TREN/D3/91-2007/Lot 26

Preparatory Studies for Eco-design Requirements of EuP

Study funded by the European Commission

EuP Preparatory Studies
Lot 26: Networked Standby Losses

Final Report Task 1
Definition

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Berlin, Paris 21st June 2011

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1.1.1 Introduction

The ENER Lot 26 Preparatory Study has been motivated by the results of the previous TREN Lot 6 preparatory study on standby and off-mode losses.[1] This earlier study by Fraunhofer IZM and BIO Intelligence Service identified the issue of networked standby, coining the term in the process. The study concluded that, with increasing network capabilities and context, more and more products will offer functions and services accessible via an existing network link. Due to the understanding that such network-based services are typically provided by the products out of a higher power mode (e.g. active, idle), regular standby and off-mode might not be utilized. This situation would result in increasing energy consumption. The first estimate showed an order of magnitude of over 25 terawatt-hours per year for the European Union. The study also indicated that products offering network services should be specifically designed for low power networked standby in order to avoid increasing energy consumption thorough prolonged high power states. Proper power management is the requirement for maintaining network services in an energy efficient way.

At the time of the Lot 6 study, it became clear that networked standby functionality will not be covered by the regular standby and off-modes. Following the study, the Commission Regulation (EC) No 1275/2008 (standby/off) excluded the networked standby topic with the indication that further investigations are necessary to address this still quite new issue. Against that background the ENER Lot 26 preparatory study was launched with the task to define Networked Standby, determine a product scope horizontally by focusing on mass product home and office equipment, to investigate the application and environmental impacts of networked standby as well as to assess the improvement potential by considering best available technology. The final task of this study is to provide recommendations on feasible eco-design measures that support the substantial improvement and avoid growing future environmental impacts.

The ENER Lot 26 preparatory study has been tasked with a horizontal approach. This means that networked standby should be addressed without limitation to a predefined product spectrum. In other words, the definition of networked standby should be generally applicable to existing and future products. Due to this condition, the selection of coherent terminology and concepts for defining networked standby and addressing the related energy

[1] The final reports of the TREN Lot 6 study "standby and off-mode losses" are available at: http://www.ecodesign.org.

consumption issues is very important. On the other hand, the study is not required to harmonize existing terminology and concepts; the study is free in the selection or introduction of new terminology and concepts. In the following paragraphs we will shortly explain our perspective concerning mode definitions and related terminology. This should be beneficial for the understanding of our own mode definition and key concepts used in this study.

1.1.2 Mode terminology

Over the past years we could observe an increasing number of modes (terminology and concepts) that basically define conditions of a product with respect to specific functionality and related power consumption (functional approach). In the context of energy efficiency labeling, environmental regulation, and product testing these modes are not only technical instruments for distinguishing different power states and functionality, but instruments for the implementation of energy-related product requirements. These are two different purposes.

The existing large number of mode definitions derives from various standardization initiatives. They have been influenced by various industry sectors (PC, CE, ICT, etc.), governmental and non-governmental agency as well as research organizations. Unfortunately, international standardization has not been able to harmonize the power mode definitions. With the recent postponement of the IEC 62542 “Glossary of Terms” these difficulties were once more manifested.

Despite the missing harmonization, most stakeholders understand the basic concept of power modes and they distinguish three larger mode categories; namely (a) on/active, (b) on/idle, (c) on/standby, and (d) off-modes. If compared, the mode definitions in the same category describe similar issues only with different terminology. Take the example of standby, for which similar terms such as “ready”, “low power”, and “sleep” exists. More important are the nuances with respect to the content; most considerably the spectrum of functions allocated to the mode. With increasing product variety, optional product configurations, new network architectures and interacting hardware and services, the so called “functional approach” in the mode definition process could reach its limits.[2]

For more information on existing mode concepts, terminology and respective definitions see Chapter 1.2 (standardization).

1.1.3 Network and Equipment

With respect to networked standby it is necessary to distinguish between network, equipment, and the resulting conditions.

[2] The Report from Energy Efficient Strategies for APP and IEA 4E with the title „Standby Power and Low Energy Networks – Issues and Directions” (September 2010) comes to a similar conclusion (p.50-53).

- **Network** is an infrastructure with a certain topology of links, an architecture including the physical components, organizational principles, communication procedures and formats (protocols). The energy consumption of the physical components of the network (even networks of same topology and architecture) depends on the actual layout of the network in the field (implementation).
- **Equipment** is an energy-using product (EuP) featuring network interfaces (hardware and software components) for providing network functionality including:
  - Establishing and maintaining a network link (physical),
  - Establishing and maintaining a network connection (protocol),
  - Utilizing the network connection (payload traffic)

Diagram (Network / Equipment)	Network Status		Comments
	Lost or No	Link	Network interface enabled, Link detection active, No link,
	Establishing	Link	Link detected, Change status from no link to link established, No network traffic
	Maintaining	Link	Link established (PHY), Traffic detection active, No connection
	Establishing	Connection	Traffic detected, Change status from no connection to connection, Low level traffic (protocol)
	Maintaining	Connection	Low level communication PHY and MAC established No traffic with payload
	Traffic with Payload	Connection	Network connection fully active

Figure 1: Network conditions, identifying link and connection concept

The Figure 1 above provides a simplified description of typical network conditions and functionality. The initiation (establishing) of a link or connection is of cause bidirectional. The network interface (and the equipment respectively) requires specific energy for each of these

conditions. With increasing network capability (point-to-multipoint) and number of network options (wired and wireless) the energy consumption is typically increasing as well.

Networked standby is addressing the capability of one or multiple equipments in the network to reduce power consumption while at the same time maintaining a certain level of access to an offered network service. We call this service “network availability”. The resume-time-to-application is the basic indicator for network availability. Due to the fact that the resume-time-to-application of the powered-down equipment is influenced by e.g. the internal device configuration and interoperability, network availability is not a fixed condition. Assuming that the highest network availability is provided in active/idle (typically >>8 Watt) and no network availability in regular standby/off-mode (<<2 Watt, and often much less), we can notice a certain range of power consumption within one or more networked standby modes could be established.

Following an extended stakeholder dialogue discussing these aspects, we have modified the draft definition and will introduce the network availability concept as an instrument to analyze the networked standby issue.

1.1.4 Definition: Networked Standby

The newly-proposed definition is as follows:

“Networked standby modes are conditions, in which the equipment provides reduced functionality, but retains the capability to resume applications through a remotely initiated trigger via network connection.

Networked standby modes may distinguish different levels of network availability and by that different resume-times-to-application as well as power consumption.”[3]

Reduced functionality means that for different levels of network availability the equipment maintains certain network interfaces, signal processing, power supply and other hardware components (devices) in an active/idle condition. This may include low level duty cycles (fluctuation of available functionality) to maintain network integrity communication as well as resume-time-to-application at the required quality-of-serve level. Reduced functionality however does not mean active (payload) traffic processing such as downloads.

Resume application means a shift from networked standby into active mode in order to provide a beneficial network service to an authorized user. Resume-time-to-application is therefore the time needed for the product to provide the desired service (e.g. main function).

[3] The bold text could potentially be used as the wording of a regulation. The non-bold text which follows serves as an explanation for the purposes of this report.

Resume-time-to-application defines a level of network availability (see chapter 1.1.8). Resume-time-to-application is not to be misunderstood as the reaction time (latency) of the network interface.

Network connection considers two general types of networks:

- Simple line connections - point to point. Apart from communication, these line connections provide the functions to switch one product on upon a trigger from the other product (this can sometimes work two ways).

- Advanced Networks with multiple nodes, and more or less advanced network functions during network standby (e.g. bridging, firewalling, NAT i.e. all routing functions may be functions in NW standby mode).

Remotely initiated trigger means that the trigger is received from outside of the product and can be received by the equipment in networked standby mode.

Three types of wake-up functionality:

- Trigger Wake-up: Wake-up is triggered by a simple event which is signaled via a wire (single transitioning from an inactive to an active state).

- Address wake-up: Wake-up is triggered by a specific pattern or code. Example would include WOL where the Ethernet NIC receives a specific “magic packet” address.

- Protocol wake-up: Wake-up is triggered by a sequence of events (protocol). Example would include waking-up due to an incoming VOIP ring from a SIP server.

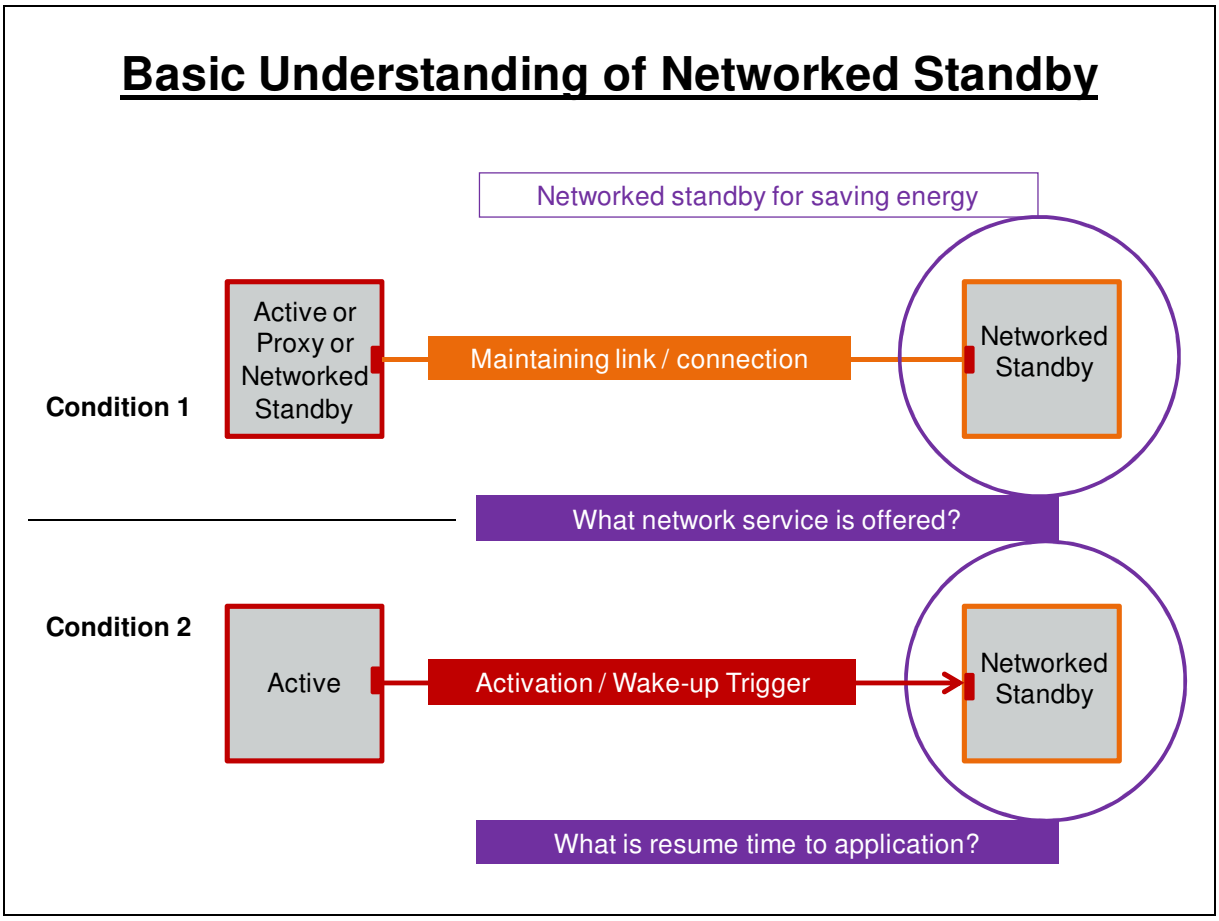

Figure 2: Networked Standby

1.1.5 Reasoning behind the modified definition

The revised definition focuses on the service provided to the user, and not the functionality built into the device. In this new definition, reactivation via network remains the primary and required service provided by the mode. Network integrity communication is a necessary condition for this, but is not sufficient on its own to justify Networked Standby Modes. **Equipment in Networked Standby should provide a beneficial network service to an authorised user, via network connections, in addition to functionalities defined by EC 1275/2008.** The mere fact that a product has an integrated network interface and could be connected to network should not be enough to allow the product to have a higher standby consumption than required in the horizontal standby regulation (Commission Regulation (EC) No 1275/2008)1275/2008), because no additional (network) services are provided to the consumer.

By taking this service-oriented perspective, the definition remains neutral with respect to different technologies and functionalities which can provide a desired service. A strict functional approach limits the horizontal applicability of the definition, particularly with regard to future (unknown) product developments and network configurations.

In a specific Networked Standby Mode, the power level of the equipment may fluctuate according to the processes that are still maintained (duty cycles in conjunction with network integrity communication, necessary synchronizations, handshakes, etc.), though this does not include “active mode” functions such as downloads, charging, etc. As such, the power consumption in Networked Standby should be understood as an average value over time (Wh/h) and should be tested accordingly.[4]

1.1.6 Proposed product scope

The definition of networked standby mode applies horizontally to a broad spectrum of equipment. We recommend that the scope covers stand-alone and mobile equipment typically used in home and office environments including the following categories:

- House equipment with integrated network interfaces (including, but not limited to, washing machines, dishwashers, smart meters, and building automation devices)[5]
- Information technology equipment (including, but not limited to, computing, imaging, communications, networking, displays and consumer premises equipment).
- Consumer electronics equipment (including, but not limited to, televisions, audio-video equipment, streaming clients, and complex set-top boxes)
- Other electrical and electronic equipment (including, but not limited to, toys, leisure and sports equipment)

This scope corresponds with EC 1275/2008 and (for the IT equipment) class B equipment as set out in EN 55022:2006.

Some limits to the scope are discussed in the following paragraph.

[4] See Chapter 1.1.10.

[5] It is worth noting that building automation devices and certain other networked products are designed to limit the overall power consumption of a larger system. As such, maintaining that functionality is key to overall energy savings and is reflected in the “Network Availability” concept presented later.

1.1.7 Reasoning behind the proposed product scope

The dynamic technical progress (digitalization and miniaturization) creates challenges as a result of the following three aspects:

1. There is now the option to combine any kind of functionality in one device. This creates a dilemma for allocating new (multi-functional) products to a specific product category.

2. By adding networking capability to these devices, the equipment can conceivably be designed to serve any role within in a given network architecture (e.g. node, server, etc.). This also includes DC-power small attachments such as e.g. USB-WiFi dongle.

3. Power over the network (e.g. power-over-Ethernet, power-over-USB) is becoming a viable option of supplying power to the equipment in addition to the other options, namely mains-connected or mains-independent (e.g. battery, fuel cell, solar, etc.).

This variability makes the allocation to specific product categories very difficult, while at the same time it currently seems to be the only possible way to define appropriate and effective implementing measures. With respect to the setting of long-term requirements, it is also recommended to maintain a horizontal application of the definition to ensure that new and emerging products are covered.

The distinction between home/office equipment and professional equipment is driven by the consideration that e.g. professional IT equipment is embedded into a larger technical infrastructure with considerably higher quality-of-service requirements. The second driver is operating costs (OPEX). Energy consumption contributes considerably due to raising prices. Industry is aware of the service provider requirement for lower operation expenditure. The market displays a clear trend featuring hardware and software solutions in support of energy efficiency (Green IT). As an example, datacenter-type (rackmount) networking equipment, server, and storage equipment are considered professional equipment with considerable higher quality-of-service requirements (service availability). Such type of equipment have most often considerable more signal processing and computing capacity (on larger, multiple or distributed boards), rack-level or central power supply units (PSU), simple or dual-conversion uninterruptible power supply (UPS), as well as system-integrated cooling and ventilation solutions. These technical aspects indicate that network functionality is provided not only by a single product but in conjunction with other components as systems.

Further reasoning for the distinction between home and office IT equipment (Class B) from professional IT equipment (Class A) is that Class A has less strict EMC requirements and therefore is not intended for rooms in which persons can continuously be present. Although networked standby mode could apply to Class A products in principle, these products include highly diverse professional equipment typically designed for constant active use (always on) and/or designed along the line of Quality of Service (QoS) requirements. Examples would be carrier and enterprise grade networking equipment (gateways, switches, router etc.), professional imaging equipment (digital press, embedded printers etc.), and commercial information displays (electronic billboards, digital signing etc.). In terms of numbers, the installed base (stock) of such equipment is clearly lower in comparison to mainstream consumer and office products.

In terms of technical characteristics important differences are the typically much higher rated power consumption, a necessary support infrastructure (including uninterruptible power supply [UPS]), and in the case of network equipment a large number of high speed network interfaces (ports). Nevertheless, power management including low power states for professional equipment – although it cannot be addressed in this study – is an important issue and should not be neglected.

1.1.8 Network availability concept (performance parameter)

As the first standby study already showed that networked standby modes have great potential for saving energy, the analysis of performance parameters relevant for networked standby mode is done not only with a view to the services provided to the user via networked standby mode, but also with a view to the environmental performance, in particular energy consumption. Generally speaking, substantial amounts of energy are saved by facilitating a technical power management that shifts the networked product automatically from a higher power level (active/idle) into a lower power level (networked/standby/off) when the full functionality is not required.

The overarching objective is to balance the benefit of the network service to the user (incl. QoS requirements) against the equipment's energy consumption. In this context, the service benefit is network connectivity and the speed (latency) at which the equipment can provide its full functionality after having been triggered over the network. The main performance parameter for networked standby, then, is resume time to application.

The “Network Availability Concept” was developed for the purposes of this study. It recognizes the following aspects:

- Connectivity: Reaction latency, complexity of network integrity communication
- Configuration: Number and type of network options (LAN, WLAN, USB, HDMi, etc.)
- Quality-of-service: Redundancy, security, scalability

This concept also reflects indirectly different utilization patterns e.g. in home and offices, technical options and configurations for networked standby (technical capabilities), and their respective power consumptions. This concept is primarily based on the resume-time-to-application which is required to provide the desired service. Resume-time-to-application is not to be misunderstood as the reaction time (latency) of the network interface.

For the purpose of this study we introduce four Network Availability levels, as follows:

- **High Network Availability (HiNA):** Resume-time-to-application in milliseconds.
- **Medium Network Availability (MeNA**): Resume-time-to-application <<10 seconds.
- **Low Network Availability (LoNA):** Resume-time-to-application >>10 seconds.
- **No Network Availability (NoNA):** Resuming application via network command is never or not always possible. This level is included to allow for realistic calculations.

The network availability concept will be fully explained in later reports. Depending on its application please see remarks the tasks reports 4 (technical assessment), 5 (environmental impact assessment), and 7 (improvement options).

1.1.9 Functional unit

The functional unit is once more very hard to describe for such a horizontal approach.

In general the functional unit covers the equipment as bought or as installed, including the relevant networking and user context. In a detailed technical view, changing the user behavior or changing the surrounding network or network events will impact the energy consumption of the equipment. This needs to be considered when the functional unit is used in a one-to-one comparison.

For the purposes of this study, the summarized functional unit is the average power consumption (Wh/h) of the equipment with respect to the following network availability levels:

- High Network Availability
- Medium Network Availability
- Low Network Availability

The eco-design improvement potential will be calculated based on the energy savings achieved through the use of networked standby modes for maintaining a defined level of network availability and through that the desired quality of network service.

1.1.10 Power measurement and testing

At present, no sufficient (standardized) testing procedures exist.

Broadband Equipment Code of Conduct - Version 4 form (published 11-02-2011) states in that respect: “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.”

IEC 62301:2011 (respective EN50564/2011) specifies methods of measurement of electrical power consumption in standby mode(s) and other low power modes (off mode and network mode), as applicable. It is applicable to electrical products with a rated input voltage or voltage range that lies wholly or partly in the range 100 V a.c. to 250 V a.c. for single phase products and 130 V a.c. to 480 V a.c. for other products. The objective of this standard is to provide a method of test to determine the power consumption of a range of products in relevant low power modes (see 3.4), generally where the product is not in active mode (i.e. not performing a primary function).

EPA Energy Star Program is currently developing a new product specification for Small Network Equipment. For data collection EPA published in February 2011 a test method (revision 4) which provides some helpful concepts also with respect to testing of networked standby.

1.2 Standardization (terminology and test procedures)

Since the publication of the first stakeholder document in September 2009 there have been considerable developments with respect to the definition of networked standby mode and respective product scope. In the following chapter we will identify and discuss technical standards and standardization processes, which overlap with the TREN Lot 26. We like to remind the reader that standardization is an ongoing process. The situation presented in this report might change in the future.

The focus of the following description of technical standards is mode definitions and terminology.

1.2.1 International Electrotechnical Commission (IEC)

The IEC is a global organisation that prepares and publishes international standards for all electrical, electronic, and related technologies. There are a variety of standards that relate to the study of networked standby.

IEC 62542 Ed. 1.0: Environmental standardization for electrical and electronic products and systems – Standardization of environmental aspects – Glossary of Terms.[6] The latest draft distinguished under the umbrella of "standby modes" three different conditions including "reactivation mode", "status information mode" and "network integrity mode". The term "network integrity mode" is replacing the term "networked standby mode" and focused through that on the function provided by the mode. It is important to notice that transitions to and from network integrity mode as well as the functions "maintenance" and "download" are considered active modes.

IEC 62301 Ed. 2.0 (2011): Household electrical appliances – measurement of standby power. The standard specifies methods of measurement of electrical power consumption in standby mode(s) and other low power modes (off mode and network mode), as applicable. This document relates to domestic appliances (white goods) only and provides a generic method for measuring off-mode and standby powers and is referenced by more specific standards covering other white goods: it also describes various modes. This standard also covers power measurement in network modes. The first edition of this standard was published in 2005 and an FDIS was circulated in 2010 which was positively voted in January

[6] As of the publication date (May 2011), this standard is not yet finalized, though publication is scheduled for the end of the month.

2011. Consequently IEC 62301 Ed 2.0 will be published in 2011. According to an earlier draft version low power modes include off-mode, standby modes and network modes:

- Standby Mode(s): this mode category includes any product modes where the energy using product is connected to a mains power source and offers one or more of the following user oriented or protective functions which usually persist:
  - To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, timer;
  - Continuous function: information or status displays including clocks;
  - Continuous function: sensor-based functions

- Network Mode(s): this mode category includes any product modes where the energy using product is connected to a mains power source and at least one network function is activated (such as reactivation via network command or network integrity communication) but where the primary function is not active

The main changes from the previous edition are as follows:

- greater detail in set-up procedures and introduction of stability requirements for all measurement methods to ensure that results are as representative as possible;
- refinement of measurement uncertainty requirements for power measuring instruments, especially for more difficult loads with high crest factor and/or low power factor;
- updated guidance on product configuration, instrumentation and calculation of measurement uncertainty;
- inclusion of definitions for low power modes as requested by TC59 and use of these new definitions and more rigorous terminology throughout the standard;
- inclusion of specific test conditions where power consumption is affected by ambient illumination.

IEC 62087 Ed. 2.0: Methods of measurement for the power consumption of audio, video and related equipment. This standard was published in 2008 and provides “active standby low” and “active standby high” references for networked standby mode as well as test conditions and measurement procedures.

IEC 62075 Ed. 1.0: Audio/video, information and communication technology equipment – environmentally conscious design. This standard derived from ECMA-341 and was adopted by IEC and published in 15 January 2008. The IEC 62075 specifies requirements and recommendation for the design of environmentally sound products regarding life cycle thinking aspects, material efficiency, consumables and batteries, extension of product

lifetime, hazardous substances/preparations, and product packaging. This standard includes the definitions of energy saving modes. According to this energy saving modes, often denoted as low power, sleep, deep sleep or stand-by, are states in which the equipment is connected to an electrical supply and is ready to resume an operational mode, within a user acceptable timeframe, through the use of remote control or another signal. In complex systems, various energy saving modes may be present.

IEC 62430 Ed. 1.0: Environmental conscious design for electrical and electronic products. This standard was published in February 2009 and specifies requirements and procedures to integrate environmental aspects into design and development processes of electrical and electronic products, including combination of products, and the materials and components of which they are composed. The standard provides relevant generic definitions as well as other terminology and documentation of environmental impacts and information disclosure.

1.2.2 ECMA International

The scope of ECMA TC38 is AV, CE and ICT products. Task is to develop environmental standards for a globally acting industry.

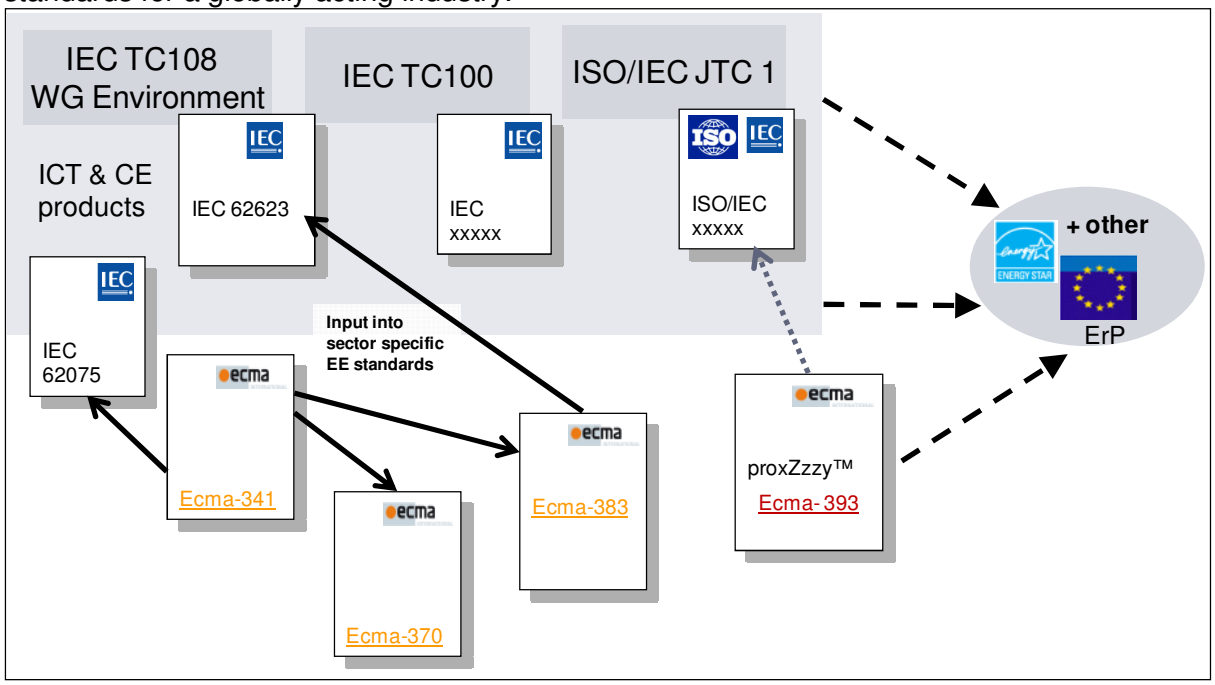

Figure 3: ECMA relations to technical standards

ECMA 383 2nd Ed: Measuring the Energy Consumption of Personal Computing Products. Ecma developed and published the world's first environmentally conscious design standard (ECD) for the ICT & CE industries in 2003.

ECMA 383 provides following mode definition:

- Sleep Mode (P_{sleep}): The lowest power mode that the UUT is capable of entering automatically after a period of inactivity or by manual selection. A UUT with sleep capability can quickly wake in response to network connections or user interface devices with a latency of ≤ 5 seconds from initiation of wake event to product becoming fully usable including rendering of display. For products where ACPI standards are applicable sleep mode most commonly correlates to ACPI system level S3 (suspend to RAM) or S4 (suspend to disk) state. When the UUT is tested with the WoL capability disabled in the sleep state it is referred to as Sleep Mode. Psleep represents the average power measured in the Sleep mode with the WoL capability disabled.

- Wake on LAN Sleep Mode ($P_{sleepWoL}$): The lowest power mode that the UUT is capable of entering automatically after a period of inactivity or by manual selection. A UUT with sleep capability can quickly wake in response to network connections or user interface devices with a latency of ≤ 5 seconds from initiation of wake event to product becoming fully usable including rendering of display. For products where ACPI standards are applicable sleep mode most commonly correlates to ACPI system level S3 (suspend to RAM) or S4 (suspend to disk) state. When the UUT is tested with the WoL capability enabled in the sleep state it is referred to as Wake on LAN Sleep Mode. PsleepWoL represents the average power measured in the Sleep mode with the WoL capability enabled.

- On Mode (P_{on}): The on mode represents the mode the UUT is in when not in the sleep or off modes. The on mode has several sub-modes that include the long idle mode, the short idle mode and the active (work) mode. Pon represents the average power measured when in the on mode.

- Idle Modes: The modes in which the operating system and other software have completed loading, the product is not in sleep mode, and activity is limited to those basic applications that the product starts by default. There are two forms of idle that comprise the idle modes, they are:

    - Short Idle (P_{sidle}): The mode where the UUT has reached an idle condition (e.g. 5 minutes after OS boot or after completing an active workload or after resuming from sleep), the screen is on and set to a shipped brightness and long idle power management features should not have engaged (e.g. HDD is spinning and the UUT is prevented from entering sleep mode). Psidle represents the average power measured when in the short idle mode.

- Long Idle (P_{idle}): The mode where the UUT has reached an idle condition (e.g. 15 minutes after OS boot or after completing an active workload or after resuming from sleep), the screen has just blanked but remains in the working mode (ACPI G0/S0). Power management features if configured as shipped should have engaged (e.g. display is on, HDD may have spun-down) but the UUT is prevented from entering sleep mode. Pidle represents the average power measured when in the long idle mode.

IEC 62623 Ed. 1.0: Measuring energy consumption of personal computing products. This standard draft is based on **ECMA 383.** Voting in September 2010 indicates disapproved as IEC standard.

It should be noted that the definitions used in IEC62542 and ECMA 383 (IEC62623) are not consistent: where IEC62542 puts network standby under the header “standby modes”, the ECMA 383 standard defines network standby as a mode that can either be a form of standby or a form of active mode, especially when the product in sleep mode can send basic communication messages over the network. It is essential that these two different types of network standby behaviour are recognized and studied in the preparatory study, as stipulated above.

Ecma 393: ProxZzzy™ for sleeping hosts:[7] Ecma International published their ProxZzzy Standard for network connected sleep states in Information and Communications Technology (ICT) devices as ECMA-393 on their public website for unrestricted download. The Standard specifies responses to traffic so sleeping PC or ICT devices maintain network presence.

The ProxZzzy standard addresses a fundamental problem with today’s PCs: when they go to sleep, they ‘fall off’ the network. This is a reason that many PCs are left on continuously, both in homes and offices. It is estimated that most computing energy consumption in the U.S. occurs when no one is present. The energy savings potential of a ProxZzzy enabled device is measured in billions of dollars per year for PCs, and grows even larger when application to game consoles, printers, set-top boxes and other digital devices is considered.

The standard provides an overall architecture for a proxy and key requirements for proxying select protocols. Handling of incoming traffic can require generating a reply packet, causing a system wakeup, or ignoring it. Proxies also do some routine packet generation on their own, and data are exchanged between a host and a proxy when the host goes to sleep and when it wakes up. Existing technologies require other entities on the network to know that the host is asleep and alter their behaviour appropriately. A key goal of a proxy is to save energy,

[7] www.ecma-international.org/publications/standards/Ecma-393.htm

while simultaneously keeping the device accessible (or at a minimum "looking alive") to the rest of the network.

The operations of the proxy are best-effort, both in attempting to extend sleep time, as well as maintaining network access. There are many possible ways to implement proxy functionality, and this standard seeks to avoid unduly restricting choices in those designs. In particular, it does not specify the location of the proxy, within the host itself or in attached network devices.

The standard defines following terms:

- Host: entity that uses a lower-power Proxy for maintaining network presence
- Proxy: entity that maintains network presence for a sleeping higher-power host
- Sleep: mode in which the host uses less energy than it does when fully operational

This Standard specifies maintenance of network connectivity and presence by proxies to extend the sleep duration of hosts.

This Standard specifies:

- Capabilities that a proxy may expose to a host.
- Information that must be exchanged between a host and a proxy.
- Proxy behaviour for 802.3 (Ethernet) and 802.11 (WiFi).
- Required and Option behaviour of a proxy while it is operating, including responding to packets, generating packets, ignoring packets, and waking the host.

This Standard does not:

- Specify communication mechanisms between hosts and proxies.
- Extend or modify the referenced specifications (and for any discrepancies those specifications are authoritative).
- Support security and communication protocols such as IPsec, MACSec, SSL, TLS, Mobile IP, etc

1.2.3 ETSI EE EEPS

ETSI EE EEPS is working on two work items:

- DEN-EE/00021 “Measurement method for energy consumption of Customer Premises Equipment (CPE)". Write a EN containing measurement methods not only for the Code of Conduct: The scope is "Define the methodology and the tests conditions to measure the power consumption of end-user broadband equipment (CPE) within the scope of EU regulation 1275/2008 in Off mode (as defined in

Commission Regulation 1275/2008) Standby (as defined in Commission Regulation 1275/2008) Networked Standby / Low Power states On mode"

- DTS-EE/00018: "Eco Environmental Product Standards Metrics and target value for Energy consumption of End-user Broadband equipment (CPE)". The target of the document is to define metrics and power limits for Customer premises networking equipment based on European code of Conduct, ATIS and HGI documents. Metrics and limits will be basically according to the specifications of the European Code of Conduct. Alternative metrics may be proposed in the next tiers, if necessary.

The definitions of standby in IEC 62542 and IEC62301 are different. IEC62301 used as the basis for the standby definition in Regulation (EC) 1275/2008. We propose to keep these definitions harmonized within the framework of the Eco-design Directive and its underlying regulations.

1.2.4 Advanced Configuration and Power Interface (ACPI)

The Advanced Configuration and Power Interface (ACPI) specification provides an open standard for unified operating system-centric device configuration and power management.[8] The standard has been developed mainly by Intel, Microsoft, and Toshiba. The current "Revision 4.0" was published on 16 June 2009. The ACPI specification defines the following seven states (so-called global states) for an ACPI-compliant computer-system:

- G0 (S0) Working
- G1 Sleeping (subdivides into the four states S1 through S4)
- The S1 sleeping state is a low wake latency sleeping state. In this state, no system context is lost (CPU or chip set) and hardware maintains all system context.
- The S2 sleeping state is a low wake latency sleeping state (CPU powered off). This state is similar to the S1 sleeping state except that the CPU and system cache context is lost (the OS is responsible for maintaining the caches and CPU context). Control starts from the processor's reset vector after the wake event.
- The S3 sleeping state is a low wake latency sleeping state where all system context is lost except system memory. CPU, cache, and chip set context are lost in this state. Hardware maintains memory context and restores some CPU and L2 configuration context. Control starts from the processor's reset vector after the wake event.

[8] http://www.acpi.info

- The S4 sleeping state is the lowest power, longest wake latency sleeping state supported by ACPI. In order to reduce power to a minimum, it is assumed that the hardware platform has powered off all devices. Platform context is maintained.
- The G2/S5 (soft off) is similar to the S4 state except that the OS does not save any context. The system is in the "soft" off state and requires a complete boot when it wakes. Software uses a different state value to distinguish between the S5 state and the S4 state to allow for initial boot operations within the BIOS to distinguish whether or not the boot is going to wake from a saved memory image.
- G3 Mechanical Off: The computer's power consumption approaches close to zero, to the point that the power cord can be removed and the system is safe for disassembly (typically, only the real-time clock is running off its own small battery).

The ACPI sleep states are a commonly used terminology which supports product designers in the facilitation of power management. The ACPI terminology however does not follow the "functional approach" for defining power modes and is therefore not fully compatible to the definition proposed by TREN Lot 26.

1.2.5 Desktop and mobile Architecture for System Hardware (DASH)

DASH Implementation Requirements V1.0.1: The Distributed Management Task Force (DMTF) DASH Initiative is a suite of specifications that takes full advantage of the DMTF's Web Services for Management (WS-Management) specification – delivering standards-based Web services management for desktop and mobile client systems. Through the DASH Initiative, the DMTF provides the next generation of standards for secure out-of-band and remote management of desktop and mobile systems.[9] DIGITALEUROPE suggested investigating DASH standard regarding power states and functionality relevant for energy saving (e.g. networked standby mode).

1.2.6 CENELEC – European Committee for Electrotechnical Standardization

CENELEC accepted Mandate M/439 for the preparation of standard(s) to support EC Regulation 1275/2008. This Regulation applies to electrical and electronic household and office equipment and consequently cut-across the various standards developed by IEC and, to address this, a Joint Working Group was set up comprising experts from the domestic appliance, ICT and consumer electronics sectors.

[9] http://www.dmft.org/standards/mgmt/dash

EN 62301-1, Electrical and electronic household and office equipment - Measurement of low power consumption: This describes the method for measuring the input power from electrical and electronic household and office equipment when operating in off-mode and standby modes and, as such, it supports EC Regulation 1275/2008. Because the set-up procedures for standby modes are product specific this standard does not address this topic, instead this matter has to be described in product-specific standards. This standard is based on IEC 62301 2nd Edition. It was positively voted in January 2011 and will then be the subject of Ratification by the CENELEC Technical Board prior to being published.

EN50523-1, Household appliances interworking - Part 1: Functional specification: This standard does not describe the measurement of power but instead it focuses on interworking of household appliances and describes the necessary control and monitoring. It defines a set of functions of household and similar electrical appliances which are connected together and to other devices by a network in the home. It does not handle power measurement procedures.

EN50523-2, Household appliances interworking – Part 2: Data structures: This standard does not describe the measurement of power but instead it specifies the message data structures used for communication between devices that comply with the Household Appliances Interworking standard. It is a companion document to EN 50523 1, Functional specification.

EN 60350, EN 60456, EN60463, EN 60705, EN 61121, prEN 62552: These are various product-specific standards covering the performance of a range of domestic appliances and all stem from IEC standards having the same numbers. These standards include set-up procedures for modes applicable to the specific appliance and the measurement of input power during those modes. Presently these standards do not address network modes.

EN 50229, EN 50350, EN50440, EN60456: These are various product-specific standards covering the performance of a range of domestic appliances have been developed entirely within CENELEC. These standards include set-up procedures for modes applicable to the specific appliance and the measurement of input power during those modes. Presently these standards do not address network modes.

1.2.7 ENERGY STAR Test Method for Small Network Equipment

Draft 4 of the ENERGY STAR Test Method for Small Network Equipment[10] was published in February 2011 and provide guidelines for testing the power consumption of modems,

10 www.energystar.gov/ia/partners/prod_development/new_specs/downloads/small_network_equip/SNE_Test_Method_Rev_4_Dataset.pdf

integrated access devices[11], switches/routers, wireless products, and wired/wireless products. The test method specifies requirements for variables such as input power, unit configuration, performance evaluation and reporting.

1.3 Existing legislation

The following section details already existing legislation, voluntary agreements and labelling initiatives related to networked standby. It is divided by region: European Community, Member States, and third countries outside of the EU-27.

1.3.1 Legislation and agreements at European Community level

Regulation 1275/2008/EC – standby and off-mode losses

According to 1275/2008/EC:

> "Standby mode(s)" means a condition where the equipment is connected to the mains power source, depends on energy input from the mains power source to work as intended and provides only the following functions, which may persist for an indefinite time:
> - Reactivation function, or reactivation function and only an indication of enabled reactivation function, and/or
> - Information or status display;

Directive 2001/95/EC – General Product Safety Directive (GPSD)

The GPSD applies to all products placed on the market, not only electronics. Under the Directive, manufacturers and distributors are responsible for ensuring the safety of these products. A safe product is defined as one that "poses no threat or only a reduced threat in accordance with the nature of its use and which is acceptable in view of maintaining a high level of protection for the health and safety of persons."[12]

Directive 2006/95/EC – Low Voltage Directive (LVD)

The LVD applies to all electrical equipment with a voltage of 50 – 1000 V_{AC} and 75 – 1500 V_{DC}. This voltage refers to that of the electrical input or output, rather than voltages within the equipment. The LVD sets out safety objectives meant to cover not only electrical, mechanical and chemical risks, but also health aspects relating to noise and vibrations.

[11] A product which provides one of the following capability combinations: (1) modem and switch, (2) router, or (3) switch and router capability.

[12] Summary of EU legislation, http://europa.eu/legislation_summaries/consumers/consumer_information/l21253_en.htm, 19/01/2009, accessed 04/11/2009.

Directive 2004/108/EC – Electromagnetic Compatibility (EMC) Directive

The EMC Directive applies to all electric devices and installations that emit electromagnetic waves. It limits emissions to an acceptable amount in order to ensure that such equipment does not disturb other radio, telecommunication, and other equipment. The Directive also governs the immunity of such equipment to interference and ensures that this equipment is not disturbed by external radio emissions.

1.3.2 Codes of Conduct

EU Code of Conduct on Energy Consumption of Broadband Equipment[13]

This Code of Conduct is a voluntary agreement targeting reduced energy consumption of broadband equipment without hampering the fast technological development and the service provided. As a voluntary agreement, it is applied through inviting providers, network operators, equipment and component manufacturers to sign. The Code of Conduct offers standards that equipment should follow in order to operate as efficiently as possible.

The Code of Conduct includes definitions of the energy states of broadband equipment:

- **Off-state:** The device is not providing any functionality, as defined by Commission Regulation EC 1275/2008.
- **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.[14]
- **On-state**: Specific to home gateways, the on-state of a home gateway is defined as all the components of the home gateway being in their on-state.
- **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. For example 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

[13] Adapted from Version 4, 10/02/2011, re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20Brodband%20Equipment/Code%20of%20Conduct%20Broadband%20Equipment%20V4%20final%2010.2.2011.pdf .

[14] In addition to the above broad definitions, the Code of Conduct gives precise definitions for on and idle states at the component level for home gateways, home network infrastructure devices, and simple broadband access devices.

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

The Code of Conduct covers equipment for broadband services both on the customer side (Table 1-1), as well as that on the network side (Table 1-2).

Table 1-1: Customer-side equipment

Home gateways:

- DSL CPEs (ADSL, ADSL2, ADSL2+, VDSL2)
- Cable CPEs (DOCSIS 2.0 and 3.0)
- Optical network termination (ONT) CPEs (PON and PtP)
- Ethernet routers
- Wireless CPEs (WiMAX, 3G and LTE)

Simple broadband access devices:

- DSL CPEs powered by USB
- Layer 2 ONTs

Home network infrastructure devices:

- Wi-Fi access points
- Small hubs and non-stackable Layer 2 switches
- Powerline adapters
- Alternative LAN technologies (HPNA, MoCA adapters)
- Optical LAN adapters

Other home network devices:

- ATA / VoIP gateways
- VoIP telephones

• Print servers

Table 1-2: Network-side equipment

• DSL Network equipment (example: ADSL, ADSL2, ADSL2+, VDSL2) • Combined DSL/Narrowband Network equipment (example: MSAN where POTS interface is combined with DSL Broadband interface, etc) • Optical Line Terminations (OLT) for PON- and PtP-networks • Wireless Broadband network equipment (example: Wi-Fi access points for Hotspot application, Wimax Radio Base Station) • Cable service provider equipment • Powerline service provider equipment

Version 4.0 of the CoC includes consumption limits for most network standards, including for on, idle and, in some cases, standby modes.

EU Code of Conduct on Digital TV Services[15]

This Code of Conduct aims to minimize the energy consumption of appliances linked to Digital TV Services, i.e. equipment for the reception, decoding, recording and interactive processing of digital broadcasting and related services through a voluntary agreement. The Code of Conduct sets out specific efficiency requirements for standard digital TV functions.

This Code of Conduct covers any dedicated equipment that receives, processes and stores data from digital broadcasting streams and related services, and provides output audio and video signals. All STB types can come as stand-alone tuners or as part of a larger device with other tuners and/or secondary functions such as, but not limited to:

- networking capability: the STB is able to interface with external devices through a network, e.g. via a network interface;
- recording/playback capability:
    - data storage on a removable standard library format
    - data storage on a non standard library format

The Code of Conduct defines three operational modes and power states:

- **Standby passive:** State in which the STB does not have the functionality of the “On” state but is only capable to switch to another state by responding to a user notification by a remote control of the unit, or an internal signal of the unit, e.g. “wake-up timer

[15] Adapted from Version 8, 15/07/2009, re.jrc.ec.europa.eu/energyefficiency/pdf/CoC_Digital_TV-version%208_2009.pdf

- **Network Standby:** State in which the STB does not have the functionality of the "On" state but is at least capable to switch to another state by responding to a notification by an external signal, e.g. from the service provider
- **On:** Operational state in which the STB is at least actively delivering the Base Functionality. Note that the energy requirements related to "On" mode might be variable over the time and dependent on the real functionality requested from the STB.

Of the three defined power modes, "network standby" falls within the scope of networked standby as defined by this preparatory study.

Different types of equipment are grouped by their "base functionality" which is related to the transmission technology used. The different base functionalities are as follows:

- **Cable STB**: A STB whose principal function is to receive television signals from a coaxial or hybrid fibre/coaxial distribution system and deliver them to a consumer display and/or external recording device.
- **Internet Protocol (IP) STB**: A STB whose principal function is to receive television/video signals encapsulated in IP packets and deliver them to a consumer display and/or external recording device.
- **Satellite STB**: A STB whose principal function is to receive television signals from satellites and deliver them to a consumer display and/or external recording device.
- **Terrestrial STB**: Any STB whose principal function is to receive television signals over the air (OTA) and deliver them to a consumer display and/or external recording device.
- **Thin-Client/Remote**: A STB that is designed to interface between a Multi-Room STB and a TV (or other output device) that has no ability to interface with the Service Provider directly and relies solely on a Multi-Room STB for content. Any STB that meets the definition of Cable, Satellite, IP or Terrestrial STB is not a Thin-Client/Remote STB.

The energy allowance for the devices is calculated on the basis of Total Energy Consumption (TEC) according to a base functionality duty cycle. The detailed requirements are listed in the Task Report 4.

The Code of Conduct requires that signatories provide consumers with detailed information about power consumption levels

General test conditions as detailed in IEC 62301 should be used. The CoC provides a specific test methods for different features included in the STB.

EU Ecolabel for personal computers (PCs) and portable computers[16]

The Ecolabel for PCs is a voluntary label for products that comply with strict environmental standards. It ensures that:

- The product consumes less energy during use and standby
- It contains fewer substances that are dangerous for health and the environment, e.g. metals
- The product can be taken back free of charge by the manufacturer after use
- It can be easily dismantled and recycled
- The product longevity can be increased through upgrades
- The product uses less polluting batteries (for portable computers)

The Ecolabel addresses networked standby in computers by defining a maximum power consumption of 4 W for PCs and 3 W for notebooks during the use of the Advanced Configuration and Power Interface (ACPI) S3 sleep state (suspend to RAM). The computer shall be able to wake up from this mode in response to a command from a modem, network connection, and keyboard or mouse action.

The criteria were passed on 11 April 2005 and are valid until 31 May 2010.

1.3.3 Legislation at Member State level

No relevant legislation that sets mandatory requirements or standards has been identified on the Member State level. However, a few Ecolabels exist.

Ecolabel Nordic Swan (Denmark, Finland, Iceland, Norway, Sweden)

The Nordic Swan has Ecolabel criteria for desktop and portable computers and displays[17]. The criteria address:

- Power consumption

[16] 11/04/2005, http://ec.europa.eu/environment/ecolabel/ecolabelled_products/categories/personal_computers_en.htm, http://ec.europa.eu/environment/ecolabel/ecolabelled_products/categories/portable_computers_en.htm

[17] Version 6.0, valid 08/06/2009 – 30/06/2012, http://www.svanen.nu/Default.aspx?tabName=CriteriaDetailEng&menuItemID=7056&pgr=48

- Design (upgradeability and disassembly)
- Plastics and their additives, e.g. flame retardants
- Heavy metals
- Recycling of discarded products
- Performance such as noise level, ergonomics, and electrical and magnetic fields

Power consumption related to networked standby is defined using the most current version of the US ENERGY STAR® specifications (discussed in section **Fehler! Verweisquelle konnte nicht gefunden werden.**).

Blue Angel (Germany)

The Blue Angel Ecolabel can be applied to desktop and portable computers and displays[18]. The environmental label addresses:

- Power consumption
- Longevity, upgradability, principles of recycling design as well as potential reuse and recycling of used products or product components
- Use of environmentally harmful substances
- Noise
- User information

Power consumption related to networked standby is defined in version 5.0 of the US ENERGY STAR® specifications (discussed in section **Fehler! Verweisquelle konnte nicht gefunden werden.**).

1.3.4 Energy Star Programme

The ENERGY STAR program originated as an energy-efficiency label within the United States. The label signifies a high performing product strictly in terms of energy efficiency. Recently, it has grown internationally to be applicable to office equipment in the EU as well. ENERGY STAR requirements are also often used as a model for the energy efficiency requirements of other programs, as seen with the Nordic Swan and Blue Angel ecolabels (section 1.3.3). For this reason, it is discussed separately from third country legislation (section **Fehler! Verweisquelle konnte nicht gefunden werden.**).

[18] Edition September 2009, http://www.blauer-engel.de/_downloads/vergabegrundlagen_en/e-UZ-78-2009.zip

While ENERGY STAR specifications exist for a wide variety of products, there are as yet no horizontal criteria for networked standby. However, ENERGY STAR requirements are defined for product groups that have networked standby functionality, as described below.

Small Networking Equipment[19]

EPA Energy Star Program is currently developing a new product specification for Small Network Equipment. For data collection EPA published in February 2011 a test method (revision 4) which provides some helpful concepts also with respect to testing of networked standby.

Computers[20]

The scope of the ENERGY STAR requirements for computers includes:

- Desktop computers
- Small-scale servers
- Game consoles
- Integrated desktop computers
- Thin clients
- Notebook computers
- Workstations

The product specifications define four operational modes, one of which is Sleep mode:

> A low power state that the computer is capable of entering automatically after a period of inactivity or by manual selection. A computer with sleep capability can quickly "wake" in response to network connections or user interface devices with a latency of ≤ 5 seconds from initiation of wake event to system becoming fully usable including rendering of display. For systems where ACPI standards are applicable, Sleep mode most commonly correlates to ACPI System Level S3 (suspend to RAM) state.

[19] ENERGY STAR SNE: http://www.energystar.gov/index.cfm?c=new_specs.small_network_equip

[20] ENERGY STAR V5.0, effective 1 July 2009, Revision starts December 2010. http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/computer/Version5.0_Computer_Spec.pdf.

The specifications also define "full network connectivity" as:

> The ability of the computer to maintain network presence while in sleep and intelligently wake when further processing is required (including occasional processing required to maintain network presence). Maintaining network presence may include obtaining and/or defending an assigned interface or network address, responding to requests from other nodes on the network, or maintaining existing network connections, all while in the sleep state. In this fashion, presence of the computer, its network services and applications, is maintained even though the computer is in sleep. From the vantage point of the network, a sleeping computer with full network connectivity is functionally equivalent to an idle computer with respect to common applications and usage models. Full network connectivity in sleep is not limited to a specific set of protocols but can cover applications installed after initial installation.

The ENERGY STAR specifications set both Typical Electricity Consumption (TEC) and Operational Mode (OM) requirements. An equation is used to calculate TEC[21].

For desktop computers, integrated computers, and notebook computers, an energy equation is used:

$$E_{TEC} = \left(\frac{8760}{1000}\right) * \left(P_{off} * T_{off} + P_{sleep} * T_{sleep} + P_{idle} * T_{idle}\right)$$

For workstations computers, a power equation is used:

$$P_{TEC} = P_{off} * T_{off} + P_{sleep} * T_{sleep} + P_{idle} * T_{idle}$$

The TEC mode weightings are summarised in Table 1-3.

Table 1-3: Summary of ENERGY STAR energy efficiency operational mode weightings

Mode	Conventional	Proxying[22]
Desktop and Integrated Computers		
T_{off}	55%	40%
T_{sleep}	5%	30%
T_{idle}	40%	30%
Notebook Computers		
T_{off}	60%	45%

[21] P_x are power values in watts, all T_x are Time values in % of year as defined by the mode weightings in Table 1-3

[22] Proxying refers to a computer that maintains Full Network Connectivity.

T_{sleep}	10%	30%
T_{idle}	30%	25%
Workstation Computers		
T_{off}	35%	Not applicable
T_{sleep}	10%	Not applicable
T_{idle}	55%	Not applicable

In addition, OM power requirements are defined to allow Wake on LAN (WOL). The specifications allow an additional 0.7 W for WOL functionality in small-scale servers (sleep mode) and thin clients (sleep or off mode).

For the complete description of the requirements, please see the ENERGY STAR website[20].

Displays[23]

The scope of the ENERGY STAR requirements includes electronic displays of 60 inches (152 cm), defined as:

> A commercially-available product with a display screen and associated electronics, often encased in a single housing, that as its primary function displays visual information from (i) a computer, workstation or server via one or more inputs, such as VGA, DVI, HDMI, or IEEE 1394, or (ii) a USB flash drive, a memory card, or wireless Internet connection. Common display technologies include liquid crystal display (LCD), light emitting diode (LED), cathode-ray tube (CRT), and plasma display panel (PDP).

Three power modes are defined, of which Sleep mode is specified as:

> The operational mode of a display that is (i) connected to a power source, (ii) has all mechanical (hard) power switches turned on, and (iii) has been placed into a low-power mode by receiving a signal from a connected device (e.g. computer, game console, or set-top box) or by cause of an internal function such as a sleep timer or occupancy sensor. Sleep Mode is considered a “soft” low-power condition, in that the display can be brought out of Sleep Mode by receiving a signal from a connected device or by cause of an internal function.

Currently, the maximum power consumption requirement for sleep mode is 2 W. Stricter requirements may come with the definition of Tier 2 type displays, which would be restricted to 1 W or less. However, the product scope for Tier 2 is not yet defined.

For the complete description of the requirements, please see the ENERGY STAR website[23].

[23] ENERGY STAR V5.0, effective 30 October 2009, http://www.energystar.gov/ia/partners/product_specs/program_reqs/displays_spec.pdf.

Imaging Equipment[24]

The scope of the ENERGY STAR requirements includes:

- Copiers
- Digital duplicators
- Facsimile (fax) machines
- Mailing machines
- Multifunction devices (MFD)
- Printers
- Scanners

Four power modes are defined, of which Sleep mode is specified as:

> The reduced power state that the product enters automatically after a period of inactivity. In addition to entering Sleep automatically, the product may also enter this mode 1) at a user set time-of-day, 2) immediately in response to user manual action, without actually turning off, or 3) through other, automatically-achieved ways that are related to user behaviour. All product features can be enabled in this mode and the product must be able to enter Active mode by responding to any potential input options designed into the product; however, there may be a delay. Potential inputs include external electrical stimulus (e.g. network stimulus, fax call, remote control) and direct physical intervention (e.g. activating a physical switch or button). The product must maintain network connectivity while in Sleep, waking up only as necessary.

Energy efficiency requirements are set in the form of TEC and OM requirements. As this product group is very diverse, the reader is urged to consult the ENERGY STAR[24] website for the full requirements.

1.3.5 Third country legislation and initiatives

Third country legislation

There are currently no legislative initiatives known for other countries that address networked standby as a horizontal issue.

[24] ENERGY STAR V1.1, effective 1 July 2009, http://www.energystar.gov/ia/partners/product_specs/program_reqs/Imaging%20Equipment%20Specifications.pdf.

Parallel efforts

Parallel efforts is work being conducted by other organisations that have similar goals to this preparatory study on networked standby. Thus, one objective of this study is to keep abreast of the work of others in order to develop coherent, internationally harmonised results.

IEA-4E Standby Power Annex[25]

IEA-4E is a program of the International Energy Agency (IEA) to promote efficient electrical end-use equipment (4E). A Standby Power Annex is currently under development with the goal of monitoring and reporting the extent of, and changes in, energy consumption by electrical appliances in low-power modes (standby power); and supporting the development of policies which seek to minimise excessive energy consumption by products in standby power modes.

Lawrence Berkeley National Laboratory (LBNL) – Energy Efficient Digital Networks[26]

LBNL is a national lab for the United States Department of Energy (DOE). It has a variety of ongoing projects related to energy efficiency in digital networks. Of particular interest for this study is the research on proxying. For full and current information, please consult the LBNL Energy Efficient Digital Networks website[26].

Ethernet Alliance

The Ethernet Alliance is a consortium of over 100 members that support the development of Ethernet and associated technologies. A few documents related to energy efficiency, such as proxying, can be found on their website[27].

Voluntary Industry Agreement for Complex Set Top Boxes

Following the recommendation of the Lot 18 EuP Preparatory Study on Complex Set Top Boxes, the industry stakeholders and the Commission are in the final stages of finalizing a voluntary agreement to limit the energy consumption of these products.

The agreement defines CSTB as “a standalone device equipped to allow conditional access that is capable of receiving, decoding and processing data from digital broadcasting streams and related services, and providing output audio and video signals. It may have either an internal or else a dedicated external power supply.”

For these devices, the VA defines the following operational modes:

[25] http://www.iea-4e.org/annexes/standby-power
[26] http://efficientnetworks.lbl.gov/
[27] http://www.ethernetalliance.org/library/white_papers#Energy%20Efficency

- **On**: Operational mode in which the CSTB is at least actively performing its base functionality. Note that the energy consumption targets related to “On” mode might be variable over the time and dependent on the real functionality requested from the CSTB.
- **Standby**: Operational mode in which the CSTB has less energy consumption, capability, and responsiveness than in the “On” mode. The energy consumption targets related to “Standby” mode might be variable and dependent on the real functionality requested from the CSTB.

  The CSTB may enter a Standby mode from the On mode after:

  - The CSTB receives a notification from the user to enter a standby mode via a power button press on a remote control or front panel of the unit, or through an electronic signal or data packet received via a digital interface on the CSTB; or
  - Where auto-power down is supported, the CSTB auto-powers down to a standby mode. The energy consumption after auto-power down to standby and after a user initiated power down to standby may, or may not be equivalent.

The VA specifies the maximum energy consumption for compliant devices (expressed in kWh/year) with two tiers, one effective from 2010 until 2013, the other from 2013 onwards. The limit values are calculated by taking a base value for the type of device and adding a functional allowance for any additional functionality present. The specific values for these different functionalities are given in Task 6, section 6.3.7.