INTERFERENCE FROM IN-HOUSE PLT

1. Introduction
PLT (or PLC) stands for Power Line (Tele)communications. In the USA it is called BPL (Broadband over PowerLines). There are two types of PLT. Access PLT which delivers internet services to a customer via signals injected at the electricity sub-station or other convenient point, and In-house PLT which uses the domestic electricity wiring for networking home computers and similar devices. The distinction here is that Access PLT is originated on the Supply Company side of the meter, whereas in-house PLT is, as it says, on the Consumer side of the meter. There are technical and commercial problems related to Access PLT and so far it has not been successfully deployed in the UK for internet access, though there have been a few trials in continental Europe. Recently there have been trials of lower data rate systems in Europe and in the UK for “Smart Metering” and similar applications. (Note 1).

2. In-House PLT
In-house PLT is technically and commercially a more practical proposition and powerline LAN adaptors (PLAs) have been on sale in UK High Street shops under various brand names for a number of years. PLAs use the HF band between about 4 and 22MHz. Until fairly recently most of the powerline LAN devices available in the UK were to an industry standard established by “HomePlug Powerline Alliance”. These were mainly used in home computer networks and caused few problems to amateur radio for several reasons:

1. They were notched in most of the amateur bands.
2. They only generated significant interference when actually exchanging data.
3. The method of encoding and the lower data rate meant that the interference generated was not particularly intrusive.
4. When the use was simply for interconnecting domestic computers, the periods when data was being passed, and interference was being generated, was fairly short.

About three years ago a much more serious problem arose, when BT Vision started using PLT devices to distribute TV signals as part of their IPTV (Internet Protocol Television) package. The type of PLA used is manufactured by “Comtrend”. While these were still notched for the amateur bands, outside the amateur bands the interference was severe. The encoding system used caused interference which was very disruptive to AM short wave broadcast services. Moreover the interference was present even when no data was being exchanged. In effect there was interference twenty-four hours a day seven days a week!

As this leaflet is being prepared information has come to hand suggesting that BT is to change to devices which reduce interference when not exchanging data. If this is true, it is
3. How Serious is the Problem

BT Vision’s deployment of PLA devices on a large scale focussed the attention of the radio world on interference generated by in-house PLT. The radio frequency properties of domestic electrical wiring varies widely. It is difficult to talk of a typical installation, but there is no doubt that any in-house PLT installation will generate radio interference; the question is not whether but how much. Measurements made by the RSGB on antennas 17 metres from a house where a pair of units were operating, showed strong interference, except where the spectrum was notched for the amateur bands. (See Section 5 below.) Since most listeners to short-wave broadcasting use antennas which are indoors or close to the house, it is clear that there will be severe interference to broadcast reception. This is born out by the many reports posted on web sites such as UKQRM. [1]. Inside the amateur bands the situation was different. The notching seems to be quite effective but there is the question of the extent to which intermodulation products (intermods) will cause the notches to fill.

However the overriding issue so far as amateur radio is concerned is that, if PLAs were not notched, interference to small signal services like amateur radio would be intolerable. There is no legal requirement to notch the PLA spectrum for the amateur bands. The whole question of notching is being addressed by the various Standards organisations. The RSGB has representatives on these bodies as well as contact with experts in other aspects of the radio field. As a result of sustained worldwide pressure, manufacturers have complied at present and all PLAs offered for sale in Europe are notched.

It is interesting to note that the level of interference - measured as conducted current – at the bottom of the amateur band notches is in the same order as the levels permitted by CISPR22 (EN55022). Outside the amateur bands they are about 30dB higher [2].

4. PLT and Interference Standards

PLT and the EMC Standards is a big issue and is covered in greater detail in [3]. In a nutshell, the Society’s view is that the In-house PLT systems discussed above, do not comply with the spirit of the EMC Regulations. For instance the “Essential Requirements” of the EU EMC Directive state that:

*Equipment shall be so designed and manufactured, having regard to the state of the art, as to ensure that:*

“(a) the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended”.

a step in the right direction, but IPTV is likely to involve data being passed for substantial periods – at times when people have leisure for radio activities. It is understood that all of the work on future Standards will mandate In-house PLAs to meet the requirement of EN55022 when not transmitting data. (In this respect it is worth noting that EN55022 does not completely protect small signal services such as amateur radio, it is simply a reasonable compromise. A device that complies with EN55022 may still cause interference to amateur radio reception.)
One might think that this is fairly clear but in fact, despite well argued cases put forward by the RSGB and others, the UK regulator Ofcom, and other Regulators in Europe have refused to rule the devices non-compliant [10]. The RSGB is concerned about the regulatory situation and has set up a Spectrum Defence Fund [4] with the object of ensuring that the legitimate rights of radio amateurs and other radio users are not pushed aside by high power commercial and political interests.

The question of legitimacy of interference generating devices such as PLAs goes further than the needs of radio amateurs and short-wave listeners. If the EMC regulations can be “interpreted” to suit the needs of high power commercial/political interests, what is to prevent anyone else from using this as a precedent to ignoring EMC requirements?

5. Practical Experience of In-house PLT

There have been a large number of complaints of interference to Short-Wave broadcasting caused by PLAs. Ofcom has dealt with over 200 cases. So far as is known all these have been from Comtrend PLAs. Other types of PLA devices also cause interference, but the widespread use of Comtrends by BT Vision means that there are a lot of them about – and they generate interference 24/7. Exploratory trials of Comtrends were carried out by the RSGB using a similar set-up to that used to observe the ambient noise floor and described in Notes on the RSGB Observations of the HF Ambient Noise Floor [5]. Inverted V dipoles were sited 17m away from the house. The interference was observed on a measuring receiver set to quasi-peak in a 9kHz bandwidth. A pair of Comtrends was set up to send video data between two computers, one upstairs and one downstairs. The measuring receiver was tuned across an amateur band and about half a MHz either side. This enabled interference to be assessed inside and outside the amateur bands. Tuning the receiver showed peaks and troughs of interference depending on the data being passed. Typical interference was up to 30dB above the ambient noise level outside the amateur bands; inside the amateur bands interference was not discernable. In this particular set-up filling of the amateur band notches by intermods was minimal. It is not known how typical this is.

Trials with the new digital short wave broadcasting technique Digital Radio Mondiale (DRM) showed that the presence of PLT interference significantly lowered the signal-to-noise margin. The audio output maintains the usual good audio quality until the S/N ratio falls to a critical level at which point the audio disappears completely [6].

6. Notching for the Amateur Bands

This is achieved by processing the spectrum of the outgoing signal to minimise power in the appropriate bands. The effect in an ideal system, is to produce notches about 30dB deep. The bands notched are usually the US amateur bands and, in almost all, experimental allocations such as 5MHz are not included. Intermods will cause some reduction of notch depth, but it is not known how significant this will be. Trials are being conducted to find out which types of loads generate intermods and how much the notch depth is reduced.

7. Proposed Mitigation of Broadcast Interference

As has been said, the broadcast bands are not protected by notching. A proposal has been made (ETSI TS 102578) to protect the HF broadcast service by notching individual broadcast signals. In effect an HF receiver is built into the PLA. This detects broadcast signals and places notches on those which are of a strength likely to be of use to broadcast listeners. On the whole radio users are sceptical as to how such a system would work in
practice. Additionally it raises the question of the rights of ordinary citizens to listen to the radio stations as they wish, without any third party making decisions for them.

**8. Identifying PLT/PLA Interference**

At the time of writing all PLAs on sale in the UK are notched for the amateur bands, so the key feature for identifying PLA interference is that it is low or not discernable inside the amateur bands but is much stronger outside the band. The edges of the interference are quite sharp. The trend should be evident over a few tens of kHz. If possible the receiver should be set to AM and the AGC switched off. Comtrend PLAs sound very distinctive, exhibiting a 1.2kHz tone across the spectrum – particularly noticeable when no data is being passed [SB2]. Other types of PLA are not so obvious and are more difficult to track down because they only generate interference while passing data.[SB4]

Before making a specific complaint of PLA interference, be as sure as you can that the interference really is from a PLA device. It is not essential to know where the device is located but it is important to be sure that the source is a PLA.

**SB1. Single Comtrend PLA.**
**SB2. Pair of Comtrends. No data being passed**
**SB3. Comtrend PLAs interfering with broadcast. Comtrends operating for first 14 seconds then both unplugged.**
**SB4. Homeplug PLAs interfering with broadcast. Quiescent for 12 seconds then passing video signals.**

**9. What To Do If You Are Suffering PLT/PLA Interference**

It is most important that all cases of interference from PLAs is reported to Ofcom so that the magnitude of the problem is officially recognised. Reports can be made by phone or on Ofcoms web site [7].

Make sure you get a reference number so that the case can be followed up. Generally speaking Ofcom will investigate reports of PLA interference, but they have no powers of enforcement should the householder refuse to co-operate. Again, the RSGB has pressed Ofcom several times to put suitable interference regulations in place under the Wireless Telegraphy Act 2006, but they have refused to do so. Thus Ofcom can only “advise” – though on the plus side it can be said that the moral authority of such an organisation is considerable. Usually Ofcom work with BT and the common solution is to install a wired system or a wireless system. By such means it is claimed that the majority of cases are solved. While it is good news that Ofcom and BT accept that interference is being caused, and accept responsibility for dealing with individual cases, it does nothing to further the general problem of PLA interference.

In addition to reporting PLA interference to Ofcom it should also be reported to the RSGB and/or other interested groups such as UKQR [1]. You don’t have to be a member to report PLA interference to the RSGB [8]

**10. New Powerline Devices.**

A new type of PLA by Belkin has come on the market. It is claimed to have a data rate in the gigabit region. This device uses not only the HF band but also extends up into the VHF region. Emissions at VHF will pose different problems from those at HF. Above 30MHz the natural noise which constitutes the ultimate noise floor at HF, starts to die away and as the
frequency rises towards 100MHz receiver noise becomes the dominant factor. This makes it possible to receive very small signals, but it also means that interference is more of a problem. Current Standards permit fairly high radiated emissions on VHF presumably on the assumption that interference will be infrequent and on discrete frequencies. Broadband interference at the maximum level permitted by CISPR22 would be a very serious problem to the amateur VHF bands. The RSGB is investigating these PLAs [9]

Notes and links.

Note 1. Access PLT was strongly encouraged by the EU Commission around 2000 to 2005. It was seen as a way of providing competition to the “old” telecommunications organisations providing internet access via telephone lines. This was supported by the UK government of the time on the mistaken assumption that it would somehow assist their “Broadband Britain” plans. Access PLT has severe technical problems and was effectively eclipsed by simpler, low cost systems using telephone lines and cable systems. Access PLT proposals in the UK involved injecting an RF signal carrying the data into the electricity cables at a convenient electricity sub-station. The idea was that customers could simply plug a modem into a 13Amp socket anywhere in the house and get an internet signal. The obvious disadvantage, apart from interference, was that the injected data stream was shared by a relatively large number of customers so that the data speeds we have now come to expect were not practical. The whole proposal to promote Access PLT was vigorously opposed by IARU, and in reality few trails of Access PLT took place. Those that did have generally been closed, and Access PLT as a mean of providing broadband access to the home is no longer considered a viable technology, nor a commercial proposition.

However, Access PLT is now being supported by the EU Commission because it provides a means of access for Smart Metering schemes as envisaged by the Energy Directive. We can expect renewed activity in the field of Access PLT, though fortunately the high data rates required for video streaming will not be required. On the other hand the prospect of every home transmitting usage data every 30 minutes means that a huge amount of data will be exchanged which could have other EMC implications. [11]

Links
[2] EMC Col. Feb 09
[3] RadCom EMC column archive
[4] Spectrum Defence Fund item
[6] PLT affects DRM
[8] Report PLA interference to RSGB
[9] EMC Col. June 10
[10] Letter on Ofcom section of RSGB site

Also of interest:
Home Grid Forum: http://www.homegridforum.org