Loudness Monitoring and CALM Compliance

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SUMMARY

Channel program and advertisement loudness has received considerable attention recently and is the subject of FCC rule making in 2011 at the direction of congress through passage of the CALM (Commerical Advertisement Loudness Mitigation) act. This presentation will describe how loudness has been defined and measured in current standards and regulations, the latest progress in FCC rule making, and how these apply to cable service providers. The presentation will describe loudness as measured in units of LKFS, Dialnorm metadata, Gating, and other key new terms that Plant Operators need to know for both minimizing trouble calls and achieving CALM compliance.

This article is for informational purposes only and does not constitute legal advice. Nothing contained herein should be used as a substitute for the advice of competent legal counsel.

TABLE OF CONTENTS

1. INTRODUCTION

Viewers have long complained about loud commercials. The introduction of digital TV and wide dynamic range, multichannel audio, while dramatically improving the quality of delivered audio, have also provided the tools, that when used incorrectly, can make the issue worse. In response to complaints, the US Government passed legislation in December, 2010 directing the FCC to make rules to address the issue to the satisfaction of many viewers who thought such rules were long overdue. In concept, the issue is simple but the resulting rules and solutions require careful consideration by the MSOs.

2. THE CALM ACT

The CALM Act (Commercial Advertisement Loudness Mitigation) [1] directs the FCC (Federal Communications Commission) to make rules intended to prevent television commercial advertisements from being transmitted louder than the programs they accompany. CALM specifies that the rules will apply to TV broadcasters, cable operat ors, and other MVPDs (Multichannel Video Program Distributors) such as cable and telco operators, direct broadcast satellite services, and OTA (Over the Air) broadcasters.

As specified in the CALM legislation, the FCC was given one year from when the legislation was passed to issue formal regulations on what MVPDs will be required to do to conform, how MVPDs can demonstrate compliance, and to define enforcement penalties and logistics. The legislation further directs the FCC to incorporate the ATSC's (Advanced Television Systems Committee) A/85 "ATSC Recommended Practice: Techniques for Establishing and Maintaining Audio Loudness for Digital Television" into the rules and make it mandatory as it concerns the transmission of commercial advertisements by MVPDs. MVPDs will then have one additional year (until December 15, 2012) to comply with the FCC's regulations.

In September 2011, Canada's CRTC (Canadian Radio-television Telecommunications Commission) announced the "Broadcasting Regulatory Policy CRTC 201 1-584" which directs both broadcasters and "Television Service Providers" to adopt the ATSC A/85 Recommended Practice on loudness. The CRTC announcement notes that the CRTC plans to publish "proposed amendments to the appropriate regulations for comment by the end of 2011." It requires compliance by September 2012.

2.1. The ATSC and A/85

The Advanced Television Systems Committee, Inc. is an international, non-profit organization developing voluntary standards for digital television. The ATSC member organiza tions represent the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries. ATSC Digital TV Standards include digital high definition television (HDTV), standard definition television (SDTV), data broadcasting, multichannel surround-sound audio, and satellite direct-to-home broadcasting (see www.atsc.org).

On May 27, 2011, the FCC released a Notice of Proposed Rulemaking (NPRM) on CALM implementation (see: http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db0527/FCC -11-84A1.pdf) including proposed rules and soliciting comments. The comment period was later extended to August 1, 2011.

In short, the proposed rules require MVPDs to manage loudness on all commercial advertisements. It allows for a one year waiver, possibly once renewable, for MVPDs who can show financial hardship to implement rules. It also solicits comments and inputs on possible compliance issues.

In May and July 2011 the ATSC issued new versions of A/85 primarily adding two new annexes: First, Annex J (Requirements for Establishing and Maintaining Audio Loudness of Commercial Advertising in Digital Television When Using AC -3 Codecs) and, later, Annex K (Requirements for Establishing and Maintaining Audio Loudness of Commercial Advertising in Digital Television When Using Non-AC-3 Codecs).

Annex J, applying to systems using the AC-3 codec, is quite concise: It states that it "…contains all the courses of action necessary to perform effective loudness control of digital television advertising." It specifies that "…when loudness of short form content (e.g., commercial advertising) is measured, it be measured in units of LKFS including all audio channels and all elements of the soundtrack over the duration of the content." And further, "…it is vital that the loudness … match the dialnorm setting of this inserted AC -3 audio stream…" The latter statement is known as A/85's "Golden Rule" for AC -3.

Annex K, applying to systems not using the AC -3 codec, is equally concise: It states that it "…contains the courses of action necessary to perform effective loudness conrol of digital television advertising when using non-AC-3 audio codecs." It further states "It is vital that the delivery channel operate at an Operator-selected loudness target value (as measured in units of LKFS) for content on the channel." and "It is vital that, when loudness of short form content (e.g., commercial advertising) is measured, it be measured in units of LKFS including all audio channels and all elements of the soundtrack over the duration of the content." And, finally, "In the case of insertion of short-form content (e.g., commercial advertising), it is vital that the loudness, measured as per section K.4, of the inserted short -form content match the delivery channel's loudness target value within +/-2 dB."

2.2. AC-3 and Dialnorm

Dialnorm is an important 5 bit field of metadata carried in the AC -3 bit stream which can significantly affect the instantaneous loudness experienced by a digital TV viewer. The AC-3 bit stream carries a number of parameters (metadata) that allow the decoder to reproduce the encoded audio according to the parameters set by the program creator and by the listener based on his equipment and environment. They consist of informational parameters which mostly describe some aspect of the transmitted bitstream and may be used by some components in the audio reproduction process and control parameters which specifically direct the encode/decode process. See the complete list below. For more information about the parameters other than Dialnorm and how they are used, see [9].
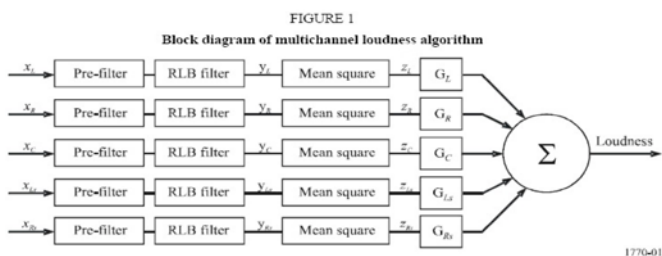
Dialogue Level (Dialnorm)	*Dolby Surround Mode*	*Surround Phase Shift A/D*
Channel Mode	*Audio Production Information*	*Converter Type Preferred*
LFE Channel	*Mix Level*	*Stereo Downmix Lt/Rt*
Bitstream Mode	*Room Type*	*Centre Downmix Level Lt/Rt*
Line Mode Compression	*Copyright Bit*	*Surround Downmix Level*
RF Mode Compression	*Original Bitstream*	*Lo/Ro Centre Downmix Level*
RF Overmodulation	*DC Filter*	*Lo/Ro Surround Downmix Level*
Protection	*Low-pass Filter*	*Dolby Surround EX Mode*
Centre Downmix Level	*LFE Low-pass Filter*	
Surround Downmix Level	*Surround 3dB Attenuation*	

AC-3 bitstream Metadata list

The Dialnorm parameter is AC-3 metadata that helps in matching reproduced audio volumes when switching between audio program sources. It is used in the decod er to adjust and normalize the reproduced audio level up to 30 dB. This parameter offers the capability to automatically adjust the viewer's playback level for a program's audio anchor element when

switching program content thus saving the user from having to manually adjust the volume. That same useful capability can cause unwanted dramatic shifts in the playback volume if the

Dialnorm parameter is set incorrectly for a program's content.

FIGURE 1
Block diagram of multichannel loudness algorithm

2.3. Loudness Measurements, LKFS, Gating, and ITU-R BS.1770

The ITU-R BS.1770 specification [4] referenced in A/85 details how to calculate subjective loudness for a multichannel audio program in units of LKFS (Loudness K-weighted relative to.

 Full Scale) representing perceived program loudness. The algorithms identified here were intended exactly for representing program loudness as in a program exchange environment and to have a single universal recommended algorithm for consistent loudness measure.

The 1770 specification employs "K" frequency weighting and uses a channel-weighting summation including all employed channels except the LFE channel is excluded.

The current, 1770-2, version of the specification includes "gating." The Gating algorithm adjusts the reported loudness to make sure that quiet periods below a certain threshold are excluded from the loudness measurement to best reflect the human perceived loudness.

See: Recommendation ITU-R BS.1770-2 (03/2011) "Algorithms to measure audio programme loudness and true-peak audio level"

2.4. The Golden Rule

The recommendation from A/85 that the measured loudness of a program should match the value of the transmitted AC-3 Dialnorm metadata has become known as the "Golden Rule". This simple guideline ensures that the reproduced audio level at the viewer's AC -3 decoder (e.g. Set Top box) correctly reflects the level that the content producer intended. Following the Golden Rule ensures that when short form content such as commercial advertising is inserted, the reproduced loudness will be correct. The same advantage of correct levels will be realized when switching between channels.

3. MONITORING AND LOGGING

Loudness monitoring should be a component of an MSO's systematic approach to signal and service quality assurance. Most MSOs recognize that with today's systems delivering hundreds to thousands of simultaneous channels to viewers, automated simultaneous channel monitoring for quality verification is required. Those same systems, with their capability to verify dozens of metrics characterizing the video and audio performance on all channels simultaneously, comparing measured values against thresholds such as those specified in various Recommended Practices such as SCTE 168-4, SCTE 168-6, and SCTE 168-7 have evolved to include ATSC A/85 recommended Golden Rule loudness monitoring. Just as the emerging 3D, DPI, PSIP, and Out of band cable plant signaling require evolving monitoring tools, loudness and audio stream quality assurance is a critical component in assuring viewers are delivered the high quality experience which they have come to expect. Likewise, the service provider has come to depend on automated monitoring solutions to quickly detect and identify problems for cost effective engineering resource allocation in today's especially cost -competitive world. Selection of a QA system that integrates QoS, QoE, and loudness/dialnorm measurements with measurement database logging, alarming, program availability reports, and customized report generation helps the MSO keep operations costs manageable and through performance trending reports helps direct future capital dollars for the best ROI. It is only reasonable that they should be expected to evolve to support emerging CALM requirements and they have.

3.1. Content supplier scorecard

Working with the content supplier to assure that the measured loudness matches the accompanying Dialnorm metadata at ingest and avoiding the need for unwanted active modification and possible impairment of a program's loudness information and quality at the MSO service provider, is the MSO's best alternative for loudness management (See "Normalizing Audio Quality Across All Service to Enhance The Customer's Quality of Experience"[6].) The distributed program is then known to be mixed and have the desired dynamic range that the producer intended for the viewer and will avoid possible corruption by attempting to dynamically correct, or, even worse, compress a stream's loudness with processing equipment.

With this approach, continuous measurement and logging is invaluable in working with the content supplier so non-compliant content can be identified and the measurement results shared.

An example of ongoing loudness tracking and Dialnorm monitoring is shown below for sample movie content. Note that loudness has significant range and can vary significantly from Dialnorm for various intervals depending on scene content.

Loudness chart for a few minutes of an action movie illustrate normal, desirable loudness/dialnorm deviations. "Flat", highly compressed audio that removes program dramatics as a loudness management solution is not recommended.

Continuous per-program archiving of measured loudness allows quick sorting for worst offenders and content provider scorecard preparation. With such a loudness scorecard in hand along with documented content identification, there is a reasonable prospect of working with the supplier to correct any anomalies.

Per-Program Continuous Loudness Monitoring Scorecard

Drilling into a 15 minute interval history for more detail identifies an offending commercial. In the example below, the orange range bars on the timeline correspond to the saved thumbnails in the screenshot shown allowing for easy identification of the commercial content during the very high loudness period. Complaints for a particular time period can readily be verified by a simple database search.

15 minute program loudness history with thumbnails identifies a loud commercial

4. CONFORMING WITH CALM

As mentioned in section 2, the proposed rules in the FCC's NPRM for MVPDs are readily summarized (quoted phrases below are from the NPRM):

MVPDs are responsible for the loudness for all commercials and are responsible whether or not AC-3 is used. Futhermore, compliance to ATSC's A/85 Recommended Practice and its successors is mandatory.

The proposed rules identify a "Safe Harbor": MVPDs that use a loudness measurement device or a loudness processing device in a "commercially reasonable manner" to ensure that content suppliers deliver A/85 golden rule compliant content are deemed compliant with the rules. The proposed rules also recognize that solutions other than those identified as qualifying under the "Safe Harbor" guide are also acceptable. In response to a complaint, an MVPD may demonstrate that the Golden Rule was met for a target commercial. "We believe the ability to make such a showing … "useful for MVPDs" that have means other than the "Safe Harbor" solution. The FCC has proposed a consumer complaint procedure to ena ble consumers to file complaints. MVPDs will be expected to demonstrate compliance in response to those complaints and such measurement and archiving tools would certainly be helpful.

It should be noted that a contractual approach with content providers is deemed "efficient" however it should be clear that MVPDs are responsible for noncompliance. If an MVPD is investigated due to complaints, it may be required to provide sufficient records and documentation to demonstrate compliance.

5. WHAT'S AHEAD

A typical course of FCC rule making would include due consideration to comments filed in response to the NPRM described here and then a formal rule making with possible amendments to the already proposed rules. CALM directs the FCC to make such rules by December 15, 2011. Per the CALM statute, MVPDs will have until December 2012 to comply.

6. SUMMARY

The U.S. CALM act from December 2010 directs the FCC to issue rules on commercial advertisement loudness and, specifically, to make mandatory the ATSC's A/85 Recommended Practice. A/85 specifies a "Golden Rule"; namely, that the AC-3 Dialnorm metadata value should equal a program's measured loudness in units of LKFS per ITU-R BS.1770 algorithm. Under the currently proposed FCC rules, an MVPD is deemed compliant if they deploy equipment to comply with A/85 while noting that u se of other methods are also acceptable. The proposed rulemaking notes that an MVPD may be required to provide sufficient records and documentation to demonstrate compliance. It also notes clearly that MVPDs are responsible for noncompliance.

7. REFERENCES

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