

IEEE Standards for Advanced Audio and Video Coding in Emerging Applications

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The IEEE audio- and video-coding standards family includes updated tools that can be configured to serve new applications, such as surveillance, Internet, and intelligent systems video.

he IEEE Standards Association recently approved a comprehensive set of standards that cover advanced audio and video coding for storage and transmission, targeting emerging applications such as Internet media streaming and smart-camera surveillance.

The standards' basic goal is to facilitate reliable and efficient exchange of audiovisual data streams between content creators and target users to provide high-quality, recognitionfriendly end presentations. They enable audiovisual content storage on a wide range of media and transmission over diverse wired and wireless networks, and offer tools for long-term picture reference, learningbased picture generation, and object-based description and coding. In addition, they establish audio and video synchronization guarantees, guidelines for operating in errorprone environments, and conventions for embedding metadata to describe content and make it discoverable.

The standards conform to IEEE's patent policy, providing access to essential patent licensing at a reasonable cost.

OVERVIEW

Three concurrent standards work together to provide complete

audiovisual capability, as Figure 1 illustrates.

The video standard—IEEE 1857-2013, published in June 2013 provides efficient video compression and facilitates tradeoffs between storage and/or transmission rate and video reproduction quality.

The audio standard—IEEE 1857.2-2013, published in November 2013—provides efficient multichannel audio compression. It can be configured to enable completely transparent audio reproduction with good coding efficiency; alternately, users can select higher degrees of compression with a graceful reduction in audio

STANDARDS





quality to suit particular application requirements.

The systems standard—IEEE 1857.3-2013, published in January 2014—provides integration of audio and video coding. It includes tools to achieve

- precise timing for reproduced audiovisual information,
- precise synchronizing of audio information with video information,
- rate buffer management in fixed bitrate storage and transmission environments,
- comprehensive content protection and conditional access,
- error resilience support, and
- metadata provision.

ADVANCED VIDEO-CODING TOOLS

Like other video-coding standards, IEEE 1857-2013 is based on a hybrid transform/differential pulse-code modulation (DPCM) compression. However, it benefits from this basic architecture's steady evolution, combined with advances in the tools that make up the complete algorithm, to provide greater coding efficiency and less complexity, thereby lowering the cost compared to earlier standards.

The video-coding standard includes tools to support a wide range of applications as well as several profiles that cater to specific emerging applications. For example, one profile is dedicated to video surveillance, which has characteristics very different from broadcast television and other video. Thus, the profile exploits surveillance data's particular redundancies to provide twice the coding efficiency with only a small increase in complexity.

ADVANCED AUDIO-CODING TOOLS

The IEEE audio-coding standard is a set of high-fidelity audio compression tools designed for high-resolution digital broadcasting, high-density digital storage media, wireless broadband multimedia communication, and network broadband streaming transactions, among other options. It provides a mixed framework of lossy and lossless audio coding that can support common mono, stereo, multichannel, and surround-sound signals, with sampling frequencies from 8 to 96 kHz.

The lossy profile adopts time-frequency transform, frequency-domain linear prediction and vector quantization, multiresolution analysis, post-quantization square polar stereo coding, and context-dependent bitplane coding. The fine-grained scalability of the output stream bitrate is 1 Kbps when the coding rate is lower than 79 Kbps per channel. The lossyto-lossless profile-an extension of the lossy profile-realizes lossless coding of residual signals and achieves a lossless framework compatible with the lossy

coding bitstream. The lossless profile adopts channel de-correlation, integer-lifting wavelets, linear prediction, residuals handling, and arithmetic entropy coding.

ADVANCED SYSTEMS TOOLS

The IEEE systems standard defines the storage file formats and real-time transport protocol (RTP) payload formats for coded audio and video, in particular, audio specified by IEEE 1857.2-2013 and video specified by IEEE 1857-2013. The storage and transmission formats are unified in the sense that conversion from audio and video bitstream to network abstraction layer unit streams occurs before the coded media content is packed in media tracks or RTP packets.

The system standard exploits the ISO base media file format by extending specific video and audio elementary stream and sample definitions as well as a metadata track for timed metadata to support surveillance applications. It augments the common RTP payload format by adding a payload structure indication byte as the RTP payload's first byte for identification.

The standard's target applications and services include, but are not limited to, surveillance video systems, Internet media streaming, Internet Protocol television services, videoconferences, video telephony, and video on demand.

INTELLECTUAL PROPERTY RIGHTS

When video-coding standards were developed 20 years ago, the cost of licensing essential patents was very high. As licensing evolved and the second generation of standards launched, licensing became complex. IEEE standards developers made a conscious effort to provide inexpensive, simple licensing. The IEEE intellectual property rights policy for standards requires licensing under non-assert or reasonable and non-discriminatory (RAND) provisions and gives essential patent holders the option to declare a commitment to licensing terms. A patent pool providing "one-stop" licensing is at an advanced stage of development for the audio- and video-coding standards.

APPLICATIONS

The new IEEE standards provide optimum audiovisual coding for advanced storage and transmission environments. For example, the coding system's efficient storage and high-speed content retrieval capabilities are useful for intelligentcity management systems, while its flexibility and low cost are ideal for Internet streaming applications with decoding and presentation on PCs, laptops, set-top boxes, tablets, and smartphones. Working together with the systems component, the audio and video codecs can accommodate the variability of packet-based communication and the error conditions of mobile networks.

he IEEE audio- and videocoding standards family includes updated tools that take advantage of modern technology for low-cost implementation and can be configured to serve emerging applications, such as Internet and intelligent systems video.

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