IEC/TS 62592

Edition 1.0 2009-09

TECHNICAL SPECIFICATION

Withdrawn

Encoding guidelines for portable multimedia CE products using MP4 file format with AVC video codec and AAC audio codec

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE XC

ICS 33.160.01

ISBN 978-2-88910-770-4

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ENCODING GUIDELINES FOR PORTABLE MULTIMEDIA CE PRODUCTS USING MP4 FILE FORMAT WITH AVC VIDEO CODEC AND AAC AUDIO CODEC

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IEC/TS 62592, which is a Technical Specification, has been prepared by prepared by technical area 7: Moderate data rate storage media, equipment and systems, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

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The text of this Technical Specification is based on the following documents:

Enquiry draft	Report on voting
100/1516/DTS	100/1563/RVC

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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0 Introduction

0.1 MP4 file format

ISO base media file format, ISO/IEC 14496-12, has been developed by ISO/IEC JTC 1/SC 29/WG 11 and WG1 as a common base media file format of audio, video and image applications. It provides a file format to contain timed media information for a presentation in a flexible, extensible format. The extensions to support specific codecs and systems are specified as the series of standard ISO/IEC 14496. The MP4 file format (MPEG-4 file format), ISO/IEC 14496-14, is an extension to support MPEG-4 systems in ISO base media file format. The extension to support Advanced Video Coding (AVC), ISO/IEC 14496-10 and ITU-T H.264[1], is standardized as AVC file format, ISO/IEC 14496-15. In this Technical Specification, the family of ISO base media file format is referred to as MP4 file format, which is the name widely used in the industry. The MP4 file format is designed very flexibly so that the series of the standard can be applied to various kinds of applications and can bring the maximum performances for the applications.

MP4 file format is adopted by various Consumer Electronics (CE) devices, e.g. broadcasting receivers, disc recorders / players, AV content distribution, portable AV recorders / players, and so on. In the CE audio, video and multimedia applications, MP4 file format with Advanced Video Coding (AVC), (ISO/IEC 14496-10 and ITU-T H.264) and Advanced Audio Coding (AAC), (ISO/IEC 13818-3 and ISO/IEC 14496-3), is employed most popularly.

AVC (ISO/IEC 14496-10 and ITU-T H.264) specifies profiles and levels to ensure interoperability of decoding procedure of a video elementary stream, which fits various levels of application. AVC, ISO/IEC 14496-10 and ITU-T H.264, specifies the bitstream syntax and its decoding process.

0.2 Issues to be considered in implementation on portable CE devices

To implement applications using MP4 file format into CE products, the characteristics of CE industry must be considered. The characteristics of CE industry and products are different from IT equipment especially personal computers (PCs) which have strong computational power and flexible software solution. That is:

- CE devices are designed with limited resources, processing power and memory size;
- most CE devices can not update software or hardware afterwards; and
- manufacturers have to assure the capability and the quality of the product for consumers, who are not familiar with processes inside the device;
- CE devices need to support functionalities, e.g. fast forward / backward play which are widely supported by existing CE devices. Manufacturers have to ensure such functionalities regardless of creators of the content (bitstreams).

Given these criteria, manufacturers need to check all the performance of the products because any defect in the products may generate serious complaints among consumers. Since the MP 4 file format is so flexible, the number of combination of setting parameters is very large and it takes tremendous workload and cost to check the performance for each combination of parameters. Even AVC (ISO/IEC 14496-10 and ITU-T H.264) specifies the decoding procedure and conformance point by a profile and a level. Furthermore, the constraints on bitstreams must be specified in order to ensure functionalities, which are widely supported by CE devices. Therefore, in most CE systems, the combination of encoding parameters is limited and the dedicated encoding rules are specified for the system, which enable designing and manufacturing process practical to guarantee the quality of the product. In general, these encoding rules are proprietary to the involved parties.

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1 ITU-T H.264 is equivalent to ISO/IEC 14496-10.

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0.3 Encoding rules for open system and application

Currently, the content of audio, video and multimedia products are provided by commercial content providers through specific sales channels such as optical discs, CDs, DVDs and Blu-ray Discs. Additional content is provided by broadcasters and commercial content providers. However, more recently end-user generated content is increasing and placed on many Internet sites enabled by the availability of digital video cameras and Internet related technology. In this situation, portable CE devices are required to store and reproduce such content for consumer satisfaction. Accordingly, portable CE devices need to guarantee the capability to decode MP4 files with AVC (ISO/IEC 14496-10 and ITU-T H.264) and AAC (ISO/IEC 13818-3 and ISO/IEC 14496-3) which are most commonly used as the file format and codecs.

- To assure decoding of such MP4 files, CE device manufacturers have to check the performance for the files encoded by unknown parameters. However, it is impossible to achieve this with limited manpower and technical resources as mentioned above. This situation may cause a problem in decoding quality and is not beneficial for both end-users and manufacturers. CE device manufacturers also have to ensure functionalities, e.g. fast forward / backward play, regardless of the creators of the content (bitstreams).

To solve this issue, this Technical Specification specifies the encoding rules for the MP4 files targeted to be stored and reproduced by portable CE devices so that the decoding of the content encoded by these guidelines is guaranteed by the portable CE product manufacturer with reasonable cost and resources.

The encoding rules are specified considering the capability of current portable CE products. However, the rules should be revised depending on the progress of CE technologies in an appropriate time frame.

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ENCODING GUIDELINES FOR PORTABLE MULTIMEDIA CE PRODUCTS USING MP4 FILE FORMAT WITH AVC[2] VIDEO CODEC AND AAC[2] AUDIO CODEC

1 Scope

This Technical Specification specifies encoding guidelines for portable multimedia CE products using ISO base media file format and its family (ISO/IEC 14496-12, ISO/IEC 14496-14, and ISO/IEC 14496-15) with AVC (ISO/IEC 14496-10 and ITU-T H.264) and AAC (ISO/IEC 13818-3 and ISO/IEC 14496-3). These guidelines may also be applicable to portable non-CE products.

This Technical Specification is applicable to the creation of MP4 files with AVC and AAC which are intended for storage, reproduction and display by portable CE products; it is applicable to both content generation software and hardware.

These guidelines are intended to encourage global interoperability between portable CE products by recommending the use of specific parameters to allow efficient interworking of devices which may have limited resources so that the decoding of content encoded in accordance with these guidelines is assured. In addition, the guidelines provide for simplified testing and verification of the interoperability of portable CE products.

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2 Normative references

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

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ISO/IEC 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*

ISO/IEC 10646:2003, *Information technology – Universal Multiple-Octet Coded Character Set (UCS)*

ISO/IEC 13818-3, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*

ISO/IEC 14496 (all parts), *Information technology – Coding of audio-visual objects*

ISO/IEC 14496-1:2004, *Information technology – Coding of audio-visual objects – Part 1: Systems*

ISO/IEC 14496-2:2004, *Information technology – Coding of audio-visual objects – Part 2: Visual*

ISO/IEC 14496-3:2005, *Information technology – Coding of audio-visual objects – Part 3: Audio*

ISO/IEC 14496-10:2009, *Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding*

ISO/IEC 14496-12:2008, *Information technology – Coding of audio-visual objects – Part 12: ISO base media file format*

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2 The full forms for AAC and AVC can be found in 3.2.

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*

3 Terms, definitions, abbreviations and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions specified in ISO/IEC 14496-1, ISO/IEC 14496-2, ISO/IEC 14496-3, ISO/IEC 14496-10, ISO/IEC 14496-12 and ISO/IEC 14496-15, as well as the following apply.

3.1.1
B-field
field consisting only of B slices

3.1.2
B-frame
frame consisting only of B slices

3.1.3
bitrate
rate at which the coded bitstream is delivered to the input of a decoder; an index to indicate how many bits are transmitted per second

NOTE The unit is bps (bits per second).

3.1.4
B-picture
frame or a complementary field pair consisting only of B slices

3.1.5
fragmented movie
movie that consists of a single Movie Box (‘moov’), Movie Fragment Boxes (‘moof’), and Media Data Boxes (‘mdat’) that contain fragmented media data

NOTE The Movie Box of a fragmented movie is referred to as an initial Movie Box to distinguish it from that of an ordinary movie in this Technical Specification. An initial ‘moov’ box contains a Movie Extends Box (‘mvex’) that indicates that the movie is possibly fragmented, which means ‘moof’s should be found and used in the file.

3.1.6
frame rate
rate at which frames are to be output from the composition process, an index to indicate how many frames can be drawn per second in video playback

NOTE The unit is fps (frames per second). When the frame rate is 30 fps, it means that 30 frames are drawn per second.

3.1.7
I-field
field consisting only of I slices

3.1.8
I-frame
frame consisting only of I slices

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3.1.9
I-picture
frame or a complementary field pair consisting only of I slices

3.1.10
main audio track
audio track that contains an audio stream as main presentation

3.1.11
main video track
video track that contains an video stream as main presentation

3.1.12
P-field
field consisting only of P slices

3.1.13
P-frame
frame consisting only of P slices

3.1.14
player
device or software with a function to play back the PCE AV files

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3.1.15
PCE AV file
file that complies with the file format described in this Technical Specification

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3.1.16
P-picture
frame or a complementary field pair consisting only of P slices

3.1.17
product
generic term of players and recorders

3.1.18
PCE AV classes
collective term for class PT, class MB, class SD, class HD and class Network HD

NOTE PCE AV classes are described in Clause 5.

3.1.19
recorder
device or software with a function to record/delete the PCE AV files and directories, compliant with this Technical Specification

NOTE A playback function is not necessarily required. Products capable of deleting files/directories or updating existing files are also included even if they cannot record new files.

3.2 Abbreviations

AAC	Advanced audio coding
AAC LC	AAC low complexity profile
ADIF	Audio data Interchange Format
ADTS	Audio data Transport Stream
AVC	Advanced video coding

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bslbf	bit string, left bit first
CE	Consumer electronics
DCF	Design rule for camera file system
Exif	Exchangeable image file format for digital still cameras
HDTV	High definition television
JPEG	Joint photographic experts group
MPEG	Moving picture experts group
PNG	Portable network graphics
QVGA	Quarter video graphics array
SDTV	Standard definition television
URL	Uniform resource locator
VGA	Video graphics array

3.3 Conventions

3.3.1 Method of presenting box definition

The term “Mandatory: Yes” or “Mandatory: No” is placed at the beginning of each definition of a box, as described in ISO/IEC 14496-12, ISO/IEC 14496-14 and ISO/IEC 14496-15.

“Mandatory: Yes” means that this box is mandatory in its container.

NOTE “Mandatory: Yes/No” is for containers, not for entire structures.

The syntax of a box is documented in the syntactic description language (SDL) defined in ISO/IEC 14496-1.

3.3.2 Unit prefixes

In this Technical Specification, the following three unit prefixes are used:

1 KB = 1 024 B
1 kbps = 1 000 bps
1 Mbps = 1 000 kbps

3.3.3 Numeric representation

A decimal number consists of digits “0” to “9”.
A hexadecimal number consists of digits “0” to “9”, upper case letters “A” to “F”, and suffix “h”.
A binary number consists of digits “0” and “1”, and suffix “b”.

3.3.4 Character data

Unless otherwise stated, character data contain a set of characters except for control codes (0000h to 001Fh, and 007Fh to 009Fh) in Unicode. Note that the code 0000h (null) and 0009h (horizontal tabulation, referred to as TAB hereinafter) may be used for the specific purposes: the code 0000h (null) may be used only as the termination code for character strings in some fields that require explicit termination; the code 0009h (TAB) may be used only as the separator code for character strings.

3.3.5 Nominal time length

In this Technical Specification, second* is defined as nominal time length and it indicates the length of time calculated by the following:

1 second* = 1 nsample * sample duration / media timescale second

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where nsample is the value calculated by rounding up the number of samples per second.

Note that in interlaced video, the number of samples is twice as much as the frame rate (number of frames per second).

For example, 1 second* for progressive video of 29,97 fps is calculated as follows:

1 second* = 30 × 1 001 / 30 000 = 1,001 second

1 second* for audio data of sampling frequency 48 kHz is calculated as follows:

1 second* = 47 × 1 024 / 48 000 = 1,002 7 second

3.3.6 Reserved fields and values

Reserved fields are provided for future expansion. Unless otherwise stated, reserved fields shall be set to '0' when data is written and shall not be interpreted when data is read. Any values already set in the reserved fields shall be kept unchanged under any circumstances.

4 Design rules

4.1 General

The file format specified in this Technical Specification is based on MP4 file format (ISO/IEC 14496-14) for a fundamental structure and AVC file format (ISO/IEC 14496-15) for a track of AVC video elementary stream, both of which are instances of ISO Base Media file format (ISO/IEC 14496-12 and ISO/IEC 15444-12). The general nature of MP4 file format and AVC file format is partly exercised, and there are some extensions and restrictions.

The following elements are defined in this Technical Specification.

a) Operational rules for MP4 file format

To achieve better interoperability and to make implementation of the format easier, the subset of MP4 file format is defined as well as operational rules for the use of MP4 file format such as the setting of boxes / fields and box order.

b) Extensions to MP4 file format

To provide more convenience and to improve usability, Technical Specification specific extensions to the MP4 File format are defined. The structures for improved file identification and those for handling metadata are provided in 4.5.

c) Operational rules for media data and track structure

The operational rules for encoding audio and video media data and the combinations of audio and video are defined to indicate the required capability of decoders. Also, the operational rules for the structures of tracks that store media data are defined.

d) Other operational rules for interoperability

Other operational rules such as required capabilities of decoders, the rules for handling of information contained in a compliant file and recommended recording modes are defined.

4.2 File structure

4.2.1 General

Of the usage modes documented in ISO/IEC 14496-12, only a simple interchange file and a content creation file are supported in this Technical Specification.

Figure 1 shows an example of a simple interchange file.

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