ENERGY STAR Audio/Video
Draft Specification Framework
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no later than Tuesday, March 3, 2009

Document Overview

This framework document presents some key "building blocks" that make up an ENERGY STAR specification. These building blocks are found in all ENERGY STAR product specifications. The purpose of each building block is explained below along with preliminary thoughts on an approach for the version 2.0 Audio/Video specification revision. At the end of each section are a series of questions aimed at generating discussion among industry stakeholders regarding the proposed approach. Please note that these questions are not meant to be comprehensive but rather serve as a starting point in EPA's efforts to learn more about this product category.

Building Block #1: Definitions

a. **Purpose:** Establish a set of definitions to explicitly describe which products are covered by the specification. Definitions are also used to describe operational modes, key components, or sub-classes of product, all of which may factor into the testing and/or energy efficiency performance of any given model. Where possible, EPA uses existing, industry accepted definitions. However, in the case where these are not available or appropriate, EPA will work with industry stakeholders to develop and modify definitions, as needed, to ensure clarity.

b. **Suggested Approach:** EPA's intent is to update the existing Version 1.0 ENERGY STAR specification for Audio/DVD products. The existing specification, which has been in effect for some time, was designed to address stand-by energy use in a limited set of product types available at the time. The rapid turnover of products and technologies and changes in usage patterns within the category necessitates the development of a new, more inclusive Version 2.0 specification to promote greater energy efficiency in today's diverse market for audio/video products.

c. **Preliminary List of Definitions:**
   - **APD (Auto-Power Down):** The capability to automatically switch a component[1] from the On state to a Sleep state after a period of time without user input, generally based on the amount of time the component has remained "idle" from last active use, i.e., user input such as channel change, volume change, menu access, etc.

[1] EPA intends to define APD at the component level, versus at the product level, for purposes of this specification. Due to the variety of features and functions available from a typical AV product, it is EPA's belief that significant energy savings may result from enabling of APD at the component level.

- **BCS (Battery Charging System):** A combination of battery charger and battery, detachable or integral, which is intended to power a cordless product. A Battery Charger is defined as a device intended to replenish the charge in a rechargeable battery. The battery charger will connect to the mains at the power input and connect to the battery at the output. The charger may be comprised of multiple components, in more than one enclosure, and may be all or partially contained in the end-use product.
- **EPS (External Power Supply):** Also referred to as External Power Adapter. A component contained in a separate physical enclosure external to the AV product, designed to convert line voltage AC input from the mains to lower DC voltage(s) for the purpose of powering the AV product. An external power adapter must connect to the AV product via a removable or hard-wired male/female electrical connection, cable, cord or other wiring**.**
- **HDMI (High-Definition Multimedia Interface):** A compact audio/video interface for transmitting uncompressed digital data.
    - **CEC (Consumer Electronics Control) Protocol[2]:** A single-conductor wire-or bus technology that is an optional feature in the HDMI specification. CEC is meant to carry IR/remote and/or control commands between HDMI devices that are interconnected. CEC is not currently required for HDMI compliance.
- **TEC (Typical Energy Consumption):** An assessment tool used in this specification that provides flexibility to approach the issue of energy efficiency while retaining a comparable metric to assess performance. In this specification, efficiency criteria are noted in terms of calculated energy use over a year for a typical user (kWh/yr) rather than power (Watts) for On/Active and Sleep modes.
- **Operational Modes and Power States:**
    - **On/Active Mode:** An operational state in which the device is actively delivering one or more of its principal functions and some or all of its applicable secondary functions.
    - **Sleep Mode[3]:** An operational state in which the device has less capability and responsiveness than in the On/Active state. The device may enter a Sleep state from the On/Active state after:
        - the device receives a notification from the user to enter a sleep state via a power button press on a remote control or front panel of the unit, or through an electronic signal or data packet received via a digital interface on the device; or
        - the device auto powers down to a Sleep state. The energy consumption after auto power down to Sleep and after a user initiated power down to Sleep may, or may not be, equivalent.

[2] CEC is just one example of an inter-device communications protocol; EPA is interested in exploring ways using inter-device communication as a way of reducing energy consumption.
[3] Sleep mode corresponds to the IEC definition of Standby typically used in Europe. However, sleep encompasses all variations of standby including standby-networked, standby-passive, standby-active low, standby-active high. It allows a more generic and flexible definition to sleep.

        - **Off Mode:** An operational state in which the device is either disconnected from the mains, or is connected to the mains and offers no Sleep mode or Active/On mode functionality.
    - **Product Classification[4,5]:**
        - **Commercial Product:** Any AV product manufactured primarily for use in a public or commercial setting.[6] Professional AV products typically operate in On/Active mode from 8 to 24 hours per day, depending on application.
        - **Residential Product[7]:** Any AV product manufactured primarily for use in a private residence for personal rather than commercial purposes. Automotive products are not included in this definition.

d. **Questions:**
    - Are there concerns about these definitions or recommendations for clarification?
    - Are there additional definitions for audio video equipment that should be reviewed and considered by EPA?
    - Is the distinction between "Professional" and "Consumer" products appropriate for this product category? Is there industry-accepted terminology that would better fit the definitions listed in this document?

Building Block #2: Eligible Product Categories

a. **Purpose:** Identify specific product categories covered by the specification based on the agreed upon definitions developed for the first building block. This is particularly important in the case where a "one size fits all" specification is not appropriate based on varying degrees of product capabilities. It is also important to identify and clearly define those product types that are not eligible for ENERGY STAR qualification due to a number of reasons, including; proprietary technologies, limited availability of data, lack of differentiation with regards to product efficiency, or niche markets.

b. **Suggested Approach:** Audio/video products are diverse and offer a wide range of functions to consumers. New products are constantly being introduced into both professional and home consumer markets. While EPA would ideally develop a single specification to cover all these products, this may not be possible without limiting the future applicability of the ENERGY STAR label. EPA has proposed that a function-

[4] EPA has modified the product classification definitions used in previous specification development documents. The "Professional/Commercial" product category is now called "Professional", while the "Home/Retail" product category is now called "Consumer." This is in accordance with commonly used industry terminology.

[5] Each qualifying product will have to be explicitly identified as either "Consumer" or "Professional". Manufacturers will submit this information through the ENERGY STAR Online Product Submission (OPS) tool.

[6] Typical markets for Professional AV products include: Schools and universities, government, military, office, healthcare, legal, retail, museums, churches, sports arenas, entertainment, and transportation.

[7] There was a suggestion to change this term to residential products.

based specification be used for this product category – wherein specific energy allowances would be defined for each in a series of typical product functions. A product manufacturer would then determine the total power consumption allowance for a product by adding together the allowances for each function offered by the product.

c. **Preliminary List of AV Product Functions**
   - Audio
     - Amplification
     - Signal Processing (Commercial Only[8])
     - Switching & Distribution
     - Output (Speaker)
     - Input (Microphone)
   - Video
     - Switching & Distribution
     - Output (Display)[9]
     - Input (Camera)
   - Media Interface
     - Optical Drive (CD, SACD, DVD, BD)
     - Digital Drive (USB, Card reader, etc.)
   - Signal I/O
     - Network Connectivity (Ethernet, Wi-Fi, etc.)
     - Audio Tuner (OTA, Satellite)
     - Video Tuner (IP)
   - Data Storage (HDD, SSD)

d. **Examples of Qualifying Products[10]**
   - AV Receiver
     - Home Theater Receiver: *An audio/video switching device for a home theater. It contains inputs for all the audio and video sources and outputs to the audio and video playback devices. Typically includes the following functions: AM/FM tuner, preamp, audio/video source selection, processing, distribution, and a multi-channel amplifier to send surround sound signals to the audio outputs.*
     - Internet Video Device (i.e. Vudu, AppleTV): *Home entertainment device that can connect to a home network to retrieve digital media files from*

[8] Though many consumer devices have signal processing, the range of processing done goes from minor tweaks or analog-digital conversion to significant alteration of the sound or video including effects. Commercial products normally dedicated to task are more the target of this requirement. This box is typically used in professional products.

[9] NOTE: Need to determine how to test products with integrated displays. Either (1) display can be turned off for testing, or (2) display component will need to meet latest ENERGY STAR displays specification at the time of product manufacture.

[10] This specification will not cover products which only offer energy savings based on the charging system or external power adapter, since these products are eligible under the requirements for end-use products.

computers or other media server devices and play them back on a home theater system or TV.[11]

- *Media Server*
  - Whole-house Audio System: *Centralized audio/video system that distributes AV signals to different rooms throughout the home. Remotely-located control panels regulate the signals in each output location.*
  - Digital Music Server System
  - Video Distribution System
- Media Player
  - Blu-ray Disc (BD) Player[12]
  - DVD Player
  - CD/SACD Player
- Amplifier
  - Preamp: *A preamplifier (preamp), or control amp, is an electronic amplifier which precedes another amplifier to prepare an electronic signal for further amplification or processing.*
  - Power Amplifier: *A device that increases the amplitude of a signal.*
- Signal Distribution & Switching
  - A/B Selector Switch
- Speaker Systems
  - Self-powered Subwoofer
  - Wireless Speaker System
- Home Theater in a Box (HTIB)
  - HTIB System
- Compact & Portable Audio Systems
  - Compact Shelf System
  - Clock Radio
  - Boombox
  - Home Radio
  - Karaoke Machine
- *Microphone & Recording Systems*
  - Wireless Microphone System
- *Videoconference & Telepresence Systems*
  - Telepresence System
- *PA & Mass Notification Systems*
  - Building PA System
- *Control Systems*[13]*:*

[11] IP devices are included in the *ENERGY STAR Program Requirements for Set-top Boxes Version 2.0* only if they are provided within a dedicated service or service contract.

[12] NOTE: Typical BD player On-mode power consumption ~25W, though recent models on display at CES were as low as 10W. EPA would like to use a TEC calculation for BD players that includes active mode (when actively playing a disc), idle mode (when power is on but disc is not actively spinning), and standby mode (when system is turned off but still plugged into the mains).

- CCTV Camera Security System
- Touch-panel Home Control System

e. **Consumer Products: Example Function Matrix**

		Audio				Video			Media I/F		Signal I/O			
		Amplification	Switching & Distribution	Output (Speaker)	Input (Microphone)	Switching & Distribution	Output (Display)	Input (Camera)	Optical Drive	Digital Drive	Network Connectivity	Audio Tuner	Video Tuner	Storage (HDD/SSD)
Home / Retail	*AV Receiver*													
	Home Theater Receiver	x	x			x			x	x	x	x	x	x
	Web Video Device (i.e. Vudu, AppleTV)		x			x					x		x	x
	Media Server													
	Digital Music Server System		x								x			x
	Media Player													
	Blu-ray Disc Player					x			x		x			
	DVD Player					x			x		x			
	CD/SACD Player													
	Amplifier													
	Power Amplifier	x												
	Signal Distribution & Switching													
	A/B Selector Switch		x											
	Signal Processor (Analog/Digital)													
	Tuner											x		
	Pre-amp	x												
	Speaker Systems													
	Self-powered Subwoofer	x		x										
	Wireless Speaker System	x		x							x			
	Home Theater in a Box (HTIB)													
	HTIB System	x	x	x		x			x				x	
	Compact & Portable Audio Systems													
	Compact Shelf System	x		x								x		
	Clock Radio	x		x								x		
	Boombox	x		x								x		
	Home Radio	x		x								x		
	Karaoke Machine	x		x	x									x
	Control Systems (whole-house systems)													
	CCTV Camera Security System				x	x	x	x						x
	Touch-panel Home Control System	x	x	x	x		x	x			x			

[13] A/V control systems are included in this initial list of products in order to provide a comprehensive list of possible products. Since there are no known test procedures for determining criteria, EPA may explore these products as part of a separate specification focused on controls.

f. **Professional Products: Example Function Matrix**

		Audio					Video			Media I/F		Signal I/O			Str
		Amplification	Signal Processing	Switching & Distribution	Output (Speaker)	Input (Microphone)	Switching & Distribution	Output (Display)	Input (Camera)	Optical Drive	Digital Drive	Network Connectivity	Audio Tuner	Video Tuner	Storage (HDD/SSD)
Professional / Commercial	*AV Receiver*														
	AV Receiver	x		x			x			x	x	x	x	x	x
	Media Server														
	Video Distribution System			x			x			x		x		x	x
	Media Player														
	Blu-ray Disc Player						x			x		x			
	DVD Player						x			x		x			
	Amplifier														
	Power Amplifier	x													
	Signal Distribution & Switching														
	A/B Selector Switch			x											
	Signal Processor (Analog/Digital)														
	Equalizer		x												
	Tuner												x		
	Pre-amp	x													
	Speaker Systems														
	Self-powered Subwoofer	x			x										
	Wireless Speaker System	x			x							x			
	Microphone & Recording Systems														
	Wireless Microphone System			x		x									
	Videoconference & Telepresence Systems														
	Telepresence System	x			x	x		x	x			x			
	PA & Mass Notification Systems														
	Building PA System	x			x	x									
	Control Systems														
	CCTV Camera Security System					x	x	x	x						x

g. **Questions:**

- What product functions are missing from the list? Is there industry-standard terminology that would better capture the full range of available product functions in this category?
- The "Signal Processing" function is only included for the Professional category, since there is assumed to be a much wider range of signal processing equipment available in pro markets, and therefore a greater opportunity to promote energy efficient product features.

Building Block #3: Energy Efficiency Criteria and Test Procedures

a. **Purpose:** Once it is determined which products will be covered by the specification, the next step is to identify metrics for energy efficiency performance. Metrics may be representative of key components, operational modes, and/or whole system energy efficiency. The chosen metrics need to be supported by industry accepted test procedures. Minimum energy efficiency criteria will be developed based on test data using these test procedures.

b. **Preliminary Approach:** EPA intends to review test procedures from Audio/DVD v1.0 and other industry sources for applicability to this product category. In the case where no existing test procedure is available or appropriate, EPA will develop new procedures for use in this specification. EPA intends to use the TEC approach to set power consumption limits wherever appropriate. For products where the TEC approach is not appropriate or feasible, EPA will establish modal power consumption limits for Sleep, Active, and Off modes[14].

c. **Energy Efficiency Functions[15]:**
   - **Enable APD**
     - Ship products with APD enabled by default.
     - Initiate upon receipt of an internal (i.e. timer) or external (i.e. CEC[16]) signal.
   - **Use an ENERGY STAR EPS**
     - To qualify for ENERGY STAR, an External Power Supply sold with an AV product must be ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the latest version of the ENERGY STAR Program Requirements for Single Voltage External Ac-Ac and Ac-Dc Power Supplies. The EPS specification and qualified product list can be found at: www.energystar.gov/powersupplies.
   - **Use an ENERGY STAR BCS**
     - To qualify for ENERGY STAR, a Battery Charging System sold with an AV product must be ENERGY STAR qualified. The BCS specification

[14] There may be products for which Active mode power consumption limits would have an adverse effect on product quality and performance. In these cases, EPA will consider implementing modal power consumption limits for only Standby and Off modes.

[15] For those products where there is circuitry in the end device that charges a battery, follow these steps to determine whether to follow the requirements for the EPS or BCS specification: (1) closely review section 2 of the BCS specification. There are three classes of products that fit into the BCS program, along with a number of sub-requirements. Cradles to charge a battery removed from the device cleanly fit as a BCS. Other cradles or chargers "Chargers" that plug into the end device to charge but meet all the other requirements should, (2) consider whether the end device, with the battery removed, can be operated when plugged into the AC adapter (even if this is not the primary use case). If so, and the "Charger" fits the EPS program, qualify the EPS as ENERGY STAR submit the Audio/Video product for qualification through the end-use products program based on the power supply.

[16] NOTE: Per stakeholder feedback: *Manufacturers today are having trouble with CEC APD among their own product lines, not to mention other manufacturers' products. Opcodes are currently not standardized.*

and qualified product list can be found at: www.energystar.gov/batterychargers.

d. **TEC Considerations[17]:** Following is an initial list of criteria which would be used to determine whether a device is evaluated using a TEC approach or a simple Modal approach.
   - The TEC approach shall be used:
     - for products with consistent, predictable duty cycles[18], and
     - when an accepted test procedure is available to measure power consumption in Active mode.
   - The Modal approach shall be used:
     - for products that are infrequently in Active mode (i.e., where the dominant energy savings opportunity is in Sleep mode), and
     - for all products that do not meet the TEC mode criteria.

e. **Existing Test Procedures for Reference:**
   - Sleep Mode Power Consumption
     - ENERGY STAR Audio/DVD v1.0
       - Defines Sleep mode power consumption requirements for cassette decks, CD players/changers, CD recorders/burners, clock radios, DVD products, equalizers, laserdisc players, mini- and midi-systems, minidisc players, powered speakers, rack systems, stereo amplifiers/pre-amplifiers, stereo receivers, table radios, and tuners.
     - CEA-2013-A (ANSI)
       - Defines maximum background mode (SLEEP state) energy consumption of basic digital set top boxes (STBs), whose primary function is video reception and delivery. CEA-2013 also provides a detailed SLEEP state power measurement specification and procedure.
     - IEC-62301 Ed. 1.0
       - Specifies methods of measurement of electrical power consumption in standby mode. It is applicable to mains powered electrical household appliances. This standard does not specify minimum performance requirements nor does it set maximum limits on power or energy consumption.
   - Active Mode Power Consumption
     - ENERGY STAR Set-Top Box v2.0
       - Defines TEC annual energy allowances for set-top box products, considering Active and Sleep mode power consumption over a standard duty cycle. Energy allowances are determined by the base functionality of a product. Additional energy allowances are

[17] The benefit of TEC is the freedom it provides for innovative approaches to efficiency along with focusing on energy consumption and not instantaneous power draw. This also provides a mechanism for incenting, without requiring APD in products.
[18] Modal limits may be appropriate for many products, because there is no information on typical duty cycles or those products duty cycles are skewed towards one activity.

provided for each supplementary function that is added to the base product. Products with APD enabled are rewarded with a revised TEC duty cycle that includes time spent in an automatically powered down condition.

- CEA-2022 (ANSI)
  - 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.
- IEC-62087 Ed. 2.0
  - Specifies methods of measurement for the power consumption of television sets, video recording equipment, Set Top Boxes (STBs), audio equipment and multi-function equipment for consumer use.

- Test Procedure Applicability: Following is a list of product types and potential test procedures. These test procedures may not apply directly to the associated product but could be used as a basis for ENERGY STAR test procedure development.

	ES Audio/DVD v1.0	CEA-2013-A	CEA-2022-A	IEC-62087	IEC-62301	Notes
Amplifiers						UL, CEA-490, FTC, IHF
AV Receiver	x					None known
Media Server				x		Also: ENERGY STAR Computers Specification
Media Player	x	x	x	x	x	
Signal Distribution & Switching					x	
Speaker Systems	x				x	
Home Theater in a Box	x	x	x	x	x	
Compact & Portable Audio Systems	x	x	x	x	x	
Microphone & Recording Systems						None known
Videoconference & Telepresence Systems						None known
PA & Mass Notification Systems						None known
Control Systems						None known
	Sleep mode only					

- Additional Notes on Amplifier Testing:
  - EPA would like to propose a “percentage of max” approach for measuring amplifier efficiency to avoid criteria that favor one class of amplifier over another. In this suggested approach, amplifier power consumption at max

unclipped output would be measured. Power consumption limits for the no-load condition would be limited to some percentage of that maximum.

- EPA would consider using some figure other than maximum power as the baseline for amp power consumption limits, as long the resulting calculation provides a basis for meaningful comparisons of power consumption. For example, UL tests amplifiers at 1/8 of total power to simulate voice and music content.[19]

f. **Questions:**
   - Are there additional industry-standard test procedures that EPA should consider during development of this specification?
   - The duty cycle for televisions is 5 hours of On/Active mode and 17 hours of Sleep mode per day. This duty cycle would also apply to AV equipment for home use. Are there any industry resources that may provide additional insight into usage patterns for either consumer or professional AV products?

[19] As per comments from Biamp Systems: *"In Professional Applications, audio wattage requirements are determined by factors such as room size, intelligibility requirements, acoustics, etc. Therefore, energy use must be budgeted as a function of maximum undistorted audio output power. A sine wave signal can be used to identify a variety of volume levels for efficiency testing such as 100%, 30% and 12.5% maximum undistorted output. A Pink Noise signal can then be applied and efficiency measured at these same volume levels. Final efficiency can be calculated as an average of the measurements at the various volume levels."*