Dolby Audio over HDMI part 1: Codecs

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INTRODUCTION

The introduction of HDMI opened up a world of possibilities for sound - it allowed devices to deliver and receive many types of audio formats, and it ensured that a device received the best and most compatible audio for that device. With HDMI, whether you were delivering sound to a stereo TV, a surround sound system, or a full Dolby Atmos setup, you could get the best possible audio given the capabilities of the playback system.

Consumers can get high quality audio from a variety of **source devices** including Blu-ray Disc players, set-top boxes, digital-media adapters, game consoles, and PCs and play back on a variety of **sink devices** such as A/V receivers, sound bars, and televisions.

Content for these sources can be in various audio formats including Dolby Digital (AC-3), Dolby Digital Plus (E-AC-3), and Dolby TrueHD.

DOLBY DIGITAL

Dolby Digital (AC-3) is the digital audio standard for DVDs and is the audio standard for digital broadcast television in many countries all over the world. Dolby Digital supports several audio channel configurations, but the most common ones are 5.1-ch and stereo. 5.1-ch Dolby Digital audio is typically encoded at bitrates between 384-640 kbps, while stereo Dolby Digital audio is typically encoded at 192 kbps.

DOLBY DIGITAL PLUS

Dolby Digital Plus (E-AC-3) provides up to twice the efficiency of Dolby Digital while adding new features like 7.1-ch audio, support for descriptive video services, and support for Dolby Atmos (but more on that later). Dolby Digital Plus is widely used by streaming and broadcast services to deliver surround sound audio at lower bitrates. 5.1-ch audio in Dolby Digital Plus is typically encoded at bitrates between 192-256 kbps while stereo audio in Dolby Digital Plus is typically encoded at bitrates between 96-128

kbps. Dolby Digital Plus bitstreams are not directly backwards compatible with Dolby Digital decoders, but Dolby Digital Plus decoders can decode Dolby Digital bitstreams.

DOLBY TRUEHD

Dolby TrueHD, also known as MLP, is a lossless audio codec used widely on HD and UHD Blu-ray Discs. Dolby TrueHD supports up to 24-bit audio and sampling rates from 44.1 kHz to 192 kHz. Dolby TrueHD supports up to 7.1 audio channels as well as Dolby Atmos immersive audio. As Dolby TrueHD is a lossless audio codec, the data rate is variable. For example, Dolby TrueHD bitrates average around 6,000 kbps for Dolby Atmos at 48 kHz with peak data rates up to a maximum of 18,000 kbps for high sampling rate content.

WHAT ABOUT DOLBY ATMOS?

Dolby Atmos is not a codec! Dolby Atmos is an immersive audio format that can be delivered via multiple audio codecs including Dolby Digital Plus and Dolby TrueHD (but NOT Dolby Digital). Blu-ray Discs deliver Dolby Atmos using Dolby TrueHD (with Dolby Digital Plus as an available alternative), and broadcast and streaming services deliver Dolby Atmos using Dolby Digital Plus. In order to maintain compatibility with millions of devices in consumer homes, Dolby Atmos in these codecs is implemented as a backwards-compatible extension. Dolby Atmos data is hidden within the bitstream and can be decoded by a Dolby Atmos-compatible A/V Receiver, soundbar or television. Non-Dolby Atmos capable devices will decode a 5.1-ch or 7.1-ch version from the Dolby Digital Plus or Dolby TrueHD bitstreams. There is new HDMI signaling to indicate that Dolby Atmos is supported by a sink device (more on that in the next article).

All of these formats are supported today on the "forward" HDMI connection between a source device and a sink device.

A SIDEBAR ON S/PDIF

S/PDIF (Sony/Philips Digital Interconnect Format) allows digital audio to be sent from a source device and a sink device over an optical or coaxial connection (by the way, I pronounce it SPEE-DIFF). It's historically been a popular connection type to get digital audio to soundbars as well as A/V receivers. S/PDIF supports 2-channels of uncompressed PCM audio OR Dolby Digital audio. S/PDIF does NOT support Dolby Digital Plus or Dolby TrueHD for 3 reasons. First, since there's no signaling on S/PDIF, there's no way for a source device to know whether a sink device supports newer audio codecs. Second, S/PDIF doesn't have enough bandwidth to support the worst case bitrates of Dolby Digital Plus or any bitrate for Dolby TrueHD (greater than 6000 kbps).

Lastly, content protection rules (e.g. HDCP) don't allow for newer formats to be sent over unencrypted links like S/PDIF.

So, in summary:

	Dolby Digital	Dolby Digital Plus	Dolby TrueHD
Stereo	✓	✓	✓
5.1	✓	✓	✓
7.1		✓	✓
Dolby Atmos		✓	✓
Lossless			✓
S/PDIF	✓		