

Dolby Pulse

— combining the merits of Dolby Digital and HE-AAC

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In late 2007, Dolby Laboratories acquired Coding Technologies, the company which had developed techniques such as Spectral Band Replication (SBR) and Parametric Stereo (PS) for enhancing the efficiency of the Advanced Audio Coding (AAC) compression standard.

This article outlines how Dolby Laboratories, Inc. has now integrated HE-AAC into the Dolby family to create a new audio coding system – called *Dolby Pulse* – for broadcasting and other applications where bandwidth is restricted.

Over the last 18 months, various national HDTV specification groups and European industry groups – such as the EBU, DVB and EICTA – have considered various audio coding systems that could be used for next-generation broadcast applications, including HDTV, that will use MPEG-4 video compression. The requirements call for an efficient audio coding technology that can deliver the next-generation consumer experience with assured reliability, consistent audio and far-reaching compatibility with the pre-installed base of home theatres, set-top boxes and television sets.

Amongst the coding schemes evaluated by the EBU in 2007 [1], Dolby Digital Plus and HE-AAC (High Efficiency Advanced Audio Coding) stood out from the rest, but for different reasons:

- Dolby Digital Plus™ was seen as the next step onwards from the industry-standard Dolby Digital™ format. It offered enhanced sound quality over Dolby Digital at comparable bitrates, an increased number of audio channels, as well as offering higher bitrates and increased meta-data functionality.
- HE-AAC was evaluated to be the most data-efficient codec [1] at lower bitrates (typically 160 kbit/s), but still lacked industry-standard metadata – critical for maintaining consistent broadcast audio quality.

For broadcasters, the lack of metadata maturity within HE-AAC was a real issue.

Two coding schemes for next-generation audio

It was the question of Surround Sound delivery that started to focus broadcasters' minds on the value of metadata within Dolby Digital (and Dolby Digital Plus). Knowing that all domestic surround-sound decoders employed Dolby Digital technology as standard, broadcasters realized that it was metadata which gave them the ability to find a solution. They realized they could control the loud-

ness [2], tailor the dynamic range and optimize the audio quality for whichever system was being used to decode and play out Dolby Digital Surround Sound in the home.

For broadcasters who were not yet using Dolby Digital and for whom bandwidth optimization was of primary importance (e.g. for digital radio and TV transmissions ... but also for emerging technologies such as IPTV and Mobile TV), HE-AAC was turning out to be an interesting option.

On the other hand, for broadcasters who were already using Dolby Digital, the choice was clearer – move to Dolby Digital Plus to ensure consistency of broadcast quality, through metadata, whilst being able to broadcast more audio channels in higher quality.

In the case of consumer electronics manufacturers, it was becoming clear that broadcasters were not going to settle on a single coding scheme, for the various reasons laid out above. This led to manufacturers starting to specify both Dolby Digital Plus and HE-AAC decoders within their next-generation products.

The acquisition of Coding Technologies and the birth of Dolby Pulse

When Coding Technologies first introduced their AAC+ implementation, it combined MPEG AAC-LC with a new technology, Spectral Band Replication (SBR), which was discussed within this publication in July 2002 [3]. SBR enabled the replication of higher frequency content, based on information present at lower and mid-frequencies within the decoded stream. Coding Technologies submitted SBR to MPEG as the basis of HE-AAC, whilst retaining exclusive patent rights to the SBR technology outside of the AAC patent pool.

Dolby saw SBR as an enabling technology for the HE-AAC standard – helping it to overcome some of the audible limitations it had previously suffered, especially at higher frequencies. Dolby also felt at the time that by connecting Coding Technologies' mature industry-standard HE-AAC implementation with its own industry-standard metadata and 5.1 surround-sound technologies, a feature-rich, consistent and reliable version of HE-AAC could be conceived ... a version which the broadcasters could feel reassured by, and would adopt.

In November 2007, Dolby Laboratories, Inc. announced that it had signed a definitive agreement to acquire Coding Technologies.

Earlier this year at NAB in Las Vegas, Dolby introduced “*aacPlus by Dolby*” as a working name for the newly-acquired technology from Coding Technologies. This new *aacPlus* technology was to use the Dolby code base for an improved audio quality version of HE-AAC, whilst being fully compliant with the HE-AAC standard, by using the Coding Technologies implementation at its core. Full support for Dolby metadata was also to be added, allowing it to deliver a consistent experience across all decoders, giving it decoding capability for traditional and non-traditional multi-channel and stereo broadcast devices, such as TVs, set-top boxes, AV receivers, mobile phones, Internet appliances and PCs.

In April this year, it was estimated that most West European terrestrial broadcasters were either using Dolby Digital or planning to move to Dolby Digital Plus but with an increasing number showing interest in HE-AAC. *Fig. 1* shows the status at that time, with significant HE-AAC interest coming from Scandinavia, France and Spain amongst others.

Launched at this year's IBC show in Amsterdam, Dolby Pulse™ is a bit-stream format with a dedicated encoder and decoder which will combine the full compatibility of the MPEG-4 HE-AAC standard with SBR (based on the Coding Technologies core codec), as well as full Dolby metadata support to correctly set the loudness level while preserving dynamic range for multi-channel audio. There will be no need for simulcasting with Dolby Pulse, as a single 5.1 stream can handle multi-channel, stereo and mono with seamless switching via Dolby down-mix metadata parameters.

Since the announcement in April earlier this year about this new HE-AAC-based Dolby technology, there has been a very positive reaction from broadcasters throughout Western Europe. Most have been reassured by the news that the new standard will include the full HE-AAC standard combined with full metadata support (see Fig. 2).

As DVB does not specify which audio codec should be used for next-generation broadcasts, various broadcaster / manufacturer groups have recently worked collaboratively to gain consensus on the formats desired by broadcasters, which will then be included in European receivers. The key outcomes for the multi-channel format requirements drawn up so far are outlined in Table 1.

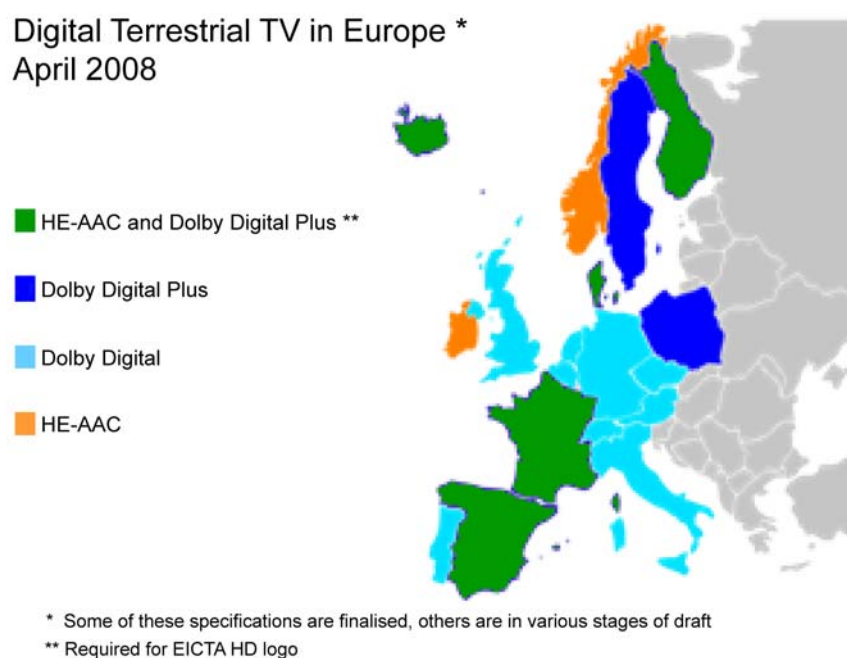


Figure 1
April 2008: Dolby remains a core technology with some HE-AAC adoption starting

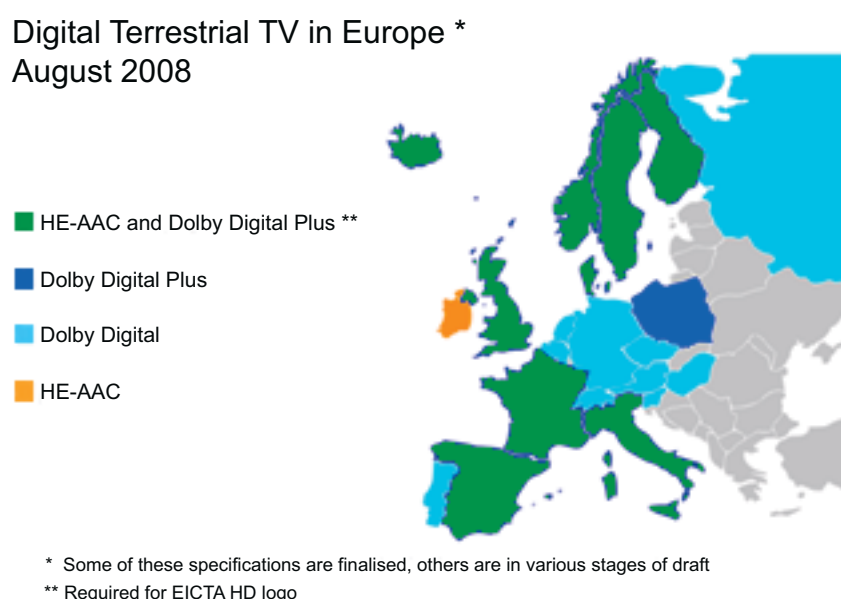


Figure 2
August 2008: combined adoption of HE-AAC and Dolby Digital Plus increasing

Table 1
Multichannel audio requirements in various European HDTV specifications

	Dolby Digital Plus	HE-AAC with Transcoder
EBU	✓	✓
EICTA	✓	✓
HD Forum (France)	✓	✓
NorDig (Sweden, Norway, Iceland, Finland, Denmark)	✓	✓
Spanish HD Forum	✓	✓

For broadcasters who have already deployed Dolby technologies in their broadcasting systems, the most likely favoured option will be to move to Dolby Digital Plus. For those broadcasters who have not yet deployed any Dolby technology in their broadcasts and who aim to start their services in approximately 18 months' time, Dolby Pulse will be the best option where efficient bandwidth utilisation is critical. For those who require a solution sooner, the choice will be between Dolby Digital Plus and the open standard of HE-AAC (without metadata support).

Three decoders, one Dolby platform

To support these multi-format broadcasting requirements, Dolby is introducing a new platform capable of decoding Dolby Pulse, Dolby Digital and Dolby Digital Plus. This platform will be able to output in true Dolby Digital as well as Stereo and Pass-through (see Fig. 3). This platform will be both Dolby tested and Dolby supported.

The first decoder ICs to support Dolby Pulse are expected to be rolled out in spring 2009. Dolby's own deliverables are expected to be available very soon, facilitating broadcast roll-out in early 2010.

Abbreviations

AAC	Advanced Audio Coding
DVB	Digital Video Broadcasting http://www.dvb.org/
EICTA	European Information, Communications and Consumer Electronics Technology Industry Association http://www.eicta.org/
HE-AAC	High Efficiency AAC
MPEG	Moving Picture Experts Group http://www.chiariglione.org/mpeg/
SBR	Spectral Band Replication

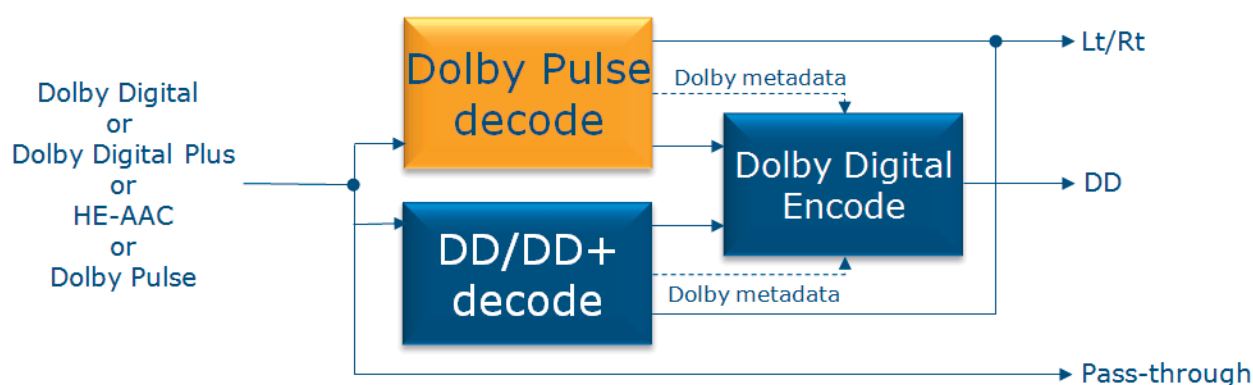


Figure 3
One decoding platform: Dolby Pulse, Dolby Digital and Dolby Digital Plus



James Caselton is responsible for marketing Dolby's Broadcast technologies & Professional products within the EMEA region. He recently joined Dolby from NXP Semiconductors, where he was responsible for the marketing of IC solutions for set-top boxes and digital TVs and where he was involved in establishing partner programmes throughout Asia and Europe with suppliers, manufacturers and retailers.

Prior to joining NXP, Mr Caselton worked for Philips, helping to develop and promote DVD+RW-based products worldwide. Before that, he gained a Communications Engineering degree from the University of Kent in England.

Conclusions

In broadcast applications, Dolby Pulse complements Dolby Digital Plus technology for next-generation applications where bandwidth efficiency is critical. With Dolby metadata and a single code base, Dolby Pulse streams provide consistent and predictable results throughout the broadcast chain to the consumer's television set.

Broadcasters must evaluate which coding scheme best suits them. Dolby Pulse should be used where bandwidth efficiency is of most concern and where a common format for both broadcast and new media content is required. Dolby Digital Plus should be adopted where bandwidth improvements over Dolby Digital are required and where higher bitrate enhanced audio is required. Dolby Digital Plus should also be used for adding more channels to existing Dolby Digital platforms.

Overall, even though broadcasters are favouring two different audio coding schemes, most agree about the importance of metadata for controllable, predictable and consistent high quality audio.

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