- **Amateur Radio Service, by design, uses sensitive equipment and weak signals**
- **The "legal limit" will result in a strong signal to nearby amateur HF installations**
- **On 3.5 MHz, a half-wave dipole placed in a 30 μV/m field will receive a –86.4 dBW signal (338 μV across 50 ohms)**
- **To amateurs, this is S9+16 dB – clearly harmful interference to typical amateur communications!**
- **Harmful interference at even greater distances than the compliance distance is likely**
- **The absolute limits are not enough to prevent interference to nearby receivers**

No!

If the absolute emissions limits were set low enough to offer unconditional protection to all radio services, the limits would be unworkably low. PLC systems could not be built Although not having PLC systems operating using the amateur bands would be acceptable to amateur radio, it is unlikely that a case could be made to completely prohibit PLC.

Stations in the Amateur Radio Service use sensitive equipment and weak signals. Amateurs are often receiving signals that are literally buried in the noise, sometimes with casual conversation, but in other cases, carrying vital emergency communications

The legal limit of 30 μV/m at 30 m will result in a strong signal to nearby amateur HF installations As one example, on 3 5 MHz, a half-wave dipole placed in a 30 μV/m field will receive a signal level of -86 4 dBW (-56.4 dBm). This is a 338 microvolt signal in a 50-ohm system. To hams, this is an S9+16 dB signal!

The absolute limits are clearly not enough to prevent harmful interference to nearby receivers. And, harmful interference at distance greater than 30 meters from the source is likely.

Harmful Interference

- **Defined as the repeated disruption of radio communications or any disruption of certain emergency communications services**
- **Merely hearing a signal is NOT harmful interference**
- **30 μV/m at 30 m works to a degree for discrete frequency signals**
- **If from broadband device, however, will interfere with entire band(s)!**
- **30 μV/m works to a degree for isolated point sources**
- **If from PLC, level will occur for entire length of line in areas where access PLC is deployed!**

Under the FCC's rules as they apply to amateur radio, harmful interference is defined as the repeated disruption of radio communications ARRL often has to explain to hams that merely hearing a signal in "our" bands does not necessarily constitute harmful interference. To be harmful interference, a signal needs to be strong, and occupying spectrum for a reasonable amount of time A bit of noise that comes on for a few seconds at a time, at long intervals, would probably not meet these criteria, for example

Relating this to amateur radio helps amateur better understand this concept. Amateurs are secondary to the commercial services on 30 meters and secondary to government operations on 70 cm. How would amateurs feel, however, if the primary users said, "We hear amateurs in our band, so they have to get out?" This point is made to help amateurs and industry understand that amateurs are reasonable in their expectations relating to Part 15 devices

Part 15 was originally written with local sources in mind. A motor or digital system would have a limited geographical range over which interference could be expected Even a carrier-current system would be limited in scope, with an AM carrier-current broadcast covering a college campus, for example Most of the these types of devices would not be close to a radio receiver operating in other services, so most of those devices could operate without causing harmful interference. The rule makers probably never envisioned a system that would be deployed in an entire community or electric-utility service area.

The rules also work to a degree for devices that radiate energy on certain discrete frequencies. A computer system, for example may have many "birdies" across an HF amateur band, but in most cases, the amateur can tune away and find a clear frequency This does minimize the harmful interference from such discrete emissions. (Not always – the birdie could be on the same frequency as a distant station)

The present rules do not apply well, however, to systems that radiate energy across several amateur bands For PLC, the problem is made even worse by the fact that the system will be deployed in entire communities If heavily deployed - a goal of the PLC industry – every single HF amateur station in that community could be strongly affected by the part of the system near his or her station. PLC clearly has the potential to cause widespread harmful interference

What Can Be Expected from PLC?

- **What amateur operator has not looked at the power lines and thought that they would make a great long-wire antenna?**
- **Overhead electrical wiring spaced 5 to 10 feet or so, far enough apart to function as an antenna**
- **Building wiring has unknown loads and open light switches that create more antennas**
- **Interference will occur at a strong level over tens of MHz, for most of entire neighborhoods or cities where PLC with overhead lines is deployed**
- **PLC performance with underground wiring can't be easily calculated, so this is best measured in field trials**

PLC uses the electrical wiring within buildings and overhead or underground electric-utility wiring to conduct its high-speed digital signals. PLC signals occupy a good portion of the HF range What amateur has not looked at the power lines and thought that they would make a great long-wire transmitting antenna? Electrical noise that is put onto power lines from bad insulators or such can and will be heard for miles, in some cases. (ARRL has records of literally hundreds of cases of power-line interference cases)

The overhead electrical wiring is a good transmission line at 60 Hz, but the conductors are typically spaced from 5 to 10 feet apart, making them a moderately effective radiator at HF. PLC signals will also be injected onto building electrical wiring. This further unbalances the electrical wiring at RF because one of the two wires is grounded at the service entrance Even worse, although building electrical wiring is a fair transmission line, it is connected to unknown loads, some of which may radiate strongly

Worse yet, when light switches are opened, they open only one of the two wires of this transmission line, leaving the other end connected to the line as an end-fed antenna. This means that PLC can radiate at a strong level, over entire neighborhoods or cities where deployed

PLC performance with underground wiring can't be easily calculated, so this is best measured in field trials