# Comments on
# DG ENER's Preparatory Study on Networked Standby Losses
# Lot 26 draft Tasks 1-7

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## Summary

The Preparatory Study on Networked Standby Losses[1] addresses electricity use of devices with low-power modes that include connection to a network. Communication adds complexities generally not addressed by policy on standby power. The draft report [hereafter just referred to as 'report' or 'study'] addresses many of the key aspects of the topic, but it omits or under-reports on others. The report's analysis and conclusions most certainly move policy in the right direction — towards effectively reducing energy use while being manageable for both policy makers and industry. However, an optimal policy would include many elements that are currently not being addressed (either at all, or not sufficiently). Some of the recommendations ("options") for policy in Task 7 are promising, but would need more policy development before they can be fully evaluated and considered for implementation. We expect, however, that these may be further developed and addressed more fully in Task 8.

A horizontal approach to the topic is needed, and the study begins from that premise. Complexity needs to be introduced, though quite carefully, as it could easily overwhelm all involved. In our view, the horizontal aspect should however not be in a single uniform policy, but rather in a "library" of elements of policy that can be brought to specific types of products as needed and warranted. The study introduces latency as a key criterion. While latency is quite important, and does sometimes need to be specified, it is the way we see it not one of the core handles to organize policy around. Topics that should be at the core of policy on network standby include details of network physical layers, network functionality at higher layers, user experience and expectations, and specific dependencies between devices that are key to effective power management.

An effective future policy must also have a strategy for test procedures, so that network connectivity can be considered for all products in a way that minimizes complexity while facilitating energy savings. Another element is a long-term strategy for how technology development interacts with energy policy, to use policy as a lever to create new energy-saving technologies and drive them into the market. Networks are a topic that needs such a strategy more than most, since individual companies may not innovate on their own when inter-device coordination is required.

The issue of network connectivity manifests itself differently for different categories of products: appliances are only now gaining communications; IT products have had them for a long time; network equipment only exists to facilitate connectivity; and audio/visual products that have long had communications, but are undergoing a transformation in the nature of that communication.

Given the nature and specificities of network connectivity, it seems that there would be a need for a global comprehensive approach to dealing with it in energy regulations. The study does not lay out or point to such an approach, but given its starting point and mandate, it could not really have been expected to. The study does move the discussion forward and so is a useful and necessary step towards this goal. The policy to aspire to should be one that is harmonized as much as possible globally, for example with Energy Star and/or programmes/policies of other governments. The possible outline of such a policy is described in a recent report from the International Energy Agency's IEA-4E programme[2].

[1] In this document we use "report" or "study" to reference the totality of the draft Task 1-7 reports and the "First Stakeholder Document", all available at ecostandby.org.

[2] "Standby Power and Low Energy Networks – issues and directions", Report for APP and IEA 4E Standby Annex, by Lloyd Harrington and Bruce Nordman, September 2010, available at; standby.iea-4e.org/files/otherfiles/0000/0023/Network-Standby-2010-09-final.pdf

If a global comprehensive approach is considered desirable, the next needed step would be to organize the most interested parties to create a global horizontal approach to the issue of network connectivity. This would also serve to make other aspects of low power mode policy more coherent and effective.

For many reasons it is difficult to quantify the energy savings potential in this area, including the rapid pace of technological change, and the large effect of user behaviour. It is clear from this study and others that the savings are measured at least in the tens of TWh/year for the EU, and so well worth considerable policy attention. We recognize that creating policy in this area is complex, but we would argue manageably so.

*Please note that in the remainder of this document, the draft Lot 26 report references are of the form (X/Y) where "X" refers to the Task report number and "Y" to the page number, while "F" denotes the First Stakeholder Document.*

## Policy Context

Network connectivity poses unique challenges to energy policy in the detail of technology that must be engaged, the rapid pace of technological change, and the interdependence of devices and interdependence with users in their energy use and savings. Crafting an effective approach to the topic is difficult, and has been wrestled with for many years, from a variety of different directions. The Lot 26 study follows many in this series, and will likely be followed by at least several more before a widely recognized solution becomes apparent.

There are at least three key lines of policy that contribute to this ongoing discussion:

- Individual product standards. These originated with appliances, and tend to focus on active energy consumption;

- Standby power. This is grounded in consumption of devices when they are off or otherwise not performing a primary or significant function;

- Low-power mode consumption. This began with IT devices that could save significant energy by "sleeping" (a basic power state intermediate between on and off) when idle.

Each of these brings value to the topic of Network Standby, but the last is most closely connected to it. Products that are asleep can generally wake in response to information over the network; devices that are off only change state due to a power control[3]. Unfortunately, policy around the EuP process seems rooted dominantly in the standby paradigm, which is much less suited to the network topic. We therefore feel that the Lot 26 process began at a conceptual disadvantage that it would need to overcome in the process of moving policy forward.

The standby power approach has been successful in its application to minimum power modes, off modes, and those closely related. Several factors have contributed to this:

- the existence of suitable horizontal test procedure infrastructure;
- the absence of a time dimension to the problem;
- the absence of significant user interactivity with the topic; and
- the minimal technical complexity of the functions provided during standby modes.

[3] These characteristics of 'sleep' and 'off' are not universal, but good assumptions from which to begin.

Unfortunately, none of these is true for modes in which network connectivity is involved.

The Lot 6 study on standby power concluded that "networked standby operating conditions have a large potential for saving energy" and estimated 2005 Network Standby energy use in the EU-25 as 26 TWh and rising (F/4).

The Lot 26 study notes (F/4) that "networked standby losses is a relatively new construct" primarily from the Lot 6 study. Networked standby is indeed new, but IT-oriented policy has been addressing sleep modes for two decades (and even longer for copiers).

The study observes (F/9): "The primary definition of "networked standby mode" derives from TREN Lot 6:

> *When the EuP is in Lot 6 standby according to (iii.) and offers either a remote network reactivation and/or network integrity communication, then the product is considered to be in networked standby mode.*

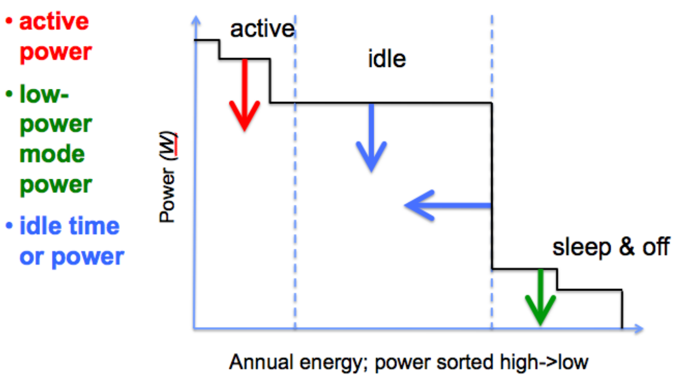
Prior to the above mentioned study, DigitalEurope proposed the following (F/8):

> *Network Standby is a low energy state in which a networked product suspends its main function, but still maintains some level of network connectivity allowing it to reactivate to a main function or some subset of the main function. The Low energy state is higher than a pure standby (device has no network function and no main function) but lower than an idle state (device has main function capability, but is currently not performing any main function work.*
>
> *Network Standby is automatically achieved after defined and/or adjustable (by user) time (time based on common standards if available).*
>
> *The reactivation functions as defined for standby in regulation (EC) 1275/2008 can be present.*

Ultimately, it is not so important what the definition is, as products will be judged not by this, but by what the test procedure they are subjected to dictates. There is however a problem with the Digital Europe definition in that it specifies that networked states are always higher than other low-power modes, as discussed below.

## Device context

Given this substrate of policy, we are aware that it was not possible for the consultants who prepared the Lot 26 analysis to explore the full range of issues and options needed. They did initiate a change in direction for this ship of state and that should over time result in a much better course. The principal act was to shift attention from a power level in a specific named mode to the issue of power management – changing the time spent in different modes. For many electronic devices, changing usage patterns is more important than changing power levels.




The figure to the left shows how energy use of electronic devices can be reduced. Power levels can be reduced when the device is active, when it is fully on (but idle), or when it is asleep or off. In addition, the time distribution can be changed, principally by moving idle time to sleep time. (Source: LBNL)

Appliance standards, traditionally only addressed energy used during the device's active use phase. Standby policy redressed this by evaluating power used when the device was off or otherwise not performing its primary function. "Standby functions" are generally unrelated to the primary function of a product.

Networks introduce functionality that is significantly connected to the primary function and so is fundamentally different. This is one reason why network standby is best considered as "sleep" (at least for electronic products).

*Product Categories*

Different product types can have substantially different characteristics that lead to different policy needs. There are a number of distinct categories, and while complete harmonization of policy would be desirable, that is not possible. Likely important categories are:

- Devices not traditionally networked, e.g. appliances. Incremental power for network connectivity should be low, as complexity and data rates are not high.

- Information Technology (IT) devices. PCs are a key example. One question is how much power is required in sleep states. However, more energy is at stake in the time potentially shiftable from on/idle to sleep, which involves network connectivity and user issues.

- Consumer Electronic (CE) devices. Both sources of data (e.g. set-top boxes and DVD players) and recipients (e.g. TVs and amplifiers) are key. The issues are the same as for IT (power in sleep, and power management), but the details are mostly different.

- Network equipment. Today these devices are almost always on continuously. While there has been effort to introduce low power modes, it is not apparent that this has been successful, or is likely to be.

- New devices. These may be wholly new, e.g. sensor networks, or new to consideration in the network context, as in having power modes, e.g. lights, lighting controls. There is little consumption of these today in a network context, but that could change in future. For these products, policy can shape technology at an early stage rather than needing to be reactive.

While a coherent structure should address all of these, the requirements can and should vary among them.

An aspect not required for appliances and network equipment is how the user — human beings — are involved. Traditional energy policy has not considered them. However, human needs and behaviour are critical to understanding energy use today, and in how energy could be saved. Traditional standby has not (needed to) consider the user. However, the consultants' reports do bring in user considerations repeatedly and in different contexts, and identify these as critical to success.

*Network Context*

Properly describing network functions requires incorporation of the concept of "layers". Networks separate different aspects of their technology into layers to enable interoperability, flexibility, and advancement in technology. While the full “OSI Model” has seven layers, these can be collapsed into three for energy purposes:

- physical link,
- basic network functionality, and
- applications

Each of these has implications for power requirements and for behaviour of the device as desired or required by the user. With the inherent complexity in networks, there is a need for much greater technical competence within the public sector (6/5).

## Notable Positive Aspects of the Report

The study contains many valuable contributions. The topic area is large and breaks new ground in attempting to address so many product types in a horizontal manner for the network topic. The study notes that the topic area is challenging due to the large number of products affected, and the rapid change of technology involved. It also notes that modes with network connectivity require more power than other low power modes and also requires considering “the interaction of more than one product” (F/4).

Different basic states of network connectivity are considered (F/10) and the importance of specific protocols is mentioned (F/11). However, a key reference on both of these is not noted[4].

There is recognition of the important dimension of time of operating modes (F/5) as well as automatic power management (and its frequent failure to engage) (F/10). The introductory section of the Task 7: Improvement Potential document is particularly insightful. The report correctly identifies “integrated power management” as the source of most potential savings (7/4), and notes that doing this involves a number of distinct groupings of products. Success in this endeavour

> *will require significant, coordinated efforts in conjunction with standardization and the development of integrated hardware and software solutions,* (7/4)

and involve

> *component and software suppliers, … equipment manufacturers, … access network and application service providers. Policy making needs to find a way to address this value chain coherently.* (7/4)

Further, in Task 6, in a discussion of best practice for consumer electronic devices:

> *With more complex, network, and storage capable devices active power management is a necessity. But at the present, no standards comparable to ACPI are available. CE industry should focus on standardization of interoperability and power management.* (6/11)

This is a clear case where the policy community needs to take the lead.

Task 5 (5/7) shows that consumption is concentrated in scenarios closest to active. Thus, if any significant portion of time can be moved from active to sleep, then this must be a large

[4] Nordman, Bruce, Hans-Paul Siderius, Lloyd Harrington, Mark Ellis, and Alan Meier, “Network connectivity and low-power mode energy consumption”, presented to the 2009 conference on Energy Efficiency of Domestic Appliances and Lighting, 2009.

(likely the largest) source of potential savings. The study does mention (F/21) the importance of "intra-device power management" (though how to accomplish this is not laid out).

For quantifying the savings potential, the report notes that this is "inherently difficult" and the authors went well beyond what is needed on this account to develop good policy. Pointing to the highly efficient nature of mobile devices as an existing proof of what is possible is also sensible.

The scope of products seems fine ("domestic" can be confusing for readers, but a feature of EU policy, and not anything specific to this study).

The First study does mention the parallel IEA 4E Network Standby study (F/6) mentioned earlier, though that project does not reappear in later tasks. The IEA 4E report was published in September, 2010.

## Main Concerns

We would like to note that the discussion of some elements of the network standby topic do seem to be lacking.

*Link Type*

The study combines all communications links, which are broadly speaking:

- network
- data
- analogue

It is appropriate to consider all communications in this study, but the three basic types of links have different characteristics which should be considered in analysis and when developing policy.

*Role of Wake Time*

The identification of resume time as THE metric of performance is not on target. Some attention to latency (resume time) is warranted, but a whole host of other topics receive scant attention, e.g. the amount of participation in the network that a sleeping device has (that is, what layers of the OSI model it implements). Long resume times can be a barrier to use of power management (e.g. imaging equipment), but that is not the dominant barrier today. The focus on convenience is absolutely correct.

It is difficult to see how Low Network Availability will be used widely in future products, which calls into question the statement (7/11) "Low network availability mode is the basic power-down target for all other home and office equipment …". Internet Protocol network protocols require response times on the order of a few seconds to function, or else the communication is deemed to have failed.

Apple computers routinely wake from sleep within a second. Microsoft currently requires Windows systems (that earn the company's quality logo) to wake within two seconds. While the addition of hardware or software to a basic system can extend these times, and some network services can require additional time, this does indicate that systems can and do wake quickly today – even complex general-purpose devices like a PC. Simpler devices should be able to wake even more quickly and many do. Even complex PCs can sleep at just a very few W.

*Terminology*

Task 7 notes (7/8) the existence of devices with long "boot times" (presumably from off), and with modes that would seem to be sleep modes which have high power consumption (tens of W). Clearer terminology would contribute to making policy regulation more transparent to users.

While the report does mostly use standby terminology, the sleep term does enter frequently. It is possible to address sleep power without mentioning standby. It is however not possible to do the reverse.

The terms "reactivation via network" and "network integrity" still seem too vague. There is discussion of these topics in the First document (F/10), but it is not revisited in later ones. The fundamental distinction to simply maintaining a data link, and full participation in the network, is not made. This issue has significant impact on functionality.

*DC products*

The report and definitions limit the scope to mains powered products. Today there are available products powered by low-power DC and their number is rising. Energy policy in general, including that for standby, should expand to equitably cover these as well.

Energy Star began recognizing DC-powered products in 2007, and now does so for imaging equipment and for displays. There is brief mention on (1/11) that DC-powered products should be considered. Exclusion of products that can be powered only by batteries is still warranted.

*Idle states*

There is the mention in Task 7 (7/10) and elsewhere that when a device is idle "there is not signal transmission or active traffic". Networked devices have a considerable amount of routine network traffic for various applications, and so some of this will occur when a system is merely idle. Some of this is generated by the device itself, and some of it is traffic from elsewhere that must be monitored and sometimes responded to. This is a feature of modern networks and not something likely to change.

*Network Equipment*

It seems unlikely that network equipment will have low-power modes the way that devices connected to them do, so this does not seem worth pursuing in general. Network equipment should reduce power as it can, particularly when data throughput is low. For power values, the Energy Star process on Small Network Equipment is planned to derive such a value, along with a system of "adders" for devices with additional capabilities, including additional ports. The EU Codes of Conduct for Broadband and Digital TV services already do this as the study notes (1/22).

Network links and equipment are generally operated at low utilization rates. While modulating power to the level of activity can significantly reduce the power needed to provide network services, this does not mean these devices are moving out of the "on" state. While network equipment may not have low-power modes, policy is still relevant. For example, it is desirable to begin to requiring use of Energy Efficient Ethernet on network equipment as well as other devices.

*User Interface*

For electronics, the user interface is a topic researched extensively several years ago[5], and the results of that work are embodied in an international standard (IEEE 1621[6]). This can provide the basis of any policy in this area. For example, colour meaning is clearly important for power control, and is covered by this research and standard. For electronics products with a network connection, having the device power down to a sleep mode (that retains connectivity) is much more likely to be acceptable to the user than to an off mode which does not.

For devices other than electronics, there is a need for attention to user interfaces, and this likely will show the need for further standards development. The report does often mention the need to attend to user issues (3/11 for example), but does not say what to do about them.

## Options

The Task 7 report includes nine options (7/15) for policy consideration. These are mostly good ideas, but key details are not covered by the task reports.

Options 1-4 are significantly entangled with the user interface, and the option descriptions note the importance of the user, and of controls having "simple and clear access, simple instructions". Option 2 references colour, which is addressed in IEEE 1621. The study notes that inconvenient low-power modes are usually not used, and gives as an example (7/13) that L3 for ADSL2+ is not used by service providers as the “several seconds transition time” is unacceptable for VOIP communications.

Options 5 and 6 propose low-power modes for network equipment. See the above Network Equipment discussion for why we think this is not a good choice. In addition, Proxying (Ecma-393) is not "interoperability with links"; rather it is about the protocols going to devices at the edge of the network, not about the link. In any case, it is not clear that proxying should require any more power on network equipment. Apple wireless access points added proxying capability in 2009 through adding software, not hardware.

Option 7 proposes that devices power down to an off state (conventional off, or a hibernate mode that has equivalent electrical consumption and method of reactivation). It seems likely that many people will disable this and so that a better approach would be to instead work towards sleep states (LowP2) that are low power, highly functional, and have quick wake times. There are some devices without network connections for which auto-power-down to off is readily acceptable (for example, copiers have had this feature for at least 30 years).

Option 8 proposes power limits for sleep modes.

Option 9 proposes power limits for what are effectively off modes (see Option 7 discussion). This likely implies a limited sense of network availability, since before 10 seconds have transpired with no response, most network protocols will assume that the device is not on the network.

[5] Nordman, Bruce, "The Power Control User Interface Standard", prepared for the California Energy Commission, 2003. www.energy.ca.gov/reports/2003-10-31_500-03-012F_APP.PDF
[6] IEEE 1621, "Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments", 2004 (reaffirmed 2009).

## The "Standby" problem/Mode definitions

There is a "theological" divide in the energy community around how to define, name, and categorize modes of products. These can be characterized as that which focuses on "standby" and another which uses "sleep" as a core term. The study acknowledges that there is a "largely un-harmonized situation with respect to environmental terminology." (F/6).

Something this raises is the question of whether power modes are "environmental" terminology – whether their most important aspect is the amount of power consumption they require, or whether it is more important what functional benefits they confer to the human being using the device. IEC 62542 (draft) takes the former view, seeing power modes as similar to chemical emission rates and similar metrics of insult to the environment. In sharp contrast, the sleep paradigm is oriented to people's use of products and their experience of them. Network connectivity is much more connected to people's use of products than to environmental emissions, which suggests that the sleep paradigm is more appropriate to use. It would be helpful if IEC 62542 did not seek to address power modes.

The study notes (F/6) that Energy Star definitions are not harmonized internally (and therefore not suitable for use in a horizontal standard). Energy Star definitions are not harmonized, but the differences are not large and reflect the test procedures and differences in product use and behaviour. Each Energy Star specification has its own test procedure, so the mode that results is a product of that test procedure. Energy Star would be served by more harmonization of mode terms for clarity, though that would not likely change the meaning of the specifications.

"Low power" is a promising term. Digital Europe's proposal (F/8) "Network Standby is a low energy state…" – suggests that "low energy" is a generic term for the topic area. Use of the descriptor "low power" is similar. (F/17) says "Network standby mode is a low power state".

In (F/4) it is stated that network functions require higher power levels than devices without them. For true network links, this may be true today, though that could change. For non-network communication, (e.g. the data link between a PC and a monitor), some current products are not measurably different in sleep and off modes, so it is not clear that maintaining the reactivation ability requires significant power for this physical layer interface. As data or network technologies are developed with very low power requirements, it is easy to imagine that some will be less than non-network standby functions, so that a network mode may be less than a non-network mode. This is a round-about way of pointing out that there is not a monotonically increasing set of named modes common across all products. This means that the common ordering on a diagram of low-power states (F/8 is an example) is misleading in that it suggests this clear ordering.

There is the problem in that a PC that is functionally off (S5 in ACPI terminology), but has Wake on LAN enabled, is in network standby state mode according to this terminology. However, the same PC while asleep but with WoL not enabled will be only in a regular standby state. This is another way that the linear ordering of functions and states breaks down.

## Testing and Regulation

Any regulation (or even voluntary specification) of network standby would require a test procedure. Network connectivity can introduce significant complexity (see the draft test procedure of Small Network Equipment on the Energy Star web site for an example). The issue of how to regulate low power modes with network connectivity was addressed in the EEDAL/2009 paper referenced above. The study notes the importance of testing (F/8), but this issue is as far as we can see not followed up with detail in the later task reports.

## Specific Technical Issues

The following is a list of specific issues noted with the report that we feel deserve comment or discussion. They are listed in no particular order of importance.

We think the first report (F/24) tends to misrepresents how most imaging equipment operates on a network. It states that imaging equipment operates like a PC, only looking for specific special "wake-up signals". There have been devices that operated this way[7], but that would not be workable for an ordinary network environment. A printer needs to maintain full network presence when asleep to be able to respond to ordinary routine data queries that do not involve any actual imaging function. This is typically done today by having the processor that interacts with the network be fully on when the product as a whole is asleep. In line with this, for network purposes, there is not a "10-15 second" latency (3/6) – that latency is for the imaging process to be able to be functional. Proxying (Ecma-393) can enable this with reduced power. Digital Front Ends for imaging equipment are essentially PCs/servers intermediate between the network and the imaging equipment. Today, these stay fully on when the imaging equipment is asleep to ensure that full network connectivity is maintained.

The point of this is that to be functional for users, imaging equipment maintains full network connectivity in sleep, and only wakes the paper-related part of the device when a print job actually requires it to. This is the model that PCs and similar devices (game consoles and IP set-top boxes) need to move to.

Frequent mention is made to Ecma TC32-TG21. In January, 2010, this working group was moved to a different committee and has been TC38-TG4 since that time. Also, Energy Star has formally recognized Ecma-393 as meeting the definition of proxying outlined in the Version 5.1 computer specification.

The first document (F/9) states that existence of networked standby modes requires automatic power management. A computer monitor only enters a sleep state when commanded to do so by the attached computer (recently models have been introduced with occupancy sensors that can also power it down, but these are exceptions). So, while automatic power management based on timers is a feature of the great majority of devices with sleep modes, it is not always required.

There is discussion (F/9) and (1/7) about different possible states of a network link. This is similar to the content in the 2009 EEDAL paper referenced above, which explores the topic of how to test devices with network capabilities for purposes of energy regulation. The test topic seems important to the issue of network standby.

The report also mentions the usefulness of Energy Efficient Ethernet (EEE, formally IEEE 802.3az) in network standby (3/9). This is true, but that technology is almost just as beneficial when the device is fully on and active. Also on (3/9) there is mention of changing the link rate as the way that the EEE operates. This was the initial proposal, but it was replaced by a different technology (Low-power Idle) several years ago. The draft Task 4 report (4/26) does note this correctly.

[7] These were noted to exist by manufacturers when developing the Energy Star version 1.0 specification. Specifically, SNMP queries (very commonly used in printers) woke the system and it remained fully on for many minutes. As a result, language was added to the test procedure to ensure that the excessive wakes these products required were measured.

Task 1 (1/6) notes that there may be brief excursions into an active mode during long periods when the device is mostly in a low-power state. This is true and needs further work to determine how it should be treated in test procedures, policy, and user interfaces. They are not an indication that the low-power mode has failed in any way.

On (1/11), ACPI states are listed. While they are listed in the standard, S1 and S2 are not used on products today. It would be helpful to group these states into On, Sleep, and Off.

The concept of “umbrella mode” is introduced (1/19); this seems to be the same concept as what IEC 62301 refers to as a “mode category”.

In the listing of product types on (4/5), game consoles seem worth including. In addition, telephones would not seem to be part of network(ing) equipment.

The four items on (4/12) under ‘remote access and reactivation’ are said to be in the context of Ethernet (IEEE 803.3). Actually, the first three are independent of the physical layer, and the fourth is not related to the topic.

In the discussion of Apple’s Wake on Demand feature, only external proxying is mentioned, though Apple has sold internal proxying for its iMac line since late 2009 (the external solution was introduced in the summer of 2009). Also, when Apple machines wake from network activity, they are able to go back to sleep quickly, and do not need to wait for the normal user inactivity timer.