# Call for Contributions

# on

# Powerline Communications

29 September 2003

# POSITION STATEMENT BY PORTUGAL TELECOM (PT) ON BROADBAND COMMUNICATIONS THROUGH POWERLINES

## I. Introduction

Portugal Telecom (PT) shares the vision of the European Commission (EC) expressed in the political initiative called “eEurope”, set during 2000, at the Lisbon European Council, for the European Union (EU) to become the most competitive Information Society (IS) in the world till 2010.

In this context, PT contributes actively to the development of broadband communications through a variety of initiatives.

Nevertheless, PT considers that the investment in alternative infrastructures has to be encouraged as the best way to promote the competition in the medium/long term and subscribes the EC historic commitment to promote infrastructure based competition.

Hence, PT admits that powerline technology adequability should be evaluated in order to make the creation of an alternative broadband network possible. However, there are already certain known aspects that should be taken into account and solved, prior to any significative deployment.

These aspects will be discussed in the following text, in more detail:

- **Technical**: it is important to evaluate the powerline impact on the telephone network, in particular on the broadband telecommunications services. Safeguarding the performance of the pre-existing telecommunications technologies and their natural upgrades is mandatory. To ensure the electromagnetic compatibility aspects (EMC), PT considers that the definition of radiated emission levels for powerline equipment, as well as of the most adequate measurement models, is essential;

- **Economic/Business**: it is important to ensure the business model viability, as well as the non-distortion of the telecommunications market;

- **Legal**: it is important to guarantee the existence of a legal framework that enables the promotion of competition and facilitates the eventual access to this infrastructure;

- **Horizontal**: it is important to consider all the collateral aspects that might be determinant for the success of the introduction of powerline technology and that may influence the other aspects previously referred.

## II. Technical Issues

Powerline technology, both indoor and outdoor, typically shares the spectrum between 1.6 and 30 MHz, which is widely used by radio communications with air interface, thus causing possible harmful interference/noise. It is therefore important to evaluate the powerline impact on these.

It can't also be forgotten, specially in outdoor applications, the potential of interference between the powerline and the xDSL broadband telecommunications services, if the same frequency bands are used and/or if cable insulation is defective or insufficient. ADSL, ADSL2+ and specially VDSL shall be severely affected when broadband communications over powerlines exist in the neighborhood.

For these reasons, PT attaches a contribution presenting some important results and conclusions obtained during the tests made to evaluate the powerline impact on the telephone network. A description of the used test model is also included.

Thus, PT considers that any significative usage of these equipments in the electric network should only be allowed if they satisfy the radiated emission levels defined, based on the most appropriate measurement methods established by the competent authorities. These radiated emission levels should safeguard the normal functioning of the systems already installed and/or respective upgrades, namely those referred in the previous paragraphs.

Still regarding the definition of these radiated emission levels, PT would also like to remember that CISPR 22 establishes limits for frequencies from 30 MHz to 1 GHz. So, the affirmation in the EC working document (see page 8, paragraph 1 and also note 5) that establishes a draft level of 22.5 dBμV/m (at a measurement distance of 30 metres) for the frequency range 1.6 MHz to 30 MHz derived from CISPR 22 seems to need some more discussion.

PT also considers that the existing standards should be used. And CISPR 22 has defined conducted energy limits for the powerline frequency band that should be necessarily met.

We consider that an approach like the one followed by PT in the attached contribution seems to give good guidelines for the establishment of the radiated emission levels.

At the same time, PT suggests that the interference model adopted should consider the typical representative situations of the European electric and telecommunications distribution networks, knowing that some national realities might be different.

## III. Economic/Business Issues

Still, PT considers that the possible sustainability of this business can only be reached through standardisation processes for this kind of equipments that will enable, namely, the interoperability and the necessary interfaces between broadband powerline equipments and between these and other telecommunications equipment.

Only through this can one reach the development maturity and the scale economy that will reduce the prices for this technology, both at the installation level, as well as at the maintenance level.

In short, one can identify three business models, represented, as follows:

- *Dark Cable Provider*: In this model, the utility builds and rents its electrical network and allows access to one (or several) Service Provider(s), which is (are) responsible for the powerline rollout;

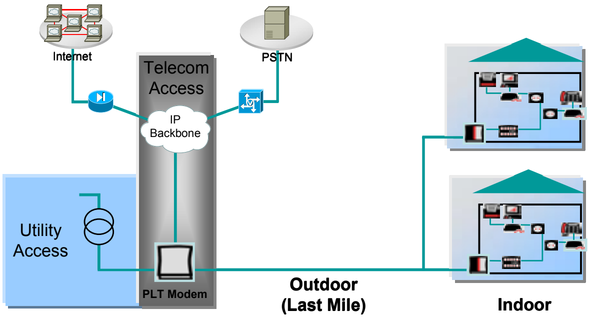


Figure 1 - *Dark Cable Provider*

- *Access Provider:* In this case, the utility builds the powerline infrastructure, allows access to one (or several) Service Provider(s), and uses its (their) connectivity services (ATM/IP);

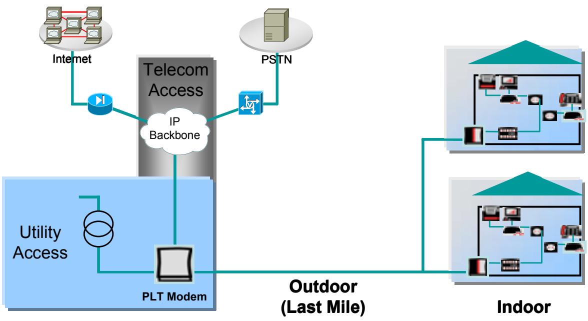


Figure 2 - *Access Provider*

- *Full Service Provider*: In this option, the utility builds the powerline infrastructure and becomes also a Service Provider.

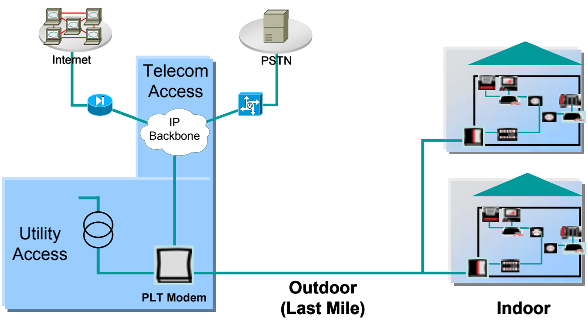


Figure 3 - *Full Service Provider*

As can be seen from the previous figures, the business models adopted can be several. However, one can find other hybrid forms of access, diverging from those previously identified. For example, in the *Dark Cable Provider* model, the totality of the infrastructure (end-to-end) can be considered, or only to the electrical meters.

Mixes of the previous models can also occur, as, for instance, the *Dark Cable Provider* with *Access Provider*, only for distributing management services of the electrical network by the utility.

PT considers, as well, that some discussion has to be done in this area, in order to find the best solutions, since the adoption of some of these models and variants could lead to an abuse of dominant position.

## IV. Legal Issues

Considering powerlines as another communications technology, the EC should adopt an equivalent policy to the one used for the unbundling of the local loop (ULL), in order to promote competition, i.e., to force the concession of access and/or interconnection to the powerline network infrastructure, specially if one acknowledges that the electrical sector has not been yet liberalised in many of the European countries, implying that it will eventually be necessary to change the legal framework of the electrical sector so that it can start to correctly encompass the potential telecommunications aspects.

The transparency and non-discrimination principles must also be ensured, i.e., that to companies in similar circumstances equivalent conditions and information should be applied, in conditions and quality identical to the services and information offered to its own services or to the services of its branches or associated companies.

## V. Horizontal Issues

Like it happened with the ULL, some aspects must be analysed and taken into account, such as co-localisation, installation and operational processes, safety and network(s) integrity processes.

## VI. Conclusion

The above stated comments allows us to conclude that it is essential that the involved powerline equipments comply with the existing standards.

The new ones to be published should be prepared having in mind guaranteeing the normal functioning of the systems already installed and/or respective upgrades.

In parallel, there are also other issues to be covered and discussed, so that the necessary regulation (namely electric loop unbundling and business model, as referred in III, IV and V) and standardisation (namely powerline equipment, as referred in II and III) processes may be properly carried out.

From the point of view of PT, the eventual introduction of powerline communications should be done carefully, safeguarding the previous aspects.

PT as an interested party in this area, is, of course and as usual, available to discuss this subject in more detail.

Portugal Telecom, SGPS, SA
Av. Fontes Pereira de Melo, 40
1069-300 Lisboa
Portugal

Tel.: +351 21 500 2000
URL: www.telecom.pt

# Annex

# CONTRIBUTION FROM PORTUGAL TELECOM (PT) ON BROADBAND COMMUNICATIONS THROUGH POWERLINES

## Powerline impact on the telephone network

Vitor Simões Ribeiro
Networking and Systems Integration
PT Inovação (Aveiro, Portugal)

Mário Rui Santos
Wireless Communications
IT - Instituto Telecomunicações (Aveiro, Portugal)

### I. Introduction

As is well known, electric wires conducting time-variant signals produce magnetic fields that can induce other signals in adjacent wires.

Consequently, this phenomenon may cause additional harmful interference/noise over the telephone network when powerlines exist in the neighborhood. Specifically, the main subject of this contribution is the impact analysis of powerlines on broadband telecommunications services, due to the utilization of the same range of frequencies.

The quantification of this interference is not a trivial issue, because there are several variables involved, like the cable type, length and distance, the transmitted power, the used modulations and the existing SNRs (Signal/Noise Ratios).

With this contribution it is intended to present the followed approach and the used test model, as well as to interpret the main results and conclusions obtained by PT Inovação/IT in this study area.

### II. Test Model

In order to evaluate the powerline impact on the telephone network, a certain number of measures were taken in telephone cables, in order to assess the impact of the proximity of electric cables (1.5 mm diameter) conducting a sinusoidal signal operating in the frequency range from 10 kHz to 30 MHz (with 201 equispaced frequencies corresponding to a 149950 Hz hop) with 0 dBm (1 mW) power.

The main equipment used during the tests was a network analyzer (HP8753D) with 50 Ω characteristic impedance.

Two cable types were analysed: TVV (3 pairs, unshielded) and TVHV (2 pairs, shielded), both with 0.5 mm diameter.

The configuration setup established is shown in Figure 1 and is characterized by the existence of an electric and a telephone cable, both with 20 m length, arranged in parallel and separated by 30 cm (a common situation, specially in buildings).

The charge impedance of the electric line was set to 50 Ω. For the telco cables a charge impedance of 120 Ω was used.

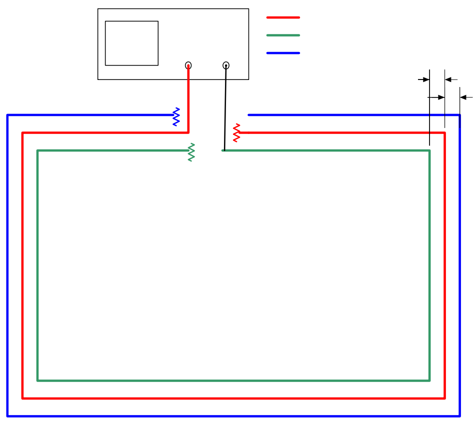

Figure 1 - Configuration setup

## III. Obtained Results

Figures 2 and 3 show the obtained results for both cables (TVV and TVHV) according to the previous mentioned setup.

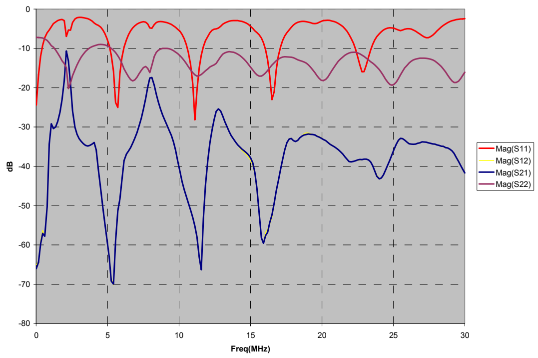

Figure 2 - TVHV cable (20m) at 30 cm ($Z_L$=120 Ω)

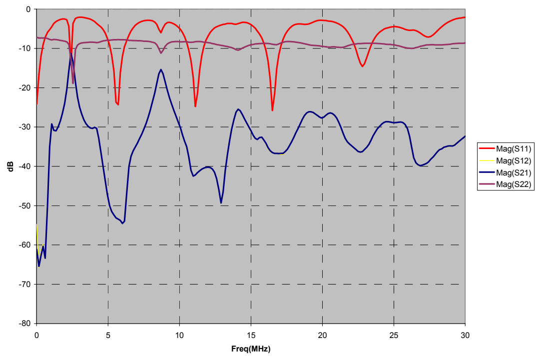

Figure 3 - TVV cable (20m) at 30 cm ($Z_L$=120 Ω)

As it can be seen, the isolation at low frequencies is high (superior to 60 dB). Nevertheless, there are some frequency bands where the coupling is higher than -30 dB, reaching -10 dB near 2.4 MHz.

The obtained values also show that the coupling for the two cables (shielded and unshielded) is very similar, which means that, in general, higher immunity from shielded telephone networks is not expected. In certain cases, the unshielded cable immunity can be even better.

## IV. Interpretation of Results

The basis of the used approach is the utilization and application of the current standard CISPR 22, which imposes the conducted power limits.

CISPR 22 defines two information technology equipment classes: Class A (industrial applications) and Class B (domestic applications) where the conducted power limits imposed for Class B are more severe than for Class A.

With these defined limits it is possible to calculate the maximum signal levels in adjacent telephone cables, according to the transfer function obtained in III. Figure 4 represents the configuration scenario.

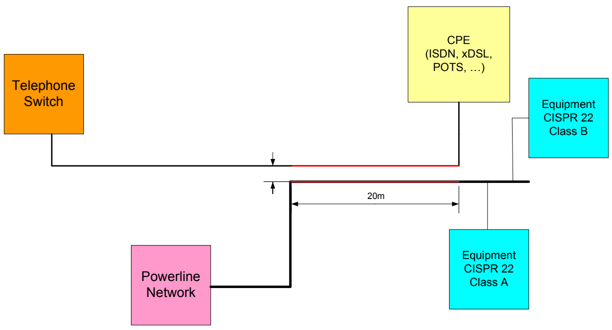


Figure 4 - Configuration scenario

If the analysis of the existing PSD (Power Spectral Density) masks for ADSL, ADSL2+ and VDSL is also included in the study the potential of interference between the powerline and the telephone network can be shown. Figure 5 presents the expected power levels of the broadband telecommunications channels (ADSL, ADSL2+ and VDSL) as well as the interference powerline levels expected for the scenario depicted in Figure 4 (considering the use of the TVHV shielded cable).

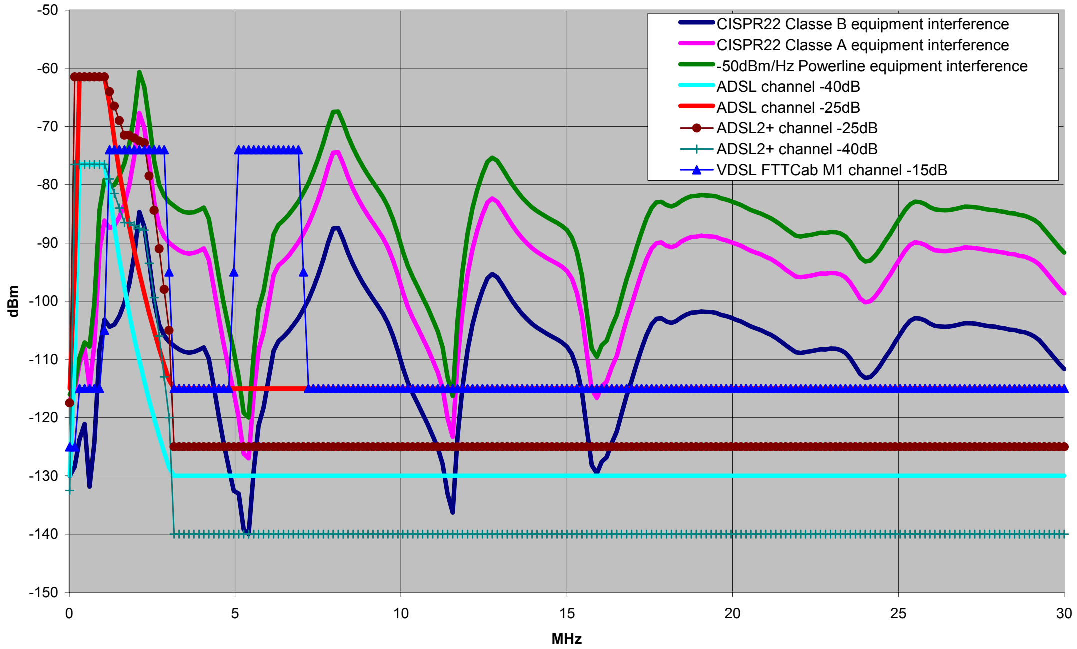


Figure 5 - Broadband telecommunications channels and interference

The interference sources considered are CISPR 22 Class A equipment, CISPR 22 Class B equipment and powerline equipment assumed to transmit a power spectral density of -50 dBm/Hz. It comes clear from our measurements that the strongest interference is the powerline spectrum radiated from the electric cable, naturally followed by CISPR 22 Class A (industrial) equipment and then by CISPR 22 Class B equipment.

The ADSL channels presented are regular ADSL and ADSL2+ downlink channels with 25 dB and 40 dB attenuations due to different distribution loss.

The VDSL channel presented is a downlink FTTCab M1 scenario, variant A (ETSI TS 101270), affected by 15 dB attenuation due to distribution loss.

Different levels of interference are expected for the various systems considered:

- ADSL: The regular ADSL channel with 25 dB attenuation is not affected by any interference source. The ADSL channel with 40 dB attenuation can suffer interference from powerline equipment and, less probably, from CISPR 22 Class A equipment at frequencies next to 1 MHz.

- ADSL2+: Because ADSL2+ has a broader spectrum it is more seriously affected by the interference sources. The ADSL2+ channel attenuated 40 dB is potentially highly interfered by powerline communications.

- VDSL: The VDSL downlink channel, assumed on this study to be attenuated by as little as 15 dB, is severely affected by all interference sources except CISPR 22 Class B equipment. Powerline interference can assume levels 13 dB higher than the VDSL channel power.

## V. Conclusion

The above mentioned results show that a very careful introduction of powerline communications should be carried out. The coexistence of ADSL and VDSL with powerline technologies is far from being peaceful. ADSL and specially VDSL (with existent standards, namely in ITU-T and ETSI) shall be severely affected if no measures are taken from the standpoint of the powerline communications sector. And it is supposed that the performance of both the pre-existing telecommunications technologies and their natural upgrades should be preserved.

In order to avoid these serious problems there should be some powerline regulation and standardisation work to be carried out in this area before any mass deployment, specially in what regards activities for the definition of power spectral density limits and for the existence of frequency guard bands to other communications systems.

## References

1. Regulamento de Segurança da Rede de Distribuição de Energia Eléctrica de Baixa Tensão ("Security Rules for the Low-Power Tension Distribution Network").

2. IEC CISPR 22, "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement", 1997.

3. IEC CISPR 16-1, "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus", 1999.

4. ETSI TS 101388, v1.3.1, "Asymmetric Digital Subscriber Line (ADSL)", 05/2002.

5. ITU-T G.992.5, "Extended Bandwidth ADSL2 (ADSL2plus)", 05/2003.

6. ITU-T G.993.1, "Very high speed Digital Subscriber Line (VDSL) foundation", 03/2003.

7. ETSI TS 101270, v1.3.1, "Very high speed Digital Subscriber Line (VDSL)", 07/2003.