Multichannel Audio Technologies

Setting up for Surround Sound on Commercial Speaker Layouts

Setting up for Surround Sound

- What are you mixing/mastering?
- Before we begin we need to know what
  - Media we intend to use
  - Loudspeaker layout
- Most importantly:
  - System Calibration
  - Console Setup
  - Sequencer Setup

But First....

- A little about Codecs

- There are 4 main types:
  - Matrixed
  - Perceptual Based lossy Codecs
  - Lossless Codecs
  - PC/MA Hybrids
Matrixed
- They use Sum and Difference techniques
- Developed initially in the Quadraphonic era
- Side effects include Crosstalk, reduced stereo imaging, reduced localisation accuracy

Examples:

Perceptual (Lossy) Encoders and Decoders:
- Similar to MP3....allow for reduced data rates
- Fully DISCRETE (5.1 = 6 audio channels)
- Based on PSYCHOACOUSTICS!
- Use properties of auditory masking

Examples:

Lossless Encoders and Decoders:
- Bit for Bit identical to the original PCM masters
- Use Numerical coding techniques

Examples:
PE/ME Hybrids
- Use a combination of Perceptual encoding/Matrix encoding
- Used for layouts greater than 5.1
- PE for 5.1, ME for extra channels
- Examples:

Loudspeaker layouts

Loudspeaker layout
- 3-2 (5.0)
- 2-2 (Quad)

-7.1 Systems
  - Codecs
  - Dolby ProLogic IIx
  - Dolby Digital Plus
  - Dolby True HD
Loudspeaker layout
- DTS-HD: Front Wide

Loudspeaker layout
- DTS-HD: Centre Overhead

Loudspeaker layout
- DTS-HD: Centre High
Loudspeaker layout

- DTS-HD: Front High

**What format are you mixing for?**

<table>
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<tr>
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<th>Source Description</th>
<th>Codec</th>
<th>Media</th>
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**System Calibration**

- Configuring a loudspeaker setup for 5.1 (Recommendation ITU-R BS. 775-1)
System Calibration
- Sub-woofer placement
  - ITU LFE playback bandwidth is specified as 20 Hz-120 Hz
  - No recommendation for placement
  - Room acoustics is key!
  - Need to avoid standing waves.

System Calibration
- Two Subwoofer stabilization

![Diagram of frequency responses and room plan with subwoofers and measured positions]

![Graphs showing single source (80Hz) and double source (80Hz) with measured sound level in a room with dimensions]
System Calibration
- Monitor alignment:
  - Powering all speakers equally is not enough!
  - Need to ensure level and timing accuracy at listening point
  - Need to use an SPL meter, Real-Time Spectrum analyzer and pink noise generator.
  - We utilize octave bands as well

System Calibration
- Octave Bands
- 1/3 Octave Bands
  - White Noise
  - Pink Noise

System Calibration
- SPL meter set to C-Weighting
System Calibration

- **C** = “all-pass level” or the sum of all the levels of all frequency bands

- Remember for adding SPLs (dB):

$$L_E = 10 \cdot \log_{10} \left( 10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + \cdots + 10^{\frac{L_n}{10}} \right) \text{ dB}$$

So note, 80dB + 80dB is not 160dB, it’s 83dB!!

System Calibration

Recommended setup all-pass level = 85dBC,

- Therefore 1/3 octave band level = 71 dB for each of the 31 frequency bands.

- We should only use an SPL meter when speakers are matched and acoustics are good.

- Alternative: Use a Real Time Spectrum Analyser to match 1/3 octave bands
LFE Consideration

Low Frequency Effects Channel (LFE):

- DVD-Audio has full bandwidth LFE channel
- Some DVD-Audio players don't have low pass filters in the LFE
- Safer to LPF at production stage

LFE Consideration

- DVD-Audio and DVD-Video/Cinema LFE playback levels are DIFFERENT!
- For DVD-Audio and Super Audio CD, the LFE playback level must be the same as the other channels. However with DVD-Video, it must be 10dB higher! (All-pass level = +4dB)
LFE Consideration

- It would be a mistake to adjust the amp gain so that the pink noise playback level shown by the SPL meter is 95 dBC (= 85dBC+10dB),

- REASON: We are not using the full spectrum in the subwoofer (only 20-120Hz).

- Use a real time analyser to adjust the 1/3 octave bands to 10dB higher

LFE Consideration

- This works out approximately as 79dBC (if we assume the LFE playback bandwidth to be 20 - 120 Hz) for DVD-Audio

- 89 dBC for DVD-Video/ Film
IMPORTANT!!
- DUAL DVD-AUDIO/ DVD-VIDEO Discs:
  In order for an LFE signal produced in a DVD-Audio environment to be converted for use with DVD-Video, the LFE master signal must be printed at a level 10 dB lower.
- i.e. PCM masters must reduce the LFE level by 10dB before conversion to Dolby Digital AC3 or DTS for Video DVD playback.

IMPORTANT!!
- Some Hybrid players do not adjust the LFE level automatically
- Remember that the surround channels are 20-20000Hz (Full Range!)
- Also...in cases where they aren't, (e.g. domestic surround systems), 'bass management' is used anyway, so a portion of the surround audio will always go to the subwoofer.... (More later)

IMPORTANT!!
- So when creating music for DVD-Audio we should ask the question.....
  “Do I need the LFE at all?”
Time Alignment

- All surround signals must arrive at the listening point at the same time.

- For irregular setups we need to impose electrical delays to time align the speakers

- Electrical delay is given by

$$\delta T_i = \left[ \frac{(D_S - D_i)}{C} \right],$$

Console Setup

- Two Methods for routing:

1. Via the mix busses

2. Via the auxiliary channels
Sequencer Setup

Click here to add a bus. The outputs selected for the channels in the busses.

The currently configured busses.

Conclusions

- Before production, decisions must be made for reproduction format and loudspeaker layout
- Speakers must be time aligned and level matched for mixing position
- LFE level must be considered for playback format
- Consoles can be configured for surround via mix busses or auxiliary sends.