

**Transmission and Multiplexing (TM);
Access networks;
Spectral management on metallic access networks;
Part 1: Definitions and signal library**

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 1 of a multi-part deliverable covering Transmission and Multiplexing (TM); Access networks; Spectral management on metallic access networks, as identified below:

Part 1: "Definitions and signal library";

Part 2: "Technical methods for performance evaluations";

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1 Scope

The present document gives guidance on a common language for Spectral Management specifications. It provides a set of definitions on Spectral Management quantities, including:

- a) a description of the technical purpose of Spectral Management;
- b) a common reference model to identify LT-ports, NT-ports, upstream, downstream, etc.;
- c) a minimum set of characteristics necessary to describe signals within the context of Spectral Management; and
- d) an informative library of electrical signals that may flow into the ports of a metallic access network.

The present document is applicable to simplify and harmonize the description of *network specific* Spectral Management documents. The objective is to be a clear reference for these documents, without making any specific choice on the technology mix that may use the access network. Network specific documents, that rule the cable fill and technology mix for Spectral Management purposes, can be kept compact by referring to the definitions in the present document.

The informative library of signal definitions is organized in clusters of signal categories. Each category defines, independent from other categories, a full set of signal limits between DC and 30 MHz. These categories are dominantly based on transmission equipment standards from ETSI and ITU (existing or in progress), and on the technical understanding of additional requirements to protect future technology. When these definitions are incomplete or not appropriate, *network specific* spectral management documents may use additional definitions.

The characteristics of each signal described in this signal library identify their absolute maximum (or minimum) values. They fully account for the spread in their actual value, unless this tolerance is explicitly specified. This means in practice that when a power limit of a signal category is specified by a single number (for instance 14 dBm), it refers to its nominal maximum power plus its tolerance (for instance $+13,5 \text{ dBm} \pm 0,5 \text{ dBm}$). This approach provides clear criteria to determine if a signal under test is compliant or not with a signal category from this library.

The intention of the present document is to present a set of signal descriptions from various sources collected into a single document. Some of the descriptions have their origin in xDSL related ETSI and ITU publications and some are completely new. Detailed references have been included where applicable.

Due to differences in the way these signals are described in the different sources, the description has been harmonized into a uniform format. This enables a unified signal specification method for spectral management purposes. It should be noted that, although this unification has been carried out with the best intentions, and with the best knowledge available, some content of the original source document may not have been correctly interpreted or copied into the present document.

In the case of discrepancies between a signal description in the present document and the original source document(s), the source(s) should be regarded as definitive. Therefore the content of the present document should be regarded as informative.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
 - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
 - for informative 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.

Not applicable.

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.

POTS and ANALOGUE

- [i.1] ETSI TBR 021: "Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling".
- [i.2] ETSI ES 201 970: "Access and Terminals (AT); Public Switched Telephone Network (PSTN); Harmonized specification of physical and electrical characteristics at a 2-wire analogue presented Network Termination Point (NTP)".
- [i.3] ETSI EN 300 001: "Attachments to the Public Switched Telephone Network (PSTN); General technical requirements for equipment connected to an analogue subscriber interface in the PSTN".
- [i.4] ETSI EN 300 450: "Access and Terminals (AT); Ordinary and Special quality voice bandwidth 2-wire analogue leased lines (A2O and A2S); Terminal equipment interface".
- [i.5] ETSI EN 300 453: "Access and Terminals (AT); Ordinary and Special quality voice bandwidth 4-wire analogue leased lines (A4O and A4S); Terminal equipment interface".

ISDN

- [i.6] ETSI TS 102 080: "Transmission and Multiplexing (TM); Integrated Services Digital Network (ISDN) basic rate access; Digital transmission system on metallic local lines".

HDSL

- [i.7] ETSI TS 101 135: "Transmission and Multiplexing (TM); High bit-rate Digital Subscriber Line (HDSL) transmission systems on metallic local lines; HDSL core specification and applications for combined ISDN-BA and 2 048 kbit/s transmission".

SDSL

- [i.8] ETSI TS 101 524: "Transmission and Multiplexing (TM); Access transmission system on metallic access cables; Symmetric single pair high bitrate Digital Subscriber Line (SDSL)".
- [i.9] ITU-T Recommendation G.991.2: "Single-Pair High-Speed Digital Subscriber Line (SHDSL) transceivers" (including all corrigenda and amendments).

ADSL

- [i.10] ETSI TS 101 388: "Access Terminals Transmission and Multiplexing (ATTM); Access transmission systems on metallic access cables; Asymmetric Digital Subscriber Line (ADSL) - European specific requirements [ITU-T Recommendation G.992.1 modified]".
- [i.11] ITU-T Recommendation G.992.1: "Asymmetric digital subscriber line (ADSL) transceivers" (including all corrigenda and amendments).
- [i.12] ITU-T Recommendation G.992.5: "Asymmetric Digital Subscriber Line (ADSL) transceivers - Extended bandwidth ADSL2 (ADSL2plus)".

VDSL

- [i.13] ETSI TS 101 270-1: "Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements".
- [i.14] ITU-T Recommendation G993.2: "Very High Speed Digital Subscriber Line Transceivers 2 (VDSL2)" (including all corrigenda and amendments).

EMC and UNBALANCE

- [i.15] ITU-T Recommendation O.9: "Measuring arrangements to assess the degree of unbalance about earth".
- [i.16] ITU-T Recommendation G.117: "Transmission aspects of unbalance about earth".

VARIOUS

- [i.17] CENELEC EN 0-1: "Information technology equipment - Safety - Part 1: General Requirements".
- [i.18] CENELEC EN 0-21: "Information technology equipment - Safety - Part 21: Remote Power Feeding".
- [i.19] CENELEC CLC/prTR 2: "Electrical safety - Classification of interfaces for equipment to be connected to information and communications technology networks".
- [i.20] CENELEC CLC/prTS 7: "Safety aspects for xDSL signals on circuits connected to telecommunication networks (DSL: Digital Subscriber Line)".

3 Definitions and abbreviations

3.1 Definitions

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

access port: physical location, appointed by the loop provider, where signals (for transmission purposes) are injected into the local loop wiring

access rule: mandatory rule for achieving access to the local loop wiring, equal for all network operators who are making use of the same network cable that bounds the crosstalk in that network cable

cable fill (or degree of penetration): number and mixture of transmission techniques connected to the ports of a binder or cable bundle that are injecting signals into the access ports

Cable Management Plan (CMP): list of selected access rules dedicated to a specific network

NOTE: This list may include associated descriptions and explanations.

deployment rule: voluntary rule, irrelevant for achieving access to the local loop wiring and proprietary to each individual network operator

NOTE: A deployment rule reflects a network operator's own view about what the maximum length or maximum bitrate may be for offering a specific transmission service to ensure a chosen minimum quality of service.

disturber: source of interference in spectral management studies coupled to the wire pair connecting victim modems

NOTE: This term is intended solely as a technical term, defined within the context of these studies, and is not intended to imply any negative judgement.

downstream transmission: transmission direction from a port, labelled as LT-port, to another port, labelled as NT-port

NOTE: This direction is usually from the central office side via the local loop wiring, to the customer premises.

Echo Cancelled (EC): term used within the context of ADSL to designate ADSL (FO) systems with frequency overlap of downstream and upstream signals

NOTE: In this context, the usage of the abbreviation "EC" was only kept for historical reasons. The usage of the echo cancelling technology is not only limited to FO systems (frequency overlapped), but can also be used by FDD systems (frequency division duplexing).

local loop wiring: part of a metallic access network, terminated by well-defined ports, for transporting signals over a distance of interest

NOTE: This part includes mainly cables, but may also include a Main Distribution Frame (MDF), street cabinets, and other distribution elements. The local loop wiring is usually passive only, but may include active splitter-filters as well.

loop provider: organization facilitating access to the local loop wiring

NOTE: In several cases the loop provider is historically associated with the incumbent network operator, but other companies may serve as loop provider as well.

LT: Line Termination, at the place where the physical line to the customer starts

LT-access port (or LT-port for short): access port for injecting signals, designated as "LT-port"

NOTE: Such a port is commonly located at the central office side, and intended for injecting "downstream" signals.

max data rate: maximum data rate that can be recovered according to predefined quality criteria, when the received noise is increased with a chosen noise margin (or the received signal is decreased with a chosen signal margin)

network operator: organization that makes use of a local loop wiring for transporting telecommunication services

NOTE: This definition covers incumbent as well as competitive network operators.

noise margin: ratio (P_{n2}/P_{n1}) by which the received noise power P_{n1} may increase to power P_{n2} until the recovered signal no longer meets the predefined quality criteria

NOTE: This ratio is commonly expressed in dB.

NT: Network Termination, at the customer premise end of the line

NT-access port (or NT-port for short): access port for injecting signals, designated as "NT-port"

NOTE: Such a port is commonly located at the customer premises, and intended for injecting "upstream" signals.

performance: measure of how well a transmission system fulfils defined criteria under specified conditions

NOTE: Such criteria include reach, bitrate and noise margin.

power back-off: generic mechanism to reduce the transmitter's output power

NOTE: It has many purposes, including the reduction of power consumption, receiver dynamic range, crosstalk, etc.

power cut-back: specific variant of power back-off, used to reduce the dynamic range of the receiver, that is characterized by a frequency independent reduction of the in-band PSD

NOTE: It is used, for instance, in ADSL and SDSL.

PSD mask: absolute upper bound of a PSD, measured within a specified resolution band

NOTE: The purpose of PSD masks is usually to specify maximum PSD levels for stationary signals.

PSD template: expected average PSD of a stationary signal

NOTE: The purpose of PSD templates is usually to perform simulations. The levels are usually below or equal to the associated PSD masks.

signal category: class of signals meeting the minimum set of specifications identified in clause 6 of the present document

NOTE: Some signal categories may be distinct between different sub-classes, and may label them for instance as signals for "downstream" or for "upstream" purposes.

signal margin: ratio (P_{s1}/P_{s2}) by which the received signal power P_{s1} may decrease to power P_{s2} until the recovered signal no longer meets the predefined quality criteria

NOTE: This ratio is commonly expressed in dB.

spectral compatibility: generic term for the capability of transmission systems to operate in the same cable

NOTE: The precise definition is application dependent and has to be defined for each group of applications.

spectral management: art of making optimal use of limited capacity in (metallic) access networks

NOTE: This is for the purpose of achieving the highest reliable transmission performance and includes:

- Designing of deployment rules and their application.
- Designing of effective access rules.
- Optimized allocation of resources in the access network, e.g. access ports, diversity of systems between cable bundles, etc.
- Forecasting of noise levels for fine-tuning the deployment.
- Spectral policing to enforce compliance with access rules.
- Making a balance between conservative and aggressive deployment (low or high failure risk).

spectral management rule: generic term, incorporating (voluntary) deployment rules, (mandatory) access rules and all other (voluntary) measures to maximize the use of local loop wiring for transmission purposes

transmission equipment: equipment connected to the local loop wiring that uses a transmission technique to transport information

transmission system: set of transmission equipment that enables information to be transmitted over some distance between two or more points

transmission technique: electrical technique used for the transportation of information over electrical wiring

upstream transmission: transmission direction from a port, labelled as NT-port, to another port, labelled as LT-port

NOTE: This direction is usually from the customer premises, via the local loop wiring, to the central office side.

victim modem: modem, subjected to interference (such as crosstalk from all other modems connected to other wire pairs in the same cable) that is being studied in a spectral management analysis

NOTE: This term is intended solely as a technical term, defined within the context of these studies, and is not intended to imply any negative judgement.