

# *Energy Efficiency in Broadband Networks*

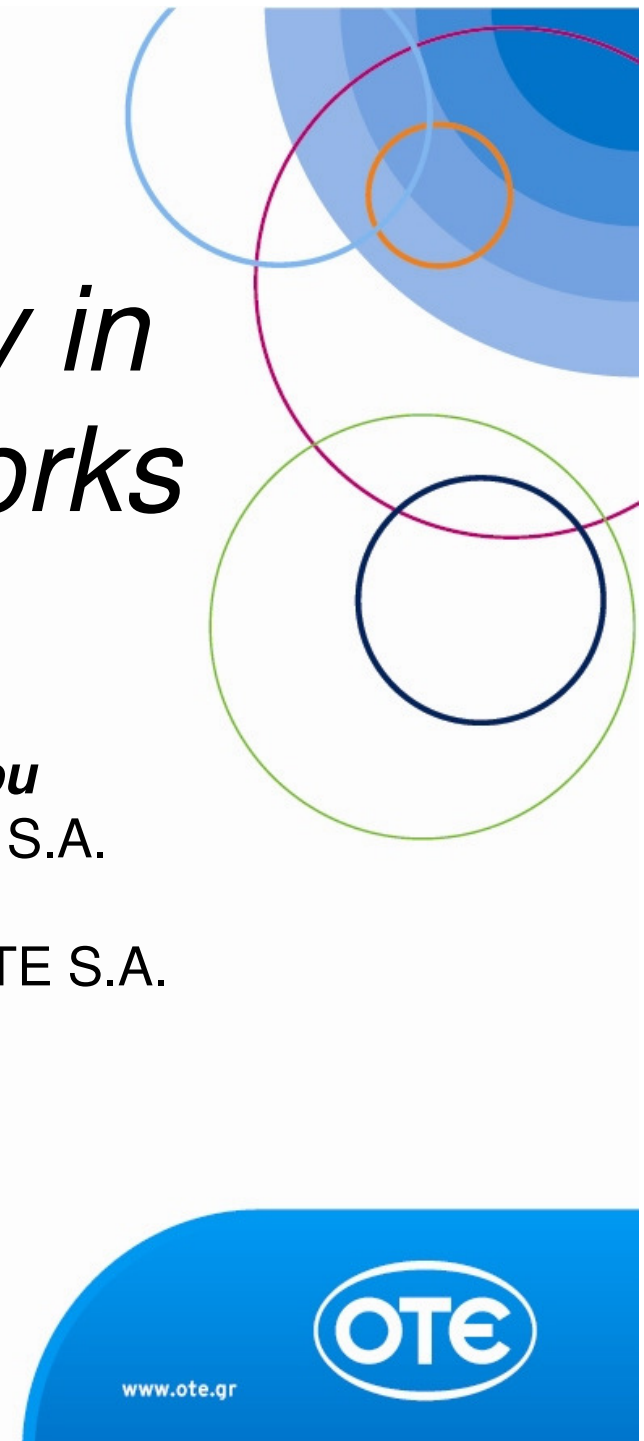
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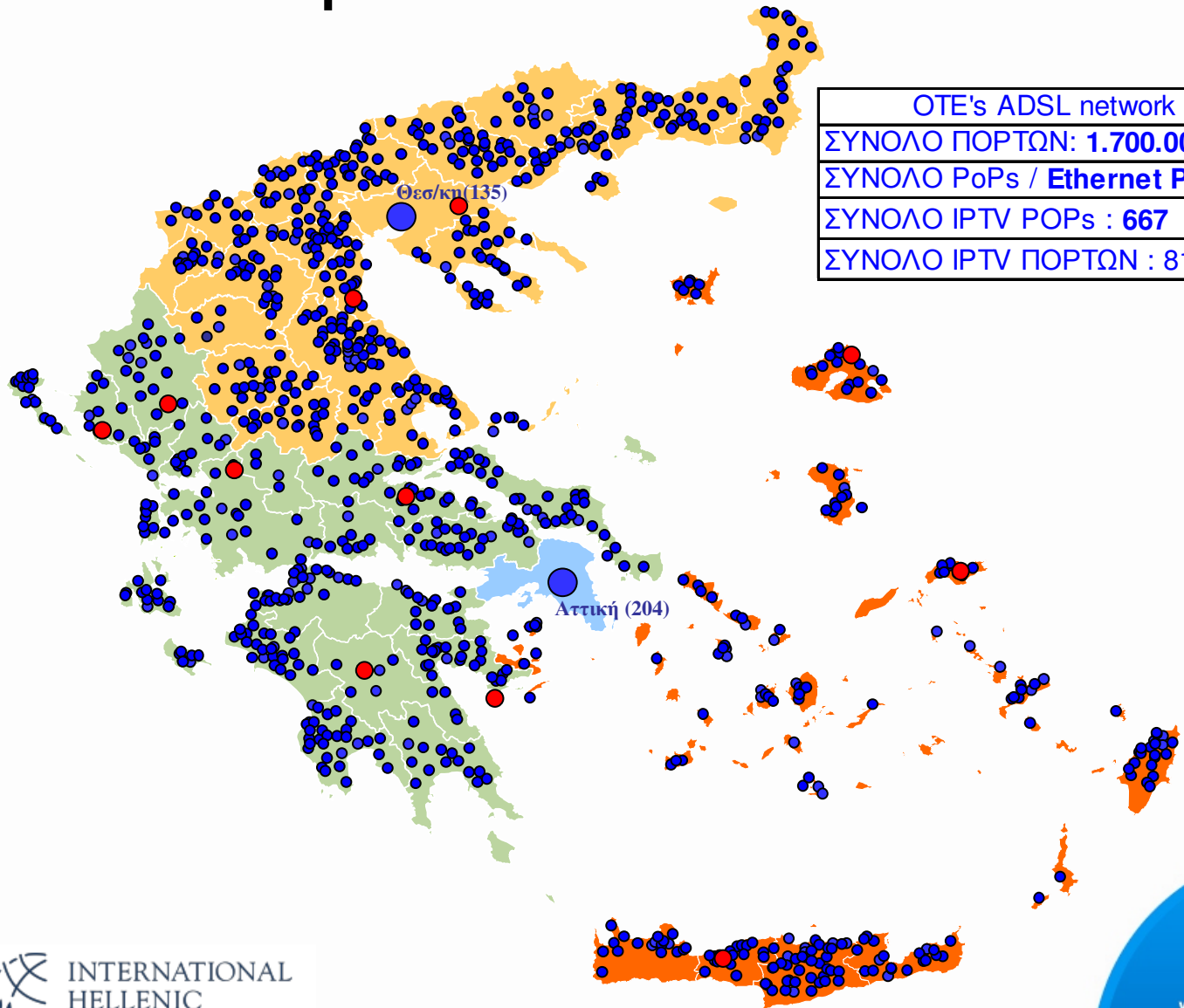
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25 November 2010

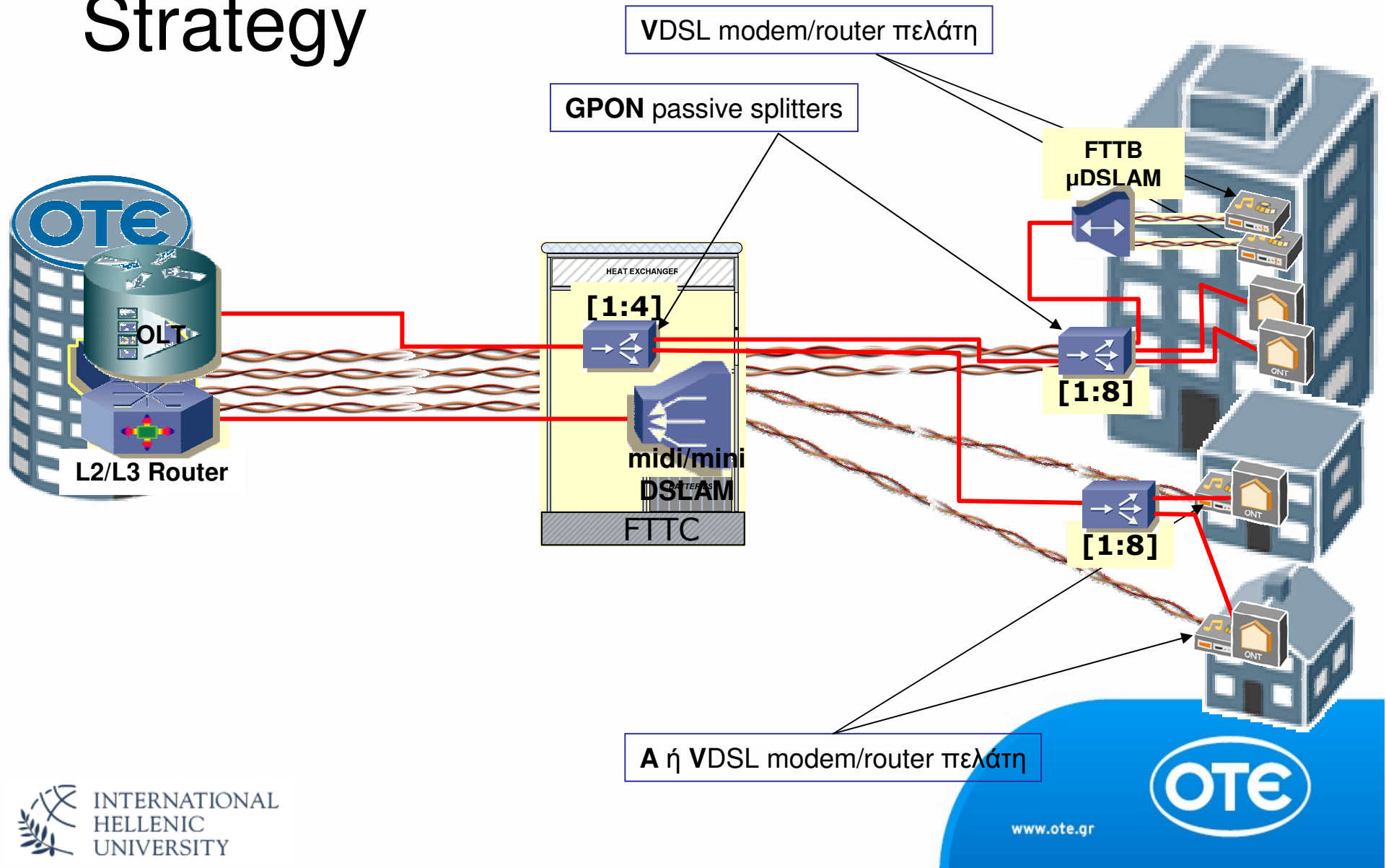


# OTE present Broadband Network



OTE's ADSL network at a glance (19/11/2010)
ΣΥΝΟΛΟ ΠΟΡΤΩΝ: <b>1.700.000</b>
ΣΥΝΟΛΟ ΡοΡs / <b>Ethernet POPs</b> : 1877 / <b>1.416</b>
ΣΥΝΟΛΟ IPTV ΡΟΡs : <b>667</b>
ΣΥΝΟΛΟ IPTV ΠΟΡΤΩΝ : 813.504 IPTV

# FTTx-Broadband Network Evolution Strategy



# Technology Outlook : NGA

- Higher speeds on Copper (VDSL2)  
50, 100 and 150 Mbps.
- Ever increasing fiber penetration  
(FTTC → FTTB → FTTH)
- Better bandwidth quality (BER, latency,..)
- Point to Multi-Point Architecture  
(unless the Government finds the money to build an P2P-  
FTTH network).
- GPON → 10 GPON → WDM PON all seamlessly coexisting  
in the access network.
- **Lower Power consumption/customer.**
- More services (triple-play, HD-Interactive IPTV, VPNs...).

# OTE and ICT sustainability

- OTE is a full member of **GeSI**  
**GeSI = Global e-Sustainability Initiative**
- OTE is a full member of **EU-Standby Initiative**
- OTE amongst the **TOP 1.000 SUSTAINABLE PERFORMANCE LEADERS GLOBALLY** for 2009 (**407th worldwide**, up 57 places )



# GeSI

- GeSI was born in 2001 to further sustainable development in the ICT sector.
- GeSI became a legal independent entity as an international non-profit association (AISBL) in 2008
- The Board includes
  - four manufacturers (NOKIA, Ericsson , Microsoft , Motorola )
  - four service providers (Deutsche Telekom, Telecom Italia, Telefónica Spain, Verizon)
  - one director representing the ITU
- GeSI
  - fosters global and open cooperation
  - informs the public of its members' voluntary actions to improve their sustainability performance
  - promotes technologies that foster sustainable development





# EU-STANDBY INITIATIVE

- A European Action to Improve the Energy Efficiency of Information and Communication Technologies
- The codes of conduct provide a platform bringing European stakeholders together to discuss and **agree voluntary actions** which will improve energy efficiency.
- By signing the codes of conduct, the individual companies voluntarily commit themselves to reducing energy consumption by an agreed amount **in a pre-defined time scale through the adoption of best practices.**

[Code of Conduct for Data Centres](#)

[Code of Conduct for Digital TV Services](#)

[Code of Conduct on Energy Consumption of Broadband Communication Equipment](#)

[Code of Conduct on Efficiency of External Power Supplies](#)

[Code of Conduct on AC Uninterruptible Power Systems \(UPS\)](#)

# Code of Contact (CoC) on Broadband Equipment

- This Code of Conduct has existed since 2007 and
  - 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.
  - **sets maximum power consumption** for many different types of equipment, such as modems, switches, routers and home gateways
- **AIM** : To target **reduced energy consumption of broadband communication equipment** without hampering the fast technological developments and the service provided.
- Energy savings are achieved through the mandatory **use of the best available low energy components**



# Customer and Network Equipment covered

Table 1: Customer premises equipment covered	
<b>Type of Customer premises equipment</b>	
Home gateways:	
<ul style="list-style-type: none"> <li>• DSL CPEs (ADSL, ADSL2, ADSL2+, VDSL2)</li> <li>• Cable CPEs (DOCSIS 2.0 and 3.0)</li> <li>• Optical network termination (ONT) CPEs (PON and PtP)</li> <li>• Ethernet routers</li> <li>• Wimax CPEs</li> </ul>	
Simple broadband access devices:	
<ul style="list-style-type: none"> <li>• DSL CPEs powered by USB</li> </ul>	
Home network infrastructure devices:	
<ul style="list-style-type: none"> <li>• Wi-Fi access points</li> <li>• Small hubs and non-stackable Layer 2 switches</li> <li>• Powerline Adapters</li> <li>• Alternative LAN technologies (HPNA, MoCA adapters)</li> <li>• Optical LAN adapter</li> </ul>	
Other home network devices:	
<ul style="list-style-type: none"> <li>• ATA / VoIP gateway</li> <li>• VoIP telephone</li> <li>• Print server</li> </ul>	
Table 2: Network equipment covered	
<b>Type of Network equipment covered</b>	
<ul style="list-style-type: none"> <li>• DSL Network equipment (example: ADSL, ADSL2, ADSL2+, VDSL2)</li> <li>• Combined DSL/Narrowband Network equipment (example: MSAN where POTS interface is combined with DSL BroadBand interface, etc)</li> <li>• Optical Line Terminations (OLT) for PON- and PtP-networks</li> <li>• Wireless Broadband network equipment (example: Wi-Fi access points for Hotspot application, Wimax Radio Base Station)</li> <li>• Cable service provider equipment</li> <li>• Powerline service provider equipment</li> </ul>	

# Commitment to the CoC

- Signatories of this CoC agree to make all **reasonable efforts** to:
  - Achieve the power consumption targets, for **at least 90% (by number) of the new-model items** of broadband equipment that are introduced to the market (this applies to equipment vendors) or procured (this applies to network operators) after the indicated dates.
  - Co-operate with the European Commission and Member State authorities in an **annual review** of the scope of the CoC and the **power consumption targets for two years ahead**.
  - Ensure that **procurement specifications for broadband equipment** are compliant with this CoC.
- The reported results will be **discussed at least once a year** in a confidential and anonymous way by the signatories, the European Commission, Member States in order to:
  - **Evaluate** the level of **compliance** and the **effectiveness** of this CoC in achieving its aims.
  - 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 CoC.
  - Set **targets for future time periods**.

# General Principles of CoC on BB

- **Broadband equipment** should be designed to meet the CoC power consumption targets. However power management **must not unduly impact**
  - the user experience
  - disturb the network
  - contravene the applicable standards.
- **CoC Presumption: The hardware has power management built-in**
  - **Full power state** is the normal operating mode of the equipment or device where all design functionality is enabled and available for useful purposes.
  - **Standby state** is defined as a state whereby the equipment or device is switched on and operating at the lowest level of power consumption, whilst still drawing energy from the mains.
  - **Low power state(s)** are modes of operation where the equipment or device has a level of operational functionality which is over and above the standby state, but not at a level associated with full power state (aka normal operation).
- The HW will **automatically switch to the state** with the lowest possible power consumption.
- Note : For DSL systems, automatic switch function will have to be activated when concerns about problems related to the **non stationary noise** have been solved.  
To this end signatories will endeavour to **develop the necessary standards**. Until then a special focus is put on the **reduction of the power consumption in DSL-full power state**.

# Customer Premises Equipment (CPEs)

- Power consumption of the **external power supply** shall be included in the power measurement.
- Even though an **on/off switch** is not a requirement of this Code of Conduct, it is highly recommended to integrate one into equipment.
- A **fast and dependable start-up and re-entry into operating state** has to be guaranteed



# Home Gateways

- ❑ A home gateway 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**.
- ❑ 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 as a whole has to **meet the summed targets** for its **various modes of operation** and activity (low-power-state , on-state )



# Power values for Home GWs – Ethernet Router Example

Table 9: Power values for home gateway central functions plus WAN interface

Home gateway central functions plus WAN interface	Tier 2009/2010: 1.1.2009- 31.12.2010		Tier 2011: 1.1.- 31.12.2011	
	Low-Power-State (W)	On-State (W)	Low-Power-State (W)	On-State (W)
ADSL/ADSL2/ADSL2+	4,2	5,0	2,6	3,8
VDSL2	5,5	7,5	3,5	6,0
Fast Ethernet WAN (100Base-T)	2,9	4,2	2,5	3,3
Gigabit Ethernet WAN (1000Base-T)	4,0	7,0	3,2	6,2
Fibre Ptp Ethernet WAN (100/1000Base-BX or FX)	3,4	7,1	2,9	5,6
GPON	5,0	9,7	4,0	7,7
DOCSIS 2.0	5,5	5,5	3,7	4,6
DOCSIS 3.0	8,0	8,0	6,2	7,1
WiMAX	8,2	11,0	7,7	10,6

Table 10: Power values for home gateway LAN interfaces and additional functionality

Home gateway LAN interfaces and additional functionality	Tier 2009/2010: 1.1.2009- 31.12.2010		Tier 2011: 1.1.- 31.12.2011	
	Low-Power-State (W)	On-State (W)	Low-Power-State (W)	On-State (W)
Fast Ethernet switch, up to 4 ports	0,8	2,2	0,6	1,8
1 Fast Ethernet port	0,3	0,5	0,3	0,4
Gigabit Ethernet switch, up to 4 ports	1,5	4,5	1,2	3,7
1 Gigabit Ethernet port	0,3	1,7	0,3	1,3
Wi-Fi interface single IEEE 802.11b/g or 11a radio	1,0	2,0	0,7	2,0

Powerline	4,0	4,0	2,5	3,0
FXS	0,8	1,5	0,5	1,5
FXO	0,4	0,9	0,4	0,9
DECT GAP	1,0	1,65	0,75	1,65
DECT Cat-iq	1,0	2,0	0,75	2,0
DECT charging station for DECT handset in slow/trickle charge	0,5	0	0,4	0
USB	0,3	0,3	0,25	0,25
Bluetooth	0,2	0,3	0,2	0,3
Femto cell	9,0	9,0	7,0	8,0
Embedded handfree system	0,5	0,5	0,5	0,5
Additional Colour Display (typically found in VoIP devices) TFT QVGA and VGA	0,7	2,0	0,5	1,0

## Ethernet router with 4 Fast Ethernet LAN ports

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

- in low-power-state: all LAN Ethernet ports disconnected
- in on-state: all LAN Ethernet ports active

Function	low-power-state		on-state	
	2009/2010	2011	2009/2010	2011
Central functions + Fast Ethernet WAN interface	2,9	2,5	4,2	3,3
4 port Fast Ethernet switch	0,8	0,6	2,2	1,8
<b>Total equipment</b>	<b>3,7 W</b>	<b>3,1 W</b>	<b>6,4 W</b>	<b>5,1 W</b>

# Network Side Equipment (1/2)

- Broadband Network equipment should be designed to fulfill the environmental specifications of Class 3.1 for indoor use
- If cooling is necessary it should be **preferably cooled with fresh air** (fan driven, no refrigeration)
- The **COP** (Coefficient Of Performance) **of new site cooling systems**, should be more than 10

(CoP: [http://en.wikipedia.org/wiki/Coefficient\\_of\\_performance](http://en.wikipedia.org/wiki/Coefficient_of_performance) )

# Network Side Equipment (2/2)

- The targets for Network Side Equipment **are power consumption targets per port.**
- All power values measured at the “A” interface as described in the standard ETSI 102533 [8] or at the AC input, in case of directly mains powered systems.
- For **directly mains powered systems, the power limits will be increased by 10%.**
- The stated target figures apply for equipment operating in their native modes only. In other words, the targets for ADSL2+ equipment apply for equipment that are designed to operate natively in ADSL2+ mode and **not VDSL2 equipment operating in ADSL2+ Fallback mode.**
- The target values are **for fully equipped with 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** (*which is applicable for all Power States (Full, Low & Standby)*) is:
  - 4,5W per equipment for each Point to Point 1000Mbit/s interface
  - 18W per equipment for each Point to Point 10Gbit/s interface
  - 6W per equipment for each Point to Multipoint (GPON) interface





# Network Side Equipment Target Values for power consumption

## Standby-state

Table 16: Broadband ports – DSL-standby-state<sup>8</sup>

Equipment	Tier 2009-2010 (1.1.2009-31.12.2010) (W)	Tier 2011 (1.1.2011-31.12.2011) (W)
ADSL 2+ (including ADSL and ADSL2)	0,4	0,4
VDSL2	0,8	0,6

## Low Power-state

Table 15: Broadband ports – DSL-low power state<sup>6</sup>

Equipment	Tier 2009-2010 (1.1.2009-31.12.2010) (W)	Tier 2011 (1.1.2011-31.12.2011) (W)
ADSL 2+ (including ADSL2)	1,1	0,8
VDSL2 <sup>7</sup>	--	1,2

- The DSL-[Low-Power-State](#) is not foreseen today in the standard for [VDSL2](#)
- The [DSL-Low Power 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](#).
- Start-up/Wake-up times [from DSL-low-power-state to DSL-full-power-state](#) should be [less than 1 second](#) to guarantee a good quality of service (e.g. voice calls)

# Network Side Equipment: Open issues

- ❑ 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 sec.)
- ❑ This requirement comes into effect when the issues on the quality of service have been solved by the **standardization bodies**.
- ❑ 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 will be available**.
- ❑ To minimize cost/dimensions/power consumption, the network equipments contain chips that **control multiple DSL lines (4-8-16) each**. If special care is not taken, a single line in DSL full- power-state could result in a chip fully operational on the other lines also (in Low power or Standby), 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.

# CoC on BB equipment Signees

10 companies (**both telecom operators and manufacturers**) had signed this code of conduct by-the-year 2009, covering about 25 million broadband lines in the EU (27%)

With the 10 new companies signed up on 2010, Sep-29th, the coverage raised to **65 million in the EU (72%)** plus 10 million more in Norway, Switzerland and Turkey.

## **New signees:**

A1 Telekom Austria AG  
Belgacom  
British Telecom  
KPN  
France Telecom-Orange  
**OTE**  
Portugal Telecom  
Telefonica  
Telenor  
Turk Telekom

## **Signees:**

Alcatel-Lucent  
CISCO  
Deutsche Telekom  
Huawei Technologies  
Nokia Siemens Networks  
  
Swisscom  
TDC Services  
Telecom Italia  
Telia Sonera  
Technicolor

# Energy Efficiency in Broadband Networks with numbers

- ❑ Broadband equipment accounts for around 15% of the ICT sector's overall energy consumption or about 47 TWh in 2010 in the EU.
- ❑ 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 CoC the (maximum) electricity consumption could be limited to 25 TWh per year, this is equivalent to
  - ❑ 5,5 Millions tons of oil equivalent (TOE) and to
  - ❑ total saving of about € 7,5 Billions per year.

# Energy Efficiency in Broadband Networks

**THANK YOU  
FOR YOUR ATTENTION**