AVI (Audio Video Interleaved) File Format

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Format Description Properties

- ID: fdd000059
- Short name: AVI
- Content categories: moving-image
- Format Category: file-format
- Other facets: container-wrapper, binary
- Last significant FDD update: 2016-03-09
- Draft status: Full

Identification and description

Full name	AVI (Audio Video Interleaved)
Description	File format for moving image content that wraps a video bitstream with other data chunks and supports synchronous picture-sound playback. AVI files consist of one RIFF "chunk" tagged as *AVI* and divided into "subchunks," each identified by Microsoft's FOURCC four character code. The first subchunk is tagged as *hdrl* and plays the role of file header, providing metadata about the video, such as width, height and frame rate. The second subchunk is tagged *movi* and it carries the actual picture and sound data, which may employ a wide range of codecs, including those listed under Relationships below. (The codecs are also identified by FOURCC tags.) A third optional subchunk is tagged *idx1* and it indexes the offsets of the data chunks within the file. AVI was first specified in 1992 and, according to the Wikipedia AVI article (consulted February 25, 2016), most AVI files today employ the 1996 OpenDML extensions; see the separate AVI_OpenDML_1_02 description. These extensions are unofficially dubbed *AVI 2.0*, and they are supported by Microsoft and help address some of the shortcomings of the original AVI format described here. One important shortcoming is limited file size: the single RIFF AVI chunk, in a FAT16 filesystem, limits file size to 2 GB; commentators state that the OpenDML extensions permit files as large as

	32 TB in an NTFS filesystem. Other AVI limitations are described in the Notes, which also provide comments on the evolution of the AVI format.
Production phase	Used as a master format, as a middle-state format, and as a final state format for enduser delivery.
Relationship to other formats	
Subtype of	RIFF, Microsoft Resource Interchange File Format
Has modified version	AVI_OpenDML_1_02, AVI File Format with OpenDML Extensions, Version 1.02
Has subtype	AVI_Cinepak, AVI with Cinepak Codec
Has subtype	AVI_DivX, AVI with DivX codec
Has subtype	AVI_Indeo, AVI with Indeo Codec
Has subtype	AVI files containing streams produced by other video codecs, not documented at this time.
May contain	WAVE, WAVE Audio File Format
May contain	MP3_CBR, MP3 Audio Encoding, Constant Bit Rate

Local use

LC experience or existing holdings	American Memory produced AVI_Indeo files in 1992 and 1993, using version 3.1 or 3.2 of the Indeo codec, at 15 fps and 320x240 pixels, and yielding a data rate of about 188 Kb/s. These AVI files were retired and replaced by MPEG-1 and QuickTime files in 1994 and 1995. After 2000, the files for web service were reproduced in the MPEG-4_AVC (profile unknown).
LC preference	For preservation reformatting, the Library of Congress' Packard Campus for Audio-Visual Conservation has chosen losslessy-compressed JPEG 2000 encoded video wrapped in MXF. For web access: MPEG-4_AVC (profile unknown).

Sustainability factors

Disclosure	Fully documented. Proprietary file format developed by Microsoft and IBM as part of RIFF, the Resource Interchange File Format for Windows 3.1.
Documentation	Specifications available from third parties; for example, the *Multimedia Programming Interface and Data Specifications 1.0* (Issued as a joint design by IBM Corporation and Microsoft Corporation, August 1991), is available online from http://www.kk.iij4u.or.jp/~kondo/wave/mpidata.txt (link available through Internet Archive) and other sites. Additional information may be found at John McGowan's AVI Overview and http://www.opennet.ru/docs/formats/avi.txt. Some additional citations in Useful references below.
Adoption	Widely adopted for video production and filemaking. Adoption may not extend to all permitted codecs and other features.
Licensing and patents	None known to the compiler of this resource.
Transparency	The AVI file wrapper is transparent; the encoded video bitstreams carried in the wrapper require tools and documentation to decode.
Self-documentation	Technical information is provided in header chunks (e.g., hdrl, movi, and others); descriptive metadata may appear in a RIFF INFO chunk. However, some desirable technical information is not well represented in the metadata; see Notes.
External dependencies	None

Technical protection considerations	None

Quality and functionality factors

Moving Image	
Normal rendering	Good support.
Clarity (high image resolution)	Depends upon the codec selected, with uncompressed or lossless codecs providing excellent clarity.
Sound	
Normal rendering	Good support.
Fidelity (high audio resolution)	Good to excellent, given that the options for audio are those available in the MP3_CBR and WAVE formats.

File type signifiers and format identifiers

Tag	Value	Note
Filename extension	avi	
Internet Media Type	video/vnd.avi	From http://www.iana.org/assignments/wave-avi-codec-registry/wave-avi-codec-registry.xml. No examples found in IANA MIME Media Types.
Internet Media Type	video/avi video/msvideo video/x-msvideo image/avi application/x-troff-msvideo audio/avi	Selected from The File Extension Source.
Magic numbers	Hex: 52 49 46 46 xx xx xx xx 41 56 49 20 4C 49 53 54 ASCII: RIFF....AVILIST	From Gary Kessler's File Signatures Table.
Microsoft FOURCC	See note.	Used to tag the chunks (by type) and to identify the video and audio codecs selected. It is hard to find a comprehensive list of FOURCC codes; see, for example, the archived version of the Microsoft registry mounted by IANA.
File signature	See note.	PRONOM entry for fmt/5 provides signatures used by the DROID software to identify AVI files. This identification is based on the byte sequence from the the beginning of the file.

Notes

General	Regarding AVI shortcomings, the Wikipedia AVI article (consulted February 25, 2016) reports the following (paraphrased): 1. AVI does not provide a standardized way to encode aspect ratio information, with the result that players cannot select the right aspect ratio automatically. 2. There are several competing approaches to including a time code in AVI files, which affects usability of the format in film and television post-

	production. 3. AVI was not intended to contain video using any compression technique that requires access to future video frame data beyond the current frame. Approaches exist to support modern video compression techniques (such as MPEG-4) that rely on this function, although this is beyond the intent of the original specification and the presence of such codecs may cause problems with some playback software. 4. AVI cannot contain some specific types of variable bitrate (VBR) data reliably (such as MP3 audio at sample rates below 32 kHz). In addition, a video specialist at the U.S. National Archives and Records Administration reports that "most implementations of AVI do not clearly specify whether content is interlaced or progressive; the missing metadata about 'scan type' is another weakness. The OpenDML specification (see AVI_OpenDML_1_02) does provide a mechanism to specify scan type and field order, but it is not reliably implemented by vendors. (Personal communication to compiler, March 28, 2016.)
History	This pathfinding format for computer-based carriage of video was created by Microsoft and introduced with Windows 3.1. In its first version, picture size was limited to 160x120 pixels and 15 frames per second; over time, capabilities were extended to larger picture sizes and higher frame rates. The OpenDML extension, version 1.02, dates from 1996-1997. Writers interested in the history of AVI sometimes use "version" language when sketching the format's evolution, which sometimes overlaps with relatively more formal versioning of subtypes, like the ones developed to carry DV encoded video. One useful summary of AVI's history is provided in a Web page with a title that refers to the two "types" of DV carriage developed for AVI: Difference between type 1 and type 2 dv-avi files (link available through Internet Archive). The article, however, sketches the topic more broadly and includes a tip of the hat to discussions on the Canopus forum: "In the beginning, there was Video for Windows (VfW) and the data-wrapping file format AVI. Video for Windows AVIs are often referred to as 'AVI 1.0' AVI files. Video for Windows AVIs were originally limited to 1 GB maximum size, but the size was later extended to 2 GB. FAT (FAT16) was the filesystem used at the time. FAT has 2GB maximum file size, and a 2GB maximum volume size (in NT you could format a FAT volume from 2GB up to 4GB with 64KB clusters, which can be problematic). Circa Windows 95, ActiveMovie was introduced. ActiveMovie still used AVI. ActiveMovie later morphed into DirectShow. DirectShow is often referred to as "AVI 2.0." At the same time, FAT32 was introduced. FAT32 has a 4GB maximum file size, and a 127GB (Win9x) or 2TB (WinME, practical limit due to partition table) maximum volume size. Meanwhile, there's NTFS, used by various versions in NT, 2000, and XP. NTFS has a current practical limit file size and volume size of about 32TB. Matrox and some others proposed an extension to AVI 1.0 called OpenDML, which was later implemented in AVI 2.0. This extension allowed AVIs to be larger than 2GB. Canopus had its own extension of AVI 1.0, used in its applications, called Reference AVIs. This allowed a single AVI up to 4 GB, and multiple 'reference' data files, allowing the total content to be over 4 GB. So, a particular AVI file can be one of four types . . ."

Format specifications

- Multimedia Programming Interface and Data Specifications 1.0 (link available through Internet Archive) (https://web.archive.org/web/20160317062723/http://www.kk.iij4u.or.jp/~kondo/wave/mpidata.txt). The Microsoft-IBM RIFF specification, 1991, from a third party.

Useful references

URLs

- John McGowan's AVI Overview (http://sites.utoronto.ca/ski/water/software/vj/avi.html).
- John McGowan's AVI Audio and Video Codecs (http://sites.utoronto.ca/ski/water/software/vj/avi.html#Codec).
- Wikipedia entry for AVI (https://en.wikipedia.org/wiki/Audio_Video_Interleave).
- Information about AVI (http://www.opennet.ru/docs/formats/avi.txt).
- The 2 & 4 Gigabyte issue with avi files (http://www.avi-io.com/2_4_gig_issue.htm). Comments about file sizes for AVI files.
- AVI RIFF File Reference (https://docs.microsoft.com/en-us/windows/win32/directshow/avi-riff-file-reference). Documentation from Microsoft.
- OpenDML specification, v. 1.02 (link available through Internet Archive) (https://web.archive.org/web/20190712214927/http://www.morgan-multimedia.com/download/odmlff2.pdf).
- PRONOM entry for fmt/5 (http://www.nationalarchives.gov.uk/pronom/fmt/5). Information in PRONOM from UK National Archives about AVI. PUID: fmt/5.
- List of chunks in a RIFF-AVI file (link available through Internet Archive) (https://web.archive.org/web/20171218125828/http://pvdtools.sourceforge.net/aviformat.txt).
- Gary Kessler's File Signatures Table (https://web.archive.org/web/20221112073316/https://www.garykessler.net/library/file_sigs.html).
- Internet Media Type/MIME Type assignments (http://www.iana.org/assignments/media-types/index.html). From IANA.
- Archived snapshots of "Microsoft registry" at Internet Archive.
    - Microsoft registry, as of December 2001 (http://web.archive.org/web/20100922105522/http://www.microsoft.com/whdc/archive/fourcc.mspx).
    - Microsoft registry, as of June 2003 (http://web.archive.org/web/20100620230818/http://msdn.microsoft.com/en-us/library/ms867195.aspx).
- WAVE and AVI Codec Registries (Historic Registry) (http://www.iana.org/assignments/wave-avi-codec-registry/wave-avi-codec-registry.xml). Former "Microsoft registry" as archived by IANA in 2008.

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