

Sustainability of Digital Formats: Planning for Library of Congress Collections

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MPEG-4 File Format, Version 2

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Format Description Properties

- ID: fdd000155
- Short name: MP4_FF_2
- Content categories: moving-image
- Format Category: file-format
- Other facets: unitary, binary, unstructured, sampled
- Last significant FDD update: 2023-04-25
- Draft status: Full

Identification and description

Full name	ISO/IEC 14496-14:2003. Information technology -- Coding of audio-visual objects -- Part 14: MP4 File Format (formal name); MPEG-4 file format, version 2 (common name)
Description	The second MPEG-4 file format developed by the Moving Picture Experts Group (MPEG). The format's object-based design defines a set of tools that present binary coded representation of individual audiovisual objects, text, graphics, and synthetic objects. (See Notes below.) This format is intended to serve web and other online applications; mobile devices, i.e., cell phones and PDAs; and broadcasting and other professional applications. See also Notes below.
Production phase	Generally a final-state (end-user delivery) format, may also serve as middle-state format.
Relationship to other formats	
Subtype of	ISO_BMFE , ISO Base Media File Format

Has subtype	MP4_FF_2_V , MPEG-4 File Format, V.2, with Visual Encoding (All Profiles)
Has subtype	MP4_FF_2_AVC , MPEG-4 File Format, V.2, with AVC, No Profile Indicated
Has subtype	MP4_FF_2_AVC_BP , MPEG-4 File Format, V.2, with AVC, Baseline Profile
Has subtype	MP4_FF_2_AVC_MP , MPEG-4 File Format, V.2, with AVC, Main Profile
Has subtype	MP4_FF_2_AVC_EP , MPEG-4 File Format, V.2, with AVC, Extended Profile
Has subtype	MP4_FF_2_AVC_HP , MPEG-4 File Format, V.2, with AVC, High Profile
Has subtype	MP4_FF_2_AVC_H10P , MPEG-4 File Format, V.2, with AVC, High 10 Profile
Has subtype	MP4_FF_2_AVC_H422P , MPEG-4 File Format, V.2, with AVC, High 4:2:2 Profile
Has subtype	MP4_FF_2_AVC_H444P , MPEG-4 File Format, V.2, with AVC, High 4:4:4 Profile
Has subtype	MP4_FF_2_AAC , MPEG-4 File Format, V.2, with Advanced Audio Coding
Has subtype	For other object types, not described at this time
Has earlier version	MP4_FF_1 , MPEG-4 File Format, Version 1

Local use

LC experience or existing holdings	The content produced by the NDIIPP partnership project with SCOLA consists of foreign television news broadcasts in MP4_FF_2_V , MPEG-4 File Format, V.2, with Visual Encoding. The Library of Congress has many MPEG-4 files in its collections - over 225TB in early 2023 - across numerous collections.
LC preference	The Library of Congress Recommended Formats Statement (RFS) lists MPEG-4 as an Acceptable viewing proxy format for Video - File-Based and Physical Media.

Sustainability factors

Disclosure	<p>Open standard in that it is fully documented and disclosed. As with any ISO-sponsored project, any updates to the specification are done through the ISO process for such which includes funneling feedback through national members, such as ANSI in the case of the USA. This process is transparent in its procedure but because membership in national bodies is limited (for example, individuals are not eligible to join ANSI as members), it is not considered an open format. Moreover, the specification documents are paywalled.</p> <p>Developed through ISO technical program ISO/IEC JTC 1/SC 29 for coding of audio, picture, multimedia and hypermedia information. The working group WG11 (for coding of moving pictures and audio) is also known as the Moving Picture Experts</p>
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	<p>Group (MPEG). See the ISO Standards Catalogue for the list of standards published by ISO/IEC JTC1/SC29. See http://mpeg.chiariglione.org/standards/mpeg-4 for information specific to MPEG-4 and its many parts.</p>
Documentation	<p>ISO/IEC 14496-14:2003. Information technology -- Coding of audio-visual objects -- Part 14: MP4 File Format.</p> <p>The total documentation package for ISO/IEC 14496 is extensive; 17 parts have been published from 1998 to 2004, with more to come. See complete list of documents in Format specifications below.</p>
Adoption	<p>Appears to be more widely adopted than MP4 FF 1. Overall, the adoption of MPEG-4 has been slowed by licensing terms that require some content disseminators to pay fees according to the number of end users or the extent of content delivered. As adoption advances, it may not extend to all profiles, levels, or parts of the standard.</p>
Licensing and patents	<p>MPEG-4 Visual, Systems, and Advanced Video Coding licensing is managed by MPEG LA LLC (https://www.mpegla.com/). These licenses cover the manufacture and sale of devices or software and, for some content disseminators, levy fees according to number of end users or the extent of content delivered. The arrangements are updated periodically; for example, in January 2005, MPEG LA announced that the patent portfolio had been expanded to cover the FRExt (Fidelity Range Extensions) associated with MPEG-4 AVC and ITU H.264.</p> <p>MPEG-4 Audio licensing is managed by Via Licensing Corporation (http://www.via-corp.com/licensing/index.html, link available through Internet Archive), an independent subsidiary of Dolby Laboratories. MPEG-4 Audio licensing appears to be limited to the manufacture of devices or software.</p>
Transparency	<p>Depends upon included encodings, but all MPEG-4 encodings depend upon algorithms and tools to read and require sophistication to build tools.</p>
Self-documentation	<p>The inclusion of metadata of various types is a key element in MPEG-4. As indicated in the notes below, object and scene descriptions are required in order for MPEG-4 content to be presented.</p> <p>Semantic description is carried by Object Content Information (OCI) descriptors and streams; the standard also permits the inclusion of MPEG-7 data, a separately standardized structure for metadata to support discovery and other purposes.</p>
External dependencies	<p>Playback of surround sound requires multiple loudspeakers.</p>
Technical protection considerations	<p>MPEG-4 offers a standardized Intellectual Property Management and Protection (IPMP) interface consisting of IPMP-Descriptors (IPMP-Ds) and IPMP-Elementary Streams (IPMP-ES) that allow the design and use of domain-specific IPMP systems.</p>

Quality and functionality factors

Moving Image

Normal rendering	Good support. The format supports <i>timescales</i> that manage the playout of time-based media streams and <i>hint tracks</i> employed in streaming applications.
Clarity (high image resolution)	Depends upon encoding; see MPEG-4_V and MPEG-4_AVC .
Functionality beyond normal rendering	MPEG-4 program streams may be multiplexed in MPEG-2 transport streams. Random access and other features are discussed in the specification.
Sound	
Fidelity (high audio resolution)	<p>Depends upon encoding; the encodings used are generally lossy and provide moderate to very good fidelity. See, for example, AAC_MP4, considered to be superior to MP3 (MPEG-2 layer 3 audio) at a given bit rate.</p> <p>The MPEG-4 standard also provides support for other "natural" sound encodings, e.g., parametric coding (HILN or Harmonic and Individual Lines plus Noise) and CELP (Code Excited Linear Prediction) and other encodings for speech. The standard also supports the synthesis of audio, and for what is called Synthetic-Natural Hybrid Coding (SNHC). The presentation of these elements depends upon the use of AudioBIFs (Audio BInary Format for Scenes). In 2005, the MPEG committee announced two additional audio capabilities: Audio Lossless coding (ALS; lossless compression of multi-channel sound using time-domain prediction and entropy coding) and Scalable to Lossless coding (SLS; a scalable enhancement layer is added to a lossy bitstream that extends the representation to lossless but which can be truncated at delivery time). The compilers of this document do not know the degree to which any of these various elements may be implemented in practice.</p>
Multiple channels	<p>The AAC_MP4 audio structure provides a capability of up to 48 main audio channels, 16 LFE (Low Frequency Encoding or Effects) channels, 16 overdub/multilingual channels, and 16 data streams.</p> <p>SNHC [and other note-based or synthetic?] sound can be spatially presented using extensions of the concepts initially implemented in Virtual Reality Modeling Language (VRML).</p>
Support for user-defined sounds, samples, and patches	Not applicable.
Functionality beyond normal rendering	Not fully investigated at this time. Recent published or announced additions to the standard include Part 16, the Animation Extension Framework; Part 17 for "timed text," e.g., subtitles or karaoke; Part 18 for font compression and streaming; and Part 22 for Open Fonts based on the OpenType specification.

File type signifiers and format identifiers

Tag	Value	Note
Filename extension	mp4 m4a	Paraphrased from the former www.m4a.com site: <i>MP4</i> can be used for MPEG 4 video files, combined video and audio files, or just plain MPEG 4 audio. <i>M4A</i> files contain only MPEG 4 Audio. Apple started using <i>M4A</i> to identify files unprotected

		<p>by digital rights management; note that protected QTA AAC files carry the <i>M4P</i> and <i>M4B</i> (for bookmarkable files) extensions. Apple felt that <i>MP4</i> was too general (video, video/audio, or audio) and might confuse some media players. Until recently, encoder and player software like Nero and Compact used <i>.mp4</i> for audio files while WinAmp 5.02, Apple iTunes, and others used <i>.m4a</i>. Today, most audio software developers allow you to choose the file extension you prefer.</p> <p>The Wikipedia article Apple Lossless (consulted November 2, 2012) reports that the <i>m4a</i> extension is used for files containing either AAC_MP4 or the Apple Lossless encoding, wrapped in the MPEG4_FF_2 (MPEG-4, version 2) file format.</p>
Internet Media Type	video/mp4	According to IETF RFC 4337 (March 2006), for files with video and audio streams (including MPEG-J ¹).
Internet Media Type	audio/mp4	According to IETF RFC 4337 (March 2006), for files with audio but no visual aspect (including MPEG-J ¹).
Internet Media Type	application/mp4	According to IETF RFC 4337 (March 2006), for files with neither visual nor audio presentations but only MPEG-J ¹ or MPEG-7 metadata.
Internet Media Type	application/mpeg4-iod application/mpeg4-iod-xmt	IOD (Initial Object Descriptor) in binary format and (with appended xmt) in textual format, from IETF RFC 4337 (March 2006).
Internet Media Type	video/mp4v-es video/mpeg4-generic	Additional MIME types referred to in various documents. IETF RFC 3016 reports that MIME types may have indicators for data rate or profile-level appended to them.
Magic numbers	Not found.	Comments welcome.
Uniform Type Identifier (Mac OS)	mpg4	Similar in function to a filename; the <i>mpg4</i> type code is documented in IETF RFC 4337 (March 2006).
File type brand (ISO Base Media File Format)	mp42	ISO BMFF includes a file type box that contains major and minor brands (identifiers); this brand is specified in Part 14, Section 4 (ISO/IEC 14496-14:2003. Information technology - Coding of audio-visual objects -- Part 14: MP4 File Format, p. 6).

Notes

General	<p>The four file formats associated with the ISO/IEC 14496 family of specifications are:</p> <ul style="list-style-type: none"> • MP4_FF_1, "version 1" from Part 1 (2001) • MP4_FF_2, "version 2," this document, from Part 14 • MP4_FF_AVCE, for Advanced Video Coding extensions, from Part 15 • MP4_XMT, "textual format" from Part 11
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Version 2 is very similar to its predecessor [MP4_FF_1](#) as both owe a debt to the [QuickTime](#) file format that preceded them. This lineage is shared with the supertype for MP4_FF_2, [ISO_BMFF](#), defined in Parts 12 of both the MPEG-4 and JPEG 2000 standards.

Note that "object-oriented building blocks" are called *boxes* in this file format and its parent, [ISO_BMFF](#); in contrast, they are called *atoms* in the predecessor MP4_FF_1 and [QuickTime](#).

The object-based design of MPEG-4 is characterized as follows in Fernando Pereira and Touradj Ebrahimi's *The MPEG-4 Book* (Upper Saddle River, NJ: IMSC Press, 2002): "MPEG-4 is an ISO/IES standard developed by MPEG for communicating interactive audiovisual scenes. The standard defines a set of tools that provide binary coded representation of individual audiovisual objects, text, graphics, and synthetic objects. The interactive behaviors of these objects and the way they are composed in space and time to form an MPEG-4 scene are dependent on the scene description, which is coded in a binary format known as binary format for scenes (BIFS) The audiovisual streams are defined as elementary streams (ESs) and managed according to the object descriptor (OD) framework In addition, the OD framework defines additional streams for object content information (OCI), MPEG-J [Java APIs], and intellectual property management and protection (IPMP)." (p. 188)

BIFS owes a debt to the Virtual Reality Modeling Language (VRML), even as it extends VRML's capabilities and employs binary encoding. Timing of elements in MPEG-4 is managed by a Synchronization Layer (SL). The delivery of MPEG-4 content is supported by the Delivery Multimedia Framework or DMIF and its application interface.

MPEG-J is described in Part 1 of the standard (ISO/IEC 14496-1:2004). This API for the interoperation of MPEG-4 media players with Java code is contrasted with a conventional parametric system. "By combining MPEG-4 media and safe executable code, content creators may embed complex control and data processing mechanisms with their media data to intelligently manage the operation of the audio-visual session. The parametric MPEG-4 System forms the Presentation Engine while the MPEG-J subsystem controlling the Presentation Engine forms the Application Engine. The Java application is delivered as a separate elementary stream to the MPEG-4 terminal. There it will be directed to the MPEG-J run time environment, from where the MPEG-J program will have access to the various components and required data of the MPEG-4 player to control it." (p. xii)

History

Format specifications

- [ISO Catalogue of standards published under ISO/IEC JTC 1/SC 29](https://www.iso.org/committee/45316/x/catalogue/) (<https://www.iso.org/committee/45316/x/catalogue/>). MPEG-4 is ISO/IEC 14496. This file format is described in Part 14. All parts and associated amendments and corrections are listed in this SC29 catalogue. Parts published through 2004 are listed immediately below.
- ISO/IEC 14496-1:2001 Information technology -- Coding of audio-visual objects -- Part 1: Systems

- ISO/IEC 14496-1:2004 Information technology -- Coding of audio-visual objects -- Part 1: Systems
- ISO/IEC 14496-1:2001/Amd 1:2001 Extended BIFS
- ISO/IEC 14496-1:2001/Amd 4:2003 SL extensions and AFX streams
- ISO/IEC 14496-1:2001/Amd 8:2004 New ObjectTypeIndication code points
- ISO/IEC 14496-2:2004 Information technology -- Coding of audio-visual objects -- Part 2: Visual
- ISO/IEC 14496-2:2004/Cor 1:2004
- ISO/IEC 14496-2:2004/Amd 1:2004 Error resilient simple scalable profile
- ISO/IEC 14496-3:2001 Information technology -- Coding of audio-visual objects -- Part 3: Audio
- ISO/IEC 14496-3:2001/Cor 1:2002
- ISO/IEC 14496-3:2001/Amd 1:2003 Bandwidth extension
- ISO/IEC 14496-3:2001/Amd 1:2003/Cor 1:2004
- ISO/IEC 14496-3:2001/Cor 2:2004M
- ISO/IEC 14496-3:2001/Amd 2:2004 Parametric coding for high-quality audio
- ISO/IEC 14496-4:2000 Information technology -- Coding of audio-visual objects -- Part 4: Conformance testing
- ISO/IEC 14496-4:2000/Cor 1:2002
- ISO/IEC 14496-5:2001 Information technology -- Coding of audio-visual objects -- Part 5: Reference software
- ISO/IEC 14496-5:2001/Amd 1:2002 Reference software for MPEG-4
- ISO/IEC 14496-5:2001/Amd 2:2003 MPEG-4 reference software extensions for XMT and media nodes
- ISO/IEC 14496-5:2001/Amd 3:2003 Visual new level and tools
- ISO/IEC 14496-5:2001/Amd 4:2004 IPMPX reference software extensions
- ISO/IEC 14496-5:2001/Amd 5:2004 Reference software extensions for error resilient simple scalable profile
- ISO/IEC 14496-6:2000 Information technology -- Coding of audio-visual objects -- Part 6: Delivery Multimedia Integration Framework (DMIF)
- ISO/IEC TR 14496-7:2002 Information technology -- Coding of audio-visual objects -- Part 7: Optimized reference software for coding of audio-visual objects
- ISO/IEC 14496-8:2004 Information technology -- Coding of audio-visual objects -- Part 8: Carriage of ISO/IEC 14496 contents over IP networks
- ISO/IEC TR 14496-9:2004 Information technology -- Coding of audio-visual objects -- Part 9: Reference hardware description
- ISO/IEC 14496-10:2003 Information technology -- Coding of audio-visual objects -- Part 10: Advanced Video Coding
- ISO/IEC 14496-12:2004 Information technology -- Coding of audio-visual objects -- Part 12: ISO base media file format
- ISO/IEC 14496-13:2004 Information technology -- Coding of audio-visual objects -- Part 13: Intellectual Property Management and Protection (IPMP) extensions
- ISO/IEC 14496-14:2003 Information technology -- Coding of audio-visual objects -- Part 14: MP4 file format
- ISO/IEC 14496-15:2004 Information technology -- Coding of audio-visual objects -- Part 15: Advanced Video Coding (AVC) file format
- ISO/IEC 14496-16:2004 Information technology -- Coding of audio-visual objects -- Part 16: Animation Framework eXtension (AFX)
- ISO/IEC 14496-18:2004 Information technology -- Coding of audio-visual objects -- Part 18: Font compression and streaming
- ISO/IEC 14496-19:2004 Information technology -- Coding of audio-visual objects -- Part 19: Synthesized texture stream

Useful references

URLs

- [Moving Picture Experts Group website](http://mpeg.chiariglione.org/) (<http://mpeg.chiariglione.org/>). From Leonardo Chiariglione, one of MPEG's founding figures.

- [MPEG-4 section of Moving Picture Experts Group website](http://mpeg.chiariglione.org/standards/mpeg-4) (<http://mpeg.chiariglione.org/standards/mpeg-4>). From Leonardo Chiariglione, one of MPEG's founding figures.
- [MPEG-4 Industry Forum \(link available through Internet Archive\)](https://web.archive.org/web/20121208092022/http://www.oipf.tv/mpegif) (<https://web.archive.org/web/20121208092022/http://www.oipf.tv/mpegif>). Existed from 2000 to 2012, when its existing documentation from <http://www.m4if.org/> was merged into the Open IPTV Forum
- [Wikipedia entry for MPEG-4](https://en.wikipedia.org/wiki/MPEG-4) (<https://en.wikipedia.org/wiki/MPEG-4>).
- [RFC 4337: MIME Type Registration for MPEG-4](https://www.ietf.org/rfc/rfc4337.txt) (<https://www.ietf.org/rfc/rfc4337.txt>).
- [RFC 3016: RTP Payload Format for MPEG-4 Audio/Visual Streams](https://www.ietf.org/rfc/rfc3016.txt) (<https://www.ietf.org/rfc/rfc3016.txt>).
- [RFC 3640: RTP Payload Format for Transport of MPEG-4 Elementary Streams](https://www.ietf.org/rfc/rfc3640.txt) (<https://www.ietf.org/rfc/rfc3640.txt>).
- [Public ISO/IEC JTC1/SC29 page at ISO](https://www.iso.org/committee/45316.html) (<https://www.iso.org/committee/45316.html>). Parent committee for WG 11, the working group for MPEG.
- [MPEG document management system](http://wg11.sc29.org/) (<http://wg11.sc29.org/>). As of late 2013, this page had little useful public information, with several links to obsolete URLs.
- [MPEG-4 FAQ](http://mpeg.chiariglione.org/faq/mp4-sys/sys-faq-esm.htm) (<http://mpeg.chiariglione.org/faq/mp4-sys/sys-faq-esm.htm>).
- [MPEG-J Extension for Rendering](http://mpeg.chiariglione.org/standards/mpeg-4/mpeg-j-extension-rendering) (<http://mpeg.chiariglione.org/standards/mpeg-4/mpeg-j-extension-rendering>).
- [MPEG-4 on the Diffuse Web Site](http://web.archive.org/web/20030218051108/http://www.diffuse.org/video.html#MPEG-4) (<http://web.archive.org/web/20030218051108/http://www.diffuse.org/video.html#MPEG-4>). Archived copy from the Internet Archive.
- [Former site for users of the AAC audio format.](http://web.archive.org/web/20130114111221/http://www.m4a.com/) (<http://web.archive.org/web/20130114111221/http://www.m4a.com/>). Archived copy from the Internet Archive.
- VIA Licensing
 - [VIA Licensing](https://web.archive.org/web/20160704161150/http://www.via-corp.com/licensing/index.html) (<https://web.archive.org/web/20160704161150/http://www.via-corp.com/licensing/index.html>).
 - [Advanced Audio Coding - AAC \(link available through Internet Archive\)](https://web.archive.org/web/20160610145721/http://www.via-corp.com/licensing/aac/overview.html) (<https://web.archive.org/web/20160610145721/http://www.via-corp.com/licensing/aac/overview.html>).
 - [AAC Frequently Asked Questions \(link available through Internet Archive\)](https://web.archive.org/web/20160610145716/http://www.via-corp.com/licensing/aac/faq.html) (<https://web.archive.org/web/20160610145716/http://www.via-corp.com/licensing/aac/faq.html>).

Books, articles, etc.

- Pereira, Fernando and Touradj Ebrahimi. *The MPEG-4 Book*. Upper Saddle River, NJ: IMSC Press, 2002.

¹ Adapted from <http://mpeg.chiariglione.org/standards/mpeg-4/mpeg-j-extension-rendering>: MPEG-J (MPEG-4 Java), originally defined in part 1 of the of the MPEG-4 standard [MPEG-4 Systems Standard]. MPEG-J lets content creators embed simple or complex algorithmic control along with audio and video streams. MPEG-J enables monitoring of network bandwidth (and packet losses) and helps in adapting to a wide range of dynamically varying network conditions.

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