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Environmental Engineering (EE); Measurement method for energy consumption of Customer Premises Equipment (CPE)

Reference

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ETSI

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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Environmental Engineering (EE).

National transposition dates	
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Modal verbs terminology

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Introduction

The present document defines the energy consumption measurement methods for Customer Premises Equipment (CPE).

1 Scope

The present document defines the methodology and the tests conditions to measure the power consumption of CPE power source within the scope of Commission Regulation 2023/826 [i.1]:

Moreover, these different modes of operation are defined.

- Disconnect mode.

- Off mode (as defined in Commission Regulation 2023/826 [i.1]).

- Idle states.

- Low Power states.

- On mode.

- Ready mode.

The methods of measurement are applicable to customer premises equipment which can be directly connected to the mains.

Equipment drawing electricity via the network connection (indirectly connected to the mains) or via local Personal Computer (i.e. via USB) is out of scope:

- Networked standby mode and stand by mode defined in Commission Regulation (EU) 2023/826 [i.1] is out of the scope of the present document and it is covered by ETSI EN 303 423 [i.4].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] EN 50160: "Voltage characteristics of electricity supplied by public electricity networks", (produced by CENELEC).

2.2   Informative references

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1]   Commission Regulation (EU) 2023/826 of 17 April 2023 laying down ecodesign requirements for off mode, standby mode, and networked standby energy consumption of electrical and electronic household and office equipment pursuant to Directive 2009/125/EC of the European Parliament and of the Council and repealing Commission Regulations (EC) No 1275/2008 and (EC) No 107/2009.

[i.2]   European Commission Directorate-General, Joint Research Centre: "EU Code Of Conduct on Energy Consumption of Broadband Communication Equipment".

[i.3]   Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast).

[i.4]   ETSI EN 303 423: "Environmental Engineering (EE); Electrical and electronic household and office equipment; Measurement of networked standby power consumption of Interconnecting equipment".

[i.5]   Cablelabs®: "Data-Over-Cable Service Interface Specifications- DOCSIS® 3.0 Interface".

[i.6]   Cablelabs®: "Data-Over-Cable Service Interface Specifications- DOCSIS® 3.1 Interface".

[i.7]   IEEE 802.3-2005™: "IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[i.8]   Commission accompanying (EU) No 801/2013 amending Regulation (EC) N° 1275/2008 with regard to ecodesign requirements for standby, off mode electric power consumption of electrical and electronic household and office equipment, and amending Regulation (EC) N° 642/2009 with regard to ecodesign requirements for televisions.

[i.9]   Guidelines accompanying 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 equipment.

[i.10]   IEEE 802.11-2021™: "IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[i.11]   Recommendation ITU-T G.993.2 (02/2019): "Very high speed digital subscriber line transceivers 2 (VDSL2)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

AI Processor: specialized computing unit capable of performing accelerated matrix calculation using dedicated hardware not normally found in a general purpose processor

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

broadband terminal equipment: equipment comprising broadband technology that is connected to a telecommunication network at a point beyond the Network Termination Point

Customer-Premises Equipment (CPE): any terminal and associated equipment located at a subscriber's premises and connected with a carrier's telecommunication channel(s) at the Network Termination Points (NTPs)

directly connected to the mains power source: equipment that could draw electricity from mains power outlet itself via its internal or external power supply

g.fin: fibre-based in-premises network consisted of a main FTTR unit and one/multiple sub FTTR unit

NOTE: The G.fin network enables network functionalities, including data backhauling, Wi-Fi® coordination, network management, etc.

indirectly connected to the mains power source: not directly connected to the mains power source e.g. the equipment could draw electricity via the network connection from a linked equipment that draws power from mains

NOTE: Examples include Power over Ethernet (PoE) and Power over USB.

logical network port: network technology running over a physical network port

network port: wired or wireless physical interface of the network connection located on the equipment through which the equipment is able to be remotely activated

Network Termination Point (NTP): point established in a building or complex to separate customer equipment from communications providers equipment

networked equipment: equipment that has the ability to connect to a network and has one or more network ports

networked equipment with high network availability or 'HiNA equipment': equipment with one or more of the following functionalities, but no other, as the main function(s):

- those of a router

- network switch

- wireless network

- access point

- hub

- modem

- VoIP telephone

- video phone

networked equipment with high network availability functionality or 'equipment with HiNA functionality': equipment with the functionality of a router, network switch, wireless network access point or combination thereof included, but not being HiNA equipment

physical network port: physical (hardware) medium of a network port

NOTE: A physical network port can host two or more network technologies.

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

reactivation function: function facilitating the activation of other modes, including active mode, by remote switch including remote control, internal sensor, timer to a condition providing additional functions, including the main function

readiness: configuration (e.g. of VLANs) that allows user traffic to pass (between WAN and LAN interfaces, wired or wireless) without the need for any reconfiguration or manual intervention to enable its forwarding

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 and/or CPE's beyond the NTPs)

user traffic: service-related traffic between (any of) WAN interfaces and (any of) LAN interfaces, wired or wireless

NOTE: Traffic across any interface or port that is not (a result or cause of) providing the intended services (such as device management, keepalive, etc.) is not considered service-related and therefore is not "user traffic".

3.2 Symbols

Void.

3.3 Abbreviations

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

4G	4th Generation (mobile networks) also known as LTE
5G	5th Generation (mobile networks)
AC	Alternating Current
ADSL	Asymmetric Digital Subscriber Line
ADSL2plus	Second generation ADSL with extended bandwidth
BW	Band Width
CF	Cable Frequency
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
DECT	Digital Enhanced Cordless Technology
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
EPON	Ethernet Passive Optical Network
FE	Fast Ethernet
FFT	Fast Fourier Transform
FTTR	Fiber To The Room
FXO	Foreign eXchange Office
FXS	Foreign eXchange Station
G.fast	Fast Access to Subscriber Terminal
GE	Gigabit Ethernet
GPON	Gigabit Passive Optic Network
HG	Home Gateway
HiNA	High Network Availability
HPNA	Home Phoneline Network Alliance
LAN	Local Area Network
LTE	3GPP Long Term Evolution
MFU	Main FTTR Unit
MoCA	Multimedia over Coax Alliance
Ms/s	Mega symbols per second
NB-IoT	NarrowBand Internet of Things
NDR	Non Drop Rate

NTP	Network Termination Point
OFDM	Orthogonal Frequency Division Multiplex
OFDMA	Orthogonal Frequency Division Multiple access
PLC	Power Line Communication
PoE	Power other Ethernet
POF	Plastic Optical Fiber
PON	Passive Optical Network
PSD	Power Spectral Density
PtP	Point to Point
QAM	Quadrature Amplitude Modulation
SC-QAM	Single Carrier Quadrature Amplitude Modulation
SFU	Subordinate FTTR Unit
USB	Universal Serial Bus
VAC	Volts Alternating Current
VDSL	Very high speed Digital Subscriber Line
VDSL2	Second generation VDSL
VLAN	Virtual Local Area Networ
VoIP	Voice over Internet Protocol
WAN	Wide Area Network
WLAN	Wireless Local Area Network
XG-PON1	10 Gigabit Passive Optical Network
XGS-PON	10-Gigabit-capable Symmetric Passive Optical Network

4   Operating modes

This clause reports a detailed explanation of the different operating mode applicable to CPE.

The different operating mode possible in a CPE are:

- Disconnected mode: the CPE is disconnected from all external power sources.

  - Off mode (from Commission Regulation (EU) 2023/826 [i.1]): means a condition in which the equipment is connected to the mains power source and is not providing any function, or it is in a condition providing only:

    a)   an indication of off mode condition;

    b)   functionalities intended to ensure electromagnetic compatibility pursuant to Directive 2014/30/EU [i.3].

  The vendor may determine that support of off-mode is inappropriate for the intended use of HiNA equipment (e.g. if intended use requires a permanent network connection or disallows end-user to switch off). See the Commission Regulation (EU) 2023/826 [i.1] and EC accompanying guidelines [i.8] and [i.9].

- Idle-state: in this state the device is not processing or transmitting a significant amount of traffic, but is ready to detect activity. All the components are in their individual Idle states.

- Low Power states: these are energy saving modes where settings should be adjustable by the user /operator and designed in a way that it is likely to be adjusted if necessary to an alternative or custom setting, more suitable to their typical use (e.g. ADSL2plus L2 mode). Other innovative solutions shall be considered.

- ON mode: The equipment is connected to the mains power source and all the main function(s) providing the intended service has been activated. All the components are in their individual On states.

- Ready mode The equipment is connected to mains power sources and configured to be ready to provide the intended services without any reconfiguration or manual intervention and a number of components are in their individual On states.

5 General requirements for measurement conditions

5.1 Measurement conditions

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

The power measurements shall be performed in a laboratory environment under the following conditions:

- Room Temperature: 25 ± 2 °C.

- Room Relative Humidity: 30 % to 75 %.

- Supply voltage:

    - AC Powered Equipment: According to EN 50160 [1], 230 V ± 1 % for nominal voltage of 230 VAC and at ±1 % of rated frequency.

- Power measurement point:

    - AC Powered Equipment: Power consumption of broadband CPE with an external power supply shall be measured at AC input in all modes.

- Minimum Measurement Duration:

    - Equipment shall be allowed to stabilize. Wait at least 60 seconds before measurements. In case the WAN interface requires extended time to stabilize wait until final trimmed power level is achieved before measurements are taken.

    - The power levels provided as a result of measurement for all modes are mean values based on sufficiently long measurement periods (at least 10 minutes), during which the equipment remains continuously in that same mode.

5.2 Measurement instruments requirements

All measurement instruments used shall be calibrated by a certified calibration provider and be within calibration, and the measurement resolution shall be within ±1 %:

- Power Source: Power sources used to provide power to the equipment under test shall be capable of providing a minimum of 3 times the power rating of the equipment under test.

Power Measurement Instrument: Power measurement instrument (such as voltmeter and ammeter or power analyser) shall have an accuracy of 0,5 % or better. Real Power, Apparent Power and Power Factor shall be accurately measured:

- AC power measurement instruments shall have the following minimum characteristics:

    1) A minimum digitizing sample rate of 40 kHz.

    2) Input circuitry with a minimum bandwidth of 80 kHz.

6 Measurement configurations

6.1 Off mode

In off mode the CPE is not fulfilling any main function. Maximum power consumption are defined in Commission Regulation (EU) 2023/826 [i.1].

Setup:

- The external power supply is connected to the mains.

The on/off switch is put in the Off position Traffic flows:

- No voice call in progress (on-hook).

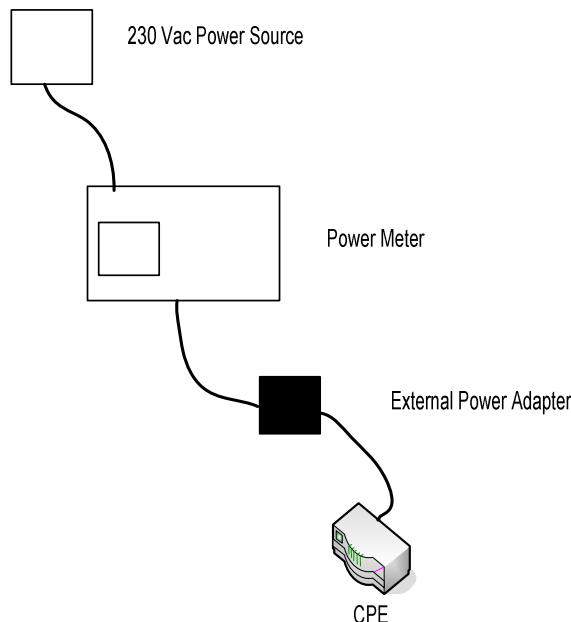- No traffic on WAN, WLAN and LAN ports.

Figure 1: Power measurement setup

6.2   Idle state

In Idle state, the broadband CPE is not processing or transmitting a significant amount of traffic but is ready to detect activity. All the components are in their individual Idle states.

Setup (as applicable):

- Central functions: Not processing user traffic.

- WAN interface:

    - Connected and synchronized, at the highest speed supported, with no user traffic present but ready to pass it.

    - Multiple WAN interfaces (for backup or alternative purposes): Only one WAN interface is connected and synchronized at the highest speed supported, with no user traffic present but ready to pass it; all other WAN interfaces are disconnected.

    - Multiple WAN interfaces (for simultaneous operation): All WAN interfaces are connected and synchronized at the highest speed supported, with no user traffic present but ready to pass it.

- LAN Ethernet ports: Ports not connected (or no Ethernet link) but with Ethernet link detection active.

- Wi-Fi® active, Lowest Rate Band Hold beacon on, no clients associated and no user traffic present but ready to pass it. In case of multiple frequency bands, only the lowest-rate frequency band (e.g. 2,4 GHz frequency band) is reserved in the beacon on state.

- FXS: One FXS port with phone connected (200 Ω, 5 m max cable length), phone is on hook, other FXS ports not connected to phone or other load, but able to detect a connection.

- FXO: No active call, incoming call detection enabled.

- DECT: No active call, incoming call detection enabled.

- DECT charging station for DECT handset: DECT handset on cradle, in trickle charge.

- USB: No USB device connected, detection of USB devices active.

- Backup battery: Battery is fully charged (trickle charging).

- Other home-network interfaces (such as PLC, Bluetooth®, Zigbee®, NB-IoT™): Inactive.

- AI Processor: Not expected to perform any calculation and remains in its lowest power state.

- Simulator: Generating no traffic.

- In case of FTTR Traffic generators generating no traffic.

- In case of FTTR, G.fin interfaces: G.fin (MFU) & G.fin (SFU) are connected at the highest speed supported, with no user traffic present but ready to pass it.
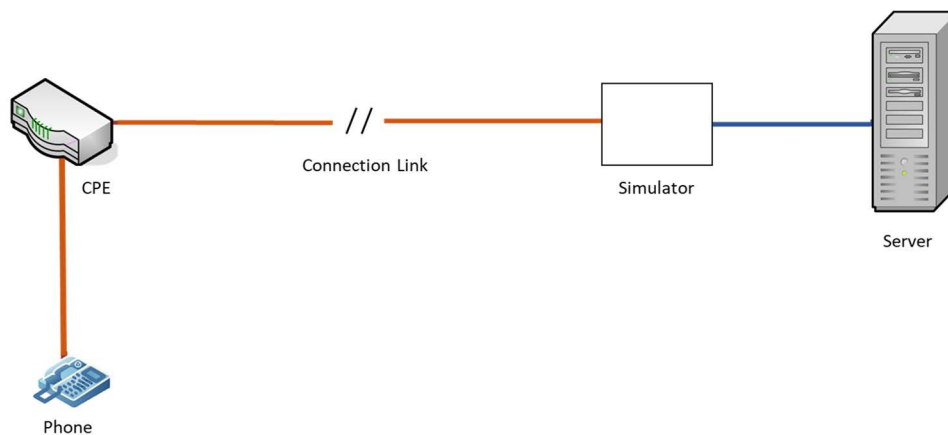
- Additional Colour Display is off.

Figure 2: Example of Idle mode setup
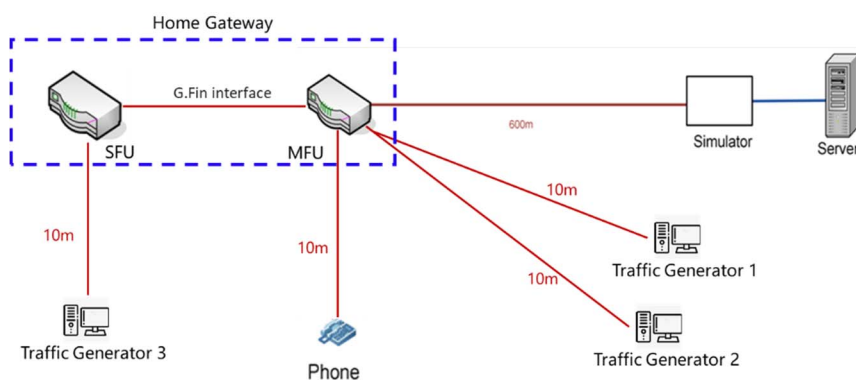

Figure 3: Example of Idle mode setup (FTTR)

6.3   ON mode

In ON mode, the broadband CPE is providing the intended service, and has all main functions activated. All the components are in their individual On states.

Maximum power consumption is define in Idle state or ON state Broadband Code of Conduct [i.2], in accordance with the different typologies of WAN interface:

1)   Setup (as applicable):

-   Central functions: Processing user traffic on WAN:

   ▪   WAN interface Single WAN interface: Connected and synchronized at the highest speed supported, and passing user traffic.

   ▪   Multiple WAN interfaces (for backup or alternative purposes): Only one WAN interface is connected and synchronized at the highest speed supported, and passing user traffic; all other WAN interfaces are disconnected. The WAN port at highest speed shall be selected.

   ▪   Multiple WAN interfaces (for simultaneous operation): All WAN interfaces are connected and synchronized at the highest speed supported, and passing user traffic.

-   Specific settings of a copper-based Ethernet WAN interface: Connected and synchronized at the highest speed supported and passing user traffic:

   ▪   User traffic for Ethernet speeds up to (and including) 100 Mbit/s: concurrent 1 Mbit/s downstream and 1 Mbit/s upstream per port, using Ethernet Frames of 500 bytes (MAC header and CRC included) evenly distributed in 10 bursts over any one second interval. The exact traffic pattern can be freely chosen.

   ▪   User traffic for Ethernet speeds above 100 Mbit/s: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per port, using Ethernet Frames of 500 bytes (MAC header and CRC included) evenly distributed in 10 bursts over any one second interval. The exact traffic pattern can be freely chosen.

-   Specific settings of a fibre PtP Ethernet WAN interface: Connected and synchronized at the highest speed supported and passing user traffic: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per port.

-   Specific settings of a PON WAN interface (such as GPON, EPON, XG-PON1, XGS-PON, etc.): Connected and synchronized at the highest speed supported and passing user traffic: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per port.

-   Specific settings of a DSL-based WAN interface:

   ▪   ADSL2plus: Select a valid ADSL2plus specific test profile, configured in rate adaptive mode. Use a test loop of 1 250 m. The DSL line is active (in showtime) and passing user traffic:

      -   1 Mbit/s downstream;

      -   1 Mbit/s upstream.

   ▪   VDSL2: Select a valid VDSL2 profile line combination, for the governing profile bandwidth (namely 8 MHz, 12 MHz 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 MHz and 17 MHz profiles. The DSL line is active (in showtime) and passing user traffic:

      -   10 Mbit/s downstream;

      -   10 Mbit/s upstream.

   ▪   VDSL2 (35b): VDSL2 Band Profile shall be: Profile 35b, using a valid Annex Q (998ADE35-M2x-M) PSD mask, configured in rate adaptive mode, as defined in Recommendation ITU-T G.993.2 [i.11].Use a test loop of 100 m. The DSL line is active (in showtime) and passing user traffic:

      -   10 Mbit/s downstream;

      -   10 Mbit/s upstream.

- ■ G.fast 106a, 106b, 106c: The line is configured with Mds=28, Mus=7, Mf=36; 106a, 106b or 106c MHz profile, operating in the 2 MHz to 106 MHz frequency band; test loop of 50 m. The line is active (in showtime) and passing user traffic:

  - 10 Mbit/s downstream;

  - 10 Mbit/s upstream.

- ■ G.fast 212a, 212c: The line is configured with Mds=28, Mus=7, Mf=36; 212a or 212c MHz profile, operating in the 2 MHz to 212 MHz frequency band; test loop of 50 m. The line is active (in showtime) and passing user traffic:

  - 10 Mbit/s downstream;

  - 10 Mbit/s upstream.

- Specific settings of a DOCSIS®-based WAN interface:

  - ■ DOCSIS® 3.0 [i.5] Active with an NxM configuration with 4downstream channels with a modulation type of 256 QAM and4 upstream channels with a modulation type of 64 QAM and a symbol rate of 5,12 Ms/s; transmit level 45 dBmV per channel. The line is passing user traffic:

    - 10 Mbit/s downstream;

    - 10 Mbit/s upstream.

  - ■ DOCSIS® 3.1 [i.6] Active with downstream configuration of 2 OFDM downstream channels with 4K FFT, 190 MHz BW, 4 096 QAM, RxPower 0 dBmV, CF 600 MHz to 800 MHz or 24 SC-QAM downstream channels with 8 MHz BW, 256 QAM, RxPower 0 dBmV, CF 300 MHz to 492 MHz; upstream configuration of 2 OFDMA upstream channels: 2K FFT, 48 MHz BW, 1 024 QAM, TxPower 45 dBmV, CF 100 MHz to 196 MHz or 8 SC-QAM upstream channels: 6,4 MHz, 64 QAM, TxPower 45 dBmV, CF 8,2 MHz to 59,4 MHz. The line is passing user traffic:

    - 10 Mbit/s downstream;

    - 10 Mbit/s upstream.

- Specific settings of a fixed wireless WAN interface (such as 4G/LTE or 5G): Passing user traffic 1 Mbit/s downstream, 200 kbit/s upstream.

- LAN Ethernet ports: All ports active, established at the highest speed supported by the interface, cable length is between 2 and 10 m:

  - ■ User traffic for Ethernet speeds up to (and including) 100 Mbit/s: concurrent 1 Mbit/s downstream and 1 Mbit/s upstream per port, using Ethernet Frames of 500 bytes (MAC header and CRC included) evenly distributed in 10 bursts over any one second interval. The exact traffic pattern can be freely chosen

  - ■ User traffic for Ethernet speeds above 100 Mbit/s: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per port, using Ethernet Frames of 500 bytes (MAC header and CRC included) evenly distributed in 10 bursts over any one second interval. The exact traffic pattern can be freely chosen).

- Wi-Fi® radio distance: Beacon on, one Wi-Fi® client associated and from 1 m to 5 m away from Access Point in the same room, established with the highest possible capability and avoiding interference in the same band. User traffic for IEEE 802.11 [i.10]: concurrent 1 Mbit/s downstream and 1 Mbit/s upstream. User traffic for IEEE 802.11 [i.10]: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream.

- Alternative LAN technologies (such as HPNA, MoCA, Powerline, POF): Activated, with user traffic concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per interface.

- FXS: One FXS port with1 phone connected (200 Ohm loop current of 20 mA 5 m max cable length), off hook, one active call. Other FXS ports not connected to phone or other load, but able to detect a connection.

- FXO: One active call.

- DECT: One active call.

- DECT charging station for DECT handset: DECT handset not on cradle, no charging.

- DECT Handset need be full charged.

- USB: No USB device connected. detection of USB devices active.

- Backup battery: Battery is fully charged (trickle charging).

- Other home-network interfaces (such as PLC, Bluetooth®, Zigbee®, NB-IoT™): Active, passing traffic 10 kbit/s.

- AI Processor: Not expected to perform any calculation and remains in its lowest power state.

- Run traffic generator at all wired and wireless IEEE 802.11 [i.10] interfaces at the specified traffic G.fin interfaces: G.fin (MFU) & G.fin (SFU) are connected at the highest speed supported and passing user traffic: concurrent 10 Mbit/s downstream and 10 Mbit/s upstream per port.
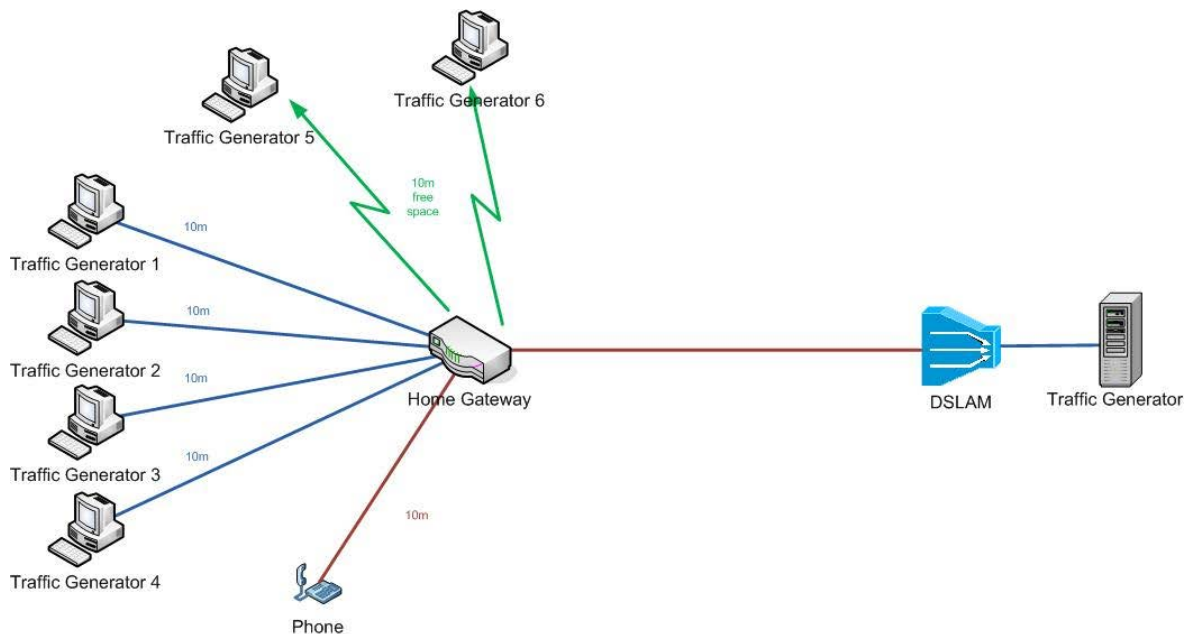
- Additional Colour Display is on.

Figure 4: Example of an ON mode setup

Figure 5: Example of an ON Mode setup (G.fin)

2)   Qualification:

-    The goal of the first step in the measurement procedure is to determine the maximum lossless throughput rate that the CPE can handle:

   ▪   As the WAN provides an asymmetrical technology (ADSL, VDSL, optical fibre or cable), the upload speed shall be taken into account.

   ▪   Traffic over the demarcation point (from WAN to LAN) is increased step by step just until a maximum Non Drop Rate (NDR) is achieved and sustained for 5 minutes.

   ▪   This maximum NDR shall be noted.
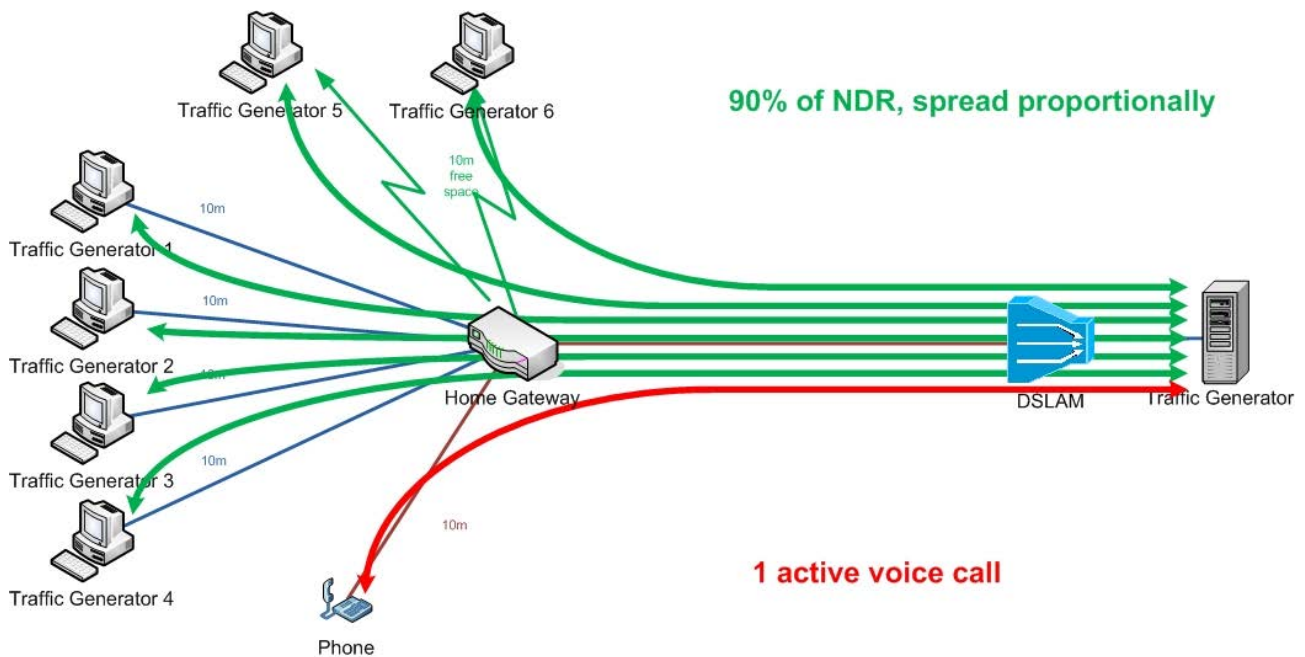
3)   Calculation of individual throughput:

-    90 % of the NDR shall be divided proportionally over the different wired and wireless 802.11 [i.10] interfaces, depending upon their theoretical maximum line rate.

-    One Wi-Fi® client per wireless frequency band 2,4 GHz to 5 GHz associated shall be used with highest available throughput.

Table 1: CPE with 10 Mbps NDR upload speed, 4 Fast Ethernet Ports

CPE1	Measured NDR (Mbps)	10,0	
	90 % NDR (Mbps)	9,0	
	Line Rate (Mbps)		Throughput (Mbps)
FE port 1	100	25,0 %	2,3
FE port 2	100	25,0 %	2,3
FE port 3	100	25,0 %	2,3
FE port 4	100	25,0 %	2,3
Sum	400	100,0 %	9,0

**Table 2: CPE with 30 Mbps NDR upload speed, 1 GE and 4 Fast Ethernet ports,
2 Wi-Fi ports**

CPE2	Measured NDR (Mbps)	30,0	
	90 % NDR (Mbps)	27,0	
	Line Rate (Mbps)		Throughput (Mbps)
GE port 0	1 000	66,3 %	17,9
FE port 1	100	6,6 %	1,8
FE port 2	100	6,6 %	1,8
FE port 3	100	6,6 %	1,8
FE port 4	100	6,6 %	1,8
wifi 1	54	3,6 %	1,0
wifi 2	54	3,6 %	1,0
Sum	1 508	100,0 %	27,0
NOTE:	wifi1 frequency according to 802.11b/g and wifi2 frequency according to 802.11a [i.10].		

NOTE: Traffic generator 1 to N can be ports on the same traffic generator.

Figure 6: Example of ON Mode traffic flows

6.4   Ready mode

In Ready mode, for device implementing this function, the CPE configured to be ready to provide the intended services without any reconfiguration or manual intervention - the broadband CPE is not passing any user traffic but is able to. The number of components that are in their individual On states reflects the attempt to reflect a typical use configuration as close as possible.

The Broadband Code of Conduct [i.2] defines the replacement of CPE idle-state by a ready-state that is more representative of typical home use ([i.2], section 8.1.1.2).

It is expected that Ready mode as defined in the present document may be referenced by future subsequent versions of the Broadband Code of Conduct. To check if a product meets the targets of the Code of Conduct, one should apply power allowances defined therein:

- Central functions: Not processing user traffic.

- WAN interface:

  - Single WAN interface: Connected and synchronized at the highest speed supported, with no user traffic present but ready to pass it.

  - Multiple WAN interfaces (for backup or alternative purposes): Only one WAN interface is connected and synchronized at the highest speed supported, with no user traffic present but ready to pass it; all other WAN interfaces are disconnected.

  - Multiple WAN interfaces (for simultaneous operation): Only one WAN interface is connected and synchronized at the highest speed supported, with no user traffic present but ready to pass it; all other WAN interfaces are disconnected.

- Specific settings of a DSL-based WAN interface:

  - ADSL2plus: Select a valid ADSL2plus specific test profile, configured in rate adaptive mode. Use a test loop of 1,250 m. The DSL line is active, with no user traffic present but ready to pass it.

  - VDSL2: Select a valid VDSL2 profile line combination, for the governing profile bandwidth (namely 8 MHz, 12 MHz 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 MHz and 17 MHz profiles. The DSL line is active, with no user traffic present but ready to pass it.

  - VDSL2 (30a/35b): VDSL2 Band Profile shall be: Profile 30a/35b, using a valid Annex B PSD mask, configured in rate adaptive mode, as defined in Recommendation ITU-T G.993.2 [i.11].Use a test loop of 100 m. The DSL line is active, with no user traffic present but ready to pass it.

  - G.fast 106a, 106b, 106c: The line is configured with Mds=28, Mus=7, Mf=36; 106a, 106b or 106c MHz profile, operating in the 2 MHz to 106 MHz frequency band; test loop of 50 m. The line is active, with no user traffic present but ready to pass it.

  - G.fast 212a, 212c: The line is configured with Mds=28, Mus=7, Mf=36; 212a or 212c MHz profile, operating in the 2 MHz to 212 MHz frequency band; test loop of 50 m. The line is active, with no user traffic present but ready to pass it.

- Specific settings of a DOCSIS®-based WAN interface:

  - DOCSIS® 3.0 [i.5]: Active with 4 downstream channels with a modulation type of 256 QAM and 4 upstream channels with a modulation type of 64 QAM and a symbol rate of 5,12 Ms/s; transmit level 45 dBmV per channel. No user traffic present but ready to pass it.

  - DOCSIS® 3.1 [i.6]: Active with downstream configuration of 2 OFDM downstream channels with 4K FFT, 190 MHz BW, 4 096 QAM, RxPower 0 dBmV, CF 600 MHz to 800 MHz or 24 SC-QAM downstream channels with 8 MHz BW, 256 QAM, RxPower 0 dBmV, CF 300 MHz to 492 MHz; upstream configuration of 2 OFDMA upstream channels: 2K FFT, 48 MHz BW, 1 024 QAM, TxPower 45 dBmV, CF 100 MHz to196 MHz or 8 SC-QAM upstream channels: 6,4 MHz, 64 QAM, TxPower 45 dBmV, CF 8,2 MHz to 59,4 MHz. No user traffic present but ready to pass it.

- LAN Ethernet ports:

  - Half of LAN Ethernet ports (rounded up to the nearest whole number) of each individual Ethernet type are active, established at the highest speed supported by the interface, cable length in the range between 2 m and 10 m. No user traffic present but ready to pass it. Ethernet interfaces operating on the same physical transmission technology (copper or fibre), at the same highest attainable speed, in the same mode (duplex operation, aggregation, etc.) and according to the same definitions in IEEE 802.3 [i.7] are considered the same Ethernet type.

  - The remaining LAN Ethernet ports are not connected (or no Ethernet link) but with Ethernet link detection active.

- Wi-Fi®: Beacon on, one Wi-Fi® client associated and from 1 m to 5 m away from Access Point in the same room, established with the highest possible capability and avoiding interference in the same band. No user traffic present but ready to pass it.

- Alternative LAN technologies (such as HPNA, MoCA, Powerline, POF): Activated, no user traffic present but ready to pass it.

- FXS: No FXS ports connected to phone or other load, but able to detect a connection.

- FXO: No active call, incoming call detection enabled.

- DECT: No active call, incoming call detection enabled.

- DECT charging station for DECT handset: DECT handset not on cradle, no charging.

- USB: No USB device connected, detection of USB devices active.

- Backup battery: Battery is fully charged (trickle charging).

- Other home-network interfaces (such as PLC, Bluetooth®, Zigbee®, NB-IoT™): Inactive, but ready to detect activity or pass user traffic.

- AI Processor: Not expected to perform any calculation and remains in its lowest power state.

- No traffic generator is required in the setup.

- G.fin interfaces: G.fin (MFU) & G.fin (SFU) are connected at the highest speed supported, with no user traffic present but ready to pass it.

- Additional Colour Display is off.

Annex A (informative):
Bibliography

- HGI RWD009-R3: "Requirements for an energy efficient HG".

Annex B (informative):
Change history

Date	Version	Information about changes
V1.1.1	November 2011	One-step Approval Procedure OAP 20120328: 2011-11-29 to 2012-03-28
V1.1.1	May 2012	Publication
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History

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V1.1.1	May 2012	Publication	
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