Submission on PLC

Brendan Minish
Raheens
Castlebar
Co Mayo
Ireland

+353 94 9023326
+353 94 9026692 (FAX)
bminish@minish.org

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As a European HF radio spectrum user I welcome this opportunity to make a submission on PLC.

Before dealing with the precise point of whether or not PLC systems will be in conflict with the essential requirements of the EMC Directive, I should like to make a general observation. It would seem that the Commission and Member States have a difficult dilemma. Most administrations will wish to encourage the implementation of broadband services, especially in rural areas and at the same time would not wish to see important radiocommunications services impaired or the introduction of new radio technologies adversely impacted. I would therefore encourage the Commission to examine all technologies capable of bringing broadband to the consumer at an economical rate, before positively discriminating in favour of one technology in particular, which is likely to add significantly to the ever increasing pollution of the spectrum resource that has been an unfortunate by-product of the digital revolution. Just like other forms of environmental pollution, realistic and cost effective means of reducing the problem should be addressed through the encouragement of less-polluting technologies. A few examples would be the use of licence exempt spectrum and the encouragement of fixed wireless access systems. The recent innovative hybrid satellite - wire-line DSL systems would be another example as would the encouragement of schemes to fibre Europe. There are numerous other possibilities which could also be investigated.

On the assumption that irrespective of standards or limits designed to provide a presumption of conformity with the EMC Directive, the essential requirement in Article 4a shall be respected; apparatus shall be so constructed that the electrical disturbance it generates does not exceed a level allowing radio and telecommunications equipment and other apparatus to operate as intended.

Against this background I would like to address some points raised in the initial working document on Broadband communications through powerlines COCOM03-32

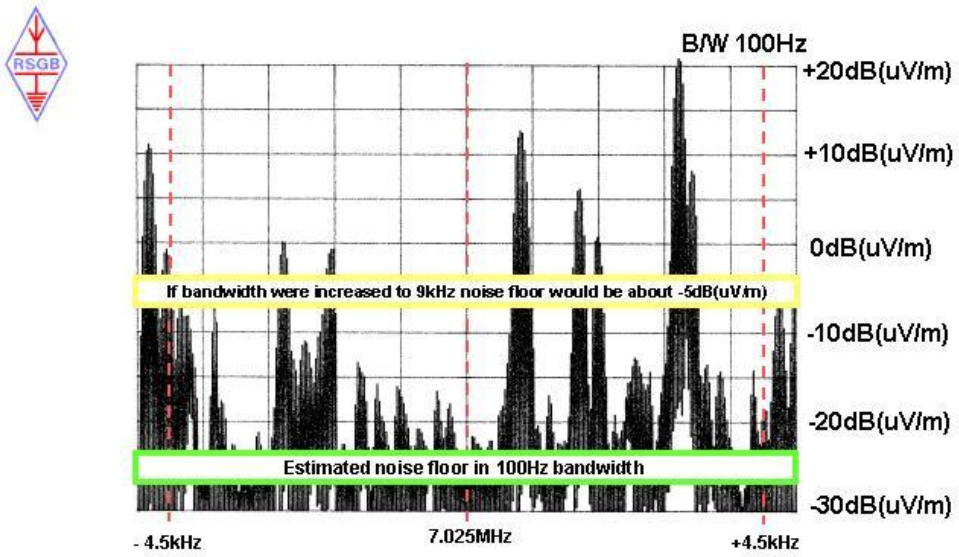
" Modern PLC systems do not seem to give rise to the same interference problems that characterized the first generation PLC systems and are flexible to adapt to interference situations, if and when such situations arise."

Recent measurements made in the UK at Creif by the UK radio authority and measurements made by Ofcom in Switzerland suggest that this statement should be questioned.

The Swiss measurements showed that the system measured in Fribourg failed to meet the German NB30 limits, which were compromise limits designed to make all telecommunications users equally miserable. In other words a radio environment which conformed to NB30 limits does not adequately protect some radiocommunications services whilst some broadband technologies may have to undertake preventative measures to comply with the limits.

It must therefore be questioned whether any standard based on NB30 limits would meet the essential requirement referenced above since its general introduction would not adequately protect radio services from interference. The current practice of making measurements using a 9 kHz bandwidth may also be inappropriate for HF radio systems where the modes of communication used can be much narrower than 9 kHz (2.3 kHz for SSB, around 500 Hz for narrowband data and less than 100 Hz for morse telegraphy).

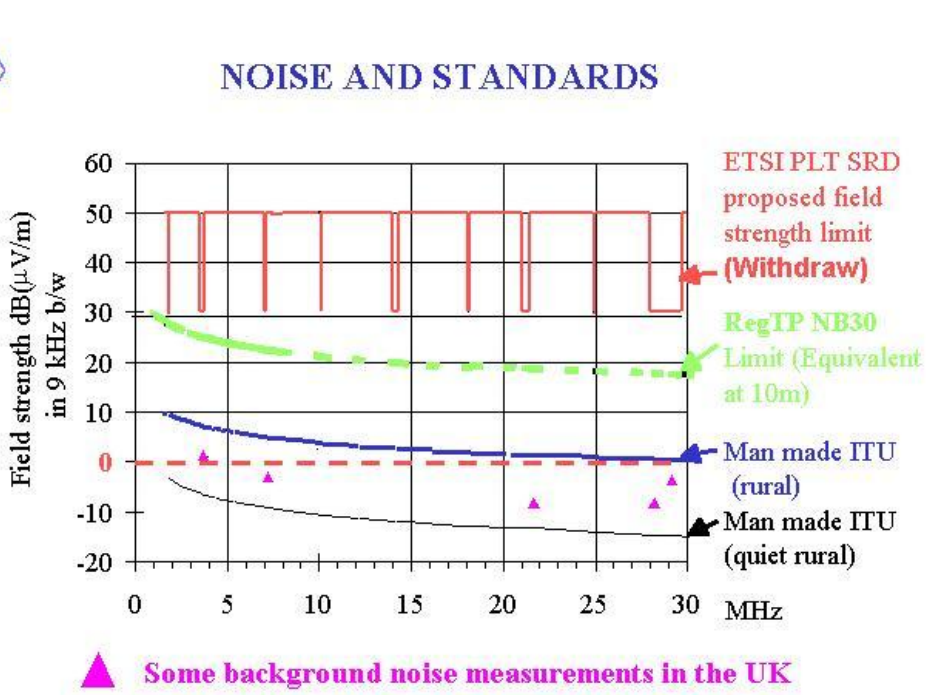
Measurements of the HF noise floor in a 9 kHz bandwidth show the background HF noise floor as being considerably higher than it would be for narrow bandwidth users. The following text illustrates this (taken from the RSGB submission to the UK radio authority technical working group on PLC and DSL)
http://www.qsl.net/rsgb_emc/emcslides.html




**Signals and Noise in a 9kHz Band Centred on 7.025MHz**

**Mid-morning at a suburban location**

**Half-wave inverted V dipole**




This illustration shows the relative level of the proposed NB30 limit. At this level only the strongest HF radio signals can be heard above the PLC systems.

The NB30 limit therefore does not protect HF users from interference. Any increase in the noise floor thus has a significant impact on some HF communications services.

There is a suggestion that the generic emission standards need to be relaxed in order to take into account PLC, or at least a specific category within the standard made for PLC which allows higher emission than other applications. However the standards have been through an extensive public consultation process worldwide, and assembled wise men and women have determined that these emission levels provide balance between competing needs. It is the central plank of the "compatibility levels" concept that is the engineering basis for all of the EMC emission / immunity standards. The counter argument is that generic EMC standards for other electrical devices e.g. railway trains and lighting, permit higher levels. However it is well known that some of the standards have been developed during a period when the European spectrum authorities have not been as involved in EMC work as they should have been. Furthermore, some of the devices mentioned here produce interference in a transient manner such as the passing train, or it can be switched off or replaced, in the case of low voltage lighting. However interference from electronic communications networks will generally be of a permanent nature. To seek to withdraw a broadband service following interference complaints would cause major political and socio-economic problems especially in the local community.

From a technical stand-point power lines make very poor RF transmission lines, are unbalanced, and are notorious radiators of electromagnetic noise. The gain of the power-line as a radiator increases rapidly with frequency - a radiating conductor with relatively low emissions at 0.1 MHz can have emissions tens of dB higher at HF. (Calculated Levels from Broadband Over Power Line Systems and their Impact on Amateur Radio Communications Circuits, Ed Hare, ARRL, July 2003).

The interference potential from PLC to other spectrum users working with weak signals in the HF and low VHF spectrum is very high and extremely widespread. This has been clearly demonstrated in the United States in the testing of trial PLC systems operating as well as testing in many other countries including Japan and in Europe, http://www.arrl.org/tis/info/html/plc/.

PLC is said to be a polluter of the radio spectrum, causing a large rise in the `noise floor' in urban areas akin to "radio smog". The introduction of PLC systems could make a mockery of existing EMC legislation requiring manufacturers of electronic and electrical equipment to meet rigid emission limits designed to protect the radio "noise floor" and guarantee the performance and co-working of sensitive radio equipment.

The American Radio Relay League (ARRL) has clearly demonstrated the interference effects of PLC on Amateur Radio communications, and has also demonstrated harmful interference from quite low power HF transmitters into the PLC network, using PLC test sites running in the U.S. They have presented a detailed submission to an FCC "Notice of Enquiry" into BPL systems.

The ARRL has also demonstrated that laboratory measurements of radiated emissions, and also computer modelling schemes, do not correlate well to real world measurements.
http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-100A1.doc All ARRL information and technical papers are available from
http://www.arrl.org/tis/info/html/plc/.

The BBC is also concerned about interference to it's short wave broadcasts, especially as most receivers use inefficient internal antennas and are often placed close to mains power wiring, ("Do EMC Limits protect Broadcasting as intended", Stott, BBC R&D). New digital technologies emerging for high fidelity streaming of HF broadcasting may mean a revival of short wave broadcasting as a mainstream entertainment medium.

DSL systems use a twisted balanced pair of conductors and as a result create negligible amounts of radio interference when operating correctly. On the other hand PLC systems use conductors that are unbalanced due to the grounding of the neutral line. Domestic Electricity installations create further problems since it is often common practice to separately route the phase and neutral lines in 240v lighting circuits, thus creating effective antenna systems.
Distributed radiation systems, such as the leaky power lines of the PLC system, create a much more harmful effect by generating interference over extremely large (city wide) areas. This interference is continuous and cannot be easily avoided by changing receiver location, (such as moving a vehicle). Since Power lines and domestic electricity installations form effective antenna systems at HF, treating PLC installations as guided networks is inappropriate.

Experiments with HF transmission near PLC installations has shown that PLC is extremely sensitive to nearby HF transmissions and that HF transmissions can cause a complete disruption to the PLC service even at low power levels. I am not aware of any public studies in which the impact of nearby HF transmissions on PLC systems has been assessed. Several amateur experiments have shown severe effects. This is discussed in Compliance Engineering magazine
http://www.ce-mag.com/archive/03/ARG/hansen2.html

PLC is offered as an alternative last mile technology yet current PLC implementations are impractical over anything but the shortest of distances, typically 300m, require work in the customers premises to allow the PLC signals to pass around metering and transformers and offer limited bandwidth since the system is shared between a group of consumers. These systems will not scale well as consumer demand for bandwidth increases.

There are other more practical solutions to the last mile problem. The most obvious being wireless systems operating on licensed or unlicensed spectrum. Systems are currently available that can span distances greater than 10 Km and offer a throughput in excess of 14 MBit/s on unlicensed spectrum. These systems are easy to deploy, scale well over larger areas and are currently cost effective for operators, especially in the urban markets where PLC is likely to roll out.

PLC will if permitted only allow one dominant operator (the power company) to enter the market in any area. Compared to currently available wireless solutions this will do little to foster competition in the market place.

In conclusion it seems that Article 4a of the current EMC directive may not be respected if PLC is widely deployed. If interference is widespread Member States face the unenviable task of ignoring interference to radio spectrum users or withdrawing broadband from a number of consumers and small businesses. Either way it is a loose – loose situation and may result in unnecessary and unfortunate litigation processes. I would propose that the Commission urge the PLC industry in the interests of technological neutrality to develop their technology further, with the overall objective of producing radiated field strengths similar to those produced by other electronic communications networks in a domestic and office environment.
I would also urge the Commission to initiate further studies of recent advances in broadband technologies in order that the telecommunications infrastructure and information society can be extended into the rural regions of the current EU15 and the new acceding States.