Welcome to the World of Standards

World Class Standards

ETSI TC "ENVIRONMENTAL ENGINEERING"- STANDARDIZATION ACTIVITIES IN THE FIELD OF ENVIRONMENTAL SUSTAINABILITY FOR ICT

Madrid, 14 April 2015

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ETSI TC-EE chairman

Outline

- **ETSI and TC-Environmental Engineering**
- **Energy efficiency of ICT:**
  - EU initiatives
  - ETSI standards in support to EU initiatives
- **Environmental impact assessment and energy efficiency management for ICT**
  - Life Cycle Assessment
  - Energy efficiency management and monitoring
  - Power distribution for data center with improved efficiency
  - KPIs for energy efficiency management
- **Conclusions**

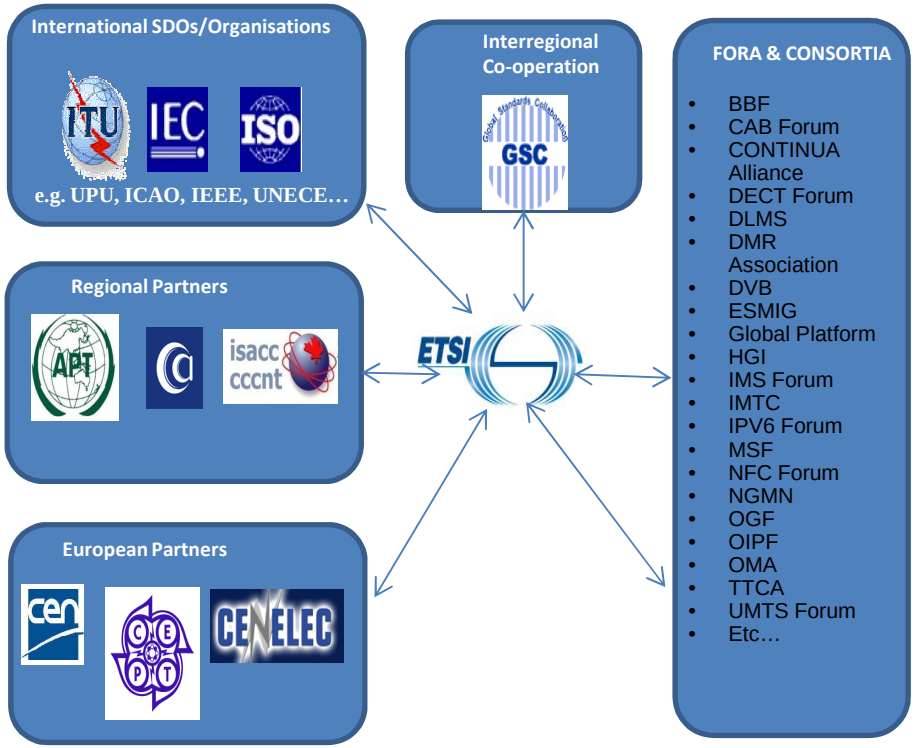
ETSI and TC-Environmental Engineering

ETSI: European roots, global outreach

- ETSI is a world leading standards developing organization for Information and Communication Technologies (ICT)
- Founded initially to serve European needs, ETSI has become highly-respected as a producer of technical standards for worldwide use

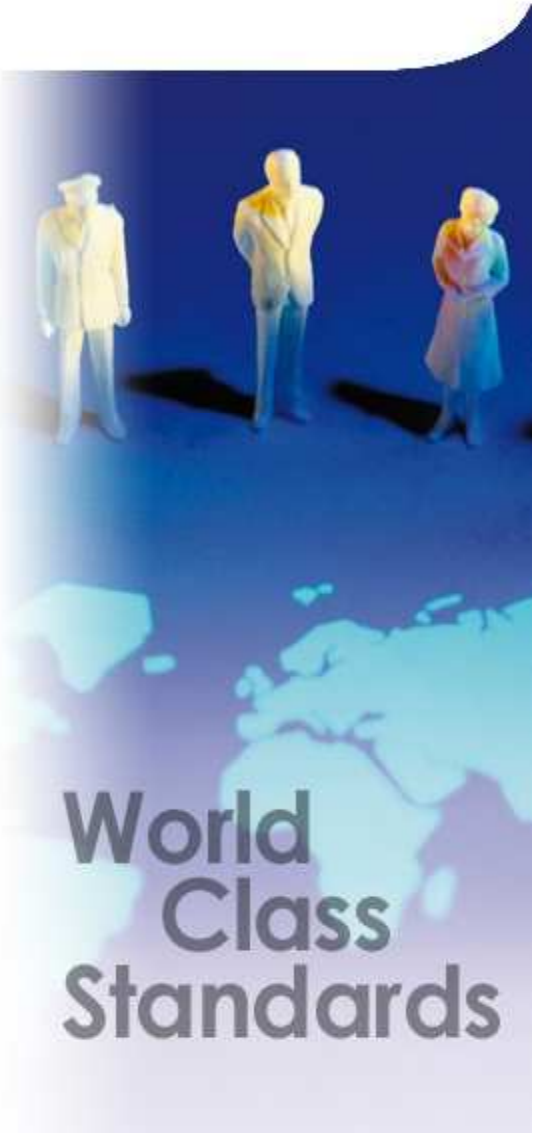
Global standard collaboration

Partners



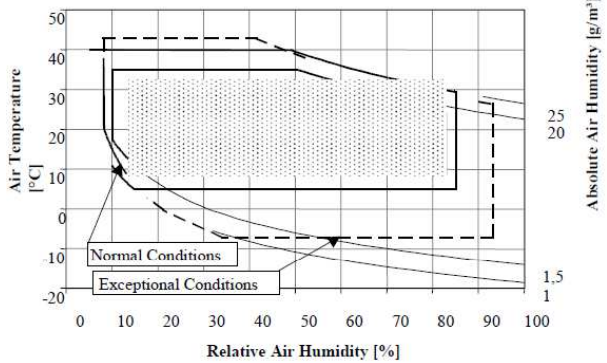
ETSI: Product and services

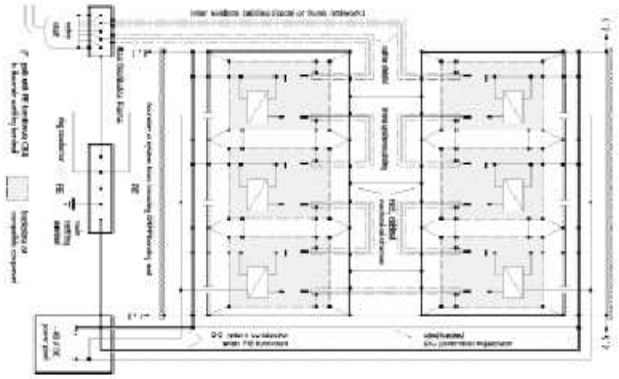
- Technical specifications and standards with global application
- Support to industry and European regulation
- Specification & testing methodologies
- Interoperability testing



ETSI Technical Committee on Environmental Engineering (ETSI TC EE)

- **"Multi-task" Technical Committee for ICT infrastructures**
  - Environmental topics (temperature, humidity, mechanical ….)
  - Acoustic
  - Equipment practice
  - Power supply interface
  - Power architectures and grounding
  - Alternative energy sources
  - Energy efficiency
  - Eco-environmental impact assessment (LCA)



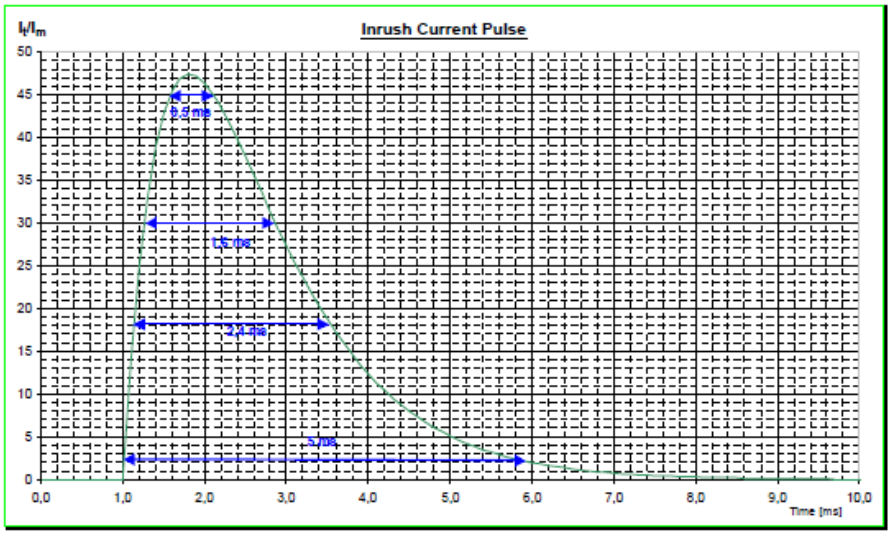


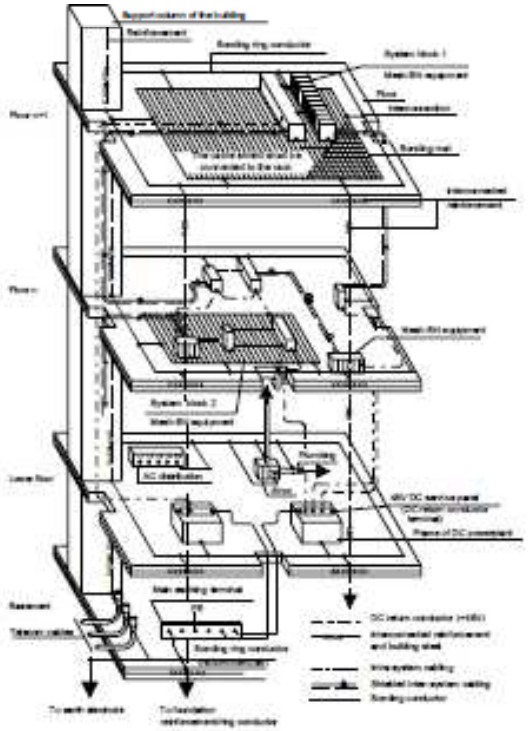
TC-EE Terms of Reference (1/4)

- **Specifications for environmental and infrastructural aspects for telecommunication equipment and its environment**
  - Environmental requirements (EN 300 019-1-x series)
  - Tests specification to verify compliance with the environmental requirements (EN 300 019-2-x series)
  - Thermal management topics
  - Acoustic noise limits for telecom equipment

TC-EE Terms of Reference (2/4)

- **Specifications of Power Supply interface requirements and grounding for telecommunication/data-com equipment**
  - Normal and abnormal voltage range, inrush current limits etc
  - Powering of equipment in access networks
  - Control and monitoring of TLC infrastructure and equipment
  - Grounding and bonding





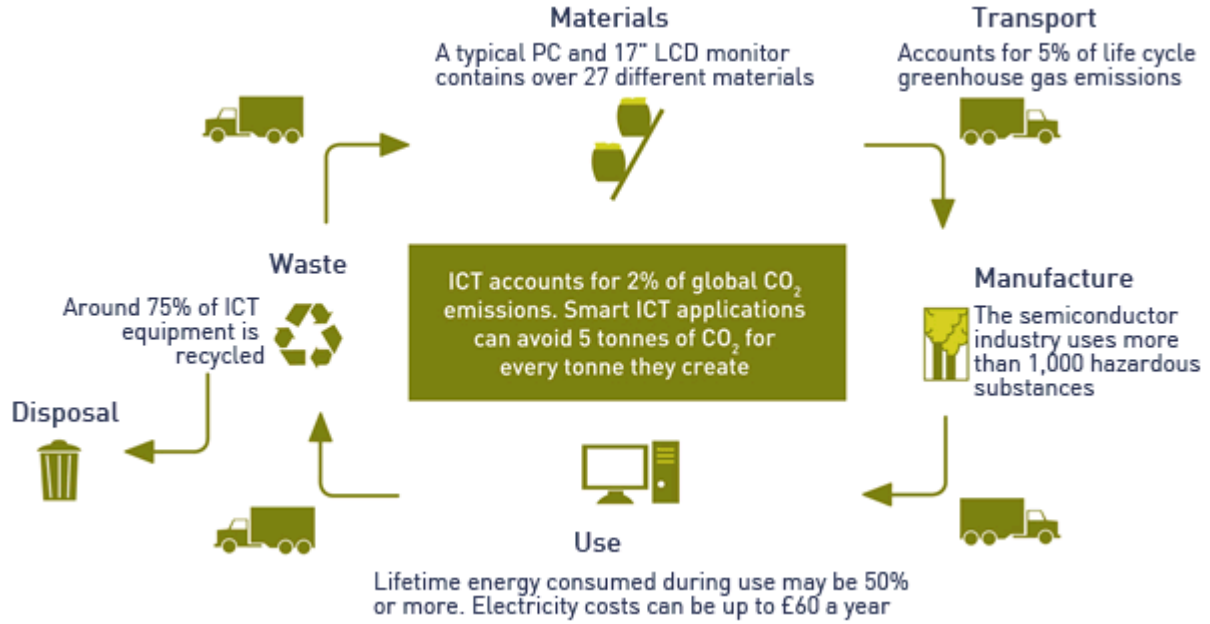
TC-EE Terms of Reference (3/4)

- **Specifications for Mechanical Structure and Physical design of telecommunication equipment**
  - Requirements for racks/sub-racks/cabinets
  - Thermal management in ETSI enclosures
  - Outdoor enclosures

TC-EE Terms of Reference (4/4)

Eco-Environmental specifications

- Measurement methods, metrics and Key Performance Indicators of Energy efficiency of TLC products/networks
- Methods for assessing the environmental impact of ICTs products/networks/services
- Use of alternative energy sources

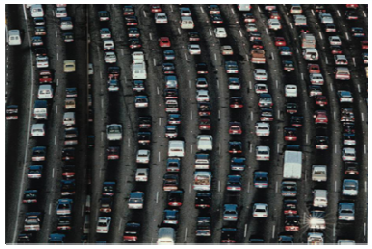


Energy efficiency of ICTs:

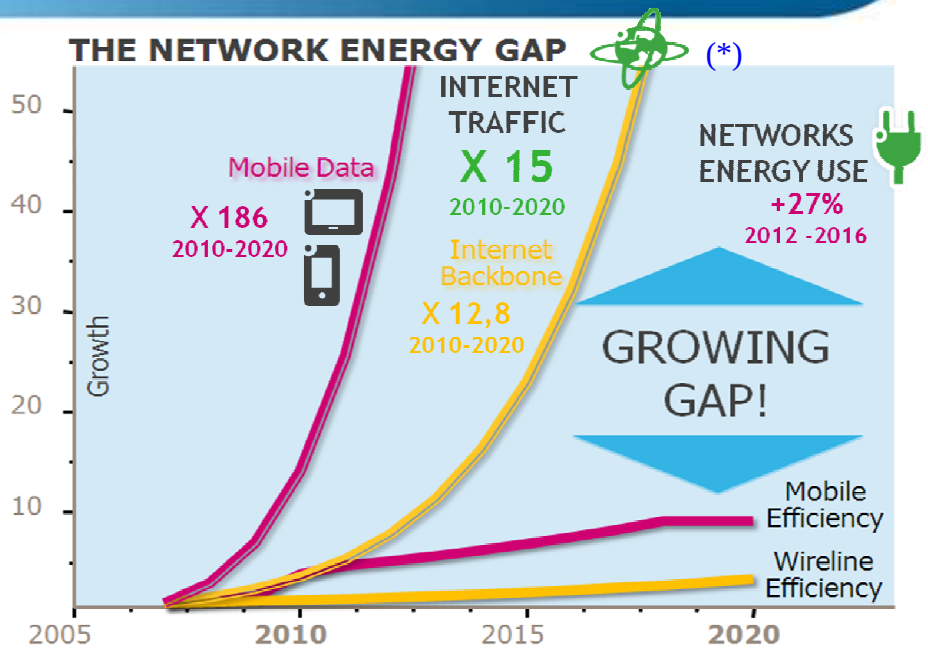
- EU initiatives
- ETSI standards for its assessment

Contribution in carbon emission due to ICT

Global aviation industry



50 million cars



Global ICT Emissions: 2.3%, Growing at 4% YoY

GeSI "SMARTer 2020: The Role of ICT in Driving a Sustainable Future", 2012

- Slow-down in technology improvements
- Network energy efficiency only increasing at 10-15% per year

ICT also has significant enabling effect to reduce global carbon emissions through increased and more intelligent use of communication and networking technologies

(*) GreenTouch source: http://www.greentouch.org/index.php?page=about-us

EU recommendation on ICT to facilitate the transition to an energy-efficient, low-carbon economy

- EU COMMISSION RECOMMENDATION of 9.10.2009 on mobilising Information and Communications Technologies to facilitate the transition to an energy-efficient, low-carbon economy
  - Initiatives addressed to ICT sector to achieve the objective to:
    - save 20% of the EU's energy consumption compared with projections for 2020
    - Reduce of 20% the greenhouse gas emissions by 2020
  - Recommendations to:
    - develop a framework to measure ICT energy and environmental performance for baseline data by 2010;
    - adopt and implement common methodologies by 2011;
    - identify, by 2011, energy efficiency targets that aim to achieve the EU 2020 targets;
  - Work with relevant public bodies and international organisations to develop methodologies for auditing and verification of energy intensity and carbon emissions reduction

EU regulations and other initiatives on energy efficiency of ICTs

- **Regulation:**
  - Directive 2009/125/EC (21 October 2009) on eco-design and associated implementing measures
- **Other initiatives:**
  - Mandate 462 on Standardization in the field of ICT to enable efficient energy use in fixed and mobile information and communication networks
    - End-user equipment under the scope of directive 2009/125/EC are excluded
    - Addressed to improve the energy efficiency of the provider infrastructure to counterbalance the growth in telecommunications networks
  - Code of Conducts (#)
    - Energy Consumption of Broadband Communication Equipment
    - Data Centres Energy Efficiency
    - Digital TV Services
    - Efficiency of External Power Supplies
    - AC Uninterruptible Power Systems

(#) http://iet.jrc.ec.europa.eu/energyefficiency/ict-codes-conducts

Directive 2009/125/EC (21 October 2009)

- Replacing Energy-using Products Directive 2005/32/EC of 6 July 2005
- Framework defining the «rules» for setting product-specific requirements/ legislation on energy efficiency and further parameters.
- Implementing measures affecting ICTs
  - Simple set-top boxes regulation No 107/2009
  - External power supplies regulation No 278/2009
  - Televisions regulation No 642/2009
  - Standby and Off Modes regulation No 1275/2008 (17 December 2008)
  - Networked Standby regulation No 801/2013 (22 August 2013) amending regulation No 1275/2008

Regulation No 1275/2008

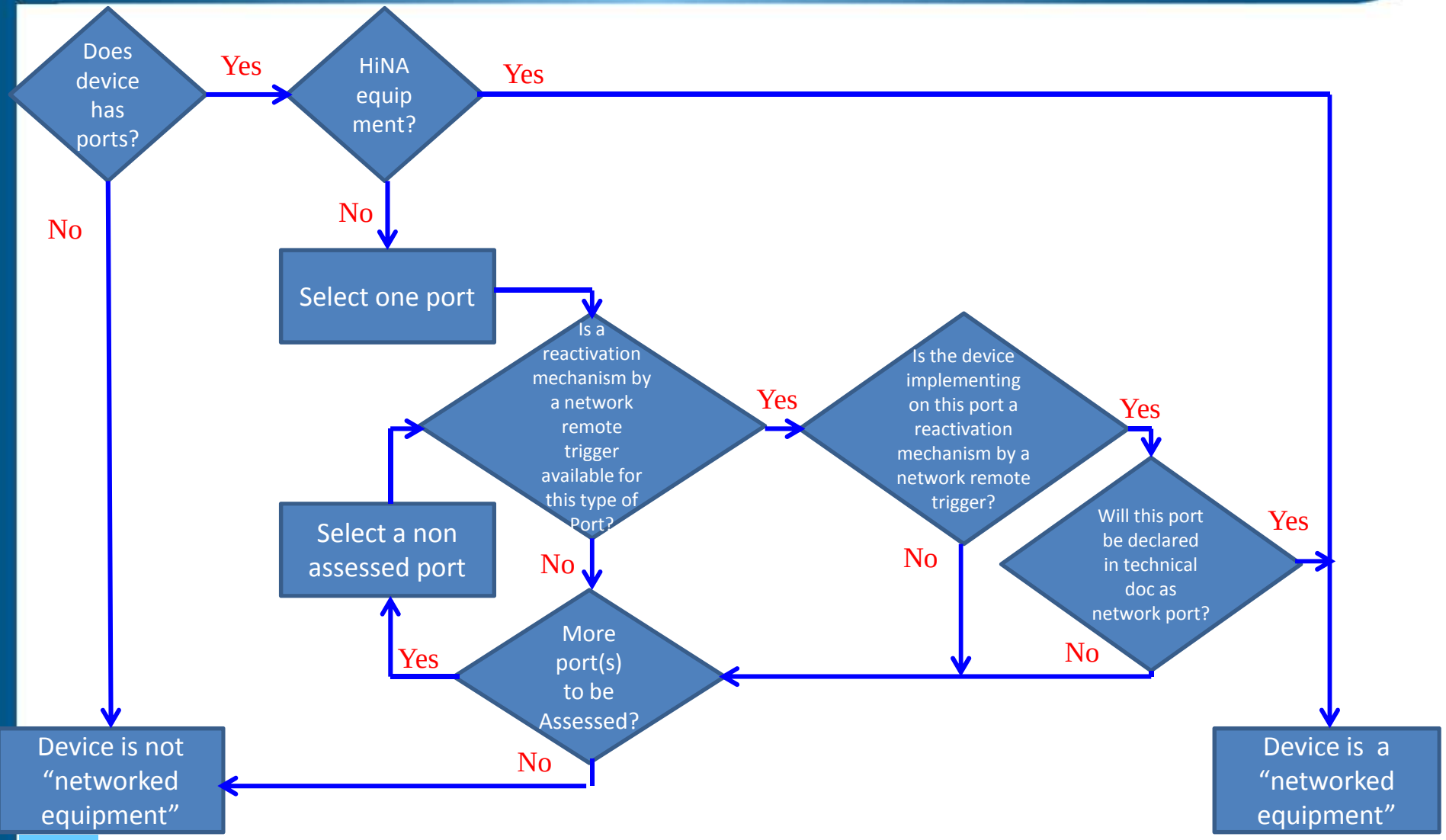
- It applies to electrical and electronic household and office equipment
  - Electrical and electronic household and office equipment means any energy using product which
    - is sold as a single functional unit and is intended for the end-user
    - is dependant on energy inputs from the mains power source in order to work as intended; and
    - is designed for use with a nominal voltage rating of 250 V or below
    - Not put on the market with a low voltage external power supply
      - *External power supply with a nameplate output voltage < 6 Volts and a nameplate output current ≥ 550 mA*
  - About ICT: "Information technology equipment intended primarily for use in the domestic environment" (typically class B equipment according to EN 55022)
- Limits from 7 January 2013:
  - 0,5 W Off mode and stand-by without display
  - 1 W stand-by with display

Regulation No 801/2013 (1/3)

- Scope remains the same of regulation No 1275/2008
- Additional requirements for networked products
- Networked products need to have power management into a network standby mode, with target limits
  - "Network port": a wired/wireless interface of the network connection at the equipment through which the equipment can be remotely activated
  - "Networked Equipment": equipment that has the ability to be connected to a network and has one or more network ports;
  - Three classes of products:
    - 1) HiNA: equipment with router, switch, wireless access point, VoIP phone, Video phone as main function
    - 2) Equipment with HiNA functionality: equipment that includes a router, switch, WAP as side function
    - 3) LoNA: all the rest of networked equipment
- Need to declare in test report which interfaces are network ports,

HiNA equipment = Networked equipment with high network availability

Regulation No 801/2013 (2/3)



Regulation No 801/2013 (3/3)

- Requirements
  - When networked equipment is not providing its main functions and when other energy-using product(s) are not dependent on its functions, equipment shall, unless inappropriate for the intended use, offer a power management function, or a similar function, that switches equipment after the shortest possible period of time appropriate for the intended use of the equipment, automatically into a mode having networked standby.
  - Within 20 minutes

	Tier 1 (1-Jan-2015)	Tier 2 (1-Jan-2017)	Tier 3 (1-Jan-2019)
HiNA	12 W	8 W	8 W
Eq. with HiNA	12 W	8 W	8 W
LoNA	6 W	3 W	2 W

Standards to address the network stand-by mode is produced by ETSI and CENELEC

ETSI standards for Mandate M/462; determination of energy efficiency of telecom products

- Well defined test methods for each type of product
  - Measurement conditions
  - Measurement uncertainty
  - Equipment configuration
  - Reporting measurements
- Specific metrics for each type of product
- Key Performance indicators

Energy Efficiency of TLC products (1/3)

Wireline Broadband Access equipment

- **EN 303 215 V1.3.1, published 04/2015**
- It replaced ES 203 215
- It defines measurement methods of energy efficiency of network access equipment
- New version includes vectoring interfaces and test conditions of small ONU

Wireless Broadband Access equipment

- **ES 202 706 V1.4.1, published 12/2014**
- It replaced TS 102 706
- It defines measurement and calculation methods of energy efficiency of radio base stations
- It takes into account traffic conditions
- New version includes enhanced test method in traffic conditions
- **TR 103 116 V1.1.1, published 10/2012**
  - It's a practical application of the TS 102 706

Energy Efficiency of TLC products (2/3)

Customer Premises equipment

- **EN 301 575 V1.1.1, published 5/2012**
- It defines methods and test conditions to measure power consumption of end-user broadband equipment in the scope of EU regulation 1275/2008 in:
  - Off mode
  - Standby mode
- It defines also measurement method for on-mode power consumption

Core Network equipment

- **ES 201 554 V1.2.1, published 07/2014**
- It defines measurement methods for:
  - IP Multimedia Subsystem (IMS) core functions (HSS, CSCF, etc)
  - Fixed core functions (softswitch)
  - Mobile core functions (HLR, MSC, GGSN, SGSN, EPC, etc)
  - Radio access control nodes (RNC, BSC)
- Core network equipment are defined in TS 123 002

Energy Efficiency of TLC products (3/3)

Transport Equipment

- **ES 203 184 V1.1.1, published 03/2013**
- Measurement method and transport equipment configuration
- It considers work done by ATIS-NIPP TEE but more details on the tests conditions and equipment configuration are added
- The gain of amplifier is part of the metric

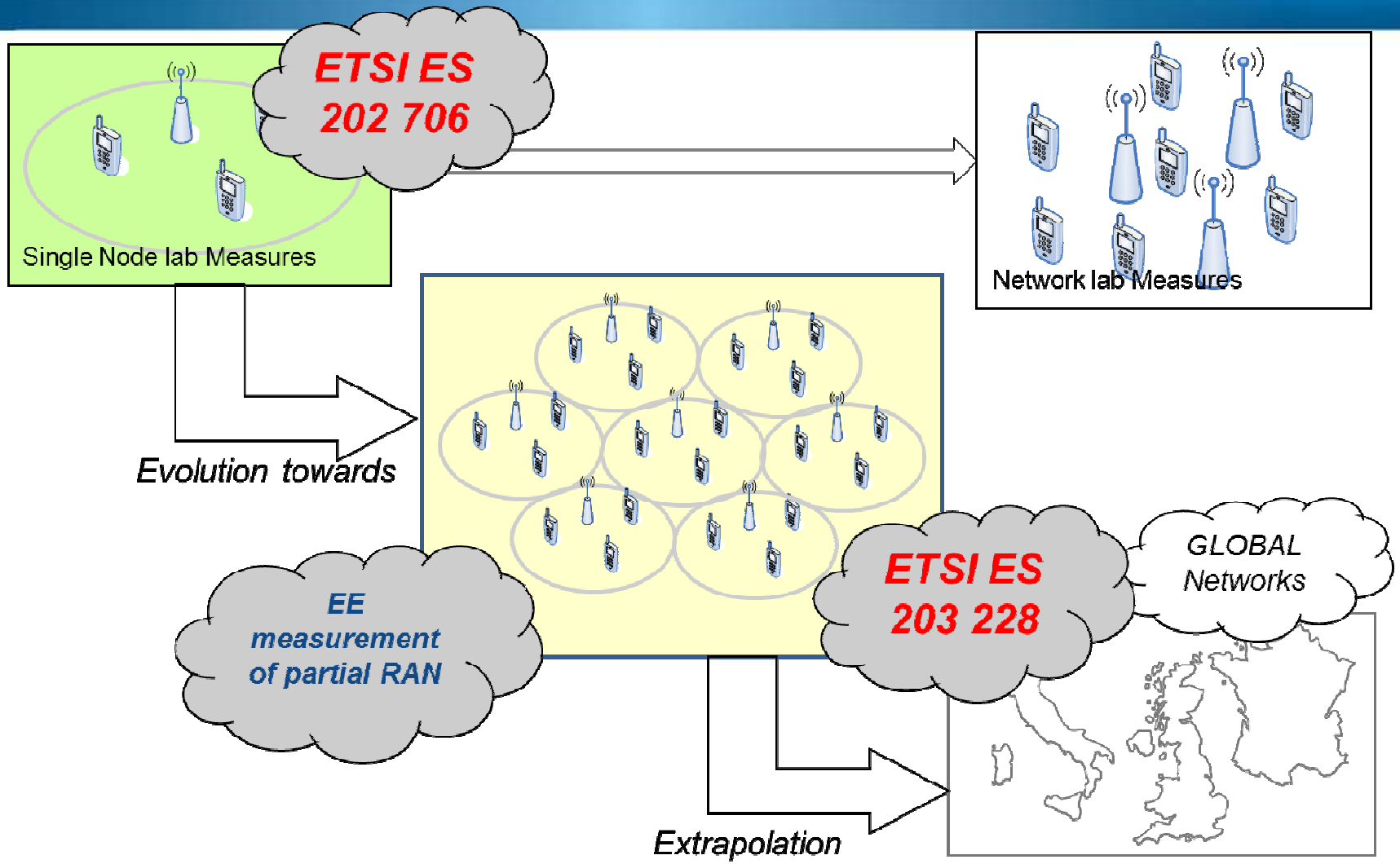
Switching and Router equipment

- **ES 203 136 V1.1.1, published 05/2013**
- Measurement method and switching/router equipment configuration
- It considers the work in ITU-T SG5 and ATIS-NIPP TEE but more details on the tests conditions and equipment configuration are added

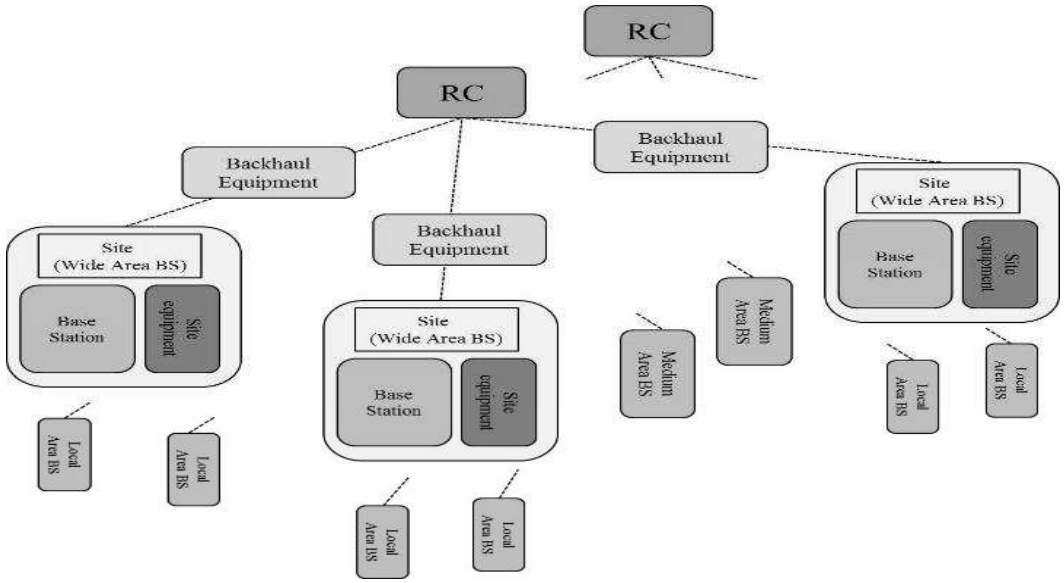
Energy Efficiency of Mobile Networks

- **ETSI Standard ES 203 228 on energy efficiency of mobile networks published on 04/2015**
  - Energy consumption metrics (all equipment in the network)
  - Performance metrics (traffic volume with a defined quality of service)
  - Energy efficiency metric (ratio of performance and energy consumption)
  - Measurement method
  - Assessment report content
- **Work Item with ITU-T SG5/WP3 and …**
- **In cooperation with 3GPP**
- **Next step → define assessment method of entire network**

Energy Efficiency for mobile radio access networks



Measurement method of energy efficiency in wireless access networks: ES 203 228



- **The standard deals with both a homogeneous and heterogeneous networks (GSM, UMTS, LTE-LTE/A) considering networks whose size and scale could be defined by**
  - topologic (a possible example a control node, its supported access nodes as well as the related network elements)
  - geographic (city-wide, national or continental networks)
  - demographic (urban or rural networks)

Measurement method of energy efficiency in wireless access networks: ES 203 228

$EE_{MN,D}$		b/J
Consumption	Energy EC_{MN}	Wh or J
Performance	Data volume DV_{MN}	bit
3GPP ref.	• TS 36.314 §4.1.8.1&2 • TS 32.425 §4.4/4.5/4.10	
Time period	week/month/year (week granularity)	
Comment	• EC Based on metering information • DV Based on O&M counters at node level • Availability/reliability as quality indicator	

$$EE_{MN,D} = \frac{DV_{MN}}{EC_{MN}}$$

$EE_{MN,C}$		m^2/J
Consumption	Energy EC_{MN}	Wh or J
Performance	Coverage Area	m^2
3GPP ref.	• TS 36.314 §4.1.8.1&2 • TS 32.425 §4.4/4.5/4.10	
Time period	week/month/year (week granularity)	
Comment	• EC Based on metering information • Coverage based on counters, for each RAT • Metric to be used in rural or deep rural areas	

$$EE_{MN,C} = \frac{coverage\ area}{EC_{MN}}$$

Measurement method of energy efficiency in wireless access networks: ES 203 228

Demography Classification	Percentage of presence in the global area	EE_{MN}	
		$EE_{MN,DV}$	$EE_{MN,C}$
Dense Urban (DU)	42%	200 b/J	2,7 m^2/MJ
Urban (U)	20%	40 b/J	19 m^2/MJ
Sub-urban (SU)	15%	8 b/J	38 m^2/MJ
Rural (RU)	13%	2 b/J	115 m^2/MJ
Unpopulated	10%	NA	NA
Global EE		103,8 b/J	28,4 m^2/MJ

- Example without any reference to actual networks
- Hypothesis of 2 weeks measurement in a network with a hypothetical demography distribution as in column 2; weighted measurement of the "available" sub-networks

Environmental impact assessment and energy efficiency management for ICT

What is required to define eco-sustainable ICT products/services/networks?

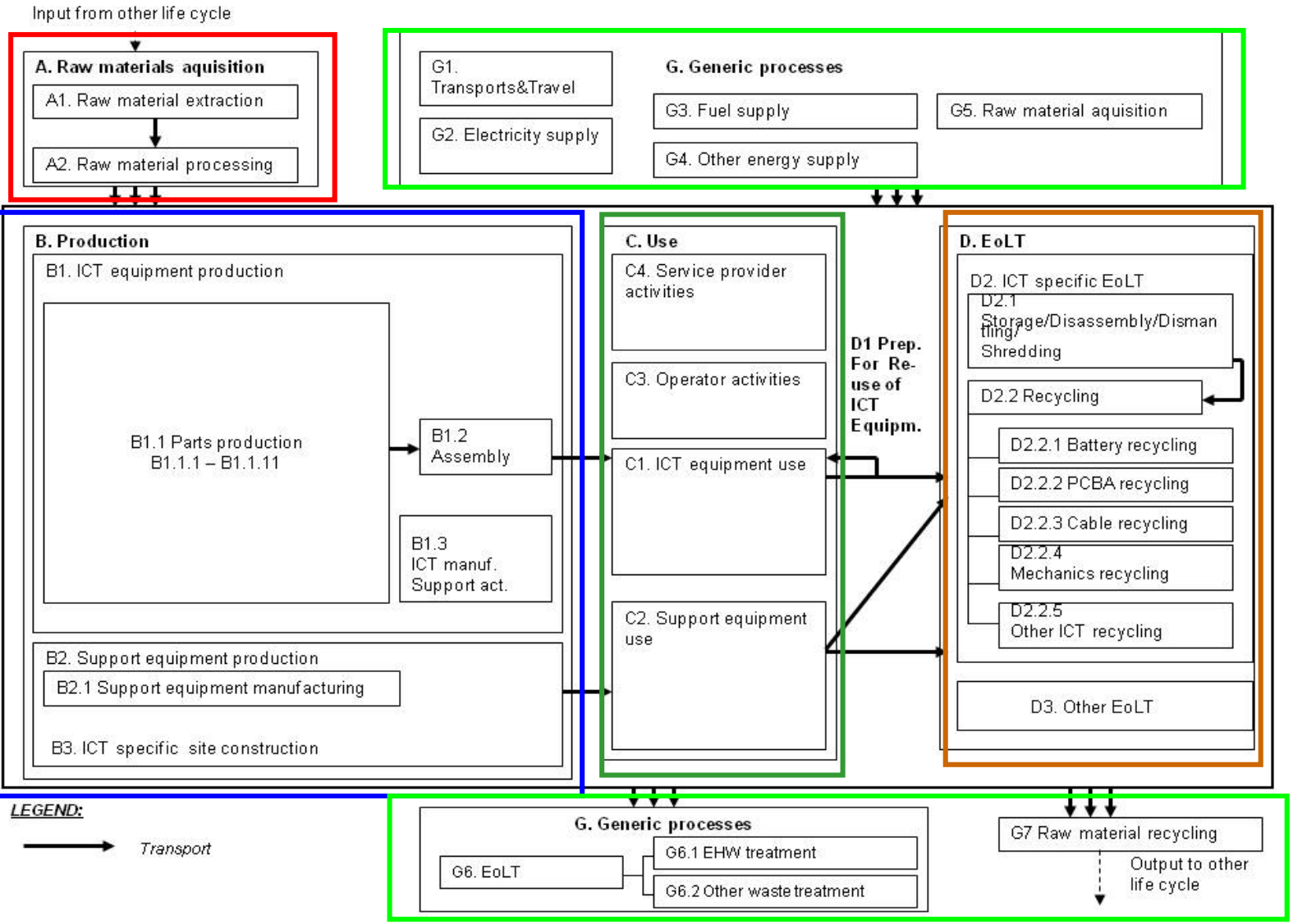
- Methodologies to determine the environmental impact assessment (e.g. GHG, resource consumption etc)
- Methods to determine the power consumption of ICTs to be used as input data for the environmental impact assessment
- Methodologies to monitor and manage the energy efficiency
- Guidelines for the realization of “green” installations
- Key Performance Indicators for products/installations

Environmental impact assessment for ICT (LCA)

Methods for assessing the environmental impact of ICT products/networks/services

- ES 203 199 V1.3.1 “Life Cycle Assessment of ICT equipment, ICT network and service: General definition and common requirement”
  - Published on 02/2015
  - The purpose of this ES is to harmonize the LCA of ICT:
    - Equipment
    - Networks
    - Services
  - It includes specific requirements for LCA of ICTs in respect to:
    - ISO 14040 Environmental management, Life cycle assessment, Principles and framework
    - ISO 14044 Environmental management, Life cycle assessment, Requirements and guidelines
    - International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment

Life Cycle stages overview



Methods for assessing the environmental impact of ICT: the improvement

- ES 203 199 replaces the TS 103 199 that was evaluated in the European Commission pilot test (assessment of ISO, IEC, ETSI, ITU, JRC, GHG protocol methodologies)
- In the pilot test, strengths and weaknesses of the ETSI LCA standard were identified
- It was decided to publish a technical aligned standard with ITU-T SG5/WP3
- Improvement in the published ES
  - More guidance for recycling allocation rules
  - Clarification on how to assess the LCA uncertainty
  - More guidance/clarifications on Network and Service LCAs
  - Clarifications when only GHG emissions are assessed

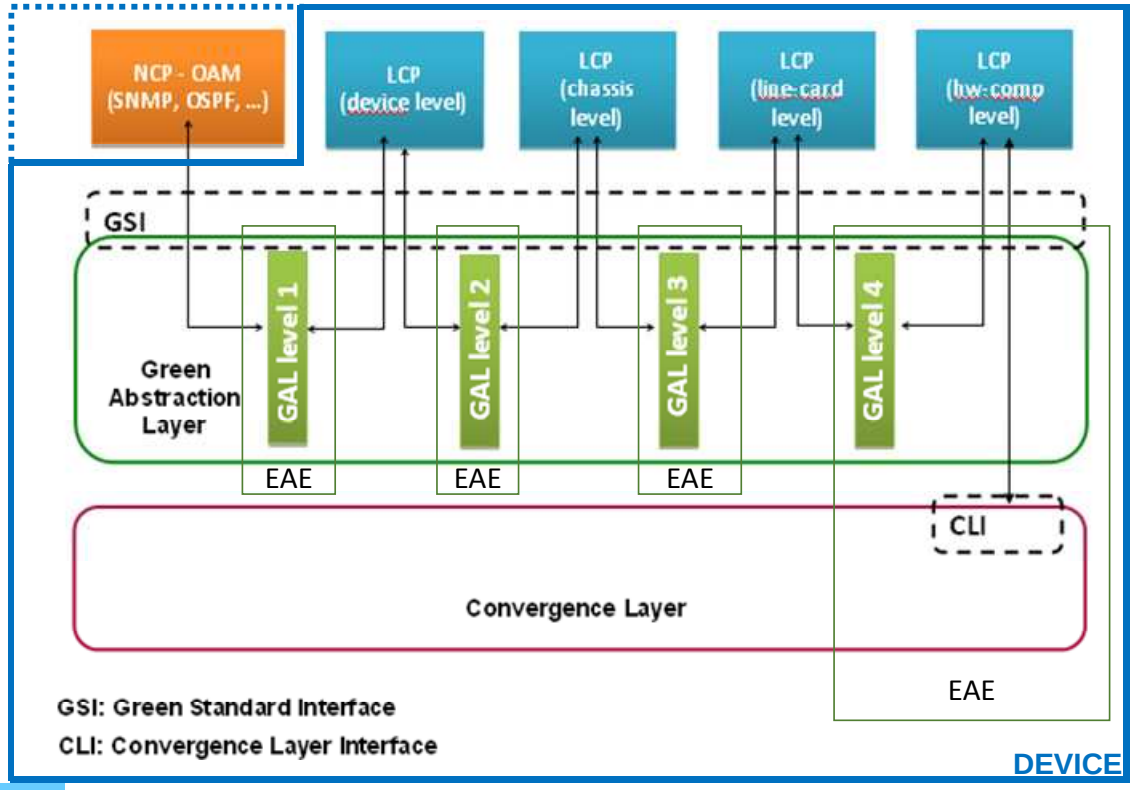
Energy efficiency management for ICT

Energy management: Green Abstraction Layer ES 203 237

- ETSI, in cooperation with European project ECONET, published the standard ES 203 237 on “Green Abstraction Layer” (GAL)
- The GAL is an architectural interface/middleware that:
  - gives access to the green networking capabilities of specific devices
  - adapts energy consumption to take into account load variations
  - offers a framework for information exchange between power-managed data-plane entities and control processes.
  - enables energy management protocols
- GAL functionalities:
  - discovery – to retrieve information about available energy configurations and network device
  - provisioning – to set the energy configuration for a network device
  - monitoring of the physical devices and relevant parameters

Energy management: Green Abstraction Layer
ES 203 237

- GAL functional architecture
  - example with 4 levels of different granularity (from device level to HW-component level through the chassis and line-card ones)
  - Control processes interact with the EAEs at different levels by means of the GSI.
  - Commands are sent to the HW by means of the CLI.



- *EAE Energy Aware Entity*
- *LCP Local Control Policy*
- *NCP Network Control Policy*
- *OAM Operations, Administration & Management*
- *OSPF-TE Open Shortest Path First - Traffic Engineering*

Energy efficiency monitoring

- Series of standards published by ETSI TC-EE on “Infrastructure equipment control and monitoring system interface” (ES 202 336-x series)
- Control processes defined in these publications aims to reduce the energy consumption by optimizing settings of utilities in the TLC infrastructure (e.g. cooling systems, power systems etc.)
- Remote monitoring and setting reduce CO2 emissions (less on-site interventions)

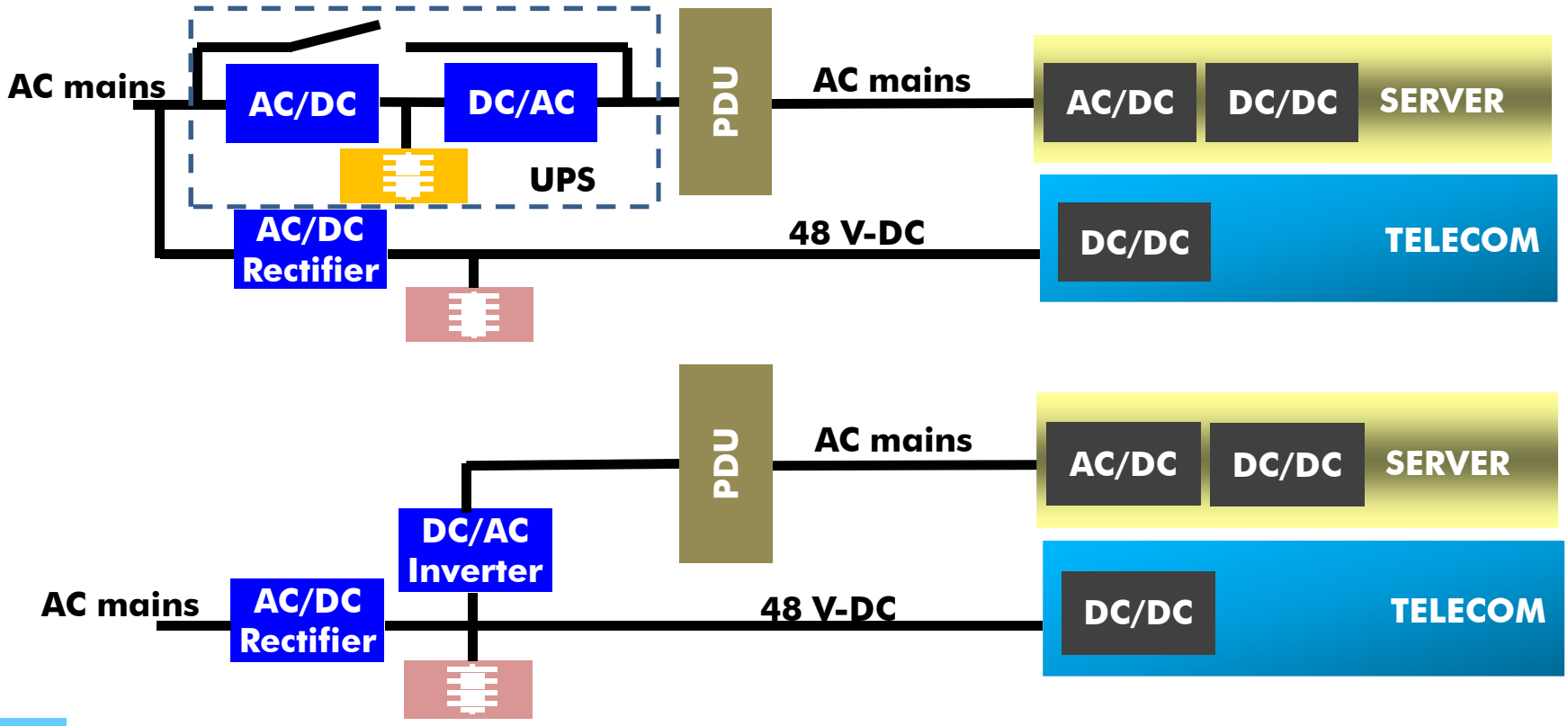
Energy efficiency monitoring: the publications

- ES 202 336-x: “Infrastructure equipment control and monitoring system interface” series
  - “1” General interface (V1.2.1, 07/2011)
  - “2” DC power systems (V1.1.1, 03/2009)
  - “3” AC-UPS power systems (V1.1.1, 10/2009)
  - “4” AC distribution power system (V1.1.1, 03/2013)
  - “5” AC-diesel backup generators (V1.1.1, 04/2010)
  - “6” Air conditioning systems (V1.1.1, 09/2012)
  - “7” Other utilities (V1.1.1, 12/2009)
  - “8” Remote power feeding (V1.1.1, 09/2009)
  - “9” Alternative power systems (V1.1.1, 09/2012)
  - “10” AC inverter power system control (V1.1.1, 09/2011)
  - “11” Battery systems (V1.1.1, 09/2014)
  - “12” Telecommunication equipment (in publication)

Power architecture for Data centers with increased energy efficiency

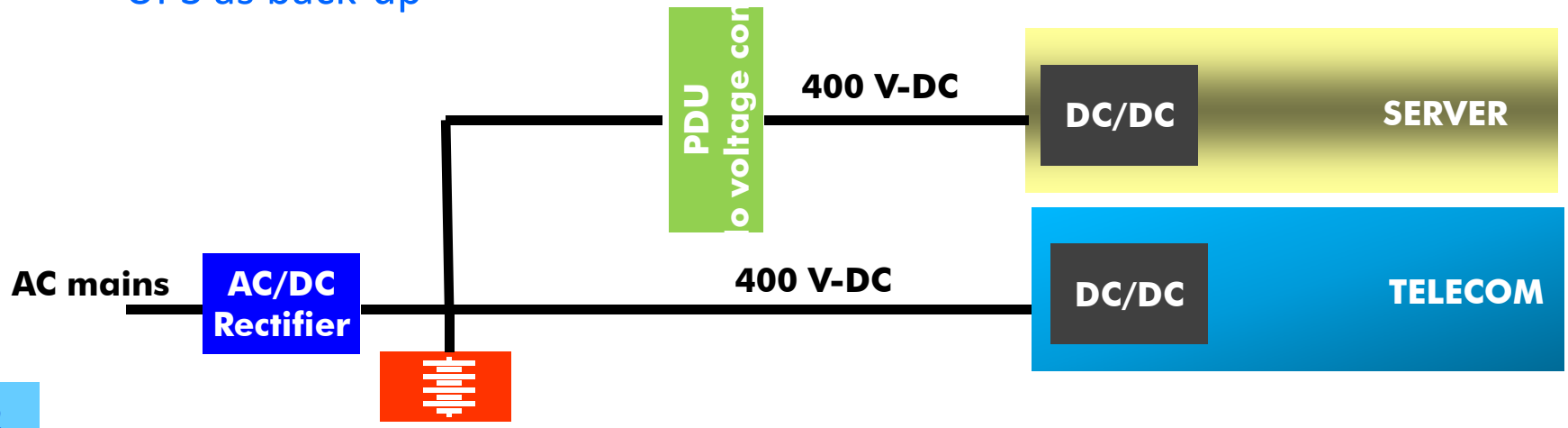
The “classical” ICT power architectures

- Data centers with telecom equipment at 48 V-DC and data equipment at AC mains power (e.g. 380 V or 220 V AC) needs a more efficient power distribution



Power architecture with better energy efficiency

- A power distribution at 400 V-DC has more efficiency
  - Less conversion stages in the overall system
  - Less losses on cables
- And …
  - Longer battery back-up without system de-rating
  - No harmonic losses and effects on distribution
  - No need for load balancing between phases
  - Smaller footprint
  - Suitable to supply all type of equipment in a data center without using UPS as back-up



Power architecture with better energy efficiency: the standards

- ETSI TC-EE has produced the standards for the power supply interface requirements of equipment to be connected to a 400 V-DC power distribution:
  - EN 300 132-3-1, V2.1.1 (02-2012): Direct current source up to 400 V
  - EN 301 605 V1.1.1 (10/2013): Earthing and bonding of 400 V-DC data and telecom (ICT) equipment

Guidelines for improvement of energy efficiency and use of alternative energy sources

GUIDELINES FOR IMPROVEMENT OF ENERGY EFFICIENCY AND ALTERNATIVE ENERGY SOURCES

TR 102 530 V 1.2.1 (07/2011): “The reduction of energy consumption in telecommunications equipment and related infrastructure”

TR 102 532 V 1.2.1 (11/2012): “The use of alternative energy sources in telecommunication installations”

- It includes an overview of the alternative energy sources and guidelines for its use (both for powering and cooling)
- Disposal of waste materials
- LCA analysis related to alternative energy solutions (e.g. batteries)

TR 103 229 V 1.1.1 (07/2014): “Safety Extra Low Voltage DC power supply network for ICT devices with energy storage and grid or renewable energy sources options”

- Improved efficiency with less conversion stages
- Reduction of CO2 emissions using renewable energy options

KPIs for energy efficiency management

Key Performance Indicators for ICT products/network/installations

- KPI for energy consumption
  - This is the total consumption of energy by an operational infrastructures
- KPI task efficiency = energy/service unit
  - The indicator for task efficiency is the assessment of the work done (as a result of design and/or operational procedures) for a given amount of energy consumed
- KPI heat reuse= reused energy / consumed energy
  - This parameter addresses the energy re-use in terms of transfer or conversion of energy (typically in the form of heat) produced by the operational infrastructure to perform other work

Key Performance Indicators for ICT products/network/installations

- KPI renewable energy= renewable / consumed energy
  - This addresses the renewable energy produced from dedicated generation systems using resources that are naturally replenished
- KPI Global Indicator
  - This KPI allows benchmarking the energy management of ICT nodes (data centres included) depending on their size in terms of energy consumption

- KPIs are defined in the ETSI standards ES 205 200 series produced by TC-ATTM

Conclusions

- Global GHG emissions of ICTs is low in respect to other sources but is not negligible
- ICT world has to pay its contribution to reduce the energy consumption and provide more sustainable service
- Initiatives have been launched in Europe to address the energy efficiency of ICTs
- ETSI is actively contributing in providing:
  - Reliable measurement methods to assess the energy efficiency of ICTs equipment and networks
  - Methodology to determine the environmental impact for ICT products/networks/service
  - Best practices and guidelines to improve/monitor ICT energy efficiency

To note

- **Third ETSI Workshop on ICT Energy Efficiency and Environmental Sustainability**
  - 3-5 June 2015, in Sophia-Antipolis, France

http://www.etsi.org/news-events/events/867-third-etsi-workshop-on-ict-energy-efficiency-and-environmental-sustainability

Thank you for the attention

Questions?