May 9, 2012

Commissioner Andrew McAllister
California Energy Commission
Dockets Office, MS-4
Docket No. 12-AAER-2A
1516 Ninth St.
Sacramento, CA 95814-5512

Re: DISH Network and DIRECTV Response to Invitation to Participate
Docket # 12-AAER-2A – Consumer Electronics – Set Top Boxes

Dear Commissioner McAllister:

This letter comprises the joint response of DIRECTV L.L.C. (DIRECTV) and DISH Network L.L.C. (DISH) (collectively, the "Joint Responders") in response to the California Energy Commission's ("Commission") March 25, 2013 Invitation To Participate in the Development of Appliance Energy Efficiency Measures, Docket # 12-AAER-2A ("Invitation").[1] Attached to this letter is the Joint Responders' response to the data request made by the Commission in the Invitation (Appendix B). Additionally, the Joint Responders are appending a list of links to certain documents, which the Responders respectfully request the Commission include in the record for the Invitation (Appendix A). These documents include presentations by the Joint Responders to attendees, including Commission staff, at recent California Plug Load Research Center set top box ("STB") workshops, submissions to the United States Department of Energy ("DOE") as part of its rulemaking process, submissions to the United States Environmental Protection Agency's ENERGY STAR STB Program, and the "Voluntary Agreement For Ongoing Improvement To The Energy Efficiency of Set Top Boxes" ("Voluntary Agreement"), discussed in detail below.

The Joint Responders welcome the opportunity to provide important information for the Commission's consideration with respect to possible future proceedings to amend the California Appliance Efficiency Regulations. For the following reasons, the Joint Responders encourage the Commission to defer to the DOE as it develops national rules and regulations concerning the energy efficiency of STBs and network equipment.

---

[1] DIRECTV and DISH are leaders in the delivery of satellite television service in the United States, together serving 34.1 million U.S. customers and constituting nearly 100% of the American satellite television market.

1. The Commission's Proposal to Regulate STBs is Unnecessary in light of DOE's Ongoing Rulemaking.

The DOE has determined that STBs and network equipment qualify as "covered products" under the Energy Policy and Conservation Act ("EPCA"), and is currently moving forward with its regulatory rulemaking for energy conservation standards for STBs. The DOE rulemaking process is comprehensive and already well underway. Indeed, the Joint Responders and many other parties have already submitted to DOE detailed responses concerning test procedure for measuring the energy efficiency, energy use and estimated annual operating costs of STBs and network equipment in response to DOE's Request for Information and Notice of Proposed Rulemaking. Links to the Joint Responders submissions to DOE are included in Appendix A.

Action on this issue by the Commission is unnecessary because of the federal rulemaking. In light of the complexity of the issues involved in STB energy efficiency regulation, the Joint Responders strongly believe that the comprehensive nature of the federal rulemaking is preferable to a state-by-state approach.

2. California Regulation of STBs would be Preempted by Federal Law.

Additionally, attempted regulation of STBs by the Commission would be preempted by federal law. In light of DOE's determination that STBs and related network equipment qualify as "covered products" under EPCA, California regulation of STBs is automatically preempted absent a waiver from DOE, which likely would be very difficult to obtain. 42 U.S.C. §6297. Additionally, the Telecommunications Act of 1996 also preempts the Commission's proposed rulemaking of STBs. In enacting the Act, Congress intended for "[f]ederal jurisdiction over DBS service [to] ensure that there is a unified, national system of rules reflecting the national, interstate nature of DBS service." H. Rep. 104-204 at 123 (1995). Accordingly, Section 303(v) of the Communications Act grants the Federal Communications Commission exclusive jurisdiction with respect to the states over "the provision of direct-to-home satellite services." 47 U.S.C. 303(v).

3. State Regulation would be Unnecessary, and even Counterproductive, Because of Voluntary Energy Efficiency Measures Undertaken by the Joint Responders and Others.

The Joint Responders have embraced energy efficiency as an important business metric and have demonstrated significant progress in energy efficiency improvements of our products and services. The Joint Responders are successful participants in the EPA ENERGY STAR STB Partnership Program and have met the requirement that 50% of our STBs purchased by service providers qualify to the most recent STB specification. (Version 3.0 of ENERGY STAR effective since September 1, 2011.) Additionally, the Joint Responders have announced and delivered millions of energy efficient Whole-Home DVRs and ENERGY STAR qualified Thin-Client STBs to our customers in the past year, which further reduce overall household energy consumption. In recognition for these efforts, EPA honored DIRECTV with Excellence in

Energy Efficient Product Design awards in 2010, 2011 and 2012, along with a 2013 ENERGY STAR Partner of the Year award for its outstanding contribution to reducing greenhouse gas emissions by manufacturing energy-efficient STBs.

In addition to meeting these significant milestones, the Joint Responders have agreed to even more stringent energy efficiency requirements by entering into the Voluntary Agreement along with the other major U.S. MVPDs and STB manufacturers. This Agreement requires an initial commitment from all participants that 90% of all new STBs purchased and deployed by service providers will conform with EPA ENERGY STAR 3.0 levels, which will make those boxes 45% more efficient than boxes that don't meet that standard.

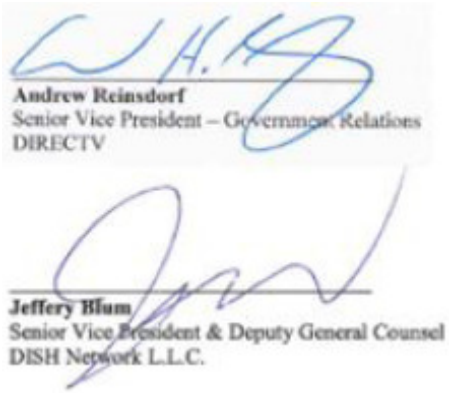
The Joint Responders fully support this Voluntary Agreement as a comprehensive, rigorous and immediately workable means to achieve the Commission's goals. Voluntary measures including industry self regulation are the preferred means for addressing the energy consumption of complex, networked, digital video service STBs that are generally owned by a MVPD and integrated with distribution networks, but deployed within the homes of customers. This provides the best framework to assure energy conservation while retaining our ability to innovate. By contrast, efforts by the Commission to regulate this rapidly changing area will likely stifle the pace of innovation, making the U.S. STB industry less competitive in the international arena and potentially slowing our progress should we need to change product development plans to meet specific Commission requirements.

Another area of collaboration, one which has the potential of delivering market transforming energy savings, is between service providers and California-based utilities. Discussed at length at the recent CalPlug workshop, the myriad opportunities of this collaboration include legacy product replacements and upgrades, consumer messaging/behavioral changes, installation of other energy savings devices, such as smart thermostats, advanced power strips, provision of energy monitoring tools and even participation in demand response solutions. These opportunities, which leverage service provider strengths, have the potential to deliver results far greater than a regulation could achieve.

We believe the success of these voluntary efforts to make our products more energy efficient today and in the immediate future belies the need for the imposition of state efficiency standards. Instead, the Joint Responders urge the Commission to defer establishing standards for STBs. This would allow the Commission to not impose duplicative, and likely preempted, regulations in the event that DOE imposes energy efficiency regulations upon STBs. It would also allow the Commission to determine if state regulation is even warranted in light of the Joint Responder's success participating in the ENERGY STAR Program and the rigorous energy efficiency commitments made in the Voluntary Agreement.

The Joint Responders appreciate this opportunity to present our views and concerns. We look forward to a continued engagement, including participation in the workshop the Commission will be hosting in Sacramento on May 29.

Sincerely,



Andrew Reinsdorf
Senior Vice President – Government Relations
DIRECTV

Jeffery Blum
Senior Vice President & Deputy General Counsel
DISH Network L.L.C.

Appendices

Appendix A
Other Documents Relevant to 12-AAER-2A
DISH Network - DIRECTV

Comments and documents relevant to 12-AAER-2A from Joint Responders and others for review by the Commission will be available at the following links:

CalPlug (calpug.org) STB Workshops –
http://calplug.uci.edu/Database/SetTopBoxWorkshopMay13/program.pdf
http://calplug.uci.edu/index.php/events/set-top-box-workshop-oct-12
http://calplug.uci.edu/index.php/events/set-top-box-workshop-feb-12

DISH/DIRECTV Comments to CEC 11-AAER-1 –
http://www.energy.ca.gov/appliances/2012rulemaking/documents/2011-08-31_workshop/comments/DIRECTV_and_EchoStar_2011-09-30_TN-62392.pdf
http://www.energy.ca.gov/appliances/2012rulemaking/documents/2011-08-31_workshop/presentations/DIRECTV_Presentation.pdf
http://www.energy.ca.gov/appliances/2012rulemaking/documents/2011-08-31_workshop/presentations/EchoStar_Presentation_2011-08-31.pdf

DISH/DIRECTV/ECHOSTAR Comments to DOE RFI –
http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-NOA-0067-0030
http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-NOA-0067-0036

DISH/DIRECTV/ECHOSTAR Comments to DOE Test Procedures NOPR –
http://www.regulations.gov/#!documentDetail;D=EERE-2012-BT-TP-0046-0019

EPA ENERGY STAR V4.1 Set-top Box Specification Review -
https://energystar.gov/products/specs/node/151
Draft 1 Version 4.1 Comments from stakeholders, including DIRECTV and DISH/ECOSTAR, were submitted April 15 2013 and are expected to be available at this link soon.
Distinct "V4.1 Launch" comments were submitted in April 2012 by stakeholders, including DIRECTV and DISH/ECHOSTAR, and are currently available at this link as well.

VOLUNTARY AGREEMENT FOR ONGOING IMPROVEMENT TO THE ENERGY EFFICIENCY OF SET-TOP BOXES -
http://www.ce.org/CorporateSite/media/ce_news/FINAL-PUBLIC-VOLUNTARY-AGREEMENT-(12-6-2012).pdf

Appendix B

DISH/DIRECTV Response to CEC ITP Information Request on Set-top Boxes and Network Equipment

I. Basic information

- **Product definition and scope**
  - **Set-top box types, thin client, router, modem?**
- **Product development Trends**
- **What product development trends in the market may have an impact on power consumption or proper categorization of devices?**

As defined in CEA-2043, a set-top box (STB) is a device whose primary purpose or function is to receive video content which is then delivered to a Display Device, recording device, or Client.

Video content for processing by a STB could be sourced from either a terrestrial, cable, satellite, broadband, or local network. While traditionally, STBs fell into the categories of non-DVR and DVR based on whether these products had the capability to time-shift content or not, more recently the concept of multiroom systems has emerged. Traditional STBs only support "direct video outputs" to one or more television sets, and include the capability to decode one or more video inputs depending on the number of TV sets supported and the availability of features like picture in picture (PIP). "Direct video outputs" include interfaces like HDMI, component, composite, S-Video, etc.

Multiroom systems are designed to more effectively and efficiently serve homes with multiple TVs and represent the trend in product development as service providers expand their services within the home.[2] In its most efficient form today, multiroom systems consist of one server and several thin client devices, with the potential for some of these thin client devices to be further subsumed (in terms of the functionality they provide) into television sets using industry standards such as RVU and DLNA[3]. Servers may also be constructed as headless STBs that do not support direct video outputs and only serve to receive the service provider's video data from its distribution network and convert that content for distribution within the home using the home network.

Beyond the kind of categorization noted above, different STBs encompass different capabilities today, including processing of Standard Definition (SD) and/or High Definition (HD) content, capability to handle different video compression technologies like MPEG-2, AVC, VC-1, etc., inclusion of functionality such as transcoding to support mobile platforms like smartphones and tablets within and outside the home, and broadband connectivity to support content delivery to

---

[2] The CEA CE Energy Use Study contains detailed information about the number of STBs per household, per SP type (http://www.ce.org/PDF/Energy-Consumption-of-CE-inUSHomes-2010.pdf). Also, Nielsen household data for 2010 indicate that: 55% have 3 or more TVs, 28% have 2 TVs, and 17% have 1 TV (http://blog.nielsen.com/nielsenwire/wp-content/uploads/2010/04/TVA_2009-for-Wire.pdf).

[3] See www.rvualliance.org and www.dlna.org for more information.

and from the STB using different networking technologies. Networking technologies vary depending on the needs of the service provider and their backbone network, and also depending on the customer home network configuration. Home networking technologies use with STBs include all versions of 802.11 (wired and wireless), HPNA, MoCA, etc.

Going forward, the variety and complexity of STB products will increase further due to many factors. New technologies such as Ultra HD, Full resolution 3D, and HEVC encoding are on the horizon to support the next generation of video features. Further consolidation of multiple functionalities, including the STB functionality into a single "Home Gateway" device, may result in further improvements in overall system efficiency and reduction of costs (including energy). Such gateway functionality could include telephone services and/or modem functionality.

The CEC is invited to read the DISH/EchoStar /DIRECTV Response to DOE RFI EERE-2011-BT-NOA-0067. (Referenced in Appendix A) The attachment document contains detailed technical answers to a series of questions posed by the DOE and explains in detail the overall operation of a satellite TV STB and the overall broadcast system.

- **Existing test procedures**
- **Existing Standards and Standards under development**

The CEC is referred to the DOE RFI EERE-2011-BT-NOA-0067 for more information with regards to test procedures that have been historically utilized. Current procedures and standards for STBs include the EPA's ENERGY STAR Program Requirements for Set-top Boxes Version 3.0, Canadian Standards Association's (CSA) test procedures C380-11, and Consumer Electronics Association's (CEA) industry standards CEA-2013 and CEA-2022. Additionally, the International Electrotechnical Commission's (IEC) industry standard IEC-62087 includes STBs in its scope.

The Industry developed and supported CEA-2043 STB Power Measurement test procedure standard which is in the process of being released. This test procedure will be used by the industry as the basis of all STB testing procedures going forward. Even as the DOE investigates its own test procedures in this regard, it will be primarily based on CEA-2043.

- **Sources of test data**

Test data is available on the EPA's Qualified Product List.
http://downloads.energystar.gov/bi/qplist/Set_Top_Boxes_Product_List.pdf
The CEC will note that the industry has achieved dramatic reduction in energy usage in STBs over multiple generations while increasing the functionality and complexity of these products. The EPA's Qualified Product List includes all STBs that are qualified for the current Version 3 STB program. While the final QPL for the previous Version 2 STB program (effective from Jan 1 2009 to August 31 2011) is no longer available on the EPA website, CEC is encouraged to request this from the EPA.

Note that the Pay TV industry has adopted a Set-Top Box Energy Conservation Agreement, and as a part of their commitments towards managing the energy usage of their products in that

home, will be putting out test results for their products on an annual basis in this regard going forward.

- **Product lifetime for each product type (products expected time in service after first deployment)**

STB lifetimes are impacted by: the adoption rate of new TV technologies (e.g., HDTV, 3DTV), which require new STB technologies; the availability of new and desirable STB features (e.g., DVR); the general growth rates of the industry (e.g., churn rates, subscriber gains/losses); advances in satellite transmission technologies which require new STB technologies; and advances in video encoding technologies that require new STB technologies. STB lifetimes historically have been from 6 to 7 years. However this was likely affected by the 2008 US Digital TV Transition and the resulting availability of HDTVs. The U.S. satellite MVPD industry experiences a significant customer churn rate in the range of 1% to 2% per month. The result is that a significant amount of customer equipment is returned, remanufactured, and reused for new customers' installations. Remanufactured products account for a significant percentage of new STB installations.

II. Operations, Functions, and Modes

- **What are the operational states of Set Top Box (STB) and network equipment? Are there methods for measuring each of these states?**

At a most basic level, there are two modes of operation for an STB: when it is actively providing one or more video streams to customer devices and when it is not providing video streams. There is far more complexity involved in defining the details of the operation of an STB. Even the basic function of providing video to customers can happen in many ways depending on the features of the STB. Regardless of whether the STB is providing content to customer devices, it is always connected to the service provider's source network, and in the case of satellite networks, there is constant communications from the satellite(s) that are required for proper functioning of the STB, regardless of whether the customer is accessing video or audio programming. These constant communication functions are related to security to protect the satellite communications link, security to protect the digital content once decoded within the STB, and critical management of the operation of the STB such as electronic channel guide updates, operational firmware updates, changes to channel positions within the satellites themselves, and the occasional download of premium and advertising content to a DVR STB.

As noted, video outputs can be provided in many different ways by the STB depending on its capability. The STB might output video directly though one of its many HD or SD output ports in digital or analog form. On the other hand, the STB could be serving one or more Clients STBs with content streams over the home network interface. In fact both processes may go on simultaneously. Each output process impacts power consumption differently. The content that is being output, either via a direct video output or home network interface, could be sourced from either a live input to the STB or from the hard drive if the STB includes DVR capability. The source content stream for a video output could also be compressed using different compression algorithms, and the content could also be at a SD or HD resolution at the input to the STB. Additionally the customer may choose to exercise functions such as fast forward, rewind, pause,

etc. A DVR STB also includes a recording functionality, and the degree to which this kind of functionality is being exercised also depends on the number of simultaneous recordings that the STB is capable of making. DVR STBs have different performance capabilities if they are required to serve a whole home or only a single user. The number of concurrent user activities that need to be supported impacts; the number of input tuners required, the speed of data transfer and the number of concurrent content streams supplied by the HDD, the processing capability of the SOC (system-on-chip), and the performance requirements of the home network interface. By way of example a Whole Home DVR STB could have the exact same size HDD capacity (e.g. 1TB) as a Single User DVR - however a Whole Home DVR would require a higher performance, more energy consuming, and larger form factor (e.g. 3.5 inch) HDD versus a lower performance, lower energy consuming, and smaller form factor (e.g. 2.5 inch) HDD, since the performance requirements and reliability of a Whole Home HDD, serving the total household, is a much more demanding application. Recordings can be made both when the customer is viewing and not viewing video using the STB, also affecting the need to support concurrent operations.

While it is in theory possible to measure power consumption in every possible state of the STB, it is in most cases impractical to try to list all of these states and attempt to make such measurements in each of them. In fact, the difference between products makes it impossible to define each state in a manner that could be considered applicable across all products.

As STBs become more complex and include more functionality, there are other states that should be considered because they impact energy usage. Feeding content to mobile devices from a STB is likely to require transcoding functionality that results in different levels of power consumptions. A simple feature such as Picture-in-Picture involves two simultaneous decoding functions which will tend to change energy usage, and decoding functionality for more complex compression algorithms such as HEVC is expected to result in increased energy use.

The complexity and performance of the content security system, the performance level of the imbedded microprocessor(s), the number of audio and video output interfaces supported (*e.g.*, HDMI, component, composite, S-Video), the size and performance level of the HDD (DVR STB only), the number and types of home network interfaces simultaneously supported (*e.g.*, 802.11, HPNA, MoCA), and the power supply efficiency all impact power consumption.

- **What is the most consumptive state, which is the lowest consumptive state (other than a mechanical off)?**

The redeeming consideration in all of the above is that the difference in power consumption for many of the above states may not be very significant. The challenge in creating a testing regime is in grouping the different states of the STB appropriately based on power consumption in such a manner that it applies to all products. The most consumptive state is likely to be when the STB is operating at full functionality, supporting all possible outputs simultaneously with the maximum resolution it is capable of and with the most complex compression or transcoding algorithm that it supports. In general, operation of the hard-drive in the context of exercising the

DVR functionality will result in higher power consumption. The least consumptive state is when no customer interactions are taking place and the only tasks going on are related to network maintenance. Examples of modes in which the STB can be expected to consume different amounts of instantaneous power include, record, play, rewind, fast forward, light sleep, deep sleep, off, multi-room or multi-stream viewing, maintenance, STB software updates, feeding mobile devices, etc.

- **How frequently are products in each of these states?**

The frequency of a product being in each of the states that it has the capability to be used in depends on the functionality of the particular STB, the usage patterns of the customers, and the service provider's network setup. One could attempt to get insight studies of such statistics and usage patterns through sources such as Nielsen who have done studies in this regard. Such studies have to be tempered by the consideration that current STB products are being used in different architectures where the usage on one of the STBs affects the usage of the other, especially in the case of server-client architectures. Also customer usage models for the home are changing constantly. Note the current shift in behavior patterns related to customers to viewing more of the content on mobile devices such as smartphones and tablets.

The current ENERGY STAR usage profiles have a basis in information from the Nielsen Television Viewer Measurement Group (http://www.nielsen.com/us/en/measurement/television-measurement.html).

- **How well does energy consumption scale with the utilization of hardware such as processors by processing load and networking hardware by data rate/volume, number of client, etc?**

In general, energy consumption directly scales with the extent of usage of hardware. Changes in energy consumption of STBs, however, depends on the types of hardware used. It is not possible to come up with a generic formula in this regard that will cover all possible hardware architectures and STB implementations. STBs can implement different technologies for their "System-on-Chip" (SOC) functionality and peripheral connectivity. At the core, the chipset could include dependence on a DSP based architecture rather than fixed hardware to enable some of the needed functionality. Core processors come in different categories, some more energy efficient than others. In some cases, the chipset might use multiple smaller processors in places of a single processor to manage the STB. Multiple chipsets may be used to manage different aspects of the STB usage. Peripheral support may or may not be included in the core chipset based on maturity of the technology and ability to integrate the functionality into the technology that the core chipset is based on. Power consumption will increase with the data flow requirements, and higher resolutions, more complex algorithms, increase in the numbers of peripherals (such as clients) supported will result in the need to move more data around, which will result in wider data buses, increased speeds, and more energy usage.

In general, as technologies mature, more is integrated into the core chipset, including functionality related to receiving signals from the service providers' network at the input, and connecting to peripherals such as displays and network interfaces on the outputs. This integration tends to reduce energy usage, but could constrain some of the means of managing

power consumption because of interdependencies within a chipset. Ultimately, energy usage in a chipset is managed via the hardware driver interface. The ability to scale power consumption with usage is also tied heavily in the software architecture on the STB, which could limit the ability to manage individual hardware drivers due to dependencies that tie different hardware elements at the middleware level. The interdependencies arise when higher level functions make use of multiple capabilities of the chipset simultaneously. Since satellite STBs must maintain communication with the satellite fleet many major system functions such as; tuning, demodulation, decompression, decoding, decryption, parsing of specific channel content, and storing critical information to an HDD or other non-volatile memory need to be continuously operational. This results in minimal possible savings during Sleep modes. The satellite industry has therefore placed significant emphasis on reducing "ON" or "Active" power levels in addition to investigating new innovative techniques to reduce consumption when in "Sleep" modes.

- **What components and functions represent a fixed energy consumption while the product is on or in a sleep state?**

The STB needs to be constantly operational on a number of different levels. At the core level the processor needs to maintain the state of the system, and communicate with the system memory that is used to store the operational parameters. The operational status of the STB, including its interfaces and peripherals (to the extent possible), is being monitored constantly. The STB is in constant communications with the service provider network using the STB front end, providing key parameters related to operations of the STB, including security, updates of user's account information, setting of timers for recordings, program guide updates, software updates, STB maintenance, prepositioning of content to customer's DVRs, etc. The processor constantly needs to be listening to user inputs, be it traditionally via the remote control, or be via new technologies that allow devices such as smartphones and tablets that communicate via the network interfaces for this purpose. Hardware elements that are involved in all of this processing include the power supply, the processor, memory, the hard drive, interface chipsets (if applicable), etc.

- **What minimum functions are required to be maintained by networking protocols?**

From the networking perspective, bringing a networking link into full operational state requires that all protocol levels be brought up to operational state starting with the physical layer up to the application layer. The requirements for maintaining the network protocols are dependent upon how quickly that network needs to be brought up to operational mode. In the case of STBs the network interfaces are used in real time so that customers can get quick access to video programming and other features such as setting of recordings, timers, etc. Therefore the requirements are fairly stringent. Satellite STB home networks are primarily based on the use of the MoCA protocol (http://www.mocalliance.com). In the case of MoCA, it is the time needed to establish the MoCA node on the MoCA home network that is a gating factor, and this is why current MoCA 1.1 implementations require the physical layer to be constantly up and running. While MoCA 2.0 is designed to keep the physical layer operational with a lower energy level, the energy use analysis must take into account that MoCA 2.0 can only realize additional energy savings if all devices on the network support MoCA 2.0. For instance, current whole DVR STBs and Thin Clients STBs from satellite providers support MoCA1.1. If a new STB utilizing MoCA2 is introduced into the market it can only realize the energy savings in a small percentage

of homes due to the existence of MoCA 1.1 STBs already installed in a customer home. When all STBs in a home use MoCA 2.0 technology it may indeed result in energy reduction.

- **What are the consumption characteristics of Low-Noise Block (LNB) and Optical Terminal Network (ONT) devices**

LNBs provide the interface between the satellite signals and the satellite signal feed network in the home for a satellite service provider. The LNB receives the low power RF signals, amplifies them, and down converts them to a signal frequency that is suitable for further distribution. Since the satellite service provider use satellites at multiple locations at multiple RF frequencies, each LNB that is used needs to be designed to the signal characteristics of the particular satellite that it is meant to operate. Because of the vast distances traversed by the RF signal from the satellite, the signal that arrives at the LNB is at a very low power level, and needs to be extracted from the noise floor. Signals that arrive at the LNB suffer various levels of degradation during transmission because of atmospheric conditions and this has to be dealt with in the LNB. Furthermore, signals transmitted at different frequencies in the Ku and Ka frequency bands experience different kinds of attenuation during transmission and this has to be factored into the individual LNB design. LNBs are an essential component of the satellite service provider's signal delivery system without proper operation of which the service provider's network essentially breaks down.

An individual LNB typically consumes between 1 to 2 watts.[4] This power consumption should be considered in the context of being able to reliably process a signal that has traversed more than 22,300 miles through the atmosphere from a solar powered satellite. This should also be considered in the context of a typical satellite single tuner Energy Star qualified HD STB that consumes between 10 to 20 watts.

III. Energy Saving Technologies, Components and Features

- **What power management features exist at both the system and subsystem levels?**

The basic mechanism in a STB to reduce power consumption is by turning off the principal function of the STB, which is its video output. This happens when the customer either puts the STB into sleep mode or the STB executes an Auto Power down (APD) function after a predetermined period of the STB not being accessed by the customer. A satellite STB must keep in communication with the satellite fleet. A large percentage of deployed satellite STBs, as of January 1, 2013, contain an APD function that is set at a default of 4 hours or less.

A more sophisticated STB that supports DVR functionality may have other hardware elements that can put into lower power states, including tuners, external HDD interfaces, analog outputs if not being used, and home network interfaces if not being used.

---

[4] Note also that while we have not observed significant power variation based on received signal or noise, LNB energy consumption is impacted by the physical distance between the power source and the ODU unit. Generally, LNB power is supplied over the ODU coaxial cable up to distances of 150 to 200 feet, depending on the provider.

At the core level, power management takes place by changing the state of hardware devices and is accessed by lower level software drivers provided by our SOC manufacturers. As more fine control of various functions is offered to satellite providers it may be possible to realize increased energy savings in both active and sleep modes.

Power usage can also be managed by the use of efficient power supplies. Satellite service providers use power supplies that meet the highest Level V efficiency standards. Internal power supplies, used in some STB models, are designed to meet high levels of efficiency with some reaching 90% efficiency levels. In summary, STBs manufacturers use highly efficient power supplies to reduce heat, to use smaller cooling fans (if needed), and to improve reliability.

- **What types of events cause a STB or network equipment to automatically awake from a sleep state?**

Sleep mode is defined in CEA-2043 as "*A range of reduced power states where the STB is connected to a mains power source and is not providing any Principal STB Function. The STB may transition to ON or OFF mode due to user action, internal signal, or external signal. The power consumed in this mode may vary based on specific use or configuration. If any Principal STB Function is activated while operating in this mode, the STB is assumed to transition to ON mode. Monitoring for user or network requests is not considered a Principal STB Function. An STB may be expected to transition from SLEEP mode to ON mode within a specified time interval however such considerations are outside the scope of this standard.*"

The STB typically wakes up from a sleep state in response to user inputs, most often in order to enable the Principal function of viewing video programming. Sometimes users access the STB in order to perform some other function related to STB operation, such as setting up of recording timers, or setting of STB parameters, but these events are typically accompanied by the STB turning ON. The user can access the STB using either the remote control or the network interface. Note that there could be variations in power consumption in the STB in sleep mode due to various background tasks that take place, while still maintaining the power consumption at a lower value than when it is in its ON state.

- **How long does it take products to wake from various sleep modes? What contributes to this wake time?**

Wake times for STB in use today from sleep modes could range from the order of fractions of seconds to tens of seconds depending on the complexity of the STB. It depends on the time it takes to bring up the individual hardware elements of the STB and to recover to the previous state before it went into a sleep mode. The goal of the service provider is to minimize start-up time in order to provide the customer with the best possible entertainment experience. This requirement is a critical element in the determination of how sleep mode is implemented in a STB. Today's satellite STBs transition from Sleep to ON in 2-3 seconds. However if power is removed from a satellite STB it generally takes upwards of 5-8 minutes to restart, reacquire the satellites, update the user guide, and be ready for use.

- **What types of operations prevent a STB and network equipment from entering a sleep state? What are some of the satellite specific barriers to sleep modes?**

Satellite STBs cannot implement a deep sleep mode because they maintain permanent communication with a network to allow for programming changes, security updates, and network resource configuration changes. This continuous connection also supports other consumer-driven features such as remote access from mobile devices and customer purchases of premium content. Many important and essential system activities take place via the STB when a user is not actively watching television.

Unlike other MVPD systems that employ a two-way communication relationship, satellite STBs employ a one-way, continuous connection with the satellite network. This means that although the satellite STB receives information from the satellite, the STB cannot send information back to the satellite. The result is that satellite STBs cannot achieve a deep sleep without resulting in an unacceptably long restart time and missed or out-of-date user information. This is a critical difference between satellite STBs and other STBs. Requiring current satellite STBs to function with a deep sleep mode would significantly limit the competitiveness between satellite STBs and STBs that do not rely on satellite technology. Indeed, interrupting the one-way satellite connection on a regular basis with a deep sleep mode would disadvantage providers of satellite television and video to a point where customers simply would not tolerate the long restart times and updating requirements. Satellite systems should not be discriminated over two-way cable and Internet Protocol (IP) based systems simply because of the inherent limitations of a one-way satellite delivery system.

Several regulatory proponents suggest that satellite STBs should be able to enter deep sleep if connected to the subscriber's home Internet network. These parties assert that the Internet can be used to download updated information to the STB that is missed while the STB is in deep sleep mode. However, third-party Internet connections are outside of the control of the satellite provider. There is no assurance of the availability, performance, and reliability of this communications path as a means to support critical and secure communications. Indeed, many rural satellite television customers currently do not have reliable Internet access. Additionally, any data sent by the satellite service provider would count against the subscriber's internet service data cap, and that would largely be unacceptable to subscribers. DISH and DIRECTV both encourage their subscribers to connect their STBs to the Internet to access additional services, but those additional services are not critical to the delivery of primary video content. The lack of an Internet connection does not result in a reduced user experience. Relying upon a customer's broadband provider to obtain critical programming updates is not a realistic solution to allow for satellite STBs to implement deep sleep modes.

- **To what extent are energy efficient mobile networking technologies incorporated into the most efficient products?**

Satellite STBs generally do not include mobile technology since STBs are not mobile devices. The core hardware is designed for a feature set that is not present in even the most sophisticated smart phones and tablets today. This feature set includes: complex requirements for tuning to satellite networks that consist of multiple satellites, capability to process multiple simultaneous high speed bitstreams from the satellites and from network connections simultaneously,

capability to decode, decompress and format high resolution video inputs at high input bit rates, present video to external devices in multiple output resolutions, sophisticated security implementations that prevent piracy of content, and the ability to support multiple client devices with high speed streams. The STB has to undertake these functions in an extremely reliable manner that provides the customer with an excellent entertainment experience. STBs include no cellphone communication technologies. For instance, many cellphones include a Wi-Fi connection (e.g. 802.11n) however this level of Wi-Fi is not adequate to guarantee the delivery of high bit rate HD content to any room in a typical household. Additionally, most video delivered to cellphones is done using adaptive-bit-rate (ABR) technology which will lower the bit rate to whatever the communications path which will result in the a softening of the displayed image. This technique is acceptable for the small screen sizes of a cellphone or tablet however it is not acceptable for a Pay-TV service on a large HDTV.

- **What are the costs associated with more efficient hardware such as energy efficient Ethernet technology?**

Service providers use home network architectures that fit properly with their signal distribution technologies, and which can avoid need for further wiring of the customer's home. In the case of satellite providers, the use of MoCA over the homeowner's coax cable is a typical configuration. Service providers are looking into the possibility of using wireless networking to connect the devices in a server-client architecture, noting that the quality of the wireless link used in this case must be good enough to provider "service provider quality" video. Satellite service providers typically do not use Ethernet technology since that would require installation of new wiring.

It has been suggested in a recent DOE STB study (NODA) that additional saving can be achieved for DVR STBs by using more energy efficient hard-drives. While details of the technology behind these energy efficient hard-drives were not explicitly stated, any potential energy savings must take into account the different performance requirements between a single user DVR and a Satellite DVR & Video Server (Whole Home DVR). A Whole Home DVR (WH DVR) must supply twelve (12) or more HD video streams concurrently. It must serve a whole household of Thin-Client STBs in addition to its own local video streams. Whereas a single user DVR has a minimal requirement for multiple concurrent video streams (2-3 streams). A WH DVR generally needs a larger storage capability than a single user DVR. The analysis of technology and efficiency must include consideration for these application scenarios.

The same DOE study (NODA) also suggested the energy savings are possible by use of a SOC Sleep mode. It is not clear if the SOC sleep savings projected by the analysis (up to 4.75W) can be fully realized due to the satellite STB requirement to maintain continuous communication with the satellite fleet. At least one satellite transponder communication path including tuning, demodulating, decrypting and decoding must be maintained by the SOC when in a sleep mode bringing into question the dramatic savings projected by the analysis.

- **How well are hardware efficiency features utilized by system software?**

Hardware efficiency features are used by the system software to the maximum extent possible. For instance it may be possible to lower the power consumption of various features that are not

used in a particular customer installation such as analog video outputs, interfaces for optional external HDDs, or other hardware based features. The satellite industry continues to investigate further opportunities to lower energy use, as STBs using less energy will tend to be more reliable, but without impacting the user or creating large customer support expenses for technical support calls and "truck rolls" to customer homes.

- **What types of products are powered by network connections such as "Power-over-Ethernet"?**

Satellite providers do not currently use Power-over-Ethernet interfaces. Power-over-Ethernet is generally used with small networked devices such as entry way security cameras and various convenience sensors to eliminate the need to install a separate power source for the device.

IV. Market Characteristics

- **How many STBs, modems, and routers are sold to end-users each year in California? How many are currently in use? Commercial or residential?**

Most satellite STBs are provided to customers on a lease basis. There are approximately 79 million satellite STBs in use by primarily residential customers in the US.[5] The US satellite industry currently reports about 34M subscribers yielding an average 2.3 STBs per subscriber household. The commercial side of the business is insignificant compared to the residential customer business. We do not currently have specific industry subscriber counts for the California market however in preparation for the August 2011 CEC STB Workshop, DISH created an estimate which indicated that California represented about 9% of the DISH subscriber base or about 1.3M subscribers. As an initial estimate, California would represent a similar percentage for DIRECTV subscribers.

- **To what extent is the market uniform or different within the State, country continent, and world?**

The distribution of customers within the State of California is typical of the rest of the country, with greater concentration of customers in higher population areas, but also with penetration levels impacted by specific locations and the nature of the competition in those locations. For example, satellite TV penetration will be higher in areas where there is no cable and/or telco infrastructure. Satellite may be the only option for subscribers in rural areas.

- **Is there a particular time of the year when new models are released?**

No.

- **What is the range of efficiency in the market for products with similar performance? Is the variance great?**

As described in the earlier section, the features sets of products released to the market at a particular time can vary widely, and the efficiency of implementation of a particular feature in a

---

[5] ECOVA (http://www.ecova.com) presentation at the 2012 ACEEE summer workshop – "Pay-Television In-Home Equipment: National Energy Consumption, Savings Potential, Policy Barriers and Opportunities"

product also changes with the maturity of the feature, and therefore the product. There is always the overarching goal of designing the product to be as energy efficient as possible given the state of the technology, but the primary objective is to make sure that the feature works properly and provides the best customer experience possible. In general, if there are multiple versions of a particular product, the energy usage of all versions will tend to be similar because the technologies used in these products will be similar.

- **How frequently are STB, routers, and modems updated after initial release (firmware and hardware)?**

STB software is updated on an as-needed basis. When products are new there is likely to be more software updates than when they reach a certain level of maturity. Software updates also happen to support new features, or modifications to existing features. Sometimes the changes could be related to regulatory requirements, for example, those having to do with accessibility features (e.g., closed captioning, emergency alerts, etc.). In the past, software updates have been used as the mechanism to enable the APD feature in STBs that are already out in the field in order to reduce energy usage.

V. Market Competition for Efficiency Products

- **How many small businesses are involved in the manufacture, sale, or installation of these products?**

Different service providers use different approaches to run their business models. Usually, STBs are manufactured by one or more vendors that are selected by the service provider. While the vendors are generally responsible for the details of the hardware design (based on service provider specifications), the hardware design itself is likely to involve the use of components from several vendors. Product distributors order and stage products for installation. In general, the satellite industry uses hundreds of distributors and installers that are under the small business category.

- **What are the current market drivers towards improving efficiency?**

The primary motivator for service providers to improve energy efficiency is to improve reliability, eliminate noise producing cooling components and to reduce overall operational costs. Inefficient product design leads to shorter product life and impacts profitability and customer satisfaction The Set-Top Box Energy Conservation Voluntary Agreement is also a driver. The industry is committed to ensuring that 90% of products deployed will meet ENERGY STAR 3.0 energy usage limits.

Carrying an ENERGY STAR logo on a product is an increasingly important market driver since the ENERGY STAR brand enjoys extremely high consumer recognition.

- **What markets currently place requirements on the efficiency of products through regulations or procurement requirements?**

The satellite providers are both ENERGY STAR Partners and are required to purchase ENERGY STAR qualified STBS for a minimum of 50% of all STB purchases. In fact both satellite

providers far exceeded the 50% minimum and DIRECTV has actually exceeded 95% of purchases. Service providers work with their vendors to ensure that the products that they deploy meet requirements so that the ENERGY STAR target is achieved. The Voluntary Agreement increases the target to 90% for 2014, and will continue to set targets for deployment of energy efficient product for the following years until 2018.

- **How are consumers able to identify the most efficient products in the market?**

At the current time, the ENERGY STAR Label and the products listing on the ENERGY STAR Qualified Product List on the EPA web site allows customers to identify products that meet certain energy efficiency targets. As part of the Industry Voluntary Agreement all signatories have agreed to list energy consumption data for all STBs on their respective web sites for use by customers. Additionally the Voluntary Agreement will issue an annual compliance report that will list all qualified STBs.

- **What is the current market share of products that meet ENERGY STAR's STB specifications 2,3 and 4 and latest small network equipment draft version 1?**

Satellite service providers are shipping products that meet ENERGY STAR 3.0 specifications today. DIRECTV recently announced that 95% of products shipped in 2012 were ENERGY STAR 3.0 compliant. While the mix of ENERGY STAR version 2 and 3 products in the market today may not be known, there is a natural tendency in the industry to move towards newer products as more capability and features are supported. In other words, there is a natural process of attrition by which the older and less efficient products get replaced by the newer and more efficient technology with time. Note that ENERGY STAR V3.0 is the program currently in place for STBs, and that the ENERGY STAR V4 program specification is expected to be finalized in the next few months.

VI. STB Specific Market Characteristics

- **How many STBs are purchased by service providers each year?**
- **How many STBs are in service in California? What percentage of STBs have been in service for 1, 2, 3, 4, or 5+ years?**

The satellite industry purchases between 10 and 15 million STBs per year. Based on the CEA study of the energy use of CE products, the satellite industry averages about 2.3 STBs per subscriber. The Satellite industry does not currently have detailed data for California for the total number of STBs and their age.

- **How do service providers determine how much to charge for a STB?**

STBS are leased as part of a subscription service that includes installation, equipment, and various content packages.

- **How are requests for more efficient set-top boxes resolved by service providers?**

We generally do not receive requests for more energy efficient set-top boxes since most of our STBs are already meet the latest ENERGY STAR specifications. As requests for a particular STB model are rare, they are handled through ad hoc, manual processes.

- **How do set-top box manufacturers collaborate with service providers during research and development (R&D)?**

Service provider and manufacturers collaborate in developing specifications for the next generation of products. Manufacturers understand the technical requirements for proper operation of the STBs. Service providers understand the customer services they want to offer. A compromise is reached to provide the best product within an acceptable cost profile.

- **For STBs where constant connection is required, how do service providers handle customer implementation of energy saving technologies such as smart power strips?**

We strongly recommend that the customer not remove smart power strips to STBs since the lifeline of the service depends on the STB not losing communications with the satellite. If a customer is using a smart power strip incorrectly, such that the power to the STB is cut off regularly, we advise them to move the STB to an always-on plug. As the STBs take some time to become operational after power is restored, customers are incented to comply with this recommendation.

References

1. CEA-2043 draft
2. DISH Network L.L.C., EchoStar Technologies L.L.C., and DIRECTV L.L.C. Response to DOE Request For Information Concerning Energy Conservation Standards for Set Top (EERE-2011-BT-NOA-0067).
3. DIRECTV L.L.C., DISH Network L.L.C., and EchoStar Technologies L.L.C. Response to the DOE NOPR – Energy Conservation Program: Test Procedure for Set-Top Boxes (EERE–2012–BT–TP–0046).
4. Energy Star Program Requirements Product Specification for Set-top Boxes: Test Method Rev, Jan-2011 (2011)
5. CE380-08: Test Procedure for the Measurement of Energy Consumption of Set-Top Boxes (2008)
6. CEA-2013-A: Digital STB Background Power Consumption (2007).
7. CEA-2022: Digital STB Active Power Consumption Measurement (2007)
8. IEC-62087: Methods for measurement for the power consumption of audio, video and related equipment. Edition 3 (2011) Section 8.
9. http://downloads.energystar.gov/bi/qplist/Set_Top_Boxes_Product_List.pdf
10. http://www.nielsen.com/us/en/measurement/television-measurement.html
11. http://www.ce.org/PDF/Energy-Consumption-of-CE-inUSHomes-2010.pdf
12. http://blog.nielsen.com/nielsenwire/wp-content/uploads/2010/04/TVA_2009-for-Wire.pdf