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Code of Conduct
on Energy Consumption of Broadband Equipment

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INTRODUCTION

Expectations are that broadband equipment will contribute considerably to the electricity consumption of households in European Community in the near future. Depending on the penetration level, the specifications of the equipment and the requirements of the service provider, a total European consumption of up to 50 TWh per year can be estimated for the year 2015. With the general principles and actions resulting from the implementation of this Code of Conduct the (maximum) electricity consumption could be limited to 25 TWh per year, this is equivalent to 5,5 Millions tons of oil equivalentand to total saving of about € 7,5 Billions per year.

The potential new electrical load represented by this equipment needs to be addressed by EU energy and environmental policies. It is important that the electrical efficiency of broadband equipment is maximised.

To help all parties to address the issue of energy efficiency whilst avoiding competitive pressures to raise energy consumption of equipment all service providers, network operators, equipment and component manufacturers are invited to sign this Code of Conduct.

This Code of Conduct sets out the basic principles to be followed by all parties involved in broadband equipment, operating in the European Community, in respect of energy efficient equipment.

1. EQUIPMENT COVERED

This Code of Conduct covers equipment for broadband services both on the customer side as listed in Table 1, and on the network side as listed in Table 2. Note that not all the equipment listed in these tables may yet have a complete set of associated power targets. Any such missing values may be added to future versions of the Code of Conduct, as may any additional technologies that become significant in the Broadband space. Figure 1 below gives examples of home gateway/modem configurations with the boundary between customer premises and network equipment that this Code of Conduct takes into account. Terminals like PCs or TVs are not covered by this Code of Conduct.

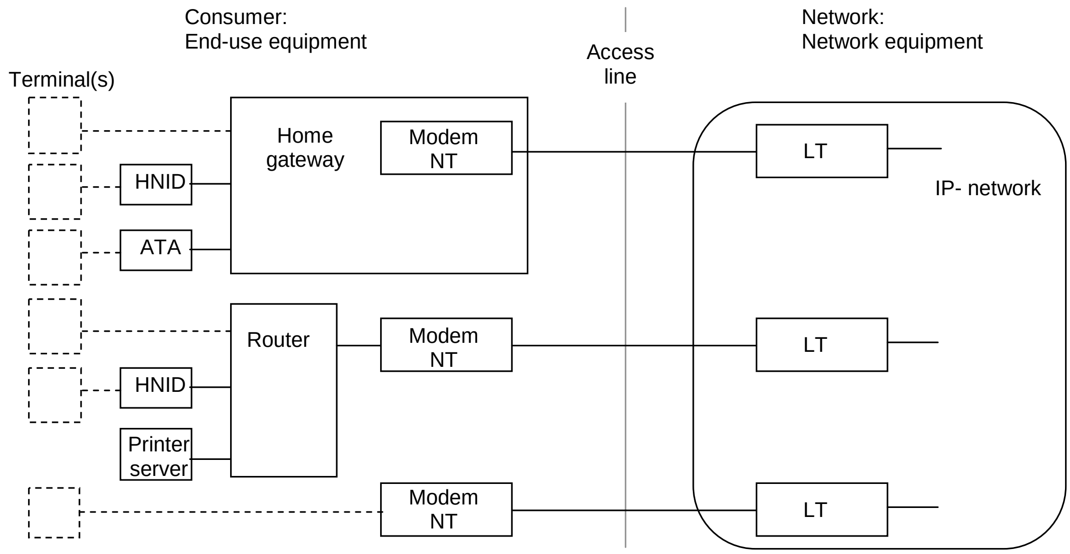

Figure 1: Examples of configurations

Broadband access equipment is defined by its incorporation of a transmission technology capable of providing more than 2048 kbit/s (ITU-T Rec I.113 [1]) full-rate capacity in at least one direction.

When equipment is in an idle state, it needs to be able to provide services with the same quality as in the on-state, or to be able transition to the on-state to deliver the service without introducing a significant additional delay from the user perspective. This requirement holds regardless of whether the service is initiated from the WAN-side, or the LAN-side.

In this Code of Conduct these categories of equipment will subsequently be referred to as "customer premises equipment" (CPE) and "network equipment" or "broadband equipment" in general.

Table 1: CPE covered

Type of CPE
Home gateways: • DSL CPEs (ADSL, ADSL2, ADSL2plus, and VDSL2) • Cable CPEs (DOCSIS 2.0 and 3.0) • Optical CPEs (PON and PtP) • Ethernet router CPEs • Wireless CPEs (WiMAX, 3G, and LTE) Simple broadband access devices:

• DSL CPEs powered by USB • Layer 2ONUs Home network infrastructure devices: • Wi-Fi access points • Small hubs and non-stackable Layer 2 switches • Powerline adapters • Alternative LAN technologies (HPNA and MoCA) adapters • Optical LAN adapter Other home network devices: • ATA / VoIP gateway • VoIP telephone (standalone standard desktop phone) • Print server

The following equipment is excluded from this version of the Code of Conduct:

- Terminals like PCs and TVs
- Set-top boxes for digital TV services; complex set-top boxes are covered by the Code of Conduct for digital TV Service Systems.
- Special purpose devices, like conference phones, video phones, or appliances that contain other main functionalities besides the VoIP function
- Video gateways providing conditional access "termination", characterized by their capability to receive select and descramble multiple digital video streams to be rerouted on a home network or/and locally decoded to output audio video content. Video gateways equipped with embedded audio/ video decoding and outputting capability are commonly called "headed" video gateways.
- Enterprise CPE products, intended as those equipment that include one or both of the following characteristics and are typically intended to be used in high end applications and users:
    - Works only with other dedicated proprietary controlling device/server.
    - Is modular (i.e., allowing non-standardized, proprietary LAN, or WAN interfaces to be inserted in the equipment).

Table 2: Network equipment covered

Type of network equipment covered
• DSL network equipment (e.g., ADSL, ADSL2, ADSL2plus, and VDSL2) • Combined DSL/Narrowband network equipment (e.g., MSAN where POTS interface is combined with DSL BroadBand interface) • Optical Line Terminations (OLT) for PON- and PtP-networks • Wireless Broadband network equipment (e.g., Wi-Fi access points for Hotspot application or WiMAX Radio Base Station) • Cable service provider equipment • Powerline service provider equipment

2. AIM

To reduce energy consumption of broadband communication equipment without hampering the fast technological developments and the service provided.

3. COMMITMENT

Signatories of this Code of Conduct agree to make all reasonable efforts to:

a) Abide by the General Principles contained in Annex A.

b) Achieve the power consumption targets set out in Annex C, for at least 90% (by number[1]) of the new-model items of broadband equipment covered by this Code of Conduct that are introduced to the market after the indicated dates. For an equipment vendor, ”new-model” means equipment that is first brought to market during a given year (note that a simple production optimisation or bug-fix would not necessarily constitute a new-model). For a network operator, "new-model" means equipment of a particular type and specification being procured for the first time in a given year. For the subsequent manufacture or purchase/installation of the same equipment, the Code of Conduct values pertaining to the original year of introduction/purchase apply. To take into account the time delay network operators need to qualify any new equipment and adapt it to specific needs of their networks, network operators are entitled to apply the targets of the year preceding that it was procured.

c) Provide end-users with information about power consumption of CPE (CPE-on-state, CPE-idle-state) and about switching off CPE in the user manual, on the Internet, the packaging, and/or at the point of sales.

d) Co-operate with the European Commission and Member State authorities in an annual review of the scope of the Code of Conduct and the power consumption targets for future years.

e) Co-operate with the European Commission and Member States in monitoring the effectiveness of this Code of Conduct through the reporting form that is available on the homepage of the EU Standby Initiative [3].

f) Ensure that procurement specifications for broadband equipment are compliant with this Code of Conduct.

Each version of the Code of Conduct, once published, is a standalone document that supersedes all previous versions, and neither refers to nor depends on such versions. When a new version of the Code of Conduct comes into force, it is assumed that companies/organizations who have already signed the Code of Conduct will remain signatories for the new version. However any company/organization may withdraw its signature from the Code of Conduct with no penalty.

4. MONITORING

Signatories agree to provide information on the power consumption of their equipment which is covered by the Code of Conduct to the European Commission on annual basis. This should be provided by the end of each March for the previous calendar year. Where a signatory first signs part way through a calendar year, then reporting for that first year should be done from the date of signing, not the beginning of that calendar year.

The anonymous results will be discussed at least once a year by the signatories, the European Commission, Member States, and their representatives in order to:

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1 For network equipment ’by number’ means ‘by number of ports’, so as to allow for equipment with very different numbers of ports.

a) Evaluate the level of compliance and the effectiveness of this Code of Conduct in achieving its aims.

b) Evaluate current and future developments that influence energy consumption, (i.e., Integrated Circuit development, etc.) with a view to agreeing actions and/or amendments to the Code of Conduct.

c) Set targets for future time periods.

5. REPORTING

The presentation of the results provided to the Commission will be in the form of the reporting sheet available on the homepage of the EU Standby Initiative [3].

A General Principles

Signatories of this Code of Conduct should endeavour to make all reasonable efforts to ensure:

A.1 For broadband equipment in general

a.1 Broadband equipment should be designed to meet the Code of Conduct power consumption targets. However, power management must not unduly impact the user experience, disturb the network, or contravene the applicable standards.

a.2 Operational and control systems are specified under the assumption that hardware has power management built in, where applicable, i.e., depending on the functionality required of the unit, the hardware will automatically switch to the state with the lowest possible power consumption.[2]

A.2 For CPE

a.3 Any external power supplies used for CPE shall be in accordance with the EU Code of Conduct for External Power Supplies [4]. Power consumption of the external power supply shall be included in the power measurement.

a.4 CPE is designed under the assumption that the equipment may be physically disconnected from the mains or switched off manually by the customer, from time to time, at their own discretion.

a.5 Power delivered to other equipment (e.g., over USB or PoE) shall not be included in the power consumption assessment. This other equipment shall be disconnected for the power consumption measurement, except when this is in contradiction with the operation of the product. However, target values are specified for some specific USB devices, as a reference for USB manufacturers, and to be considered separately from the evaluation of the power budget (and related consumption objectives) of the CPEs they can be connected to.

A.3 For network equipment

a.6 Broadband network equipment should be designed to fulfil the environmental specifications of Class 3.1 for indoor use according to the ETSI Standard EN 300019-1-3[5], and where appropriate the more extended environmental conditions than Class 3.1 for use at outdoor sites. At remote sites the outdoor cabinet including the Broadband network equipment shall fulfil Class 4.1 according to the ETSI Standard EN 300019-1-4[6]. Broadband network equipment in the outdoor cabinet should be designed taking in account the characteristics of the cabinet and the outdoor environmental condition; e.g., in case of free cooling cabinet it should be considered that the equipment inside the cabinet could operate (for short time periods) at temperature up to 60°C.If cooling is necessary, it should be preferably cooled with fresh air (fan driven, no refrigeration). The Coefficient of Performance of new site cooling systems, defined as the ratio of the

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[2] For WAN-side DSL systems, this function can be activated (with care) for deployed ADSL2/2plus (see BBF TR-202 guidelines).However, this is not the case for VDSL2. To this end, signatories will endeavour to assist in the improvement of the existing low-power DSL standards, and the development of new ones as appropriate. Until these are available, the focus should be on the reduction of power consumption in DSL-full power state for VDSL2.

effective required cooling power to the energy needed for the cooling system, should be higher than 10.

B Definition of operation states

B.1 Definitions of CPE operation states

B.1.1 Off-state

In the **off-state**, the device is not providing any functionality. This state is defined by EC No 1275/2008[9].

B.1.2 Idle-state

In the **idle-state**, the device is idle, with all the components being in their individual idle states. In this state the device is not processing or transmitting a significant amount of traffic, but is ready to detect activity.

Transitions between the idle-state and on-state must occur without manual reconfiguration of the device, i.e., they must happen automatically.

The idle-state of a home gateway is defined as all the components of the home gateway being in their idle-state as defined in Table 3.

Table 3: Definition of the idle-state for home gateways

Port / component	Idle-state
Central functions (processor and memory: routing, firewall, OAM (e.g., TR-069), user interface)	Not processing user traffic
WAN interface	Single WAN: Idle (link established, but no user traffic transmission). More details on the physical layer configuration of certain interfaces can be found in the on-state definitions (see Table 7). The idle state configuration can be different than in on-state if this does not require a manual reconfiguration by the end user (e.g., in case of DOCSIS 3.0, the CPE could transition to a 1x1 configuration or in case of ADSL2plus to the L2 mode). In case of dual WAN interface[3], for backup or alternative purposes, only one of the two ports will be in the above described state, while the second will be disconnected or not active, but able to be manually or automatically activated if needed. In case of dual WAN interface for simultaneous operation, both ports will be in the above described state.
LAN Ethernet ports	Ports not connected (or no Ethernet link) but with Ethernet link detection active
Wi-Fi	Beacon on, but no user traffic transmitted, no client associated

[3] It should be noted that CPEs may exist with more than two WAN interfaces (e.g. in case of DSL bonding over more than two copper pairs). In the remainder of this document dual WAN interface CPEs are mentioned as the most common category of multi-WAN CPEs.

Port / component	Idle-state
Alternative LAN technologies (e.g., HPNA, MoCA, Powerline, POF)	MoCA, Powerline, HPNA, or POF capability is activated, but no user traffic transmitted
FXS	1 FXS port with phone connected (200 Ohm / 5mmax cable length), phone on-hook, off hook detection active Remaining FXS ports: no phone or other load connected, but able to detect a connection
ISDN S0	1 phone connected (5m max cable length), the phone is powered locally by its own power supply (i.e., it is not powered via the S0 interface), phone on-hook, off hook detection active. Remaining ISDN S0 ports: no phone or other load connected, but able to detect a connection.
FXO	No active call, incoming call detection enabled
DECT interface	No active call, incoming call detection enabled
DECT charging station for DECT handset	DECT handset on cradle, in trickle charge
Backup battery	Battery is fully charged (trickle charging)
USB	No devices connected, detection of USB devices active

When activity is detected on a component, the appropriate components transition to the on-state. The transition time should be less than 1 second wherever possible in order to not adversely impact the customer experience. The detection of the Ethernet link may take more than 1 second, but must stay below 3 seconds. This longer transition time can be tolerated in this case because it requires some user interaction to bring up the link (e.g., connect a device or boot a PC).

Note that because only those components required to support the activated service go into their on-state, for a complete device (as opposed to a functional component) there will in fact be a range of power states. At any given time, the CPE should consume the minimum power commensurate with its current level of activity (with the appropriate hysteresis).

Table 4: Definition of the idle-state for simple broadband access devices (modems and NTs)

Port / component	Idle-state
WAN port	Idle (link established, but no user traffic transmission)
LAN port	Idle (link established, but no user traffic transmission), cable length = 5m

Table 5: Definition of the idle-state for Home Network Infrastructure Devices (HNID)

Port / component	Idle-state
Ethernet port	1 port idle (connected, but no user traffic transmission), cable length = 5m, in case of more than 1 port the remaining ports are disconnected but with Ethernet link detection active

The definitions of the idle-state for all other interfaces and functionality are the same as defined in Table 3.

Table 6: Definition of the idle-state for other home networking devices

Port / component	Idle-state
Ethernet port	Port idle (connected, but no user traffic transmission), cable length = 5m: in case of more than 1 port, one is idle and the others are disconnected."
VoIP/telephony	No active call, call detection active, inactive display
Print server	No print job active

B.1.3 On-state

The on-state of a home gateway is defined as all the components of the home gateway being in their on-state as defined in Table 7.

For the interfaces carrying user traffic the minimal throughput (UDP, packet 500 bytes) that needs to be considered is indicated as well in Table 7. As this is the minimal traffic load to be applied to a certain interface, some interfaces can carry more traffic in order to accommodate all minimal traffic loads. This excess traffic should be carried on Ethernet LAN port(s).

Customer-side Ethernet ports present on CPEs are responsible of non-negligible energy consumption. IEEE 802.3az (Energy Efficient Ethernet) standard [11] defines power saving mechanisms for wired, customer-side Ethernet ports (see also Annex G). It is then recommended that copper Ethernet (IEEE 802.3[11]) interfaces in the CPE comply with IEEE 802.3az. To allow sufficient time for equipment implementation, a requirement to progressively phase in IEEE 802.3az support will come into force starting from the 1st of January 2014. During testing, the measurement equipment connected to IEEE 802.3az capable ports must support IEEE 802.3az and LLDP for IEEE 802.3az[11].

Transitions between the idle-state and on-state must occur without manual reconfiguration of the device, i.e., they must happen automatically.

Table 7: Definition of the on-state for home gateways

Port / component	On-state
Central functions (processor and memory: routing, firewall, OAM (e.g., TR-069), user interface)	Processing the user traffic present on the WAN and LAN interfaces
WAN port	Single WAN: Active (link established and passing user traffic) In case of dual WAN interface, for backup or alternative purposes, only one of the two ports will be in the above described state, while the second will be disconnected or not active, but able to be manually or automatically activated in case of need. In case of dual WAN interface for simultaneous operation, both ports will be in the above described state.

Port / component	On-state
ADSL2plus	Line is configured as per TR-100[13], Table 7.3. Select a valid ADSL2plus specific test profile, configured in rate adaptive mode. Use a test loop of 1250m. The DSL line is active (in showtime) and passing user traffic: 3 Mbit/s downstream, 0,3 Mbit/s upstream
VDSL2 (8, 12a, 17a, but not 30a)	Line is configured as per TR-114[14],Table 13 (Specific Line Settings): Select a valid VDSL2 profile line combination, for the governing profile bandwidth (namely 8, 12, or 17 MHz), configured in rate adaptive mode. Use a test loop of 300 m for the 8 MHz profile and 150 m for each of the 12 and 17 MHz profiles. The DSL line is active (in showtime) and passing user traffic: 10 Mbit/s downstream, 2 Mbit/s upstream
VDSL2 (30a)	Line is configured as per Broadband Forum Recommendation TR-114 VDSL2 Band Profile shall be: Profile 30a, using a valid Annex B PSD mask, configured in rate adaptive mode. Use a test loop of 100m The DSL line is active (in showtime) and passing user traffic: 20 Mbit/s downstream, 5 Mbit/s upstream
Fast Ethernet WAN	Link established at 100 Mbit/sand passing user traffic: 20 Mbit/s downstream, 5 Mbit/s upstream
Gigabit Ethernet WAN	Link established at 1000 Mbit/sand passing user traffic: 50 Mbit/s downstream, 10 Mbit/s upstream
FibrePtPFast Ethernet WAN	Link established at 100 Mbit/sand passing user traffic: 20 Mbit/s downstream, 5 Mbit/s upstream
Fibre PtPGigabit Ethernet WAN	Link established at 1000 Mbit/sand passing user traffic: 50 Mbit/s downstream, 10 Mbit/s upstream
GPON	Passing user traffic: 20 Mbit/s downstream, 5 Mbit/s upstream
1G-EPON	Passing user traffic: 20 Mbit/s downstream, 5 Mbit/s upstream
10/1G-EPON	Passing user traffic: 50 Mbit/s downstream, 5 Mbit/s upstream
10/10G-EPON	Passing user traffic: 50 Mbit/s downstream, 10 Mbit/s upstream
XG-PON1	Passing user traffic: 50 Mbit/s downstream, 10 Mbit/s upstream
DOCSIS 2.0	Active with a downstream channel with a modulation type of 256 QAM and an upstream channel with a modulation type of 64 QAM and a symbol rate of 5.12 Ms/s and passing user traffic:

Port / component	On-state
	10 Mbit/s downstream, 2 Mbit/s upstream
DOCSIS 3.0	Active with an NxM configuration with N downstream channels with a modulation type of 256 QAM and M upstream channels with a modulation type of 64 QAM and a symbol rate of 5.12 Ms/s. Modem is passing user traffic: 20 Mbit/s downstream, 5 Mbit/s upstream. Basic configuration: • The basic NxM configuration is a 4x4 configuration. Additional power allowance for each additional 4 downstream channels: • The basic NxM configuration is an Nx4 configuration where N is the maximum number of downstream channels supported by the modem. (Testing may be restricted by the number of channels supported by the plant.)
WiMAX, 3G, LTE	Passing user traffic: 1 Mbit/s downstream, 200 kbit/s upstream
LAN Fast Ethernet ports	All ports active, link established at 100 Mbit/s, cable length=5m and passing user traffic: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per port
LAN Gigabit Ethernet ports	All ports active, link established at 1000 Mbit/s, cable length=5m and passing user traffic: concurrent 20 Mbit/s downstream and 20 Mbit/s upstream per port
Wi-Fi 802.11g or 11a	Beacon on, 1 Wi-Fi client associated and 1-5m away from AP in the same room, avoid interference in the same band, with user traffic: concurrent 5 Mbit/s downstream and 5 Mbit/s upstream (where simultaneous dual-band operation is supported, this traffic is used on each of the band)
Wi-Fi 802.11n	Beacon on, 1 Wi-Fi 802.11n client associated and 1-5m away from AP in the same room, avoid interference in the same band, with user traffic: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream (where simultaneous dual-band operation is supported, this traffic is used on each of the band)
Alternative LAN technologies (e.g., HPNA, MoCA, Powerline, POF)	MoCA, Powerline, HPNA, or POF capability is activated, with user traffic: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per interface
FXS	1 phone connected (200 Ohm / loop current of 20 mA / 5m max cable length), off hook, 1 active call. Remaining FXS ports: no phone or other load connected, but able to detect a connection (for those FXS ports, the idle targets apply).
ISDN S0	1 phone connected (5m max cable length), the phone is powered locally by its own power supply (i.e., it is not powered via the S0

Port / component	On-state
	interface), phone off hook, 1 active call. Remaining ISDN S0 ports: no phone or other load connected, but able to detect a connection (for those ISDN S0 ports, the idle targets apply).
FXO	1 active call
DECT interface	1 active call
DECT charging station for DECT handset	DECT handset not on cradle, no charging
Backup battery	Battery is fully charged (trickle charging)
USB	No USB device connected, detection of USB devices active
Low speed power line	Active, with traffic: 10 kbit/s
Bluetooth	Active, with traffic: 10 kbit/s
Zigbee	Active, with traffic: 10 kbit/s
Femto cell (Home use, RF power ≤10mW, RF power 10mW-50mW)	active, client 5m away in the same room, with user traffic: 2 Mbit/s

Table 8: Definition of the on-state for simple broadband access devices (modems and NTs)

Port / component	On-state
WAN port	Active (link established and passing user traffic with the traffic load defined in Table 7 for a given WAN interface type)
LAN port	Active (link established and passing the same amount of user traffic as defined for the WAN port)

For the on-state of Home Network Infrastructure Devices (HNID) the same definitions as listed in Table 7 apply.

Table 9: Definition of the on-state for other home networking devices

Port / component	On-state
Ethernet port	Port active (user traffic transmission to support the functionality of the device as described in the rows below), cable length=5m
VoIP/telephony	1 active call
Print server	Print job active

B.2 Definitions of network operation states

For Broadband-Network-technologies the following states are differentiated:

- Network(e.g., DSL)-stand-by state: This state has the largest power reduction capability and there is no transmission of data possible. It is essential for this state that the device has the capability to respond to an activation request, leading to a direct state change. E.g., a transition to the network-full-load state may happen if data has to be transmitted from either side.
- Network(e.g., DSL)-low-load state: This state allows a limited power reduction capability and a limited data transmission is allowed. It is entered automatically from the network-full-load state after the data transmission during a certain time is lower than a predefined limit. If more than the limited data has to be transmitted from either side, a state change to the network-full-load state is entered automatically. The network-low-load state may comprise multiple sub-states with history dependent state-transition rules.
- Network(e.g., DSL)-full-load state: This is the state in which a maximal allowed data transmission is possible. The maximum is defined by the physical properties of the line and the settings of the operator.
- For the wireless network equipment also the following states are defined:
  - Full-load-state
  - Medium-load-state
  - Low-load-state

C Power levels: targets and time schedule

C.1 CPE

CPEs covered by this Code of Conduct (home gateways, home network infrastructure devices and other home network devices) should meet the following maximum power consumption targets in the on-state and in the idle-state as defined in section B.1. In the off-state, these CPEs must meet the requirements of the Code of Conduct for External Power Supplies [4].

The CPEs should apply all possible energy saving actions, minimizing the overall power consumption whenever possible (e.g., when all or some of its functions are not operating).

The power levels defined in this document for all states are mean values based on sufficiently long measurement periods (at least 5 minutes),during which the equipment remains continuously in that same state (measurements should only start when the equipment is stable in this state for at least 60 seconds). Power is measured at the 230V AC input.

C.1.1 Home Gateways

The home gateway[4]is composed of several components, namely a processor plus memory, a WAN interface and several LAN interfaces. Depending on the purpose of a given home gateway, different components may be included. The power consumption targets for each type of home gateway are calculated by summing the values of its individual components. The home gateway as a whole has to meet the summed targets for its various modes of operation and activity. Component power consumption values are used to compute the overall home gateway target for a given configuration and mode of operation, but are not themselves normative.

The home gateway must meet the power targets for idle-state and for on-state as defined in section B.1. Depending on the actual state of the individual components, several intermediate power consumption levels for the home gateway exist.

The values per component for the idle-state and the on-state are given in the following tables.

If an interface is able to work in different modes it must establish a link with the highest possible capability and the targets have to be chosen accordingly. This for example applies to Wi-Fi 802.11n interfaces or Gigabit Ethernet LAN ports, i.e., to a Gigabit Ethernet interface a Gigabit Ethernet capable device must be connected for measurement purposes and the Gigabit Ethernet target applies. If a lower capability device is connected, the power consumption should be lower and ideally reach the target of this lower capability technology, i.e., if a Fast Ethernet device is connected to a Gigabit Ethernet LAN port.

In case of dual WAN, with reference to the definition of states, the calculation of targets for idle and on state will be performed on the basis of the following rules:

In case of dual WAN interface for backup or alternative purposes, the backup or alternative interface will be activated when the main interface loses connectivity. The target will be calculated as the sum of the values for both interfaces, reduced by 1,8 W in idle-state and by 2,6 W in on-state. This target must be met under two conditions (and both should be measured and reported):

- The first one, corresponding to the situation when the main WAN interface is active and the backup or alternative interface is disconnected or not active

[4] A home gateway is used here as a generic term which encompasses all kinds of access interfaces (e.g. DSL, cable, fibre, etc.)

- The second one, corresponding to the situation when the backup is activated and the main interface is disconnected or not active

In case of dual WAN interface for simultaneous operation, the target will be calculated as sum of the values for both interfaces, reduced by 1,6 W in idle-state and by 2,4 W in on-stateto consider that some of the central functions are shared by the two functionalities active at the same time.

In case of dual WAN interface for simultaneous operation for ADSL2plus or VDSL2 (bonding), for the idle-state, the target will be calculated as the sum of the values for both interfaces. For the on-state, the target will be calculated as the sum of the values for both interfaces reduced by 2,4 W.

As an example for dual WAN interface for backup or alternative purposes, let x be the power target of a device with the main interface active and y the power target when the backup or alternative interface is active, the targets correspond to (x_{IS}+y_{IS}) – 1,8 W in idle-state (IS) and to (x_{ON}+y_{ON}) – 2,6 W in on-state (ON).

If the same interfaces work simultaneously, then the targets correspond to (x_{IS}+y_{IS}) – 1,6 W in theidle-state and to (x_{ON}+y_{ON}) – 2,4 W in on-state.

Table 10: Power values for home gateway central functions plus WAN interface

Home gateway central functions plus WAN interface	**Tier 2011-2012:** 1.1.2011- 31.12.2012		**Tier 2013-2014:** 1.1.2013 - 31.12.2014	
	Idle-State (W)	***On-State (W)***	***Idle-State (W)***	***On-State (W)***
ADSL2plus	2,6	3,8	2,4	3,4
VDSL2 (8, 12a, 17a, but not 30a)	3,5	6,0	3,2	4,6
VDSL2 (30a)	4,2	6,7	4,7	5,3
Fast Ethernet WAN	2,5	3,3	2,0	3,0
Gigabit Ethernet WAN	3,2	6,2	2,5	5,0
FibrePtPFast Ethernet WAN	2,9	5,6	2,9	5,0
Fibre PtPGigabit Ethernet WAN	3,5	6,2	3,2	5,6
GPON	4,0	6,5	3,5	5,0
1G-EPON	3,7	5,5	3,5	4,7
10/1G-EPON	5,1	7,0	4,8	6,2
10/10G-EPON	5,6	8,8	5,3	7,7
XG-PON1	5,1	7,3	4,8	6,5
DOCSIS 2.0	3,7	4,6	3,7	4,6
DOCSIS 3.0 basic configuration	6,2	7,1	6,2	7,1
DOCSIS 3.0 additional power allowance for each additional 4 downstream channels	2,2	2,8	2,2	2,8
WiMAX	7,7	10,6	3,5	6,0
3G	4,0	7,0	3,5	6,0
LTE	4,0	7,0	3,5	6,0

Notes:

(1) The ONU values shown in Table 10 assume that the home gateway central functions include a Gigabit Ethernet switch functionality (the additional power budget for the PHY interface of the LAN ports will have to be accounted separately).

(2) The above consumption targets for all ONUs in Table 10 assume the use of optics that meet the PR-30 or PRX-30 power budgets (IEEE 802.3) or ITU-T G.984.2/G.987.2 [15]Class B/B+ power budgets, whichever is applicable.

Table 11: Power values for home gateway LAN interfaces and additional functionality

Home gateway LAN interfaces and additional functionality	Tier 2011-2012: 1.1.2011- 31.12.2012		Tier 2013-2014: 1.1.2013 - 31.12.2014	
	Idle-State (W)	***On-State (W)***	***Idle-State (W)***	***On-State (W)***
1 Fast Ethernet port	0,3	0,4	0,2	0,4
1 Gigabit Ethernet port	0,3	0,9	0,2	0,6
Wi-Fi interface, single band IEEE 802.11g or 11a/h radio[5] with up to 23 dBm EIRP	0,7	2,0	0,7	1,5
Wi-Fi interface, single band 11a/h radio[5] with up to 30 dBm EIRP	0,7	2,5	0,7	2,5
Wi-Fi interface, single band IEEE 802.11nradio[5]with up to 23 dBm total EIRP (up to 2x2)	1,0	2,5	0,8	2,0
Wi-Fi interface, single band IEEE 802.11nradio[5] with up to 30 dBm total EIRP (up to 2x2)	1,0	3,0	0,8	3,0
Wi-Fi, single band IEEE 802.11ac 2x2 radio with up to 20 dBm EIRP per chain (23 dBm EIRP total for 2x2)	1,2	2,9	1,2	2,9
Wi-Fi, single band IEEE 802.11ac 2x2 radio with up to 27 dBm EIRP per chain (30 dBm EIRP total for 2x2)	1,2	5,9	1,2	5,9
Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4)	0,1	0,4	0,1	0,3
Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4) with up to 27 dBm EIRP per chain	0,1	1,6	0,1	1,6
HPNA	2,0	2,5	1,5	2,0
POF (up to 200 Mbit/s)	-	-	0,5	0,5
POF (above 200 Mbit/s)	-	-	2,0	2,0
MoCA 1.1	2,0	2,5	1,8	2,2
MoCA 2.0	1,8	2,2	1,8	2,2
Powerline- High speed for broadband home networking (less than 30MHzbandwidth)	2,5	3,0	1,5	2,0
Powerline- High speed for broadband home networking (between 30 and 68 MHz bandwidth)	2,5	4,7	2,0	2,7
PowerLine - Low speed for smart metering and appliances control (Green Phy)	0,9	2,0	0,8	1,5
FXS	0,5	1,5	0,3	1,2
ISDN S0	0,2	0,4	0,2	0,4
FXO	0,4	0,9	0,2	0,9

[5] For simultaneous dual-band operation the allowances for the individual radios can be summed up

Home gateway LAN interfaces and additional functionality	**Tier 2011-2012:** 1.1.2011- 31.12.2012		**Tier 2013-2014:** 1.1.2013 - 31.12.2014	
	Idle-State (W)	***On-State (W)***	***Idle-State (W)***	***On-State (W)***
Emergency fall-back to analog telephone	0,8	0,8	0,6	0,6
DECT GAP	0,75	1,65	0,5	1,0
DECT Cat-iq	0,75	2,0	0,5	1,2
DECT ULE	-	-	0,1	0,2
DECT charging station for DECT handset in slow/trickle charge	0,4	0	0,4	0
USB 2.0 – no load connected	0,25	0,25	0,1	0,1
USB 3.0 – no load connected	0,15	0,15	0,15	0,15
SATA – no load connected	0,3	0,3	0,3	0,3
Built-in back-up battery	0,2	0,2	0,1	0,1
Bluetooth	0,2	0,3	0,1	0,3
ZigBee	0,15	0,15	0,1	0,1
Z-Wave	-	-	0,1	0,2
IEC 14543-310 (“EnOcean”)	-	-	0,1	0,2
Femto cell (Home use, RF power ≤10mW)	7,0	8,0	6,0	7,0
Femto cell (Home use, RF power 10mW-50mW)	11,0	12,0	9,0	10,0
RF modulator (TV overlay for fibre network)	3,5	3,5	3,2	3,2
Embedded handsfree system	0,5	0,5	0,5	0,5
Additional Colour Display (typically found in VoIP devices) TFT QVGA and VG	0,5	1,0	0,5	1,0

There are types of home gateway device (e.g., a USB attached DSL modem or pure Layer 2ONUs) that are so simple (e.g., only provide Layer 2functionality, does not contain an Ethernet switch, and has a single LAN interface) that it cannot be usefully decomposed into components. The power targets for such devices are given in Table 12.

Table 12: Power targets for simple broadband access devices (modems and NTs)

Modem and NT total power target for simple broadband access devices	**Tier 2011-2012:** 1.1.2011 - 31.12.2012		**Tier 2013-2014:** 1.1.2013 - 31.12.2014	
	CPE-Idle-State (W)	***CPE-On-State (W)***	***CPE-Idle-State (W)***	***CPE-On-State (W)***
DSL-modem powered by USB	1,5	1,5	1,5	1,5
GPON ONU with 1Gigabit Ethernet LAN port	3,0	5,5	2,5	4,0
1G-EPON ONU with 1 Gigabit Ethernet LAN port	2,7	4,0	2,3	3,5
10/1G-EPON ONU with 1 Gigabit Ethernet LAN port	4,1	6,2	3,8	5,7
10/10G-EPON ONU with 1 Gigabit Ethernet LAN port	4,6	7,9	4,3	7,0
XG-PON1ONU with 1 Gigabit Ethernet LAN port	4,1	6,5	3,8	6,0

Modem and NT total power target for simple broadband access devices	Tier 2011-2012: 1.1.2011 - 31.12.2012		Tier 2013-2014: 1.1.2013 - 31.12.2014	
	CPE-Idle-State (W)	*CPE-On-State (W)*	*CPE-Idle-State (W)*	*CPE-On-State (W)*
Fast Ethernet PtPONU with 1 Fast Ethernet LAN port	3,0	3,0	2,8	2,8
Gigabit Ethernet PtPONU with 1 Gigabit Ethernet LAN port	3,5	3,5	3,2	3,2

Notes:

(1) USB Modem Power consumption (W) is defined at the 5V USB Interface.

(2) The above consumption targets for all ONUs in Table 12assume the use of optics that meet the PR-30 or PRX-30 power budgets (IEEE 802.3) or ITU-T G.984.2/G.987.2 Class B+ power budgets, whichever is applicable.

(3) If the ONU has a Fast Ethernet LAN port instead of a Gigabit Ethernet port the power targets are reduced by the difference between a Fast Ethernet LAN and a Gigabit Ethernet LAN port from Table 11.

C.1.2 USB dongles

For a home gateway with USB ports additional functionality originally not built into the device can also be provided via USB dongles. The power consumption of USB dongles is measured at the DC 5V USB interface.

Please note that the USB devices are considered as not equipped with additional chipsets implementing applications or complex software stacks that will drastically change the power values.

Table 13: Power values for USB dongles

USB powered peripherals and dongles	Tier 2011-2012: 1.1.2011- 31.12.2012		Tier 2013-2014: 1.1.2013 - 31.12.2014	
	Idle-State (W)	*On-State (W)*	*Idle-State (W)*	*On-State (W)*
3G/4G	0,7	2,45	0,5	1,75
DECT	0,6	0,8	0,4	0,6
DECT GAP	-	-	0,4	1,3
DECT Cat-iq	-	-	0,4	0,6
DECT ULE	-	-	0,1	0,4
Wi-Fi interface single IEEE 802.11b/g or 1x1 IEEE 802.11n radio[6]	0,8	2,0	0,8	2,0
ZigBee	0,1	0,5	0,1	0,4
Z-Wave	-	-	0,1	0,4
IEC 14543-310 (“EnOcean”)	-	-	0,1	0,4

[6] For Wi-Fi USB dongles with more than 1 RF chain, an allowance for additional RF chains as defined in Table 11 can be added.

C.1.3 Home Network Infrastructure Devices

Table 14: Power targets for Home Network Infrastructure Devices (HNID)

Power targets for Home Network Infrastructure Devices	**Tier 2011-2012:** 1.1.2011- 31.12.2012		**Tier 2013-2014:** 1.1.2013 - 31.12.2014	
	Idle-State (W)	***On-State (W)***	***Idle-State (W)***	***On-State (W)***
Wi-Fi Access Points with single band IEEE 802.11b/g or 11a	2,3	3,6	2,2	3,4
Wi-Fi Access Points with single band IEEE 802.11n or 802.11ac radio	3,5	5,0	2,3	3,9
Wi-Fi Access Points with single band IEEE 802.11n or 802.11ac radio with up to 30 dBm EIRP	-	-	2,3	4,9
Gigabit Ethernet optical LAN adapters (fiber converter or POF adapter)	3,5	3,5	3,2	3,2
Ethernet optical LAN adapters (fiber converter or POF adapter) up to 200 Mbit/s	-	-	1,5	1,5
G.hn LAN adapters	-	-	n,a,	n,a,
G.hnem LAN adapters	-	-	n,a,	n,a,
MoCA LAN adapters	-	-	4,0	4,0
ZigBee LAN adapters	-	-	0,25	0,4
Z-Wave LAN adapters	-	-	0,25	0,4
IEC 14543-310 (“EnOcean”) LAN adapters	-	-	0,25	0,4
High speed powerline adapters (less than 30 MHz bandwith)	3,5	4,5	3,0	4,0
High speed powerline adapters (between 30 and 68 MHz bandwith)	4,5	4,5	3,5	5,0
PowerLine – low speed for smart metering and appliance control (Green Phy)	-	-	0,8	1,5
HPNA LAN adapter	-	-	3,5	4,0
Small hubs and non-managed 4 port Layer 2Fast Ethernet switches without CPU (no VPN or VoIP)	1,6	2,0	1,4	2,0
Small hubs and non-managed 4 port Layer 2 Gigabit Ethernet switches without CPU (no VPN or VoIP)	1,8	3,6	1,5	2,8

An HNID is typically a relatively simple device, where 1 Ethernet LAN port is already considered to be part of the initial configuration. Ethernet switches with 4 ports are considered to be part of the initial configuration. If an HNID has more than 4 Ethernet ports, additional allowances for those Ethernet ports can be added as defined in Table 11.

For more complex HNIDs, the same allowances for additional functionality apply as for home gateways (see Table 11). A function used for control or monitoring such as smart plugs, smart sensor and remote controllable light devices are considered equivalent to an HNID.

C.1.4 Other Home Network Devices

Table 15: Power targets for other home network devices

Power targets for Home Network Devices	**Tier 2011-2012:** 1.1.2011- 31.12.2012		**Tier 2013-2014:** 1.1.2013 - 31.12.2014	
	Idle-State (W)	***On-State (W)***	***Idle-State (W)***	***On-State (W)***
ATA / VoIP gateway	1,5	2,2	1,3	2,1
VoIP telephone	3,0	3,7	2,7	3,5
VoIP telephone including Gigabit Ethernet Switching Function	4,2	4,5	3,9	4,3
Print server (without Wi-Fi)	2,0	4,0	1,8	3,6

Some types of other home network devices require additional functionality; in that case the same allowances for additional functionality apply as for home gateways (see Table 11).

C.2 Network equipment

The following targets are power consumption targets per port.

a) All power values measured at the power interface port interface as described in the standard ETSI ES 203215[16] or at the AC input, in case of directly mains powered systems. For directly mains powered systems, the power limits stated in Table 16 through Table 27, will be increased by 10%.

b) The stated target figures apply for equipment operating in their native modes only. In other words, the targets for ADSL2plus equipment apply for equipment that are designed to operate natively in ADSL2plus mode and not VDSL2 equipment operating in ADSL2plusfallbackmode.

c) Although no target is defined in this version of the broadband Code of Conduct for the energy consumption of VDSL2 equipment when operating in fallback mode, the actual consumption has to be tested and reported within the reporting sheet.

d) For multi-profile boards, the power consumption limits do not apply to boards profile not optimized under energy efficiency point of view. Equipment makers shall specify what the optimized profile for the given board under test is at which the power consumption target limit apply. For instance, a board optimized for VDSL2 8b can support other profiles (e.g., 12a, 17a, 30a) but might have suboptimal performance at such additional profiles in terms of power consumption.

e) For boards which have additional functions (e.g., MELT, vectoring, test access and channel bonding) in addition to the bare DSL functionality, such boards are to be used in normal DSL mode of operation with any additional functions disabled. Optionally, a measurement with these functions enabled can be described/requested. If such additional functions cannot be fully disabled, manufacturers will declare what the extra power budget due to the added functionality is. Such an extra budget will not be considered in the per port power consumption computation.

f) Version 5 of the broadband Code of Conduct will set targets for VDSL2 equipment supporting vectoring per ITU-T Rec. G.993.5[17].

C.2.1 Broadband DSL network equipment

Table 16: Broadband ports – DSL-full-load-state(with service traffic on the lines as specified in Table 7)

Power targets for DSL-full-load-state	Tier 2011-2012 (1.1.2011-31.12.2012) (W)	Tier 2013-2014 (1.1.2013-31.12.2014) (W)
ADSL2plus (including ADSL and ADSL2 and with transmission power of 19,8 dBm)	1,2	1,1
VDSL2 (profile 8b) transmission power 19.8 dBm	1,8	1,6
VDSL2 (profile 12a and 17a) transmission power 14.5 dBm	1,6	1,5
VDSL2 (profile 30a) transmission power 14.5 dBm	2,0	1,7

The above values apply to fully equipped, maximum configuration DSLAMs with more than 100 ports. For equipment up to 100 ports (and with maximum configuration) 0,3 W per line may be added to the above values, with a minimum value of 10 W for the whole DSLAM.

The additional allowance for the uplink interface (applicable for all power states: full, low &standby) is:

- 4,5 W per equipment for each PtP 1000Mbit/s interface
- 9,0 W per equipment for each PtP 10Gbit/s interface
- 6,0 W per equipment for each PON (GPON) interface
- 5,0 W per equipment for each PON (1G-EPON) interface
- 7,5 W per equipment for each PON (10/1G-EPON) interface
- 9,0 W per equipment for each PON (10/10G-EPON) interface

Table 17: **Broadband ports – DSL-low-load-state**[7]

Power targets for DSL-low-load-state	Tier 2011-2012 (1.1.2011-31.12.2012) (W)	Tier 2013-2014 (1.1.2013-31.12.2014) (W)
ADSL2plus (including ADSL2)	0,8	0,7
VDSL2 [8]	1,2	1,0

Start-up/Wake-up times from DSL-low-load-state to DSL-full-load-state should be less than 1 second to guarantee a good quality of service (e.g., voice calls).

7 The DSL-low-load-state should allow a bit rate of a configurable value (e.g. for keep-alive-signals, voice). The DSL-low power state levels shall not hamper the quality of service. In order to solve the issues caused by non stationary cross talk, further investigations need to be done. They could be attenuated by the application of much longer time intervals between state transitions (15-30 minutes) than those defined today (1-255 seconds). This requirement comes into effect when the issues on the quality of service have been solved by the standardization bodies.

8 The DSL-low-load-state is not foreseen today in the standard for VDSL2. Operators and manufacturers are urged, through their representatives in the standardization bodies, to make effort towards low power states with corresponding values, which are indicated here as targets for future standard revisions. This requirement comes into effect when relevant standards are available.

Table 18: **Broadband ports – DSL-standby-state**[9],

Power targets for DSL-standby-state	**Tier 2011-2012 (1.1.2011-31.12.2012) (W)**	**Tier 2013-2014 (1.1.2013-31.12.2014) (W)**
ADSL2plus (including ADSL and ADSL2)	0,4	0,3
VDSL2	0,6	0,5

The above values for DSL-low-load and -standby-states are for fully equipped, maximum configuration DSLAMs with more than 100 ports. For equipment up to 100 ports (and with maximum configuration) 0,3 W per line may be added to the above values for the whole DSLAM, with a minimum value of 10W

Start-up/Wake-up times from DSL-standby-state to DSL-full-power-state should be less than 1 second to guarantee a good quality of service (e.g., voice calls).

To minimize cost, dimensions, and power consumption, the network equipment contains chips that control multiple DSL lines (4-8-16) each. If special care is not taken, a single line in DSL-full-load-state could result in a chip fully operational on the other lines also (in low-load or standby states), resulting in an unnecessary waste of energy. The network systems (and their basic components) shall therefore be designed in order to tackle this issue, maximizing the energy savings also in mixed environments with lines in different power states, being this the typical situation found in the network.

C.2.2 Combined DSL/Narrowband network equipment

Power consumption limits for POTS interface implementation into an MSAN are defined in Table 19. The values defined apply to a testing condition where the line length equivalent resistance (including the CPE resistance)is assumed to be 510 Ohm.

It is further assumed that power consumed by MSAN functionality which is common to both Broadband and POTS is split appropriately across the two functions. For those boards, such as combo interface board and combo main control board, which integrate Broadband and POTS functions, the power consumption of these boards are to be measured separately for each function, i.e., measure Broadband with POTS disabled and vice versa. In case the two functions cannot be fully disabled separately, the power values for each function can be declared in proportion according to the measured total power values.

Table 19: **Per-port MSAN POTS power consumption limits**

Per-port MSAN POTS power consumption limits in Watt	**Tier 2011-2012**				**Tier 2013-2014**			
	Port State line feed (W)				**Port State line feed (W)**			
Port State	**40mA**	**32mA**	**25mA**	**20mA**	**40mA**	**32mA**	**25mA**	**20mA**
Not provisioned for POTS *10,11*	0,5	0,5	0,5	0,5	0,3	0,3	0,3	0,3

9 DSL-standby-state shall correspond to the L3 mode as defined in ITU-T Rec G.992.3[19], ITU-T Rec G.992.5[20] and ITU-T Rec G.993.2[18]. A short start up time of <1 second has to be realized to guarantee triple-play functions like VoIP and Video over IP (while the current value for this start up time is around 3 seconds). This requirement comes into effect when relevant standards are available·

10 These figures are additive to those existing in the code of conduct section C.2 (network equipment) for Broadband to form the per port limit for combo operation.

Per-port MSAN POTS power consumption limits in Watt	Tier 2011-2012				Tier 2013-2014			
	Port State line feed (W)				Port State line feed (W)			
Port State	**40mA**	**32mA**	**25mA**	**20mA**	**40mA**	**32mA**	**25mA**	**20mA**
Provisioned for POTS - on-hook 10,*12*	0,5	0,5	0,5	0,5	0,3	0,3	0,3	0,3
Provisioned for POTS - off-hook 10	3	2,3	2,0	1,9	2,6	1,9	1,6	1,5

The above values are for fully equipped, maximum configuration MSAN with more than 100 ports. For equipment up to 100 ports (and with maximum configuration) 0,3 W per line may be added to the above values for the whole MSAN, with a minimum value of 10 W.

It is further assumed that power consumed by MSAN functionality which is common to both Broadband and POTS is split appropriately across the two functions. For those boards, such as combo interface board and combo main control board, which integrate Broadband and POTS functions, the power consumption of these boards are to be measured separately for each function, i.e., measure Broadband with POTS disabled and vice versa. In case the two functions cannot be fully disabled separately, the power values for each function can be declared in proportion according to the measured total power values.

The additional allowance for the uplink interface is:

- 4,5 W per equipment for each PtP 1000Mbit/s interface
- 9,0 W per equipment for each PtP 10Gbit/s interface
- 6,0 W per equipment for each PON (GPON) interface
- 5,0 W per equipment for each PON (1G-EPON) interface
- 7,5 W per equipment for each PON (10/1G-EPON) interface
- 9,0 W per equipment for each PON (10/10G-EPON) interface

C.2.3 Optical Line Terminations (OLT) for PON and Pt Pnetworks

11 Note that this assumes that the port is equipped to supply POTS but has not been configured for use by an end customer.

12 Note that this excludes any on-hook charging current, which may be drawn by the CPE (up to 3mA in some countries).

Table 20:Optical Line Terminations for PON ports

			<= 32 PON ports		> 32 PON ports	
Power targets for Optical Line Terminations for PON ports	**Tier 2011** (1.1.2011) (W)	**Tier 2012** (1.1.2012) (W)	**Tier 2013** (1.1.2013) (W)	**Tier 2014** (1.1.2013) (W)	**Tier 2013** (1.1.2013) (W)	**Tier 2014** (1.1.2013) (W)
GPON (2.5G/1G)						
OLT (GPON, fully equipped with maximum configuration implementing standard Layer-2 (Ethernet) aggregation functionalities, including Multicast)	11	11	8,8	8,1	8,3	7,7
OLT (GPON, fully equipped with maximum configuration implementing also functionalities at the IP layer such as routing, MPLS, and IP QoS)), or more advanced Layer 2 functionality (QOS, shaping, policing)	12	12	9,3	8,5	8,7	8,0
XG-PON1 (10G/2.5G)						
OLT (XG-GPON1 10G/2,5G, fully equipped with maximum configuration implementing standard Layer-2 (Ethernet) aggregation functionalities, including Multicast)[1]	18	15	15		14	
OLT (XG-GPON1 10G/2,5G, fully equipped with maximum configuration implementing also functionalities at the IP layer such as routing, MPLS, and IP QoS), or more advanced Layer 2 functionality (QOS, shaping, policing). [1]	19	16	16		15	
Additional per port allowance for 10G GPON and 10G EPON OLT, with independent traffic process component (not embedded in PON MAC) on each line cards, implementing Layer 3 functionalities of Edge Router (at least IP/MPLS routing and interface and policy based hierarchical QoS (H-QoS)), providing extendable capability to evolve adding new functionalities currently under discussion, and variable traffic processing functions and/or market specific customization requirements.	9	9	7,0		7,0	
EPON (1G/1G)						
OLT (1G-EPON, fully equipped with maximum configuration implementing standard Layer-2 (Ethernet) aggregation functionalities, including Multicast)	9	7	8,1		7,7	
OLT (1G-EPON, fully equipped with maximum configuration implementing also functionalities at the IP layer such as routing, MPLS, and IP QoS), or more advanced Layer 2 functionality (QOS, shaping, policing)	10	8	8,8		8,1	
10G/1G EPON						
OLT (10/1G-EPON, fully equipped with maximum configuration implementing standard Layer-2 (Ethernet) aggregation functionalities, including Multicast)	18	15	18,3	17,5	15,3	14,6

			<= 32 PON ports		> 32 PON ports	
Power targets for Optical Line Terminations for PON ports	**Tier 2011** (1.1.2011) (W)	**Tier 2012** (1.1.2012) (W)	**Tier 2013** (1.1.2013) (W)	**Tier 2014** (1.1.2013) (W)	**Tier 2013** (1.1.2013) (W)	**Tier 2014** (1.1.2013) (W)
OLT (10/1G-EPON, fully equipped with maximum configuration implementing also functionalities at the IP layer such as routing, MPLS, and IP QoS), or more advanced Layer 2 functionality (QOS, shaping, policing)	19	16	19,3	18,8	15,9	15,4
Additional per port allowance for 10G GPON and 10G EPON OLT, with independent traffic process component (not embedded in PON MAC) on each line cards, implementing Layer 3 functionalities of Edge Router (at least IP/MPLS routing and interface and policy based hierarchical QoS (H-QoS)), providing extendable capability to evolve adding new functionalities currently under discussion, and variable traffic processing functions and/or market specific customization requirements	9	9	7,0	7,0	7,0	7,0
10G/10G EPON						
OLT (10/10G-EPON, fully equipped with maximum configuration implementing standard Layer-2 (Ethernet) aggregation functionalities, including Multicast)	19	16	19,5	18,8	16,9	16,2
OLT (10/10G-EPON, fully equipped with maximum configuration implementing also functionalities at the IP layer such as routing, MPLS, and IP QoS), or more advanced Layer 2 functionality (QOS, shaping, policing)	20	17	20,5	20,0	17,4	16,7
Additional per port allowance for 10G GPON and 10G EPON OLT, with independent traffic process component (not embedded in PON MAC) on each line cards, implementing Layer 3 functionalities of Edge Router (at least IP/MPLS routing and interface and policy based hierarchical QoS (H-QoS)), providing extendable capability to evolve adding new functionalities currently under discussion, and variable traffic processing functions and/or market specific customization requirements	9	9	7,0	7,0	7,0	7,0

Notes:

(1) These numbers assume a certain level of product maturity, early implementations based on FPGA may not be able to achieve these limits

Table 21:Optical Line Terminations for PtP ports

Power targets for Optical Line Terminations for PtP ports	Tier 2011 (1.1.2011) (W)	Tier 2012 (1.1.2012) (W)	Tier 2013 (1.1.2013) (W)
PtP 1000Mbps			
OLT (PtP up to 1000 Mbit/s, up to 100 ports, fully equipped with maximum configuration)	4,5	4,5	4
OLT (PtP up to 1000 Mbit/s, from 100 and 300 ports, fully equipped with maximum configuration)	2,8	2,8	2,7
OLT (PtP up to 1000 Mbit/s, with more than 300 ports, fully equipped with maximum configuration)	2	2	1,9
Additional per port allowance for PtP up to 1000 Mbit/s OLT, with independent traffic process component (not embedded in LAN switch) on each line cards, implementing Layer 3 functionalities of Edge Router (at least IP/MPLS routing and interface and policy based hierarchical QoS (H-QoS)), providing extendable capability to evolve adding new functionalities currently under discussion, and variable traffic processing functions and/or market specific customization requirements	0,4	0,4	0,3
PtP 10Gbps			
OLT (PtP at 10 Gbit/s, up to 12 ports, fully equipped with maximum configuration)	38	38	28
OLT (PtP at 10 Gbit/s, from 12 to 42 ports, fully equipped with maximum configuration)	28	28	20
OLT (PtP at 10 Gbit/s, with more than 42 ports, fully equipped with maximum configuration)	18	18	13

The above values are for fully equipped with maximum configuration OLTs.

The additional allowance for the uplink interface is:

- 4,5 W per equipment for each PtP 1000Mbit/s interface
- 9,0 W per equipment for each PtP 10Gbit/s interface
- 6,0 W per equipment for each PON (GPON) interface
- 5,0 W per equipment for each PON (1G-EPON) interface
- 7,5 W per equipment for each PON (10/1G-EPON) interface
- 9,0 W per equipment for each PON (10/10G-EPON) interface

The above consumption for GPON, XG-PON1 and EPON OLT is per port whatever the number of ONU connected to it is. The above consumption for GPON OLT is with ClassB+ (ITU-T G.984.2 amd1) optical modules.

The above consumption for PtP OLT is per user port. The optical budget for the OLT P2P interfaces shall be in line with IEEE802.3,Clause 58 for the 100BASE-LX10 and 100BASE-BX10 interfaces and IEEE802.3,Clause 59 for the 1000BASE-LX10 and 1000BASE-BX10 interfaces. The PtP 10 Gbit/s limits are applicable only to PtPlinks operating at 10 Gbit/s, fully equipped with maximum configuration that directly connect to CPE associated with broadband distribution for residential customers and SOHO.

The above power consumption for EPON OLT is per port and with PRX30 class for 10/1G-EPON OLT, PR30 class for 10/10G-EPON and PR30 class for 1G-EPON [12].

C.2.4 Wireless Broadband network equipment

Table 22:Wi-Fi network equipment

Power targets for Wi-Fi network equipment	**Tier 2011-2012** (1.1.11) (W)	**Tier 2013-2014** (1.1.2012) (W)
Wi-Fi access points (Hotspot application) 802.11b/g/n or 802.11/b/g/a – ON state and Active Standby[13]	10	8

Table 23:WiMAX network equipment

Power targets for WiMAX network equipment	**Tier 2011 (1.1.2011) (W)**		**Tier 2012 (1.1.2012) (W)**		**Tier 2013-2014 (1.1.2013) (W)**	
	2,5 GHz	3,5 GHz	2,5 GHz	3,5 GHz	2,5 GHz	3,5 GHz
WiMAX Radio Base Station (3 sectors) -Full-load-state	715	685	640	610	560	530
WiMAX Radio Base Station (3 sectors) -Medium load -state	670	640	570	550	480	460
WiMAX Radio Base Station (3 sectors) - Low load -state	580	550	480	460	390	370

Configuration of WiMAX Radio Base Station:

1) 3 sectors, 2,5 GHz/3,5 GHz, 10 MHz bandwidth channel, 4 × 4 MIMO, 29:18 DL/UL subframe ratio
2) Output power: 28 W (7 W × 4) (3,5 GHz) / 40 W (10 W × 4) (2,5 GHz) at antenna interface for each sector

For Wimax Radio base station the following states are differentiated:

Full-load-state is the operating mode of the equipment or device where it provides maximum capacity and RF transmit with the maximum output power.

Medium-load-state is the operating mode of the equipment or device where RF transmits with the 50% DL symbol.

Low-load-state is the idle mode of the equipment or device where it works with no traffic and only transmits the Preamble and MAP.

Table 24:GSM/EDGE network equipment

Power targets for GSM/EDGE network equipment	**Tier 2011 (1.1.2011) (W)**	**Tier 2012 (1.1.2012) (W)**	**Tier 2013-2014 (1.1.2013) (W)**
	0,9/1,8/1,9 GHz	0,9/1,8/1,9 GHz	0,9/1,8/1,9 GHz
GSM/EDGE Radio Base Station (3 sectors) -Full-load-state	1000	950	800
GSM/EDGE Radio Base Station (3 sectors) –Medium load -state	800	750	700
GSM/EDGE Radio Base Station (3 sectors) – Low load -state	650	600	580

1)Three sectors, four carriers per sector (S444)

[13] The On-state is defined with no traffic on the Wi-Fi port. Therefore there is no difference in power consumption between the On-state and the Low-load-state (Active Standby) for this equipment.

2)Output power: 20 W at antenna interface for each carrier (4 × 20 W for each sector) using 8PSK modulation. For equipment that, differently from Remote Radio Units, are designed to be installed in shelters and will face feeder loss, the output power will have to be incremented by the feeder loss. For the table above, that loss is defined to be 3dB.

For GSM/EDGE Radio base station the following states are differentiated (the state definitions are based on ETSI TS 102 706[10]):

Full-load-state is the operating mode of the equipment or device where BCCH TRX8 active TS and other TRXs 12 active TS per each sector are transmitting.

Medium-load-state is the operating mode of the equipment where BCCH TRX 8 active TS and other TRXs 6 active TS per each sector are transmitting.

Low-load-state is the idle mode of the equipment or device where it works with no traffic and only transmits common signals where BCCH TRXis transmitting

Table 25:WCDMA/HSDPA network equipment

Power targets for WCDMA/HSDPA network equipment	Tier 2011 (1.1.2011) (W)	Tier 2012 (1.1.2012) (W)	Tier 2013-2014 (1.1.2013) (W)
	2,1 GHz	2,1 GHz	2,1 GHz
WCDMA/HSDPA Radio Base Station (3 sectors) -Full-load-state	1000	900	800
WCDMA/HSDPA Radio Base Station (3 sectors) -Medium load -state	910	780	670
WCDMA/HSDPA Radio Base Station (3 sectors) - Low load -state	835	690	570

1) 3 sectors, two carrier per sector (S222), Distributed Radio Base station with dual-TX Radio Remote Unit which nominal output power is less than 80W.

2) Output power: Output power: 20 W at antenna interface for each radio cell. (20 W+20 W for each sector).For equipment that, differently from Remote Radio Units, are designed to be installed in shelters and will face feeder loss, the output power will have to be incremented by the feeder loss. For the table above, that loss is defined to be 3dB

For WCDMA/HSDPA Radio base station the following states are differentiated (the state definitions are based on ETSI TS 102 706[10]):

Full-load-state is the operating mode of the equipment or device where it provides maximum capacity and RF transmit CCH plus first fifteen codes

Medium-load-state is the operating mode of the equipment or device where RF transmits CCH plus first three codes

Low-load-state is the idle mode of the equipment or device where it works with no traffic and only transmits primary CPICH

Table 26:Wireless broadband network equipment – LTE

Power targets for LTE wireless broadband network equipment	Tier 2011 (1.1.2011) (W)	Tier 2012 (1.1.2012) (W)	Tier 2013-2014 (1.1.2013) (W)
LTE Radio Base Station (3 sectors) - Full- load-state	1200	1100	900
LTE Radio Base Station (3 sectors)- Medium load -state	1080	950	750
LTE Radio Base Station (3 sectors)-	800	750	650

Low load -state			

Configuration of LTE Radio Base Station:

1) 3 sectors, 2,6 GHz, 20 MHz bandwidth channel 2 × 2MIMO
2) Output power: 40 W (20 W × 2) at antenna interface for each sector. For equipment that, differently from Remote Radio Units, are designed to be installed in shelters and will face feeder loss, the output power will have to be incremented by the feeder loss. For the table above, that loss is defined to be 3dB

For LTE Radio base station the following states are differentiated (the state definitions are based on draft ETSI TS 102 706[10]):

Full and Medium-load-state: All REs dedicated to CCHs, reference and synchronisation signals shall be transmitted. In addition a certain number of PRBs dedicated to PDSCH shall be trans-mitted. The number of transmitted PRBs dedicated to PDSCH shall be calculated as such, that the complete power over the baseband bandwidth (20 MHz) and averaged over one LTE FDD frame (10 ms) is 50% (full-load) and 30% (medium load) of the maximum rated power of the cell

Low-load-state:all REs dedicated to CCHs, reference and synchronization signals shall be transmitted

C.2.5 Cable network equipment

Table 27:Cable network equipment

Power targets for cable network equipment	Tier 2012-2013 (1.1.2012) (W)
I-CMTS ≤32 DS (downstream) ports	6
I-CMTS >32 DS ports	6
M-CMTS ≤ 280 DS ports	6
M-CMTS > 280 DS ports	6

An allowance of 8 W is provided for each M-CMTS Ethernet Point-to-Point 10 Gbit/s interface between M-CMTS core and EQAM.

The above values are nominal at 25°C for a fully equipped chassis at its maximum configuration. Sparing features are not assumed. The above values are for fully equipped systems with maximum configurations. The assumed configuration includes a ratio of two upstream Service Groups paired with one downstream Service Group. It is assumed that the ratio of number of channels in an upstream Service Group to number of channels in a downstream Service Group is 1:4.

C.2.6 Powerline network equipment

Access powerline networks have not reached a high importance in Europe yet. When powerline networks are developed, additional power targets for power line access equipment should be included in this Code of Conduct.

D Example Home Gateway Power Consumption Targets

The home gateway power consumption targets are computed from the components according to the configuration (profile) of the home gateway. Some example profiles are provided below. Home gateways having these exact configurations must meet these power targets, and by using this approach it is possible to create the targets that must be met for a home gateway of arbitrary functionality.

D.1 ADSL Home Gateway

ADSL home gateway with 4 Fast Ethernet LAN ports, a single radio IEEE 802.11b/g Wi-Fi interface and 2 USB ports:

- in idle-state: all Ethernet LAN ports disconnected, no traffic on Wi-Fi
- in on-state: all Ethernet LAN ports active, traffic on Wi-Fi

Function	idle-state		on-state	
	2011/2012	**2013/2014**	**2011/2012**	**2013/2014**
Central functions + ADSL WAN interface	2,6	2,4	3,8	3,4
4 Fast Ethernet LAN ports	4 × 0,3 = 1,2	4 × 0,2 = 0,8	4 × 0,4 = 1,6	4 × 0,4 = 1,6
single radio IEEE 802.11b/g Wi-Fi interface (23 dBm EIRP)	0,7	0,7	2,0	1,5
USB ports	2 × 0,25 = 0,5	2 × 0,1 = 0,2	2 × 0,25 = 0,5	2 × 0,1 = 0,2
Total equipment	**5,0W**	**4,1W**	**7,9W**	**6,7W**

D.2 VDSL2 Home Gateway

VDSL2 home gateway with 4 Gigabit Ethernet LAN ports, a single radio 802.11n Wi-Fi interface, 2 USB ports and 2 FXS ports:

- in idle-state: all Ethernet LAN ports disconnected, no traffic on Wi-Fi, no active voice call
- in on-state: all Ethernet LAN ports active, traffic on Wi-Fi, 1 active voice call (the second FXS port has no device connected and for this port the idle target needs to be considered)

Function	idle-state		on-state	
	2011/2012	**2013/2014**	**2011/2012**	**2013/2014**
Central functions + VDSL2 WAN interface (17a)	3,5	3,2	6,0	4,6
4 Gigabit Ethernet LAN ports	4 × 0,3 = 1,2	4 × 0,2 = 0,8	4 × 0,9 = 3,6	4 × 0,6 = 2,4
single IEEE 802.11n radio Wi-Fi interface with 3 RF chains 3x3 MIMO (23 dBm)	1,0+0,1 = 1,1	0,8+0,1 = 0,9	2,5+0,4 = 2,9	2,0+0,4 = 2,4
USB ports	2 × 0,25 = 0,5	2 × 0,1 = 0,2	2 × 0,25 = 0,5	2 × 0,1 = 0,2
FXS ports	2 × 0,5 = 1,0	2 × 0,3 = 0,6	1,5+0,5 =2,0	1,2+0,3 = 1,5
Total equipment	**7,3W**	**5,7W**	**15,0W**	**11,1W**

D.3 Ethernet router with 4 Fast Ethernet LAN ports

Fast Ethernet router with 1 WAN and 4 LAN Ethernet ports:

- in idle-state: all Ethernet LAN ports disconnected

- in on-state: all Ethernet LAN ports active

Function	idle-state		on-state	
	2011/2012	2013/2014	2011/2012	2013/2014
Central functions + Fast Ethernet WAN interface	2,5	2,0	3,3	3,0
4 Fast Ethernet LAN ports	4 × 0,3 = 1,2	4 × 0,2 = 0,8	4 × 0,4 = 1,6	4 × 0,4 = 1,6
Total equipment	**3,7W**	**2,8W**	**4,9W**	**4,6W**

D.4 Cable DOCSIS 3.0 CPE

DOCSIS 3.0 CPE in 8x4 configuration with 1 Gigabit Ethernet LAN port:

- in idle-state: the Ethernet LAN port is disconnected
- in on-state: the Ethernet LAN port is active

Function	idle-state		on-state	
	2011/2012	2013/2014	2011/2012	2013/2014
Central functions + DOCSIS 3.0 basic configuration WAN interface	6,2	6,2	7,1	7,1
1 DOCSIS 3.0 Additional power allowance for the additional 4 downstream channels	2,2	2,2	2,8	2,8
1 Gigabit Ethernet LAN port	0,3	0,2	0,9	0,6
Total equipment	**8,7W**	**8,6W**	**10,8W**	**10,5W**

Complex HNID: dual-band 11n access point with 4 Gigabit Ethernet LAN ports

Function	idle-state		on-state	
	2011/2012	2013/2014	2011/2012	2013/2014
Wi-Fi Access Points with single band IEEE 802.11n radio (23 dBm), 2x2 MIMO	3,5	2,3	5,0	3,9
single IEEE 802.11n radio Wi-Fi interface (23 dBm), 2x2 MIMO	1,0	0,8	2,5	2,0
3 additional Gigabit Ethernet LAN ports	3 × 0,3 = 0,9	3 × 0,2 = 0,6	3 × 0,9 = 2,7	3 × 0,6 = 1,8
Total equipment	**5,4W**	**3,7W**	**10,2W**	**7,7W**

E Reporting Form

See Reporting Sheet on the homepage of the EU Standby Initiative [3].

The reporting spreadsheet should be filled in on the basis of equipment capability, in particular the actual number of ports on cards or chassis should be entered, regardless of any design or regulatory constraints which may result in the suboptimal use of those cards.

For Network Operators, the tier to be used for compliance purposes should be that pertaining to the year when equipment of a given type was ordered for the first time.

F Test methods

F.1 Customer premises equipment

Customer premises equipment with an external power supply shall be measured 230V AC input in all states (when existing) as they are described in section B.1. In the future, standardization bodies like ETSI could provide a more detailed specification for the measurement of the power consumption in different states.

F.2 Network equipment

The values given in section C.2 are indicating the averaged power consumption per port for a fully equipped system as delivered by the manufacturer.

Systems powered by DC voltage shall comply with the standard ETSI EN 300 132-2 [8]. The method of power measurement shall comply with the Technical Specification ETSI ES 203 215 [16].

In case of systems powered directly by AC mains voltage, the power consumption will have to be measured at the AC input. For such systems, the power limits stated in Table 16 through Table 27:, may be increased by 10%.

The power limits have to be fulfilled for the system operating at ambient temperature (23±2°C. Fans, if present, have to be kept at maximum speed.

Note: for both Customer premises and network equipment the xDSL test conditions under which energy consumption is measured should be representative of the scenario(s) under which network equipment or CPE is to be deployed (e.g., selection of band plan for VDSL2).The Broadband Forum and ETSI EE provide xDSL test plans, which may be used prior to the general availability of a unified test methodology which is fully compatible with the Code of Conduct.

In the spirit of industry harmonization, ETSI EE and the Broadband Forum will collaborate on the review/definition of the Broadband Energy efficiency measurement methods standards and test plans for xDSL CPE and network equipment published by ETSI with the aim of making joint recommendations for the next revision of the Code of Conduct.

G Evolution of power saving for broadband equipment

The volume of deployed broadband equipment is increasing dramatically and so does its combined power consumption. Due to low customer aggregation ratios (typically, one CPE per customer), such equipment is typically idle most of the time, most of the time exchanging data only to maintain its network status. It is therefore evident that such equipment can be optimized in terms of its power consumption and activity profiles. Examples of such techniques include dynamic adaptation (e.g., performance scaling), smart standby (e.g., through proxying network presence and virtualization of functions) and energy aware management. The following list gives an overview of some of available optimization techniques.

- Energy Efficient Ethernet (EEE) as defined in IEEE 802.3az – wired copper Ethernet interfaces on CPEs have the ability to operate at a data rate lower than their nominal data rate, reducing power consumption of the interface as a whole. Different port-type-specific signalling mechanisms are used in EEE, including Low Power Idle. To take the full advantage of the EEE potential, both link peers must support EEE.
- Network Proxying defined by the ECMA task group under the work programme of TC38-TG4 - Proxying Support for Sleep Modes. The work is focused on providing support for the Network Proxy function for various types of broadband equipment, including VoIP phones. A proxy in this context is an entity that maintains network presence for a sleeping higher-power broadband device. A VoIP phone remains idle most of the time. VoIP phones cannot be put into a full standby mode, since they are required to maintain network presence through persistent data connectivity. Through proxying, another entity within the broadband network can assure such persistent data connectivity on behalf of a VoIP phone and wake it up when required. In this way, a device can enter a full standby mode, without any adverse effects on associated communication protocols.
- Energy aware management IETF EMAN. Provides a framework for Energy Management for devices within or connected to communication networks, and components thereof. It defines an Energy Management Domain as a set of Energy Objects, for which each Energy Object is identified, classified and given context. Energy Objects can be monitored and/or controlled with respect to Power, Power State, Energy, Demand, Power Quality, and battery. https://datatracker.ietf.org/wg/eman/

Implementing those functions in broadband equipment enhances its capabilities for power saving.

H List of abbreviations

1G-EPON	EPON operating at 1 Gbit/s downstream and 1Gbit/s upstream (IEEE 802.3)
10/1G-EPON	EPON operating at 10 Gbit/s downstream and 1Gbit/s upstream (IEEE 802.3)
10/10G-EPON	EPON operating at 10 Gbit/s downstream and 10Gbit/s upstream (IEEE 802.3)
ADSL	Asymmetric Digital Subscriber Line
ADSL2plus	Second generation ADSL with extended bandwidth
ATA	Analogue Terminal Adapter
CoC	Code of Conduct
COP	Coefficient Of Performance
CPE	Customer Premises Equipment
DECT	Digital Enhanced Cordless Telecommunications
DOCSIS	Data Over Cable Service Interface Specification
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
EPON	Ethernet Passive Optical Network, as specified by IEEE 802.3
ETSI	European Telecommunications Standards Institute
FXO	Foreign eXchange Office
FXS	Foreign eXchange Station
GPON	Gigabit Passive Optical Network
GSM/EDGE	Global System for Mobile communication/Enhanced Datarate GSM Evolution
HPNA	Home PNA Alliance
IEEE	Institute of Electrical and Electronics Engineers
I-CMTS	Integrated Cable Modem Termination System
IP	Internet Protocol
ITU	International Telecommunication Union
LAN	Local Area Network
LT	Line Termination
LTE	Long Term Evolution
M-CMTS	includes CMTS core and EQAM (Edge Quadrature Amplitude Modulator)
MoCA	Multimedia over Coax Alliance
MSAN	Multi Service Access Node
NAT	Network Address Translation
NT	Network Termination
ONU	Optical Network Unit
PtP	Point-to-Point Optical Network
PLC	PowerLine Communication
PoE	Power over Ethernet
PON	Passive Optical Network
POTS	Plain Old Telephone Service
SOHO	Small Office, Home Office
USB	Universal Serial Bus
VDSL2	Very High Speed Digital Subscriber Line 2nd generation
VoIP	Voice over IP
WAN	Wide Area Network
WCDMA/HSDPA	Wideband Code Division Multiple Access/High Speed Packet Access
Wi-Fi	Wireless Fidelity; technology using IEEE 802.11 standards
XG-PON1	10-Gigabit passive optical network

I List of references

[1] ITU-T recommendation I.113,"Vocabulary of terms for broadband aspects of ISDN"

[2] Code of Conduct for Digital TV Services (version 7 – 15th of January 2008),http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative.htm

[3] Reporting sheet CoC BB equipment http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_broadband%20communication.htm

[4] EU Code of Conduct for External Power Supplies Version 3 of 28.11.2008, http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_External%20Power%20Supplies.htm

[5] ETSI Standard EN 300019-1-3 European Standard, Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations

[6] ETSI Standard EN 300019-1-4 European Standard, Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weather protected locations

[7] EU Code of Conduct on Energy Efficiency of Broadband Equipment, Version 4,10th of February2011

[8] ETSI EN 300 132-2 European Standard, Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)

[9] COMMISSION REGULATION (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment

[10] ETSI TS 102 706 V1.2.1, "Technical Specification, Environmental Engineering (EE), Energy Efficiency of Wireless Access Network Equipment"

[11] IEEE Std 802.3™-2012, IEEE Standard for Ethernet

[12] IEEE P802.3bk, draft D2.0, Draft Standard for Ethernet, Amendment 2: Physical Layer Specifications and Management Parameters for Extended Ether-net Passive Optical Networks

[13] Broadband Forum TR-100 Issue 1 (March 8, 2007), ADSL2/ADSL2plus Performance Test Plan, http://www.broadband-forum.org/technical/download/TR-100.pdf

[14] Broadband Forum TR-114 Issue 1 (November 2009), VDSL2 Performance Test Plan, http://www.broadband-forum.org/technical/download/TR-114.pdf

[15] ITU-T Recommendation G.984,"Gigabit-capable passive optical networks (GPON): General characteristics"

[16] ETSI ES 203 215 V1.2.1, "ETSI Standard, Environmental Engineering (EE); Measurement Methods and Limits for Power Consumption in Broadband Telecommunication Networks Equipment"

[17] ITU-T Recommendation G.993.5, “Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers”

[18] ITU-T Recommendation G.993.2, “Very high speed digital subscriber line transceivers 2 (VDSL2)”

[19] ITU-T Recommendation G.992.3, “Asymmetric digital subscriber line transceivers 2 (ADSL2)”

[20] ITU-T Recommendation G.992.5, “Asymmetric digital subscriber line 2 transceivers (ADSL2)– Extended bandwidth ADSL2 (ADSL2plus)”

K Signing form

Code of Conduct
On Energy Consumption of Broadband Equipment

SIGNING FORM

The organisation/company/

………………………………………………………………..

signs the Code of Conduct on Energy Consumption of Broadband Equipment and commits itself to abide to the principles described in point 3 "Commitment" for the equipment it produces, buys, installs or specifies.

The organisation, through regular upgrade reports, will keep the European Commission informed on the implementation of the Code of Conduct of Broadband Equipment.

for the organisation

Director or person authorised to sign:

Name:	**……………………………. . . . .**
Managerial Function:	**…………………………….. . . . .**
Address	**………………………………………………**
Tel. / Fax.	**………………………………………………**
Email:	**………………………………………………**
Date	**………………………………………………**

Signature ………………………………………………

Please send the signed form to:

Paolo Bertoldi
European Commission - DG JRC
TP 450
I-21027 Ispra (VA)
tel. +39 0332 78 9299
fax. +39 0332 78 9992
E-mail: paolo.bertoldi@ec.europa.eu