Object-based Audio for Home Theater Systems and Video Games

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by

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Abstract

Home theater systems have seen great advanced in video quality with 4K resolution, 3D and high dynamic range with the recently introduced Ultra HD and Dolby Vision™.

The correspondent advances for the soundtrack uses object-based audio technology to offer 3D-like sound fields. This presentation will discuss Dolby Atmos® and DTS:X® object-based audio, and the applications for home theater, video games and mobile.

Object-Based Audio

Object vs Channel Based Audio

- Channel-based audio format is fundamentally limited because it is created to play back on a specific speaker array configuration. Expanding the system by adding more speakers do not result in better audio field.

- If a movie is mixed for a 5.1 speaker configuration, it has just the information required to play back to five speakers, set in predefined locations, and one subwoofer. There is no information for additional speakers. The speaker positions are rigidly defined.

Object vs Channel Based Audio

- Object based audio is not locked to a certain number of speakers. Instead, the audio data carries additional information about the audio objects to allow the final audio rendering to occur at the processor in the living room, using the particular speaker configuration.

- In Dolby Atmos and DTS:X, each sound in a movie scene—a gunshot or a scream, for instance—can be an object. Filmmakers can precisely specify where those sound objects should appear in the 3D acoustic space and how they should move around.

Object-based Audio Codecs

- Dolby Atmos
- DTS:X
- Auro 3D
- MPEG-H

3D Audio in Home Theater

DOLBY ATMOS®
FEEL EVERY DIMENSION™

"Dolby Atmos transports you into the story with moving audio that flows all around you with breathtaking realism."

DTS:X®
EXPERIENCE DTS:X

"DTS:X places sound where it would occur naturally in space, creating the most lifelike, multi-dimensional audio experience ever. Be prepared — this improved immersion and heightened realism makes horror movies scarier, comedies more laugh-out-loud, and car chase scenes even more intense."

Evolution of Home Theater Audio (Dolby)

- Mono: one Front speaker (C)
- Stereo: two Front speakers (L, R)
- Dolby Prologic: three Front speakers (L, C, R), plus rear surround.
- Dolby Digital 5.1 surround sound - Front speakers (L, C, R) and Surround speakers (LS and RS), plus effects channel.
- Dolby Surround 7.1 - Front speakers (L, C, R), Surround speakers (LS and RS), Rear Surround (RLS and RRS), plus effects channel. May get to 9.1 with the addition of two front height speakers.
- Dolby Atmos – builds on top of Dolby Surround 7.1, adding overhead speakers, from 5.1.2 up to 9.1.2 speaker configurations.
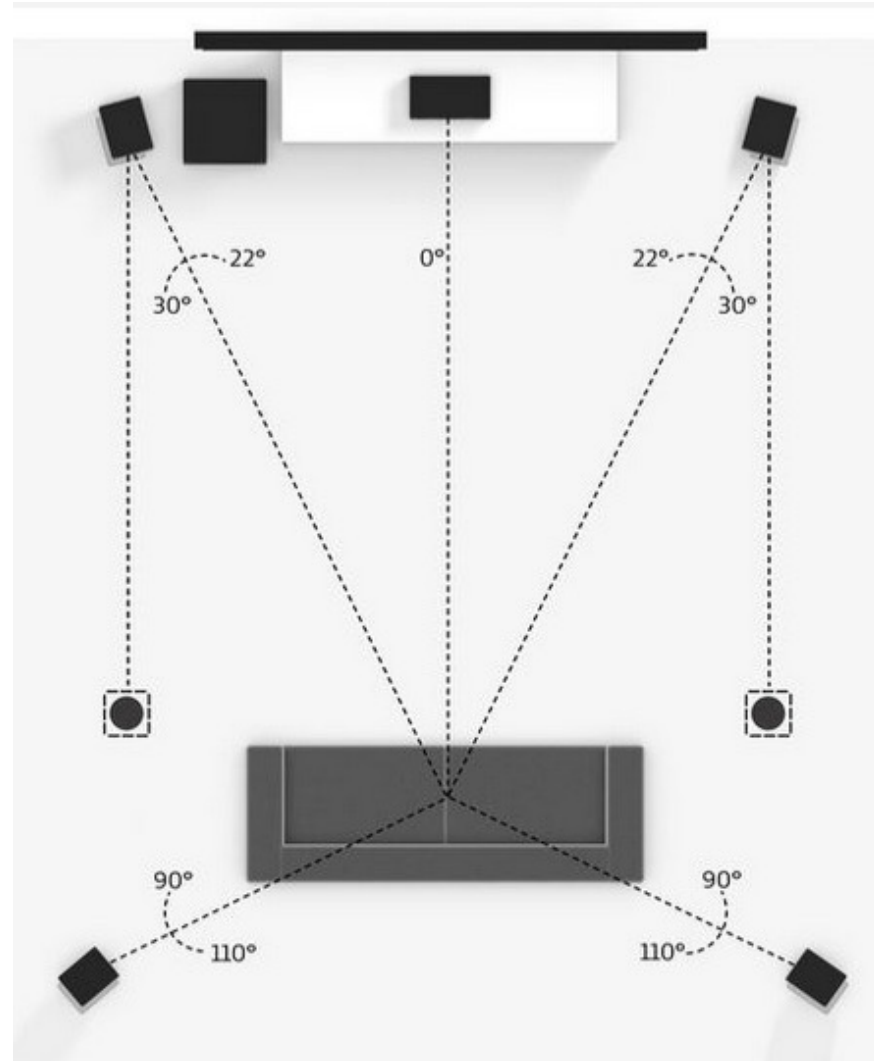
Dolby Atmos and DTS:X
Channel and Object Audio Hybrids

- Dolby Atmos adds object based audio to channel based Dolby Digital Plus. Assumes specific speaker arrays to reduce complexity.

- DTS:X also adds object based audio to DTS channel audio streams. However, DTS:X allows arbitrary speaker array configurations for more flexibility.
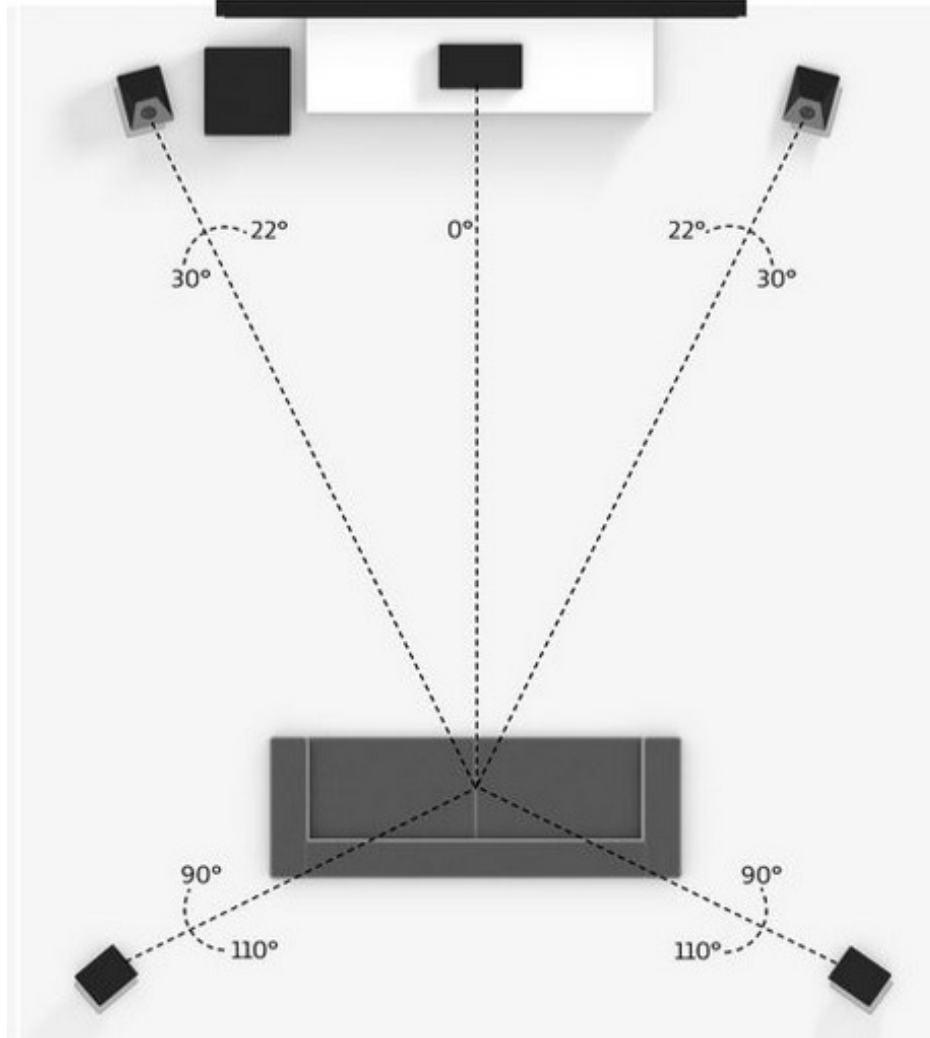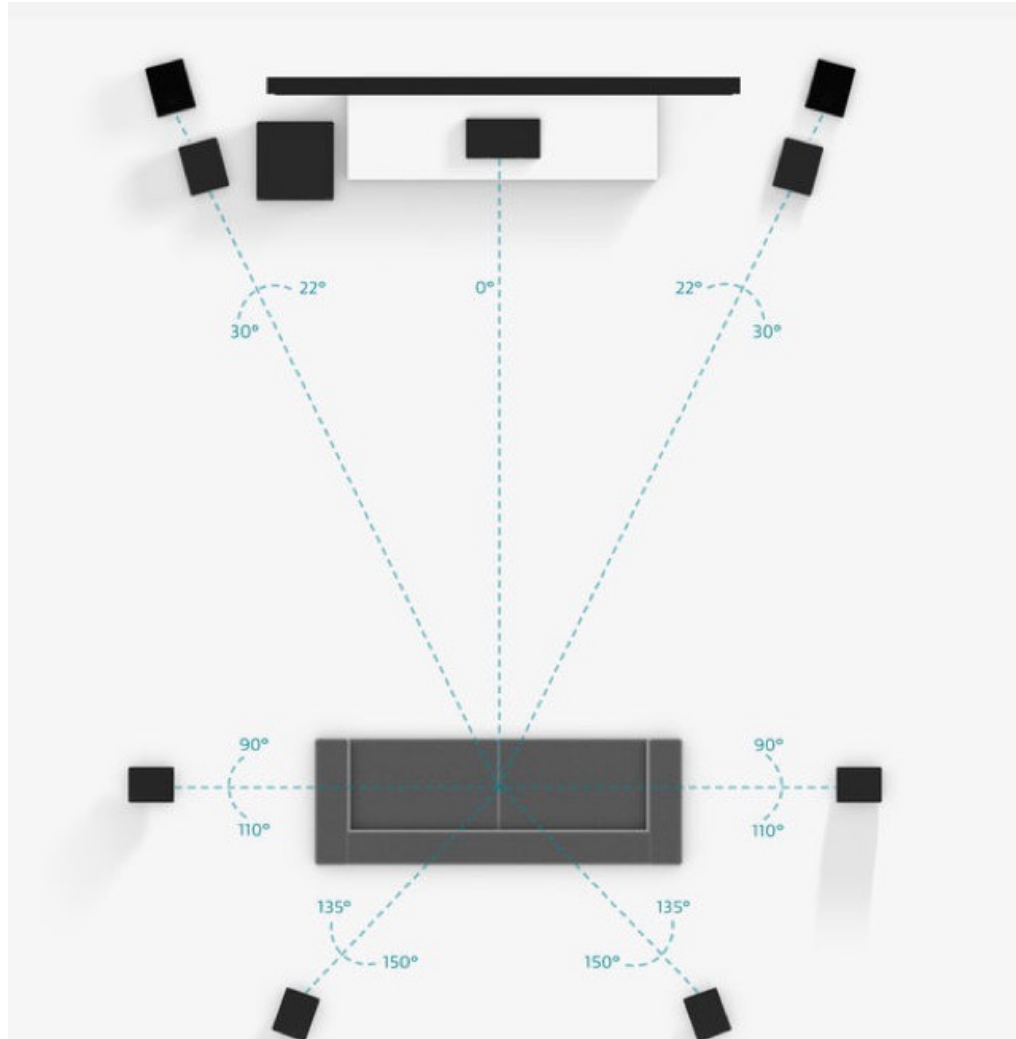
5.1 Speaker Array
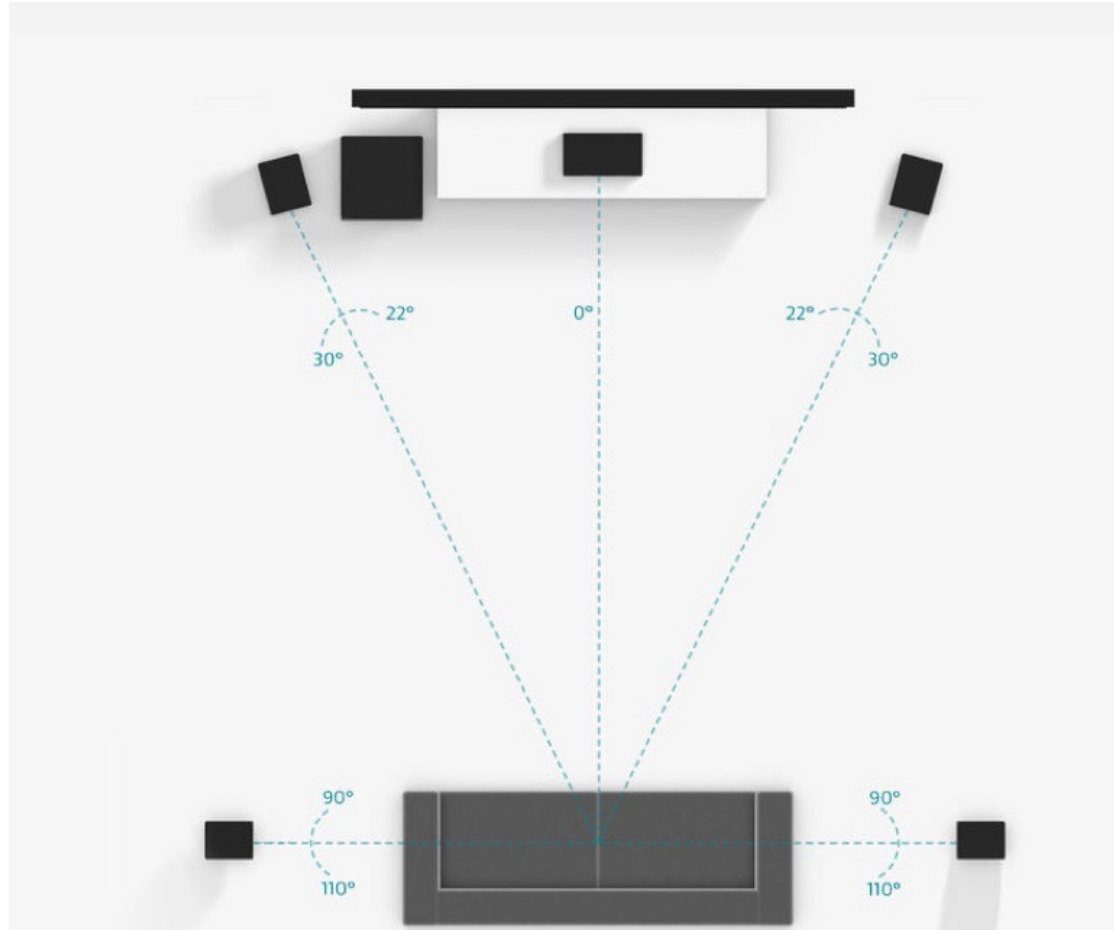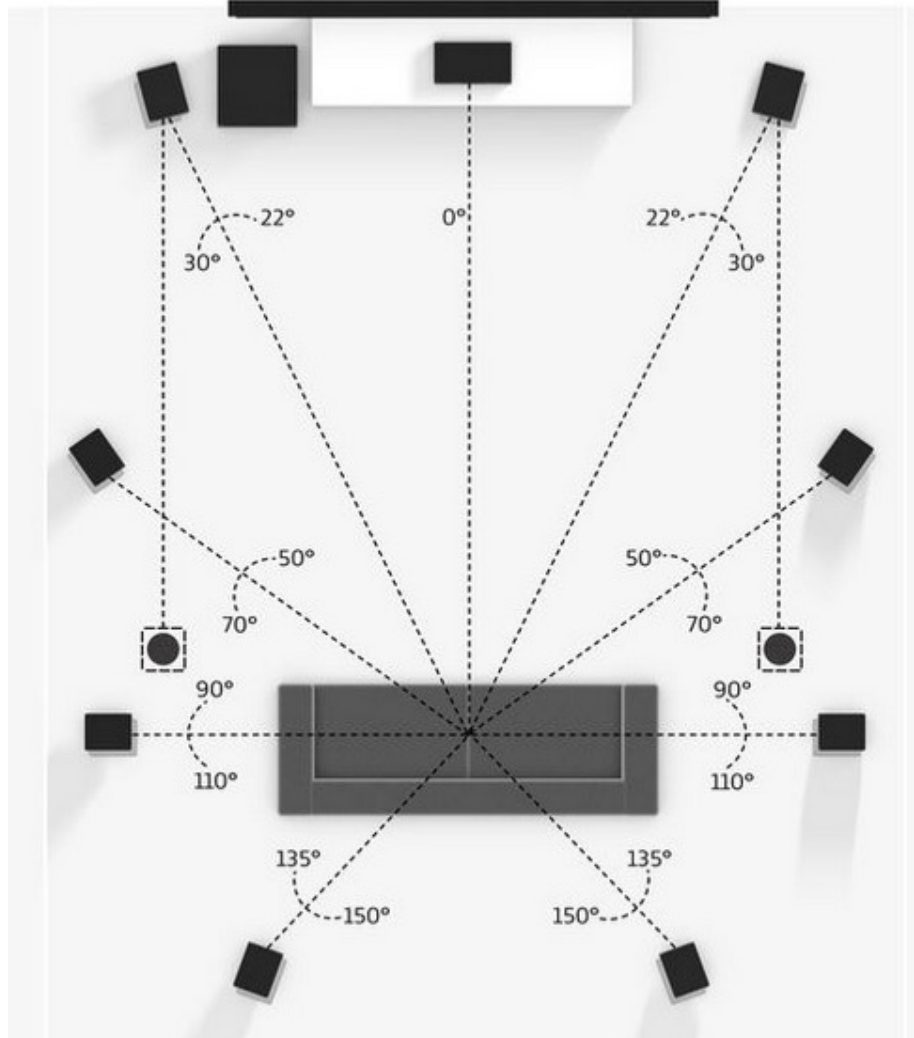
5.1.2 Atmos Ceiling Speaker Array

5.1.2 Atmos Enabled Speaker Array

9.1 Speaker Array

9.1.2 Atmos Speaker Array

Yamaha YSP-5600 Dolby Atmos Enabled Sound Bar

What equipment is required for Dolby Atmos and DTS:X playback?

- Blu-ray player – existing Blu-ray players are compatible.

- Soundbar – must be equipped with Dolby Atmos and/or DTS:X decoders, and the additional height speakers.

- A/V Receiver – must be equipped with Dolby Atmos and/or DTS:X decoders.

- Speakers: additional height speakers or Dolby Atmos Enabled speakers are required.

Dolby Atmos and DTS:X Blu-Ray Discs

- Dolby Atmos:
  - http://www.dolby.com/us/en/experience/dolby-atmos/bluray-and-streaming.html
- DTS:X:
  - http://dts.com/dtsx

For more information

- http://dts.com/dtsx
- http://www.dolby.com/us/en/brands/dolby-atmos.html

Dolby Atmos at the movie theater:

- http://www.dolby.com/us/en/experience/dolby-atmos/movies.html

Dolby Atmos movie theaters in the Austin area:

- EVO Entertainment Center, 3200 Kyle Crossing, Kyle TX 78640
- Santikos Mayan Palace, 1918 S.W. Military Drive, San Antonio TX 78221

3D Audio in Games

3D Audio in Games

- Object-based audio offers the flexibility required for sound events in games.

- Being free of the restrictions of channel-based audio allows precise positioning of the audio events in the 3D acoustic space, tailored to the end-point speaker or headphone system configuration.

3D Audio in Games

"A video game's audio scene is made up of many independent audio objects, like the engines of a ship flying above you or weapons firing at targets past your head. Traditional audio technologies require game sound designers to flatten the three-dimensional audio into a two-dimensional plane, losing valuable positioning information in the process.

But Dolby Atmos removes this barrier. For the first time, the three-dimensional audio scene is preserved, so you're right in the middle of the action. Now, not only can you can hear the enemy in front and behind you, but above you as well—giving you a competitive advantage."
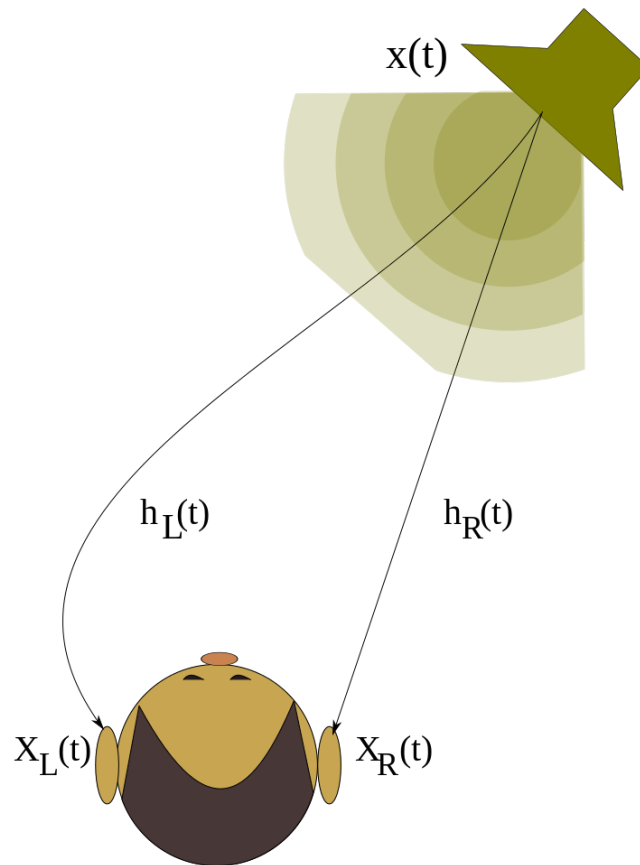
Star Wars Battlefront
with Dolby Atmos

3D Audio in Headphones

Head-related Transfer Function

x(t)

$h_L(t)$ $h_R(t)$

$X_L(t)$ $X_R(t)$

3D Audio in Headphones

- A head-related transfer function (HRTF) is a response that characterizes how an ear receives a sound from a point in space; a pair of HRTFs for two ears can be used to synthesize a binaural sound that seems to come from a particular point in space.

- Humans have just two ears, but can locate sounds in three dimensions – in range (distance), in direction above and below, in front and to the rear, as well as to either side. This is possible because the brain, inner ear and the external ears (pinna) work together to make inferences about location.

3D Audio in Headphones

- Dolby Headphone
- DTS Headphone:X
- Smyth Realiser
  The Realiser provides an experience in which multichannel (or stereo) recording sounds are indistinguishably through headphones as it does through a loudspeaker array in a real room. The Realiser applies HRTFs to multichannel sound to drive the headphones. The Realiser employs three critical components not seen in the other products:
  - personalization
  - head tracking
  - the capture of the properties of any real listening space and sound system.
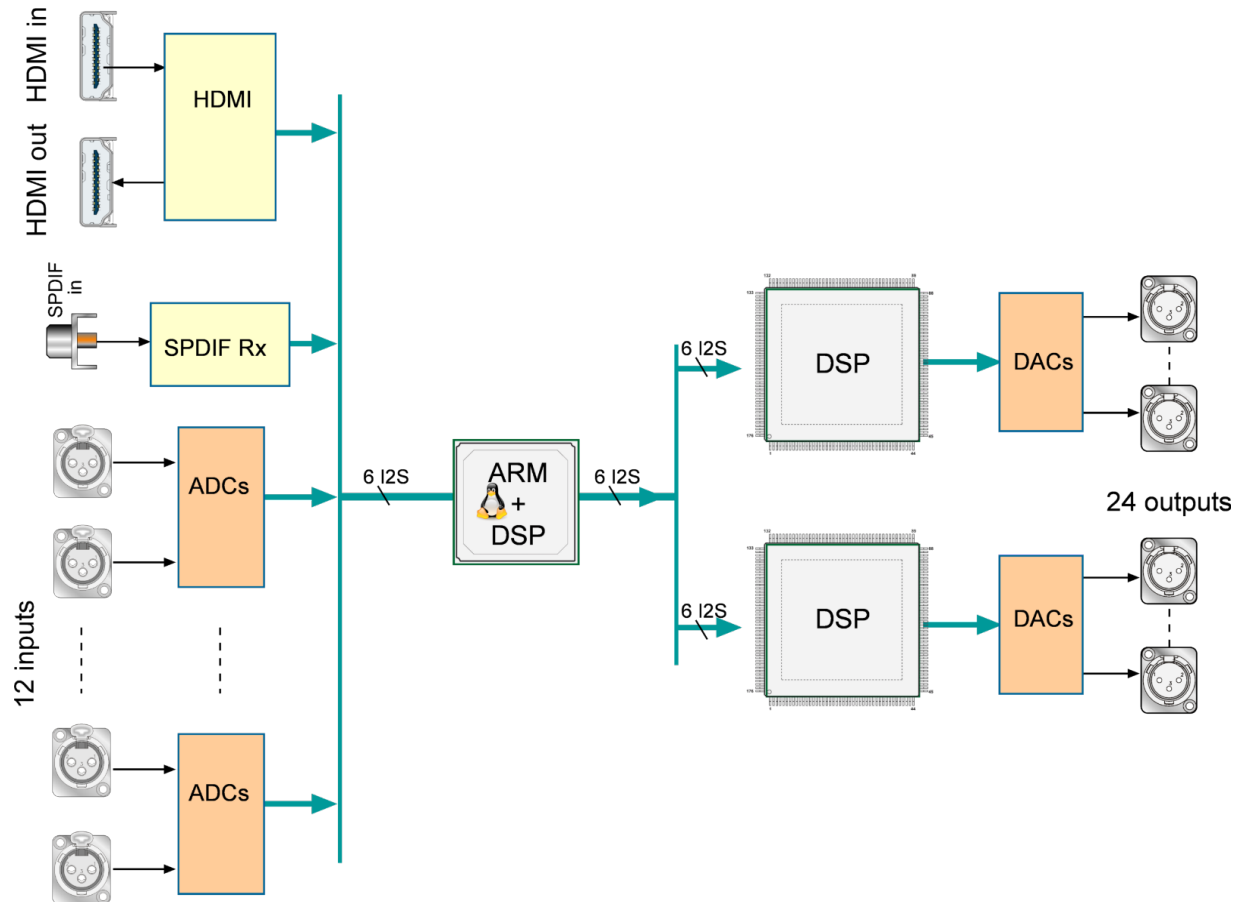
Signal Processing Platforms for Development and Implementation

Momentum Data Systems EQ1

- Development platform for Dolby Atmos and DTS:X
- Uses standard DA8xx TI tools (CCS, PA, Linux, etc.)
- Multi DSP system:
  - Three TI DSP chips: DA830 + 2 x DA808
  - ARM926 + 3 x C647x DSP cores @ 456MHz
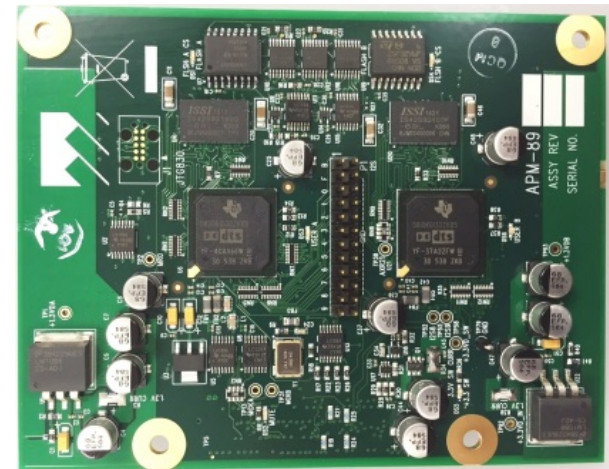 - 12-channel analog in, 24-channel analog out.
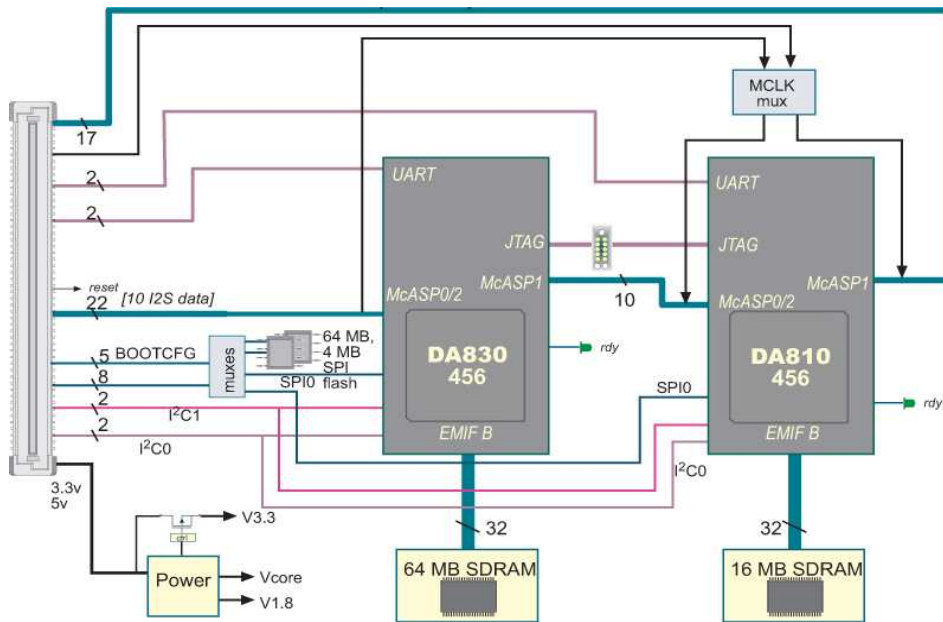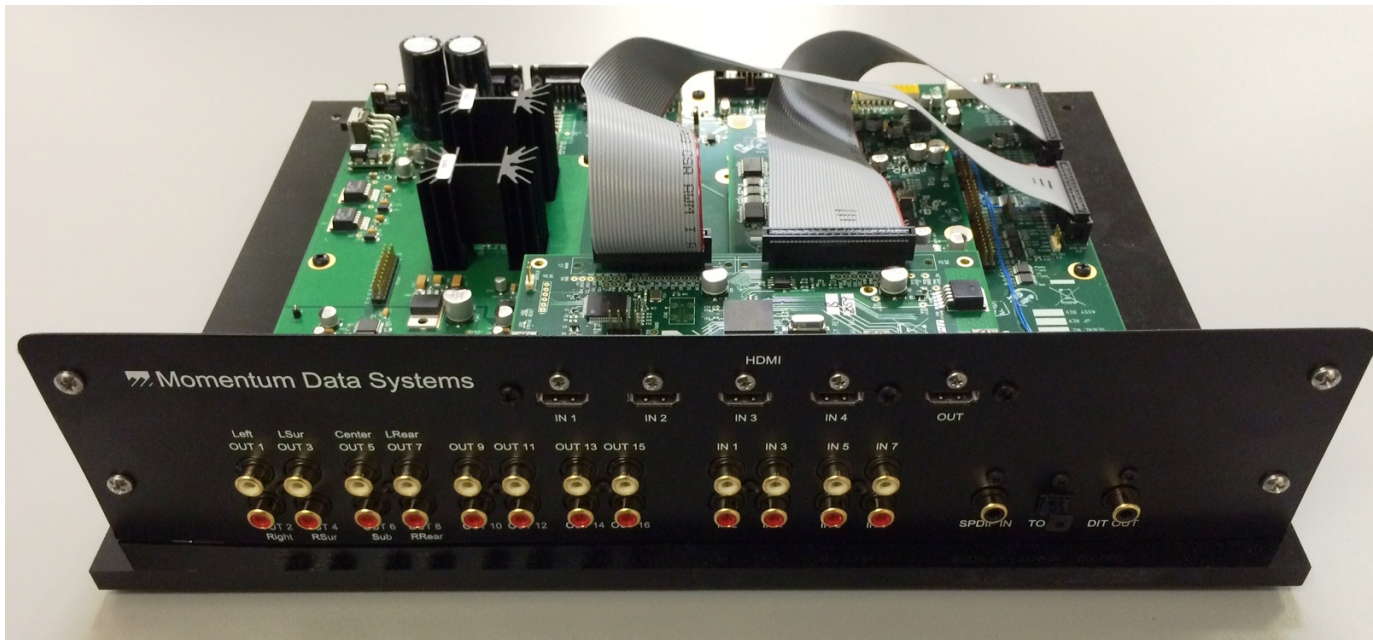 - HDMI I/O
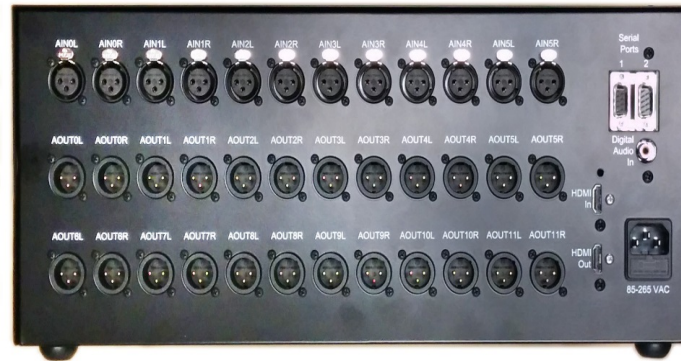
MDS EQ1 Block Diagram

MDS APM-89L

- APM-89L processor module for Dolby Atmos and DTS:X decoding
- Two DSP chips: DA830 + DA810

MDS EVMD

- Dolby Atmos and DTS:X demo platform for the APM-89L processor module.
- 8-channel analog in, 16-channel analog out.
- HDMI I/O

Thank You

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