

First By Design

# WARD-BECK SYSTEMS





# Control Your Surroundings: Audio Monitoring and Corrections

**Presented By**

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**Ward-Beck Systems Limited**



# Control Your Surroundings: Audio Monitoring and Corrections

Monitoring and Processing Considerations in a Multi-Channel Embedded Environment

Topics:

- Multi-Channel Embedded Audio
- Monitoring and Processing
- Dolby Encoded Audio
- Ward-Beck Systems Solutions

## Control Your Surroundings: Audio Monitoring and Corrections

### Analog to Digital Conversion

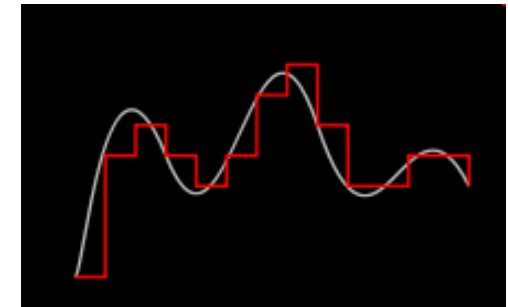
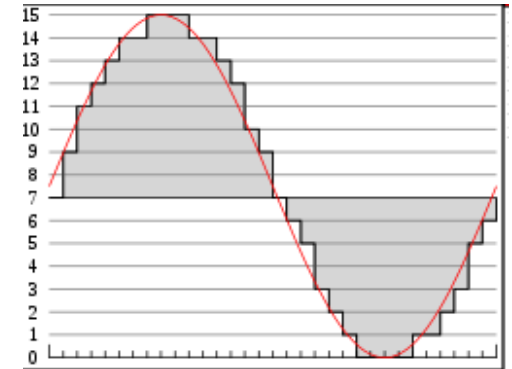
#### Processing:

A single channel of digital audio is visualized as a 2D wave, the vertical represents the bit depth and the horizontal represents the sampling rate.

Sampling and quantization of an analog signal using Pulse Code Modulation.

A digitized analog signal

"Bit depth" refers to the number of allowed values for sampled volume that can be represented, and the "sampling rate" (or *frequency*) refers to the number of recorded positions (or "snapshots") of individual measurements of volume per second, measured in hertz (Hz).





## Control Your Surroundings: Audio Monitoring and Corrections

### Multi-channel embedded audio

Both SD and HD serial interfaces provide for up to 16 channels of embedded audio

The two interfaces use different audio encapsulation methods-

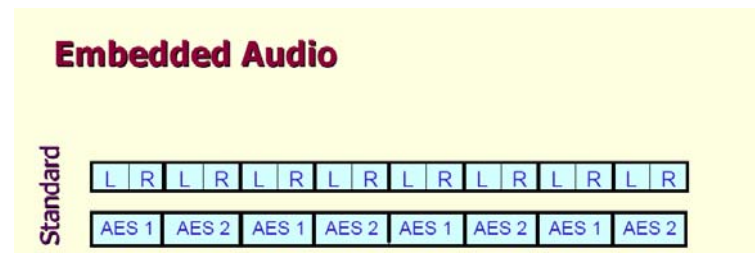
SD uses the **SMPTE 272M** standard,

HD uses the **SMPTE 299M** standard.

In either case, an SDI signal may contain up to sixteen audio channels (8 pairs) embedded 48 kHz, 24-bit audio channels along with the video.

The SMPTE standard stipulates that all audio channels in a given group have the same sample rate, sampling phase, and be either all synchronous or all asynchronous.

Also, audio data for each channel in a group is always transmitted, even if less than the four are active. For inactive channels, the standard states that the value of the audio data, V, U, C, and P bits is set to zero.



Technology	Audio Channels
Hdcam VTR	4
270 Mbit/s ASI-mux Link	4/8
Dolby E (16 bit)	6
Dolby E (20 bit)	8
HdcamSR VTR	12
E <sup>2</sup> (Linear Acoustics)	16
SD-SDI	16
HD-SDI (1.5 Gbit/s)	16
HD-SDI (1.5 Gbit/s) Dual link	16 x 2
HD-SDI (3 Gbit/s)	32(Proposed)



# Control Your Surroundings: Audio Monitoring and Corrections

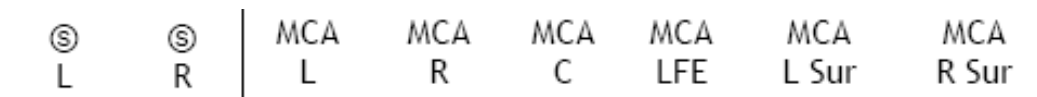
## Multi-channel embedded audio

Typically, 48 kHz, 24-bit (20-bit in SD) PCM audio is stored, in a manner directly compatible with the AES3 digital audio interface. These are placed in the (horizontal) blanking periods, when the SDI signal carries nothing useful, the receiver generates its own blanking signals.

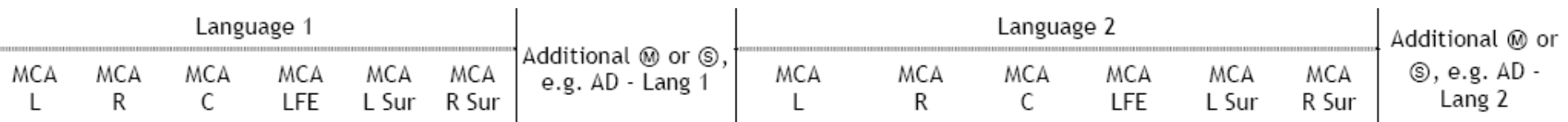
Multi-channel audio may contain surround sound (5.1) but it also contains other audio that a broadcaster can use such as secondary audio, descriptive audio, etc. Some TV stations in the US are embedding their radio signal into their signal.

## Channel Assignments

**SMPTE 2035** channel assignments allocates 8 channels for program interchange and is used on VTR's, servers and most other storage devices.



**EBU Recommendation R123** proposes to allocate all 16 channels for program interchange





## Control Your Surroundings: Audio Monitoring and Corrections

### **Multi-channel embedded audio**

#### **Processing:**

Level Adjustments

Gain Control

Signal shuffling i.e. reassigning audio to different tracks

Substituting embedded AES signals with external AES signals

Voice over's

SMPTE 2020 insertion / detection



## Control Your Surroundings: Audio Monitoring and Corrections

### **Multi-channel embedded audio**

### **Monitoring Multi Channel Audio Signals**

Correctly producing and distributing multi-channel audio content requires a diverse monitoring tool. That should include:

Level bars displays with selectable meter ballistics and scaling

Display for verifying the phase relationships between channels

Display for verifying the phase relationships in surround sound content

Data displays for verifying metadata content

Dolby decoder



## Control Your Surroundings: Audio Monitoring and Corrections

### **Multi-channel embedded audio**

### **Monitoring Multi Channel Audio Signals**

Correctly producing and distributing multi-channel audio content requires a diverse monitoring tool. That should include:

### **Alarms**

Clip – determined from the number of consecutive samples at full scale

Mute - determined from the number of consecutive samples at zero scale

Silence – user selectable when audio falls below a value for a determined period of time

Over - user selectable when audio goes over a value for a determined period of time



## Control Your Surroundings: Audio Monitoring and Corrections

### **Multi-channel embedded audio**

### **Surround Sound Audio (5.1)**

#### **Center Channel Monitoring**

There one critical area that is generally overlooked when broadcasting in 5.1. The center channel

When creating 5.1 the dialog is hard-mixed to the center channel and matrixed together (amplitude and phase) with the left and right channels so it can still be heard without any program material loss. If the center channels levels are incorrect or corrupt it can cause the dialog to be either too loud or too low or be lost. So it's critical to ensure the integrity of the center channel.



## Control Your Surroundings: Audio Monitoring and Corrections

### Dolby E and Dolby Digital (AC-3)

Dolby E allows broadcasters to carry up to 8 channels of audio complete with metadata on a single AES stream. Dolby Digital (AC-3) allows up to 6 channels in a single AES stream.

The main difference between the two formats is Dolby E is frame locked to the video which should allow clean switching between video channels. Dolby Digital has no relationship to the video.

### Dolby E

Dolby E has been designed to be distributed through a facility with standard AES devices. It must be remembered that Dolby E is no longer audio but data. It is important to ensure that equipment is Dolby E compliant devices that use Sample Rate Converters will either corrupt or destroy the audio data.

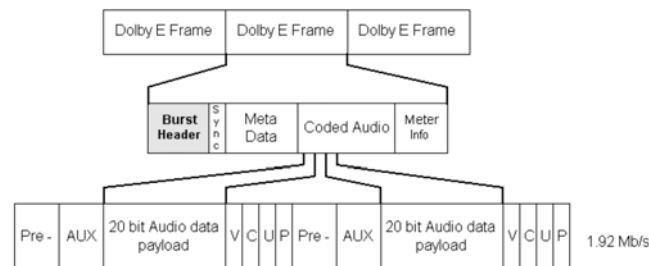


Figure 2 AES-3/Dolby E Packet Structure

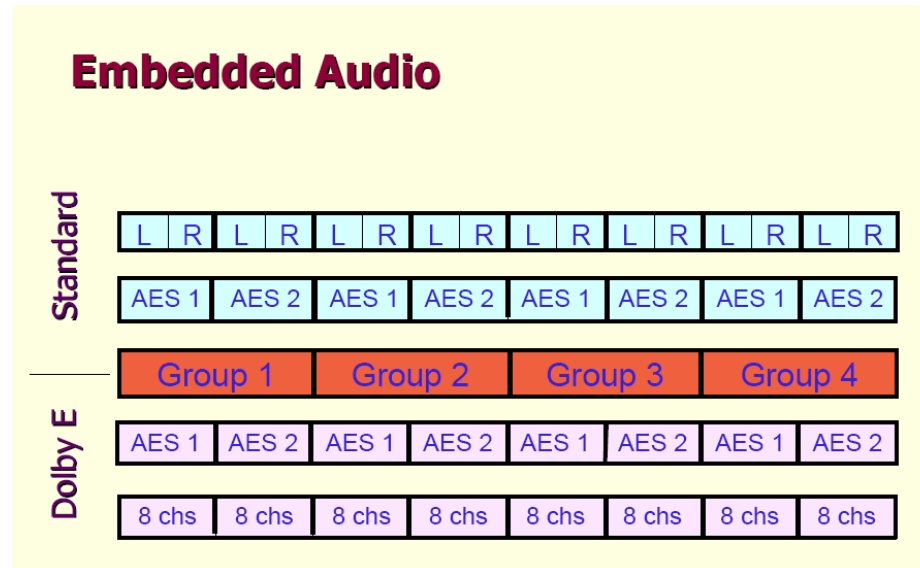


## Control Your Surroundings: Audio Monitoring and Corrections

### Dolby E and Dolby Digital (AC-3)

#### Dolby E

Each uncompressed AES channel can carry 2 mono audio channels or 8 compressed. So it is theoretically possible to transport up to 64 mono audio channels. This greatly increases the need to properly monitor all your audio channels.





## Control Your Surroundings: Audio Monitoring and Corrections

### **Dolby E and Dolby Digital (AC-3)**

#### **Metadata**

The Dolby stream also includes information about how the channels are to be processed by the receiver. Probably the two most significant metadata components are:

#### **Dialnorm**

#### **Downmixing**

#### **Dialnorm (Dialog Normalization)**

Dialnorm is the metadata parameter that controls decoder gain

Has the force of law for US Digital Broadcasting, through the FCC's adoption of ATSC A/53 Annex B, section 5.5

The dialnorm value is presented to the Dolby Digital encoder, which then sends it to the home decoder, where it is received and applied to the decoded audio signal in order to modify the level of the program. As the viewer changes from channel to channel, or as the broadcaster switches from segment to segment, the associated dialnorm value is used by the audio decoder to dynamically adjust the overall audio level so that consistent loudness is maintained.

That's the theory anyway.



## Control Your Surroundings: Audio Monitoring and Corrections

### **Dolby E and Dolby Digital (AC-3)**

#### **Dialnorm**

Dolby had two choices to insure consistent loudness with their system.

- a fixed digital dialog level and the means for it's measurement
- make it variable and dynamic.

Dolby realized it would be hard to get consensus as to where a fixed level should be set so they opted for a variable system range from -31 dBFS to -1 dBFS, as measured during dialog with an A-weighted long-term average meter.

Instead of helping to iron out interchannel and intersegment loudness issues, the dialog normalization feature has often made things worse due to the fact that it is incorrectly set or not set at all. The US the government has introduced the CALM (Commercial Advertisement Loudness Mitigation) Act to force broadcasters to keep audio levels correct or face being fined.

One possible solution is ITU-1770 which proposes to monitor and control levels. In November of 2009 it was passed as a preferred practice by the ATSC committee.



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### **Dolby E and Dolby Digital (AC-3)**

#### **Downmixing**

The left rear channel is put into the front left speaker at -3dB down from its original level. The right rear channel is put into the front right speaker at -3dB down, the center channel is put into both the left and right front speakers at -3dB down, and the LFE (Low Frequency Effects) channel is eliminated from the downmix.

The problem with the Dolby downmix is that any phase or delay in the audio can caused an echo.



## Control Your Surroundings: Audio Monitoring and Corrections

### **Dolby E and Dolby Digital (AC-3)**

#### **Latency**

Both Dolby E and Dolby Digital introduce significant amounts of delay.

Dolby E introduces 1 frame of delay on encode and a further 1 frame on decode.

Dolby Digital introduces 5 frames of delay in encoding and 1 frame during decode.

Due to the various amounts of delay that are introduced care must be taken to ensure that lip sync issues are dealt with.

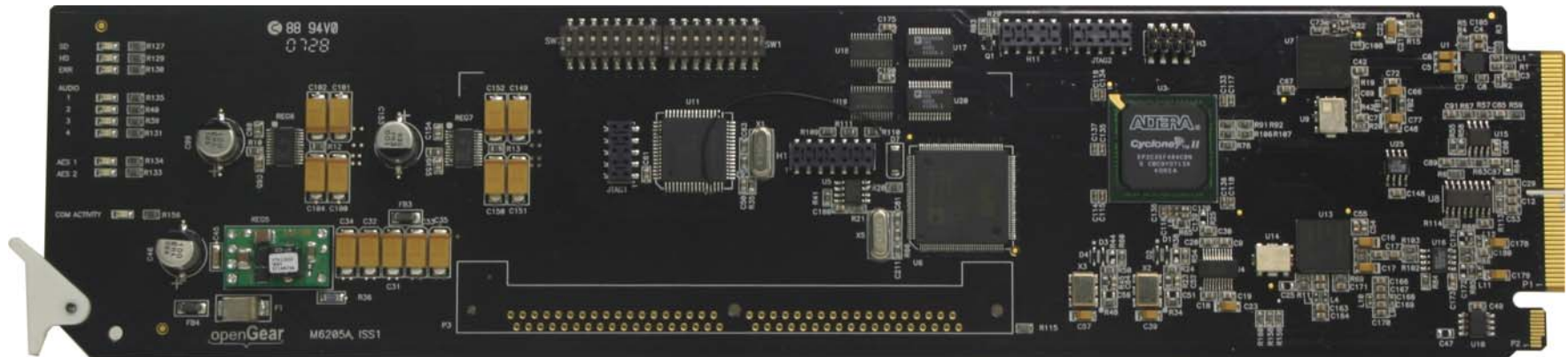


## Control Your Surroundings: Audio Monitoring and Corrections

### Ward-Beck Systems Embedded Processing Solution



### M6205 “Swiss army knife of embedded audio processors”





## Control Your Surroundings: Audio Monitoring and Corrections

### **Ward-Beck Systems Embedded Processing Solution**

#### **M6205 “ Swiss army knife of embedded audio processors”**

Level Adjustments manual or automatic

Gain Control

Signal shuffling i.e. reassigning audio to different tracks

Substituting embedded AES signals with external AES signals

Voice over's

SMPTE 2020 processing

Dolby decoding

NAB 2010 - **Dolby encoding**



## Control Your Surroundings: Audio Monitoring and Corrections

### Ward-Beck Systems Embedded / Dolby Monitoring Solution

#### AMS-16





## Control Your Surroundings: Audio Monitoring and Corrections

### Ward-Beck Systems Embedded / Dolby Monitoring Solution

#### AMS-16

##### Monitoring

- 16 channel embedded audio monitor
- 2 HD-SDI Inputs / Outputs
- 8 channel discrete output
- Level bars with selectable meter ballistics and scaling
- Verification of phase relationships between channels
- Verification of phase relationships in surround sound content
- Data displays for verifying metadata content
- Optional Dolby decoder
- And more

##### Alarms

- Clip
- Mute
- Silence
- Over



## Control Your Surroundings: Audio Monitoring and Corrections

### **Conclusion**

With the large amounts of audio that broadcast and post facilities handle proper monitoring and processing of your audio may be a challenge but if done properly will give your viewers the best possible experience and keep them from switching channels. Whatever your needs Ward-Beck Systems has a solution.



## Control Your Surroundings: Audio Monitoring and Corrections

**Thank You**

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