ENERGY SOLUTIONS

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Dear Docket Office Staff,

At the direction of Gary B. Fernstrom of Pacific Gas and Electric, on the behalf of Pacific Gas and Electric, I am submitted the following document (file name DTA CASE Report 6_20_06.pdf) for insertion into the Docket for the EPS and DTA Rulemaking is 06-AAER-1.

Please note: yesterday, I submitted a previous version of this document (MS Word format) that had a missing section to certain employees of the Commission. References to that deleted section have been removed along with the extra header. In the event that Messers Tutt, Wilson, Holland or others at the CEC may have forwarded that previous version (a word document title DTA CASE Report 6_19_06.doc) [note the different date extension] for docketing on my behalf, I request that the now obsolete document be recalled and replaced with this version.

Regardless of whether you received the previous document, please do insert the attached current document into the docket.

Please don't hesitate to contact me if you have any questions.

Thank you for your consideration!

Ted Pope

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Codes and Standards Enhancement Initiative
For PY2006: Title 20 Standards Development

DTA Standards Feasibility Research Report

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Submitted On:
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Executive Summary

An estimated 15% of California households do not have cable or satellite television systems and therefore will be directly affected by the upcoming national transition to digital-only terrestrial broadcast television programming. Digital television adaptors (DTAs) are a plug and play solution for the three million existing televisions in these households not capable of receiving digital television signals. California adopted a Title 20 energy standard for DTAs in December of 2004. Subsequent to the adoption, the Consumer Electronics Association has led an active effort to convince the Commission to eliminate the standard, a standard for a product that does not currently exist in the US market. The California Energy Commission has, as a result of the industry allegations, indicated a willingness to reconsider the standard in the near future.

In support of the adopted standard, Pacific Gas and Electric Company (PG&E) directed its technical consultants to hire an electronics specialist to further evaluate the feasibility of the standard in view of industry comments subsequent to the adoption of the standard. Energy Solutions hired Paul Rudnick to gather the necessary technical and market status information to further evaluate the existing standard and identify potential savings beyond the standards level. Mr. Rudnick's analysis shows that manufacturers may comply with the California standard using off the shelf components at cost lower than estimated for products not meeting the standard. Furthermore, he found that power requirements could be reduced to one-fourth of the minimum set by California if a product is designed with energy as a key design criteria and using new componentry that is announced but not yet on the market. Based on his findings, the PG&E consulting team strongly encourages the retention of the California Energy Commission DTA standard of 8 watts active, 1 watt standby. Furthermore, we recommend a 4 watt active Energy Star standard level for consideration by EPA in its new initiative described in Appendix B.

Introduction

As part of the federally mandated national conversion to digital broadcasting, terrestrial broadcasting of analog television signals will cease on February 17th, 2009. Most stations are already broadcasting digital television signals along with the analog. An estimated 15% of California households do not have cable or satellite television systems and therefore rely solely on terrestrial broadcasts for television viewing. While an increasing number of televisions sold in the last few years have digital tuners and are capable of receiving digital programming, many new and all older "legacy" televisions not equipped with digital-ready tuners will not be able to receive terrestrial broadcast television programming beyond the transition date. We estimate that by 2009 three million televisions in California will be both unconnected to cable or satellite systems and unable to view digital terrestrial broadcast signals.

External digital television adapters (DTAs), while not yet available for the American market, will soon become available to convert the digital signals into analog signals for the legacy analog televisions. To ease the transition, the federal government will be providing consumer rebates of approximately $40 per DTA for up to two DTAs per household starting on January 1, 2008. DTA prices are expected to be on the order of $50 to $60 per unit at retail (before rebate).

Based on the energy consumption of DTAs deployed in other countries, it is expected that simple (i.e., minimal feature set) DTAs made for the American market would draw on the order of 18 watts in active mode and 5 watts in standby mode—in the absence of regulatory and/or high impact voluntary efficiency programs. Furthermore, it is not clear whether the DTAs now being conceived by industry will spend a significant time in standby mode. The deployment of three million DTAs in California, therefore, could very likely increase statewide annual energy usage in 2009 by over 400 Gigawatt hours and increase statewide peak load by more than 50 megawatts.

Substantial improvement in DTA energy efficiency is technically possible and several voluntary and code specifications have been developed around the globe to address the savings opportunity. In 2004, the California Energy Commission (Commission) adopted a DTA appliance efficiency (Title 20) standard that limited power input to 8 watts or less in active mode and 1 watt in standby mode. PG&E supported this particular DTA standard level as part of its Consumer Electronics CASE study leading up to the adoption. This Title 20 rulemaking was a rare opportunity to eliminate manufacturing "stranded assets" associated with implementation of appliance standards by setting performance expectations prior to manufacturers finalizing their designs and gearing up production infrastructure. While the California Energy Commission proactively engaged industry, including the Electronic Industries Association, during the two year development and adoption process for this standard, industry was essentially non-responsive in justifying or elaborating on their opposition to the standard. Since the adoption in 2004, the Consumer Electronics Association (CEA) began aggressively lobbying for the repeal of the California DTA standard. The Commission considered changes to the DTA standard as part of a review of the external power supply standards revision process in 2005 and early 2006. Given the urgency of the revision process for external power supplies and the desire to collect more information on DTAs, the Commission ultimately did not make any changes to the DTA standard, but indicated a willingness to hear industry concerns and reevaluate the standard in the future.

Research Objective

In response to CEA's pressure following the adoption of the DTA standard, Commission staff, the Natural Resources Defense Council (NRDC), and PG&E have been looking further into CEA concerns to re-evaluate the feasibility of the DTA standard. PG&E directed Energy Solutions, one of its Title 20 technical consultants, to hire Paul Rudnick to assist with additional research due to his expertise in this specialized technology area and because he had already provided related consulting services to Commission regarding DTA standards feasibility. Davis Energy Group, which authored the PG&E standards proposals for consumer electronics, including DTAs, provided additional technical assistance in contributing to and reviewing this summary of the recent DTA research.

Paul Rudnick was charged with assessing what energy efficiency levels were feasible for simple DTAs and recommending an appropriate level for California standards and voluntary efforts such as Energy Star. More specifically, Mr. Rudnick was charged with gathering specific industry data including parts lists, power budgets for components, and approximate material costs for product "constructs" that could meet both Commission and proposed voluntary specifications. Additionally, Mr. Rudnick was charged with recommending whether to construct a product prototype that could demonstrate compliance with the Commission standard and potential voluntary program levels. This report synthesizes the findings and recommendations of Paul Rudnick's research to date.

Research Approach

The methodology used in the research included meeting with or calling representatives (typically application engineers) or manufacturers of DTAs and DTA components to ascertain what systems designs would be used and what components (chipsets) are currently available or announced for availability over the next year. Specification sheets were obtained from manufacturers for many of the components considered in this analysis. The rated energy consumption was noted for each component. Consideration was given to how the components would work together and from these data, power requirement estimates were calculated. Two overall questions were addressed: 1) What would be the power requirement for a hypothetical DTA based on components currently on the market today and 2) what would be the power requirements for a best-in-class hypothetical DTA to be built with components announced for availability in late 2007 or early 2008. Special research emphasis was placed on developments in the handheld mobile market, as streaming video/TV is a fast growing development area with many new products expected in 2007 and 2008. As these devices are battery powered, the design of these new components will be optimized for minimal power use to increase battery life. As such, transfer of this technology to DTAs will reduce DTA power use. These mobile chip developments, more than developments in the general set-top box market, are representative of where DTA standards and guidelines can and should go, given the minimal functional requirements of DTAs.

Overview of Television Broadcasting Signal Processing

Until recently, all televisions in the United States received terrestrial broadcasts via the National Television Standards Committee (NTSC) analog transmission standard. This is a broadcast format that uses a 6 Mhz wide "channel" that is commonly identified as channel 2 to 69. Each "channel" contains the information that is needed to produce a black and white image (luminance), color (chrominance), and sound (audio). The channels are located in the 54Mhz to 760Mhz band and use frequency modulation to carry the signal. Selecting a "channel" on the television causes a tuner to select the specific channel frequency, down-convert it to an intermediate frequency (usually 45 Mhz), and then amplify, demodulate, and convert it into the components of luminance, chrominance and audio.

The reception of non-terrestrial signals (e.g., cable and satellite) is similar except that the tuning function is performed over a different frequency range. For cable, there are more channels available as excluded frequencies in the broadcast band are available to the cable provider for their own allocation. For satellite the frequency band is optimized for the specifics of a satellite down link. Nonetheless, the functions that are required to decode and present the analog signal are similar:

- Tune to the broadcast frequency of the desired station,
- Down-convert the signal to an intermediate frequency,
- Demodulate the broadcast signal, and
- Extract the luminance, chrominance and audio information.

Nearly a decade ago, work began by the Advanced Television Standards Committee (ATSC) to upgrade the terrestrial broadcast system to a digital format. This work was carried out in order to allow for more channels, provide higher definition formats, and free up the current analog spectrum for use by public safety communications equipment. Almost all broadcasters in the United States are now transmitting both analog and digital signals and will be required to turn off their analog transmissions on February 17th, 2009. The format of the digital broadcast is fundamentally different from the above described analog format, but the processes required to receive and extract the video and the audio information is similar: tune, downconvert, demodulate, and decode.

The ATSC standard uses a system known as 8-level vestigial sideband (8-VSB) to encode the digital signal, which contains one of 18 potential formats of the video signal as well as 4 formats of audio[1]. The 18 video standards range from standard definition (480i - similar to NTSC resolution) to high definition (1080i). The complexity of the signal requires a more precise and complex tuner to tune and downconvert the digital

[1] Europe and some Southeast Asian nations selected Coded Orthogonal Frequency Division Modulation (COFDM) instead of 8-VSB and require a different tuner and demodulator than the ATSC standard.

signal. A completely different demodulator process is required for this digital television signal and the output of this process is a digital data stream, not luminance, chrominance and audio. The digital data stream is in MPEG-2 (motion picture experts group standard 2) format. Due to the efficiency of the MPEG-2 encoding process, it is possible for a broadcaster to fit more than one signal in a "channel". The result is that the consumer will be able to receive, for example, "channel" 4-1, 4-2, and even 4-3 depending on the resolution of the format. The ATSC signal also contains Program and System Information Protocol (PSIP) data. PSIP data contains a set of tables that describe the sub-channels, the current time, program ratings, and event information. A receiver can use this data to build an electronic program guide.

DTA Functionality

After the termination of analog broadcasting in February 2009, a set-top box will be needed to receive the ATSC digital signal and convert it to a standard definition NTSC video and audio signal. We call this set-top box a digital television adaptor (DTA), also known as a digital terrestrial converter.

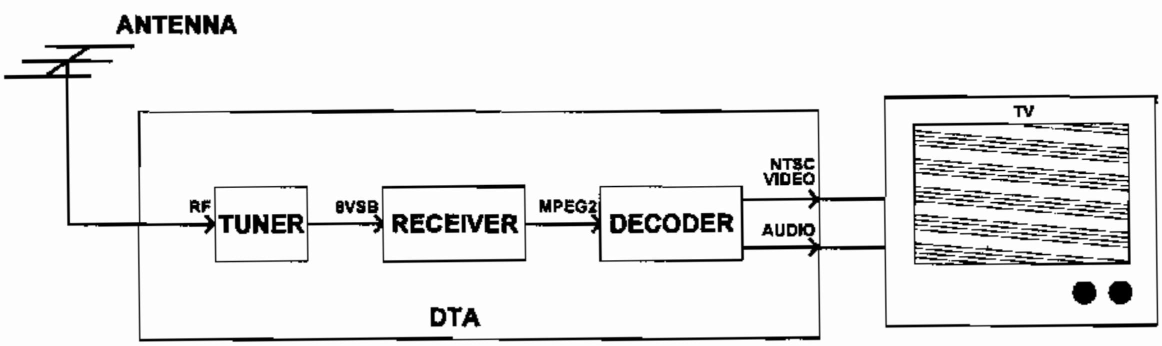
The California Energy Commission Title 20 standards define DTAs as follows:

"Digital television adapter" means a commercially-available electronic product for which the sole purpose is the conversion of digital video terrestrial broadcast signals to analog NTSC video signals for use by a TV or VCR.

The DTA must accomplish three functions: tuning – the selection of the desired 8-VSB signal; receiving - the demodulation of the 8-VSB signal into a MPEG-2 stream; and decoding – the conversion of the MPEG-2 digital HD stream into a standard definition NTSC video and audio signal. The components that provide these three functions are known as the:

- Tuner
- Receiver, and
- Decoder.

Figure 1. DTA Function Diagram



Tuner

There are fundamentally two tuner styles. These are the "tin can" and the single chip. Tin can tuners traditionally are physically larger, have many individual components, and tend to consume significantly more power than single chip tuners. Tin can tuner power can range from 1.5 to over 3 watts. Single chip tuners themselves are characterized by the core technology upon which they are based. The earliest single chip tuners utilized gallium arsenide (GaAs) materials to achieve the speed needed for the highest frequencies of the television band. These designs were characterized by high cost and high power consumption. GaAs designs are now being replaced by both silicon germanium (SiGe) and pure silicon (Si) designs, with silicon having the lowest power consumption. Single chip tuner power can range from 0.35 to 1.2 watts, depending on the type and vendor.

Receiver

A number of single chip receiver designs vary from the early Skytune to state-of-the-art implementations by Broadcom and Philips. Early designs actually had lower power draw than the current designs, as new features and functions have been added to the core designs. However, simple receivers now draw less than 1 watt.

Decoder

A number of vendors have decoder products available including Zoran, Broadcom, Philips, and even firmware implementations on programmable integrated circuits. Power consumptions vary by architecture from 3.5 watt down to less than 1 watt.

Most recently, several vendors have announced new components that combine the receive and decode functions together on a single chip. These vary in power from 3 watts to less than 1.2 watts. With the development of broadcast receivers for cellular phones, the power required and the compression of functionality into single components will continue with a handheld implementation available early next year at much less than a watt for all three functions.

One of the fundamental problems for implementation of a low-power DTA is that chip designers attempt to provide the maximum functionality in each design so as to address the widest possible market for each chip. Chip design is extremely complex and expensive, with development times of greater than a year. Therefore, product marketing managers often specify designs that reach multiple markets and clients, rather than focus on a minimal requirement market such as the DTA. However, power consumption is computed as a function of the number of design blocks needed and is only computed once a package for the IC is required, late in the design cycle. In the case of simple DTAs--a product with comparatively limited market potential--it would appear that manufacturers intended to construct DTAs using chips that are were designed to meet higher functionality (and greater power requirements) appropriate to fully-featured set top boxes and other more sophisticated electronics. On the other hand, the drive to put television in mobile devices will produce parts that are viable for an extremely low-power DTA implementation.

Energy Consumption

In general, the designers of mains-connected consumer electronic products have not treated power consumption as a primary design criteria. Rather, feature set, time-to-market, and cost have been the primary design criteria. Power consumption falls out as a derivative parameter rather than a design specification. When power consumption is considered a primary design criteria—as in the case of mobile devices—the incremental cost of energy efficiency is minimized.

In this analysis, we considered three approaches to estimating future DTA energy use.

- First, we looked at the energy use of DTAs manufactured for foreign markets including Europe and Australia, which may provide a reasonable proxy for the baseline performance of future North American DTAs in the absence of standards or other regulatory or programmatic strategies that drive DTA efficiency.
- Second, we evaluated the estimated efficiency of a DTA conceptual design presented by industry in the context of the California Energy Commission hearing, the design of which was based on currently available parts.
- The third approach was to estimate savings for the technically achievable, reasonably priced unit designed with energy efficiency as a key design criteria, taking advantage of the latest components announced for delivery by mid-2007 in time for production of DTAs in later 2008.

DTA energy consumption is estimated based on active mode power consumption and standby mode power consumption (potential standby power requirements are discussed in a later section). There is great uncertainty over how much time DTAs will spend in standby modes. NRDC has been actively working to encourage the CEA DTA guidelines subcommittee to include requirements for a factory default set auto-shutdown. These proposals have not been embraced to date and our understanding of the conversation is that manufacturers may not attempt to include auto-shutdown features. If most DTAs will require manual standby mode selection, the expected amount of standby time will be small. The savings assumptions included in this report assume 80% active and 20% standby when averaged out across California households.

Expected baseline energy performance

DTAs sold in Europe and Australia appear to use technology which is at least two generations old with low levels of integration, power hungry components, and additional functionality beyond the DTA. Levels in current Australian HD DTAs range from 12 to 35 watts in active mode and from 2 to 20 watts in standby mode. This translates to a range of 88 to 280kWh/yr. Over the 5 year life of the box, this could easily translate to a range of $66 to $210 per box in electric costs, which exceeds the likely cost of the set-top box. Please see Appendix A for more calculation details.

Current off-the-shelf solutions

On the behalf of CEA, Vikram Shrivastava of Zoran, a manufacturer of chipsets and consumer electronics products, presented the California Energy Commission with an estimate of probable best case power requirements for simple DTAs. While power requirements for each DTA function were presented as ranges, the point was made that DTAs could not be presumed to be made to meet the 8/1 watt standard. As the first step in this research, Paul Rudnick and others met with Zoran to further discuss Zoran's estimates. The Zoran team demonstrated a number of products that include Zoran chip and chipset solutions. This included a DTA constructed with a tin can tuner, an Oren receiver chip, and a SupraHD-650 MPEG processing engine. This unit included 32 MB of frame store, an antenna alignment tool, and an advanced set of algorithms for picture management including, color density, hue, brightness and contrast. In addition, support was provided for closed captioning, full 5.1 audio processing and V-chip.

We note that the Zoran construct was, in fact, receiving an HD signal off-air, tuning, demodulating, decoding and then transcoding the HD MPEG signal to NTSC baseband in the power budget shown in Table 1, below. This function is included in the SupraHD family of processors that Zoran has developed, as well as in the Thompson, and Broadcom chips. It should be noted that some stakeholders still hold the view that an additional 5 watts of power is required for transcoding HD to SD signals compared to DTAs that receive SD signals. Older designs, upon which, the 5 watt rule of thumb is based, did not transcode natively. The early efforts internationally, focused on demonstrations that the channel modulation coding, 8-VSB, worked in urban and suburban settings with reflections and real world interference. This is why transcoding was left until late in the development cycle as it was not required to show proof of concept. This "additional 5W" is not required with current and future designs.

After an extended, detailed and constructive discussion with Zoran representatives, Paul Rudnick used the Zoran DTA construct as a starting point from which to investigate more precise power requirement specifications and component substitutions--in general, power ranges were given that had bounds as much as 50%, but accurate measurements with a 5% bound are usual from a chip vendor.

Using their datasheets, Paul Rudnick found that the unit should be 6.7 watts active, not including the power supply. If an 84% efficient power supply is substituted for the specified 57% one, the total power draw would be 8 watts—meeting the current standard active power level. This was the result of analyzing their design with their publicly available information, and for components that were listed in their presentation.

Furthermore, using alternative components that are currently available – excluding better components under development or to be announced this quarter – we were able to get well below the 8 watt standard, inclusive of an 80% efficient power supply. Thus, a new design accomplished now for a January 2009 introduction was possible. The table below represents the power data by function.

Table 1. Per Unit Active Power Requirements Data (watts)

	DTA Estimated Input Power (watts)				
	Zoran design		PG&E coneptual designs		
Component	Low	High	Zoran (low) with efficient power supply	Zoran (low) with single chip receiver and eff power supply	Low power design
Tuner	0.9	1.5	0.9	0.9	0.4
Receiver/demodulator	0.75	1.2	0.75	2.7	1.2
Decoding	3.0	3.5	3.0	incl. above	incl. above
Memory	1.5	1.5	1.5	0.8	incl. above
Assorted analogue	0.5	0.5	0.5	0.5	Incl. above
Subtotal	6.7	8.2	6.7	4.9	1.5
Power supply	5.0	6.0	1.3	1.2	0.5
Total	**11.7**	**14.2**	**8.0**	**6.1**	**2.0**
Power supply efficiency (%)	57%	58%	84%	80%	75%

Source: First two columns from Zoran, presentation to the California Energy Commission, January 30, 2006. Remaining column data obtained from product specification sheets and conversations with manufacturer representatives.
Note: Standby power requirements of the Zoran construct were not specificially evaluated. Standby power consumption is discussed in a later section.

Best Feasible Design with Parts Available in 2007

Analysis of newly announced and soon to be announced components yield far more substantial energy savings opportunities. Not only are the new chips more efficient, but the functions are being combined into single chip solutions for multiple functions. For example:

Tuner power has been significantly reduced with the transition in technology from GaAs to SiGe to pure Si (Microtune MT2131 and the Xceive 3028). This trend will continue with the drive to cell phone television receivers. While much of this work today is for single chip solutions that use the 3G capabilities of the carrier networks, there is also a broadcast standard (DVB-T and DVB-H) that is being endorsed by industry. Single chip solutions for similar complexity as DTA reception are being implemented at less than 350 mW (Microtune 2266).

Xilinx has a software partner that has done a transcoder for HD to SD conversion that needs about 1 watt (compared to the 3.5 watts for the Zoran chip). A custom chip such as the Zoran SupraHD should use less power than a programmable IC such as the Xilinx, from which we conclude that the Zoran solution incorporates significantly more functionality than is needed in its proposed DTA chip and that the SupraHD processor family is actually one design.

LG will have a product that will include their new single chip receiver/MPEG processor. Phillips has a single chip solution that will be available prior to end of year. Broadcom has even combined the receiver function with the MPEG decoder into a single chip design (Broadcom BCM3560) to reduce the footprint for next generation set-top boxes. This has reduced the power to less than 2 watts for the combined functions but there are no customers for this part at this time as it does not support personal video recording functionality (NAB 2006). It is unclear if this part will be placed into production without a launch customer.

These new chips make a 2 W active goal seem feasible. Products that could be designed to meet such a stretch goal would incorporate a state of the art tuner (as shown by Microtune 2266 (350 mW), and a next generation receiver (e.g., Broadcom BCM3560 running at 100Mhz rather than 250Mhz) and with the HD to SD transcoded rather than brute forced. This part would need around 1.2 W. Such a design would consume well under 2 watts including power supply efficiency.

"Standby" energy performance

Current set-top boxes do not support a true sleep mode that can be activated by the consumer. In general, when a user powers off their television, they rarely do the same with the set-top box. In addition to this behavior, the current generation of set-tops that support cable and satellite services support a significant number of housekeeping tasks even when in standby. The tasks include continuously downloading program guide information, uploading pay-per-view data, usage tracking and confirming system security. These encompass nearly all of the functionality of the set-top and, as a result, the standby power is equivalent to the active power on virtually all set-tops. This trend we believe has driven the CEA to resist the establishment of a maximum low power dissipation level for the new DTA.

A review of the requirements of a DTA suggests a completely different functionality in support of a very low current standby standard. Specifically, the DTA will not retain a multi-channel program guide, but rather will be refreshed once each minute in the data stream from the broadcast channel that it is tuned to. In fact, each time a new channel is selected, the user will need to wait for the refresh interval before the program guide "catches up." The requirement that the DTA "track" an incoming channel is now irrelevant as each time the DTA is tuned to a new channel, the acquisition and tracking interval will be virtually the same as from power up. The delay that a user experiences from a "cold start" (versus that experienced by selecting a new channel) will be the same because broadcasters on different channels each have their own master clock and timing references that are completely asynchronous—unlike cable and satellite systems that provide synchronous timing references across their spectrum.

The requirement that a DTA can be powered up by a remote remains the sole use of standby current. This has been demonstrated in current television designs to be on the order of less than 100 mW. Thus, it is anticipated that the DTA standby power will be on the order of one tenth of the adopted California standard. We presume that a properly designed DTA standby mode shall require enough power to recognize a remote control power up command and retain the last channel viewed, both channel number and sub-stream if so selected. No other functionality need be enabled in standby for a simple DTA to serve its purposes.

Cost Considerations

There has been considerable concern that the California Energy Commission power dissipation standard of eight (8) watts will require an increase in the cost of the unit over current designs that dissipate greater amounts of power. These concerns are without merit as designs with currently available components that nearly meet the power standard have cost basis's that are less than $30. New designs that incorporate latest components can easily meet the standard and have a cost under $18.

The period from April 2005 to present has seen the announcement, development and pilot releases of highly integrated components that are less power greedy, use the current integrated circuit design rules, and feature small die size. In fact, several of these designs are pad limited, not core limited. (In designing a silicon chip, the floor plan designer must consider how many connections to the outside world are required and then allocate enough real estate for these connections, called pads. The pad is more than just a place to attach a wire; it must include static protection, current limitations, and whether the connection is an input, an output, or bi-directional. The core elements include the main functional blocks of the chip.)

Examples of these parts include the Broadcom 3650 which incorporates the entire receiver function as well as the MPEG decoding and digital to analog processing, including two dimensional signal processing. This part features a less than three (3) watt power dissipation with all internal blocks operational, and a 474 pin PBGA package. At an announced cost of $7 in large quantities, and when coupled with a second generation tuner, a complete assembled DTA with remote has a total cost under $20. Considering that a direct to retailer solution will permit the retailer an excellent margin of nearly 50%. (Sharper Image usually attempts to achieve a 60 percent margin, while Toys R U's margins vary from 30 to 40 percent. (Personal knowledge based on sales to these two vendors) Best Buy attempts to hold to 30 percent but acknowledges that 25 percent is typical (2006 Annual report.))

Table 2. DTA Cost Estimate Summary

	Estimated Costs for Specified Zoran Construct	Zoran DTA Re-analyzed with 80% Efficient Power Supply	Simple DTA Alternative to Zoran (with better available parts priced at volume of min. 1 million guaranteed, one time buy)
Estimated Power (watts) (including power supply)	12-14	8.3	6.1
Tuner	$ 5.00	$ 5.00	$ 3.00
Receiver/demodulator	$ 5.00	$ 5.00	$ 4.00
Decoding	$ 5.00	$ 5.00	$ -
Memory	$ 1.20	$ 1.00	$ 1.00
Assorted analogue	$ 1.00	$ 0.50	$ 0.50
Internal power supply	$ 3.00	$ 5.00	$ 5.00
Subtotal	$ 20.20	$ 21.50	$ 11.50
Conversion	$ 3.00	$ 3.00	$ 2.50
Remote	$ 2.00	$ 2.00	$ 1.00
Package	$ 0.50	$ 0.50	$ 0.50
Manual	$ 0.75	$ 0.75	$ 0.50
Warranty reserve	$ 1.00	$ 1.00	$ 1.00
Total cost	**$ 27.45**	**$ 28.75**	**$ 17.00**

Details for the cost buildups can be found in table above. Estimates for cost have been provided for the current Zoran DTA design discussed above. A few costs were updated in the second column to reflect prices currently found in the market for memory, assorted analogue and a more efficient power supply (estimates vary between no incremental cost to 2 to 3 dollars). The third column shows costs for a two chip implementation that could be designed and prototyped today and with a first production ship date mid-2007. As would be expected, the newer, higher level of integration actually results in lower costs than with the current implementations. The estimates are based on component pricing extrapolated from the die yield from 12" wafers and core size on current design rules, package cost, assembly and testing. The tuner cost is estimated based on currently quoted wafer prices for 8" SiGe wafers, yield, package, assembly and test, where test includes some RF cornerstone testing to confirm yields.

Conversion prices are based on quotes from Flextronics (private communication using 3Com pricing), other prices based on personal experience with high volume products (1.25 million per month), warranty reserve based on total component count and failure estimates, not consumer discontent or inability to use the product, only DOA)

Conclusions and Recommendations

The research to date clearly indicates that there are a number of possible off-the-shelf solutions for building low cost, simple DTAs. On that basis, we strongly encouraged the retention of the California Energy Commission DTA standard of 8 watts active, 1 watts standby. This can be readily accomplished today with current technology and careful engineering inclusive of an 80% efficient power supply. These designs can be completed and manufacturing begun well prior to the termination of analog broadcast in February of 2009, and to the January 1, 2008 start date of the $40 federal rebate.

Marketing groups at current set-top manufacturers (e.g., Scientific Atlanta) do not have this DTA on their roadmaps and probably will not attempt to fulfill this perceived niche (NAB 2006). It appears that there are foreign manufacturers who are prepared to engineer and manufacture the DTA however, some lack the marketing and sales expertise to bring the product to market.

The component manufacturers are driven entirely by their customer base, which, as indicated above, do not have this product on their roadmaps and have asked for feature richness and minimal foot print for their product families, rather than energy efficiency. This has driven one manufacturer to support a chip whose features can be enabled or disabled so as to fulfill three market niches. (Zoran Supra HD product family) The result is a common design that consumes the same amount of energy even though features have been disabled.

Design of low power DTAs within the 8 watt standard is possible today and with the opportunity for two design cycles prior to the market window meeting an Energy Star 4 watt goal, would be possible, as well. Two set-top box manufacturers have confirmed that they could easily design, and manufacture units in the low millions within an eight month timeline. They lack the go-to-market capacity and would need to have a strategic partner to succeed (SWT 2006). This company is already producing customized set-top boxes in large quantity for private labeling and distribution worldwide.

Other component manufacturers have indicated that they have interests in supporting energy conserving designs by adding power control to their current, fully-featured components but only if driven by their customers (Philips 2006).

It is the authors conclusion that without a mandatory standard, there is little incentive in this market to develop the simple DTA (irrespective of the 17th February 2009 deadline), nor to drive lower power consumption in next generation set-top designs. Rather, set-top vendors will continue to focus on first cost, feature richness for product differentiation, and the addition of personal recording solutions.

A minimal DTA needs to be defined so that consumers will not have to pay more than $40 for the unit, and include descriptions of the program guide, v-chip implementation, and last channel viewed, and meet a maximum four (4) watt power requirement, including power supply. A demonstration unit should be assembled and configured that meets the price and power standard.

Based on these findings, we recommend the following:

- The California Energy Commission standard should not be modified.
- EPA should consider a 4 watt active mode specification for the Energy Star standard level.
- The Energy Star program should also strive to include an auto-power down requirement. Ideally, this feature would come factory pre-set to take advantage of the lower energy consumption of the standby state.
- The authors also recommend that California IOUs or the California Energy Commission have a prototype built that demonstrates that power consumption below the proposed Energy Star level is feasible and reasonable and that performance would as acceptable (quick channel changes, good picture, etc.)

References

NAB (National Association of Broadcasters convention). 2006. Personal communications. April.

SWT (Shenzhen Wanlida Digital Technology Co. LTD). 2006. Personal communications, April.

Philips Components 2006. Personal communications, April.

Appendix A

Assumptions

DTA use (hrs/yr)	Hours	%
Active	7,008	80%
Standby	1,752	20%

DTA power (W)	Basecase	CEC std
Active	18.0	8.0
Standby	5.0	1.0

Elec cost ($/kWh)	$0.15
Life (yrs)	5

Number of DTAs	CA	US
	3,000,000	40,000,000

Results

Savings/DTA	Basecase	CEC std	Savings
kWh/yr	135	58	77
$/yr	$20	$9	$12
$/life	$101	$43	$58

CA savings	Basecase	CEC std	Savings
kWh/yr	404,712,000	173,448,000	231,264,000
$/yr	$60,706,800	$26,017,200	$34,689,600
$/life	$303,534,000	$130,086,005	$173,448,000
MW	54	24	30

US savings	Basecase	CEC std	Savings
kWh/yr	5,396,160,000	2,312,640,000	3,083,520,000
$/yr	$809,424,000	$346,896,000	$462,528,000
$/life	$4,047,120,000	$1,734,480,000	$2,312,640,000
MW	720	320	400

Appendix B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

April 5, 2006

Dear ENERGY STAR® Stakeholder:

The US Environmental Protection Agency (EPA) is launching the development of an ENERGY STAR specification for Digital Television Adapters (DTAs). The purpose of this letter is to provide some background on the ENERGY STAR program, to explain the Program's interest in DTA's and to alert you to an initial stakeholder meeting we have planned.

ENERGY STAR is a voluntary, public-private partnership. More than 1,500 manufacturers currently participate in the program, qualifying over 35,000 product models across 40 product categories, including a broad array of consumer electronics and information technology products. (A complete list of ENERGY STAR products can be found at www.energystar.gov.) More than 60% of Americans nationwide recognize the label, with 30% of households reporting that they knowingly purchased a qualified product within the past year.

The ENERGY STAR program benefits partners by benefiting their customers. Last year alone, with the help of ENERY STAR, Americans saved $12 billion dollars on their energy bills and prevented 35 million metric tons of greenhouse gas emissions – equivalent to the emissions of 23 million cars

According to a survey conducted in May 2005 by Opinion Research Corporation for the Consumer Electronics Association (CEA), approximately 33.6 million (12 percent) of the 285 million televisions in use in the United States are used to view over-the-air (OTA) programming. Following the February 17, 2009, analog transmission cut-off for OTA programming, these televisions will need DTAs in order to continue displaying OTA programming. Anticipating the large scale manufacture and sale of DTAs presents a unique opportunity to take steps to ensure these new devices are as energy efficient and cost effective in operation as possible.

EPA is launching this effort now, well before the 2009 transition, to give manufacturers time to design products that meet ENERGY STAR. EPA invites stakeholders to participate in an initial meeting to discuss this specification in the June/July timeframe in Washington, DC (an exact meeting date and detailed logistics to follow). This meeting will be key as EPA begins development of a draft of the specification and we hope you can participate. EPA recognizes that efforts to encourage the efficiency of DTAs are underway in Canada, Australia, China, and California for example, and is tracking this work. Unlike other more established product categories in the ENERGY STAR portfolio, DTAs are not yet on the market and therefore EPA's specification setting process will involve some forecasting of where the market can go from an energy efficiency perspective. As such, EPA invites both component providers and potential DTA manufacturers/resellers to bring information related to state of the art designs that use one or more digital chips to perform the key DTA functions to the planned stakeholder meeting.

As EPA moves forward with developing a specification for DTAs, we will solicit input from all stakeholders on an ongoing basis. Stakeholder participation is critical to developing a meaningful specification and to the overall success of ENERGY STAR. As such, we welcome your input and encourage you to periodically visit the ENERGY STAR Web site at www.energystar.gov/productdevelopment for important updates. Please also feel free to contact me at (202) 343-9120 or osdoba.katharine@epa.gov with any questions or comments.

Best Regards,

Katharine Kaplan Osdoba

Katharine Kaplan Osdoba, EPA Product Manager
ENERGY STAR for Consumer Electronics