



DTS Symmetry™: Mitigate Sudden Loudness Changes

White Paper

Document No. 9302K11400
Revision A
Effective Date: June 2011

DTS, Inc.
5220 Las Virgenes Road
Calabasas, CA 91302
USA

www.dts.com



Table of Contents

| | |
|----------------------------------|---|
| Executive Summary | 1 |
| The Scramble for CALM | 1 |
| The DTS Symmetry™ Solution | 2 |
| Conclusion | 5 |



Executive Summary

The audio industry, US government and millions of consumers are demanding a solution to jarring spikes in audio loudness heard with a variety of devices. Currently, perceived loudness levels differ significantly between programs (such as music tracks and commercials), and from one recording format to another when played on the same device. With DTS Symmetry, consumers can enjoy more consistent overall loudness and set their own preferred loudness levels. While maintaining the fidelity and flavor of the original audio mix, DTS Symmetry delivers dependable loudness levels despite transitions between program content, audio/video formats and input sources.

The Scramble for CALM

Annoying and inconsistent changes in loudness often send listeners scrambling to adjust volume controls when watching television, listening to the radio or playing recorded music. Audiences are angered most by loud commercials that interrupt quieter, regular broadcast programming. Transitions from quiet dialogue to loud action scenes also send listeners scrambling to adjust volume.

To date, device manufacturers and broadcasters have taken a heavy-handed approach to loudness adjustment that renders audio lifeless and unexciting. Broadcasters typically rely on metadata and consumer technology to solve the problem. So far, devices designed to control the “amplitude envelope” have proved unsatisfying.

Fortunately, consumer demand for relief from annoying and inconsistent loudness levels is forcing further action. Task groups are working toward new loudness standards (ATSC, 2009), and the U.S. Congress has passed regulation of loud TV commercials. More audio device manufacturers are conforming to ITU (International Telecommunication Union) loudness perception standards (see ITU-R BS.1770) and new loudness balancing solutions are entering the marketplace.

On the science and technology front, psychoacoustic modeling has given birth to a host of audio post processing solutions. Psychoacoustics can be used to address loudness issues by estimating perceived loudness levels as part of an algorithm designed to make accurate corrections.

US Government Regulates Loud Commercials

The US Congress took action against “annoying” loudness in TV advertising in December, 2010 by passing the Commercial Advertisement Loudness Mitigation (CALM) Act. It is designed to prevent the broadcast of loudness levels that are significantly higher than accompanying TV program material.

According to Senator Roger Wicker, “Excessively loud television commercials are annoying and drive families away from quality programming.” The European Broadcasting Union recommended establishing maximum audio broadcast levels in August of 2010.

The DTS Symmetry Solution

DTS Symmetry has been designed with the ITU-R BS.1770 loudness measurement 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 sets itself apart from 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 an adjustable target level for loudness
- Mimics the human auditory response to perceived loudness based on psychoacoustics, detecting spectral and intensity differences within the audio signal
- 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. Using it, they can count on uniform loudness across all content, programs and input sources - delivered in real time, with a satisfying dynamic range.

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. It also resolves annoying loudness fluctuations in live broadcast feeds and recorded samples that vary widely in loudness and quality.

DTS Symmetry enables the listener to set a preferred loudness level. Perceived loudness is then balanced by applying an appropriate amount of audio gain or attenuation to achieve a consistent, listener-defined level.

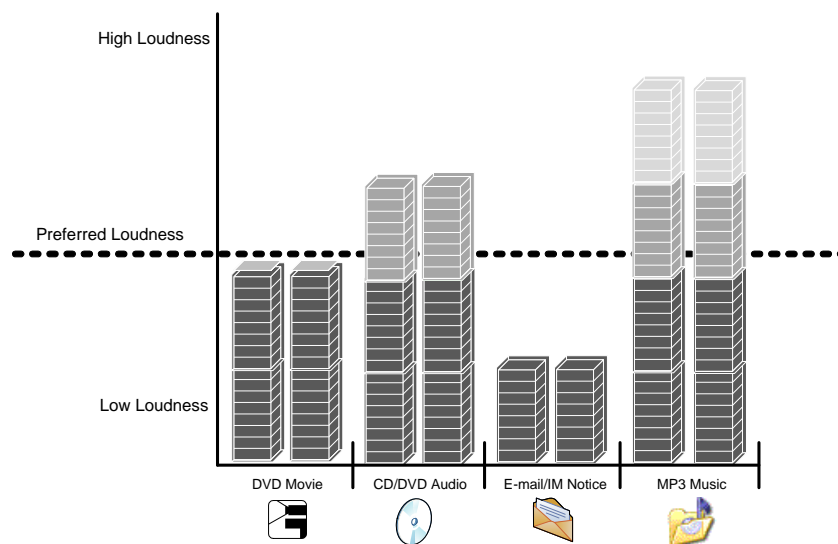


Figure 1: Variances in Perceived Loudness from Different Sources

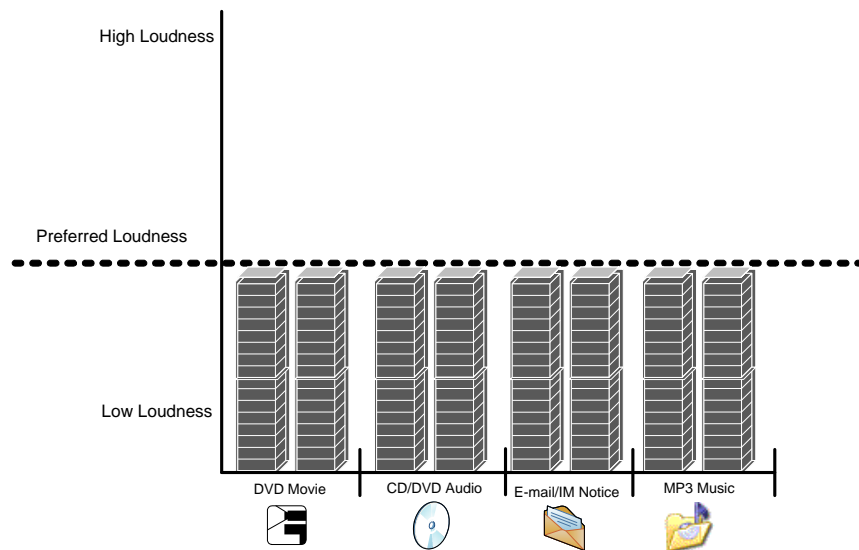


Figure 2: DTS Symmetry Balances Perceived Loudness

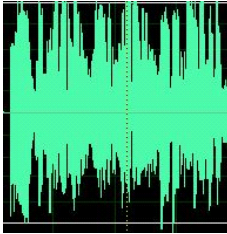
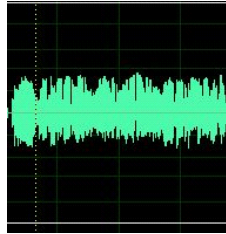
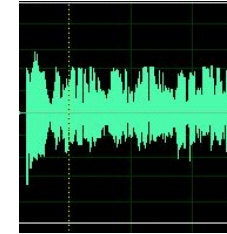
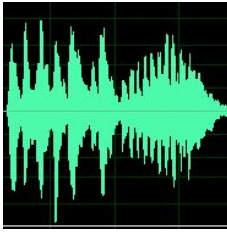
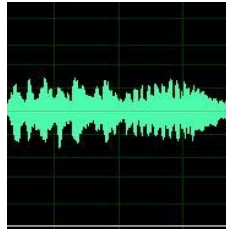
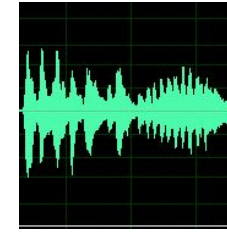



“Loudness” is a measure of how the power of the audio signal is perceived. To ensure that this correlates with what is actually heard and felt, a loudness perception profile needs to be applied when measuring loudness. This profile takes into account the human hearing response or the richness of the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

Based on loudness measurement and the preferred Target Level setting, DTS Symmetry corrects deviation in a controlled manner to effect a smooth gain 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-like 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 |
|---|---|---|--|
|  |  |  | <p>A: The original track simulates a loud commercial. B: An AGC crushes the dynamics to maintain level loudness. C: DTS Symmetry preserves the dynamics to provide sound that is natural, as the artist intended.</p> |
|  |  |  | <p>A: An original audio track that contains generous headroom and dynamics, delivering punch and clarity to the listener. B: The AGC only maintains the widest ranging dynamics. C: DTS Symmetry maintains dynamics at the desirable level.</p> |
|  |  |  | <p>A: An original audio track at a very soft loudness level. Typically, the listener would raise the volume to compensate. B: An AGC only applies gain to the quiet regions. C: DTS Symmetry intelligently applies gain and brings the audio to life while preserving dynamics.</p> |



Conclusion

DTS Symmetry maintains a consistent loudness level based on personal preference, so listeners do not need to frequently adjust for loudness spikes due to changes in program content, AV formats and input sources. It does this in real time, monitoring audio content and adjusting loudness to levels based on the most widely used industry standard for measurement, the ITU-R BS.1770.

As one of the fastest algorithms of its kind, DTS Symmetry can be easily integrated into any existing system on any platform. Using psychoacoustic modeling, it mimics human hearing to deliver a more enjoyable entertainment experience with consistent loudness.

Do Not Duplicate. © 2011 DTS, Inc. All Rights Reserved. Unauthorized duplication is a violation of State, Federal, and International laws.

The hardware, software and methods discussed in this document may be protected by U.S. and other International patents issued and pending.

DTS, the Symbol & DTS and the Symbol together are registered trademarks of DTS, Inc. All other trademarks are the property of their respective owners.