PLT . . . . . and the Future of the HF Spectrum

by Hilary Claytonsmith, G4JKS *, RSGB EMC Committee

WE ALL KNOW the UK government's position on 'Broadband Britain'. This has been made clear in statements from the DTI in various technical meetings effectively saying that Broadband Britain is so important that the government will decide permissible interference levels after weighing up the compromises which will have to be made.

The Society formally flagged the potential radio interference problems from systems "using the existing copper infrastructure" in early 1998, and has been involved in forums, discussions and working groups ever since. The question now is, "Will the people who actually make the decision, whoever they are, be fully informed and not be led astray by short term political and commercial expediency?"

The Society's most important activities in this area have been our participation in the RA's Technical Working Group (TWG) on "Compatibility of VDSL and PLT [see box below right] with Radio Services in the Range 1.6 to 30MHz". The Society has been pleased to serve on the RA TWG itself and also on the drafting group. On completion of this Group's work it is believed that the Report was revised and amended by representatives of various governmental bodies. The final version of the report has been circulated to members of the TWG. The majority of the points raised by the Society and other radio users seem to have been addressed. However, there are still certain aspects of the report with which the Society does not wholly agree.

In the European context, the Society has been represented in the CEPT / ECC Project Team SE35 looking at "PLT, DSL, cable communications (including cable TV), LANs and their effect on radio services" and in the Joint Working Group of ETSI/CENELEC, charged with drafting the final European standard for emissions from telecommunication networks.

Looking at the general run of papers, discussion documents and web pages on the use of "the existing copper infrastructure" for transmitting data signals, a few are excellent, presenting good engineering information in a professional manner. Others are quite the opposite, claiming unbelievable data throughputs and completely ignoring EMC - or more often passing it off as simply a question of getting the EMC standards sorted out to accommodate their system - as if their right to the spectrum was a foregone conclusion.

The Society's involvement over the years has led to the sad conclusion that although the impact of systems such as ADSL and perhaps VDSL on the electromagnetic environment has been reasonably well thought out, the potential problems of the more controversial proposals, such as various forms of PLT, are much less well understood even by some of their proponents.

MISUNDERSTANDINGS

HERE ARE A few of the misunderstandings and half-truths put forward in various guises. In some cases these may have been due simply to a lack of knowledge of the electromagnetic environment. In other cases the misinformation appears deliberate.

1. "*There is no need for interference control more stringent than that of the existing EU Product Standards*". This is simply not true. The product standards (such as EN55022) are a practical compromise. Most interference to amateur radio comes from sources which themselves are compliant with the standards. The only reason that small signal services like amateur radio can exist is because most products are much better than the standards require and in many cases are operating for only a limited time. Broadband emissions 24 hours a day at the maximum level permitted by the current product standards would be a disaster.

2. "*The ambient noise level on HF is so high that high levels of emission on the HF band are justified*". Again this is simply not true. In residential areas, the HF ambient noise is relatively low for most of the time, with bursts of noise which are a nuisance but which do not prevent radio communication. Again, broadband noise present all the time would be a totally different problem.

3, "*Measurements made on high grade calibrated instruments can be relied on to give a true picture*". Plots have been published where the presenter has "forgotten" to note that the lowest level of the plot is the noise floor of the measuring antenna not the ambient noise floor, which

TECHNOLOGIES FOR SYSTEMS USING EXISTING CABLING

ADSL (ASYMMETRIC DIGITAL SUBSCRIBER LINE):

Frequencies used - up to 1.1MHz. Generally launched into the phone line at the local exchange.
Deployment: ADSL is being deployed in the UK and there are many thousands of customers.
Interference potential: The standard laying down permissible emission limits on ADSL is not as tight as we would like, but in practice systems seem to be better than the standard requires, and there does not seem to be a significant problem. So far the EMCC has not received any reports of interference from, or breakthrough to, an ADSL installation.

VDSL (VERY HIGH BIT RATE DIGITAL SUBSCRIBER LINE):

Frequencies used: up to 12MHz. Generally launched into the telephone lines at the street cabinet.
Deployment: Not deployed (except perhaps on an experimental basis) in the UK.
Interference potential: The launch powers are tightly controlled by international regulations to avoid mutual interference in the multicore cables. The regulation includes optional 'notches' for the amateur bands. The intention is that these would be invoked should there be an interference problem. It is not possible at the moment to say whether VDSL - if it is ever deployed in the UK - will be a problem to amateur radio.

PLT (POWER LINE TELECOMMUNICATIONS):

Frequencies used: For Internet access (generally known as 'access PLT') up to about 10MHz. Broadband signals are injected at the electricity sub-station and enter the domestic wiring of each house on the circuit. Proposed 'in house' systems could go up to 30MHz.
Deployment: Access PLT is not deployed in the UK (except for some very limited experiments). Trials so far have confirmed high levels of emission from access PLT systems.
Interference potential: There is no imperative system requirement to limit launch power, so ultimately the only limit on radio interference will be the emission regulations which are presently under discussion. The available bandwidth is shared by all the householders on the circuit, encouraging the use of the highest possible launch power to achieve a high data throughput to an economic number of customers. The question is, how will amateur radio be affected if access PLT is deployed on a commercial basis? On present showing it would be disastrous.

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RADIO SMOG

A commentary by David Sumner, K1ZZ, and published in the 'It Seems to Us . . .' column in the ARRL members' magazine, QST*, October 2002.*

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

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

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

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

Unfortunately, the same cannot be said of spectrum policy. In some ways we do indeed seem to be going backwards, or having to fight against pressures in that direction.

Many sources of radio smog are unintentional. Switch-mode power supplies are not designed to generate radio interference. Unfortunately, in some cases they are not designed not to. They could be, and if either consumers or governments insist on it they will be.

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

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

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

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

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

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

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

can be up to 30dB lower than the plot indicates. This is then used to justify claims that existing ambient noise is high. Similarly unsuitable measuring bandwidths have been used giving the impression that the ambient noise is much higher than it actually is.

4. "*Security and safety of life services could be protected from interference by having exclusion zones around receiving sites".* This may or may not be true. Some studies indicate that the exclusion zones might be impractical. In any event the Society has made it quite clear that such a concept is totally unacceptable. If emissions are so bad that such measures are required then there can be no justification for inflicting the interference on the private citizen.

5. "*HF communication is out of date and the HF band would be more profitably used for low cost Internet access".* This is so ridiculous it hardly needs an answer, though believe it or not, it has been made at more than one "professional" meeting. It is worth pointing out that it is not necessary to have high HF emissions to provide low cost high speed Internet access over the existing copper infrastructure. Satisfactory xDSL systems are being widely deployed in the UK and abroad and do not seem to cause any insoluble problems. The question is presumably whether to raise permissible emissions on HF to give greater competition, however great the cost to the environment. Could anyone seriously call this a level playing field?

6. "*Trials of our system have been held and there were no complaints of radio interference".* This is one of the most dangerous claims because it sounds so convincing to non-technical people. A few trials organisers have acknowledged that radio interference is a crucial issue and have cooperated in attempts to determine the extent of the problem. Other have kept their trials 'under wraps' and then claimed that no interference has been reported. In the case of PLT, where the frequencies of operation are in the HF band, away from the domestic broadcast bands, it might be some time before the interference is identified and reported. Even without this problem it is hopeless to rely on complaints from members of the general public - most people have no idea how to identify and report radio interference. Members can listen to sound-clips on the RSGB EMC website which show the nature of PLT interference.

Whilst the Society has been concerned for some time about these systems, the general level of concern elsewhere,

PLT WARNING!

The proposed use of power lines for broadband Internet access is raising very serious concerns for the low power radio industry, as Brian Back (MD of Radio-Tech and LPRA vice-chairman) explains.

The technology behind power generation and distribution has changed very little over the past 80 to 100 years. In fact the largest step change the industry saw was the introduction of AC and the subsequent construction of the National Grid between the 1920s and 1950s. Fundamentally, the system is much the same as it was in those early days: the insulating materials may have changed, but the network still comprises of unshielded conductors passing down every street across the land, both above and below ground.

Then came the telecommunications revolution. Again distribution networks were rapidly established, but this time using shielded / balanced conductors, optical fibres and regulated radio channels. So why the different approach? Simply to optimise propagation and to minimise interference!

WHERE DOES PLT FIT IN?

So, then, if power distribution uses unshielded cables and telecommunication uses controlled / shielded media, what is PLT and where does it fit in?

Power Line Telecommunication, sometimes referred to as Power Line Communication, is simply the superimposing of data on top of the mains. However, the network is not intended for that purpose, the cables are not shielded, and the noise generated by the data can potentially radiate everywhere.

In its defence, small-scale narrowband PLT has been around for a number of decades and is strictly regulated to minimise emissions and to reduce the risk of interference. So why, then, if PLT is so easy and can follow the path of the mains supply down every valley, every street, up every lighting column, into every home, up every tower block and into every workplace, don't we find it everywhere? Simply, experience has shown that it doesn't work very well under the emission constraints currently in place. Modifications are also often required to street furniture and, in spite of this, many of the systems in service struggle even with simple tasks such as switching on and off street lighting.

So what are the UK and other European and international governments planning, and why the concern of bodies such as the LPRA? In summary, they believe that PLT can be used to provide broadband Internet access, bypassing the monopoly of the existing cable providers, to deliver an Internet service 24 hours a day, seven days a week. Like it or not, every home, office, factory and building connected to the mains will in theory get the service.

So what is the problem with this? *Interference!*

In practice, to deliver that data rate required for broadband Internet access will require expanding the occupied bandwidth of PLT up to at least 30MHz, moving the goal posts on emission levels and introducing aggressive modulation schemes.

Apparently, signal levels of up to 20V are already used with the existing narrowband PLT systems and these do not always work! So what will be required for broadband PLT? What will be the effect of these modulation schemes and the increased bandwidth? We simply do not know and are unable to find out! We have not been invited to observe any trials and have not been able to obtain copies of any reports! We have met with a wall of secrecy.

RAISING THE NOISE FLOOR

The consequence of introducing broadband PLT will no doubt result in raising the 'radio spectrum noise floor'. How far we do not know, but is doesn't need to move very far: the spectrum is already polluted with noise from computing, commercial and domestic appliances. Just imagine damage from a broadband PLT network spanning an entire country! The consequential noise could be high enough to mask the monitoring of distant transmissions for national security purposes; the BBC SW broadcast bands will without doubt be hit with the quality of service reduced or blocked; the various international radio societies, including the UK's RSGB, will no doubt have major concerns over interference to their members' protected spectrum; radio astronomers will be effectively blindfolded; and finally LPRA members' equipment operating in the low frequency region could be seriously affected.

In summary, broadband PLT is like pollution: you receive it without choice, it is not biodegradable and it is impossible to clean up! It is alarming to think that not all the implications of PLT have been considered and the public and industry alike have been kept *totally* in the dark.

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particularly about PLT systems, is now rising. With the agreement of the authors, we reproduce here two examples of recent articles expressing concerns about the threat from any widespread deployment of PLT.

We also asked the RA for a statement to include in this article, setting out their position, and this is reproduced here (see 'Compatibility of Wired Telecommunication Networks with Radio Services').

The Society will continue to work in the UK and European standards forums to argue for common sense in setting emission limits to ensure that the HF spectrum remains a usable resource for radio communication. Whether technical arguments alone will be adequate now seems very doubtful. ♦

WWW.

RSGB EMC Committee: www.qsl.net/rsgb_emc

COMPATIBILITY OF WIRED TELECOMMUNICATION NETWORKS WITH RADIO SERVICES

- a statement from the RA

"RECENT DEVELOPMENTS in broadband telecommunication technologies, such as Digital Subscriber Line (DSL) and Power Line Telecommunication (PLT), have raised concerns amongst some radio users about the potential for emissions from these wired networks to cause radio interference. The Agency is therefore shortly to introduce Regulations to control emissions from cables and wires associated with specific broadband technologies operating below 1.6MHz. Studies have also been conducted to assist in determining what future measures might be needed to limit emissions from emerging technologies that operate above 1.6MHz.

"In March 2001, the Agency formed a Technical Working Group on Compatibility of VDSL and PLT with Radio Services in the Range 1.6 to 30MHz. All interested parties were welcome to attend and membership included radio users; telecommunication operators and manufacturers. Around 70% of the radio frequency spectrum in the range considered by the group is used for Government sponsored radio services and officials from all the relevant departments also participated. The Agency was particularly pleased that representatives of the RSGB were fully involved in the group, providing a detailed input on behalf of radio amateurs and more general technical advice concerning this important area of spectrum. The group has now completed its work and a Final Report has been agreed for publication. It is anticipated that the report will be published in December 2002 alongside a National Consultation, which will be seeking views on appropriate emission limits needed to control radio interference from wired networks to ensure the successful coexistence of radio services and broadband telecommunications.

"The consultation will last three months. The results will inform the Government's position before responding to any request by the Joint Working Group of ETSI [the European Telecommunications Standards Institute - *Ed*] and CENELEC, which is currently in the process of developing a harmonised European EMC Standard for wired networks. Any UK Government position will take account of both the need to adequately protect radio services from undue interference and the need to encourage widespread deployment of broadband using competing technologies."

Radiocommunications Agency, Department of Trade & Industry, December 2002