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Technical Specification

Powerline Telecommunications (PLT);
Coexistence of Access and In-House Powerline Systems

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Foreword

This Technical Specification (TS) has been produced by ETSI Project Powerline Telecommunications (PLT).

The present document specifies the procedures to ensure a co-existence of access and inhouse PLC (powerline communication) systems in the spectrum from 1,6 to 30 MHz. The definition of this whole spectrum range and details concerning the layer 1 are subject for specification in CENELEC SC205A WG 10 with the 1st step in drafting the SRD (system reference document) together with ETSI PLT and ETSI ERM.

Introduction

The SRD (system reference document) on PLT defines the spectrum and characterizes the transmission parameters for powerline communications as such without distinction of the actual application into access and inhouse services.

When using the same frequencies, inhouse PLC is visible in the access and might potentially interfere with access PLC. The same situation appears also vice versa as powerlines are a shared medium. Therefore it is essential to specify the co-existence between access and inhouse to protect each service from interference by the other.

1 Scope

The present document defines the technical mechanism for co-existence between access and inhouse systems or to be more precisely in reference to the Network Architecture Model, the co-existence of the interfaces I_{P-yL} (interface between access Head End and Network Termination Low Voltage) and I_{P-yP} (interface between inhouse Central Node and Network Termination Premises or between several Network Termination Premises). The co-existence between inhouse systems of different vendors is not within the scope of the present document and will be handled in a separate document.

From the legal aspect, the scope of the present document deals with the coexistence between a power line communication system intended for consumer usage (home, apartment, SOHO) where the powerlines are privately owned, and a power line system owned and operated by an administrative entity. The aim of the present document is to avoid interference between these 2 groups of legal owners by technical measures when appropriate mutual agreements between both parties have not been reached. In the presence of mutual agreements, the present document is not applicable.

PLC systems, both access and inhouse, defined in the present document share the spectrum between 1,6 and 30 MHz. Although frequency planning with access systems could possibly be done by operators or power utilities, frequency planning with inhouse systems is difficult to coordinate as inhouse systems are consumer goods supplied by many different manufacturers. Therefore a mechanism is needed to ensure that interference between access and inhouse is avoided.

The present document is applicable to PLC systems for both services, access and inhouse, through all possible generations.

2 Void

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

access/inhouse co-existence: co-existence between access and inhouse systems - or to be more precisely in reference to the Network Architecture Model, the co-existence of the interfaces I_{P-yL} (interface between Low Voltage substation and Network Termination Low Voltage) and I_{P-yP} (interface between Network Termination Low Voltage and Network Termination Premises or between several Network Termination Premises).

inhouse/Inhouse co-existence: co-existence between PLC inhouse systems. Standardization of the interface I_{P-yP} can solve this issue, as this interface is always physically available between several Network Termination Premises.

PLC access system: PLC access service means the local loop (= last mile) to the PLC subscriber from the access Head End (interface I_{P-yL} In the Network Architecture Model). Usually a utility or access provider will offer this service to his subscribers.

PLC inhouse system: PLC inhouse service means that the user employs PLC within his property under his own responsibility.

subscriber: the subscriber has a contract with the utility or access provider for access service.

user or **end-user**: the user employs PLC services, either PLC access or PLC inhouse or both. The user can be the same person as the subscriber, but not necessarily.

3.2   Abbreviations

For the purposes of the present document, the following abbreviations apply:

CSMA	Carrier sense multiple access
FDM	Frequency division multiplexing
PLC	Powerline Communication
PLT	Powerline Telecommunications (ETSI Project)
TDM	Time division multiplexing
OFDM	Orthogonal Frequency Division Multiplexing
GMSK	Gaussian Minimum Shift Keying
QPSK	Quadrature Phase Shift Keying
CDMA	Code Division Multiple Access

4   Blocking filters or other measures to achieve sufficient attenuation between 2 systems.

The idea of introducing blocking filters is to split up powerline network topology (e.g. access and inhouse) into sub-networks, which could then use the same frequencies for PLC transmission.

It is an option in the present document, that a power line system A can coexist with another power line system B if the maximum noise injected by the power line system A on any point of the coexisting network area B is limited in a mandatory way to the noise floor level of -120 dBm/Hz (or to the Pimax levels specified in clause 5 of the present document) all over the SRD band. Within this option the mandatory requirement for the limit of -120 dBm/Hz (or the Pimax level specified in clause 5 of the present document), can be achieved by blocking filters or by other measures to achieve this limit.

If this option for co-existence is chosen, the following clauses are not mandatory. If the mandatory requirement for attenuation down to -120 dBm/Hz (or the Pimax level specified in clause 5 of the present document) within this option is not fulfilled, the subsequently specified mechanism is mandatory.

5   Frequency division for 1st generation PLC systems

5.1   Frequency management

Whereas the evolutionary aim is to achieve a flexible frequency resource allocation scheme (please refer to clause 6), for 1st generation PLC systems the following fixed frequency division is mandatory.
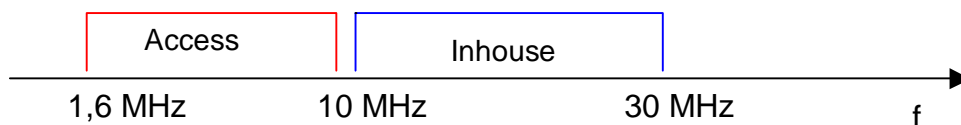
1,6 MHz ≤ faccess < 10 MHz

Exclusive frequency range for inhouse PLC systems:

10 MHz < finhouse < 30 MHz

Access devices may be installed on the subscriber's wiring within its premises.

5.2   Separation between access and inhouse systems

Access and inhouse systems shall follow mandatory the parameters shown in figure 1. In order to ensure that access and inhouse systems can co-exist on the same power network, the transmitter output spectrum of access and inhouse systems must be within the following PSD (Power Spectral Density) masks.
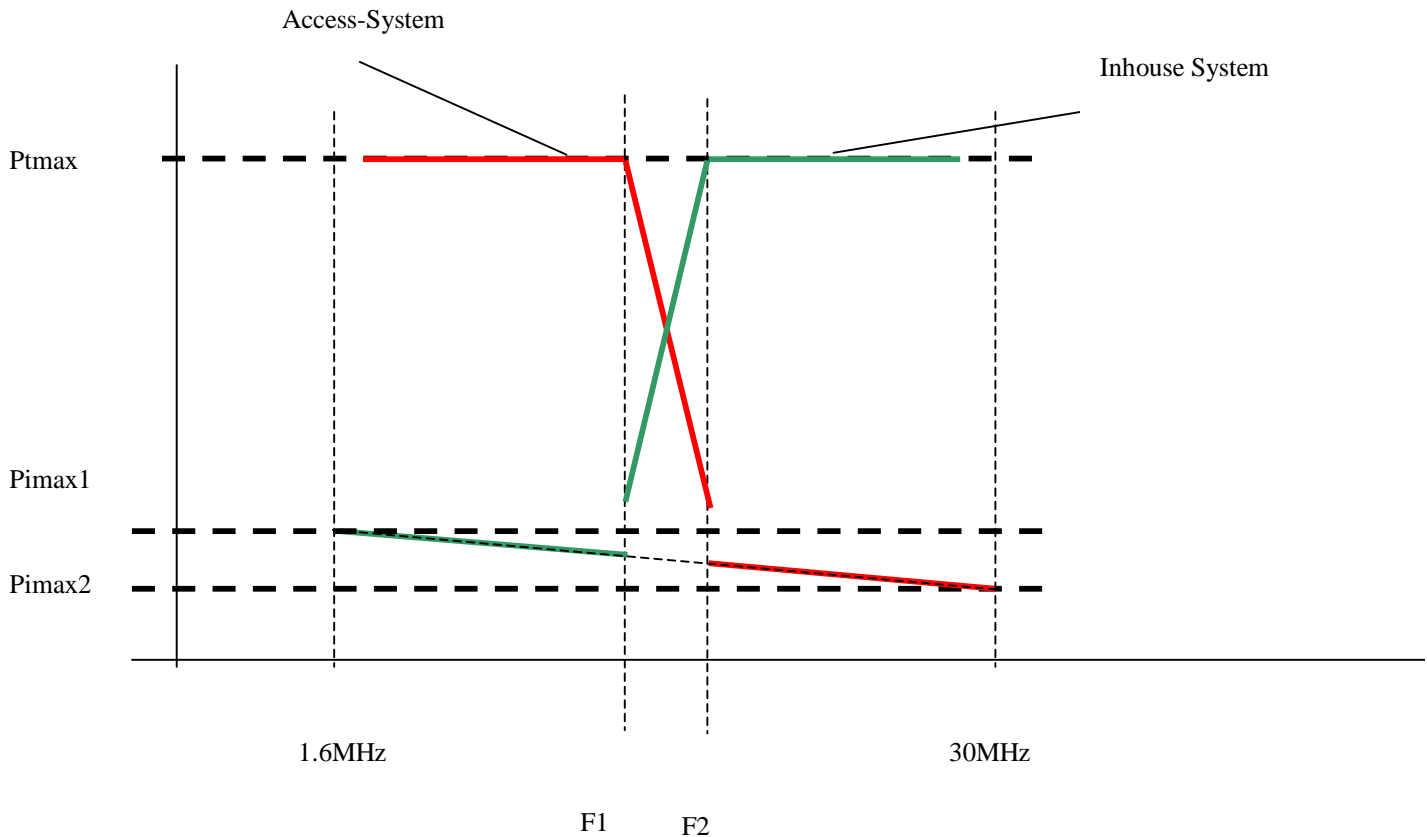
Figure 1: Separation between access and inhouse

The notches in the PSD, as defined in the SRD document, do also apply for the band gap defined in figure 1.

With:

F1 = 9,4 MHz   F2 = 11 MHz

The PSD mask is not applicable if an appropriate incoming filter is installed at the border between the Access and the Home LAN as explained in clause 4.

Maximum Transmit Power Density Ptmax and Plmax1 and Plmax2 (power levels allowed to be injected below 1,6 Mhz or over 30 Mhz) are subject to be defined in the SRD. It is optional to be below these limits.

NOTE 1: Pimax is a representation of the average noise floor level. An inhouse system (or access) must not transmit a power density over Pimax(f) in the access band (or inhouse band).

NOTE 2: The actual Noise Floor Level may vary several dBs on a geographical basis.

Maximum Interference Power Density Pimax(f_{MHz}) = (f_{MHz} – 1,6$_{MHz}$) * (Pimax2 - Pimax1) / (30 $_{MHz}$ -1,6 $_{MHz}$) + Pimax1

Pimax1= -105 dBm/Hz.

Pimax2=-125 dBm/Hz.

NOTE 3: Pimax must be mandatoryly achieved at F1 by PLC inhouse systems and at F2 by PLC access systems.

The other values given within the figure itself are defined by the system reference document on PLT.

6 Flexible frequency management for 2nd generation systems

With the additional proposal for flexibility more sophisticated inhouse systems can offer a higher transmission capacity. This clause is only optional for the present time for both, access and inhouse, systems and will become mandatory for the 2nd generation, which will be described in a revised version of this specification. Thus for the time being, the outline of clause 6 is a very rough indication and is subject for detailed specification till release for the 2nd generation.

6.1 Frequency management

The aim is to achieve a flexible frequency resource allocation scheme. This scheme offers more spectrum for inhouse or access systems, in the case that no access or inhouse service (respectively) is used in a timely and geographically limited situation. The precondition is that inhouse and access systems, which want to use this additional spectrum, have mandatory implemented common channel signalling as described subsequently. The aim of this common channel signalling is to ensure that the access and inhouse services is guaranteed. The Inhouse or access service must release the frequency range with dedicated priority to access or inhouse service (respectively) immediately when an access or inhouse service requires spectrum.
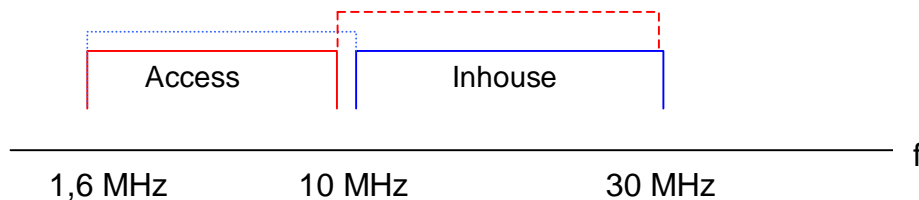
The picture shows the frequency ranges for access and inhouse which are in the solid lines. The dotted line shows the flexible area which can be used by the inhouse service in absence of access service or by the access service in absence of inhouse service.

Priority frequency range for access PLC systems:

1,6 MHz ≤ faccess < 10 MHz

Priority frequency range for inhouse PLC systems:

10 MHz < finhouse < 30 MHz

6.2   Common channel signalling

This clause is subject of revision during the specification phase for the 2nd generation PLC systems. The description here is considered as a rough outline to define the direction for further specification work.

For the time being, no common layer 1 for PLC systems has been agreed. Therefore a mechanism is needed for coexistence of different physical layers (OFDM, GMSK, QPSK, CDMA, etc.). It is proposed to introduce a beacon frequency range for each frequency channel/range as a common signalling channel. To keep this solution feasible (time-to-market, low cost) this signalling channel is located in the spectrum right beside the concerned data channel and contains only a very few information such as channel used/free and possibly system OFDM/GMSK/QPSK/CDMA/etc. As this beacon frequency range uses a common physical layer for all PLC systems, a collision detection mechanism on how to write information into this channel can be defined.

Annex A (informative):
Bibliography

- ETSI Systems Reference Document (V1.5): "Broadband Powerline Telecommunication".

- DTS/PLT-00001: "Powerline Telecommunication (PLT); Reference Network Architecture Model".

History

Document history		
V1.1.1	November 2000	Publication