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Lot 26: Networked Standby Losses

Draft Report Task 1

Definition

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1 Task 1: Definition

1.1 Mode definition and product scope

1.1.1 Introduction

Before discussing the definition and product scope we would like to position the issue of networked standby within the environmental policy of the European Union. The technical, environmental and economical analysis for possible eco-design requirements on networked standby power consumption (ENER Lot 26 preparatory study) is motivated by the results of the previous study on standby power consumption (TREN Lot 6 preparatory study) carried out in preparation of Commission Regulation (EC) No 1275 of 17 December ("standby regulation"), which concluded that "networked" standby operating conditions have a large potential for saving energy.¹ However, the first preparatory study could not look into the details of "networked" standby.

In September 2009 the first ENER Lot 26 stakeholder document was published. In this paper we proposed and explained a definition for Networked Standby Mode. This definition was generally accepted by stakeholders.² There have been two major starting points for this definition proposal.

The first input derived from the earlier TREN Lot 6 study on standby and off-mode losses (2006 to 2007) which resulted in the EuP standby regulation Its first stage requirements took effect January 2010 and defining standby and off modes based on a "functional approach". By allocating a certain set of functions a distinction was made between a "standby mode" that includes reactivation (e.g. by remote control or push button) and status information (e.g.

¹ According to the TREN Lot 6 study the electricity consumption related to networked standby was an estimated 26 Terawatt-hours for EU-25 in the year 2005. The study finally indicated that "networked" standby mode energy consumption will increase over the coming years and therefore suggested minimum power level requirements for three different types of networks.

² Written stakeholder comment have been received from DIGITALEUROPE (coordinated by Dr. Jos Beekwilder from Océ-Technologies B.V.); G. Bellingham and Jane Palmer from the UK Market Transformation Programme; Jan Viegand and Annette Gydesen, Viegand & Maagøe ApS, on behalf of the Danish Energy Agency; Jürgen Brieskorn from Siemens Enterprise Communications GmbH & Co KG; Hans-Paul Siderius of SenterNovem; Manabu Sakai, Global Environment Management Toshiba. Individual stakeholder meetings on the issue of definition and product scope with Shahid Sheik, Jim Kardach, Steve Harper from Intel, Pierre Sicsic, Environmental Steward, from Hewlett Packard France.

by display or LED) on the one hand and a “networked standby mode” that provides remote network reactivation and/or network integrity communication functionality on the other hand.³

The second input for the definition derives from the ongoing standardization process regarding the “glossary of terms” within the framework of the IEC 62542. This standard follows also the so called functional approach and provides an overall classification and terminology which is to a large extent consistent with the standby regulation and provided useful elements for the purpose of ENER Lot 26.

³ Whereas simple standby functions consume only about 1 Watt, it was considered that networked standby functions demand more energy in the range of about 1 to 10 Watts.

1.1.2 Definition “Networked Standby Mode”

The following mode definition concerns the condition of single equipment – not a network – in respect to power demand of the equipment for providing certain functions. This particular set of functions is based on the assessment of the performance parameters of Section 1.1.4.

Conditions that provide less functionality including standby mode and off-modes have been defined by EC 1275/2008. Conditions that provide more functionality are considered active modes similar to the definitions of the Draft IEC 62542 including operation mode, no-load mode (idle), maintenance mode, and download mode.

Networked standby mode means a condition during which the equipment is directly or indirectly connected to the mains power source and provides the following functions:

- Reactivation via network; this function means analyzing the incoming signals on one or more communication paths external to the equipment in order to initiate the reactivation of the equipment.
- Network integrity communication; this function applies additionally for more complex network types and means maintaining the external communication paths.
- Reactivation, information and status display; this means that standby functions according to EC 1275/2008 may also be provided during networked standby mode.

“External communication paths” means a network connection between at least two physically separated devices that could be digital or analogue and electrical or optical in nature. The equipment could be connected by one or more wired or wireless network interfaces. Unidirectional connections between EuPs are considered communication paths as well.

“Analyzing the incoming signals” means the physical signal detection and may include a sequence of decoding and verifying (e.g. security authorization) the incoming traffic.

“The transition to and from networked standby mode” means a new condition such as active modes. Networked standby mode ends when the mode change is initiated internally, i.e. when the decoding sequence has determined a legitimate reactivation event (for practical reasons the measurable rise in power consumption serves as the typical identifier of the mode change).

“Directly or indirectly connected to the mains power source” means that the equipment could either draw electricity from mains power outlet itself or could receive power via the network connection from the linked equipment that draws power from mains. An example is Power over Ethernet (PoE) and Power over USB.

“Maintaining the external communication path” means an optional function which is essential for more complex network protocols. This includes two-way communication in the sense of network protocol responses (handshake, acknowledge or similar) and the exchange of status information, i.e. sending / requesting device ID (address information) or timestamps to show that the device is still alive.

Regarding the connectivity status the following variations have to be differentiated for networked standby mode:

- Connected and enabled: The equipment provides one or more wired or wireless network communication interfaces. An external communication path has been established to another or multiple equipments. At least one network communication interface is enabled and scans incoming signals. This condition is considered networked standby mode.
- Equipment is disconnected and enabled: The equipment provides one or more wired or wireless network communication interfaces. The equipment is disconnected (e.g. cable is unplugged) but the network interface is enabled (fully operational). This condition is considered networked standby mode, even though in reality the equipment can not be reactivated through the network. However, all function blocks of the network interface(s) are set for networked standby mode, so the disconnected equipment draws similar power as if connected.
- Wireless "disconnected and enabled" is a more complex situation: In case of an interruption of a wireless signal during networked standby it could be possible that the equipment needs slightly more power (wireless signal power and processing power) due to an active adjustment of signal strength in order to re-establish the connectivity with the access point. This condition or function sequence should still be considered fully as networked standby mode.
- Equipment is connected and disabled: The equipment provides one or more wired or wireless network communication interfaces. The equipment is physically connected

(only in case of wired networks) but the network communication interface(s) has/have been disabled by the user for various reasons (e.g. saving energy). Because the equipment is not providing network integrity communication nor can it be reactivated via the network we consider this status not to fall under networked standby mode.

1.1.3 Proposed product scope

The networked standby mode applies horizontally to a broad spectrum of equipment. The proposed product scope corresponds initially to the scope of the existing EC 1275/2008 namely the four categories of “electrical and electronic household and office equipment” listed in Annex I of the regulation:

- Household equipment
- Information technology equipment
- Consumer equipment
- Toys, leisure and sports equipment

The product category “information technology equipment” has been further defined by EC 1275/2008, Article 2/7:

“Information technology equipment means any equipment which has a primary function of either entry, storage, display, retrieval, transmission, processing, switching, or control, of data and of telecommunication messages or a combination of these functions and may be equipped with one or more terminal ports typically operated for information transfer”.

The preamble of the EC 1275/2008 specifies furthermore the products scope of Information Technology Equipment by stating (8):

“The application of this Regulation should be limited to products corresponding to household and office equipment intended for use in the domestic environment, which, for information technology equipment, corresponds to class B equipment as set out in EN 55022:2006.”

The EN 55022:2006 specifies: Information Technology Equipment, radio disturbance characteristics, limits and methods of measurement. Class B equipment is defined by its electromagnetic characteristic and basically allows domestic and office use.

Class A in contrast 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, we exclude them from this study due to the following reasons. Class A products are considered 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 these products is much lower in comparison to consumer and office products. In terms of technical characteristics important differences are the typically much higher rated power consumption, a necessary support infrastructure, and in the case of network equipment a much higher number of network interfaces (ports). Nevertheless, power management including low power states for professional equipment is an important issue. However, this study cannot address such power management in general.

Products investigated in the study

The dynamic technical progress creates the challenge to cover a wide span of product groups, feature-rich product designs, and a whole range of network technologies including hardware and software aspects. The ENER Lot 26 preparatory study is focusing its assessment of networked standby implemented in equipment which is installed and used by customers in private households, offices, and the corresponding buildings or rooms. This includes home gateway and local area network equipment, personal computers, and respective peripheral devices such as printers, displays or storage devices, entertainment equipment including Set-Top-Boxes, TVs, and various media player/recording equipment. Furthermore we intend to investigate possible network integrity communication of other household equipment (white goods and small household appliances) as well as building automation equipment and sensor networks.

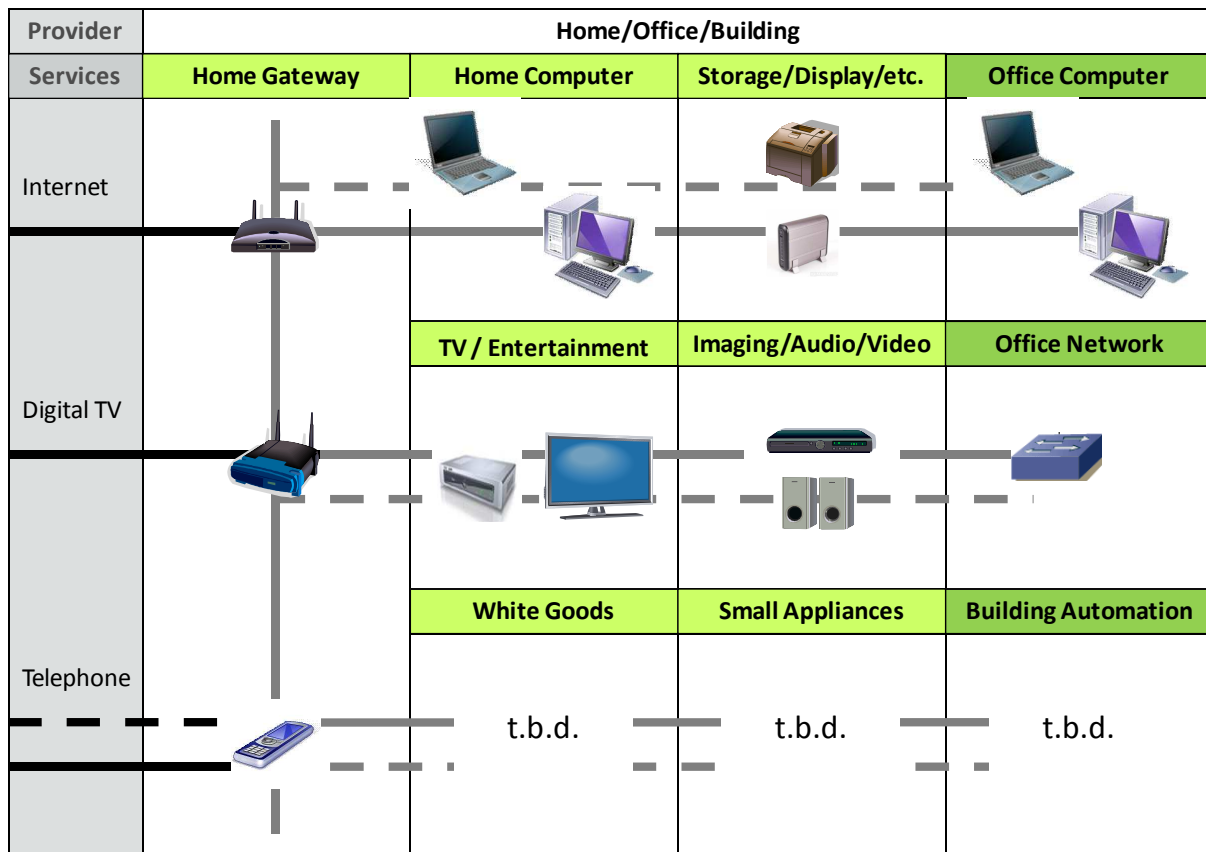


Figure 1: Proposed product scope

This proposed product scope (see **Erreur ! Source du renvoi introuvable.** above) shows that the implementation of networked standby mode will be investigated across a number of product groups that have been already studied within the EuP regulatory framework. It also covers products that have not been investigated in a vertical product lot yet.

Networked standby mode descriptive product criteria

In order to help identify products that fall or could fall into the scope of networked standby mode we provide additional to the definition the following list of criteria for inclusion in the scope:

- Products, which feature one or more network communication interfaces for two-way communication. A product without any cable, optical or wireless network interface can not exhibit networked standby.
- A product, which is exclusively sending (via all its communication paths), can not be in networked standby mode. The condition for receiving battery powered IR

remote control is covered under the EC 1275/2008 and is not a case of networked standby mode..

- Products with internal or external power supplies that can be connected to mains and which, when connected, do not only provide a charging function. In reverse, products, which are never connected to mains or only for charging, are not considered in scope. Products powered only indirectly via Power over Ethernet, USB or other network standards need to be part of the investigation.
- For the study scope one additional criterion is, whether a product significantly influences the networked standby mode usage of other products (i.e. hinders or facilitates that other products go or stay in networked standby mode).

This is not an exhaustive list of criteria from which a decision tree could already be drawn, but for some individual products or product groups an inclusion or exclusion from the scope can be derived more easily.

1.1.4 Performance parameters

The analysis of performance parameters relevant for networked standby mode is done not only with a view to the functionalities of networked standby mode, but also with a view to the environmental performance, in particular power management, because the first standby study already showed that networked standby mode has a great potential for saving energy. The result of the analysis is the basis for the definition of networked standby mode and its functions proposed in Section 1.1.

The general idea is that energy is saved substantially by facilitating a technical power management that shifts the networked product automatically from a higher power level (active modes) into a lower power level (networked standby mode) when the product is not tasked with primary or supportive function(s). In order to be environmentally and technically beneficial it is necessary that products, which shifted into networked standby mode remain in this state for a longer period of time (e.g. from a couple of minutes to a couple of hours). Very frequent booting of the main operation system (e.g. within a couple of seconds up to a couple of minutes) could lead to increased product failures or accelerated deterioration (aging) of certain components, or potentially before that to consumer dissatisfaction.

An energy and resource saving effect is achieved when a product maintains capabilities such as reactivation via network and network integrity communication with a comparably lower power level of a few Watts than in no-load or other active modes. Because the total number

of networked products and products that are controlled and reactivated via networks is increasing, a few Watts power reduction could have a considerable impact. To give a simple example: if we assume that every second household in the EU, roughly 100 million, has a product that is on a daily basis for 12 hours (e.g. at night) "available" but not in active use. Assuming 15W for network capability in no-load/idle or 5W for a networked standby mode then the resulting annual electricity consumption is 6.57TWh per year for the first case compared to 2.19 TWh/a for the second case. In this example the substantial effect in shifting from no-load/idle into networked standby mode is a reduction of energy consumption by 4.38 TWh per year. This order of magnitude can be considered as a starting point.

In reality there are many more networked products already, with a vast increase in numbers predicted and a fundamental shift of the user or system expectation that the devices are always available via some network. From the environmental perspective a longer duration in (passive) standby or off-mode is even more desirable, so offering a more efficient networked standby mode can in some cases be argued to increase electricity consumption. But if no convenient and transparent networked standby mode is offered, then as shown in the example calculation the devices will remain in no-load/idle to satisfy the (rather subjective) user needs.

In real life the environmental performance is influenced by technical configurations and operational conditions under which a product is utilized.

Technical parameters (variables) that influence the level of power consumption in networked standby mode:

- Number and type of network communication interfaces
- Distance and medium (wired/wireless, electrical/optical) of external communication path (network)
- Bandwidth and/or transfer rate (Note: this parameter can be actively influenced by technical means in order to reduce energy consumption, so not necessarily the maximum transfer rate)
- Uni/bidirectional communication path as well as single/multipoint communication
- Security overhead (Note: secure communication and protection against external assaults is an increasing user requirement and technically supported by network

standards, which generalized leads to more bits for transmission and more processing power)

- Reactivation time requirements (Note: In this context the term reactivation time means the duration from receiving a reactivation command until active operation is possible)
- Power supply unit (internal/external, functionality and conversion efficiency in low power range)
- Indirect powering (e.g. Power over Ethernet or USB) of external devices, which have no mains power connection

These technical as well as user influenced conditions will be analysed in more detail within the context of Task 4 (technical assessment).

The **functional unit** is once more very hard to describe for such a horizontal approach. In a generalized way it is to maintain the availability of reactivation over network for one EuP for a prolonged duration (technically then calculated on a per hour basis).

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.

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. The standard is in ACDV — Draft approved for Committee Draft with Vote – with CCDV on 28 February 2010. The current document 111/148/CD had been subject to modifications and amendments. In order to simplify and better distinguish standby modes a new terminology was introduced. The current draft is distinguishing 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 focuses 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. The expected publication date is December 2010.

IEC 62301 Ed. 2.0: Household electrical appliances – measurement of standby power. There are two main stakeholder groups active in this standardization process – white goods and ICT. This standard’s second edition has been in 59/540 CDV -- Committee Draft for Voting – until 29 January 2010. It seems that the current draft was not fully accepted and is again subject to modifications and amendment. The standard provides in general mode definitions comparable to IEC 62542 and EC 1275/2008. 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

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 May 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 off-mode and standby definition as well as other terminology and documentation of environmental impacts and information disclosure.

1.2.2 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.⁴ The standard has been developed mainly by Intel, Microsoft, and Toshiba. The current

⁴ <http://www.acpi.info>

"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.
- 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.

1.2.3 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.⁵ DIGITALEUROPE suggested investigating DASH standard regarding power states and functionality relevant for energy saving (e.g. networked standby mode).

1.2.4 ECMA International

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-341 is aimed at the designer and provides pragmatic advice on how to reduce the environmental footprint of a product by taking the right decisions at the design stage. ECMA-341 has been adopted as IEC 62075. Although this standard's title covers all personal computing products, the scope of this edition is desktop and notebook computers. The 1st edition of ECMA-383 required the support of a benchmark in order to measure the performance of the product. In order to improve the usability of this standard the 2nd edition utilises a system of categorisation to enable like for like comparisons of the energy consumption of different products rather than a benchmark.

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. P_{sleep} 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

⁵ <http://www.dmtf.org/standards/mgmt/dash>

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. P_{sleepWoL} 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. P_{on} 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). P_{sidle} 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. P_{idle} represents the average power measured when in the long idle mode.

ECMA-383 mode definition is not comparable to the functional approach of TREN Lot 26. The definitions contain time limits that we regard as a condition. Nevertheless the definitions provide further understanding of distinction of power states.

Ecma TC32-TG21: ProxZzy™ for sleeping hosts: A final draft of this standard was published 17 November 2009.⁶ 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

⁶ <http://www.ecma-international.org/memento/TC32-TG21.htm>

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, 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/Network 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

We will further monitor the development of this standard.

1.2.5 Mapping of common mode definitions

The following table provides the schematic comparison (mapping) of common terminology and definitions of modes.⁷ The intention of this mapping is to help stakeholders to allocate and compare mode definitions. At the top we have placed our own definition for networked standby mode and then listed below other commonly used mode definitions deriving from IEC standards, ECMA, and ACPI. Please note that we distinguished what we like to call "umbrella modes" and "function specific sub-modes" and introduced a colour code in order have an easier allocation of modes.

⁷ Status February 2010

Table 1: Mapping of common terminology according to standards

EuP ENER Lot 26 EC 1275/2008	Modes	Discon.	Off Modes (EC 1275/2008)		Standby Mode (EC 1275/2008)	Networked Standby Mode	Active Mode	
	Function		off without losses	off with losses	reactivation	network integrity	maintenance	no-load/idle
	Function		no function	protective function	info status display	reactivation via net	download	operation
IEC 62542 (CDV)	Modes	Discon.	Off Modes		Standby Modes		Active Modes	
	Sub-modes		off without losses mode	off with losses mode	reactivation mode status info mode	network integrity mode	maintenance mode download mode	no-load mode operation mode
IEC 62087 Ed. 2	Modes	Discon.	Off Mode		Standby Modes		On Modes	
	Sub-modes		off		standby passive remote control internal signal	standby active low standby active high (download)	on record	on average on play
IEC 62301 Ed. 2 (CDV)	Modes	Discon.	Off Mode		Standby Modes	Network Modes	Active Modes	
	Sub-modes				reactivation status/display	network integrity network reactivation	in-use/normal operation	
ECMA 383 / Ed. 2	Modes		Off Mode		Sleep Modes		On Modes	
	Sub-modes		Off Mode (P_{off}) does not exist		Sleep Mode (P_{sleep}) latency < 5sec without WoL	WoL Sleep Mode	idle long idle short	Active (Work) Mode
ACPI Revision 4.0	State	G3 mech off	Off Mode		Sleep Modes		On Modes	
	Global		does not exist	G2 (soft-off)	G1 (sleeping)		G1/G0	G0 (working)
	Sleep		does not exist	S5 (complete reboot)	S4 (suspend to disk)	S3 (suspend to RAM)	S2/S1/S0	S0
	WoL sleep		does not exist	S5 (complete reboot)	S4 (suspend to disk)	S3 (suspend to RAM)	S2/S1/S0	S0

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.”⁸

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.

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

⁸ Summary of EU legislation, http://europa.eu/legislation_summaries/consumers/consumer_information/l21253_en.htm, 19/01/2009, accessed 04/11/2009.

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.

EU Code of Conduct on Energy Consumption of Broadband Equipment⁹

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 begins with a definition of the energy states of broadband equipment:

- **Full power state:** normal operating mode of the equipment or device where all design functionality is enabled and available for useful purposes
- **Low power state(s):** mode(s) of operation where the equipment or device has a level of operational functionality which is over and above the standby state, but not at a level associated with full power state.
- **Standby state:** mode whereby the equipment or device is switched on and operating at the lowest level of power consumption, while still drawing energy from the mains. One or more internal functions or external interfaces (e.g. wired or wireless) may be effectively switched off. This mode includes functionality such as wake-up signals.

Of the three defined states, “standby state” would fall into the scope of networked standby as defined by this preparatory study.

The Code of Conduct covers equipment for broadband services both on the customer side (Table 1-2), as well as that on the network side (Table 1-3).

Table 1-2: 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
- Wimax CPEs

⁹ Adapted from Version 3, 18/11/2008,
http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_broadband%20communication.htm

Simple broadband access devices:

- DSL CPEs powered by USB

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 1-3: 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

However, standby mode is specifically addressed only for DSL broadband ports in Digital Subscriber Line Access Multiplexers (DSLAMs), as seen in Table 1-4.

Table 1-4: Broadband ports - DSL-standby-state¹⁰

Equipment	Tier 2009-2010 (01/01/2009-31/12/2009) (W)	Tier 2011 (01/01/2011-31/12/2011) (W)
ADSL 2+ (including ADSL and ADSL2)	0.4	0.4

¹⁰ A short start up time of < 1 second has to be realised to guarantee triple-play functions like VoIP and Video over IP (while the current value for this start up time is around 3 seconds). This requirement comes into effect when relevant standards will be available.

VDSL2	0.8	0.6
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These values are applicable for DSLAMs with more than 100 ports. For equipment of less than 100 ports, 0.3 W per line may be added to the corresponding value for the whole DSLAM, with a minimum value of 10 W. Start-up/Wake-up times from DSL-standby-state to DSL Full Power-state should be less than 1 second to guarantee a good quality of service (e.g. voice calls).

EU Code of Conduct on Digital TV Services¹¹

This Code of Conduct aims to minimise 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 equipment for the reception, decoding, recording and interactive processing of digital broadcasting and related services. Examples of such equipment are complex integrated receiver decoders and other set-top boxes (STB)¹², digital TVs with built-in integrated receiver decoder, internet TV and simple converters to adapt analogue TVs and equipment with recording capabilities, known as personal video recording equipment (PVR). Furthermore, the Code of Conduct also covers analogue PVR equipment for household use that is capable of receiving analogue broadcasts and related services, and of recording on non-volatile memory and of playing the recorded signals.

The Code of Conduct defines four power modes:

- **Off:** The equipment is connected to a power source, fulfils no function and cannot be switched into any other mode with the remote control unit, an external or internal signal.
- **Standby passive:** The appliance is connected to a power source, does not fulfil a main function but can be switched into another mode with the remote control unit or an internal signal.
- **Standby active:** The appliance is connected to a power source, does not fulfil a main function but can be switched into another mode with the remote control unit or an internal signal. It can additionally be switched into another mode with an external signal or it is receiving a minimal level of data from an external source.

¹¹ Adapted from Version 7, 15/01/2008,

http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_digital%20tv%20services.htm

¹² Also covered by TREN Lot 18: Complex set-top boxes, TREN Lot 0: Simple set-top boxes, 107/2009/EC on Ecodesign requirements for simple set-top boxes.

- **On:** The appliance is connected to a power source and fulfils a main function, including the provision of signals to supported devices.

Of the four defined power modes, “standby active” falls within the scope of networked standby as defined by this preparatory study.

For certain devices, power requirements are defined for the standby active mode, as seen in Table 1-5.

Table 1-5: Standby active mode power requirements for Digital TV Service equipment

Analogue PVR and PVR with standard library removable media in the basic configuration	<i>From 01/01/2006 to 31/12/2009</i>			
	6 W			
Complex STB in the basic configuration	<i>Cable</i>	<i>Terrestrial</i>	<i>Satellite</i>	<i>DSL</i>
	<i>From 01/01/2009 to 31/12/2009</i>			
	6 W	5 W	7 W	5W
Digital TVs with integrated receiver and decoder (IRD) in the basic configuration	<i>TV with built-in Cable</i>	<i>TV with built-in Terrestrial</i>	<i>TV with built-in Satellite</i>	
	<i>From 01/01/2009 to 31/12/2009</i>			
	7 W	6 W	8 W	

For additional functionality beyond the basic configuration, the following features are allocated extra maximum power consumption as defined in Table 1-6. However, the maximum power consumption in standby active mode should not exceed:

- 13 W¹³ for the complex STB (except for MPEG4 and multi-decode platforms) and analogue PVRs.
- 14 W for TVs with integrated digital receiver and decoder.

¹³ For cable with DOCSIS modem (except for MPEG4 and multi-decode platforms – see footnote 16) the maximum power consumption in standby active mode is 15 W (until 31/12/2009)

Table 1-6: Additional power consumption allowed for features in standby active mode

Feature	Indicative additional maximum power consumption (at the AC mains) for additional features in standby active mode
Internal hard disk drive	2.2 W
IEEE 1394 interface	0.8 W
Ethernet interface 100 Mbit	0.4 W
Each home network interface	2.5 W
Each serial USB interface	0.3 W
Home automation interface	0.4 W
HDMI interface	1.0 W
ADSL modem	2.0 W
Docsis 1.1 or 2.0 modem	4.5 W
Out of Band Transport	4.0 W
Additional LNB feed	1.3 W (with an additional 80 mA for the LNB ¹⁴ current)
Additional tuner/demodulator	2.0 W
Powered remote IR receiver (loaded at 15 mA)	0.25 W

There are additional allowances for MPEG4 and multi-decode platforms¹⁵ in standby active mode, listed in Table 1-7. The total maximum power consumption in standby active mode should not exceed 17 W¹⁶ for MPEG4 and multi-decode platforms.

Table 1-7: Additional power consumption allowed for MPEG4 and multi-decode platforms in standby active mode

Feature	Indicative additional maximum power consumption (at the AC mains) for additional high definition features in standby active mode
MPEG4 standard or high definition decoder	2.5 W
Each additional decoder	1.5 W
Each DVBS2 front end (or demodulator)	2 W

¹⁴ Low Noise Block

¹⁵ Products capable of decoding more than one signal stream

¹⁶ For cable STB MPEG4 and multi-decode platforms with DOCSIS modem the maximum power consumption in standby active mode is 19 W

The Code of Conduct requires that information on all four defined power modes (including standby active) be made available to the customers.

The power consumption shall be measured and declared according to IEC 62087, with LNB current set to 80 mA during the test, and the current for active antennas set at 35 mA as well.

EU Code of Conduct for Data Centres¹⁷

The goal of this Code of Conduct is to minimize the energy use of data centres. The target stakeholders are data centre owners and operators. The focus currently covers two main areas:

- **IT load:** related to the consumption efficiency of the IT equipment in the data centre and can be described as the IT work capacity available for a given IT power consumption. It is also important to consider the utilisation of that capacity as part of efficiency in the data centre.
- **Facilities load:** related to the mechanical and electrical systems that support the IT electrical load such as cooling systems (chiller plant, fans, pumps), air conditioning units, uninterruptible power supplies (UPS), power distribution units (PDUs), etc.

This Code of Conduct has both an equipment and system-level scope. The equipment level includes typical equipment used within data centres required to provide data, internet and communication services, such as:

- IT equipment (e.g. rack optimised and non-rack optimised enterprise servers)
- Blade servers
- Storage and networking equipment (e.g. UPS and PDUs)
- Miscellaneous equipment (e.g. lighting)

At the system level, the Code of Conduct proposes actions which optimise equipment interaction and the system design (e.g. improved cooling design, correct sizing of cooling, correct air management and temperature settings, correct selection of power distribution) to minimise overall energy consumption.

Both existing and new data centres are covered by the Code of Conduct.

The Code of Conduct does not directly address the issue of networked standby. However, it is important to note that networked standby could be an important contributor to data centre efficiency. As of Version 1.0, the Code of Conduct is still in the preliminary stages of being developed, and may be extended to discuss networked standby issues in the future.

¹⁷ Adapted from Version 1, 30/10/2009,
http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_data_centers.htm.

EU Ecolabel for personal computers (PCs) and portable computers¹⁸

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.

1.3.2 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 displays¹⁹. The criteria address:

- Power consumption
- Design (upgradeability and disassembly)
- Plastics and their additives, e.g. flame retardants

¹⁸ 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

¹⁹ Version 6.0, valid 08/06/2009 – 30/06/2012,

<http://www.svanen.nu/Default.aspx?tabName=CriteriaDetailEng&menuitemID=7056&pgr=48>

- 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 1.3.3).

Blue Angel (Germany)

The Blue Angel Ecolabel can be applied to desktop and portable computers and displays²⁰. 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 1.3.3).

1.3.3 Third country legislation and voluntary agreements

ENERGY STAR®

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 1.3.2). For this reason, it is discussed separately from third country legislation (section 1.3.3).

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.

²⁰ Edition September 2009, http://www.blauer-engel.de/downloads/vergabegrundlagen_en/e-UZ-78-2009.zip

Computers²¹

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.

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

²¹ ENERGY STAR V5.0, effective 1 July 2009,
http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/computer/Version5.0_Computer_Spec.pdf.

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 TEC²².

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

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

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 1-8.

Table 1-8: Summary of ENERGY STAR energy efficiency operational mode weightings

Mode	Conventional	Proxying ²³
Desktop and Integrated Computers		
T _{off}	55%	40%
T _{sleep}	5%	30%
T _{idle}	40%	30%
Notebook Computers		
T _{off}	60%	45%
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 website²¹.

²² P_x are power values in watts, all T_x are Time values in % of year as defined by the mode weightings in Table 1-8

²³ Proxying refers to a computer that maintains Full Network Connectivity.

Displays²⁴

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 website²⁴.

Imaging Equipment²⁵

The scope of the ENERGY STAR requirements includes:

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

²⁴ ENERGY STAR V5.0, effective 30 October 2009,
http://www.energystar.gov/ia/partners/product_specs/program_reqs/displays_spec.pdf.

²⁵ ENERGY STAR V1.1, effective 1 July 2009,
http://www.energystar.gov/ia/partners/product_specs/program_reqs/Imaging%20Equipment%20Specifications.pdf.

- 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 STAR²⁵ website for the full requirements.

Third country legislation

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

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 Annex²⁶

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 Networks²⁷

²⁶ <http://www.iea-4e.org/annexes/standby-power>

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 website²⁷.

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 website²⁸.

²⁷ <http://efficientnetworks.lbl.gov/>

²⁸ http://www.ethernetalliance.org/library/white_papers#Energy%20Efficiency

1.3.4 Summary

Table 1-9: Summary of existing legislation

	Scope	Life stages concerned	Aspects considered	Region	Type
1275/2008/EC – Standby and off-mode losses	Electrical and electronic equipment	Use	Energy consumption	EU	Mandatory
2001/95/EC – General Product Safety	All products placed on the market	Use	Safety	EU	Mandatory
2006/95/EC – Low Voltage	Electrical equipment	Use	Safety	EU	Mandatory
2004/108/EC – Electromagnetic compatibility	Electric devices and installations	Use	Interoperability	EU	Mandatory
Code of Conduct on Energy Consumption of Broadband Equipment	Customer- and network-side broadband equipment	Use	Energy consumption	EU	Voluntary standard
Code of Conduct on Digital TV Services	Equipment required for digital TV services	Use	Energy consumption	EU	Voluntary standards
Code of Conduct for Data Centres	IT equipment and associated facilities equipment	Use	Energy consumption	EU	Voluntary standards
EU Ecolabel	PCs and portable computers	All	Energy consumption, hazardous substances, end-of-life, longevity,	EU	Voluntary ecolabel

			batteries		
Nordic Swan	Computers and displays	All	Energy consumption, design, hazardous substances, recycling, noise	Denmark, Finland, Iceland, Norway, Sweden	Voluntary ecolabel
Blue Angel	Computers and displays	All	Energy consumption, longevity, hazardous substances, noise, user information	Germany	Voluntary ecolabel
ENERGY STAR	Computers, displays, and imaging equipment	Use	Energy consumption	USA, EU, basis for other standards	Voluntary ecolabel
IEA-4E	Horizontal standby	Use	Energy consumption	International	Parallel effort
Ecma TC32-TG21	Network proxying	Use	Energy consumption	International	Parallel effort/Standards development
LBNL – Energy Efficient Digital Networks	Horizontal network efficiency	Use	Energy consumption	International	Parallel effort
Ethernet Alliance	Horizontal network efficiency	Use	Energy consumption	International	Parallel effort
IEC standards	Electrotechnical standards	Use	Energy consumption, environmental impacts	International	Standards development