List of technical standards for equipment connected to energy-using networks

Final Report

Australian Governement, Departement of Climate Change and Energy Efficiency

20 June 2011

bio Intelligence Service

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Project description

CLIENT:	
REPORT TITLE:	Final Report
REPORT SUB-TITLE:	APP Project A – List of technical standards
PROJECT NAME:	List of technical standards for equipment connected to energy-using networks
DATE:	20 June 2011
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ACKNOLEDGEMENTS:	The project team would like to thank the review committee and, in particular, Lloyd Harrington and Bruce Nordman, for their detailed and helpful input.

Please cite this publication as:

BIO Intelligence Service (2011), List of technical standards for equipment connected to energy-using networks, Final Report prepared for Australian Governement, Departement of Climate Change and Energy Efficiency.

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Chapter 1: Introduction

This report reviews existing technical standards which are relevant to measuring and establishing performance requirements for equipment connected to energy-using networks. The term 'technical standard' is understood in a broad sense and is taken to include the following categories:

- 'pure' **technical** standards (e.g. IEEE 802.3 Ethernet);
- power **measurement** specifications or test methods (e.g. IEC 62301 Household electrical appliances – measurement of standby power); and
- mandatory or voluntary environmental **performance** standards (e.g. EC 1275/2008 EU Regulation on Standby and off-mode losses).

Standards falling into one of these above categories were reviewed and classified according to several criteria, namely if they include power management or energy-saving features, which category of the above types of standards they fall into, and their geographic scope (global, regional, or APP Member State[1]). The classified standards were further analysed to determine if they are widely implemented, and what any future developments could bring (e.g. incorporating energy management features.)

In total, 56 such standards have been identified and reviewed. Table 1 and Table 2 summarise the number of standards according to each of the classification criteria.

Table 1: Number of standards with and without energy-management features, and by type

	Technical	Performance	Measurement	Total
Without energy-management	7	8	5	**20**
With energy-management	22	12	2	**36**
Total	**29**	**20**	**7**	**56**

Table 2: Number of standards by geographic scope

Global	41
APP Member State	8
Europe[2]	7

[1] These include Australia, Canada, China, India, Japan, Republic of Korea, and the United States.

[2] While a search was conducted for any regional standards, only European standards were identified as being relevant.

A full list of standards reviewed and their status for each of the criterions is given in Section 3.

It is important to note that **this review is not meant to be exhaustive**, but to cover the most relevant standards which could eventually form the basis of a future harmonised, international standard.

Chapter 2: Key findings

Following the review of the standards, several areas of focus have emerged as warranting the attention of international policy makers seeking to use standards as a means to improve the energy performance of networks and network-connected devices.

2.1 Protocols warranting generalisation and policy support

In seeking to leverage technical standards as a way to encourage widespread implementation of power management and other energy-saving features, policy makers should focus on standards, which are:

- **open** (i.e. non-proprietary),
- **extensible** (i.e. designed to accommodate future developments), and
- **foundational** (i.e. provide the basis for further development of specific implementations).

This combination of characteristics will help to ensure that the efforts of the policy makers will result in outcomes which are accessible, "future-proof" (or, at least "future-resistant") and broadly impactful.

Of the standards reviewed, those which are developed by the Institute of Electrical and Electronics Engineers (IEEE) have generally been found to contain these characteristics. Additionally, the work of the Internet Engineering Task Force (IETF)[3] would appear to share these characteristics as well.

Given the foundational nature of many of these standards, their potential applications are quite diverse. Additionally, the energy-saving properties of each can vary; some directly reduce the energy used by the network components themselves, whereas others allow the network to support the implementation of technologies which will enable energy savings.

Finally, each standard has different aspects which can contribute to energy savings. This is highlighted in the standard-specific factsheets (Annex) and also explains why certain standards may appear in several of the following sections.

The following paragraphs highlight the standards which are taken to be of greatest interest to policy makers. Additional details on each can be found in the linked factsheets in the Annex.

[3] datatracker.ietf.org/wg/eman/charter/

IEEE 802.3 (specifically, IEEE 802.3az Energy Efficient Ethernet)

The collection of standards formulated by the IEEE 802.3 Working Group defines the Ethernet family of technologies, the *de facto* global standard for wired Local Area Networks (LANs). Given the standard's ubiquity, the introduction of the 802.3az Energy Efficient Ethernet enhancements represents a significant opportunity to reduce the direct energy consumption of many domestic, commercial and industrial networks. Additionally, this standard is significant in that it represents one of the few occasions where energy efficiency is taken into consideration in such a standard.[4]

As the 802.3az enhancements are relatively recent, it is yet to be seen if they will naturally gain significant market share. While energy-conscious users — such as data centre operators — would presumably be interested given the significance of energy costs as a fraction of their overall operating costs, other users — especially domestic and most commercial users — may not be sufficiently motivated by cost reductions alone to ensure the widespread uptake of the product. Therefore, regulations requiring the use of the technology may be appropriate to ensure that the standard's promise of widespread energy savings becomes a reality.

IEEE 1901: High-speed power line communications

While the Ethernet standard remains the dominant communications medium for wired IT devices, there is a growing interest in bringing network functionality to non-networked products (e.g. smart grid applications). The ability to provide network connectivity via the AC power lines which power the device is the goal of this standard. As such, the standard has great potential to enable energy savings. That said, with the exception of the IEEE 1901-compliant HomePlug Green PHY amendment (low-bandwidth uses for smart grid applications), the standard does not include explicit power management functionality. As such, in other applications — distributing multimedia content throughout a house, for example — the issue of energy consumption is not addressed.

As such, the standard has promising aspects in terms of being an enabling technology, as well as providing an interesting means for achieving power management in the Green PHY implementation[5], the standard could benefit from energy saving features throughout its different implementations.

IETF Energy Management Working Group

This Working Group is aiming to develop standards, which will integrate "energy awareness" into devices connected to the Internet. The work of the Group is ongoing, but deserves attention as the output of the IETF constitutes much of the functional foundation of the modern Internet. As such, it is likely that the standards the Energy Management Working Group will produce will have widespread impact.

[4] That said, the Ethernet standard is one of the oldest networking standards with its first instance being ratified in 1983, while the 802.3az enhancements were ratified in 2010, fully 27 years later.

[5] The specification includes an advanced power save mode which coordinates awake windows and sleep windows across a network to allow devices to sleep without risk of being reactivated by non-critical network traffic.

2.2 Improving standars for WAN/LAN network equipment

In addition to the promising efforts outlined in Section **Erreur ! Source du renvoi introuvable.**, there are also numerous standards which are cause for concern due to their lack of energy saving features. One specific area for concern is the lack of widespread and effective energy-saving features in the industrial, commercial, and domestic equipment which constitutes the essential infrastructure of Wide and Local Area Networks (WAN and LAN).

IEEE 802.11: Wireless LAN (Wi-Fi)

While the mobile products which connect to Wireless LAN (Wi-FI) networks generally possess quite advanced energy-saving features due to their size and performance constraints, the base stations and access points which they connect to often do not. This results in wasted energy as the device, for example, continually broadcasts its identifying information, namely the SSID and/or MAC address.

By working with manufacturers and consumers to address this issue (either through regulation, voluntary measures, information campaigns, or other means), policy makers could begin to tackle this issue.

IEEE 802.16: Wireless Broadband MAN (WiMAX)

Similar to the 802.11 standard, the 802.16 standard often sees highly efficient mobile devices connected to less efficient base stations which are primarily concerned with providing the highest quality of service possible. While the 802.16 standard includes a mandatory sleep state for its base stations, ensuring that such states are activated quickly and that the base station is able to remain in that state as long as possible will be essential to controlling energy consumption of this increasingly popular standard.

ITU J.222: DOCSIS

The DOCSIS standard, which provides high-bandwidth data streaming to cable TV devices, is notable for its high power consumption at the component level and the lack of any active energy-saving features. As it is a widely implemented standard in consumer IT and A/V equipment, seeing that these issues are addressed in a way which is not unduly disruptive to manufacturers could have significant benefits. Additionally, DOCSIS is an educational example of the challenge of "retrofitting" existing standards to include power management features when none were included in the initial design phase.

2.3 Improving standards for consumer electronics

The growing market of consumer electronics is notable for its lack of harmonisation among existing standards, the proliferation of proprietary standards, and the lack of power-saving features across all standards.

The High-Definition Multimedia Interface (HDMI) standard embodies many of these limitations. A popular standard due to its ability to transmit high-definition audio and video signals over a single cable, it is a proprietary standard, which currently lacks any energy-saving features. That said, as a standard cable which links diverse consumer audio-video components (e.g. media players, game consoles, televisions, etc.) it could be a convenient means to manage energy use across the entire entertainment system.

In order to introduce energy-saving features into the standard, however, would necessarily involve Video Electronics Standards Association (VESA)[6], the HDMI Foundation, as well as representative manufactures of the devices and cables. While it is unlikely that this group would come together voluntarily in order to address power management (as it is not a feature generally requested by consumers), the possibility of regulation requiring such features could be enough to motivate a voluntary initiative.

2.4 Harmonising smart grids standards

Given the potential benefits of smart grid technologies regarding electricity peak load management and load shifting, they rightly receive considerable attention from policy makers. The implementation of smart grid technologies could result in energy savings as well thanks to a better energy management. Given the very diverse types of appliances which need to be connected to make the smart grid effective, standardisation is particularly important. Competition in this field is fierce, with no set of standards emerging as a clear winner.

That said, the HomePlug Alliance claims[7] that their collection of standards is about to make this breakthrough. The Alliance serves as an umbrella organisation for device manufacturers developing technologies based on IEEE standards. This includes HomePlug Green PHY (based on IEEE 1901), ZigBee (based on IEEE 802.15) and Wi-FI (802.11).

The primary competitor of the HomePlug Alliance is the HomeGrid Forum, which is focusing on standards developed by the International Telecommunications Union (ITU) such as G.hn. While it is often difficult to anticipate which standard or set of standards will finally attain market dominance, the fact that the HomePlug Alliance and the Wi-Fi Alliance signed a liaison agreement in November 2010[7] may be a significant competitive advantage for that Alliance.

[6] VESA has experience implementing power management standards, being the creators of the successful DPMS standard for computer monitors.

[7] www.homeplug.org/news/press_kit/HomePlug_Electronic_Press_Kit.pdf

The emergence of a single set of standards for smart grid technologies will hasten the deployment of the technologies as device manufacturers will gain the confidence needed to develop compliant products. Unfortunately, the set of tools which policy makers could use to encourage alignment behind a particular set of standards is limited and fraught with risk of being accused of interventionism. Among the few tools available is selective public procurement in the hopes of helping a particular set of standards achieve the necessary market share to become dominant.

2.5 Improving performance standards

Environmental performance standards are an important tool of policy makers in promoting energy savings. Often, however, power management features are not explicitly required of the products within the scope of the standard. Including such requirements could strengthen the standards. For example, even if a performance standard requires the inclusion of efficient low-power modes, the device may never enter these modes in practice in the absence of an effective power management scheme.

An alternative to explicitly requiring the inclusion of power management features is simply setting duty-cycle[8] requirements for energy consumption which are sufficiently stringent so as to effectively require active power management. This is essentially the approach taken by the EU Codes of Conduct for Broadband Equipment, Digital TV Services, and Data Centres.

2.6 Improving measurement standards

As with performance standards, it is important that measurement standards also focus on duty-cycle assessments and not only measurements of specific power modes. By working with standardisation organisations responsible for developing the measurement standards, policy makers can help to ensure that effective standards exist which will in turn support the development of effective policies which include power management provisions.

[8] It is important that the standard measure energy consumption over an entire duty cycle which includes low-power and active modes. If it measures energy consumption only in a specific mode then there is a risk that it will not effectively determine if the device will ever enter that mode under normal use conditions.

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Chapter 3: Standards reviewed

Table 3 below summarises the main criteria of the standards reviewed in this report. The values in the three right-most columns have the following signification:

- Region
  - G = Global
  - MS = APP Member State
  - EU = European
- Type
  - T = Technical standard
  - P = Environmental performance standard
  - M = Power measurement specification`
- Includes power management
  - Y = Yes
  - N = No

Table 3: Summary of standards reviewed

Name of the standard	Region	Type	Includes power management
Technical Standards			
Advanced Configuration and Power Interface (ACPI) specification 4.0	G	T	Y
Apple Sleep Proxy Service	G	T	Y
BACNET	G	T	Y
Bluetooth 4.0: Low Energy Profile	G	T	Y
DASH Implementation Requirements V1.1.0	G	T	Y
ECMA 393: ProxZzzy for sleeping hosts	G	T	Y
EN50523 Household appliances interworking - Part 1: Functional specification and Part 2: Data structures	EU	T	N
Green Plug Greentalk	G	T	Y
High-Definition Multimedia Interface (HDMI)	G	T	N
HomePlug Green PHY	G	T	Y

Name of the standard	Region	Type	Includes power management
IEEE 1394: Standard for a High-Performance Serial Bus (FireWire)	G	T	Y
IEEE 1901-2010: Broadband over power line	G	T	N
IEEE 802.1: Bridging & Management (LLDP)	G	T	N
IEEE 802.3at Power over Ethernet	G	T	Y
IEEE 802.3az: Energy Efficient Ethernet	G	T	Y
IEEE 802.11 a/b/g/n: Wireless LAN	G	T	Y
IEEE 802.15: Wireless Personal Area Networks (5 sub-parts)	G	T	N
IEEE 802.16: Broadband Wireless MANs (WiMAX)	G	T	Y
IEEE 802.21: Media Independent Handoff	G	T	Y
IETF Energy Management Working Group	G	T	Y
Internet 0	G	T	Y
ITU G.992.5 (ADSL2+)	G	T	Y
ITU G.9960: Unified high-speed wire-line based home networking transceivers (G.hn)	G	T	N
ITU J.222 (DOCSIS)	G	T	N
MoCA 2.0	G	T	Y
Universal Serial Bus (USB) 3.0	G	T	Y
VESA Display Power Management Signalling (DPMS)	G	T	Y
ZigBee	G	T	Y
Z-Wave	G	T	Y
Mandatory and Voluntary Performance Standards			
Announced 1 Watt limit on standby (E3 2006)	MS	P	Y
Australia: Energy labelling and Minimum Energy Performance Standards	MS	P	N
Blue Angel	G	P	Y
Canada: Energy Efficiency Regulations	MS	P	N
China: Voluntary Endorsement Energy Efficiency Labelling Program	MS	P	N
DTS-EE/00018 (early draft): Eco Environmental Product Standards Metrics and target value for Energy consumption of End-user Broadband equipment	G	P	Y
ENERGY STAR International	G	P	Y
EU Code of Conduct on Data Centres	EU	P	Y

Name of the standard	Region	Type	Includes power management
EU Code of Conduct on Digital TV Services	EU	P	Y
EU Code of Conduct on Energy Consumption of Broadband Equipment	EU	P	Y
EU Ecolabel for personal computers (PCs) and portable computers	EU	P	Y
EU Regulation 1275/2008/EC – Standby and off-mode losses	EU	P	Y
e-Standby Program	MS	P	Y
IEC 62075 Ed. 1.0 Audio/video, information and communication technology equipment – environmentally conscious design	G	P	N
IEC 62430 Ed. 1.0: Environmental conscious design for electrical and electronic products	G	P	N
India: Voluntary comparative star rating label	MS	P	N
International Energy Agency 1 Watt Plan	G	P	N
National Telecommunications and Information Administration (NTIA) coupon program	MS	P	Y
TCO	G	P	N
Top Runner Program	MS	P	Y
Measurement Standards			
CEA-2013-A (ANSI) Digital STB Background Power Consumption	G	M	Y
CEA-2022 (ANSI), Digital STB Active Power Consumption Measurement	G	M	N
DEN-EE/00021: Measurement method for energy consumption of Customer Premises Equipment	EU	M	N
ECMA 383 3rd Ed: Measuring the Energy Consumption of Personal Computing Products	G	M	Y
IEC 62087 Ed. 2.0: Methods of measurement for the power consumption of audio, video and related equipment	G	M	N
IEC 62301 Ed. 2.0: Household electrical appliances – measurement of standby power	G	M	N
IEC 62623 Ed. 1.0 Draft (expected 2012): Measuring energy consumption of personal computing products	G	M	N

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Annex 1: Technical summary factsheets

The following factsheets summarise the key information concerning each of the reviewed technical standards. They are organised alphabetically.

Advanced Configuration and Power Interface (ACPI) specification 4.0

Type of standard	Technical scope	Geographic scope
Technical	Operating system	Global

General description

An industry initiative, ACPI was developed to establish industry common interfaces enabling robust operating system-directed motherboard device configuration and power management of both devices and entire systems. Primarily targeted at PCs and servers, ACPI may also be used for printers, game consoles, set-top boxes, etc.

Purpose

ACPI is the key element in Operating System-directed configuration and Power Management (OSPM), which enables power management and configuration policy without any platform-specific firmware. Once ACPI is activated by an operating system compatible with OSPM, this operating system has exclusive control of these power management and configuration aspects.

Power management

The ACPI standard provides a common standard for the power management of a computing system's hardware components via the operating system. Previously, this was done at the BIOS level, relying on device-specific firmware.

Scale of implementation

ACPI is the *de facto* industry standard for power management and is very widely implemented on Windows-based and many Unix-derived systems.

Future development

Given the standard's current broad implementation and advanced development, no additional action is recommended.

Responsible organisation

Hewlett-Packard, Intel, Microsoft, Phoenix, Toshiba

Reference

www.acpi.info/DOWNLOADS/ACPIspec40a.pdf

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Apple Sleep Proxy Service

Type of standard	Technical scope	Geographic scope
Technical	Network link	Global

General description

An open-source approach to proxying developed by Apple, the Apple Sleep Proxy Service (also referred to as the Bonjour Sleep Proxy) allows a connected device to remain in a low power mode by responding on its behalf to multicast DNS queries. It is not properly a standard but implements other IETF standards in particular.

Purpose

The proxy responds to Multicast DNS queries (application layer) on behalf of the low-power-mode devices. When a request is made for a device which requires it to be reactivated, the proxy forwards a so-called 'magic packet' to the device which causes the device to reactivate and allows it to respond to the request. The feature can also be internally implemented, e.g. in computers running Mac OS X Snow Leopard.

Power management

As a proxying service, the Apple Sleep Proxy Standard facilitates power management in devices by allowing them to remain in a low-power state while low-level network interactions are managed by the proxy.

Scale of implementation

While the standard is published under an open source license, its real-world implementation is limited to Apple products which represent approximately 5%[9] of the global computer market. Furthermore, it requires the use of Apple networking devices (e.g. AirPort Wi-Fi base station), limiting the scale of its implementation.

Future development

At present, proxying is not widely implemented and there could be gains to be made from further coordination between existing open standards, namely Apple Sleep Proxy Service and ECMA 393: ProxZzzy for sleeping hosts (even if currently consistent). As the ECMA 393 standard currently lacks a central body with the budget and mandate to promote its use, it is conceivable that this is a role which Apple could contribute to. That said, the involvement of Apple in such an endeavour could discourage competing manufacturers from taking part.

Responsible organisation

Apple

References

General description: en.wikipedia.org/wiki/Apple_Sleep_Proxy_Service_(Bonjour_Sleep_Proxy)

Standard: tools.ietf.org/html/draft-cheshire-dnsext-multicastdns-14

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[9] www.electronista.com/articles/11/05/01/netapplications.shows.mac.ios.ieg.gains.in.april/ Note that Apple commands a much larger share of the mobile market, its products which use its iOS operating system (iPhone, iPad Touch, and iPad) account for approximately 17% of the mobile market.

BACNET

Type of standard	Technical scope	Geographic scope
Technical	Heating, ventilating, and air-conditioning control, lighting control, access control, and fire detection systems and their associated equipment.	Global

General description

BACnet is a communications protocol for building automation and control networks. It is an ASHRAE, ANSI, and ISO standard protocol.

Purpose

The BACnet protocol defines: services that are used to communicate between building devices; objects that are acted upon by the services (i.e. the most common functions like analog input/output, binary input/output); and some data link and physical layers (e.g. ARCNET, Ethernet, BACnet/IP).

Power management

While BACnet is an enabling technology which can be used in support of energy management applications within a building, it does not explicitly include power management features in its specification.

Scale of implementation

BACnet is widely used in building automation applications.

Future development

Given the depth of the standards current implementation and technicians' and engineers' experience in working with the standard, it could prove to be an interesting candidate for the introduction of energy management features (e.g. setting power modes of remote devices).

Responsible organisation

ASHRAE

Reference

en.wikipedia.org/wiki/Bacnet

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Bluetooth 4.0: Low Energy Profile

Type of standard	Technical scope	Geographic scope
Technical	NIC and network link	Global

General description

The Bluetooth 4.0 technical specification introduces several different core configurations: Basic Rate, Enhanced Data Rate, High Speed, and Low Energy. This last configuration, while implemented primarily for the functional benefit it provides to users[10], will also bring the environmental benefit of reduced energy consumption.

Purpose

Bluetooth Low Energy operates in the same spectrum range (2402-2480 MHz) as classic Bluetooth, but uses a different set of channels. The lowest energy consumption of the feature results in a wider range of potential applications of this physical layer technology (e.g. healthcare, fitness, security and home entertainment).

Power management

The Low Energy profile achieves lower power consumption by reducing the data transfer rate and using "system-on-a-chip" integration. This profile could also have smart grid and energy management applications in buildings, thereby serving as an enabler for additional energy savings.

Scale of implementation

The standard has only recently been released and the first compliant chips are beginning to appear on the market. As such, the current scale of implementation is low.

Future development

While the direct energy savings from the Low Energy profile are a positive development and will likely be sought by consumers for reasons of convenience, greater potential energy savings are likely to be induced by the technology in building automation and energy management settings. That said, there is a risk of a proliferation of competing, similar standards (e.g. ZigBee and Z-Wave) which would likely be detrimental to the widespread implementation of such technologies.

Responsible organisation

Bluetooth Special Interest Group

Reference

www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=229737 (12 MB)

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[10] The Bluetooth marketing for this new standard has prominently featured the promise of devices which will "operate for years on just a tiny, button-sized battery."

DASH Implementation Requirements V1.1.0

Type of standard	Technical scope	Geographic scope
Technical	Manageability access point (can be any DASH-enabled plug-in card, firmware, software process or service, or subsystem that has access to a managed client)	Global

General description

, The Desktop and mobile Architecture for System Hardware (DASH) is a standard developed by the Distributed Management Task Force (DMTF), an industry organisation, and published in 2007. It describes requirements for the implementation of desktop and mobile architecture for system hardware.

Purpose

The Desktop and mobile Architecture for System Hardware (DASH) is an application-layer standard which provides Web services management for desktop and mobile client systems. This includes the ability to manage power state profiles.

Power management

The DASH standard enables the power states of systems to be managed remotely. This allows for improved energy management of distributed systems (e.g. in an enterprise setting) by allowing systems to be reactivated only when needed (e.g. for maintenance purposes).

Scale of implementation

At present there is no evidence that the DASH standard is widely used.

Future development

Given the standard's current broad implementation and advanced development, no additional action is recommended.

Responsible organisation

Distributed Management Task Force (DMTF) - Desktop and Mobile Working Group

References

www.dmtf.org/sites/default/files/standards/documents/DSP0232_1.1.0.pdf

www.amd.com/us/Documents/44474B_DASH_1_0.pdf

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ECMA 393: ProxZzzy for sleeping hosts

Type of standard	Technical scope	Geographic scope
Technical	Network link (can be positioned on the NIC of the host device, between the host and the networking equipment as a separate, or within the networking equipment)	Global

General description

The ECMA 393 standard (ProxZzzy) specifies maintenance of network connectivity and presence by proxies to extend the sleep duration of hosts. In particular, it specifies the capabilities and the behaviour of the proxy in different situations, as well as the information that it must exchange with the host.

Purpose

The standard provides hosts with the ability to remain in a lower power state while a proxy handles network requests which do not require the reactivation of the host. Conversely, when the reactivation of the host is required, the proxy wakes it up by sending it the required 'magic packet' in case of an external proxy, or via internal mechanisms in case of an internal one.

Power management

As a proxying service, the ECMA 393 standard facilitates power management in devices by allowing them to remain in a low-power state while low-level network interactions are managed by the proxy.

Scale of implementation

The standard was published in February 2010 and has yet to find widespread adoption in the market place. Apple has implemented parts of this standard, via the Apple Sleep Proxy Service.

Future development

At present, there is no body which has the budget and mandate to effectively market the standard to manufactures. Developing a means to further promote the standard could be an effective means to increasing its adoption. Furthermore, coordination with similar standards (e.g. Apple Sleep Proxy Service) could lead to greater interoperability and adoption.

Responsible organisation

ECMA International

Reference

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

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EN50523 Household appliances interworking - Part 1: Functional specification and Part 2: Data structures

Type of standard	Technical scope	Geographic scope
Technical	Household electrical appliances	Europe

General description

This standard, developed by CENELEC, governs the interactions between household appliances.

Purpose

Part 1 describes the necessary control and monitoring and 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. Part 2 specifies the message data structures used for communication between devices that comply with the Household Appliances Interworking standard.

Power management

The standard does not explicitly include power management features.

Scale of implementation

The standard is not yet widely implemented.

Future development

While power management functions are not explicitly stated, given the expected growth of smart grid applications and "home area networks", the standard could have broad application within this field. Including, for example, a data field in Part 2 for power state would be one aspect of ensuring that this is possible.

Responsible organisation

CENELEC

Reference

shop.bsigroup.com/en/ProductDetail/?pid=000000000030186988

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Green Plug Greentalk

Type of standard	Technical scope	Geographic scope
Technical	Application layer	Global

General description

The Greentalk protocol, developed by Green Plug, aims at reducing the number of incompatible adapters, as well as reducing the amount of energy wasted by these adapters while not in use.

Purpose

Greentalk is an application layer API which provides a foundation for higher-level applications for home and office power management and reporting. Greentalk protocol messages include device identification, requests for voltage changes, setting maximum output current thresholds, power consumption data and more.

Power management

The Greentalk standard supports energy management application by providing a standard protocol for communication between interconnected devices.

Scale of implementation

The standard has only been demonstrated and is not yet widely implemented.

Future development

In order to achieve wide implementation, the Greentalk standard will need to attract more significant support from manufacturers. Additionally, it is currently being developed as a proprietary standard, rather than an open standard, which could limit its adoption further.

Responsible organisation

Green Plug

Reference

www.greenplug.us/greentalk.php?id=2

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High-Definition Multimedia Interface (HDMI)

Type of standard	Technical scope	Geographic scope
Technical	Network links between multimedia products	Global

General description

The High Definition Multimedia Interface (HDMI) is a proprietary standard for transmitting uncompressed digital data between audio-video equipment.

Purpose

HDMI is a compact audio/video interface, supporting any uncompressed TV or PC video format, up to 8 channels of compressed or uncompressed digital audio, a Consumer Electronics Control (CEC) connection and an Ethernet data connection. While the CEC connection allows HDMI devices to control each other when necessary, using this feature for power management is generally discouraged by manufacturers when all devices are from the same manufacturer

Power management

At present, HDMI does not support power management of connected devices.

Scale of implementation

HDMI is a very widely implemented across diverse types of audio-video equipment worldwide.

Future development

Given the ubiquity of HDMI in the growing segment of consumer audio-video equipment, there is a significant opportunity for energy savings if it were possible to include power management features. As HDMI is a proprietary standard and the primary concern of the developers is interoperability and reliability, energy consumption is not yet a primary concern. As such, aside from strong consumer demand, regulation is likely to be the only lever to induce power management features in the standard.

Responsible organisation

HDMI Founders (Hitachi, Matsushita Electric Industrial, Philips, Silicon Image, Sony, Thomson, Toshiba)

Reference

en.wikipedia.org/wiki/Hdmi

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HomePlug Green PHY

Type of standard	Technical scope	Geographic scope
Technical	Wired home networks using telephone wiring, coaxial cables and power lines	Global

General description

The HomePlug Green PHY specification is a reduced data rate protocol designed specifically for smart grid applications which is based on the HomePlug AV protocol and which is compatible with the IEEE 1901 standard.

Purpose

HomePlug Green PHY is specifically designed for the requirements of the smart grid market: it is designed to go into smart meters and smaller appliances such as HVAC/thermostats, home appliances and plug-in electric hybrid vehicles so that data can be shared between the home network and the utility.

Power management

In addition to enabling energy management through smart grid applications, the specification includes an advanced power save mode which coordinates awake windows and sleep windows across a network to allow devices to sleep without risk of being reactivated by non-critical network traffic.

Scale of implementation

While the HomePlug alliance is the dominant set of standards for power line communications, the first version of the Green PHY specification was published in June 2010 and, as such, the standard is not yet widely implemented.

Future development

The specification could serve as a foundation for further deployment of smart grid applications. Furthermore, the use of windows to schedule awake and sleep time across the network is a technique which could potentially be applied to other applications in other standards.

Responsible organisation

HomePlug Alliance

Reference

www.atheros.com/media/nav1/HomePlug_Green_PHY.pdf

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IEEE 1394: Standard for a High-Performance Serial Bus (FireWire)

Type of standard	Technical scope	Geographic scope
Technical	Computer systems and peripherals	Global

General description

IEEE 1394 (commonly known by its trade names FireWire, i.LINK and Lynx) is a high-speed serial bus interface standard.

Purpose

IEEE 1394 belongs to the physical layer: it is a serial bus (information transmitted one bit at a time) for high-speed data transfer and can be used in personal computers, digital audio, digital video, automotive and aeronautics applications. It has replaced parallel SCSI, because of lower costs and a simplified cabling system.

Power management

The IEEE 1394 standard supports the management of the power states of peripherals attached to a host. For example, given the appropriate drivers, a computer can control the power mode of an external hard disk drive connected over an IEEE 1394 connection. Additionally, since IEEE 1394a amendment (released in 2000), the protocol includes a power-saving suspend mode.

Scale of implementation

Though never having achieved the ubiquity of competing standards such as USB, the standard is quite common in computer systems and peripherals worldwide (in addition to industrial and military applications).

Future development

As the standard already contains power management features and has likely reached is market peak, no additional action is recommended in the context of this report.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

en.wikipedia.org/wiki/IEEE_1394

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IEEE 1901-2010: Broadband over power line

Type of standard	Technical scope	Geographic scope
Technical	NIC and data link	Global

General description

This IEEE working group is developing a global standard for high-speed power-line communications, via alternating current electric power lines, so called Broadband over Power Line (BPL) devices.

Purpose

The standard aims at providing a minimum implementation subset allowing the fair coexistence of the "Broadband over Power Lines" devices, and their interoperability, as well as interoperability with other networking protocols. It is limited to the physical layer (two PHY options included) and the medium access sub-layer of the data link layer.

Power management

While the standard does not explicitly include power management features, it and its derivative technologies could have smart grid and energy management applications.

Scale of implementation

As the final specification was published recently (February 2011), the standard is not yet widely implemented.

Future development

The standard could have important applications for energy management and derivative standards with explicit power management features are being deployed (i.e. HomePlug Green PHY)

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

grouper.ieee.org/groups/1901/

en.wikipedia.org/wiki/IEEE_P1901

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IEEE 802.1: Bridging & Management (LLDP)

Type of standard	Technical scope	Geographic scope
Technical	NIC and data link of networking equipment at various scales (LAN, MAN, WAN)	Global

General description

The IEEE 802.1 working group is subdivided into four task groups: Interworking, Security, Audio/Video Bridging and Data Centre Bridging. As part of the IEEE 802 standards family, it deals with local area networks and metropolitan area networks and more precisely networks carrying variable-size packets.

Purpose

The IEEE 802.1 standard is a working group which covers 802 LAN/MAN architecture; internetworking among 802 LANs, MANs and other wide area networks; 802 Link Security; 802 overall network management; and protocol layers above the MAC & LLC layers.

Power management

Power management is not explicitly included in the standard.

Scale of implementation

The standard is very widely implemented and forms the backbone of modern network architecture.

Future development

While power management is not explicitly included, within this broad remit, there are certain aspects — such as the 802.1X[11] standard for port-based network access control — which require closer evaluation in order to determine their impact on power management across the network.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

en.wikipedia.org/wiki/IEEE_802.1

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[11] en.wikipedia.org/wiki/IEEE_802.1X

IEEE 802.3at Power over Ethernet

Type of standard	Technical scope	Geographic scope
Technical	NIC	Global

General description

Power over Ethernet is a standard which specifies how to pass electrical power safely over Ethernet cabling, in parallel with data transmission.

Purpose

Using the physical and data link layers of wired Ethernet, this standard can provide up to 25.5 W of power. It is in particular more adapted than USB powering for applications such as IP telephones, wireless LAN access points, remote Ethernet switches, embedded computers, thin clients and LCDs.

Power management

The 802.3at standard for Power over Ethernet does not explicitly include any power management features. Yet, if integration with the IEEE 802.3az standard occurs, these standards are expected to bring an important potential of energy management.

Scale of implementation

The standard has been published and numerous products are on the market. That said, the standard has not yet achieved widespread consumer adoption.

Future development

As Power over Ethernet is a highly desirable feature which may lead to an increase in the number of devices using the standard, it is important that its power consumption be taken into account. While coordination between the 802.3az (Energy Efficient Ethernet) and 802.3at working groups, the feasibility of integrating the two standards needs to be explored further.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

en.wikipedia.org/wiki/Power_over_Ethernet

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IEEE 802.3az: Energy Efficient Ethernet

Type of standard	Technical scope	Geographic scope
Technical	NIC	Global

General description

The IEEE 802.3 collection of standards which define the physical layer and data link layer's media access control of wired Ethernet. Included within this collection of standards is the IEEE 802.3az standard for Energy Efficient Ethernet[12].

Purpose

This standard is a set of enhancements to the twisted-pair and backplane Ethernet networking standards resulting in power savings during periods of low data activity.

Power management

This standard aims to reduce power consumption of Ethernet-based networks by 70-90% or more. The physical layer transmitter chips can be put into "sleep" mode when no data transmission, and waken up when needed. The data link remains operational, because the receiving signal circuit remains active. In addition, a lower power mode was added to the twisted pair cable, reducing the power needed for each interface.

Scale of implementation

The standard was only recently ratified and, as such, only the first components (e.g. chipsets) are beginning to come to market.

Future development

Given the ubiquity of networks based on the IEEE 802.3 suite of standards, the possibility of using adaptive link rates could lead to a broad increase in the efficiency of such networks.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

en.wikipedia.org/wiki/IEEE_802.3

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[12] en.wikipedia.org/wiki/802.3az

IEEE 802.11 a/b/g/n: Wireless LAN

Type of standard	Technical scope	Geographic scope
Technical	NIC and data link	Global

General description

IEEE 802.11 is a suite of standards for Wireless LAN (Wi-Fi) allowing for high-speed network access.

Purpose

This standards set consists of a series of over-the-air modulation techniques that use the same basic protocol. Most recent one is 802.11n which adds multiple-input multiple-output antennas as an improvement.

Power management

Includes many different power modes designed to maximise the battery life of portable devices implementing the standard. These modes include Constantly Awake Mode (CAM), Power Save Mode (PSM), Unscheduled Automatic Power Save Delivery (U-APSD), WMM Power Save (WMM-PS), Power Save Multi-Poll (PSMP), Dynamic MIMO Power Save, and Wake on Wireless.

Scale of implementation

The standard is very widely implemented and is found on diverse mobile and stationary products worldwide.

Future development

While much attention has been given to the power-savings modes from the perspective of mobile, battery-powered devices, the consumption of mains-powered base stations has not been fully addressed. The introduction of more advance power management features in these devices could result in significant energy savings.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

Overview of the standard: en.wikipedia.org/wiki/802.11

Review of the power modes: www.networkworld.com/research/2008/051208-wireless-power-standards.html

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IEEE 802.15: Wireless Personal Area Networks (5 sub-parts)

Type of standard	Technical scope	Geographic scope
Technical	NIC and data link of small personal computing devices (e.g. smartphones and other peripherals)	Global

General description

Originally based on the Bluetooth standard, this standard has been independent since the Bluetooth 1.2 revision (meaning that recent advances in Bluetooth power management have not been included). Working group IEEE 802.15 is subdivided into seven task groups: WPAN/Bluetooth, Coexistence, High Rate WPAN, Low Rate WPAN, Mesh networking, Body Area Network, and Visible Light Communications.

Purpose

WPANs address wireless networking of portable and mobile computing devices such as PCs, Personal Digital Assistants (PDAs), peripherals, cell phones, pagers, and consumer electronics, which allows these devices to communicate and interoperate with one another.

Power management

Power management is not explicitly included in the standard though derived technologies (e.g. Bluetooth 4.0 Low Energy, ZigBee) are being put forward as having home automation and energy management applications.

Scale of implementation

Certain derived technologies are already very widely implemented (e.g. Bluetooth) whereas others are still coming to market.

Future development

While the fact that many of the devices operating under the standard are small, mobile (battery powered) devices, most are designed with power management in mind. That said, including power management requirements for mains-connected equipment (e.g. base stations for non-mesh-based sub-parts) could prevent this aspect from being overlooked.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

en.wikipedia.org/wiki/IEEE_802.15

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IEEE 802.16: Broadband Wireless MANs (WiMAX)

Type of standard	Technical scope	Geographic scope
Technical	NIC and data links of base stations and mobile/subscriber stations	Global

General description

IEEE 802.16 is a series of wireless broadband standards which intends to support the development of wireless metropolitan area networks and has been commercialised under the name 'WiMAX'.

Purpose

The series standardises the physical layer (PHY) and the Media Access Control layer (MAC) of the air interface.

Power management

The standard includes mandatory sleep modes for base stations.

Scale of implementation

The standard is not yet widely implemented. That said, many demonstration and small- to medium-scale implementations have been developed and the standard is receiving wide industry attention, indicating that its rate of adoption may soon increase rapidly.

Future development

Given the potential for rapid future growth, attention to the power consumption of base stations will be especially important (it is assumed that the power management of mobile devices will be quite advanced regardless as they are limited by performance and autonomy constraints). While the standard already includes mandatory sleep states for base stations, ensuring that such states are effectively implemented will be essential to realising the energy savings potential.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

standards.ieee.org/getieee802/download/802.16-2009.pdf

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IEEE 802.21: Media Independent Handoff

Type of standard	Technical scope	Geographic scope
Technical	NIC and data link layers of mobile devices	Global

General description

The IEEE 802.21 standard provides information to allow handing over to and from cellular, 802.11, 802.15, 802.16 and 3GPP networks through different handover mechanisms.

Purpose

This standard supports algorithms which enable seamless handover between networks of the same type as well as handover between different network types.

Power management

Integral to the general architecture of the standard is the principal of power management whereby the mobile node is able to avoid excessive scanning across multiple radios when searching for potential handover candidates.

Scale of implementation

The standard is implemented in various mobile devices worldwide.

Future development

As the standard already contains power management features and is widely implemented, no additional action is recommended in the context of this report.

Responsible organisation

Institute of Electrical and Electronics Engineers (IEEE)

Reference

standards.ieee.org/getieee802/download/802.21-2008.pdf

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IETF Energy Management Working Group

Type of standard	Technical scope	Geographic scope
Technical	All networked products	Global

General description

As an active working group within the Internet Engineers Task Force (IETF) the Energy Management Working Group (eman) contributes to the organisations overall objectives by developing frameworks and Management Information Bases (MIBs) which are generally published as IETF Requests for Comment (RFC).

Purpose

This working group investigates existing standards on power management and works on: requirements for energy management; energy management framework; Energy-aware Networks and Devices management information base; Power and Energy Monitoring management information base; Battery management information base; and Applicability statement.

Power management

Eman has published several draft MIBs and frameworks, including Definition of Managed Objects for Battery Monitoring (provides means for reporting detailed properties of the actual charge, age, and state of a battery), Energy-aware Networks and Devices MIB (addresses devices identification, context information, and potential relationship between devices), Energy Management Framework, and Requirements for Energy Management (specifies energy management properties allowing networks and devices to become energy aware).

Scale of implementation

These Internet-Drafts have not yet been published as RFC, with most being submitted in the first quarter of 2011. As such, they are not yet widely implemented.

Future development

The efforts of the Working group to standardise aspects of Internet energy management is quite encouraging. The work is largely based on Simple Network Management Protocol (SNMP) which allows devices to be managed on IP networks. Given the openness of the development process and the reliance on ubiquitous IP networks, the potential impact of the Working Group is great.

Responsible organisation

Internet Engineers Task Force (IETF)

Reference

datatracker.ietf.org/wg/eman/

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Internet o

Type of standard	Technical scope	Geographic scope
Technical	Distributed computing devices and sensors in various applications	Global

General description

Internet o was developed by the Center for Bits and Atoms at the MIT and was originally intended to network buildings, improve efficiency, and gather data through the control of HVAC systems.

Purpose

Internet o is a physical layer specification which is designed to route Internet Protocol (IP) data over any medium, including radio frequency, infrared, ultrasonics, optical, DC and AC power wiring, and even physical representations such as printed bar codes and engraving on a key.

Power management

As Internet o is a physical layer specification, it does not include any internal power management specifications, but could have wide spread applications as an enabling technology for the power management of devices throughout a house (and beyond). That said, as a result of the specification's low data rate and the high fault tolerance, a network based on the technology will generally have very lower energy consumption.

Scale of implementation

While the specification has received some attention and interest, it has not yet been fully formalised into a standard, though a limited number of demonstration projects have been implemented.

Future development

The limited implementation of the Internet o specification can be partially attributed to the lack of involvement of major hardware manufacturers. While corporations such as Ciscso and Schneider Electric have expressed interest in developing technologies according to the specification, none have been brought to market yet. Given the strong theoretical basis of the specification, however, it would be of interest to explore options for building interest among OEMs.

Responsible organisation

Center for Bits and Atoms (MIT)

Reference

en.wikipedia.org/wiki/Internet_o

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ITU G.992.5 (ADSL2+)

Type of standard	Technical scope	Geographic scope
Technical	Physical layer: Network infrastructure and consumer premises equipment (e.g. DSLAM, modems)	Global

General description

ADSL is a data communications technology that enables faster data transmission over copper telephone lines than a conventional voiceband modem can provide by utilizing frequencies that are not used by a voice telephone call. The ADSL2+ standard doubles the downstream bandwidth.

Purpose

ADSL2+ doubles the number of downstream bits in comparison with ADSL. The maximum theoretical download speed is 24 Mbit/s and upload speed is 3.3Mbit/s. It also allows port bonding.

Power management

The ADSL2+ standard introduces energy management principles to the preceding ITU G.992.3 (ADSL) standard by adding two low power modes (L2 and L3) which allow the transceiver to drastically reduce its power consumption when data traffic is low.

Scale of implementation

The ADSL2+ standard is very widely implemented[13] by various Internet service providers worldwide.

Future development

As the standard already contains power management features and is widely implemented, no additional action is recommended in the context of this report.

Responsible organisation

International Telecommunication Union (ITU)

Reference

www.eetimes.com/electronics-news/4136967/ADSL2-Helps-Slash-Power-in-Broadband-Designs

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[13] Reports have been received that ADSL2+ is often deactivated due to unsatisfactory performance resulting from crosstalk. No hard evidence was found in this respect though a survey of industry experts could provide greater insight.

ITU G.9960: Unified high-speed wire-line based home networking transceivers (G.hn)

Type of standard	Technical scope	Geographic scope
Technical	NIC and network link	Global

General description

The ITU G.9960 standard is competing with the IEEE 1901-2010 standard mentioned above for high-speed communications over wire lines including power lines, phone lines, and coaxial cables.

Purpose

G.hn aims at operation over all three types of legacy home wires: telephone wiring, coaxial cables and power lines. G.9960 specifies the physical Layer and the architecture of G.hn while G.9961 specifies the data link layer.

Power management

Similar to the IEEE standard, the ITU G.9960 standard does not include explicit power management features but could have applications for 'smart grids'.

Scale of implementation

As with the IEEE 1901-2010 standard, the ITU G.9960 has not yet achieved widespread implementation.

Future development

Device manufacturers would benefit from a harmonisation between the competing power-line communications standards. Additionally, there are aspects of one standard which could potentially be applied to the other. For example, this standard could potentially base power management features on those used in the HomePlug Green PHY amendment (derived from the IEEE 1901-2010 standard).

Responsible organisation

International Telecommunication Union (ITU)

Reference

www.itu.int/rec/T-REC-G.9960/en

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ITU J.222 (DOCSIS)

Type of standard	Technical scope	Geographic scope
Technical	Physical and data link layers of cable gateways, modems, STB and CSTB	Global

General description

The Data Over Cable Service Interface Specification, standardised by the International Telecommunications Union as ITU J.222, is an international telecommunications standard that permits the addition of high-speed data transfer to an existing cable TV system.

Purpose

DOCSIS provides a large variety of possible options in the physical and data link layers. DOCSIS architecture includes two primary components: a cable modem located at the customer premises, and a cable modem termination system located at the cable TV headend.

Power management

The DOCSIS standard is notable for its high energy consumption at the component level and the lack and any power management features.

Scale of implementation

The standard is widely implemented in broadcast and ISP technologies worldwide.

Future development

Given the combination of high component energy consumption and lack of any power scaling or other power management features, introducing such features to the standard could have a broad impact on power consumption of compliant devices.

Responsible organisation

International Telecommunication Union (ITU)

Reference

www.itu.int/rec/T-REC-J.222.0/en

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MoCA 2.0

Type of standard	Technical scope	Geographic scope
Technical	NIC, network link (home IT and A/V equipment such as set-top-boxes, PVR, home gateways, wireless access points, game consoles, etc.)	Global

General description

The Multimedia over Coax Alliance (MoCA) 2.0 standard is a standard for home entertainment networking, consisting of devices such as TV decoders (set-top-box), home gateways, wireless access point, game consoles etc.

Purpose

This standard uses existing coax cabling in households for connecting domestic IT and A/V equipment and allowing data communication and the transfer of multimedia streams.

Power management

The MoCA 2.0 standard allows for reduced link power relative to the preceding MoCA 1.1 standard, as well as sleep and standby modes.

Scale of implementation

The standard was ratified in June 2010 and the first compliant products are now beginning to come to market. As such, the standard is not yet widely implemented.

Future development

The inclusion of power saving features in the MoCA 2.0 standard is an important development in the development of power management features for domestic A/V applications. That said, as MoCA is a proprietary standard which may limit its further adoption.

Responsible organisation

Multimedia over Coax Alliance

Reference

en.wikipedia.org/wiki/Multimedia_over_Coax_Alliance#MoCA_2.0

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Universal Serial Bus (USB) 3.0

Type of standard	Technical scope	Geographic scope
Technical	Computer systems and peripherals	Global

General description

The USB standard is a ubiquitous standard used for connecting internal and external components and devices to a host.

Purpose

It is part of the physical layer and allows high-speed, easy connection of a wide variety of peripherals to a host.

Power management

The standard supports power management of the link as well as the connected device. In particular, new features of USB 3.0 include support of idle, sleep and suspend states, as well as link-, device-, and function-level power management.

Scale of implementation

The USB standard is very widely implemented, across diverse product types worldwide.

Future development

As the standard already contains power management features and is widely implemented, no additional action is recommended in the context of this report.

Responsible organisation

USB Implementers Forum (USB-IF)

Reference

www.usb.org/developers/docs/

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VESA Display Power Management Signalling (DPMS)

Type of standard	Technical scope	Geographic scope
Technical	Computer monitors	Global

General description

The DPMS standard allows for the power states of video monitors for computers to be controlled by the computer's graphics card.

Purpose

DPMS defines the four following modes: normal, standby, suspended, and off. It specifies how to signal the horizontal and vertical synchronisation pins in a standard SVGA monitor to trigger the monitor's power saving capabilities.

Power management

VESA DPMS is a standard which enables management of the connected computer monitor, for instance shutting off after the computer has been idle for some time.

Scale of implementation

The standard is very widely implemented worldwide.

Future development

As the standard already contains power management features and is widely implemented, no additional action is recommended in the context of this report.

Responsible organisation

VESA

Reference

en.wikipedia.org/wiki/VESA_Display_Power_Management_Signaling

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ZigBee

Type of standard	Technical scope	Geographic scope
Technical	Low-Rate Wireless Personal Area Networks, such as wireless light switches with lamps, electrical meters with in-home-displays, consumer electronics equipment	Global

General description

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for Low-Rate Wireless Personal Area Networks.

Purpose

ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking over wireless mesh networks (e.g. wireless light switches with lamps, electrical meters with in-home-displays). It is low-cost, low power usage (longer batteries lifetime) and mesh networking (high reliability)

Power management

ZigBee is an enabling technology for different applications which could lead to advanced power management at the level of a building. Additionally, given that the standard is designed to be used with low-power, distributed (often battery-powered) processors and microcontrollers, effective power management of these devices is also important. As such, the standard supports power-saving features such as fast reactivation from sleep modes.

Scale of implementation

Among WPAN technologies, ZigBee has gained some attention but is still not yet widely implemented, especially in domestic settings.

Future development

While ZigBee is based on the open IEEE 802.15.4-2003 standard, it is proprietary to the ZigBee Alliance. This could limit its future adoption as, for example, it is not possible to create open source applications based on the standard.

Responsible organisation

ZigBee Alliance

Reference

en.wikipedia.org/wiki/Zigbee

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Z-Wave

Type of standard	Technical scope	Geographic scope
Technical	Low-Rate Wireless Personal Area Networks, such as wireless light switches with lamps, electrical meters with in-home-displays, consumer electronics equipment	Global

General description

Z-Wave is a non-standards-based specification for low-data rate wireless mesh networks, aimed at home control and automation.

Purpose

Z-wave uses a low-power RF radio embedded or retrofitted into home electronics devices and systems. Its protocol is designed for reliable, low-latency communication of small data packets. Like ZigBee, it is mesh networking: each node or device on the network is capable of sending and receiving control commands and use intermediate nodes to route around obstacles or radio dead spots that might occur.

Power management

Z-Wave is an enabling technology for different applications which could lead to advanced power management at the level of a building. Additionally, the protocol itself is designed to promote low power consumption for compliant devices.

Scale of implementation

Z-Wave is competing with other technologies (e.g. Bluetooth 4.0, ZigBee) in the market WPAN-based home automation applications. At present, Z-Wave is not yet widely implemented.

Future development

Z-Wave is a proprietary standard based on technology developed by Zensys Corporation and, as such, could encounter greater difficulty in gaining widespread implementation across different hardware manufacturers.

Responsible organisation

Z-Wave Alliance

Reference

en.wikipedia.org/wiki/Z-Wave

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Annex 2: Performance summary factsheets

The following factsheets summarise the key information concerning each of the reviewed performance standards. They are organised alphabetically.

Announced 1 Watt limit on standby (E3 2006)

Type of standard	Technical scope	Geographic scope
Performance	All products	Australia

General description

The Australian Government has proposed a regulatory approach to limit standby power to 1 Watt by 2013, within the framework of the International Energy Agency's "One Watt" initiative.

Purpose

According to an announcement, a regulatory approach to limit standby power to one watt would be introduced by 2013. This horizontal approach would apply to all devices having a standby mode, in order to results in significant energy savings.

Power management

Regulatory proposals in Australia are likely to be broadly harmonised with the requirements in Europe in the first instance, implying a requirement for energy management features.

Scale of implementation

Once implemented, the regulation will have universal applicability in Australia.

Future development

As the regulation is finalised, it will be important to ensure that power management requirements are adequately integrated into the standard.

Responsible organisation

International Energy Agency (IEA)

Reference

www.energyrating.gov.au/standby.html

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Australia: Energy labelling and Minimum Energy Performance Standards

Type of standard	Technical scope	Geographic scope
Performance	Clothes washers and dishwashers, set top boxes, external power supplies, TVs, air conditioners	Australia

General description

The Australian Government has implemented a number of labelling and MEPS initiatives which broadly align (or plan to align) with European regulations.

Purpose

The aim of this standard is to ensure a minimum level of energy performance of products put on the market.

For set-top boxes: maximum power requirements are set independently for the on mode, active standby mode and passive standby mode (when relevant)

For televisions: requirements are set on the annual energy consumption in kWh/year (Comparative Energy Consumption) which is calculated from the specified usage pattern taking into account the on mode, active standby and passive standby modes.

For air conditioners: the approach is the same than for TVs, except that the standby mode is replaced by a non-operating mode (average power consumption of the air conditioner when not providing a cooling, heating or air circulation function)

For external power supplies: Energy performance requirements include the average efficiency (measured at 25%, 50%, 75% and 100% of rated output power) and consumption at no load.

For laundry appliances and dishwashers (labelling, no MEPS): Energy consumption is determined on a specific program and other requirements are set on performance (washing efficiency, etc.)

Power management

These standards do not require power management features. "Standby" is proposed as a product group for regulation in the future.

Scale of implementation

The standard is widely implemented in Australia.

Future development

The standard could be strengthened by including a recommendation for the inclusion and default activation of power management features.

Responsible organisation

Australian government – Department of Climate Change and Energy Efficiency

Reference

www.energyrating.gov.au/man1.html

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Blue Angel

Type of standard	Technical scope	Geographic scope
Performance	Computers and computer monitors	Global

General description

Developed in Germany, the Blue Angel environmental certification is now applied to products worldwide, including consumer electronics and IT equipment.

Purpose

Energy-related requirements include:

For system units and portable computers, the device and the operating system installed must at least offer the ACPI Mode (or comparable mode) as well as the Off mode as energy-saving stand-by modes (designations: energy-saving mode, ready mode, sleep mode, etc.). Energy requirements are set using a Total Energy Consumption approach (like Energy Star).

Energy requirements for separate monitors are set independently for the on mode, the sleep mode and the off mode.

Power management

While this standard collects information on power management features if present, they are not required for the awarding of the certificate.

According to the Energy Star requirements system units and portable computers must automatically switch to the ACPI S3 sleep mode (or comparable mode) and turn off the monitor. For this purpose, the following default times must be pre-installed upon delivery of the device:

ACPI Mode S3 ≤ 30 minutes

Monitor Off ≤ 15 minutes

The user must be able to reduce the pre-installed default times.

Scale of implementation

Adoption of the label has been modest, with 36 licensed products from 4 vendors.

Future development

Requiring power management features to be present and activated by default would strengthen the impact of the standard.

Responsible organisation

Blue Angel

Reference

www.blauer-engel.de/_downloads/vergabegrundlagen_en/e-UZ-078.zip

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Canada: Energy Efficiency Regulations

Type of standard	Technical scope	Geographic scope
Performance	Compact audio products, TVs, video products	Canada

General description

The Canadian Government is developing a two-staged plan to introduce standards which are equivalent to the current ENERGY STAR criteria for compact audio products, TVs, video products, printers, and multi-function devices. These initiatives are planned to be effective in 2011.

Purpose

The Tier 1 limits (2009) imposed the following power consumption in standby mode: 2 W for compact audio products, 4 W for TVs, 3 W for video products, 2 W for printers and 4 W for multifunction devices. For Tier 2 (2011), the limit is reduced to 1 W for all product, except multi-function devices (2 W).

Power management

These standards do not require power management features.

Scale of implementation

The standard is widely implemented in Canada.

Future development

The standard could be strengthened by including a recommendation for the inclusion and default activation of power management features.

Responsible organisation

Canadian government - Natural Resources Canada's Office of Energy Efficiency

Reference

oee.nrcan.gc.ca/regulations/bulletin/standbypower-jan09.cfm?attr=4

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China: Voluntary Endorsement Energy Efficiency Labelling Program

Type of standard	Technical scope	Geographic scope
Performance	Televisions, DVD players, printers, faxes, copiers, computers, monitors, multifunction devices, projectors and external power supplies.	China

General description

The voluntary energy efficiency endorsement labelling program, analogous to the US Energy Star program with which it cooperates closely, has been administered by CSC since 1998. Currently, the program labels 50 products from over 300 participating manufacturers including: home appliances; consumer electronics; office equipment; lighting; and selected industrial equipment. The program requires manufacturers to: submit to an on-site audit of production facilities; undertake third-party testing in certified laboratories; and to accord with ISO 9000 standards. Audits are repeated annually.

Purpose

Some examples of requirements:

For computer monitors: energy efficiency in use (in m^2nit/W for CRT ones and Cd/W for LCD) and off mode energy use (in W) are considered.

For computers and printers: currently under consideration.

Power management

At present, the standard does not require power management features.

Scale of implementation

The standard is widely implemented in China.

Future development

The standard could be strengthened by including a recommendation for the inclusion and default activation of power management features.

Responsible organisation

Chinese government - Environmental Energy Technologies Division

Reference

china.lbl.gov/sites/china.lbl.gov/files/LBNL_251E._Status_of_Chinas_Energy_Efficiency_Standards_and_Lables._Mar2008.pdf

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DTS-EE/00018 (early draft): Eco Environmental Product Standards Metrics and target value for Energy consumption of End-user Broadband equipment

Type of standard	Technical scope	Geographic scope
Performance	End-user broadband equipment not covered by the WI DEN/EE-00021	Global

General description

This standard will 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.

Purpose

Power management

This standard does not explicitly include power management features.

Scale of implementation

Once ratified, the standard will be implemented at the global level.

Future development

Including the transition between active and standby modes would allow this standard to better capture real-world use patterns.

Responsible organisation

European Telecommunications Standards Institute (ETSI)

Reference

bit.ly/eVsb54

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ENERGY STAR International

Type of standard	Technical scope		Geographic scope
Performance	■ Audio/Video equipment ■ Battery Chargers ■ Computers ■ Cordless Phones ■ Digital to Analogue Converter Box (suspended) ■ Displays	■ Enterprise Servers ■ External Power Supplies ■ Imaging Equipment ■ Set-top Boxes & Cable Boxes ■ Televisions	Global

General description

Energy Star International is a multi-regional (if not truly global) standard which has a number of specifications that deal with products that are connected to networks, most notably PCs and imaging equipment. These are mostly based on a functional allowance approach, which recognises the diversity of product design and functionality in this product group.

Purpose

Some examples of performance requirements include:

For computers: the use of energy efficient power supply; operating efficiently in multiple modes of operation (Off, Sleep, and Idle); and including and enabling power management features of the system and provide user education about these features.

For TVs: Specific power limits for on mode, download acquisition mode, sleep mode (1W).

For Home audio and DVDs: auto power down requirements, sleep mode, on mode and idle state power consumption limits.

Power management

Depending on the product group, power management features must be included and shipped activated in order for the device to receive the certification.

Scale of implementation

Energy Star labels have gained widespread, international adoption across a variety of product groups.

Future development

Support for power management is already quite strong for this widely implemented standard, therefore no additional action is recommended in the context of this report.

Responsible organisation

Energy Star

Reference

www.energystar.gov/index.cfm?c=computers.pr_crit_computers

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EU Code of Conduct on Data Centres

Type of standard	Technical scope	Geographic scope
Performance	IT infrastructure equipment	Europe

General description

The EU Code of Conduct on Data Centres is a voluntary initiative by industry which aims to improve the energy efficiency of their products.

Purpose

The aim of the EU Code of Conduct on Data Centres is to inform and stimulate data centre operators and owners to reduce energy consumption in a cost-effective manner without hampering the mission critical function of data centres. It aims to achieve this by improving understanding of energy demand within the data centre, raising awareness, and recommending energy efficient best practice and targets. It therefore proposes general principles and practical actions to be followed by all parties involved in data centres.

Power management

These requirements do not set explicit requirements for power management, although the limits implicitly require this in some cases.

Scale of implementation

The Code of Conduct includes the major economic actors from the European market.

Future development

While it is conceivable that energy management features could be made mandatory for signatories, this would have to be weighed against simply setting more stringent requirements and allowing the industry to meet them (via power management or otherwise).

Responsible organisation

Joint Research Centre (Institute for Energy) – European Commission

Reference

re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_data_centers.htm

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EU Code of Conduct on Digital TV Services

Type of standard	Technical scope	Geographic scope
Performance	Complex set-top boxes and similar equipment for the reception, decoding, recording and interactive processing of digital TV and related service	Europe

General description

The EU Code of Conduct on Digital TV Services is a voluntary initiative by industry which aims to improve the energy efficiency of their products.

Purpose

It proposes general principles and practical actions to be followed by all parties involved in products within the scope. For instance for monitoring and information purposes, both the measured power consumption values in the on and standby states as well as the calculated Total Energy Consumption value shall be provided.

Power management

These requirements do not set explicit requirements for power management, although the limits implicitly require this in some cases.

Scale of implementation

The Code of Conduct includes the major economic actors from the European market.

Future development

While it is conceivable that energy management features could be made mandatory for signatories, this would have to be weighed against simply setting more stringent requirements and allowing the industry to meet them (via power management or otherwise).

Responsible organisation

Joint Research Centre (Institute for Energy) – European Commission

Reference

re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative.htm

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EU Code of Conduct on Energy Consumption of Broadband Equipment

Type of standard	Technical scope	Geographic scope
Performance	Customer premises equipment and network infrastructure equipment	Europe

General description

The EU Code of Conduct on Broadband Equipment is a voluntary initiative by industry which aims to improve the energy efficiency of their products.

Purpose

It sets out the basic principles to be followed by all parties involved in broadband equipment, operating in the European Community, in respect of energy efficient equipment. In particular, it specifies maximum power consumption targets in the on-state, in the idle-state, and in the off-state.

Power management

These requirements do not set explicit requirements for power management, although the limits implicitly require this in some cases.

Scale of implementation

The Code of Conduct includes the major economic actors from the European market.

Future development

While it is conceivable that energy management features could be made mandatory for signatories, this would have to be weighed against simply setting more stringent requirements and allowing the industry to meet them (via power management or otherwise).

Responsible organisation

Joint Research Centre (Institute for Energy) – European Commission

Reference

re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_broadband%20communication.htm

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EU Ecolabel for personal computers (PCs) and portable computers

Type of standard	Technical scope	Geographic scope
Performance	Personal and portable computers	Europe

General description

The EU Ecolabel is a voluntary labelling scheme for products with the lowest environmental impact within a particular product category.

Purpose

Ecolabelled computers consume less energy during use and standby modes. The Ecolabel also includes other criteria not related to the energy consumption (hazardous substances, ease of dismantling, etc.).

Power management

The EU Ecolabel for personal and portable computers follows the ENERGY STAR requirements mentioned above, indicating power management parameters such as time before entering a particular low power mode. Specifically, the label criteria define a maximum power level 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.

Additionally, the criteria specify that the default mode-change time from operation to the ACPI S3 sleep state shall be no more than 30 minutes of inactivity. The manufacturer must enable this feature by default, but the user may disable it.

Scale of implementation

Adoption of the Ecolabel among manufacturers has been limited, with only 8 desktop models from 4 manufacturers and 24 portable models from only 2 manufactures receiving the label.

Future development

While the label is quite specific in requiring power management features (in addition to many other environmental aspects), it is struggling due to a lack of uptake from manufacturers. As the value of the label is often not communicated directly to consumers (e.g. by showing running cost savings over the lifetime of the product), there is little incentive for manufacturers to submit themselves to this voluntary scheme.

Responsible organisation

EU Ecolabel – European Commission

Reference

ec.europa.eu/environment/ecolabel/brochures/producers/en/personal.pdf

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EU Regulation 1275/2008/EC – Standby and off-mode losses

Type of standard	Technical scope	Geographic scope
Performance	All products (excluding networked devices)	Europe

General description

EU Regulation 1275/2008/EC sets upper limits for standby power consumption for all products with such a feature (excluding networked products).

Purpose

This Regulation ensures a certain level of product performance for all products put on the EU market, especially thanks to market surveillance. Energy requirements are set for power consumption in off mode and standby mode, and the presence of these modes is compulsory when possible.

Power management

Starting from 2013, Tier 2 of this standard will require that all products subject to its horizontal scope include an energy management function which will switch the equipment into a standby or off mode, as appropriate for the intended use of the device.

Scale of implementation

The Regulation is universally implemented in the EU.

Future development

The Regulation will likely be amended to include networked products following the conclusion of the preparatory study underway on "Networked standby losses" (DG ENER Lot 26). This amendment will likely require energy management features.

Responsible organisation

European Commission

Reference

eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:339:0045:0052:en:PDF

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e-Standby Program

Type of standard	Technical scope	Geographic scope
Performance	All products	Korea

General description

Korea's e-Standby Program is part of a national 1-Watt initiative.

Purpose

The program encourages the adoption of energy saving modes while the appliances are idle and the minimization of standby power. An Energy Boy label is attached to those products that meet the standards for standby power. It is the core program to reduce standby power below 1W by 2010.

Power management

The standard specifies power down targets as well as the maximum delay before a product must enter a specific low power mode and power down the monitor. The standard also requires that the product be shipped with these power management features activated.

Scale of implementation

The standard is universally implemented in Korea.

Future development

As the standard is widely implemented and already includes power management features, no additional action is recommended in the context of this report.

Responsible organisation

Korea Energy Management Corporation (KEMCO)

Reference

89.206.150.89/documents/congresspapers/31.pdf

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IEC 62075 Ed. 1.0 Audio/video, information and communication technology equipment – environmentally conscious design

Type of standard	Technical scope	Geographic scope
Performance	All audio/video, information and communication technology equipment marketed as final products	Global

General description

The IEC 62075 specifies requirements and recommendations 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.

Purpose

This standard sets the horizontal basis for environmental design of products, not only from the energy efficiency point of view, but also considering material efficiency, consumables and batteries, emissions, packaging and hazardous substances aspects.

Power management

This standard includes the definitions of energy saving modes but otherwise does not make a specific recommendation in that regard.

Scale of implementation

The standard is implemented at the global level.

Future development

The standard could be strengthened by including a recommendation for the inclusion and default activation of power management features.

Responsible organisation

International Electrotechnical Commission (IEC)

Reference

webstore.iec.ch/webstore/webstore.nsf/Artnum_PK/38890

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IEC 62430 Ed. 1.0: Environmental conscious design for electrical and electronic products

Type of standard	Technical scope	Geographic scope
Performance	Electrical and electronic products, including combinations of products, and the materials and components of which they are composed	Global

General description

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.

Purpose

It has the status of a horizontal standard in accordance with IEC Guide 108. It presents the fundamentals of environmentally conscious design (ECD) and the ECD process.

Power management

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

Scale of implementation

The standard is implemented at the global level.

Future development

The standard could be strengthened by including a recommendation for the inclusion and default activation of power management features.

Responsible organisation

International Electrotechnical Commission (IEC)

Reference

webstore.iec.ch/webstore/webstore.nsf/Artnum_PK/42644

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India: Voluntary comparative star rating label

Type of standard	Technical scope	Geographic scope
Performance	Set-top boxes	India

General description

The Indian Government has implemented a comparative star rating label for set-top boxes.

Purpose

The objective, like for any other labelling scheme, is to promote most efficient products by offering the consumer a harmonised comparison between products.

Power management

At present, this does not include power management features.

Scale of implementation

The standard is widely implemented in India.

Future development

The standard could be strengthened by including a recommendation for the inclusion and default activation of power management features.

Responsible organisation

Indian government – Bureau of Energy Efficiency

Reference

www.bee-india.nic.in/

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International Energy Agency 1 Watt Plan

Type of standard	Technical scope	Geographic scope
Performance	All equipment with a standby mode	Global

General description

In 1999, the IEA proposed that all countries harmonise energy policies to reduce standby power use to no more than one watt per device. The proposal contained 3 elements:

- participating countries would seek to lower standby to below 1 watt in all products by 2010;
- each country would use measures and policies appropriate to its own circumstances; and
- all countries would adopt the same definition and test procedure.

Purpose

The purpose of this horizontal approach is to cover all relevant equipment, i.e. all equipment with a standby mode. Even is the absolute standby power levels may not be the most appropriate for all types of products, it is considered as a valuable first step to encourage other initiatives in this field.

Power management

While the 1 Watt initiative does not include power management requirements, the two approaches are complimentary.

Scale of implementation

The standard is implemented at the global level.

Future development

As the standard is already compatible with power management requirements, and is often a driver for power management requirements, there is no need to introduce them directly into the standard itself.

Responsible organisation

International Energy Agency (IEA)

Reference

www.iea.org/papers/2007/standby_fact.pdf

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National Telecommunications and Information Administration (NTIA) coupon program

Type of standard	Technical scope	Geographic scope
Performance	Digital television adaptors	USA

General description

To support the transition from analogue to digital over-the-air broadcast television, the US Government provided coupons to offset the purchase of converter boxes.

Purpose

Coupon eligible converters shall respect permitted and disqualifying feature requirements, in particular for energy standards: equipment may comply with standards established by the EPA Energy Star program or state regulatory authorities.

Power management

In order to be eligible for the program, boxes needed to include power management features such as auto-power-down.

Scale of implementation

The programme was widely implemented and quite successful when it was active.

Future development

The programme is no longer active but demonstrates the way in which subsidies can be used to promote the uptake of more efficient products in the context of a broader technological transition.

Responsible organisation

National Telecommunications and Information Administration (NTIA)

Reference

www.ntia.doc.gov/frnotices/2007/DTVFinalRule_2e.htm

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TCO		
Type of standard	**Technical scope**	**Geographic scope**
Performance	Displays, desktops, notebooks, projectors	Global
General description		
TCO is a third-party environmental certification scheme which covers home and office IT equipment.		
Purpose		
Energy consumption requirements include: For displays, desktop computers and notebooks: The requirement and test method is based on the most recently published Energy Star standard for displays. For projectors: the projector shall be possible to set in an eco mode and requirement levels for maximum power consumption in the on mode, standby mode and off mode shall be fulfilled. Besides, it shall be possible to set the projector to automatically enter standby mode, after a specified time period when the video or computer interface is disconnected.		
Power management		
Power management schemes are required for projects as shown above, and for other products based on Energy Star criteria as well (see Energy Star fact sheet).		
Scale of implementation		
The standard has been widely implemented globally, with tens of thousands of products carrying the label.		
Future development		
The standard could be strengthened by including a recommendation for the inclusion and default activation of power management features.		
Responsible organisation		
TCO Certification		
Reference		
www.tcodevelopment.com		

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Top Runner Program

Type of standard	Technical scope	Geographic scope
Performance	Selected domestic appliances (including computers, TV sets, routers, switches, etc.)	Japan

General description

The Japanese Top Runner program sets ambitious, quasi-voluntary requirements for a wide variety of products, including network-connected devices such as computers and other IT peripherals.

Purpose

It is a regulatory scheme designed to stimulate the continuous improvement of the use-phase energy efficiency of products. The obligation of compliance with Top Runner regulations rests entirely with manufacturers and importers, and not on the demand-side. In iterative cycles, it introduces product-specific energy performance requirements, where the basis for the adoption of standards is pre-defined as the use-phase energy performance of the best technology available on the market at the time of revision.

Power management

The strict nature of the requirements implicitly makes power management functions necessary.

Scale of implementation

The programme is implemented universally in Japan.

Future development

As the standard is widely implemented and already includes power management features, no additional action is recommended in the context of this report.

Responsible organisation

Energy Conservation Center, Japan

Reference

www.eccj.or.jp/top_runner/pdf/computers_magneticdiscunits-eng.pdf

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Annex 3: Measurement summary factsheets

The following factsheets summarise the key information concerning each of the measurement standards reviewed in this report. They are organised alphabetically.

CEA-2013-A (ANSI) Digital STB Background Power Consumption

Type of standard	Technical scope	Geographic scope
Measurement	Set-top boxes	Global

General description

CEA-2013 defines maximum background mode energy consumption of basic digital set top boxes.

Purpose

CEA-2013 provides a detailed SLEEP state power measurement specification and procedure, which can be used as the test method for specifying SLEEP state power of any Set-Top Box, including types with advanced features. Measurement methods defined in CEA-2013 are applicable to both basic and advanced STB types.

Power management

While consumption in the sleep state is covered, transition to and from this state is not.

Scale of implementation

This standard is widely implemented at the global level.

Future development

Adapting the standard (or using it as a basis for a combined measurement standard) to include the transitions between active and standby modes would provide a more accurate assessment of a device's true performance.

Responsible organisation

Consumer Electronics Association

Reference

www.ce.org/Standards/browseByCommittee_2785.asp

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CEA-2022 (ANSI), Digital STB Active Power Consumption Measurement

Type of standard	Technical scope	Geographic scope
Measurement	Set-top boxes	Global

General description

CEA-2022 defines a method for measuring power consumption of a digital set top box (STB) whose primary function is video reception and delivery when operating in an active (ON) state.

Purpose

Like ANSI CEA-2013, this standard is a measurement standard providing a power measurement specification and procedure.

Power management

Similar to ANSI standard CEA-2013-A, this standard covers only the active mode consumption and not the transition between power modes as would be controlled by a power management scheme.

Scale of implementation

This standard is widely implemented at the global level.

Future development

As with ANSI standard CEA-2013-A, adapting the standard (or using it as a basis for a combined measurement standard) to include the transitions between active and standby modes would provide a more accurate assessment of a device's true performance.

Responsible organisation

Consumer Electronics Association

Reference

www.ce.org/Standards/browseByCommittee_3373.asp

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DEN-EE/00021: Measurement method for energy consumption of Customer Premises Equipment

Type of standard	Technical scope	Geographic scope
Measurement	End-user broadband equipment within the scope of EU regulation 1275/2008	Europe

General description

This standard is designed to test standby and off mode losses in CPE in compliance with the EU Regulation 1275/2008.The development of this standard is on-going, with a final standard expected in 2011.

Purpose

Power management

No indication is given of testing of power management features (to be required by the 1275/2008 Regulation in 2013).

Scale of implementation

Once finalised, the standard will be widely implemented within the EU.

Future development

Including the transition between active and standby modes would allow this standard to better capture real-world use patterns.

Responsible organisation

European Telecommunications Standards Institute (ETSI)

Reference

www.etsi.org/WebSite/document/Technologies/LEAFLETS/Energy_Efficiency.pdf

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ECMA 383 3rd Ed: Measuring the Energy Consumption of Personal Computing Products

Type of standard	Technical scope	Geographic scope
Measurement	Desktop and notebook computers	Global

General description

The ECMA 383 standard specifies:

- A test procedure to enable the measurement of the power and/or energy consumption in each of the equipment-under-test's (EUT) power modes.
- Formulas for calculating the TEC (Typical Energy Consumption) for a given period (normally annual).
- A majority profile that should be used with this Standard which enables conversion of average power into energy within the TEC formulas.
- A system of categorisation enabling like for like comparisons of energy consumption between EUT's.
- A pre-defined format for the presentation of results.

This Standard does not set any pass/fail criteria for the EUT.

Purpose

This measurement standard represents a harmonised basis to carry out energy consumption measurements of desktop and notebook computers.

Power management

The ECMA 383 standard for measuring the energy consumption of personal computing products explicitly addresses testing of devices with and without power management functions engaged (depending on the state of the device when shipped).

Scale of implementation

The standard is widely used at the international level.

Future development

The definitions used in the standard are not consistent with the IEC 62542 which is currently under review. Harmonisation of these standards could be beneficial to manufacturers and, given that the IEC standard is currently under review, it could be an opportunity to harmonise it with the ECMA standard.

Responsible organisation

ECMA International

Reference

www.ecma-international.org/publications/standards/Ecma-383.htm

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IEC 62087 Ed. 2.0: Methods of measurement for the power consumption of audio, video and related equipment

Type of standard	Technical scope	Geographic scope
Measurement	• Television sets • Video recording equipment • Set-top Boxes (STBs) • Audio equipment • Multi-function equipment for consumer use	Global

General description

The IEC 62087 standard specifying the measurement procedure for the products listed in the technical scope.

Purpose

In particular, the operating modes considered are: disconnected; off; standby passive; standby active, low; standby active, high; on (play) and on (record).

Power management

While the IEC 62087 standard provides definitions of different power modes (including standby modes), it does not cover how the transition between those modes should be measured.

Scale of implementation

This standard is widely implemented at the global level.

Future development

Including the transition between active and standby modes would allow this standard to better capture real-world use patterns.

Responsible organisation

International Electrotechnical Commission (IEC)

Reference

www.lnvtesting.com/manages/pic/20084143468226 9.pdf

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IEC 62301 Ed. 2.0: Household electrical appliances – measurement of standby power

Type of standard	Technical scope	Geographic scope
Measurement	Household electrical appliances with a rated input voltage in the range 100 V AC. to 250 V AC (single phase products) and 130 V AC to 480 V AC (other products)	Global

General description

This standard is a generic testing method for measuring off-mode and standby power consumption.

Purpose

The objective of this measurement standard is to provide a method of test to determine the power consumption of a range of products in relevant low power modes, generally where the product is not in active mode (i.e. not performing a primary function).

Power management

While the standard specifies how to measure power consumption in low-power modes, it does not cover the transition between modes, a key aspect of power management.

Scale of implementation

This standard is widely implemented at the global level.

Future development

Including the transition between active and standby modes would allow this standard to better capture real-world use patterns.

Responsible organisation

International Electrotechnical Commission (IEC)

Reference

webstore.iec.ch/preview/info_iec62301%7Bed2.0%7Db.pdf

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IEC 62623 Ed. 1.0 Draft (expected 2012): Measuring energy consumption of personal computing products

Type of standard	Technical scope	Geographic scope
Measurement	Personal computing products	Global

General description

This standard will be a generic testing method for measuring energy consumption of personal computing products.

Purpose

See description

Power management

It is unknown at this stage whether the standard will cover the transition between different power modes (thus including power management) or not.

Scale of implementation

Once ratified, the standard will be implemented at the global level.

Future development

As the standard is based on the ECMA 383 measurement standard, both standards shares the limitation, namely inconsistent definitions of networked standby modes with regard to the IEC 62542 standard.

Responsible organisation

International Electrotechnical Commission (IEC)

Reference

www.iec.ch/dyn/www/f?p=103:38:0::::FSP_ORG_ID,FSP_LANG_ID,FSP_PROJECT:1311,25,IEC%2062623%20Ed.%201.0

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