



IEC/TS 62592

Edition 2.0 2012-07

TECHNICAL SPECIFICATION

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XD**

ICS 33.160.01

ISBN 978-2-83220-220-3

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	6
0 Introduction	8
0.1 MP4 file format	8
0.2 Issues to be considered in implementation on portable CE devices	8
0.3 Encoding rules for open system and application	9
1 Scope	10
2 Normative references	10
3 Terms, definitions, abbreviations and conventions	11
3.1 Terms and definitions	11
3.2 Abbreviations	13
3.3 Conventions	13
3.3.1 Method of presenting box definition	13
3.3.2 Unit prefixes	14
3.3.3 Numeric representation	14
3.3.4 Character data	14
3.3.5 Nominal time length	14
3.3.6 Reserved fields and values	14
4 Design rules	14
4.1 General	14
4.2 File structure	15
4.2.1 General	15
4.2.2 Movie structure	16
4.2.3 Fragmented movie structure	17
4.3 Box order	18
4.4 Operational rules for boxes defined in ISO file format standards	20
4.4.1 General	20
4.4.2 Size fields	20
4.4.3 Versions and flags	20
4.4.4 File identification	20
4.4.5 File extension	21
4.4.6 Handler reference types	21
4.4.7 Movie header box	22
4.4.8 Track header box	22
4.4.9 Media header box	22
4.4.10 Sample size box	22
4.4.11 Time to sample boxes	22
4.4.12 Sample entries	22
4.4.13 Movie fragment boxes	22
4.4.14 Track fragment random access boxes – Version fields	23
4.4.15 Edit list entries	23
4.4.16 Template fields used	23
4.5 Additional definitions	24
4.5.1 Private extension box definitions	24
4.5.2 Profile configuration	30
4.5.3 Function flags	30

4.5.4	Codec specific information.....	31
4.5.5	Attribute flags	33
4.6	Operational rules for tracks	33
4.6.1	General	33
4.6.2	Main audio track	34
4.6.3	Main video track	35
4.6.4	Thumbnail picture track	36
4.7	Operational rules for media data	38
4.7.1	MPEG-4 AAC elementary stream.....	38
4.7.2	AVC video elementary stream.....	41
4.7.3	JPEG image sequence for thumbnail pictures	66
4.8	Logical structure of media data.....	67
4.8.1	General	67
4.8.2	Interleaving of main audio and video	67
4.8.3	Arrangement of data chunks	68
4.8.4	Placement of thumbnail picture.....	68
4.8.5	Media data structure in movie fragment	68
4.8.6	Exception for logical structure of media data	68
4.9	Presentation arrangement for tracks.....	68
4.9.1	Alternate group support	68
4.9.2	Edit list support	69
4.10	Metadata	70
4.10.1	Metadata types	70
4.10.2	Metadata types definition.....	71
4.11	Pixel aspect ratios	74
5	PCE AV classes	76
5.1	Class.....	76
5.2	Class PT	76
5.2.1	General	76
5.2.2	Level 1	77
5.2.3	Level 2	77
5.2.4	Level 3	77
5.3	Class MB.....	77
5.3.1	General	77
5.3.2	Level 1	78
5.3.3	Level 2	78
5.3.4	Level 3	79
5.3.5	Level 4	79
5.4	Class SD	79
5.5	Class network SD.....	80
5.6	Class HD.....	81
5.6.1	General	81
5.6.2	Level 1	82
5.6.3	Level 2	82
5.7	Class network HD.....	82
5.7.1	General	82
5.7.2	Level 1	83
5.7.3	Level 2	83
5.7.4	Level 3	84

6	Definitions for other files.....	84
	Annex A (normative) Operation rules for compliant products.....	85
	Annex B (normative) Capabilities required for compliant products.....	89
	Annex C (informative) Recommended recording modes.....	91
	Annex D (normative) Operation rules for rotated video file.....	96
	Bibliography.....	98
	Figure 1 – Example of a simple interchange file.....	15
	Figure 2 – Examples of movies.....	17
	Figure 3 – Example of a fragmented movie.....	18
	Figure 4 – Example of AAC bitstream.....	38
	Figure 5 – Example of a closed GOP.....	52
	Figure 6 – Example of an open GOP.....	52
	Figure 7 – Reference structure of a reference B-picture.....	60
	Figure 8 – Reference structure of a non-reference B-picture.....	61
	Figure 9 – Example of a closed GOP.....	61
	Figure 10 – Example of an open GOP.....	62
	Table 1 – Supported track types.....	16
	Table 2 – Supported stream and data.....	16
	Table 3 – Box types, structure, and cross-reference.....	19
	Table 4 – brand identifier.....	21
	Table 5 – handler_types.....	22
	Table 6 – Common portion of the audio attribute flags.....	26
	Table 7 – Common portion of the video attribute flags.....	27
	Table 8 – encoding_type.....	29
	Table 9 – Function flags.....	30
	Table 10 – Data form type.....	31
	Table 11 – Data form type.....	32
	Table 12 – Codec specific portion of audio attribute flags.....	33
	Table 13 – Codec specific portion of video attribute flags.....	33
	Table 14 – The values of pic_struct and ct_type.....	54
	Table 15 – Allowed values of frame_mbs_only_flag, pic_width_in_mbs_minus1 and pic_height_in_map_units_minus1.....	63
	Table 16 – Allowed values of frame cropping related fields.....	63
	Table 17 – data_type_ID.....	71
	Table 18 – Presentation types.....	72
	Table 19 – Track attribute flags.....	73
	Table 20 – Usage of the metadata.....	74
	Table 21 – Resolution values in visual sample entry.....	75
	Table 22 – spacing values in pixel_aspect_ratio.....	75
	Table C.1 – Recommended recording modes for Class PT.....	91
	Table C.2 – Recommended recording modes for Class MB.....	92

Table C.3 – Recommended recording modes for Class SD	92
Table C.4 – Parameters for progressive video 25[fps] and 29.97[fps].....	93
Table C.5 – Recommended recording modes for Class network SD	93
Table C.6 – Recommended recording modes for Class HD	94
Table C.7 – Recommended recording modes for Class network HD	95
Table D.1 – Width and height in the track header box	97

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

This Technical Specification cancels and replaces the first edition published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) added 23,976 fps to all classes;

- b) added new class (class network SD);
- c) added some metadata for CE content;
- d) inserted some editorial improvements and clarifications.

IEC/TS 62592, which is a Technical Specification, has been prepared by technical area 6: Storage media, data structures, equipment and systems, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

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

Enquiry draft	Report on voting
100/1926/DTS	100/1970/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 stability 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.

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.264¹, 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.

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

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.

ENCODING GUIDELINES FOR PORTABLE MULTIMEDIA CE PRODUCTS USING MP4 FILE FORMAT WITH AVC VIDEO CODEC AND AAC 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 AVC² (ISO/IEC 14496-10 and ITU-T H.264) and AAC² (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.

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

ISO/IEC 10646:2012, *Information technology – Universal Coded Character Set (UCS)*

ISO/IEC 10918-1, *Information technology – Digital compression and coding of continuous-tone still images – Part 1: Requirements and guidelines*

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

ISO/IEC 14496-1:2010, *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 14496-3:2009, *Information technology – Coding of audio-visual objects – Part 3: Audio*

ISO/IEC 14496-10:2012, *Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding*

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

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

ISO/IEC 14496-14:2003, *Information technology – Coding of audio-visual objects – Part 14: MP4 file format*

ISO/IEC 14496-15:2010, *Information technology – Coding of audio-visual objects – Part 15: Advanced Video Coding (AVC) file format*

ISO/IEC 15444-12, *Information technology – JPEG 2000 image coding system – Part 12: ISO base media file format*