ETSI TS 102 533 V1.1.1 (2008-06)

Technical Specification

Environmental Engineering (EE)
Measurement Methods and limits for Energy Consumption in Broadband Telecommunication Networks Equipment

Reference
DTS/EE-00005

Keywords
power supply, Broadband

ETSI

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Environmental Engineering (EE).

Introduction

The present document defines the energy consumption limits and measurement methods for fixed broadband (DSL) telecommunication network equipment.

1 Scope

The present document defines the power consumption limits, the methodology and the test conditions to measure the power consumption of broadband fixed telecommunication networks equipment.

The power consumption limits are based on the European Code of Conduct for Broadband Equipment [i.1].

The types of broadband access technologies covered by the present document are the ones widely deployed at the date of publication. Other access technologies may be included in further versions of the present document.

In addition to the full power state, power-saving states asdefined in DSL standards [i.2] and [i.3] are also covered.

Currently, the present document only considers DSLAM DSL equipment.Future versions will also include MSAN equipment.

Other access technologies (e.g. WiMAX, PLC, optical) are not yet considered because they are still in an early stage of development/deployment

The present document focuses on Network Equipment.The end-user equipment is not handled in the present document.For limits for end-user Equipment please refer to the current revision of the Code of Conduct for Broadband Equipment [i.1].

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] 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]".

[2] ETSI EN 300 132-2: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".

[3] 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".

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.

[i.1] "Code Of Conduct on Energy Consumption of Broadband Communication Equipment European Commission Directorate-General, Joint Research Centre; Final v2: 17 July 2007".

[i.2] ITU-T Recommendation G.992.3 (01/2005): "Asymmetric digital subscriber line transceivers 2 (ADSL2)".

[i.3] ITU-T Recommendation G.992.5 (01/2005): "Asymmetric Digital Subscriber Line (ADSL) transceivers - Extended bandwidth ADSL2 (ADSL2plus)".

[i.4] ITU-T Recommendation G.993.2 (02/2006): "Very high speed digital subscriber line 2 (VDSL2)".

[i.5] ETSI TR 102 530: "Environmental Engineering (EE); The reduction of energy consumption in telecommunications equipment and related infrastructure".

3 Definitions and abbreviations

3.1 Definitions

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

active line: line in operational mode and carrying traffic as specified for that mode of operation (ADSL2plus or VDSL2)

broadband terminal equipment: equipment of broadband technology that is connected beyond the Network Termination Point of a telecommunication network

broadband telecommunication network equipment: equipment of broadband technology that is part of a telecommunication network

full-power state: state in which the maximal allowed data transmission is possible.The maximum is defined by the physical properties of the line and the settings of the operator (e.g. L0 for ADSL2/2plus)

low-power state: allows a limited power reduction capability and a limited data transmission is allowed

NOTE: It is entered automatically from the full power state after the data transmission during a certain time is lower than the limit. If more than the limited data has to be transmitted from either side a state change to the full power state is entered automatically. The low power state may comprise multiple sub-states with history dependant state transition rules (e.g. L2 for ADSL2/2plus).

stand-by state: has the largest power reduction capability and there is no transmission of data possible

NOTE: From this state a direct state change to the full-transmission state is possible, if data has to be transmitted from either side (e.g. L3 for ADSL2/2plus).

power consumption: power used by a device to achieve an intended application performance

telecommunication network: network operated under a license granted by a national telecommunications authority, which provides telecommunications between Network Termination Points (NTPs) (i.e. excluding terminal equipment beyond the NTPs)

3.2 Abbreviations

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

ADSL	Asymmetric Digital Subscriber Line
ADSL2plus	Second generation ADSL with extended bandwidth
CoC	Code of Conduct

NOTE: On Energy Consumption of Broadband Equipment.

CPE	Customer Premises Equipment
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DSM	Dynamic Spectrum Management
MIMO	Multiple Input Multiple Output
MSAN	Multi Service Access Node
NPC	Normalized Power Consumption
PLC	Power Line Communication
PSTN	Public Switched Telephone Network
VDSL	Very high speed Digital Subscriber Line
VDSL2	Second generation VDSL
VoIP	Voice over Internet Protocol
WiMAX	Worldwide interoperability for Microwave Access

4 Definition of power consumption

4.1 Definition of power consumption per line of Broadband Equipment

The power consumption of broadband telecommunication network equipment (i.e. in the case of DSL access technology, the DSLAM) is defined as:

$$P_{BBline} = P_{BBeq} / N_{subscrib\text{-}lines}$$

where:

P_{BBeq} is the power consumption (in W) of a fully equipped broadband equipment (DSLAM), measured at the electric power input interface, placed at the premises of the operator or the equipment supplier, which connects multiple broadband subscribers to a backbone.

P_{BBline} is the power consumption per line in W of the broadband equipment for which the limits are defined in the present document.

$N_{suscrib\text{-}lines}$ is the maximum number of subscriber lines served by the broadband equipment (DSLAM) under test.

P_{BBeq} is measured in determined environmental conditions defined in clause 5.1.7.

4.2. Definition of Normalized Power Consumption per line for Broadband Network Equipment

In addition to the power P_{BBline} that is defined for one equipment, an indication of global network power performance might be given.

The "Normalized Power Consumption" (NPC) is an indicator of the amount of power required to transport 1 Mbps of data over a 1 kilometre distance

$$NPC = 1000 \times \mathbf{P_{BBline}} / (bitrate \times line\ length)$$

NPC is expressed in mW/Mbps/km.

where:

Bitrate is in Mbps and line length is in km.

For DSLAM, the NPC shall be based on the bitrate and reach at full-power state as defined in the measurement method (see clause 5.1.5).The definition of the NPC can be found in TR 102 530 [i.5].

This NPC enables comparison of different technologies (such as ADSL2(plus) and VDSL2) regarding the efficiency of transporting information (in terms of power). It shall be calculated at relevant data points for each technology. These data points are derived from the typical or targeted working conditions of these technologies and are given in the clause on measurement methods (clause 5.1.5).

For instance, ADSL2plus might be deployed with a loop length of around 3 km with a data rate of 5 Mbps, or with shorter loops of 1 km with a data rate of 20 Mbps.

NOTE: NPC can be used for comparing different products with the same technology, different products in different technologies or different generations of the same technologies. Using the NPC to compare the different working states (e.g. L0 with L2 or L3) is not recommended as the intention of some of these working states is to save energy at times of no or low-rate transmission - i.e. when there is no need to transmit high data rates. NPC is not the only parameter to compare power consumption at service level. For comparing power consumption of certain service types (e.g. VoIP vs. PSTN) a different parameter might be more relevant.

4.2.1 Power consumption taking into account the low-power states

The low-power states are intended to reduce the power consumption during periods of no or minimal traffic needs (e.g. low data-rate applications or control signalling only). When these low-power states are used, the achievable power consumption reduction can be estimated by using profiles based on user traffic assumptions, as illustrated in annex A.

NOTE 1: Usage of power-saving states.

A number of power-saving states are defined in the DSL standards (L2, L3, ITU-T Recommendation G.992.3 [i.2], ITU-T Recommendation G.992.5 [i.3]).These power-saving states shall be implemented, both in the Network equipment subject of the present document and the CPE/end-user equipment deployed at the premises of the user of the broadband line; this will enable the operator to use these to further limit the power consumption of the equipment.

Further study is required to optimize the way in which the low-power states are controlled.In particular, to determine the levels of interference that might arise due to the fluctuating crosstalk caused by frequentmulti-state power transitions.

NOTE 2: Additional power saving solutions.

A number of additional power saving solutions are available.Some of these are listed below.However the list is not complete and both the developers and users of broadband equipment are encouraged to investigate and introduce new power saving solutions.

- Politeness algorithms.
- Dynamic Spectrum Management.
- Boards optimized for remote applications (reduced line power).

5 Measurement methods

This clause describes the methods to measure the power consumption of broadband equipment and also gives the conditions under which these measurements shall be performed.

5.1 Method and conditions for measurement of power consumption for DSLAM Equipment

5.1.1 Considered Equipment

The following items are considered part of the DSLAM and therefore their power consumption shall be taken into account to get the total power consumption (P_{BBeq}) of the DSLAM:

- Network Termination board, providing one or more links to the Core or Backhaul Network.

NOTE: The actual number of links should reflect the normal resilience practice for that type of equipment.

- Line Termination board, providing a number of xDSL ports connected to the end-user through the local loop.
- Splitter (Low Pass Filter) function.
- Backplane (or other) to interconnect the different blocks of the DSLAM.
- Inside Rack Cooling system (e.g. fans drawer inside cabinet based DSLAM systems).
- Normal operational power supply unit.

5.1.2 Not Considered Equipment

The following items are not considered part of the DSLAM and therefore their power consumption shall not be added to the power consumption of the DSLAM:

- Rectifier (AC/DC).
- Room or outdoor Cabinet Ventilation and Air Conditioning Unit (VAC Unit).
- Auxiliary power unit.
- Battery.
- Additional External signal processing (Dynamic Spectrum Management (DSM) and Multiple-Input Multiple Output (MIMO) techniques if not implemented as part of the Line Termination board)