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Technical Specification

PowerLine Telecommunications (PLT);
Coexistence between PLT Modems
and Short Wave Radio broadcasting services

Reference

DTS/PLT-00021

Keywords

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Foreword

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

Throughout the present document the term "broadcasting services" refers to "short wave radio broadcasting services".

Introduction

State of the art PowerLine Telecommunications (PLT) may cause coexistence limitations with broadcasting services. It is intended that PLT Modems compliant with the present document will provide less interference or greater orthogonality between broadcasting services and PLT Modems.

Requirements for the present document are:

- optimum reduction of interference between PLT and short wave radio broadcast;
- minimum impact on data throughput and QoS requirements of PLT.

The presence of broadcasting signals must be detected by PLT Modems by sensing the "noise" (including radio broadcast picked up on the mains cabling) at an electrical socket. Frequencies where short wave Radio broadcasting signals are identified must be omitted from the transmitted signal by inserting a notch into the transmitting spectrum. This automatic process is called "Smart Notching".

1 Scope

The present document specifies a mechanism for PLT modems to avoid possible coexistence difficulties between PLT and Short Wave radio broadcast.

Frequency allocation of the radio broadcasting services are defined by ITU-R Radio Regulations [1].

The mechanism described here is called "smart notching" whereby the PLT-spectrum mask is adjusted to avoid the use of frequencies which are found to be coincident with receivable broadcast signals.

2 References

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ITU Radio Regulations, edition of 2004.

[2] ETSI ES 201 980 (V2.2.1): "Digital Radio Mondiale (DRM); System Specification".

[3] ITU-R Recommendation 560-3: "Radio-frequency protection ratios in LF, MF and HF broadcasting".

[4] ITU-R Recommendation BS.1615: ""Planning parameters" for digital sound broadcasting at frequencies below 30 MHz".

[5] ITU-R Recommendation BS.703: "Characteristics of AM sound broadcasting reference receivers for planning purposes".

[6] CISPR 16-1-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus".

[7] CISPR 16-1-2: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances".

[8] CISPR 22: "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

Not applicable.

3 Definitions and abbreviations

3.1 Definitions

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

acceptable reception of radio service: human could understand what a speaking voice is trying to say

Class A device: PLT device as defined in CISPR 22 [8]

Class B device: PLT device as defined in CISPR 22 [8]

live: live contact (also known as phase, hot or active) carries alternating current from the power source to the equipment

measurement bandwidth: bandwidth used to specify limits and thresholds

NOTE: The resolution bandwidth a PLT modem uses to derive any signal level is implementation dependent. To compare the derived levels with the values given in this specification they must be converted to the measurement bandwidth.

neutral: neutral contact returns current from the equipment back to the power source or distribution panel

3.2 Abbreviations

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

AE	Auxiliary Equipment
AM	Amplitude Modulation
CE	Consumer Electronics
DRM	Digital Radio Mondiale

NOTE: See ES 201 980 [2] (http://www.drm.org/).

EUT	Equipment Under Test
PLT	PowerLine Telecommunications

NOTE: See http://portal.etsi.org/portal_common/home.asp?tbkey1=PLT.

PSD	Power Spectral Density
QoS	Quality of Service
SW	Short Wave

4 Detection of the presence of radio broadcasting signals

Radio broadcast signals transmitted with a high power from the antenna of a radio station will electromagnetically couple onto any wire, e.g. an electrical power grid.

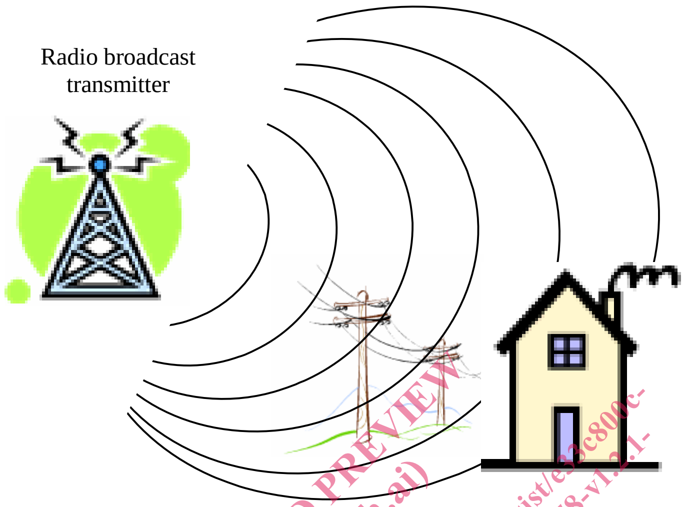

Figure 1: Example of ingress of radio signals into mains wiring in a house

Within the reception range of the radio broadcast signals the ingress of the broadcast signal can be detected.

Sensing the ingress magnitude at a PLT modem, e.g. at the socket between live and neutral line, enables the PLT modem to identify the presence of a radio broadcast signal that is receivable by a typical CE radio receiver. Figure 2 shows a "snapshot" measurement of the noise between live and neutral at a socket using a spectrum analyzer. Each "peak" (e.g. at 5 955 kHz or 6 075 kHz) visible in figure 2 shows the presence of an AM - SW Radio broadcast signal. A "rectangle" (e.g. around 5 990 kHz, marked in red dashed ellipse) shows the presence of a DRM radio station. The AM - SW Radio broadcast signals marked with the green dotted ellipses show acceptable reception quality using a typical consumer electronics SW radio receiver.

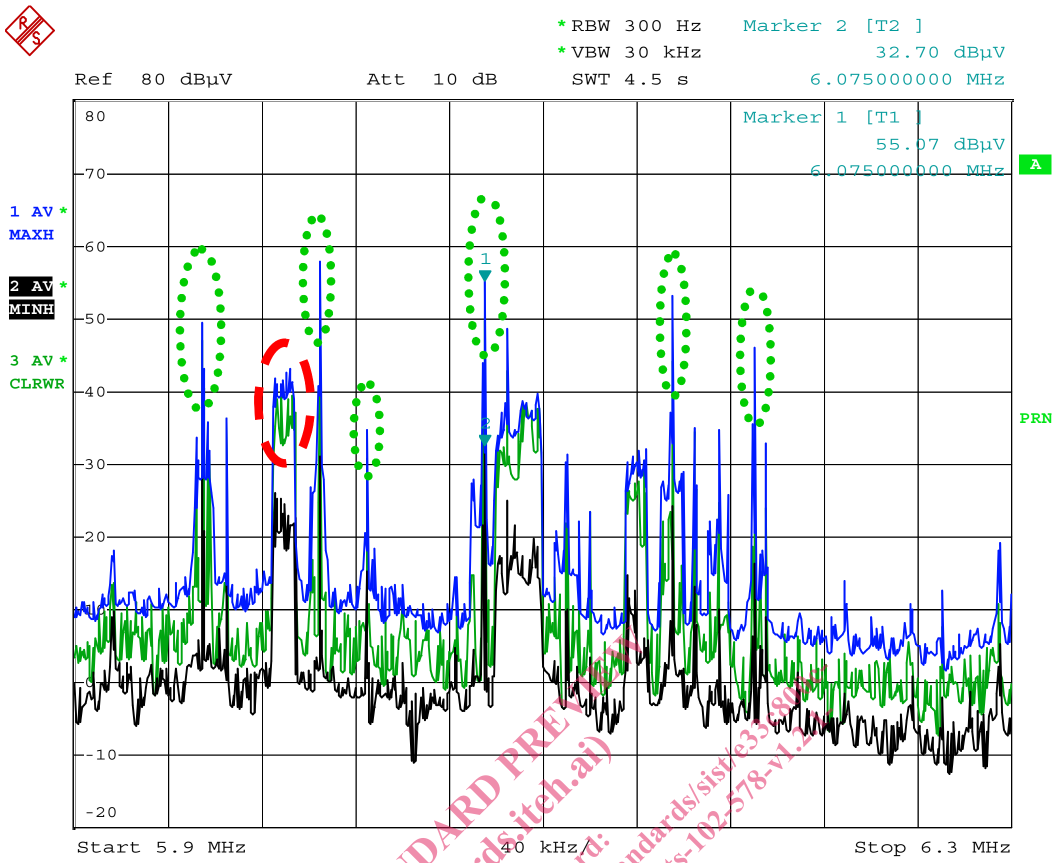

Figure 2: Example of a snapshot of ingress in the 49 m SW-Band at one location measured between live and neutral

The amplitude of SW radio broadcast signal ingress changes strongly with time and location. Also, the level of these signals depends on the location of the modem and the structure of the wiring of the electricity grid. The PLT modem will periodically sense the ingress and identify the presence of SW radio broadcast signal. The thresholds used for detecting receivable signals and the frequency of sensing are specified in clause 4.

4.1 Noise Floor

The Noise Floor shall be measured at adjacent frequencies lower and higher than the short wave Radio band given in table 1. The adjacent frequency block to be monitored shall be as wide as the Radio band allocation itself. The adjacent frequency blocks must be completely monitored by the PLT modems without any gaps. The noise floor is the median value of all measured values of the electrical energy in the adjacent frequency blocks on the powerline channel excluding all powerline communication signals. An individual noise floor level shall be calculated for each Radio broadcast band. The frequency locations and resolution bandwidth of the measured values is implementation dependent on the PLT modem.

A short impulsive noise e.g. caused by a light switch must not influence noise floor measurement.

4.2 Levels and Thresholds

Signal ingress shall be identified as a receivable radio broadcast service if the signal is at least:

Criterion (1): 14 dB above the noise floor

If criterion (1) is satisfied, the threshold level of ingress of a broadcast signal identified as receivable is:

Criterion (2): -95 dBm

Additionally PLT modems may limit the identification of a receivable radio broadcast service to such signals that are AM or DRM modulated including very low AM modulated signal (plain carrier or a silent period).

Noise floor and signal shall be measured between the live and neutral conductor at the socket to which the PLT modem is connected. The measurement shall be made using a spectrum analyser or measurement receiver specified and adjusted as in CISPR 16-1-1 [6] - average detector.

The threshold is defined to take into account the sensitivity of broadcast CE radio receivers and reception factor between the field and the signals on the mains. The measurement bandwidth and detectors specified here are for verification of the implementation of the present document, which is described in detail in clause 6. Resolution bandwidth and detectors used by the PLT modem are implementation dependent.

Taking into account the fading effects defined in ITU-R Recommendation BS.1615 [4] and the robustness of radio receivers (ES 201 980 [2]) the signal is considered to be present if Criterion (1) and (2) is exceeded in 30 % of time in any 10 seconds interval.

4.3 Timings

A radio broadcast signal shall be detected and the corresponding notch shall be activated by the PLT modem in no more than:

15 seconds

after the receivable radio broadcast service is actually present.

The notch shall remain active continuously for the whole time that the SW radio broadcast is present.

After the radio broadcast service has been identified as no longer receivable the notch shall still remain active for at least:

180 seconds

4.4 Frequencies

Radio frequencies are allocated to the broadcasting service under article 5 of the Radio Regulations [1]. In practice, HF broadcasts are to be found on frequencies outside these bands. Countries (Administrations) can, on a national basis allocate additional frequencies under article 4.4 of the Radio Regulations [1]. This practice is commonplace. A realistic assessment of the actual bands used for SW radio broadcasting is:

Table 1: The HF Broadcasting Bands

From (kHz)	To (kHz)
2 300	2 498
3 200	3 400
3 900	4 000
4 550	4 650
4 750	5 110
5 750	6 200
7 100	7 700
9 300	9 950
11 550	12 100
13 550	13 900
15 050	15 850
17 400	17 950
18 900	19 020
21 450	21 850
25 670	26 100

The automatic process of "Smart Notching" shall work at least in the frequency allocations defined in the table 1.

NOTE: Frequency bands requiring protection for compliance with the present document may be affected by future changes to regulatory requirements.