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Information technology — Coding of audio-visual objects —

Part 4: Conformance testing

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

ISO/IEC 14496-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 14496-4:2000), which has been technically revised.

ISO/IEC 14496 consists of the following parts, under the general title *Information technology — Coding of audio-visual objects:*

- *Part 1: Systems*
- *Part 2: Visual*
- *Part 3: Audio*
- *Part 4: Conformance testing*
- *Part 5: Reference software*
- *Part 6: Delivery Multimedia Integration Framework (DMIF)*
- *Part 7: Optimised reference software for coding of audio-visual objects*
- *Part 8: Carriage of ISO/IEC 14496 contents over IP networks*
- *Part 9: Reference hardware description*
- *Part 10: Advanced Video Coding*
- *Part 11: Scene description and application engine*
- *Part 12: ISO base media file format*
- *Part 13: Intellectual Property Management and Protection (IPMP) extensions*
- *Part 14: MP4 file format*
- *Part 15: Advanced Video Coding (AVC) file format*
- *Part 16: Animation Framework eXtension (AFX)*
- *Part 17: Streaming text format*
- *Part 18: Font compression and streaming*
- *Part 19: Synthesized texture stream*

Introduction

Parts 1, 2 and 3 of ISO/IEC 14496 specify a multiplex structure and coded representations of audio-visual information. Parts 1, 2 and 3 of ISO/IEC 14496 allow for large flexibility, achieving suitability of ISO/IEC 14496 for many different applications. The flexibility is obtained by including parameters in the bitstream that define the characteristics of coded bitstreams. Examples are the audio sampling frequency, picture size, picture shape, picture rate, bitrate parameters, synchronisation timestamps, the association of bitstreams and synthetic objects within objects, the association of objects within scenes, the protection of bitstreams, objects and scenes. Part 6 of ISO/IEC 14496 specifies a framework for uniform delivery of MPEG-4 content according to the requested associated QoS, irrespective of their location and the transport technology.

This part of ISO/IEC 14496 specifies how tests can be designed to verify whether bitstreams and decoders meet the requirements as specified in parts 1, 2, 3 and 6 of ISO/IEC 14496 and allow interoperability with remote terminals in interactive, broadcast and local (with stored contents) sessions. These tests can be used for various purposes such as:

- manufacturers of encoders, and their customers, can use the tests to verify whether the encoder produces bitstreams compliant with parts 1, 2 and 3 of ISO/IEC 14496.
- manufacturers of decoders and their customers can use the tests to verify whether the decoder meets the requirements specified in parts 1, 2 and 3 of ISO/IEC 14496 for the claimed decoder capabilities.
- manufacturers and customers of terminals supporting interactive, broadcast and local sessions over a multitude of transport protocols and networks, can use the tests to verify whether the claimed functionalities are compliant with ISO/IEC 14496-6.
- manufacturers of test equipments, and their customers can use the tests to verify compliance with parts 1, 2 and 3 of ISO/IEC 14496.

Information technology — Coding of audio-visual objects —
Part 4:
Conformance testing

1 Scope

This part of ISO/IEC 14496 specifies how tests can be designed to verify whether bitstreams and decoders meet requirements specified in parts 1, 2 and 3 of ISO/IEC IEC 14496 and for part 6 of ISO/IEC 14496 it specifies how tests can be designed for bitstream delivery over various delivery technologies in an interoperable transparent manner to parts 1, 2 and 3. In this part of ISO/IEC 14496, encoders are not addressed specifically. An encoder may be said to be an ISO/IEC 14496 encoder if it generates bitstreams compliant with the syntactic and semantic bitstream requirements specified in parts 1, 2 and 3 of ISO/IEC 14496.

Characteristics of coded bitstreams and decoders are defined for parts 1, 2 and 3 of ISO/IEC 14496. The characteristics of a bitstream define the subset of the standard that is exploited in the bitstream. Examples are the applied values or range of the picture size and bitrate parameters. Decoder characteristics define the properties and capabilities of the applied decoding process. An example of a property is the applied arithmetic accuracy. The capabilities of a decoder specify which coded bitstreams the decoder can decode and reconstruct, by defining the subset of the standard that may be exploited in decodable bitstreams. A bitstream can be decoded by a decoder if the characteristics of the coded bitstream are within the subset of the standard specified by the decoder capabilities.

Procedures are described for testing conformance of bitstreams and decoders to the requirements defined in parts 1, 2 and 3 of ISO/IEC 14496. Given the set of characteristics claimed, the requirements that must be met are fully determined by parts 1, 2 and 3 of ISO/IEC 14496. This part of ISO/IEC 14496 summarises the requirements, cross references them to characteristics, and defines how conformance with them can be tested. Guidelines are given on constructing tests to verify bitstream and decoder conformance. This document gives guidelines on how to construct bitstream test suites to check or verify decoder conformance. In addition, some test bitstreams implemented according to those guidelines are provided as an electronic annex to this document. The procedures and signaling messages for session and channel establishment are defined in part 6 of ISO/IEC 14496.

Conformance with the signaling messages and procedures in this part of ISO/IEC 14496 are defined in accordance to the specifications in part 6 of ISO/IEC 14496. This specification allows the manufacturer to identify the conformance of the signaling message in a static review and provides abstract test cases to test the conformance to the procedures in a dynamic review of an implementation as defined in ISO/IEC 9646 Conformance Testing standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14496. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 14496 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 639:1988, *Code for the representation of names of languages*

ISO 8859-1*, Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

IEC 461:1986, *Time and control code for video tape recorders*

IEC 908:198, *Compact disk digital audio system*

ITU-T Rec. T.81 (1992)|ISO/IEC 10918-1:1994, *Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines*

ISO/IEC 9646-1:1994, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 1: General concepts*

ISO/IEC 9646-2:1994, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 2: Abstract Test Suite Specification*

ISO/IEC 9646-7:1995, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 7: Implementation Conformance Statements*

ISO/IEC 11172-1:1993, *Information technology — Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s — Part 1: Systems*

ISO/IEC 11172-2:1993, *Information technology — Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s — Part 2: Video*

ISO/IEC 11172-3:1993, *Information technology — Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s — Part 3: Audio*

ISO/IEC 11172-4:1995, *Information technology — Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s — Part 4: Compliance testing*

ITU-T Rec. H.222.0(2000)|ISO/IEC 13818-1:2000, *Information technology — Generic coding of moving pictures and associated audio information: Systems*

ITU-T Rec. H.262(1995)|ISO/IEC 13818-2:1996, *Information technology — Generic coding of moving pictures and associated audio information: Video*

ISO/IEC 13818-3:1998, *Information technology — Generic coding of moving pictures and associated audio information — Part 3: Audio*

ISO/IEC 13818-7:1997, *Information technology — Generic coding of moving pictures and associated audio information — Part 7: Advanced Audio Coding (AAC)*

ISO/IEC 14496-1:2001, *Information technology — Coding of audio-visual objects — Part 1: Systems*

ISO/IEC 14496-2:2001, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ISO/IEC 14496-3:2001, *Information technology — Coding of audio-visual objects — Part 3: Audio*

ISO/IEC 14496-6:2000, *Information technology — Coding of audio-visual objects — Part 6: Delivery Multimedia Integration Framework (DMIF)*

Recommendations and reports of the CCIR, 1990, XVIIth Plenary Assembly, Dusseldorf, 1990 Volume XI — Part 1: Broadcasting Service (Television) ITU-R BT.601-5, *Studio encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios*

CCIR Volume X and XI Part 3 Rec. 648: *Recording of audio signals*

CCIR Volume X and XI Part 3 Report 955-2: *Sound broadcasting by satellite for portable and mobile receivers, including Annex IV Summary description of advanced digital system II*

IEEE Standard Specifications for the Implementations of 8 by 8 Inverse Discrete Cosine Transform, IEEE Std 1180-1990, December 6, 1990

ITU-T Rec. H.261, *Codec for audiovisual services at px64 kbit/s,* Geneva, 1990

3 Terms and definitions

Relevant definitions for this part of ISO/EC 14496 can be found in ISO/IEC 14496-1, ISO/IEC 14496-2, ISO/IEC 14496-3 and ISO/IEC 14496-6 for Systems, Visual, Audio and DMIF definitions respectively.

Relevant abbreviations and symbols for this part of ISO/EC 14496 can be found in ISO/IEC 14496-1, ISO/IEC 14496-2, ISO/IEC 14496-3 and ISO/IEC 14496-6 for Systems, Visual, Audio and DMIF definitions respectively.

4 Systems

4.1 Conformance Points

Figure 1 illustrates a typical MPEG-4 terminal, as per the specifications of the Systems Decoder Model as identified in ISO/IEC 14496-1. With reference to this model, the following conformance point types have been identified.

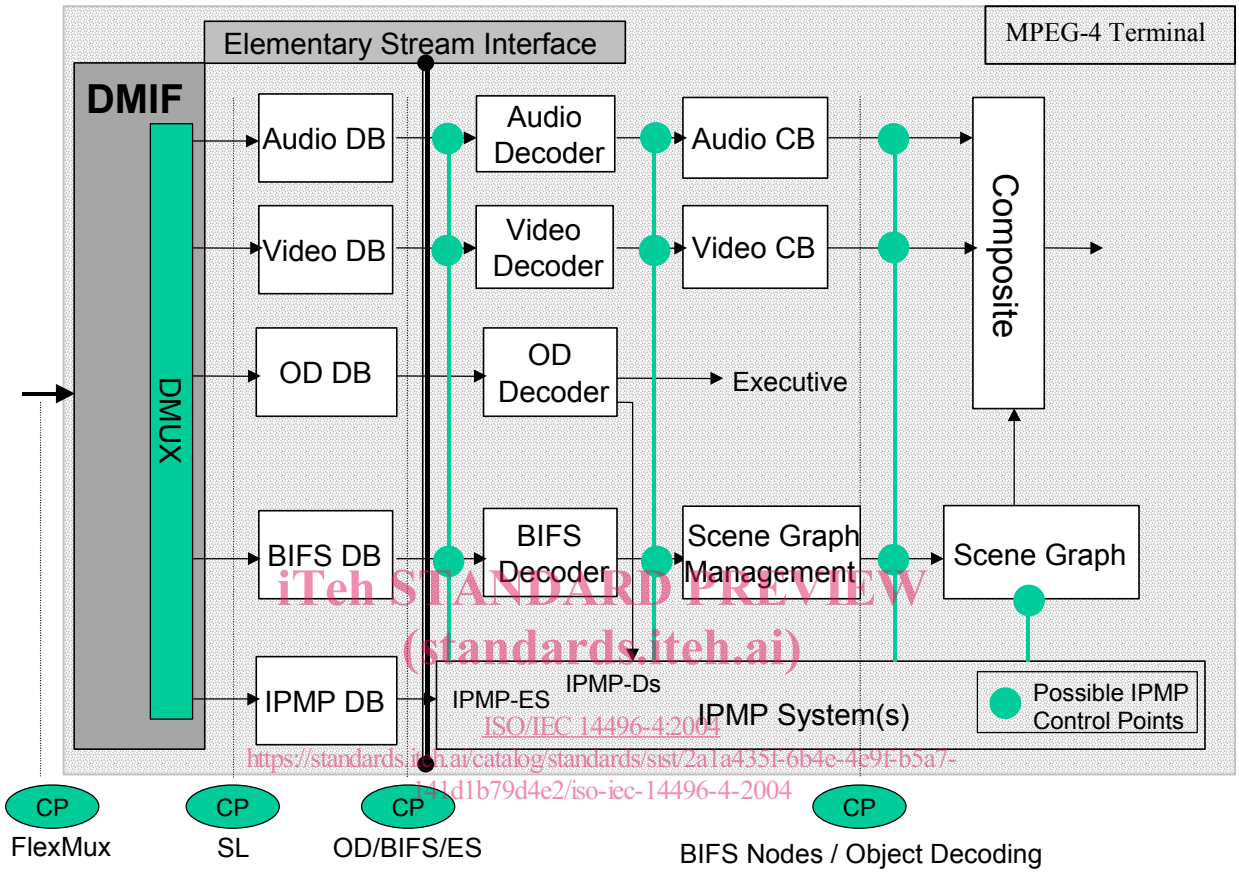

Figure 1 — Typical MPEG-4 terminal

Figure 1, DB are Decoding Buffers, CB are Composition Buffers. Audio CB contain PCM data. Video CB contain pixel data. Decoding buffers contain reconstructed Access Units (AU) or pieces of AU.

Bitstream conformance points are:

- FlexMux
- Synchronisation Layer
- OD Decoding
- BIFS Decoding
- OCI Decoding
- IPMP
- Systems Decoder Model conformance

At a bitstream conformance point, bitstreams will be acquired for use in testing.

Terminal conformance points are:

- FlexMux
- Synchronisation Layer
- OD Decoding Buffer
- BIFS Decoding Buffer

- OCI Decoding Buffer
- IPMP
- Scene Graph
- Systems Decoder Model conformance

4.1.1 FlexMux Conformance Point

A FlexMux conformance point is a conformance point where FlexMux streams as defined in subclause 12.2 of ISO/IEC 14496-1 can be acquired or inserted. According to a scene delivery, there may be several FlexMux conformance points. Each FlexMux conformance points correspond to one FlexMux channel allocated under DMIF responsibility. A FlexMux conformance point can be envisaged according to a bitstream point of view and according to a Terminal point of view. FlexMux bitstream conformance points are dedicated to the syntactic aspect of the FlexMux streams that can be acquired, while FlexMux Terminal conformance points are more dedicated to the semantics and the coherence of the FlexMux-ed streams, which can be acquired or inserted, with their associated signalling. The MPEG-4 signalling can be found in the Object descriptors.

4.1.2 Sync Layer Conformance Point

A Synchronisation Layer (SL) conformance point has to be considered from two possible points of view : the SL bitstream point of view and the SL Terminal point of view. SL bitstream conformance points are dedicated to the syntactic aspect of the SL bitstreams which can be acquired or inserted, assuming that the SL configuration of each SL stream is known upon acquisition of the Object Descriptor. SL terminal conformance points are more dedicated to the semantics and the coherence of the SL bitstreams with the associated signalling acquired from the Object descriptors, with the information found in the related SLConfigDescriptor, and with the information found in the associated SL_PDU packet headers.

4.1.3 OD Conformance Point

This is a point situated between the DMIF interface and the OD parser/decoder. Access Units from OD Elementary Streams are present at this point in the terminal.

4.1.4 BIFS Conformance Point

This is a point situated between the DMIF interface and the BIFS parser/decoder. Access Units from BIFS Elementary Streams are present at this point in the terminal. BIFS Elementary Streams contains BIFS Command Frames or BIFS Anim Frames.

4.1.5 OCI Conformance Point

This is a point situated between the DMIF interface and the OCI parser/decoder. Access Units from OCI Elementary Streams are present at this point in the terminal.

4.1.6 IPMP Conformance Point

IPMP information shall be conveyed in an MPEG-4 bitstream using the IPMP framework described in ISO/IEC 14496-1, subclauses 8.3 and 8.8. This includes the IPMP Elementary stream (IPMP-ES) and the IPMP Descriptors (IPMP-Ds). IP Identification information shall be conveyed using IPI Data sets as specified in ISO/IEC 14496-1, subclause 8.6.8. IPMP bitstream conformance points are dedicated to syntactic conformance. IPMP terminal conformance points are dedicated to semantic conformance.

4.1.7 Scene Graph Conformance Point

This is a point situated between the Scene Graph Management and the Compositor. The data present at this point represents the current state of the Scene Graph, i.e. the integration over time of all BIFS Commands and BIFS Anims received by the terminal as well as all interactions from the viewer.

It is the last point in the BIFS information flow where conformance can be specified. The format of the data at this point is implementation-dependent. However, there shall be a way to extract this implementation-dependent information and present it for conformance testing in the Scene Dump format specified in the Test Material subclause below.

4.2 Bitstream Conformance

Each bitstream shall meet the syntactic and semantic requirements specified in ISO/IEC 14496-1. This subclause describes a set of tests to be performed on bitstreams. In the description of the tests it is assumed that the tested bitstream contains no errors due to transmission or other causes. For each test the condition or conditions that must be satisfied are given, as well as the prerequisites or conditions in which the test can be

applied. Note that the application of these tests requires parsing of the bitstream to the appropriate levels. Parsing and interpretation of ODs is also required. In some cases of IPMP-protected data, de-scrambling may be required before the tests can be performed on non IPMP-related features.

4.2.1 FlexMux Conformance

4.2.1.1 Conformance Requirements

FlexMux-ed bitstreams shall comply with the specifications in subclause 12.2 of ISO/IEC 14496-1.

4.2.1.2 Measurement procedure

Syntax of the bitstream shall meet the requirements of subclause 12.2 of ISO/IEC 14496-1.

4.2.1.3 Tolerance

There is no tolerance for bitstream syntax checking. The diagnosis is pass or fail.

4.2.2 Synchronization Layer Conformance

4.2.2.1 Conformance Requirements

SL-packetized bitstreams shall comply with the specifications in subclause 10.2 of ISO/IEC 14496-1.

4.2.2.2 Measurement procedure

Syntax of the SL Packets shall meet the requirements of subclause 10.2 of ISO/IEC 14496-1.

4.2.2.3 Tolerance

There is no tolerance for bitstream syntax checking. The diagnosis is pass or fail.

4.2.3 OD Conformance

4.2.3.1 Conformance Requirements

OD streams shall comply with the specifications in clause 8 of ISO/IEC 14496-1.

4.2.3.2 Measurement procedure

Syntax of the OD stream shall meet the requirements of clause 8 of ISO/IEC 14496-1.

4.2.3.3 Tolerance

There is no tolerance for bitstream syntax checking. The diagnosis is pass or fail.

4.2.4 BIFS Conformance

4.2.4.1 Conformance Requirements

BIFS streams shall comply with the specifications in subclause 9.3 of ISO/IEC 14496-1.

4.2.4.2 Measurement procedure

Syntax of the BIFS stream shall meet the requirements of subclause 9.3 of ISO/IEC 14496-1.

4.2.4.3 Tolerance

There is no tolerance for bitstream syntax checking. The diagnosis is pass or fail.

4.2.5 OCI Conformance

4.2.5.1 Conformance Requirements

OCI descriptors included in ObjectDescriptors or ES_Descriptors shall comply with ISO/IEC 14496-1 subclause 8.4. A conformant OCI bitstream shall only contain OCI events and OCI descriptors that are compliant to ISO/IEC 14496-1 subclause 8.4. A conformant OCI bit stream shall be embedded in SL bitstreams, the configuration of which complies to ISO/IEC 14496-1 subclause 8.4.2

4.2.5.2 Measurement procedure

Syntax of the OCI stream and of the OCI descriptors shall meet the requirements of subclauses 8.4 and 8.6 of ISO/IEC 14496-1.

4.2.5.3 Tolerance

There is no tolerance. The diagnosis is pass or fail.

4.2.6 IPMP Conformance

4.2.6.1 Conformance Requirements

The IPMP information in a conformant bit stream shall consist only of IPMP-ESs and IPMP-Ds that are compliant to ISO/IEC 14496-1 subclauses 8.3 and 8.8 as well as IPI Data Sets that are compliant to ISO/IEC 14496-1 subclause 8.6.9.

4.2.6.2 Measurement procedure

The IPMP information in a conformant bit stream shall consist only of IPMP-ESs and IPMP-Ds that are parse-able to the extent of the specification of ISO/IEC 14496-1 subclauses 8.3 and 8.8 as well as IPI Data Sets that are parse-able.

4.2.6.3 Tolerance

There is no tolerance for bitstream syntax checking. The diagnosis is pass or fail.

4.2.7 Miscellaneous Conformance

4.2.7.1 Conformance Requirements

4.2.7.1.1 Private data handling

The normal operation of compliant MPEG decoders shall not be affected by the presence of private data in MPEG4 system streams, i.e. decoders shall operate in the same way, if any private data are inserted or are not inserted in the already predefined fields.

Decoders shall be at a minimum capable of parsing and ignoring all private fields.

Decoders shall be at a minimum capable of parsing and ignoring all private elementary streams.

4.2.7.1.2 Buffer management

The SDM testing, in terms of buffer underflow and overflow in the SDM is done one elementary stream at a time.

From a System Decoder Model point of view, FlexMux bitstream compliance, SL and Elementary stream compliance are required.

4.2.7.2 Measurement procedure

All the implied bitstream syntaxes shall meet their associated requirements defined in ISO/IEC 14496-1, clause 7.

4.2.7.3 Tolerance

There is no tolerance. The diagnosis is pass or fail.

4.3 Terminal Conformance

This subclause describes procedures to verify conformance of terminals. Each compliant decoder shall be able to decode all compliant ISO/IEC 14496-1 streams within the subset of the standard defined by the specified capabilities of the decoder.

All tests are performed using error free bitstreams. To test for correct interpretation of syntax and semantics, test sequences covering a wide range of parameters shall be supplied to the decoder under test and its output sequence shall be compared with the known expected output as described for the specific test sequence or bitstream. The comparison can be done, for example, by performing subjective evaluation, by verification of the expected result, or by comparing the timing performance. Such tests are necessary but not sufficient to prove conformance. They are helpful for discovering non-compliant implementations.

Tests are expected to be used for testing ISO/IEC 14496 decoders, including video and audio decoding, as it is generally not practical to test system decoders (or ISO/IEC 14496-1 decoders) alone. Practical test results depend on successful (or expected) output of the entire ISO/IEC 14496 decoder (systems, video, audio and DMIF).

Visual composition conformance is out of the scope of this document, as there is no specification of the visual result of object composition in ISO/IEC 14496-1.

Transport conformance is also out of the scope of this document.

4.3.1 FlexMux conformance

4.3.1.1 Conformance Requirements

The FlexDemux shall recover the SL Packets in the appropriate Decoding Buffer bit-exact as presented to the multiplex, and this for every Elementary Stream present in the FlexMux-ed stream under test.

A maximum bitrate can be specified for each Elementary Stream, see ISO/IEC 14496-1, subclause 8.6.5. Conformant bitstreams shall obey this constraint.

4.3.1.2 Measurement procedure

The recovered SL Packets shall be compared bit-wise with the original packets.

4.3.1.3 Tolerance

There is no tolerance. The diagnosis is pass or fail.

4.3.2 Synchronization Layer Conformance

Although the associated descriptor, called the SLConfigDescriptor, is conveyed as a part of the object descriptor framework, it's conformance issues are of great concern in this subclause since it pertains to the syntax and semantics of the SL-packet headers.

4.3.2.1 Conformance Requirements

The Sync Layer shall recover Access Units (AU) of the embedded Elementary Stream, from the consecutive SL layer packet payload and provide fragments of AU, fragment by fragment , or complete AU, to the associated decoder buffers through the ESI Interface, with the relevant parameters when present in the SL packet headers.

When OCR samples are present, they shall be used to reconstruct the Object Time Base, and shall comply with the timing accuracy conformance described in the following paragraph.

When DTSs and CTSs are present, they shall be coherent with the reconstructed OTB, in order to satisfy the constraint of the System Decoder Model.

On the Sync Layer (ISO/IEC 14496-1, clause 10), the elementary streams are mapped into sequences of SL-packets. The underlying stream that carries these packets is called the SL-Packetized stream (SPS). The Sync Layer specifies a syntax for the packetization of these elementary streams into access units, which are the basic units for time synchronization. The SL-packet consists of a header (SL-packet header) and the payload (SL-packet payload). The header carries the coded representation of time stamps and other associated information necessary for timing and synchronization processes.

This subclause deals with conformance issues related to the sync layer. Although the associated descriptor, called the SLConfigDescriptor, is conveyed as a part of the object descriptor framework, it's conformance issues are included in this subclause since it pertains to the syntax and semantics of the SL-packet headers. The subsequent subclauses deal with the conformance issues related to the SL-packets themselves. It is to be noted that these subclauses are rather incomplete. The Sync layer was designed to be delivery agnostic, i.e., the DMIF provided the interface and exchange between the external delivery layers and the internal elementary stream generation and packetization layers.

NOTE — However, with the ongoing discussions within ISO/IEC JTC 1/SC 29/WG 11 regarding the carriage of MPEG-4 over MPEG-2 transport as well as over IP, the conformance issues regarding the Sync layers must be revisited at the appropriate junctures, in these contexts. However, some of the following will still hold for implementations using the DMIF.

The Sync Layer shall recover the Access Units of the Elementary Stream and store them in the decoder buffer.

4.3.2.1.1 The Synchronization Layer Configuration Descriptor

The descriptor SLConfigDescriptor, which is conveyed within the ES_Descriptor for the elementary stream under consideration, contains the configuration information for the syntax of the SL Packet Headers for the access units in this elementary stream. The syntax of the SLConfigDescriptor is detailed in ISO/IEC 14496-1, subclause 10.2.3. This subclause deals with the syntactic conformance of the SLConfigDescriptor elements.

4.3.2.1.2 Structure

The SLConfigDescriptor element shall have the tag value equal to 0x06.

If predefined = 0x01, the packet header is empty.