



# **DTS Premium TV™: A Higher Standard for TV Audio Entertainment**

White Paper

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## Executive Summary

Most of today's flat panel televisions produce less than ideal sound through internal speakers. Without costly add-on accessories, such as soundbars, consumers have few options to improve the low quality, two-channel audio such TVs produce. The audio experts at DTS have created a way to enhance flat panel television sound using DTS-HD decoding technology coupled with DTS Envelo and DTS Symmetry post-processing solutions. Together, they enable TVs to deliver virtual surround sound, improved bass response, clearer vocals, and consistent loudness. Consumers offered TVs that bear the DTS logo can expect premium sound quality that exceeds their expectations.

## TV Audio Processing, Speaker and Loudness Issues

As television design has evolved, video quality has steadily improved, while sound quality has deteriorated. This is due to the acoustic limitations of slimmer flat-panel TVs. Insufficient bass, unclear dialogue and poor overall frequency response are typical problems that manufacturers of these televisions need to solve.

While the TV consoles of yesteryear had ample room for larger speaker components and many good, front-firing speaker configuration options, today's flat-panel TVs are severely space-constricted. Small, limited-range stereo speakers point down, to the side or even to the rear in some models, limiting their ability to deliver a rich audio experience. Users can buy add-on audio equipment to gain better sound, but many are put off by the extra cost and added space requirements of such equipment.

### ***"Tinny" Flat Panel TV Audio***

"Flat panel HD TVs might have conquered the living room, but despite their glorious picture quality, their audio can't match CRT TVs... We've tested hundreds of flat panel TVs since they first appeared, but I can count on one hand the few that have delivered truly impressive sound quality. Too many are weedy, bass-free zones that give nothing but the odd spot of earache and a new level of meaning to the word "tinny."

*Mike Briggs, Technology Researcher for Which? Conversation*

### ***DTS Audio for TV At-A-Glance***

*Immersive surround sound as part of the TV package*

#### ***DTS-HD Decoder***

*Decoding technology from the Industry Leader*

#### ***DTS Envelo Speaker***

*Virtual surround sound, improved bass and vocal clarity*

#### ***DTS Symmetry***

*Automatic loudness control*

Some of the chief complaints about audio produced by flat panel TVs are that it sounds muffled, lacks bass and center imaging, and dialogue is often unclear. So far, minimal audio processing technology has been applied to address this, other than very basic tonal controls.

To make matters worse, many of today's TVs allow inconsistent and annoying variance in loudness. Consumers complain that quieter, regular broadcast programming is frequently interrupted by loud commercials. Likewise, transitions between quiet dialogue and loud action can be jarring. In both cases, listeners are sent scrambling to find the remote control to adjust the volume.

Consumers and manufacturers alike need a solution that improves perceived audio quality for flat-panel TVs without adding significant cost and space requirements. This can be accomplished by optimizing the sophisticated audio processing technology used in higher-end audio entertainment systems for use in TVs.

## The DTS Solution for Built-In TV Audio

The DTS solution for built-in TV audio transcends the limitations of built-in stereo speakers. With its expertise in decoding, audio enhancement and tuning, DTS Premium TV offers higher quality TV audio at a substantially lower cost than add-on audio equipment.

Using its industry-leading decoding technology and DTS Envelo Speaker, DTS transforms standard stereo audio into impressive virtual surround sound with improved bass and vocal clarity. Instead of the “tinny” sound common with flat panel TVs, DTS Premium TV creates a richer, more expansive sound field. The most compelling surround experience is produced when the audio source delivers a multichannel stream to DTS Premium TV. These multichannel tracks are directly transferred to the Virtualizer of DTS Envelo Speaker, which uses them to create a more immersive surround effect.

The DTS solution also features DTS Symmetry to automatically smooth sudden loudness spikes in programming. As a result, users do not need to compensate by frequently adjusting the volume.

DTS provides precise tuning for manufacturers as part of its TV audio solution. This ensures that each model takes full advantage of the performance enhancements that DTS Envelo Speaker and DTS Symmetry offer. Tuning includes adjustment of the speaker EQ, so speakers perform at the highest level with and without DTS post-processing turned on.

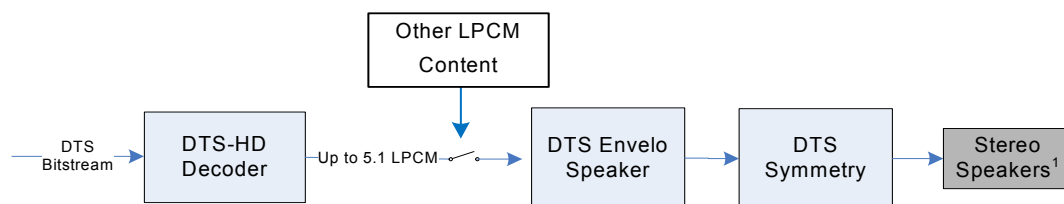


**Figure 1: The DTS Solution for TV's with Built-In Speakers Creates an Immersive, Virtual Surround Sound Experience**

The complete, integrated DTS solution for built-in TV audio includes the following technologies:

- **DTS-HD Decoder** - the DTS brand means higher quality in audio decoding. As the first stage of audio processing, the decoder enables TVs to play back DTS stereo and multichannel bitstreams. High quality multichannel content is now broadcast with some of the most popular entertainment events, including high-definition broadcasts of live sports and concerts.
- **DTS Envelo Speaker** - delivers a virtual surround sound experience through stereo speakers. Bass response is improved with Virtual LFE technology that uses psychoacoustic techniques to produce a richer and warmer low frequency effect. Vocals are processed with Phase Corrected Equalization to achieve greater clarity.
- **DTS Symmetry** - maintains consistent, preset loudness levels despite transitions between program content, formats and inputs.

Figure 2 illustrates the algorithm architecture for the DTS solution for built-in TV audio.



**Figure 2: High Level Architecture**

<sup>1</sup> Virtualization not available with mono speaker systems

## HD Audio Access - DTS-HD Decoder

DTS is the most well known brand in audio decoding, recognized by consumers for delivering premium sound. As the gateway to the DTS Premium TV experience, the DTS-HD decoder is the first step toward creating a virtual audio effect, granting access to the exploding amount of DTS content available to TVs in stereo and higher definition, multichannel audio streams.

## Versatile Audio Enhancement - DTS Envelo Speaker

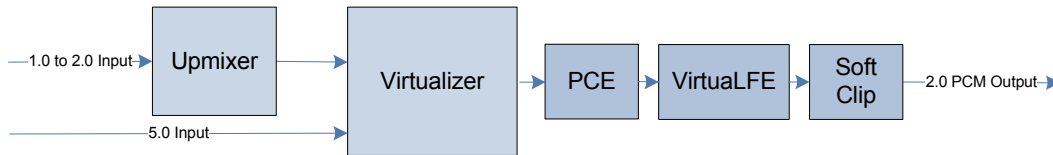
DTS Envelo Speaker is a flexible, cost-effective virtual surround sound solution for TVs that offers performance enhancement designed to impress listeners. To complement the surround effect, vocals are centered and clarified and musical instruments and ambient effects are further refined.

Keeping vocals firmly centered, DTS Envelo Speaker widens the sound stage and adds depth and dimensionality while maintaining the positive effects of the wide-panned ambient audio and instruments. The result is a fuller and richer sound delivered across a larger listening area, especially when the source signal contains multichannel audio. DTS Premium TV transfers multichannel content to the DTS Envelo Speaker Virtualizer (see Figure 3), creating the most compelling surround experience.

Easy to integrate into all forms of signal processing integrated circuits, DTS Envelo Speaker has a scalable architecture that allows maximum flexibility. It requires only a small fraction of available MIPS and memory, while still providing outstanding audio performance. It is also optimized for closely spaced micro-speakers.

With DTS Envelo Speaker, consumers experience an improved experience from TV audio. High frequencies sound clearer, crisp and brilliant and low frequencies are dramatic and tight, for greater impact.

Figure 3 illustrates the algorithm processing blocks for DTS Envelo Speaker.



**Figure 3: DTS Envelo Speaker Processing Blocks**

DTS Envelo Speaker offers the following features and characteristics:

- **VirtualLFE Technology:** Dramatically enhances low frequencies (bass) even from inexpensive speakers. The result is a richer, warmer listening experience.
- **Phase Corrected Equalization (PCE):** Polishes and more clearly defines both dialog and music, while enveloping the listener in an immersive virtual surround sound field.
- **Center Channel Enhancement:** Provides spatial enhancement for the phantom center channel.
- Accepts mono, stereo and multichannel signal input
- Speaker angle adjustment enables ultimate sweet spot location to match speaker layout

### Mitigate Sudden Loudness Changes - DTS Symmetry

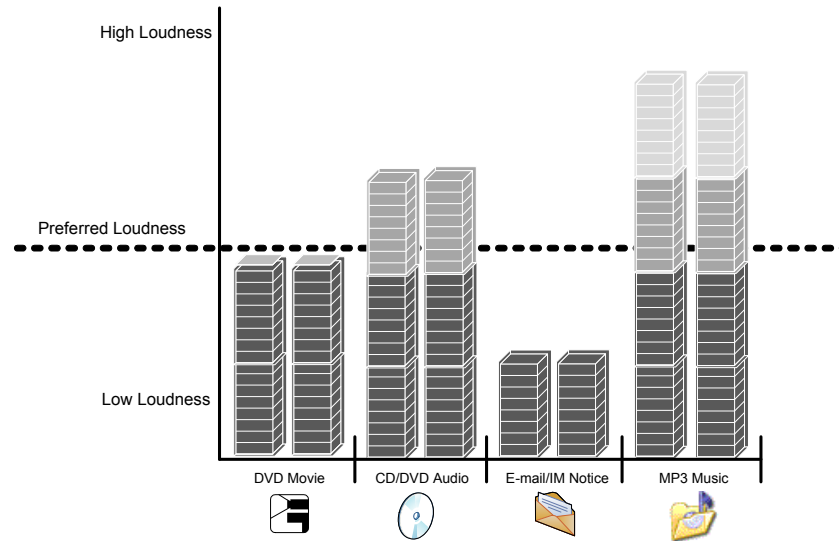
The audio industry, government agencies, and consumers alike are demanding a solution to jarring spikes in TV audio loudness. Perceived loudness levels differ significantly between programs (such as music tracks and commercials) and from one recording format to another. With DTS Symmetry, consumers can set their own preferred loudness levels and enjoy more consistent overall loudness.

DTS Symmetry has been designed with the ITU-R BS.1770 loudness measurement standard at its core. This enables the algorithm to identify and correct loudness issues, while remaining within industry standard compliance metrics. As a result, the solution surpasses others of its kind.

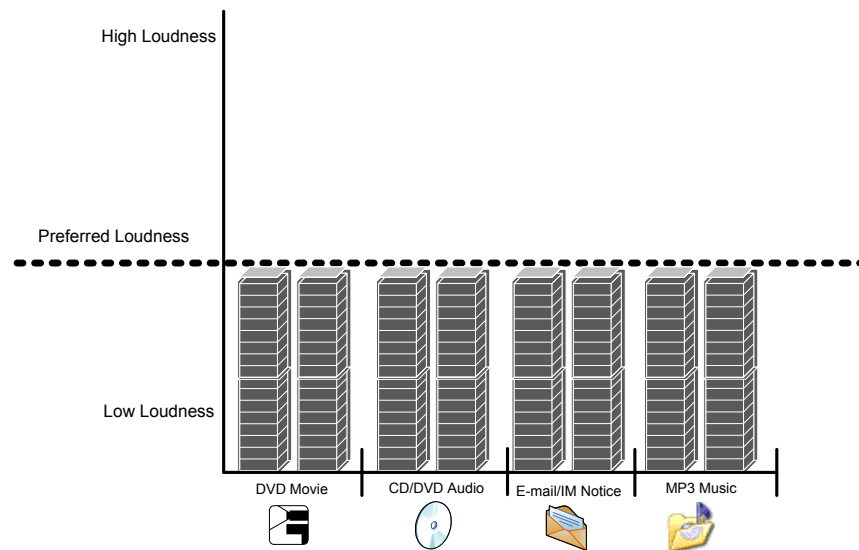
DTS Symmetry offers the following key features:

- Resolves annoying loudness fluctuations between different audio sources
- Balances perceived loudness levels by applying appropriate gain or attenuation
- Enables listeners to set the target loudness level. An appropriate amount of audio gain or attenuation is applied to achieve a consistent, listener-defined level
- Unlike conventional energy-based loudness management solutions, DTS Symmetry uses advanced psychoacoustic and signal processing techniques to accurately detect and regulate the perceived loudness of different stereo input sources.
- Delivers quality audio output without unpleasant artifacts

DTS Symmetry is the fastest and most sophisticated loudness leveling algorithm available to control loudness, from the listener's perspective. It delivers uniform loudness across all content, programs and input sources – in real time, with a satisfying dynamic range.



**Figure 4: Variances in Perceived Loudness from Different Sources, Without DTS Symmetry**



**Figure 5: DTS Symmetry Balances Perceived Loudness**

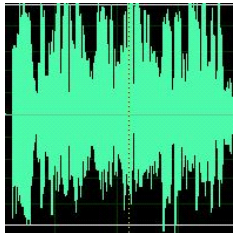
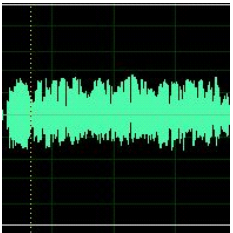
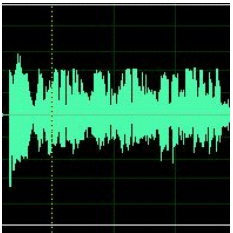
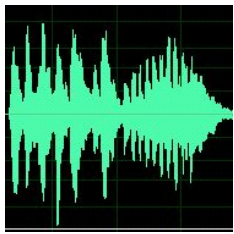





“Loudness” is a measure of how the power of the audio signal is perceived. To ensure that this correlates with what is actually heard, a loudness perception profile needs to be applied when measuring loudness. This profile takes into account the human hearing response, richness of the sound, spectral power distribution/density, time duration and constancy.

Based on the loudness measurement and preferred Target Level setting, DTS Symmetry corrects gain deviation in a controlled manner to effect a smooth change over time.

Because DTS Symmetry runs entirely in the time domain, it is much faster than most products that convert the signal to the frequency domain and back again. Tracking historical loudness, the algorithm estimates inbound signals with no problematic signal loss or degradation. If an excessively loud event occurs, DTS Symmetry automatically constrains the output signal level.

Table 1 illustrates how DTS Symmetry balances loudness while preserving dynamics. By comparison, most Automatic Gain Control algorithms crush dynamics to maintain balanced loudness levels. The wider variance in audio signal amplitude achieved by DTS Symmetry offers more natural sound, with the punch and clarity the artist intended.

**Table 1: DTS Symmetry Performance**

A: Original	B: Automatic Gain Control (AGC), or Similar Algorithm	C: DTS Symmetry	Benefits
			<b>A:</b> The original track simulates a loud commercial. <b>B:</b> An AGC crushes the dynamics to maintain level loudness. <b>C:</b> DTS Symmetry preserves the dynamics to provide sound that is natural, as the artist intended.
			<b>A:</b> An original audio track that contains generous headroom and dynamics, delivering punch and clarity to the listener. <b>B:</b> The AGC only maintains the widest ranging dynamics. <b>C:</b> DTS Symmetry maintains dynamics at the desirable level.
			<b>A:</b> An original audio track at a very soft loudness level. Typically, the listener would raise the volume to compensate. <b>B:</b> An AGC only applies gain to the quiet regions. <b>C:</b> DTS Symmetry intelligently applies gain and brings the audio to life while preserving dynamics.





## Conclusion

To dramatically improve the listening experience from flat panel TVs with constrained built-in stereo speakers, DTS has combined the power of its decoding, audio enhancement, and loudness leveling technology to create DTS Premium TV. Consumers who recognize the DTS brand as a symbol of audio quality can expect DTS to deliver a premium listening experience that exceeds their expectations.

DTS Premium TV sets a higher audio standard for TV audio by combining the DTS-HD Decoder with DTS Envelo, a flexible virtual surround sound solution that improves vocal clarity and bass response, and DTS Symmetry, the fastest and most sophisticated loudness leveling algorithm available.

Instead of “tinny” audio, lacking in bass response, DTS Premium TV delivers an enhanced low frequency effect. Instead of muffled sound, without clear center imaging, consumer can expect a full, rich virtual surround sound effect with firmly centered dialogue. The most compelling surround experience occurs when the audio source delivers a multichannel stream to DTS Premium TV, which is used directly by the Virtualizer in DTS Envelo Speaker to create a noticeable improvement.

As part of its offering, DTS provides precise tuning of all TV models sent to them by manufacturers to ensure they perform at the highest level. For manufacturers and consumers who want more immersive TV sound without expensive add-on audio equipment, DTS provides a cost-effective, performance-enhancing solution.

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