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

In the Matter of	)	
	)	
Carrier Current Systems, including Broadband over Power Line Systems	)	ET Docket No. 03-104
	)	
	)	
Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems	)	ET Docket No. 04-37
	)	

COMMENTS ON NOTICE OF PROPOSED RULE MAKING

Commissioners:

I have a B.S. in electrical engineering, have in the past worked for a power and distribution transformer manufacturer, a manufacturer of amateur radio equipment, and a manufacturer of semiconductor IC's, not to mention being chief engineer for a couple AM radio stations. I have held an amateur radio license for over forty years, extra class for thirty. I've had my share of experience on the ham bands including Worked-All-States (WAS) and Worked-All-Continents (WAC) certificates using no more than five watts output from or ten watts input into my transmitter, many evenings operating HF portable in the parks, and pedestrian mobile on ten meters. I have come across and dealt with various noise and interference problems from Part 15 devices which I've either solved, compromised with, or moved away from. My philosophy has been to promote peace in the neighborhood rather than having a heavy-handed FCC intervene, and your "note that hundreds of kinds of unlicensed devices are successfully operating under the current Part 15 limits without causing harmful interference to licensed operations" (**FCC 04-29 ¶ 34**) is a little more optimistic for the efforts of others and me to resolve matters without contacting you. Furthermore, HomePlug's contention "that joint testing by the ARRL and HomePlug has demonstrated a very low probability of interference between its devices and amateur radio use[1]" (**FCC 04-29, ¶ 21**) was perhaps a bit rosier for the fact that HomePlug at the urging of ARRL installed notches on its devices to cut out interference to the amateur service which it had generated in abundance under mere Part 15 limitations.

[1] *See* comments of HomePlug at 5. *See also*, HomePlug & ARRL Joint Test Report, January 24, 2001, <http://www.arrl.org/tis/info/HTML/plc/files/HomePlug_ARRL_Dec_2000.pdf>.

CSD December 2000: Feature
HomePlug Standard Brings Networking to the Home[2]
By Steve Gardner[3], Brian Markwalter[4], and Larry Yonge[5].

> The HomePlug PHY occupies the band from about 4.5 to 21 MHz. The PHY includes reduced transmitter power spectral density in the amateur radio bands to minimize the risk of radiated energy from the power line interfering with these systems.

Perhaps you are taking undeserved credit for Part 15 protection, and perhaps radio users have had all they can take with making up the difference, but I want to move on to addressing implications of access BPL. In particular the **STATEMENT OF COMMISSIONER JONATHAN S. ADELSTEIN** has it,

> While we must be mindful of harmful interference, we cannot let unsupported claims stand in the way of such an innovation as BPL systems. Provided that the engineering bears out, I believe that we need to push the boundaries to accommodate new technologies. A little noticed provision of the Communications Act, Section 157, reads that "[i]t shall be the policy of the United States to encourage the provision of new technologies and services to the public." I am fully committed to that mission to promote new technologies, and to provide a framework for innovation so they can succeed. In order to do so, we must first resolve the technical interference issues addressed in this NPRM.

I take it that "we cannot let unsupported claims stand in the way of such an innovation as BPL systems" refers in part to AEC's statement "that the notion that the power lines will act as efficient antennas and pollute their surroundings with harmful interference is not supported by scientific measurements,"[6](**FCC 04-29, ¶ 23**) and that your disagreement in

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[2] Copyright © 2003 CMP Media LLC, The complete May 2003 issue of *Communication Systems Design* magazine is live on CommsDesign.com.

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[6] Reply comments of AEC at 2.

part with ARRL is with some unspecified unscientific point. Fine, for the purposes of my comment, I won't rely on the ARRL material where you disagree; I'll get my material from the Science Library at the University of Oregon. Plenty of science there.

But if you want the amateurs' assertions to be scientific, I for my part want BPL systems to be soundly engineered. Fair enough? You said yourself, "In general, we believe that a properly designed and operated BPL system will pose little interference hazard to non-amateur services such as aeronautical, maritime and public safety" (**FCC 04-29, ¶ 37**). And when the FCC talks about "a properly designed and operated system" we take it to mean something on the order of F.C.C RULES AND REGULATIONS 32.6 (*c*):

> **... essential phases of the operation which control the external effects shall at all times conform to the requirements of good engineering practice.**

Okay, here's what I am going to do. BPL systems are to be limited in the effects of their rf emissions (à la Part 15) under the scientific basis of this proceeding and good engineering practice as in a properly designed and operated system. Amateurs also have to limit their emissions by certain formulas (or hard limits) to reduce risks of human exposure. That is based on scientific calculations with respect to the antenna(s) they use *and the proper operation and design of the system so that it can be regarded as operating along the lines of those scientific models.* What I want to do is take the same science that both BPL companies and hams must use when designing their systems, and show what assumptions I may as a ham make under *good* engineering and operation, which I couldn't make under the poor, and then show how it applies as well to the goose as to the gander, that BPL companies must actually follow good engineering practice in order to make the same assumptions.

> *Types of Transmission Lines*[7] The purpose of a transmission line is to transfer energy from a power source to a load with a minimum amount of loss. ... Any wire carrying an r-f current will radiate some amount of energy. The energy loss due to radiation can be reduced to a minimum by (1) using a low value of line current, (2) using a specially designed transmission line. The types of transmission lines generally used ... are (1) the two conductor open-wire line, (2) the twisted-pair line, (3) the coaxial line, (4) the single-wire system. ... Transmission lines may also be classified as being tuned or resonant, and untuned or nonresonant.
>
> *Single-wire System*[8] Another method of reducing the energy loss due to radiation is to use a single conductor to feed the antenna. In this system the earth or ground is used as a return circuit and it is therefore essential that a good ground connection be used. The single-wire system operates

[7] Morris Slurzberg, B.S., M.A., Instructor of Radio and Electronics, Jersey City Vocational High School, and Jersey City Vocational Evening School, Trade Extension Courses, *and* William Osterheld, B.S., M.A., Instructor of Electricity and Radio, Wm. L. Dickinson High School, Jersey City, Essentials of Radio (New York: McGraw-Hill Book Co., 1948) p. 619.

[8] Ibid., p. 623.

> as a nonresonant line. No standing waves will appear on the line when its characteristic impedance is matched by the impedance of the antenna at the point of connection. The distance from the center of the antenna to the point where the line connects to the antenna, represented by *d* in Fig. 13-39, is approximately 14 per cent of the length of the antenna. The distance *d* is dependent upon the size of the conductor used for the feeder and the height of the antenna. Proper matching of the impedances is best obtained by use of an r-f ammeter and adjusting the position of the feeder on the antenna for maximum current flow.

Actually, I've experimented with such an antenna feed myself, and the results are applicable to this proposed rule making. See, I was renting a room at a place with the landlord's permission to erect a ham antenna in the 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 garage 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 ≈ 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.

Eventually I bought a more powerful rig that could transmit up to 80 watts. By and by the FCC came out with some radiation exposure limits for humans. Even operating 80 watts, that would average 40 watts with a 50% duty cycle on cw, which is below the 50 watt threshold even on 10 meters that would require me to investigate my radiated field. But, say, I did operate with more power and I used established figures for that single wire feedline to show that radiation was within limits to any exposed human. I would have done my part.

But, say, people fussed and complained and worried——as a goodly number of the > 5,200 comments you received were worries about interference from BPL. The question could be asked, yes, but is mine "a properly designed and operated system"——as you similarly state for BPL in (**FCC 04-29, ¶ 37**). Well, as per above, "Proper matching of the impedances is best obtained by use of an r-f ammeter and adjusting the position of the feeder on the antenna for maximum current flow." So just to make everybody happy, and make sure my line is tuned properly, I would terminate my single wire feed in a clip which I would attach to the antenna off to one side of the theoretical matched feed spot. I would break the line below the antenna and place an rf ammeter in series. Then I would put a brick on the key with enough power out to move my meter, and I would climb up on the

garage roof and use a stick to slide the clip down the antenna while I watched the meter for a peak. Not too difficult.

But try to so tune a BPL system——which is more complicated and uses a broader frequency range and so harder to figure out theoretically——and we find you "are proposing to exempt Access BPL systems from the existing conducted emission limits of Section 15.107(c). Because Access BPL systems are installed on power lines that can carry 1,000 volts to 40,000 volts, conducted emission measurements are very difficult to measure, and present safety hazards in connecting test equipment to these lines." (**FCC 04-29, ¶ 38**). Even though you "do not believe that this exemption would have any impact on interference potential since Access BPL would still be required to comply with our radiated emissions rules," (**FCC 04-29, ¶ 38**) a mismatch, or a less than optimum match, would result in less signal transferred to the ongoing line compared to signal radiated before the transfer, and so the need for more "repeaters and boosters" (**FCC 04-29, ¶ 45**) to get the signal to its destination, each of them injecting more signal to radiate, so one cannot say this is a properly tuned and operated system, not in the normal sense. This safety concern overrides the economic, "Given that there is significant investment in the deployment of the service, we agree with several commenters that Access BPL providers would have a strong incentive to exercise the utmost caution in installing their systems to avoid harmful interference and ensure uninterrupted service to their customers." (**FCC 04-29, ¶ 39**).

If a single wire feed cannot be properly tuned and operated in a BPL system because of the dangerous voltages, we must find another kind of feedline. Suppose for my amateur station I decided to use a coaxial feedline. That would present a problem at that location which the neighborhood made into an historical district. (Actually the district boundary fell just outside my residence but here I'm supposing I were included.) The historical district represented the industrial era of the '20's and '30's. My Windom antenna fit right in as, "A multiband antenna that enjoyed considerable popularity in the 1930's——the 'off-center feed' of 'Windom,'"[9] But coaxial cable was not available at reasonable price until after World War II. A coaxial feedline would clash with the historical motif.

I bring this up because according to the **STATEMENT OF COMMISSIONER JONATHAN S. ADELSTEIN**, "A little noticed provision of the Communications Act, Section 157, reads that "[i]t shall be the policy of the United States to encourage the provision of new technologies and services to the public."" If you want to encourage new technologies, I might suggest coaxial cable, or as "Other amateur operators, such as Lee McVey, suggest `that the Commission deny the proposed adoption of Access BPL in favor of a more practical, reliable and universally deployable fiber optic alternative'" (**FCC 04-29, ¶ 15**), or at the very least go beyond the single wire or common mode feed.

The next suggestion would be:

> *Two Conductor Open-wire Line*[10] The type of transmission line most commonly used to transfer energy ... is the two conductor open-wire line. The radiation from the two wires

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

[10] Slurzberg & Osterheld, pp. 619f.

> is reduced to practically zero by having the electromagnetic field about each wire cancel the other. This is accomplished by having the currents in the two wires equal in magnitude but opposite in phase. This action is obtained by placing the two wires parallel to each other and relatively close together. An insulator, commonly called a *spreader*, is used to maintain the distance between the two wires at a fixed value; the spacing is generally on the order of two to six inches.
>
> Cancellation of the electromagnetic fields is obtained when the two lines are perfectly balanced. Any unbalance in the lines can be overcome by reversing the positions of the two wires at regular intervals. A type of spreader called a *transposition block* is used for this purpose.

Where I currently live there is a power line that cuts through the property above a public-access stairs. There is no reason why this power line absolutely has to go through there as it loops back around to within a pole of the same line farther on. If the power company wanted to, it could connect their power at the other pole, disconnect it coming through my yard, and vacate that line. Suppose they did that and I wanted to use the vacated power line to feed my antenna. I would run a line of coax to one end and feed it through a balun (balanced to unbalanced transformer) and take the signal off from the other end through another balun and line of coax off to an antenna some distance away. I don't know why I would ever do that, but suppose I did.

The double power line is balanced and spaced five feet apart. It runs above a public access stairs for fifty feet, but for the sake of our discussion, let's say it's 100 feet. I want to document that it is safe regarding rf exposure to people walking under it (though they don't spend much time on the stairs). (A BPL company using the same power line would need to document that it's within Part 15 limits.) I have the formulas to use based on antenna gain with respect to an isotropic radiator. What gain (loss) would my feedline represent?

We want to be scientific, so let's look at the formulas.

> *Balanced and Unbalanced Transmission Lines.*[11]—A line is said to be balanced when its two sides are symmetrical with respect to ground. Thus a horizontal two-wire line, and four-wire lines, are balanced structures, while a two-wire line in vertical configuration and a concentric line are unbalanced structures. Except for the concentric line, in which the outer conductor acts as a shield, unbalance causes earth currents to flow, because part of the current that should be carried by the conductor having larger capacity to earth is diverted to the earth. This causes the current in the two sides of the transmission line to be unequal, and results in a component of current that flows out along the two transmission lines in parallel, and returns through the

[11] Frederick Emmons Terman, Sc.D., Professor of Electrical Engineering and Dean, School of Engineering, Stanford University, Past President, Institute of Radio Engineers, Radio Engineers' Handbook (New York: McGraw-Hill Book Co., 1943) p. 193.

earth. Such unbalanced currents are to be avoided, because they give rise to extra energy loss, cause the radiation of the system to be greatly increased, and in general serve no useful purpose.

Radiation from Transmission Lines[12]——All transmission lines, except those of the concentric type, radiate some energy. Such radiation is often of importance, since it represents an additional energy loss. ...

The radiation from a two-wire nonresonant line is given approximately by the following formula,[13] provided that the length is at least twenty times the spacing and the spacing is not greater than one-tenth of a wave length and the line is nonresonant:

$(\text{Radiated Power})/I^2 = 160(\pi D/\lambda)^2$ where D/λ is the spacing in wavelengths, and I is the rms line current. This radiation is twice that resulting from a doublet antenna carrying the same current as the line and having a length equal to the line spacing. In addition to the radiation given by [that] equation, the terminating connections also produce radiation, so that the total radiation from the line with its terminations will be approximately four times the power radiated by a doublet having a length equal to the line spacing, and carrying the line current.

In the case of resonant lines the amount of energy radiated in proportion to the power transmitted to the load will be somewhat greater than is the case with the nonresonant line. However, unless the reflection coefficient of the load departs greatly from unity, the increase will not be great.

So in order for my transmission line to be properly constructed, of good engineering, it must be balanced so as not to "give rise to extra energy loss, caus[ing] the radiation of the system to be greatly increased, and in general serv[ing] no useful purpose." But having a balanced line five feet apart I can use that formula for frequencies up to the 15 meter (21 MHz) ham band, beyond which the spacing becomes larger than a tenth of a wavelength. It's radiation is approximately equal to twice that of a five foot doublet carrying the same line current, with another five foot doublet on either end to account for the connections.

Now, this is not much and pedestrians passing under the feedline will not be harmed by rf, especially as they are not standing still. Okay, let's say instead of my ham feedline a BPL company uses the same 100 feet of line to transmit its signal. Assuming it's fed balanced and taken off in a balanced load, it would represent the same equivalent radiation from four doublets of five feet each carrying the line current. That's not too bad. And even if the load wasn't perfectly matched, as long as it was somewhere in the

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[12] Ibid.

[13] E.J. Sterba, C.B. Feldman, "Transmission Lines for Short Wave Radio Systems," *Proc. I.R.E.*, Vol. 20, p. 1163, July, 1932.

ballpark, the radiation wouldn't be that much higher.

From (**FCC 04-29, ¶ 22 & 23**) BPL companies are saying "that BPL emissions drop off very rapidly away from the BPL source and that emissions fall off in point-source fashion," and "that its research to date would suggest that a BPL signal injection point can appear like a point-source radiator, with the power line having characteristics somewhere between a waveguide and an antenna." Since the radiation from such a *balanced transmission line* is spread along the whole line, if we assume an infinite balanced line, then indeed we would have a point source equivalent to a five foot doublet carrying the line current, and the radiation from the line would by unmeasurable as it is spread out along an infinite distance, and the end would never radiate because the signal would never reach it. In that model the BPL signal would in fact radiate like a point source.

Okay, now let's look at the real world. I don't think any hams use feedlines with a five foot spacing, more like the two to six inches unless they are using ladder line and then it's less. Mostly we just use coax. We go to great lengths to make sure our balanced line carries balanced currents. I use the right kind of balun for my application, and usually spring for a commercially made one though I can construct them myself, just to get a better quality. I will twist the line to keep it balanced, make no sharp bends, avoid large metal objects, and keep it away from the sides of a building. It's sorta like;

> He'd seen the surveillance around his taxi on the way in from Kai Tak Airport. The Hong Kong Narcotics Bureau had the best surveillance teams in the world, men and women on foot, bicycles, motorcycles, in cars, trucks, and taxis, weaving in and out, coming and going, here one moment, gone the next. They didn't fight the traffic, they became the traffic. They didn't watch you, they enveloped you.[14]

When hams string balanced feedline, it's not so much they fight the environment as they orchestrate it, so that not only is the feedline designed balanced but the whole space it traverses is designed to keep that balance too.

Where I go to eat dinner, as I stand in line I look at the power line going down the street. It's a horizontal line, but at a certain pole it switches to vertical, and farther down the road to horizontal again, then some blocks later later back to vertical. Ham lines and power lines are like the difference between East and West.

> This time he didn't have to worry about surveillance. London cops couldn't follow a train through a tunnel.[15]

Power companies can't seem to keep a balanced line in a straightforward run down the street, not to mention any tricky situation. They never needed to before, so they never did. Even if we were to use some kind of HF isolation transformer after the house wiring——with its attendant imbalanced wiring such as single sided light switches——, and we limited our runs to straight lines——no corners——there are buildings on one side that would unbalance the line. If we moved the buildings back, there is traffic on the road

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[14] James Mills, The Hearing (New York: Warner Books, 1998) p. 106.

[15] Ibid., p. 109.

beneath: cars, trucks, buses, and motorhomes; and that traffic passing underneath would upset the capacitance to ground for the adjacent wire more than the far one causing unbalance, so what are we to do? Block off the street? No, BPL intends to use "the existing electric power lines" (**FCC 04-29, ¶ 3**), "using existing electrical lines" (**FCC 04-29, ¶ 18**), "Access BPL systems use existing electrical power lines as a transmission medium" (**FCC 04-29, ¶ A of Appendix A**). So we may expect an inherently unbalanced line, and often spaced greater than five feet. Let's see what that results in.

> Unbalanced currents[16] are much more effective in producing radiation than the normal balanced currents because of the considerable distance between the two sides of the circuit through which the unbalanced currents flow. The amount of radiation depends both on the height of the line above ground and on the line length. The order of magnitude of the factors can be estimated with the aid of Fig. 56.

Looking at the figure (which I am unable to reproduce) I see two graphs of Watts per Amperes Squared vs. Line Length in wavelengths: one for a height of a quarter wavelength and one for a half wavelength. The half-wavelength height produces more radiation as would be expected: "The higher the antenna, the more energy radiated."[17] They each reach a plateau the lower one after about one and a half wavelengths, the higher one not yet after five. There is sort of a sine wave superimposed on the main graph.

This is pretty consistent with the BPL proponents' assertions that "BPL emissions drop off very rapidly away from the BPL source" (**FCC 04-29, ¶ 23**), and with your assertion that "the primary source of emissions will be the individual couplers, repeaters and other devices and, to a lesser extent, the power line immediately adjacent thereto" (**FCC 04-29, ¶ 36**) (although in the latter case I am not making comparisons with the radiation generated by the source). That doesn't mean the ARRL is wrong, because according to their research BPL will raise the noise floor near its source from 50 dB to 66 dB. That is from 100,000 times to 4 million times. My graph cannot depict a 100,000th down to the noise floor, not to mention a 4 millionth; it couldn't even do a thousandth or a hundredth for that matter.

I am not sorting out the numbers here; what I am showing is that such a radiator is not a properly installed transmission line in the ordinary sense. That radiated power is lost; it's not coming back. That the power lines farther along don't radiate as much is only because there is less left to radiate as it has gone out already. That means the BPL companies will have to install repeaters/boosters to pick it back up, each of them contributing additional radiation.

If I had a ham antenna fed by an unbalanced line, that hybrid "having characteristics somewhere between a waveguide and an antenna" (**FCC 04-29, ¶ 22**) would be treated by the FCC as an antenna for purposes of restricting harmful radiation, not as a feedline which may be ignored. That's because "**essential phases of the operation which control**

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[16] Terman, p. 194.

[17] George E. Sterling, The Radio Manual *For Radio Engineers, Inspectors, Students, Operators, and Radio Fans* (New York: D. Van Nostrand Co., 1938) p. 52.

the external effects shall at all times conform to the requirements of good engineering practice." If you treat BPL by the same rule, then their systems using the existing unbalanced power line infrastructure would not conform to the standard of "properly designed and operated."

But that is the very language you use in ¶ 37. You also state, "We seek comment on the appropriate period of time that we should allow for BPL systems to come into compliance with any new requirements that we may adopt pursuant to this rule making proceeding" (**FCC 04-29, ¶ 42**), as if the BPL companies could have a "properly designed and operated" system without the power companies first having balanced their lines with respect to rf signals. When would the power companies ever get around to that? They have other priorities.

Excerpt from EWEB[18] Pipeline[19]

Lessons from the Blackout

EWEB electrical system very reliable, but age, growth and new technology spur need for capital spending

> The massive outage that hit the North-eastern United States on Aug. 14, 2003 was a wakeup call for the entire nation about the risks of an aging and overworked electric power system. ...
>
> One of the lessons we can learn is the need for utilities to maintain and upgrade their electric system "infrastructure"—the network of generating plants, transmission lines, poles, wires, substations and other facilities that are designed to keep power on; get it back on quickly when there is an outage; and minimize surges and other fluctuations in power that can disrupt sensitive electronic equipment.
>
> Most utilities across the country see an increasing need for capital investments to maintain reliability. ...
>
> One area of concern is the vast network of 23,000 power poles that EWEB owns or maintains. About 60 percent of the mostly-wooden poles are at least 30 years old. ... Weather and decay can weaken poles over time so that they no longer are strong enough to safely support lines and equipment.
>
> "The system is getting older. It's still working well now, but we want to deal with our aging system before it's too late, before reliability starts to slip," says Ken Beeson, a senior resource planner for EWEB.

It probably will not be in our lifetimes we see any such balancing of the lines.

So here is what bothers me about **FCC 04-29**. In ¶ 36 I see "the power line

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[18]Eugene Water & Electric Board is Oregon's largest customer-owned utility.

[19]Pipeline is a biannual customer newsletter produced by EWEB's Public Affairs department, www.eweb.org

immediately adjacent to the individual couplers, repeaters and other devices [being] the primary source of emissions" just as antenna theory shows us. Then in the next paragraph (¶ 37) I see you talking about a "properly designed and operated" system, just as one would expect from a well designed and implemented transmission line. And in between the two paragraphs I see no waiting for the power companies to redesign their lines to conform to good rf practice, nor indeed as a practical matter can we expect them to. So how did power-lines-as-antennas get transformed so suddenly into power-lines-as-rf-transmission-lines?

I wondered and wondered. And then I got to thinking maybe it has something to do with that needed "last mile," that when a complex technological system is missing a critical link, then something not ordinarily useful for such a link becomes it. I decided to look at history for an example, and ended up considering Japan in 1941. They had a fine fleet of battleships but they were lacking oil because of the embargo, and they weren't free to raid the Dutch Indies until they "conducted a pre-emptive defence against its rivals, beginning with the attack on Pearl Harbour."[20] Their navy had little oil, and civilians had none. They developed an ingenious method to power their cars with charcoal burners in the back, but those engines lacked horsepower, so when they came to a hill, the occupants had to get out to push. How can that not remind us of slow speed internet access, not very powerful and liable to get bogged down?

Here's a story in a novel[21] that can perhaps shed some light on our own times.

> A NAVY CAR with an anchor insignia picked Harry up at the Paris the following night. Gen was inside behind window curtains. He wore navy blues, and his easygoing manner of the previous evening was replaced by a somber mood.
>
> "Where's our friend with the cards?" Harry asked.
>
> "He'll be there. No names," Gen warned Harry.
>
> "Whatever you say."
>
> It didn't matter. Harry knew the player's name. Anyone who read a newspaper or saw newsreels knew the dour face and blunt manner of the commander in chief of the Combined Fleet. Although no names had been exchanged, Harry had recognized Yamamoto as soon as the admiral shuffled the deck of cards with the famous eight fingers instead of ten. Harry also understood that the meeting had been engineered for invisibility, at midnight in the back room of a willow house with no witnesses but the loyal acolyte Gen. Could Harry claim that he had even been introduced to Yamamoto? No. That was okay. A lot of people didn't want to be associated with Harry.
>
> Gen said, "This is a very sensitive situation."
>
> "You mean your career is on the line. Magic or miracle, what is that supposed to mean? The Great Man has looked me over and approved, but I'm still kept in the dark. Give me a clue.

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[20] Warwick Collins, Computer One (New York: Marion Boyars, 1998) p. 93.

[21] Martin Cruz Smith, December 6 (New York: Simon & Schuster, 2002) pp. 147-162)

"You have to see it to believe it."

"That's a good clue. Are we talking about the resurrection? Water to wine? A burning bush?"

"On a par."

"On a par? Wow. Like parting the sea and just marching where you want to go?"

"Sort of. This is very big, but ..." Gen lowered his voice. "But there is also a risk of embarrassment."

"Losing face?"

"Not face. Enormous, disastrous embarrassment."[22]

One thing for sure, "This is a very sensitive situation" in terms of possible "Enormous, disastrous embarrassment." I am sure you realize what would happen if existing radio services were not adequately protected, if indeed those power lines acted more like antennas than transmission lines to the detriment of radio users. It would be analogous to the story of Union Carbide setting up shop in Vienna, W.Va. and being the hero of the economy until people realized they could not live with the pollution, and then they were the bad guy. I related the story in my first comments, but I include it as a supplement here. You don't want to get the blame for excessive radio pollution.

"You have to see it to believe it."

"That's a good clue. Are we talking about the resurrection? Water to wine? A burning bush?"

"On a par."

"On a par? Wow. Like parting the sea and just marching where you want to go?"

"Sort of. This is very big, but ..." Gen lowered his voice. "But there is also a risk of embarrassment."

That sounded intriguing to Harry, but Gen shook his head to indicate the end of the conversation. South of the palace, the driver swung into an alley behind the Navy Ministry and stopped. Gen studied the shadows, then rushed Harry out of the car and down a flight of stairs as if delivering a prostitute. Inside they followed a trail of dusty lights through a tunnel of steam and water pipes to a door that admitted them to a basement hall of office doors. Harry wondered who would be working at one in the morning. Someone was, judging by the sound of voices and haze of light down the hall. Gen went almost on tiptoe and, when they were nearly on top of the voices, slipped Harry through a door into what was more a tight space than a proper room, a catchall crammed with scales, sterilizing trays, bedpans. At one level was an inset pane of glass.

Gen whispered, "On the other side, it's a mirror. This used to be a medical clinic where we examined pilots. Sometimes that demanded discreet observation."

Harry observed a room dominated by a metal table supporting a tank of water about eight feet wide and four

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[22] Smith, pp. 147f.

feet high, a good-size aquarium that contained, instead of sand and fish, six bottles of blue glass. Each bottle was sealed and connected via an overhead electrical line to a battery big enough for a submarine. It had to be like moving a piano to get it in. V-shaped wands wrapped in copper wire stood around the tank, and over it hung a copper sphere. A small but impressive audience had been gathered: four Navy officers, no grade less than a commander, and two unhappy civilians. Harry noticed a couple of petty officers with pistols standing at the door. He also saw Yamamoto, with so many rings around his sleeves they looked as if he had dipped his cuffs in gold. The uniform seemed to weigh on him, and his attention, like everyone else's, was anxiously focused on a gaunt little man in a white lab coat jotting numbers from a bank of gauges individually wired to the copper wands. Welder's goggles hung around everyone's neck. By Harry's watch, five minutes had elapsed before the man in the lab coat raised his head and declared, "Progress, definite progress."

"Progress in what?" Harry asked Gen. "What is he doing?"

Gen couldn't get the words out right away. "He's making oil."

"What do you mean?"

"He's turning water into oil."

Harry actually took a step back. He wasn't dazzled by much, but this was blinding. "Water into oil?"

"You can smile, but I've seen him do it."

"I don't think even God tried that. Water into wine, yes; oil, no. You realize it's impossible?"

"Opinion is divided," Gen granted. "The program is secret."

"I bet. What's the researcher's name?"

"Ito. Dr. Ito."

While Ito adjusted controls, Gen explained what the doctor had explained to him, that the table of the elements was neither fixed nor limited and that through "electric remapping," their atomic bonds could be broken and recombined. Ito was in the middle of mapping the transitional states of elements and, in recognition of the national need, had diverted his talents and discoveries toward the transformation of water into oil. From their faces, Harry saw who in the room bought it. At least one civilian was visibly suppressing professional outrage, but there were hopefuls and believers among the Navy. And it wasn't a bad show. Ito was dramatically thin, with lank hair overhanging a pale forehead and eyes hollow from lack of sleep. His coat was dirty, his hands filthy; everything about him spelled genius. He worked on the run in rubber overshoes, resetting dials, repositioning the copper wands, stopping only to cough in a tubercular way. In a hoarse voice, he said, "Perhaps that's all for tonight."

Yamamoto said, "Doctor, would you please try one more time? It's so important."

Ito seemed to gather inner strength. "One more."

He pulled on rubber gauntlets as he moved to an oversize switch. At his lead, everyone in the room pulled on goggles with smoked lenses, and Ito seemed to wait until the entire room had stopped breathing. Harry thought that only an audience brought up on Kabuki's overheated posing would swallow Ito for a minute.

"Take your positions."

There was a general shuffling onto a rubber mat. Before Harry could figure out what that was about, Ito slapped the switch handle down and the tank water turned a vivid blue. As Ito turned up the voltage, white bolts of electricity ran up the two arms of the wands, flickered back and forth, joined hands from wand to wand, then arced the tank and shot up to the overhead sphere so that the tank and table were domed by an electrical jellyfish that sizzled and popped and smelled of singed wool. Gen and Harry threw up their arms to shade their eyes from light that flooded the cubicle they were in. Ito cranked a transformer, and the protoplasm threatened to spread tentacles and float from the table. It was a view of the forces of the universe, an electrical cauldron, a glimpse of Creation itself. Waves rolled on an oscilloscope screen. Ito circled the tank with a small neon tube that lit, faded, glowed again. His long hair stood on end and twisted and wrestled first toward one wand and then the other. Electricity lapped like fire up his arms, yet Ito moved with the assurance of a sorcerer. When he threw the switch off, Harry felt half blinded. Those who had been in the room with the tank looked as shaken as survivors of a lightning bolt.

"Not bad," Harry said. "Electrical arcs, sparks, everything but a hunchback running around with a bucket of brains."

Yamamoto stepped off the mat and approached the tank. He laid on his hands, minus the two fingers he'd lost pursuing Russians. Yamamoto again ready to risk all. As if his touch were a signal, a bottle stirred. It leaned, lifted clear and steadily rose to the surface, where Ito caught it, snipped its wire and set it by a rack of test tubes. Of course, Ito didn't unstop the bottle himself.

"Professor Mishima, you are such an eminent scientist. Would you do me the honor?"

The smaller, rounder civilian huffed. "This is ridiculous, this is not science."

"Please," Yamamoto said.

Mishima broke the wax seal with a penknife and poured the contents into a tube, reserving a last drop to roll around his fingertip and taste.

"What is it?" Ito asked as if they were the closest of colleagues.

The professor wiped his mouth. "Oil."

"What was in the bottle originally?"

"Water."

"Your conclusion?" Yamamoto asked.

"It's preposterous. You cannot change water to oil with a little lightning, or else the oceans would be oil."

Ito was unperturbed. "That is salt water. This is very different water."

"You cannot defy the laws of nature."

"We are rewriting the laws of nature."

"Impossible ..." The professor tried, but he had lost, trumped by a card from his own hand.

"Perhaps this is the Yamamoto spirit we have heard so much about," Yamamoto said. "But, Dr. Ito, only one bottle out of six seems to have changed."

"Yes, we need more research."

The doctor went out of Harry's range of vision for a minute and returned with a new bottle of water. With great scruple, he turned his back while a vice admiral wrote on a cork. Then Ito took the cork back, immediately stopped the bottle and lit a sealing candle, the flame a tiny footlight to his face while he turned the bottle to catch the dropping wax.

"We need production," Yamamoto said.

"First research."

"With a deadline," the admiral insisted.

Ito excused himself to cough, and Harry saw the spots of red bloom in the doctor's handkerchief. Ito was sickly enough to begin with, and all at once he seemed exhausted, as if the lightning had been drawn from his own being. A chair was found for him to sit on, while coughs racked his body. Yamamoto was forced to relent, but he raised his eyes directly toward the glass that Harry watched through.

"What do you think?" asked Gen.

"Wonderful," Harry said. "Lightning bolts, levitation, transmigration. I loved it."[23]

We ordinarily think of transmission lines as separate from antennas, like water and oil not being able to mix, the antenna sitting on top of a transmission line. But what if through "electric remapping," we could transform those radiating power lines into a "properly designed and operated" transmission line? It would be like changing water to oil, providing the missing ingredient to make our technology work.

"It's preposterous. You cannot change water to oil with a little lightning, or else the oceans would be oil."

Ito was unperturbed. "That is salt water. This is very different water."

You cannot change antennas to transmission lines with a little injected signal, or else all the transmitter towers would be transmission lines.

Ah, but those are radio aerials, these are power lines.

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[23] Smith, pp. 148-52.

GEN BROUGHT DIAGRAMS to the Happy Paris at noon the following day. Michiko sorted records and watched sullenly, like a cat jealous of attention.

"You and Harry went with geishas again last night?" she asked Gen.

"I told you," Harry said. "The first was a card game."

"And last night?"

"A con." Harry spread the plans across a table. "No, more than that, it's the most beautiful con I've ever seen. This is the mother lode, this is magic."

That's all you're going to say?" Michiko asked.

"My lips are sealed."

"I'm going out, Harry. I'm going to go spend all your money and then find a better lover."

"Hope he has a dick that rings like a bell."

"I'm not coming back."

"Have fun."

Gen shuddered as the door slammed behind her. "Kind of tough."

"No Shirley Temple," Harry said. "Have you slept?"

"I had coffee." True enough, the officers of the Japanese navy started each day with coffee and scrambled eggs. Harry's sympathy dried up.

Besides the diagrams, Gen had had the water and oil tested. The water was two parts hydrogen, one part oxygen, and the oil was the equivalent of Rising Sun crude.[24]

We had the ARRL do some testing. The power lines sure radiated a signal which you heard the recording of. Definitely started out as antennas. But your proposed rulemaking treats them like *rf* transmission lines.

"Imagine if we could produce that," Gen said. "If we could get past the experimental stage. There were six bottles. Five bottles failed to change."

"Failure is important. Adds mystery and stalls for time. The navy might want to move to production, but production would entail real amounts of oil and a staff of genuine technicians. No, a con is much happier with endless, expensive research. How much is this costing the navy now?"

"With gold water filters and electrical gear, ten thousand yen a week."

"That's worth stringing out. And anytime the navy presses for results, Ito can play Camille and start to cough to death. If I were you, I would have the doctor's handkerchief searched for a little vial of red liquid."[25]

"There were six bottles. Five bottles failed to change."

"Failure is important. Adds mystery and stalls for time. ... No, a con is much

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[24] Smith, pp. 152-3.

[25] Smith, p. 153.

happier with endless, expensive research."

As a con it works much better with partial results. Remember:

> **The Electric Kool-Aid Bandwidth Test**[26]
>
> Besides, all skepticism and disbelief would fade, he reasoned, when Media Fusion demonstrated the technology via a dramatic broadband test, sending HDTV across the grid for the public to see. According to Stewart, the company had negotiated with Dallas media giant Belo to provide the signal for the test, which had been delayed several times but was now scheduled for March 15, 2000.

The test kept getting delayed and never happened. I have included the story again as a supplement.

A wording that makes power lines look like antennas part of the time, and like good transmission lines some of the time is all that is needed to keep the project afloat. Even the Japanese project shows more hope in the development stage than when they try to deploy it, as I note again in another supplement.

> "You're sure this is a hoax? He's fooling real scientists."
>
> "Well, I've been to the Universal back lot, and it looks like the doctor bought half of Frankenstein's lab. The wands are called Jacob's ladders, and the sphere is a Van de Graaf generator, wonderful for effects. The electricity is all static, perfectly harmless as long as you aren't grounded. You better tell me more about Ito."[27]

The story actually is not that far from reality. Nickolai Tesla started working for Thomas Alva Edison who didn't compensate him very richly for his innovations, so Tesla struck out on his own. There was a debate between using d.c. or a.c. for electric distribution. Edison provided d.c. power which had some disadvantages. Light bulbs close to the power station tended to burn out quickly, while distant bulbs glowed too dim. Tesla figured that by using step-up and step-down transformers, a.c. power could be sent at higher voltages, lower currents, and losses would be less. He was having success with a.c., which was a worry to Edison who had invested in d.c.

Then it seemed Edison was starting to come around. He asked permission from Tesla to use a.c. for an installation in upstate New York. Tesla gladly granted it to him. Then he read the newspaper. Edison was going to use a.c. in the electric chair because it was more "deadly" than d.c. Suddenly the public was made to fear a.c. as being dangerous.

So what Tesla did was set up some Jacob's ladders and a big Van de Graaf generator. He would sit atop the device at the World's Fair in and let sparks trail off his

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[26] *Wired Magazine*, Issue 9.11 - Nov 2001. Copyright © 1993-2003 The Condé Nast Pub. Inc. All rights reserved. Copyright © 1994-2003 Wired Digital, Inc. All rights reserved.

[27] Smith, p. 153.

body, just like Ito. That was to promote a.c. over d.c. for power distribution. Now some BPL companies want to promote rf over power lines. Of course, they are going to have an impressive demonstration witnessed by Commissioner Copps and Commissioner Adelstein! It goes with the territory, just as there was a demonstration by Tesla and by Ito, impressive ones at that. It didn't prove that a.c. was safe, that water could change into oil, or that power transmission lines won't radiate like antennas, but it sure was impressive.

> Ito had been born in Kyoto, but his family moved first to Malaya and then to London, where he claimed to have studied chemistry and physics at university level and done research with British Petroleum. Who could say? Records from England were unavailable, burned by the Luftwaffe. Ito had recently returned to his homeland to study in solitude at Cape Sata, the southern tip of Japan. There, on a cliff overlooking the restless sea, he had achieved insight into the very nature of atomic structure. Man could split the atom. New elements were being created all the time. Water and oil were different states of electrons in flux. Rather than take the slow, cautious route of academic publication, he offered his services directly to the nation. And the navy ate it up. How could they not? Harry thought. With a reliable source of oil, they could rule the Pacific. Without oil, the Combined Fleet would sooner or later sit in port, steel hulls covered in gull shit.
>
> "There are plenty of magicians in Asakusa. I'll ask around," Harry said.
>
> "No. This is secret, we're not even supposed to mention his name."
>
> "Then let me ask about the trick. I won't mention oil."
>
> Gen laid his arm across the table. "No, these are for you alone. No one else can see anything."
>
> Harry knew that meant that no one else should know he was involved with a navy project.
>
> "Just you," Gen insisted. "You think Ito is not a real scientist?"
>
> "I think I've seen him. It was years ago, at the Olympic Bar in Shanghai. I just noticed him out of the corner of my eye. He was working the tables. He was a close-up artist, card tricks, disappearing coins, and he was bald and dressed like a monk and looked completely different."
>
> "That's it? Someone you barely noticed in a bar years ago? Who looked different?"
>
> "And the cough and the bloody handkerchief when the British grabbed him for lifting wallets."
>
> "Well, I think we have to be more exact than that."[28]

Have we seen tricks by BPL companies before? We certainly have. It sounds an awful lot like what happened to the scheme of inventor William "Luke" Stewart, for

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[28] Smith, pp. 153-4.

conveying broadband data over electric power lines as reported in **The Electric Kool-Aid Bandwidth Test**,[29] By Evan Ratliff:

> The broadband test scheduled for March 15 was delayed month after month. ... Even by the standards of the dotcom boom, the founders' spending habits had been extraordinary. Stewart often flew by private jet and would commonly offer prospective employees double the salaries they requested. Corporate checks, wire transfers, and credit card records show that Stewart spent $350,000-plus on jewelry and more than $50,000 on sound equipment. But the "software gurus" described to me by Blair had never been hired. Over three years, in fact, Media Fusion employed only one engineer besides Stewart.

A lot of us have some real questions about the competence of the engineers at the BPL companies. Either they are totally ignorant of RFI matters, or their advice is being suppressed, or there is some kind of conspiracy of denial. Take a basic reference, **Electronics Engineer's Reference Book**.[30]

> **Noise and Communication** by K R Sturley, PhD, BSc, FIEE, FIEEE Telecommunications consultant
>
> **51.1 Interference and noise in communication systems**
> Information transmission accuracy can be seriously impaired by interference from other transmission systems and by noise. Interference from other transmission channels can usually be reduced to negligible proportions by proper channel allocation, by operating transmitters in adjacent or overlapping channels geographically far apart, and by use of directive transmitting and receiving aerials.

BPL interference puts us in the difficult position where proper channel allocation won't help as BPL covers the whole spectrum, it is geographically in ones own neighborhood, and if the noise is coming from the power lines strung in every direction, a directive antenna will do little or no good.

> **51.2 Man-made noise**
> Man-made electrical noise is caused by switching surges, electrical motor and thermostat operation, insulator flash-overs on power lines, etc. It is generally transmitted by the mains power lines and its effect can be reduced by:
>
> (i) Suitable r.f. filtering at the noise source.
> (ii)Siting the receiver aerial well away from mains lines and in a position giving maximum signal pickup;

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[29] *Wired Magazine*, Issue 9.11 - Nov 2001. Copyright © 1993-2003 The Condé Nast Pub. Inc. All rights reserved. Copyright © 1994-2003 Wired Digital, Inc. All rights reserved.

[30] Published 1984, Boston: Butterworths

(iii) Connecting the aerial to the receiver by a shielded lead.

This reference book was published in 1984 when we didn't have an internet whose distribution could cause radio interference, but the reference does allow for the etcetera, and that "information transmission accuracy can be seriously impaired by interference from other transmission systems," so radio reception being interfered with by internet data transmission is allowed for. Note where it says, "Man-made electrical noise ... is generally transmitted by the mains power lines," so how could the engineers think BPL would be a point source, not one radiated over the lines? It's right there in an engineer's standard reference book!

Let's look at the means to prevent interference, or reduce its effect, right from the engineer's reference book. "(i) Suitable r.f. filtering at the noise source." Well, here BPL won't do anything but make it worse. It injects its own signals into the mains, and when other sources of interference would normally have been blocked by the distribution transformer from radiating along the lines, that transformer is going to be bypassed for HF-VHF by a device to allow the BPL signal through.

"(ii) Siting the receiver aerial well away from mains lines and in a position giving maximum signal pickup." Well, since the mains lines will pass close to the home of the listener to shortwave, and then BPL will enter the house wiring itself, in the case of an apartment or the like, it will be rather difficult to do that. Add the high signal levels present, and we don't have a real solution. Even amateurs with directive antennas can't avoid BPL interference if its coming from several directions and/or the direction of the intended signal, not to mention the fact that BPL will operate on frequency bands for which hams don't always have directional antennas.

"(iii) Connecting the aerial to the receiver by a shielded lead." Now, there's an idea. But if the feedline from the antenna needs to be shielded, then so does the feedline for the internet signal need to be shielded cable.

At any rate, since a standard engineer's reference tells about such RFI problems, how can the BPL engineers say there is no interference potential?

What it comes down to is the FCC was presented with a bill of goods: a working demonstration of BPL *without* any HF receivers in the vicinity to clue you guys in. You were shown its benefits, not its terrible shortcomings.

If the engineers at the BPL companies really had a way to keep those lines from radiating, why didn't they publish it in a technical journal? No, they offer their science directly for our benefit just as did Ito to a desperate people.

It comes down to "With a reliable source of oil, they could rule the Pacific. Without oil, the Combined Fleet would sooner or later sit in port, steel hulls covered in gull shit." If we had the "last mile" connection to our computers, we'd have all kinds of benefits; otherwise what good are computers sitting there collecting dust?

Gen had listed the preparations of the experiment: the elaborate filling of the bottles with water, how witnesses marked the corks with private words or numbers that Ito didn't even see before he inserted electrical wire, sealed the cork with molten wax and set the bottle in the tank of water. Gen had listed each of Ito's steps: safety procedures

of the goggles and mat, positioning of the copper wands and dialing in voltage at each "to orchestrate the electrical field."

"Does the transformation usually take one jolt?" Harry asked.

"No, it might take days before it takes effect, but once the bottles are in the tank, they can't be touched. In fact, you'd be electrocuted if you tried. Besides, the guards are in the examining room around the clock."

"Why blue bottles?" They looked like medicine bottles to Harry.

"Ito says they filter harmful rays."

"But you can't see whether the contents are oil or water."

"Yes, you can. That's when the bottle rises."

"Well, there's your answer."

"You don't believe any of it?"

"Neither do you, or you wouldn't have brought me in. Yamamoto can't be fooled, not really."

"But——"

"I know." Harry had to smile. "It's like the old joke. a woman brings her husband to the psychiatrist. She says, 'Doctor, my husband is crazy. He thinks he's a chicken.' The psychiatrist says, 'Leave him with me, I'll cure him in a week.' She says, 'But we need the eggs.' That's the navy. You know this is crazy, but you need the oil."[31]

When I read, "On balance, we believe that the benefits of Access BPL for bringing broadband services to the public are sufficiently important and significant as to outweigh the potential for increased harmful interference that may arise" (**FCC 04-29, ¶ 33**), I can't help but think that after the ARRL and others tried to disabuse you of the notion that wires strung like antennas are not transmission lines, "She says, 'But we need the eggs.'"

It occurred to Harry that Yamamoto had an especially good chance of coming out of the affair looking like a fruitcake. Since he was the sanest man in the navy, and the strongest opponent to war, the army would seize on anything to discredit him. Harry was not surprised that he'd had no more direct contact with the admiral. That was the beauty of using a gaijin; he could always be disavowed.[32]

It has occurred to me that the FCC has "an especially good chance of coming out of the affair looking like a Fruit-Cake [Commission]."

Gen had diagrammed the room like elevations. Along the east wall were medical cabinets, carboys of water, anatomical charts. North: cabinets, scale, door and transom, table of rubber boots, gloves and smoked goggles, eye chart, sink,

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[31] Smith, pp. 154f.

[32] Smith, p. 155.

instructions for winding cloth around the midriff to counteract the G-force of a tight turn. South: wheelchairs, cabinets, the observation mirror, more carboys and a row of bottles.

"But imagine," Gen said. "Imagine if we could transform water into oil. Nothing could stop us, Harry. We could be a force for good, for progress."

"Gen, not that it makes any difference to me, but I've seen progress. I've seen mounds of progress. I've seen the streets run with progress, I've seen progress shoved into pits and stacked to the sky and burned like logs. Progress is overrated."

"But you'll help?"

"What are friends for?"[33]

Are we talking about a "good" evolution as Stravinsky viewed it: "revered as a goddess——a goddess who turned out to be somewhat of a tramp, let it be said in passing, even to having given birth to a little bastard myth that looks much like her and that has been named Progress, with a capital P."[34]? Or are we looking at how scattered progress manifests itself:

When people imagined the future, they imagined progress advancing in a more or less even line, like troops across a field. But in practice the advance of what was sometimes called `progress' was very ragged. Three miles away from a great international airport, in sight of modern traffic, you could find an old man driving a cart and horse. Beneath the shadows of jets, there were old farmhouses locked in the past, dogs sleeping, chickens clucking, and a way of life suited to the Middle Ages.[35]

I personally am not so keen progress, the progress entailed by BPL, but that doesn't mean I won't try to offer some helpful suggestions in areas where you've requested comments.

Gen laid his head on a table and closed his eyes while Harry looked at the diagrams. With cons, the simplest answer was best, you didn't have to go to Harvard to know that. Harry discounted Ito's elaborate procedure of marking and sealing corks as hokum. As for the electric lights and bangs? A hell of a show. All that really mattered was the apparent change of water to oil in six blue bottles in a tank of water. Oil was lighter than water, which was why a bottle floated when its contents were supposedly transformed by

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[33] Smith, pp. 155-6.

[34] Igor Stravinski, Poetics of Music (Cambridge: Harvard University Press, 2000) pp. 71f.

[35] Collins, p. 107.

> Ito's bolts of lightning. But a fine string could raise a bottle, and the change of contents could have taken place anytime. And not even six had to rise, all the con needed was one bottle to maintain excitement because this was an audience who wanted, in spite of its intelligence, to believe what a magician showed them. Houdini once made an elephant disappear in Madison Square Garden. He showed the crowd the elephant standing face out, then drew the curtain, and when he reopened it, the elephant was gone. All Houdini had done was stand the elephant sideways behind a drop of black velvet. As simple as that, because people wanted to believe.[36]

Here's how I view matters. The assertions by BPL companies that they've had no interference complaints is so much hokum. As for the impressive demonstrations witnessed by a couple commissioners, "A hell of a show. All that really mattered was the apparent change of" antenna wires to transmission lines. And the FCC's approach of mitigating interference, why, that's the great Houdini and the disappearing elephant.

The proportions of potential interference problems are elephantine——as the ARRL puts it, a Pandora's box of unprecedented proportions. Houdini made the elephant "disappear" simply by rearranging it behind a veil. So here's how you do it. The BPL companies commence operation like the elephant facing out. People complain, so they move their frequencies, like the elephant facing sideways, until the complaints stop. The complaints stop not because the elephant has disappeared, but because it is now on frequencies behind a veil of ignorance, where people hearing it don't know what the problem is.

I ran into an old friend outside the other day who showed me a small portable shortwave receiver he purchased mail order for $9.95. I turned it on, extended the small whip antenna and pulled in a shortwave broadcast station in China, clear reception. I congratulated him on his purchase. Then I told him about the planned BPL which could potentially interfere with his reception. He said he hadn't heard anything about that. Then I asked him what he would have thought if instead of hearing shortwave broadcast stations, he heard a bunch of noise which I imitated like a BPL operation. He replied that he would just think his radio "wasn't reaching out far enough."

If some hams get the BPL off their frequencies, it doesn't necessarily mean the elephant has disappeared, maybe only that it has been repositioned behind a veil of ignorance. One of your commenters mentioned the fact that immigrants often listen to shortwave broadcasts as a means of keeping in touch with the old country. Does your observation: "Given that there is significant investment in the deployment of the service, we agree with several commenters that Access BPL providers would have a strong incentive to exercise the utmost caution in installing their systems to avoid harmful interference" (**FCC 04-29, ¶ 39**) mean that BPL companies will canvass the immigrant communities to find if there are any interference problems? Sure, they will go around with interpreters. No, more likely, if there is no complaint, there is no problem; that elephant is gone.

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[36] Smith, p. 156.

Under Part 15 it is easy enough to make a mouse disappear——though some of them grow to the size of rats——but an elephant is trickier. The media is promoting BPL without informing the public of its downside, so there's plenty of ignorance out there. Enough to hide the elephant? Perhaps.

> There were other possibilities. The steadfast guards might be bribed. The irate Professor Mishima might have been a shill. That got complicated, however, and Harry focused more and more on Dr. Ito's lab coat as the most likely source of the "blood" the doctor coughed up at will and as a blind for a last-minute switch. Between the fireworks and smoked goggles and his voluminous lab coat, Ito could switch a case of beer.
>
> At four in the afternoon, Harry woke Gen. Kondo had started setting up the bar, briskly wiping glasses. From outside came the street calls of sake vendors and fortune-tellers.
>
> "You can't cheat an honest man."
>
> Gen sat up and rubbed his eyes. "What are you talking about?"
>
> "You can't cheat an honest man. Do you know what that means, college boy?"
>
> "Yes," Gen said.
>
> "No, you don't. It means an honest man can afford to be objective, he doesn't care one way or the other, so he's hard to fool. A mark, on the other hand, wants something for nothing. He wants the pea under the shell, his share of a lost wallet, a tip on a horse, oil for water. His objectivity is already blown, he's bought in. And because the game itself is dishonest, he can't go crying to the police when he's cheated of what he hoped to steal. Or to God because you can't change water into aviator fuel. Have you got some dress whites?"[37]

What it comes down to is, "You can't cheat an honest man." An honest man is objective, he doesn't expect to get something for nothing, to violate the laws of physics. The concept is pretty well known: "It has often been said that the Watergate people hid what they were doing from themselves behind a cloud of fuzzy notions they never rigorously examined."[38] I have some real questions whether you have not likewise hid your optimistic interference assessment from yourselves behind a cloud of fuzzy notions you never rigorously examined. I think about that when I read your unsupported statements: "After careful consideration, however, we believe that [harmful] interference concerns can be adequately addressed. We believe that Access BPL systems can operate successfully under the non-interference requirements of the Part 15 rules. Furthermore, we believe that the current Part 15 emission limits for carrier current systems in conjunction

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[37] Smith, pp. 156-7.

[38] Edwin Newman, Strictly Speaking (Indianapolis: Bobbs-Merrill Co., 1974) p. 7.

with certain additional requirements specific to Access BPL operations will be adequate to ensure that existing radio operations are protected against harmful interference from such operations. We therefore are proposing changes to our Part 15 rules that we believe will facilitate the deployment of Access BPL technology while protecting licensed users of the spectrum. ... On balance, we believe that the benefits of Access BPL for bringing broadband services to the public are sufficiently important and significant as to outweigh the potential for increased harmful interference that may arise. Furthermore, as indicated above, we are proposing to subject Access BPL operations to the existing Part 15 radiated emission limits for carrier current systems." (**FCC 04-29, ¶ 31, 33**). A lot of "we believe" in there but not much why. Francis Bacon said: Man prefers to believe what he prefers to be true. Of course, we'd *prefer* that BPL is compatible with over-the-air users, but your rationale sounds more like fuzzy wishful thinking than reasoned thinking. Let's take an example:

FRAUD, LIES, AND DECEIT[39]

One of the main targets of my Homeless Updates over the years was Mitch Snyder, the nation's premier homeless advocate. You remember Mitch. He's the guy who went on a hunger strike until President Reagan coughed up several million dollars for his shelter so he wouldn't die on network news. He finally assumed room temperature in the spring of 1990, by means that only Dr. Jack "Jack the Dripper" Kervorkian would endorse. But during his last years Mitch committed more mischief, spread more outrageous propaganda, and simply *made up* more "facts" than almost anyone else I know in America.

What really frosts and frustrates me—a condition I call frostrating—is the ease with which the media will believe almost any "fact" about the homeless. Mitch Snyder claimed early in the Reagan years that there were three million homeless in America. This figure was accepted on faith by almost everyone in the media. You heard that number bandied about everywhere. "This country can't be doing well. We have three million homeless." All our homeless policies were supposed to be based on this number drawn from Mitch Snyder's fevered imagination.

But in 1990 the Census Bureau decided to settle the controversy by a special census with which they planned to count the number of homeless on a given night. You would have thought that Mitch and company would have welcomed this effort. But noooo. They told the homeless not to participate. They told them that the government was only going to use the information to harass them and that they dare not participate. Who knows how many people chose not to cooperate with the Census Bureau because of that.

When the night of the Homeless Census rolled around, it took only hours for the media and others to declare it a failure. Television reporters would stand in out-of-the-way

[39] Rush Limbaugh, The Way Things Ought to Be (New York: Pocket Books, 1992) pp. 242-4.

corners where a few homeless were hiding and report that no Census worker had visited them.

The final Census Bureau count of the homeless was 272,000 people. In fairness, I believe the number of homeless is actually higher—closer to the Urban Institute's estimate of 600,000—but the Census Bureau's effort was helpful in dispelling the grossly exaggerated numbers of Snyder and his disciples. The reaction of the homeless advocates who had counseled the homeless not to cooperate was sputtering rage. They couldn't deal with it. They ranted and complained about the inaccuracy of the count. Just for the sake of it, let's give them that. Let's say the number was grossly under-counted ... say by 100 percent. If we missed 100 percent of the number of homeless and arrived at 272,000, then the actual number would be 544,000. Still less than the Urban Institute number and far less than the 3 million claimed. Still not satisfied? Okay, let's say the census missed 500 percent. We are still below 1.5 million. The point is that there is absolutely no way we have, or ever did have, 3 million homeless people in this country.

It "really frosts and frustrates me" too, "the ease with which the [FCC] will believe almost any 'fact' about the" benign interference footprint of BPL. *Early* in the game some companies made some assertions that BPL would not interfere with radio users, and ever since it has been taken as gospel. Commissioner Adelstein's comment, or one like it, was made with the NOI way before the NPRM: "While we must be mindful of harmful interference, we cannot let unsupported claims stand in the way of such an innovation as BPL systems." It seems to me the FCC doesn't *want* to strongly consider any claims that would support interference levels that would "stand in the way of such an innovation as BPL systems," just as Mitch (above) didn't want to hear support for claims that his homeless cause wasn't as deserving as he'd made it out to be. Mitch brushed the homeless census aside, and the FCC has not waited for the NTIA, which has indicated "that it has initiated modeling, analysis and measurement efforts in order to develop means for accommodating BPL technologies while precluding unacceptable interference to Federal Government systems" (**FCC 04-29, ¶ 16**) before coming out with this NPRM. Isn't that jumping the gun? I mean, where is your objectivity? Such a study could show whether many of the concerns expressed to you by the amateur community and others are valid or unfounded. Even if the ARRL study erred by a factor of 500%, it still leaves plenty of cause for concern.

A US Representative from my state, Greg Walden, wrote in a January 15 letter to Chairman Michael Powell, "I feel that it is important to give the NTIA study thorough consideration before proceeding further with BPL technology, in view of the importance of avoiding interference to federal government HF communications." I realize you are still waiting and asking for more information, but still...

THAT NIGHT, Harry alone slipped behind the observation mirror as Gen joined the band of witnesses. The group was entirely navy, which Harry took as a sign that scientific quibbles were on the verge of being totally ignored. With Yamamoto present, there was enough gold braid in the room for a bell-

pull. Only one officer was in dress whites, and that was Gen. All eyes, of course, were on Dr. Ito and the six blue bottles in the water tank.

The emaciated doctor looked as if he had spent the entire day under a mushroom. He did cast a spell. Officers who generally believed only in six-inch armor hung on every word. Harry concentrated on what Ito did; the restless stride around the tank, the long hands and deft fingers, the flapping laboratory coat. Everyone had pulled on dark goggles, and Ito was moving toward the switch when Gen begged to borrow his lab coat. "I'm concerned about sparks that might burn my jacket. It's the only one I own. Would you mind very much?"

The senior officers were appalled, all but Yamamoto, who looked impartially curious.

Ito hesitated. He had the ability to write amazement on his face. "You need my lab coat?"

"Yes." That was what Harry had told Gen to say.

"In that case." Ito shrugged off the coat and handed it to Gen, then continued in shirtsleeves and threw the switch.

Luminous lines of energy filled the room, pulsing back and forth from wand to sphere over the blue bed of the water tank and the dark blue bottles that trembled within. As Ito modulated the voltage, the lines spread like a hypnotic sea of rolling waves, like the view, perhaps, from Sata, where he had first glimpsed the fluid forces of nature. When he shut off the power, one bottle had already risen to the surface. Ito scooped out the bottle and elected Gen to break the seal, verify the mark on the cork, and identify the contents. Gen's face burned with shame down to his white collar.

"It's oil."

"You're positive?"

"Yes, Doctor."

"Then may I have my coat?" As he pulled the coat on, Ito fell against the tank and began coughing up blood. He waved his hand like a swimmer going under. "No more experiments this week. I cannot proceed with such suspicion, the strain is too much.

The C in C averted his eyes from the disgrace of his lieutenant.[40]

It seems to me that amateurs' and others' worry over Part 15 levels is a red herring, like Ito's bulky lab coat. So what if we restrain BPL companies from increasing Part 15 limits? Ito seemed just as comfortable doing his experiments in shirtsleeves. If we tighten up on Part 15 emission limits, BPL companies will be allowed less injected signal into the lines, so they will compensate by putting more repeaters/boosters in the lines. Half the emission, twice the boosters; something like that. What difference does it make? A strict Part 15 limit would in fact limit the damage if a BPL company got carried away, but other

[40] Smith, pp. 157f.

than that, nearby hams would be wiped out at any usable level, and more distant ones would get the boosted signals adding up anyway.

AT THREE in the morning, Harry and Gen got back to the Happy Paris to salute the end of Gen's career. Harry brought a bottle of Scotch from the bar while Gen smoked a cigarette as if he were chewing on a nail.

"Sorry, Gen. I guess it wasn't the lab coat."

"Wasn't the coat? Wasn't the *coat*? Harry, you've ruined me. I can't face those officers tomorrow."

"Technically speaking, tomorrow is today. Banzai!" Harry raised his glass.

"Banzai!" Gen threw the drink back." One commander said I had embarrassed the entire navy. He suggested a letter of resignation."

"You were doing what Yamamoto asked you to do."

"No, I was doing what you told me to do. How could you be so sure about the coat?"

"It seemed logical. I figured, forget the light show, he's just switching bottles."

"We mark the cork. It's the same cork when we put the bottle into the water and when we pull it out, so it's the same bottle. Now what?"

"I don't know. I'm not a scientist. Maybe he's really doing it."

"Water to oil?"

"What do I know? Scientists are doing all sorts of stuff, synthetic this and that. I guess you have a real Einstein on your hands."

"A Japanese Einstein." Gen laughed. "And I'll go down in history as a fool."

"You and me."

"Harry, you won't go down in history at all. How could you say take away his lab coat? You gambled, and I'm the one who paid. If I were a samurai, I'd kill myself. No, I'd kill you first. If I had a gun, I'd shoot you right now."

"Water to oil. One of the pivotal moments in science. Like the first electric bulb, that's exciting."

"And now you say he's really doing it?"

"It looks that way. He puts water in a bottle and takes oil out."

"I know, I was there."

Now that Harry thought about it, he himself wasn't, not for everything. Ito had moved out of Harry's vision to fill the bottle. "He didn't use the sink tap. Where did he get the water?"

"He siphoned it."

"Why? A sink is easier." Harry remembered the diagrams of the room and the big glass carboys of water. "That's a lot of effort when a sink is right there. It's distilled water? Filtered water?"

"It's from Fuji. The water in the carboys is from a sacred spring on Mount Fuji, it's the only water Ito will use."

"Sacred water?"

"Yes."

Harry took a deep breath and raised his arms. "Praise the Lord! I feel my heart leap and the veils part. I hate to admit it, but I was starting to doubt myself. I'm sane again. Oh, it's a scam."

"How?"

"I don't know. I have no idea. Ito is a better magician than I am. I do know that for con games, holy water is the best kind. Now maybe you'll let me talk to other magicians."

"I can't, Harry. You were my shot."[41]

Okay, let's say I'm about convinced with your "reasoning" that BPL can be accommodated as those long unbalanced power lines will act like proper rf transmission lines, not like the radiating wires one would expect. Say, we've got some BPL Einsteins who have gotten results contrary to common sense. Say, you've almost convinced me. Then I see all this to-do about "homeland security" over and over: "BPL proponents also state that Access BPL technology will offer benefits to improve the provision of electric power service and advance homeland security" (**FCC 04-29, ¶ 13**); "Access BPL may allow electric utilities to improve the safety and efficiency of the electric power distribution system and also further our national homeland security by protecting this vital element of the U.S. critical infrastructure" (**FCC 04-29, ¶ 30**); "we believe that Access BPL has the potential to offer a number of significant benefits, such as ... 4) advancing homeland security" (**FCC 04-29, ¶ 48**); BPL technology could also improve the provision and management of electric power systems, homeland security, and protect vital elements of our Nation's critical infrastructure" (**CHAIRMAN MICHAEL K. POWELL**); "BPL systems also serve an important homeland security function, providing a redundant data network" (**COMMISSIONER KEVIN J. MARTIN**). Even if I were snowed by the technical "findings," reading about homeland security, I would throw up my hands and declare it a scam. Homeland security is as much a religious sentiment a government agency here can promote.

... Before I could speak, he showed me the eager smile of a youth presenting a gift to an elder and pressed the keys into my hand. He said, "Should you desire to return, Master Berekiah, your house in Lisbon awaits you."

I reached out to his arm to steady myself; my heart was drumming the single word *homeland*. As the teeth of the keys began biting into the fist I had formed around them, I caressed open my fingers and leaned down to sniff the old-coin scent of the metal. Memories of serpentine streets and olive trees swept me to my feet. The hairs of my arms and neck stood on end. A door opened inside me, and a vision

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[41] Smith, pp. 158f.

entered: I was standing just outside the iron gate to the courtyard at the back of our old home in the Alfana district of Lisbon. Framed inside the gate's arch and standing at the center of the courtyard was Uncle Abraham, my spiritual master. Draped in his vermillion travel robe of English wool, he was picking lemons from our tree, humming contentedly to himself. His dark skin, the color of cinnamon, was lit gold, as if by the light which heralds sunset, and his wild chest of silver hair and tufted eyebrows shimmered with magical potential. Sensing my presence, he ceased his melody, turned with a smile of welcome and shuffled closer to me with the duck-like walk he normally only adopted in synagogues. His warm green eyes, opened wide, seemed to embrace me. With an amused twist to his lips, he began undoing the purple sash to his robe as he walked, let the garment slip away onto the slate paving stones of the courtyard. Underneath, he was naked except for a prayer shawl over his shoulders. As he continued to approach me, rays of light began to tear. When a first drop slipped salty into the corner of my mouth, he stopped and called to me using my older brother's name: "Mordecai! So you have finally heeded my prayers!" His face was framed now by an aura of white flame. With a solemn nod, as if he were passing on a verse of ancient wisdom, he tossed me a lemon. I caught it. Yet when I looked down upon the fruit, I found instead tarnished Portuguese letters knotted into a chain. They read: *as nossas andorinhas ainda estao nas maos do faraó*—our swallows are still abandoned to Pharaoh. As my gaze passed over these words of New Christian code a second time, they lifted into the air, then broke with a tinkling sound.

I found myself looking once again upon the keys. Warm tears were clouding my eyesight. The door upon my vision had closed.

Lourenço was gripping my shoulders, his face pale and panicked. Reassuring words somehow found their way to my lips.

To understand the revelation which then came to me, the Hebrew words *mesirat nefesh* must be explained. They mean, of course, the willingness to sacrifice oneself. And their occult power resides in the tradition among some kabbalists to risk even a journey to hell for a goal which will not only help to heal our ailing world but also effect reparations inside God's Upper Realms.[42]

Homeland security "means, of course, the willingness to sacrifice oneself." And I admit it, if I were experiencing BPL interference and called the company to complain and got visited by official men in black suits telling me they were monitoring a terrorist cell who thought their BPL communications were more encrypted than they really were, and

[42] Richard Zimler, The Last Kabbalist of Lisbon (Woodstock: The Overlook Press, 1998) pp. 18-19.

the men wanted me to just put up with it until they made their bust, I'd go along with it like any patriotic American. But valid technological advances don't have to be bolstered by such feelings of patriotism.

Video cassette technology was developed for the pornography industry, but all video movie buffs benefited, even the security/surveillance industry, but it didn't need the tag of a security venture to get developed. No, what happens is high speed internet access brought to more people will be helping **a)** pornographic users who need to download all those images, and **b)** music and movie pirates who need the speed to get their black market copies. But we are not going to sacrifice the use of our radios so the neighbors can watch pornography and download pirated movies. So we are told about homeland security.

That's a little bit beyond my expertise, but I am aware that one can find out how to make a sophisticated bomb on the internet. Now, I figure, God forbid, a dyed-in-the-wool terrorist coming over here will figure out what he needs to do regardless, but easy access to such information can turn a youthful group of troublemakers into genuine terrorists.

As for protecting the grid through increased scrutiny, a lot, if not most, of what may be done by the power companies can be accomplished with their low frequency control frequencies that they already use and can't benefit terrorists.

As for BPL being a "redundant data network," BPL is largely supported by the same infrastructure likely to get damaged in a terrorist attack. The redundant system is HF radio and batteries. Austria discontinued their BPL after they found it interfered with their test of HF emergency communications (see supplement). That should tell us something.

We as a society chose the utility of a.c. power over the safety of d.c. The most efficient frequency for transmitting power down a line——taking into account resistance losses in the wires, hysteresis losses in the transformers, etc.——is 60 cps. Diverge much from that and you get more losses. But that frequency is close enough to the one regulating the human heartbeat that one's muscles will freeze and seize passing 60 cps house current. Grab two ends of a 120 V. 60 cps line and your muscles will contract so you can't let go, then your heart will flutter and you will die. But grab two ends of a 120 V. dc line and you will feel a jolt and let go and live. DC is much safer than AC for power distribution, regardless of Tesla's assurances, but we as a society have opted for utility and use other means for safety. Personally, I think that we should opt for the utility of an uncluttered HF spectrum and find other ways to establish homeland security.

> In his rumpled whites, Gen looked like a laundry bag. He was the football hero stopped on the one-yard line, the movie star who'd lost his script, the aviator out of gas. He was no longer in the game, in the picture or in the air, and he couldn't understand why. Handsome had gotten him only so far, which wasn't far enough. Harry had seen it before, this capacity of Gen's to lose all confidence, implode and go inert.[43]

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[43] Smith, p. 160.

You know, your NPRM has really brought the ARRL, and others concerned about interference, up short. They studied and elaborated on the problem only to have it minimized by the FCC.

"Harry?" Michiko came in the door with Haruko. Both were in chic new outfits, hats and shoes. Haruko's, Harry suspected, a copy of Michiko's. We were at Haruko's for a day and a half, waiting for you to come looking for me."

"And I was going to, as soon as Gen and I were done. I was very worried."

Seeing Gen low raised Michiko's spirits; she generally treated him as a usurper of Harry's interest, and he treated her the same. She showed Harry a small blue pharmacy bottle of laudanum from her purse. "I have enough here that I will never have to think about you again."

Harry didn't take the threat seriously. Michiko was more the hand-grenade type. "Haruko's was the first place I was going to look."

"You should have called."

"I should have. I've been thinking about you. I really have been. Missed you." He turned the jukebox on low. The plastic canopy took on a pearly hue. An arm laid a disc on the turntable, and a needle slipped into a groove while Harry's hand slid into the small of Michiko's back. *Blue moon, you saw me standing alone/ Without a dream in my heart/ Without a love of my own*. She was one of the few Japanese girls who knew how to dance, knew that sinuous was better than stiff and that the hips should be involved just so. He touched a certain point between two vertebrae, and her head settled on his shoulder. "You look agonizingly beautiful, you really do." Her right hand rested in his left, bottle and all, his thumb on the underside of her wrist.

When Haruko tried to get Gen to dance, he brushed her hand from his shoulder.

"Gen is feeling a little low." Harry said.

"Gen is always low," murmured Michiko.

Haruko said to Gen, "Maybe I can cheer you up. You can call me sometime. I have a phone."

"Imagine that, her own phone. Haruko has an admirer at the telephone exchange," Harry told Gen. "But she's nuts about you, always has been."

"What would cheer you up?" Haruko asked.

Gen said, "I'm just not in the mood."

"When is he?" asked Michiko. "Gen, when are you in the mood? Are you ever in the mood, Gen?"

"Don't pick on him," Harry said.

"But I want to pick on him. What kind of lover are you, Gen?"

"Not your kind."

"Definitely not, I'd say. Absolutely not."

"Ssh." Harry put his finger to Michiko's lips and took her hand again. *You knew just what I was there for/ You*

heard me saying a prayer for/ Someone I really could care for.

He felt how cool and delicate her fingers were around the bottle and how nubby the surface of the bottle was. They took another turn around the jukebox, but Harry's mind was already moving in a different direction.

"What now, Harry" Michiko asked.

Harry had the pharmacy bottle. He set it beside the bottle of Scotch in front of Gen, so smartly that Haruko jumped.

"What do you see?" Harry asked.

Gen wrestled his glare from Michiko and refocused. "Two bottles."

"High-class Johnnie Walker bottle. Cheap blue bottle."

"Yes."

"Wake up, what's the difference?"

"Smooth and clear. Blue and crude."

Blue glass recycled from old sake bottles, Harry thought. Glass removed too fast from the blowpipe, a fact that could save Gen's skin, to say nothing of his commission and fancy dress whites. "What makes it crude?"

"Bubbles."

"Say it again, Lieutenant."

Gen sat back. His chin and shoulders rose. "Bubbles."

BUBBLES WERE the answer.

While there were no experiments, Gen had draftsmen secretly draw all four sides of each blue bottle in the water tank and in the examining room, taking care to pinpoint every bubble in the glass, a pattern that was each bottle's "fingerprint." At the next Magic Show, Dr. Ito transformed not one but two bottles of water into oil. However, when the sketches were compared, it was plain that, while the specially marked stoppers might be the same, the bottles containing the oil were not——by the evidence of their own "prints"——the bottles of water originally placed in the tank. At which point, the guards confessed to being bribed for turning a blind eye and tried to shoot themselves with their own handguns. Gen got the credit for exposing the subterfuge, and Ito went off with the police.[44]

You know, the difference between voice communication and Morse code communication is like: "High-class Johnnie Walker bottle" vs. "cheap blue bottle." If you can get good glass, why would you ever want the poor? Ah, but those bubbles, those dots and dashes, can give to each signal an identifying fingerprint. And while the corks may check out——the records in the BPL office indicate no interference complaints——, the bottles themselves might be a different matter, that signal one copies in the field.

Both low-power TV / TV translator stations and FM boosters / translators

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[44] Smith, pp. 160-2.

operating at one watt or more must identify by Morse code (Part 74, see attachment). BPL systems will inject more or less than one watt——who knows as it isn't measured——and as the widespread potential antennas they use could make their signals more pervasive than the one watt on a hill, why not investigate means to have BPL operations identify by Morse code. That code is understood internationally, so that any boy scout, and even our hypothetical immigrant might be able to pick it out. At least it would be there. See my attached article, which is dated but mostly valid, on the widespread use of Morse code.

Let's look at digital modulation, and we'll see but a blurry line between traditional Morse code sending and modern digital modulation.

UNDERSTANDING DIGITAL MODULATION [45] By Fernando Garcia

Digital modulation is the key to today s high speed data transfers and has made possible such developments as high-speed digital modems and even HDTV.

... As most of course know, modulation is the process of encoding information onto a carrier signal. Since the carrier remains analog, the term "digital modulation" is a bit misleading, in digital modulation what is happening is that a carrier is modulated in discrete increments instead of the continuous envelope of conventional analog modulation methods. Each increment is then assigned a value of a bit or group of bits. Before we go on, it is interesting to note that digital modulation techniques are not new by a long shot. The earliest wireless communications used Morse code, which is in essence digital modulation. The dots and dashes that comprise the code are basically the short and long pulses of RTZ-encoded digital data. During the earliest days of personal computers, hackers would build Morse-keyers, where the text would be typed on the computer screen, and the computer would toggle a relay to simulate the keying. Morse code is bandwidth-efficient, and although slow and a little dated, it still remains useful to this day.

ASK and FSK.

Morse code-modulated signals would be known today as Amplitude Shift Keying or ASK, With ASK, the carrier is keyed between two discrete levels. Although any two carrier values could be used, for maximum efficiency these levels are keyed between full carrier and no carrier. ... ASK suffers from very poor noise immunity during the period where the carrier is off. Therefore, it is not the modulation of choice for fast or critical transmissions. However, ASK consumes transmitter power only during the period the carrier is actually keyed on, and the transmitter design itself is uncomplicated. Thus, it is widely used for simple battery-powered devices, such as garage-door openers.

With Frequency Shift Keying or FSK, the carrier is always on. ... FSK is a much more robust modulation method,

[45] *Electronics Now*, Dec., 1999, Vol. 70 Issue 12, p38, 4p

as it has superior noise immunity. Receivers incorporate a limiter circuit much like FM detectors do, thus removing most, if not all, amplitude disturbances. Due to its robust receiving characteristics, the FSK modulation technique was frequently used in early modems.

The pitfall with FSK is that it occupies quite a lot of bandwidth for the amount of data-per-unit of time that it transmits, Bandwidth is a scarce commodity, and the need to transmit ever increasing data rates seems to be ever increasing. In order to minimize the occupied bandwidth, the frequency shifts are kept as narrow as possible. Engineers soon realized that as the frequency shifts became narrower and narrower, they would look more like instantaneous phase shifts. Thus, Phase Shift Keying (PSK) was born; and its several variants, which allow extraordinary data rates to be transmitted, have largely superseded FSK.

Enter PSK.

Phase Shift Keying was the next logical development, and it is what has allowed today's high-speed modems. In PSK, the carrier is subjected to abrupt phase changes as the modulation varies. ...

It did not take very long for engineers to realize that there is plenty of empty space between zero and 180 degrees. Would it be possible to modulate both the in-phase axis and the quadrature axis in varying amounts and obtain a vector with smaller phase shifts--say 90 degrees, or even lower, perhaps to 45 degrees? ...

Quadrature Phase-Shift Keying or QPSK.

Each discrete state is known as a symbol, and since there are 8 different states, that means that each symbol is capable of carrying three bits. Thus, QPSK allows dramatic increases in the baud rate without substantially increasing bandwidth.

The phase shifts could be further reduced to obtain additional symbols, but again we run into trouble since all modulated data suffers from certain limitations. Although PSK is relatively immune from amplitude noise, phase modulated signals suffer from phase uncertainties called jitter. The jitter might be produced at either the transmitting or receiving ends, or caused by the medium used to send the signal. Thus, as the number of symbols increases, it becomes more difficult to accurately resolve the ever decreasing phase shifts. Additional sophistication and improvements are required to achieve higher modulation densities.

Marrying Phase and Amplitude.

Further improvements upon the basic phase shifting might be possible. For instance, ASK modulation requires keying the amplitude between two states, but the only reason that one of those states traditionally has been fully off was to conserve transmitter power. Without such a requirement, amplitude modulation could take the form of several discrete levels, each one providing additional symbols. Engineers have found a

way to happily marry multi-level ASK and QPSK, and thus provide a waveform with simultaneous amplitude and phase shifts where a very dense modulation (with many symbols) could be achieved. This modulation method is known as Quadrature Amplitude Modulation, or QAM-xx, where the "xx" are the number of symbols supported by the modulation. ...

High Definition Irv and Beyond.

With its very high baud rate, QAM has pushed digital modulation into the mainstream, allowing a variety of devices to become feasible. Digital video broadcasts, the dramatic speed increases of PC modems, and other improvements have been made possible by this technique.

This does not mean that QAM's supremacy is unchallenged. The FCC's Advisory Committee on Advanced Television Service evaluated a vestigial sideband (VSB) digital transmission system that had been developed for terrestrial, MMDS, and cable television broadcasting by the Zenith Electronics Corp. After extensive field tests and a long debate among the members of the Grand Alliance (a consortium of several corporations and the MIT), the system was adopted as the new high-definition, digital terrestrial standard for the United States. This finally occurred on December 1996. Among the reasons cited for the adoption was that VSB is more robust than QAM with regards to fading and that it provides faster recovery from dropouts, since VSB will still maintain receiver synchronization even if the received data is in error. Synchronization is extremely important, as all modern digital modulation methods use extensive error-correction algorithms, and these require at least data-clock synchronization.

QAM is a self-clocked modulation, and data dropouts will wipe the error-corrector's capability to recover. VSB, on the other hand, uses supplementary synchronization, which allows the receiver to rapidly recover after a data loss.

Just as with QAM, there are several variants for VSB, depending on the required data rates and robustness. Recommended modes are 8-VSB for terrestrial broadcasting, and 16-VSB for cable systems, although there is flexibility to accommodate other modes. Those modes allow one HDTV channel for the former, and two HDTV channels for the latter, to be transmitted within the 6 MHz bandwidth currently allotted to existing NTSC channels. The maximum data rate under optimum conditions for 8-VSB signal is 19.39 Mbps and twice that much for 16-VSB.

This is not to say that VSB has completely won the HDTV battle. Japanese and European consortiums are holding steadfastly to the newer OFDM (Orthogonal Frequency Division Multiplexing) modulation, which requires a lot of computer power to implement--so much, in fact, that until recently there were no cost-effective digital processors powerful enough to implement the OFDM demodulator on a consumer product. OFDM uses hundreds or even thousands of quadrature-

modulated carriers, each transmitting at a low data rate. The parallelism of those carriers allow for the extremely high data rate required for HDTV applications. Each digital-modulation system has, of course, its technical advantages and pitfalls. The advocates for each camp remain stubborn in their attempt to prove that their system provides the best solution. Even here in the US, there are uncertainties for VSB. Cable operators that have already committed to digital programming have done so by deploying QAM systems. They maintain that since a cable system does not suffer from multipath, fading, or other off-air disturbances, QAM is as robust as VSB in this application. Perhaps a better explanation would be that they are extremely reluctant to replace the very substantial investment made in equipment and training.

It would probably be easy as pie to briefly slow down a modern digital system to have it send out characters recognizable to the ear as Morse code. And we could even go one better.

The Guide to Life, The Universe and Everything.

Everything / Science & Technology / Computers

Digital Codes[46]

Written and Researched by: Lucinda (et al) - Dun Researchin' Bossel

Created: 12th June 2001

Computer programs are forever transforming data from one format to another, from Zip files, through Rich Text Format (RTF), to GuideML. This process causes no end of problems and at first glance, it seems to have been dreamt up solely to make life difficult.

Well, maybe it was, but there's more to coding things than making life difficult for users. Coding helps you to store within a structure, store compactly, and store safely. Depending on which of these three things you need most, a different code should be used. Codes for transmission can be a separate thing altogether. Using the wrong code can be counter-productive; ...

Multiple Codes

It's worth mentioning that it's possible to apply more than one code to a given piece of data. If the answer to a question is emailed to a lecturer, it might first be given structure as a word file, then compressed as a zip file, then attached to the email (more structure), then compressed and encrypted before being sent over the network.

[46] BBC © MMIV, Powered by DNA, the BBC's community website engine, www.bbc.co.uk/dna/h2g2/A533170

Structures Made of Bits and Bytes

...

Sometimes structure can be added using 'control characters'. For example, in morse code the receiver needs to distinguish where one letter ends, and the next begins. This is done by having a short pause between each letter. A longer pause occurs between each word, and a longer pause still between each sentence.[47] This works because pauses are not dots and dashes; the characters which make up normal morse code.

Creating Control Characters

If control characters are not already available, they can be created. In programming, a special character is needed to distinguish between some text to be shown to the user and the rest of the program: ...

Delimitors

These control characters, however they are obtained, can be used in a variety of ways, but there are really only two good methods: delimitors and tags. Delimitors are less powerful, but simpler, and take up less space. For example, in a shopping list one might write a comma between each item and its successor. In such a list the humble comma would be a control character, and it would be called a comma-delimited list.

Similarly morse code could be said to be pause-delimited. ...

Huffman-like Codes

This is the method that is used in morse code. The concept is that because different characters have different frequencies, we should send common characters with fewer bits - or fewer dots and dashes. Mr Morse spent a good deal of time selecting one plausible set of rules for changing letters to bits based on this observation.

"It's worth mentioning that it's possible to apply more than one code to a given piece of data." A BPL provider could either have Morse pauses be control signals on top of its data, or initiate its own control carrier to have its data retrieval wait until after the pause. Either way they could send recognizable-to-the-ear identification either with data being transferred during the "on" state or mere holding data being transferred then. It's a simple matter of software and should not appreciably retard data flow. If a device operates, say, over a range of 60 MHz, then it could break its data (frequency agility, remember) into 1 MHz groups and spend a minute apiece in rotation every hour with identification tags attached. You don't have to tell them how to arrange their i.d., just so every frequency gets identified once an hour.

The bonus is, remember from the story, that second blue bottle? What about signals adding up to an aggregate signal propagating interference through skip? Just have the

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[47] Or instead of sentence-gaps, a version of morse code which includes full stops, semi-colons, and other punctuation characters can be used.

whole system key a simultaneous identification once a day at midnight. If that doesn't get heard then there is no aggregate problem.

Oh, but the BPL companies have assured us no identical frequencies will be used in common in the same area. Right! We need to take a closer look at the historical context of BPL:

1.1.1 Early Years of Radio[48]

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 nonlinear modulation scheme of FM was capable of trading usable bandwidth for signal fidelity. For once, engineers could

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

> 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." Computer talk over the internet is fast and would necessitate blanketing HF between 2-30+ MHz to cause massive radio interference when they are piped into power lines, effective antennas at HF. That is because among "bandwidth, signal power, and noise power" you've determined that signal power is to be low, noise power will be high——since internet operation was not envisioned in the past when power lines were strung up and electrical devices turned on——, and all that remains is bandwidth which must be broad to compensate.

Now, it may be true that no two devices in the same area will use the same *discrete* frequencies——that's only good engineering——, but all those discrete frequencies have small bandwidths associated with them, and those bands of energy would necessarily overlap as such a BPL system will need enormous amounts of spectrum, and there is only so much to be had. A VHF TV channel is 6 Mhz wide, and let's say the BPL system uses such an amount of spectrum for each device in operation and covers 60 MHz altogether. That means only 10 could operate on independent frequencies. Say, you've got a BPL system in a city of millions, and 100,000 devices are being operated at the same time. That means the whole 60 MHz will be loaded with devices on same frequencies 10,000 deep. I say let's identify them in the aggregate once a day, at midnight to help separate out the various time zones propagating by skip.

So once interference is identified, it can just be switched off. "We propose to require that Access BPL devices incorporate a shut-down feature that would deactivate units found to cause harmful interference, and thereby allow speedy implementation of interference mitigation measures" (**FCC 04-29, ¶ 42**). Easier said than done. What if instead of your optimistic occasional problem here or there, an identification system shows that there are problems all over. Shutting down a whole system might not be what a

company wants to do or can do.

A BRIEF POSTSCRIPT[49]

> ... A number of critics claimed that any potential threat from computers could be countered easily by `switching off' the system.
>
> In practice, this argument is somewhat wide of the mark. Perhaps I could demonstrate this by inviting you, the reader, to `switch off' the internet now. You will see that it is a vastly more difficult problem than at first it seems.
>
> The critical feature of a `switch' is that it must be designed and constructed and installed before it can be used. We have only to look at our own households to see that a switch is a highly specific physical entity designed for a specific purpose. We install a light switch, for example, to turn the light of a bathroom on or off. If I may turn the argument against such critics, the idea that there is no great threat posed by computers because in an emergency we can switch off the system is simply untrue. The precise opposite is the case. The system can only be switched off if we agree that a threat exists, and take steps to install such a switch or switches as a result of this prior agreement.
>
> But this is hardly the end of our problem. How can such a switch be constructed without extreme political and social resistance? The right to communicate on the net without interference from some arbitrary authority is one of the established freedoms of liberal society. Who or what authority should be granted the power to switch off the international net? ... These are highly complex political and social issues.
>
> Switches and `firebreaks' (which separate one part of the net from another) are only possible if there is both prior agreement as to the dangers and considerable political will to act.

If there is not the political will to turn a switch off, how does the switch really exist? If the FCC will only protect "critical communications," and not the routine, how can you say Part 15 protects those others from interference by not allowing it? Let's take some concrete examples.

Okay, we want to bring BPL to farm communities, fine. I am an amateur radio operator who sometimes works other hams who live on farms. Many have quite elaborate antenna systems and know antenna theory. If the BPL companies succeed in turning antenna wires into well-behaved transmission lines, how will these hams react to such a miracle?

> The farmer used the time to reach a conclusion: he couldn't keep something like this to himself. This was mighty peculiar stuff. Tomorrow, or the day after, he'd get

[49] Collins, pp. vii.-viii.

the Ford started somehow, drive slowly and carefully into town, and tell everybody what happened.

Only trouble was, they'd never believe him in a million years.[50]

Farmers talk to each other. BPL companies contravene the laws of physics, word will get around.

Okay, let's say the wires radiate like antennas, after all, and there's a lot of HF interference. I grew up in the country. When I was a boy I bought a used shortwave receiver from my uncle for $5. I listened all over the bands and so developed a fascination for radio that profoundly influenced my life. Let's say a small community invests many thousands of dollars in BPL. They could have used another method just as cheap, or maybe cheaper, but that's how it worked out. Say, a kid on the only access road to town buys a shortwave receiver for $5 which is overwhelmed by BPL interference, so that the only cure is to shut down the system. Is the company and community going to turn off thousands of dollars of investment just so some kid with a $5 receiver can hear SW broadcast stations and whatever else he wants to tune in?

I don't know, maybe it's an upright community that goes by the Good Book: (Lev. 19:15) "Ye shall do no unrighteousness in judgment: thou shalt not respect the person of the poor, nor honor the person of the mighty: but in righteousness shalt thou judge thy neighbour." They take the law to heart and turn off their system so the kid can hear his radio. However, some of your commenters have reminded you of what happened in the 1970's with the CB boom, when communities tried to take the law into their own hands regarding interference. It's likely that would happen again.

I know from my own experience that a kid might not be allowed by the other kids to have that much power. There would be retribution. I don't know how much the adults have grown up either. A farm community is where everyone knows everybody else's business. They would know who the kid with the shortwave radio is. If the FCC told a BPL company to shut down their system because it was interfering with someone's shortwave reception, it wouldn't be long before they figured out who that person was. If you are targeting farm communities for development of BPL, relying on turning off an interfering system, then I advise you to give some thought to a person's anonymity, more than just withholding his name.

Okay, another example is amateur operators who experiment with low power, say < 5 watts. Quite a number of them sent in their comments asking for protection from interference. I have done my share of such QRP operating. I know that to get the contacts I seek, I must have real good propagation conditions. As the maximum usable frequency (MUF) changes with ionospheric conditions, the ionosphere becomes a near perfect reflector right at the MUF which only lasts minutes. During that time I've got to try to make my contact.

What happens if I am experiencing severe BPL interference? Do I have to go through a long bureaucratic process to get my frequencies clear? But the band may change from day to day and definitely according to the eleven year sunspot cycle. If it takes days, weeks, months, to get a frequency clear, why the MUF could be in an entirely different

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[50] Joe de Mers, The Return (New York: Dutton Books, 1996) p. 8.

band by that time. So how has that implemented, your proposal "to require that Access BPL devices incorporate a shut-down feature that would deactivate units found to cause harmful interference, and thereby allow speedy implementation of interference mitigation measures" (**FCC 04-29, ¶ 42**)?

For the third example let's look at mobile operation. How is a ham traveling in his car (or on bicycle or by foot) going to speedily implement a shutdown of an interfering BPL network? The power lines follow the roads, so this situation is bound to come up. Furthermore, the FCC is required by law to take some care to facilitate such operation.

PUBLIC LAW 103-408 [S.J. Res. 90]; October 22, 1994
SECTION 1 FINDINGS AND DECLARATIONS OF CONGRESS.
Congress finds and declares that--
...
(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.

I suggest that BPL companies be required to send out a Morse code identification, at between 5 wpm to 10 wpm, using the initials of the power company they are operating in conjunction with (as long as it isn't S.O.S.), and the mode of modulation they are using modulating the signal, like an audio modulation only this is a digital signal superimposed on the on-off morse sending. They can either use a test modulation or they can send actual data on top of the Morse. This would be broken up into band segments of the company's choosing, so long as they each span not less than 100 KHz. I should note here that as the power lines have nonlinear junctions in them and also pick up other strong signals like broadcast stations, we'd expect to find mixed signals and harmonics popping up at weird places, not according to the frequency tables of their operation. This would help us pick off the offender.

Each frequency band would be required to identify at least once an hour and at startup and shutdown. Along with the power company initials would be sent a seven digit number that the BPL company makes up and changes at midnight every day. That provides a daily way to identify interference sources. In addition to this is a system-wide identification with its own protocol sent every day at midnight. That would help us to locate aggregate interference arriving by skip.

The BPL companies would be required to send out a pamphlet in the mail to all power users in the power company's service area explaining interference issues and what it would sound like. The pamphlet could be enclosed with a person's power bill and sent periodically. The pamphlet would include an interference phone number that is adequately manned. The phone number would also be indicated on the monthly power bills themselves. Additionally, that interference hotline number should be listed in the local phone directory next to the power company's listing, this to help the mobile stations driving through an area.

Okay, when one calls that number, he is presented with a menu of options. First, he can talk to a live person conversant with the technical issues. Next menu option is that he

can enter a frequency in kilocycles, and the system will avoid using that frequency, plus and minus 10 kc, for one hour. That will free up a frequency from interference. This would go into effect automatically as long as the call monitored on caller-i.d. was originating in the local service area.

The next option is that he can enter the secret 7 digit number that he copied by Morse code, the one that the company changes daily at midnight. That will shut down that frequency band for the rest of the day, until midnight when a system i.d. is sent and the numbers get changed. BPL companies are encouraged to use assigned bands, like 350 KHz for a ham band, so much for an HF broadcast band, etc., but a minimum of 100 KHz spread is required.

The next menu option is that a caller may send a *recording* of the Morse i.d. and the BPL company software will decipher it and make the necessary adjustments to its signal.

That method will preserve the anonymity of the caller, offer a truly speedy solution to someone who needs it, and make provision for a mobile operator who can pull off the road and look up a number in the phone book to take care of his problem. It would also protect a BPL company from nuisance calls, as the only way anyone would know the i.d. numbers would be to have copied them over the air.

One variation might be a series of i.d. numbers sent at decreasing power levels. The lowest one capable of being heard, or that one could live with, would get reported, and the BPL company would have to reduce power one step below that on that frequency band.

Now some brief comments on measurement:

> **2. Fields in the Vicinity of an Antenna——Induction Fields.**[51]**——**The electric and magnetic fields in the immediate vicinity of an antenna are greater in magnitude, and differ in phase, from the radiation field as calculated by Eq. (2). The electric and magnetic fields that must be added to the radiation field in order to give the fields actually present are termed *induction fields.* These induction fields diminish in strength more rapidly than inversely proportional to distance. Thus the induction magnetic field from a doublet is inversely proportional to the square of the distance, and the induction electric field from a doublet has one component that is inversely proportional to the square of the distance and another that is inversely proportional to the cube of the distance. Inasmuch as the radiation field is inversely proportional to the distance, the induction fields die away much more rapidly with distance than do the radiation fields, and at distances of a few wave lengths become negligible in comparison with the radiation field. However, at distances from the antenna that are small compared with a wave length (or small compared with the antenna dimensions if the antenna is large), the induction and magnetic fields will be much greater than the radiation field of the antenna.
>
> The induction field also differs from the radiation field in that, unlike the latter, the magnetic and

[51] Terman, pp. 771f.

electrostatic field intensities of the induction wave are not proportional to each other, nor are they in phase.

The electric induction field becomes proportionately stronger than the magnetic induction field as the distance to the antenna becomes less in the case of a doublet antenna. With a loop antenna, the magnetic induction field is increasingly predominant as the distance becomes less.

Being surrounded by power lines, I have done some experimenting with small antennas responsive selectively to electric or magnetic fields, and I have discovered that though power lines surround me, they behave like the doublets with electric fields predominating in close proximity, not like loops with magnetic fields predominate close by. I am curious about something. Below 30 MHz, measurements are to be performed with a magnetic loop antenna (**FCC 04-29, ¶ 45**). As the magnetic field declines by the square of the distance, then a decade range (10:1) closer would result in a 20 dB (x 100) increase in signal rather than the 40 dB stated in footnote 104. The 40 dB figure would give one an actual 30 meter distance signal that is 20 dB higher than the allowed. I believe you should fix that glitch to reflect only a 20 dB difference in the *magnetic* fields between 3 meters and 30 meters, to limit radiation to the required amount when using the adjustment method. Not only does it give a signal 20 dB too strong as it is now set up, but it provides a temptation for BPL companies to use the adjustment method to allow a higher output.

There is another concern regarding bandwidth of measurement which isn't specified. It might be needed which wasn't needed for discrete frequency devices. I've included an article that elaborates on the problem.

Finally, in answer to your question on allowable signal limits for BPL in the AM broadcast band assignment, I'd just like to point out that there are 575 million AM radios in the United States, so that if you allow BPL operation in the AM broadcast band, you might want to prepare for an added workload to resolve interference complaints.

Respectfully Submitted,
Earl S. Gosnell III