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Standard

ISO/IEC 14496-15

**Information technology — Coding of
audio-visual objects —**

Part 15:

**Carriage of network abstraction
layer (NAL) unit structured video in
the ISO base media file format**

*Technologies de l'information — Codage des objets
audiovisuels —*

*Partie 15: Transport de vidéo structurée en unités NAL sur la
couche réseau au format ISO de base pour les fichiers médias*

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This seventh edition cancels and replaces the sixth edition (ISO/IEC 14496-15:2022), which has been technically revised. It also incorporates the Amendment ISO/IEC 14496-15:2022/Amd 1:2023.

The main changes are as follows:

- support for the Low Complexity Enhancement Video Coding (ISO/IEC 23094-2);
- addition of the supplementary track reference and the picture region replacement sample group, for support of picture-in-picture services.

A list of all parts in the ISO/IEC 14496 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

This document defines a storage format based on, and compatible with, the ISO Base Media File Format (ISO/IEC 14496-12), which is used by the MP4 file format (ISO/IEC 14496-14) and the Motion JPEG 2000 file format (ISO/IEC 15444-3) among others. This document enables video streams formatted as Network Adaptation Layer Units (NAL Units) to

- a) be used in conjunction with other media streams, such as audio,
- b) be used in an MPEG-4 systems environment, if desired,
- c) be formatted for delivery by a streaming server, using hint tracks, and
- d) inherit all the use cases and features of the ISO Base Media File Format on which MP4 and MJ2 are based.

This document may be used as a standalone document; it specifies how NAL unit structured video content shall be stored in an ISO Base Media File Format compliant format. However, it is normally used in the context of a specification, such as the MP4 file format, derived from the ISO Base Media File Format, that permits the use of NAL unit structured video such as AVC (ISO/IEC 14496-10) video and High Efficiency Video Coding (HEVC, ISO/IEC 23008-2) video.

The ISO Base Media File Format is becoming increasingly common as a general-purpose media container format for the exchange of digital media, and its use in this context should accelerate both adoption and interoperability.

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Information technology — Coding of audio-visual objects —

Part 15:

Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format

1 Scope

This document specifies the storage format for streams of video that is structured as NAL units, such as AVC (ISO/IEC 14496-10) and HEVC (ISO/IEC 23008-2) video streams. In addition, [Annex E](#) specifies parameters and sub-parameters applying when sample entries specified in this document are used as the 'codecs' parameter of a MIME type, as specified in IETF RFC 6381.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14496-12, *Information technology — Coding of audio-visual objects — Part 12: ISO base media file format*

ISO/IEC 14496-10¹⁾, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

ISO/IEC 23008-2, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*

ISO/IEC 23008-12, *Information technology — MPEG systems technologies — Part 12: Image file format*

ISO/IEC 23090-3, *Information technology — Coded representation of immersive media — Part 3: Versatile video coding*

ISO/IEC 23094-1, *Information technology — General video coding — Part 1: Essential video coding*

ISO/IEC 23094-2, *Information technology — General video coding — Part 2: Low complexity enhancement video coding*

IETF RFC 4648, *The Base16, Base32, and Base64 data encodings*

IETF RFC 6381, *MIME codecs and profiles*

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14496-10, ISO/IEC 23008-2, ISO/IEC 23090-3 or ISO/IEC 23094-1, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

1) Under preparation. Stage at the time of publication: ISO/IEC DIS 14496-10:2024.

— IEC Electropedia: available at <https://www.electropedia.org/>

3.1.1

3D-AVC NAL unit

3D AVC VCL NAL unit

NAL unit with type 21 with `avc_3d_extension_flag` equal to 1

3.1.2

aggregator

in-stream structure using a NAL unit header for grouping of NAL units belonging to the same sample

3.1.3

alternate region set

set of rectangular regions that are alternatives to be used as a rectangular region when reconstructing a VVC bitstream from a VVC extraction base track

3.1.4

applicable video coding standard

video coding standard for the data carried in the track

Note 1 to entry: The video coding standard can be ISO/IEC 14496-10, ISO/IEC 23008-2, ISO/IEC 23090-3, or ISO/IEC 23094-1.

3.1.5

AU- or picture-level non-VCL NAL unit

non-VCL NAL unit that applies to one or more entire AUs or one or more entire pictures

Note 1 to entry: An AU-level non-VCL NAL unit applies to one or more entire AUs. A picture-level non-VCL NAL unit applies to one or more entire pictures. In VVC, AU-level or picture-level non-VCL NAL units include: 1) all the DCI, OPI, VPS, SPS, PPS, AUD, PH, EOS, and EOB NAL units; 2) APS NAL units that apply to one or more entire AUs or pictures; and 3) SEI NAL units that only contain SEI messages that apply to one or more entire AUs or pictures.

3.1.6

AVC base layer

maximum subset of a bitstream that is AVC compatible

Note 1 to entry: The AVC base layer is represented by AVC VCL NAL units and associated non-VCL NAL units. The AVC base layer is not using any of the functionality of ISO/IEC 14496-10:—, Annex G, Annex H, Annex I, or Annex J.

Note 2 to entry: The AVC base layer itself can be a temporal scalable bitstream.

3.1.7

AVC parameter set sample

sample in a parameter set elementary stream that consists of those parameter set NAL units that are to be considered as if present in the video elementary stream at the same instant in time

3.1.8

AVC sample

access unit as defined in ISO/IEC 14496-10

3.1.9

AVC NAL unit

AVC VCL NAL unit or a non-VCL NAL unit associated with an AVC VCL NAL unit as specified in ISO/IEC 14496-10

3.1.10

AVC VCL NAL unit

NAL unit with type 1 to 5 (inclusive)

3.1.11

canonical order

order of NAL units that conforms to the applicable video standard

Note 1 to entry: When a single track carries a video bitstream, the NAL units are stored in the canonical order. When multiple tracks are used to carry a video bitstream, an implicit or explicit video bitstream reconstruction process might be applied to recover the canonical order.

3.1.12

canonical stream format

elementary stream that contains NAL units in the canonical order and conforms to the constraints specified in this document for carrying an elementary stream of the applicable video standard in one or more tracks

3.1.13

complete subset

minimal set of tracks that contain all the information in the original bitstream

3.1.14

cropped frame dimensions

width and height of the decoded frame after applying the output cropping parameters

3.1.15

default sample group description index

default_group_description_index of SampleGroupBox with version greater than or equal to 2

3.1.16

elementary stream

sequence of one or more bitstreams of the applicable video standard

Note 1 to entry: The term elementary stream is not directly related to the terms video elementary stream, parameter set elementary stream, and video and parameter set elementary stream.

Note 2 to entry: The applicable video standard can be included as a prefix to the term elementary stream. For example, an AVC elementary stream refers to an elementary stream that is a sequence of one or more bitstreams conforming to ISO/IEC 14496-10.

3.1.17

extractor

in-stream structure using a NAL unit header for extraction of data from other tracks

Note 1 to entry: Extractors contain instructions on how to extract data from other tracks. Logically an Extractor can be seen as a pointer to data. While reading a track containing Extractors, the Extractor is replaced by the data it is pointing to.

3.1.18

HEVC sample

access unit as defined in ISO/IEC 23008-2

3.1.19

implicit reconstruction

reconstruction of a stream of access units from two or more tracks not using extractors

3.1.20

in-stream structure

structure residing within sample data

3.1.21

layer scalable layer

<SVC, MVC, and MVD> set of VCL NAL units with the same values of dependency_id, quality_id, and temporal_id, and the associated non-VCL NAL units

Note 1 to entry: A scalable layer with any of dependency_id, quality_id, and temporal_id not equal to 0 enhances the video by one or more scalability levels in at least one direction (temporal, quality or spatial resolution)

Note 2 to entry: SVC uses a "layered" encoder design that results in a bitstream representing "coding layers". In some publications the 'base layer' is the first quality layer of a specific coding layer. In some publications the base layer is the scalable layer with the lowest priority. The SVC file format uses "scalable layer" or "layer" in a general way for describing nested bitstreams (using terms like AVC base layer or SVC enhancement layer).

3.1.22

layer scalable layer

<HEVC and VVC> set of VCL NAL units with the same value of nuh_layer_id and the associated non-VCL NAL units

3.1.23

layer set

set of layers represented within a bitstream created from another bitstream by operation of the sub-bitstream extraction process

3.1.24

L-HEVC sample

picture units that are within an access unit as specified in Annex F of ISO/IEC 23008-2 and are represented by the track

3.1.25

MVC NAL unit

MVC VCL NAL unit or a non-VCL NAL unit associated with an MVC VCL NAL unit as specified in ISO/IEC 14496-10

Note 1 to entry: The association of non-VCL NAL units with MVC VCL NAL units is specified in Annex H of ISO/IEC 14496-10.

3.1.26

MVC sample

one or more view components as defined in Annex H of ISO/IEC 14496-10:— and the associated non-VCL NAL units

3.1.27

MVC VCL NAL unit

NAL unit with type 20, or NAL unit with type 14 when the immediately following NAL unit is an AVC VCL NAL unit

Note 1 to entry: MVC VCL NAL units do not affect the decoding process of a legacy AVC decoder.

3.1.28

MVC+D depth NAL unit

MVC+D depth VCL NAL unit

NAL unit with type 21 containing a coded slice extension for a depth view component

3.1.29

MVD NAL unit

MVD VCL NAL unit

NAL unit with type 21, containing a coded slice extension for a depth view component coded with MVC+D or 3D-AVC, or a 3D-AVC texture view component