

# WHITE PAPER

## FRAUNHOFER IIS MPEG AUDIO SOFTWARE

### MPEG AUDIO ENCODERS AND DECODERS ON VARIOUS PLATFORMS

Fraunhofer IIS offers quality- and resource optimized software implementations of the MPEG-4 audio en- and decoding algorithms on various platforms, including related parts of MPEG-2 AAC and MPEG-D. This document gives an overview about the types of software, platforms and supported features.

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\* Fraunhofer USA Digital Media Technologies, a division of Fraunhofer USA, Inc., promotes and supports the products of Fraunhofer IIS in the U. S.

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## SCOPE

Generally, the Fraunhofer MPEG audio software portfolio can be split up into 2 different categories:

### PC software

Running on a variety of operating systems, supporting X86\_32 and X86\_64 compatible as well as PowerPC platforms including hardware support for floating point arithmetic.

### Core Design Kit (CDK) software

Reference and template code for resource optimized implementations on 16/32-bit fixed point RISC processors or DSPs with fractional or integer arithmetic. Directly usable on a wide range of 16/32-bit processors and on floating point DSPs.

## FRAUNHOFER MP3 SOFTWARE

Technicolor is our software and patent licensing partner for mp3. For information about royalty rates and licensing details, please visit [www.mp3licensing.com](http://www.mp3licensing.com).

## MPEG-4 AUDIO OBJECT TYPES

MPEG-4 is a combination of different audio coding algorithms. There are algorithms specialized on speech coding such as CELP and general speech and music coders e.g. Advanced Audio Coding (AAC). Most of these basic algorithms are specified in different flavors, influencing the complexity, performance or behavior in case of transmission errors. One specific algorithm in a specific flavor is called an 'audio object type' (AOT). For a complete list of audio object types please see ISO/IEC 14496-3.

The following table lists the most common MPEG-4 AOTs supported by Fraunhofer IIS software:

MPEG-4 Audio Object Type	Description	No.
AAC LC	AAC Low Complexity	2
SBR	Spectral Band Replication	5
ER AAC LD	Error Resilient AAC Low Delay	23
PS	Parametric Stereo	29
MPEG Surround <sup>1</sup>	Compatible Surround extension of mono/stereo coders	30
LD-MPEG Surround <sup>2</sup>	Low Delay stereo and surround extension for low delay coders	44
SLS	Scalable Lossless with core layer	37
ER AAC ELD	Error Resilient AAC Enhanced Low Delay	39

<sup>1</sup>MPEG Surround usually contains a core coder, e.g. AAC LC (AOT 2) or SBR (AOT 5).

<sup>2</sup> LD-MPEG Surround contains AAC LD (23) or AAC ELD (39) as core coder.

The following table lists the most common MPEG-2 AAC types supported by Fraunhofer IIS software:

MPEG-2 ACC Type	Description	No.
MPEG-2 AAC-LC	MPEG-2 AAC Low Complexity	m2
MPEG-2 AAC-LC+SBR	MPEG-2 AAC Low Complexity with Spectral Band Replication	m5
MPEG-2 AAC-LC+SBR+PS	MPEG-2 AAC Low Complexity with Spectral Band Replication and Parametric Stereo	m29
MPEG-2 AAC-LC+MPS	MPEG-2 AAC Low Complexity with SBR and MPEG surround	m30

## MPEG-4 AUDIO PROFILES

MPEG-4 combines different sets of audio object types to 'profiles'. With the support for AOT 2 (AAC LC), AOT 5 (SBR) and AOT 29 (PS) almost any of the Fraunhofer IIS MPEG-4 encoders and decoders fully support the MPEG-4 AAC profile as well as the MPEG-4 HE AAC (High Efficiency) and HE AAC v2 profile. The Low Delay and Enhanced Low Delay profiles are particularly designed for delay-sensitive applications.

MPEG-4 Profile	Contained Audio Object Types
AAC profile	AAC LC (2)
High Efficiency AAC profile	AAC LC (2), SBR (5)
High Efficiency AACv2 profile	AAC LC (2), SBR (5), PS (29)
Low Delay-AAC profile	AAC LD (23)
Low Delay AAC v2 profile	AAC LD (23), AAC ELD (39), LD MPEG surround (44)
Baseline MPEG surround profile	MPEG surround (30)

## PC SOFTWARE

For PC platforms several types of encoder software and one decoder are available. While the regular PC encoder (PcEnc) supports the AAC-LC based audio profiles, the 'low delay' encoder (PcEncELD) supports all AAC low delay audio object types. Both encoders are targeted to achieve maximum encoding speed and highest audio quality. This includes special optimization techniques for SIMD execution units present in modern CPUs.

The PC decoder (PcDec) is an MPEG-4/MPEG-D compliant audio decoder supporting a variety of AOTs. It comes with CPU-specific optimizations.

The PC software is available in source or object code form for several processor types and operating systems.

PC Software is available for the following OS/CPU platforms:

Software package	Platforms
PcEnc	Win32, Win64, MacOS X Universal (Intel32/64+PPC32), Linux32, Linux64, others on request
PcEncELD	Win32, Win64, MacOS X Universal (Intel32/64+PPC32), Linux32, Linux64, others on request
PcDec	Win32, Win64, MacOS X Universal (Intel32/64+PPC32), Linux32, Linux64, others on request

## CORE DESIGN KIT (CDK) SOFTWARE

The Fraunhofer IIS CDKs (CDKEnc, CDKDec) are bit-precise reference and template codes optimized in terms of memory requirements and processing power. They are written in C or C++ and are available in two different versions: directly compilable for 16-bit or 32-bit fixed-point processors (ARM, MIPS, PowerPC, ADI, TI, Freescale, and more) or as a template code for DSPs with fractional or integer arithmetic.

Software package	Target Platforms	Target OS	Development Platforms
CDKEnc, CDKDec Native code	Directly compilable code for ARM, MIPS, PowerPC, ADI Blackfin, TI-C6x, any other 16/32-bit processor	Embedded Linux and Windows, iOS, native object code	Various embedded compiler tool sets. Compilable also with PC compiler tool sets for test purposes
CDKEnc, CDKDec Template code	Template code for any fixed-point (fractional or integer) DSP or custom core	-	Simulation code compiled with standard PC development tool sets (MS DevStudio, gcc etc)

*Other processors or targets on request.*

## MPEG-4 AUDIO OBJECT TYPE/MPEG-2 AAC SUPPORT

The following MPEG-4 audio object types and MPEG-2 AAC types are supported by the different software packages:

Software package	MPEG-4 Audio Object Types/MPEG-2 AAC Types
PcEnc	2, 5, 29, 30, m2, m5, m29, m30
PcEncELD	23, 39, 44
PcDec	2, 5, 23, 29, 30, (37, 38,) 39, m2, m5, m29, m30 (others on request)
CDKEnc	2, 5, 23, 29, 39, 44, m2, m5, m29
CDKDec	2, 5, 23, 29, 30, 39, 44, m2, m5, m29, m30

## TRANSPORT FORMAT SUPPORT

The following MPEG-4 transport or file formats are directly supported by the different software packages:

Software Package	File format
PcEnc	ADIF, ADTS, MP4FF, LATM/LOAS
PcEncELD	MP4FF, LATM/LOAS
PcDec	ADIF, ADTS, MP4FF, LATM/LOAS
CDKEnc	ADIF, ADTS, MP4FF, LATM/LOAS
CDKDec	ADIF, ADTS, MP4FF, LATM/LOAS

*Note: MP4FF support always includes support for 3GPFF as well.*

## FEATURES SUPPORTED

The following coding features are supported by the different software packages:

Software Package	Multi-channel	24 bit/96 kHz Audio	Variable Bit rate	Error Robustness	Spectral Band Replication	Parametric Stereo	MPEG Surround	Concealment
PcEnc	Yes	Yes	Yes	On request	Yes	Yes	Yes	n.a.
PcEncELD	Yes	Yes	-	On request	Yes	Yes (ld MPEG Surround)	Yes (ld MPEG Surround)	n.a.
PcDec	Yes	Yes	Yes	ER / Eptool	Yes	Yes	Yes	Yes
CDKEnc	Yes	On request	Yes	On request	Yes	Yes	-	n.a.
CDKDec	Yes	Yes	Yes	On request	Yes	Yes	Yes	Yes

*n.a. = not applicable*

## RESOURCE REQUIREMENTS/SPEED

Some information about the performance requirements can be found in the following table. All figures are valid for AOT-2 AAC-LC stereo encoding or decoding at an audio sampling rate of 44.1 kHz.

Software package	Speed <sup>1</sup>
PcEnc	~35 on Pentium 4 2.0 GHz
PcDec	~40 on Pentium 4 2.0 GHz

<sup>1</sup>Speed means *n* times faster than real-time, approx. values for AOT 2, AAC-LC stereo @44.1 kHz.

## SOFTWARE LICENSING

For further information about Fraunhofer IIS MPEG audio software, please contact [amm-info@iis.fraunhofer.de](mailto:amm-info@iis.fraunhofer.de).

U.S. based customers, please contact the San Jose, CA office of Fraunhofer USA at [codex@dmf.fraunhofer.org](mailto:codex@dmf.fraunhofer.org), +1-408-573-9900.

## PATENT LICENSING

Audio patent licensing of MPEG AAC and MPEG Surround is handled by Via Licensing.  
Please visit <http://www.vialicensing.com> for more information.

## APPLICABLE DOCUMENTS

- ISO/IEC 13818-7 MPEG-2 AAC
- ISO/IEC 14496-1,3,12,14 MPEG-4
- ISO/IEC 23003-1,2 MPEG-D
- Core Design Kits, Reference and Template Code for MPEG Audio Encoders and Decoders on Fixed Point Processors, FhG/IIS Whitepaper, <http://www.iis.fraunhofer.de/amm>
- Embedded and Mobile Multimedia Solutions, FhG/IIS Whitepaper, <http://www.iis.fraunhofer.de/amm>
- Overview available platforms, FhG/IIS Whitepaper, <http://www.iis.fraunhofer.de/amm>

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## ABOUT FRAUNHOFER IIS

When it comes to advanced audio technologies for the rapidly evolving media world, Fraunhofer IIS stands alone. For more than 25 years, digital audio technology has been the principle focus of the Audio and Multimedia division of Fraunhofer Institute for Integrated Circuits (IIS). From the creation of mp3 and the co-development of AAC to the future of audio entertainment for broadcast, Fraunhofer IIS brings innovations in sound to reality. Today, technologies such as Fraunhofer Cingo for virtual surround sound, Fraunhofer Symphoria for automotive 3D audio, AAC-ELD for telephone calls with CD-like audio quality, and Dialogue Enhancement that allows television viewers to adjust dialogue volume to suit their personal preferences are among the division's most compelling new developments.

Fraunhofer IIS technologies enable more than 7 billion devices worldwide. The audio codec software and application-specific customizations are licensed to more than 1,000 companies. The division's mp3 and AAC audio codecs are now ubiquitous in mobile multimedia systems.

Fraunhofer IIS is based in Erlangen, Germany and is an institute of Fraunhofer-Gesellschaft. With 23,000 employees worldwide, Fraunhofer-Gesellschaft is comprised of 67 institutes making it Europe's largest research organization.

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