
**Information technology — Generic
coding of moving pictures and
associated audio information: Systems**

AMENDMENT 3

*Technologies de l'information — Codage générique des images
animées et du son associé: Systèmes*
AMENDEMENT 3
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ISO/IEC 13818-1:2000/Amd 3:2004

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Foreword

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Amendment 3 to ISO/IEC 13818-1:2000 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*, in collaboration with ITU-T. The identical text is published as ITU-T Rec. H.222.0/Amd. 3.

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INTERNATIONAL STANDARD
ITU-T RECOMMENDATION**Information technology – Generic coding of moving pictures and associated audio information: Systems****Amendment 3****Transport of AVC video data over ITU-T Rec. H.222.0 | ISO/IEC 13818-1 streams****1) Subclause 1.2.2**

Add the following "paired" reference to subclause 1.2.2:

- ITU-T Recommendation H.264 (2003), *Advanced video coding for generic audiovisual services*.
ISO/IEC 14496-10:2003, *Information technology – Coding of audio-visual objects – Part 10: Advanced video coding*.

2) Subclause 2.1.1

Add to the definition for access unit in subclause 2.1.1:

For the definition of an access unit for ITU-T Rec. H.264 | ISO/IEC 14496-10 video, see the AVC access unit definition in 2.1.3.

3) New subclauses 2.1.2 to 2.1.7

Insert the following definitions as subclauses 2.1.2 to 2.1.7 and renumber existing ones accordingly:

2.1.2 AVC 24-hour picture (system): An AVC access unit with a presentation time that is more than 24 hours in the future. For the purpose of this definition, AVC access unit n has a presentation time that is more than 24 hours in the future if the difference between the initial arrival time $t_{ai}(n)$ and the DPB output time $t_{o,dpb}(n)$ is more than 24 hours.

2.1.3 AVC access unit (system): An access unit as defined for byte streams in ITU-T Rec. H.264 | ISO/IEC 14496-10 with the constraints specified in 2.14.1.

2.1.4 AVC Slice (system): A `byte_stream_nal_unit` as defined in ITU-T Rec. H.264 | ISO/IEC 14496-10 with `nal_unit_type` values of 1 or 5, or a `byte_stream_nal_unit` data structure with `nal_unit_type` value of 2 and any associated `byte_stream_nal_unit` data structures with `nal_unit_type` equal to 3 and/or 4.

2.1.5 AVC still picture (system): An AVC still picture consists of an AVC access unit containing an IDR picture, preceded by SPS and PPS NAL units that carry sufficient information to correctly decode the IDR picture. Preceding an AVC still picture, there shall be another AVC still picture or an End of Sequence NAL unit terminating a preceding coded video sequence.

2.1.6 AVC video sequence (system): Coded video sequence as defined in ITU-T Rec. H.264 | ISO/IEC 14496-10, clause 3.27.

2.1.7 AVC video stream (system): An ITU-T Rec. H.264 | ISO/IEC 14496-10 stream. An AVC video stream consists of one or more AVC video sequences.

4) Subclause 2.1.52

Replace the still picture definition in subclause 2.1.52:

2.1.52 still picture: A coded still picture consists of a video sequence containing exactly one coded picture which is intra-coded. This picture has an associated PTS and the presentation time of succeeding pictures, if any, is later than that of the still picture by at least two picture periods.

by:

2.1.52 still picture: A still picture consists of a video sequence, coded as defined in ITU-T Rec. H.262 | ISO/IEC 13818-2, ISO/IEC 11172-2 or ISO/IEC 14496-2, that contains exactly one coded picture which is intra-coded. This picture has an associated PTS and in case of coding according to ISO/IEC 11172-2, ITU-T Rec. H.262 | ISO/IEC 13818-2 or ISO/IEC 14496-2, the presentation time of succeeding pictures, if any, is later than that of the still picture by at least two picture periods.

5) New subclause 2.4.2.8

Add after subclause 2.4.2.7:

2.4.2.8 T-STD extensions for carriage of ITU-T Rec. H.264 | ISO/IEC 14496-10 Video

To define the decoding in the T-STD of ITU-T Rec. H.264 | ISO/IEC 14496-10 video streams carried in a Transport Stream, the T-STD model needs to be extended. The T-STD extension and T-STD parameters for decoding of ITU-T Rec. H.264 | ISO/IEC 14496-10 video streams are defined in 2.14.3.1.

6) Subclause 2.4.3.5

a) Replace in the semantics of *discontinuity* indicator under subclause 2.4.3.5 starting from the 5th paragraph:

For the purpose of this clause, an elementary stream access point is defined as follows:

- Video – The first byte of a video sequence header.
- Audio – The first byte of an audio frame.

After a continuity counter discontinuity in a Transport packet which is designated as containing elementary stream data, the first byte of elementary stream data in a Transport Stream packet of the same PID shall be the first byte of an elementary stream access point or in the case of video, the first byte of an elementary stream access point or a `sequence_end_code` followed by an access point.

by:

For the purpose of this clause, an elementary stream access point is defined as follows:

- ISO/IEC 11172-2 video and ITU-T Rec. H.262 | ISO/IEC 13818-2 video – The first byte of a video sequence header.
- ISO/IEC 14496-2 visual – The first byte of the visual object sequence header.
- ITU-T Rec. H.264 | ISO/IEC 14496-10 video – The first byte of an AVC access unit. The SPS and PPS parameter sets referenced in this and all subsequent AVC access units in the coded video stream shall be provided after this access point in the byte stream and prior to their activation.
- Audio – The first byte of an audio frame.

After a continuity counter discontinuity in a Transport packet which is designated as containing elementary stream data, the first byte of elementary stream data in a Transport Stream packet of the same PID shall be the first byte of an elementary stream access point. In the case of ISO/IEC 11172-2, or ITU-T Rec. H.262 | ISO/IEC 13818-2 or ISO/IEC 14496-2 video, the first byte of an elementary stream access point may also be the first byte of a `sequence_end_code` followed by an elementary stream access point.

b) Replace in the semantics of *random_access_indicator* under subclause 2.4.3.5:

Specifically, when the bit is set to '1', the next PES packet to start in the payload of Transport Stream packets with the current PID shall contain the first byte of a video sequence header if the PES stream type (refer to Table 2-29) is 1 or 2, or shall contain the first byte of an audio frame if the PES stream type is 3 or 4. In addition, in the case of video, a presentation timestamp shall be present in the PES packet containing the first picture following the sequence header.

by:

Specifically, when the bit is set to '1', the next PES packet to start in the payload of Transport Stream packets with the current PID shall contain an elementary stream access point as defined in the semantics for the discontinuity_indicator field. In addition, in the case of video, a presentation timestamp shall be present for the first picture following the elementary stream access point.

c) *Replace in the semantics of elementary_stream_priority_indicator under subclause 2.4.3.5:*

In the case of video, this field may be set to '1' only if the payload contains one or more bytes from an intra-coded slice.

by:

In the case of ISO/IEC 11172-2 or ITU-T Rec. H.262 | ISO/IEC 13818-2 or ISO/IEC 14496-2 video, this field may be set to '1' only if the payload contains one or more bytes from an intra-coded slice.

In the case of ITU-T Rec. H.264 | ISO/IEC 14496-10 video, this field may be set to '1' only if the payload contains one or more bytes from a slice with slice_type set to 2, 4, 7, or 9.

d) *Replace in the semantics of splice_countdown under subclause 2.4.3.5:*

For the purpose of this subclause, an access point is defined as follows:

- Video – The first byte of a video_sequence_header.
- Audio – The first byte of an audio frame.

by:

For the definition of an elementary stream access point, see the semantics of discontinuity_indicator in 2.4.3.5.

e) *Replace in the semantics of seamless_splice_flag under subclause 2.4.3.5 the sentences:*

When this flag is set, if the elementary stream carried in this PID is an audio stream, the splice_type field shall be set to '0000'. If the elementary stream carried in this PID is a video stream, it shall fulfil the constraints indicated by the splice_type value.

by:

When this flag is set, and if the elementary stream carried in this PID is not an ITU-T Rec. H.262 | ISO/IEC 13818-2 video stream, then the splice_type field shall be set to '0000'. If the elementary stream carried in this PID is an ITU-T Rec. H.262 | ISO/IEC 13818-2 video stream, it shall fulfil the constraints indicated by the splice_type value.

f) *Replace in the semantics of splice_type under subclause 2.4.3.5 the sentences:*

If the elementary stream carried in that PID is an audio stream, this field shall have the value '0000'. If the elementary stream carried in that PID is a video stream, this field indicates the conditions that shall be respected by this elementary stream for splicing purposes.

by:

If the elementary stream carried in that PID is not an ITU-T Rec. H.262 | ISO/IEC 13818-2 video stream, then this field shall have the value '0000'. If the elementary stream carried in that PID is an ITU-T Rec. H.262 | ISO/IEC 13818-2 video stream, then this field indicates the conditions that shall be respected by this elementary stream for splicing purposes.

7) Subclause 2.4.3.7

a) Replace Table 2-18 in subclause 2.4.3.7 by:

Table 2-18 – Stream_id assignments

Stream_id	Note	stream coding
1011 1100	1	program_stream_map
1011 1101	2	private_stream_1
1011 1110		padding_stream
1011 1111	3	private_stream_2
110x xxxx		ISO/IEC 13818-3 or ISO/IEC 11172-3 or ISO/IEC 13818-7 or ISO/IEC 14496-3 audio stream number x xxxx
1110 xxxx		ITU-T Rec. H.262 ISO/IEC 13818-2, ISO/IEC 11172-2, ISO/IEC 14496-2 or ITU-T Rec. H.264 ISO/IEC 14496-10 video stream number xxxx
1111 0000	3	ECM_stream
1111 0001	3	EMM_stream
1111 0010	5	ITU-T Rec. H.222.0 ISO/IEC 13818-1 Annex A or ISO/IEC 13818-6_DSMCC_stream
1111 0011	2	ISO/IEC_13522_stream
1111 0100	6	ITU-T Rec. H.222.1 type A
1111 0101	6	ITU-T Rec. H.222.1 type B
1111 0110	6	ITU-T Rec. H.222.1 type C
1111 0111	6	ITU-T Rec. H.222.1 type D
1111 1000	6	ITU-T Rec. H.222.1 type E
1111 1001	7	ancillary_stream
1111 1010		ISO/IEC 14496-1_SL-packetized_stream
1111 1011		ISO/IEC 14496-1_FlexMux_stream
1111 1100		metadata_stream
1111 1101		extended_stream_id
1111 1110		reserved_data_stream
1111 1111	4	program_stream_directory

The notation x means that the values '0' or '1' are both permitted and results in the same stream type. The stream number is given by the values taken by the x's.

NOTE 1 – PES packets of type program_stream_map have unique syntax specified in 2.5.4.1.

NOTE 2 – PES packets of type private_stream_1 and ISO/IEC_13522_stream follow the same PES packet syntax as those for ITU-T Rec. H.262 | ISO/IEC 13818-2 video and ISO/IEC 13818-3 audio streams.

NOTE 3 – PES packets of type private_stream_2, ECM_stream and EMM_stream are similar to private_stream_1 except no syntax is specified after PES_packet_length field.

NOTE 4 – PES packets of type program_stream_directory have a unique syntax specified in 2.5.5.

NOTE 5 – PES packets of type DSM-CC_stream have a unique syntax specified in ISO/IEC 13818-6.

NOTE 6 – This stream_id is associated with stream_type 0x09 in Table 2-29.

NOTE 7 – This stream_id is only used in PES packets, which carry data from a Program Stream or an ISO/IEC 11172-1 System Stream, in a Transport Stream (refer to 2.4.3.7).

b) Replace the semantics of data_alignment_indicator in subclause 2.4.3.7 by:

data_alignment_indicator – This is a 1-bit flag. When set to a value of '1', it indicates that the PES packet header is immediately followed by the video syntax element or audio sync word indicated in the data_stream_alignment_descriptor in 2.6.10 if this descriptor is present. If set to a value of '1' and the descriptor is not present, alignment as indicated in alignment_type '01' in Table 2-47, Table 2-48 or Table AMD3-1 is required. When set to a value of '0', it is not defined whether any such alignment occurs or not.

c) *Replace in the semantics of PTS in subclause 2.4.3.7:*

In the case of video, if a PTS is present in a PES packet header it shall refer to the access unit containing the first picture start code that commences in this PES packet. A picture start code commences in PES packet if the first byte of the picture start code is present in the PES packet.

For audio presentation units (PUs), video PUs in low_delay sequences, and B-pictures, the presentation time $tp_n(k)$ shall be equal to the decoding time $td_n(k)$.

For I- and P-pictures in non-low_delay sequences and in the case when there is no decoding discontinuity between access units (AUs) k and k', the presentation time $tp_n(k)$ shall be equal to the decoding time $td_n(k')$ of the next transmitted I- or P-picture (refer to 2.7.5). If there is a decoding discontinuity, or the stream ends, the difference between $tp_n(k)$ and $td_n(k)$ shall be the same as if the original stream had continued without a discontinuity and without ending.

NOTE 1 – A low_delay sequence is a video sequence in which the low_delay flag is set (refer to 6.2.2.3 of ITU-T Rec. H.262 | ISO/IEC 13818-2).

by:

In the case of ISO/IEC 11172-2 video, ITU-T Rec. H.262 | ISO/IEC 13818-2 video, or ISO/IEC 14496-2 video, if a PTS is present in a PES packet header, it shall refer to the access unit containing the first picture start code that commences in this PES packet. A picture start code commences in a PES packet if the first byte of the picture start code is present in the PES packet. For I- and P-pictures in non-low_delay sequences and in the case when there is no decoding discontinuity between access units (AUs) k and k', the presentation time $tp_n(k)$ shall be equal to the decoding time $td_n(k')$ of the next transmitted I- or P-picture (refer to 2.7.5). If there is a decoding discontinuity, or the stream ends, the difference between $tp_n(k)$ and $td_n(k)$ shall be the same as if the original stream had continued without a discontinuity and without ending.

NOTE 1 – A low_delay sequence is an ITU-T Rec. H.262 | ISO/IEC 13818-2 or ISO/IEC 14496-2 video sequence in which the low_delay flag is set to '1' (refer to 6.2.2.3 of ITU-T Rec. H.262 | ISO/IEC 13818-2 and to 6.2.3 of ISO/IEC 14496-2).

For ITU-T Rec. H.264 | ISO/IEC 14496-10 video, if a PTS is present in the PES packet header, it shall refer to the first AVC access unit that commences in this PES packet. An AVC access unit commences in a PES packet if the first byte of the AVC access unit is present in the PES packet. To achieve consistency between the STD model and the HRD model defined in Annex C of ITU-T Rec. H.264 | ISO/IEC 14496-10, for each decoded AVC access unit, the PTS value in the STD shall, within the accuracy of their respective clocks, indicate the same instant in time as the nominal DPB output time in the HRD, defined herein as $t_{o,n,dpb}(n) = t_{r,n}(n) + t_c * dpb_output_delay(n)$, where $t_{r,n}(n)$, t_c , and $dpb_output_delay(n)$ are defined as in Annex C of ITU-T Rec. H.264 | ISO/IEC 14496-10.

NOTE 2 – Different clocks may be used for derivation of PTS and $t_{o,n,dpb}(n)$.

The presentation time $tp_n(k)$ shall be equal to the decoding time $td_n(k)$ for:

- audio access units;
- access units in ITU-T Rec. H.262 | ISO/IEC 13818-2 or ISO/IEC 14496-2 low delay video sequences;
- B-pictures in ISO/IEC 11172-2, ITU-T Rec. H.262 | ISO/IEC 13818-2 or ISO/IEC 14496-2 video streams.

d) *Replace in the semantics of DTS in subclause 2.4.3.7:*

In the case of video, if a DTS is present in a PES packet header it shall refer to the access unit containing the first picture start code that commences in this PES packet. A picture start code commences in PES packet if the first byte of the picture start code is present in the PES packet.

by:

In the case of ISO/IEC 11172-2 video, ITU-T Rec. H.262 | ISO/IEC 13818-2 video, or ISO/IEC 14496-2 video, if a DTS is present in a PES packet header, it shall refer to the access unit containing the first picture start code that commences in this PES packet. A picture start code commences in a PES packet if the first byte of the picture start code is present in the PES packet.

For ITU-T Rec. H.264 | ISO/IEC 14496-10 video, if a DTS is present in the PES packet header, it shall refer to the first AVC access unit that commences in this PES packet. An AVC access unit commences in a PES packet if the first byte of the AVC access unit is present in the PES packet. To achieve consistency between the STD model and the HRD model defined in Annex C of ITU-T Rec. H.264 | ISO/IEC 14496-10, for each AVC access unit the DTS value in the STD shall, within the accuracy of their respective clocks, indicate the same instant in time as the nominal CPB removal time $t_{r,n}(n)$ in the HRD, as defined in Annex C of ITU-T Rec. H.264 | ISO/IEC 14496-10.

NOTE 3 – Different clocks may be used for derivation of DTS and $t_{r,n}(n)$.

ISO/IEC 13818-1:2000/Amd.3:2004 (E)

e) Add to the semantics of *P-STD_buffer_size* under subclause 2.4.3.7:

The size BS_n shall be larger than or equal to the size of the CPB signalled by the *CpbSize[cpb_cnt_minus1]* specified by the *NAL_hrd_parameters()* in the AVC video stream. If the *NAL_hrd_parameters()* are not present in the AVC video stream, then BS_n shall be larger than or equal to the size of the NAL CPB for the byte stream format defined in Annex A of ITU-T Rec. H.264 | ISO/IEC 14496-10 as $1200 \times \text{MaxCPB}$ for the applied level.

8) Subclause 2.4.4.10

Replace Table 2-29 in subclause 2.4.4.10 by:

Table 2-29 – Stream type assignments

Value	Description
0x00	ITU-T ISO/IEC Reserved
0x01	ISO/IEC 11172-2 Video
0x02	ITU-T Rec. H.262 ISO/IEC 13818-2 Video or ISO/IEC 11172-2 constrained parameter video stream
0x03	ISO/IEC 11172-3 Audio
0x04	ISO/IEC 13818-3 Audio
0x05	ITU-T Rec. H.222.0 ISO/IEC 13818-1 private_sections
0x06	ITU-T Rec. H.222.0 ISO/IEC 13818-1 PES packets containing private data
0x07	ISO/IEC 13522 MHEG
0x08	ITU-T Rec. H.222.0 ISO/IEC 13818-1 Annex A DSM-CC
0x09	ITU-T Rec. H.222.1
0x0A	ISO/IEC 13818-6 type A
0x0B	ISO/IEC 13818-6 type B
0x0C	ISO/IEC 13818-6 type C
0x0D	ISO/IEC 13818-6 type D
0x0E	ITU-T Rec. H.222.0 ISO/IEC 13818-1 auxiliary
0x0F	ISO/IEC 13818-7 Audio with ADTS transport syntax
0x10	ISO/IEC 14496-2 Visual
0x11	ISO/IEC 14496-3 Audio with the LATM transport syntax as defined in ISO/IEC 14496-3/AMD-1
0x12	ISO/IEC 14496-1 SL-packetized stream or FlexMux stream carried in PES packets
0x13	ISO/IEC 14496-1 SL-packetized stream or FlexMux stream carried in ISO/IEC14496_sections
0x14	ISO/IEC 13818-6 Synchronized Download Protocol
0x15	Metadata carried in PES packets
0x16	Metadata carried in metadata_sections
0x17	Metadata carried in ISO/IEC 13818-6 Data Carousel
0x18	Metadata carried in ISO/IEC 13818-6 Object Carousel
0x19	Metadata carried in ISO/IEC 13818-6 Synchronized Download Protocol
0x1A	IPMP stream (defined in ISO/IEC 13818-11, MPEG-2 IPMP)
0x1B	AVC video stream as defined in ITU-T Rec. H.264 ISO/IEC 14496-10 Video
0x1C-0x7E	ITU-T Rec. H.222.0 ISO/IEC 13818-1 Reserved
0x7F	IPMP stream
0x80-0xFF	User Private

9) Subclause 2.5.2.4

Add in subclause 2.5.2.4 "PES streams" the sentence:

- For ITU-T Rec. H.264 | ISO/IEC 14496-10 video:

$$BS_n = 1200 \times \text{MaxCPB}[\text{level}] + BS_{oh}$$

Where MaxCPB[level] is defined in Table A.1 (Level Limits) in ITU-T Rec. H.264 | ISO/IEC 14496-10 for each level.

10) New subclause 2.5.2.7

Add after subclause 2.5.2.6:

2.5.2.7 P-STD extensions for carriage of ITU-T Rec. H.264 | ISO/IEC 14496-10 Video

For decoding of ITU-T Rec. H.264 | ISO/IEC 14496-10 video streams carried in a Program Stream in the P-STD model, see 2.14.3.2.

11) Subclause 2.5.3.6

- a) Replace in the semantics of the system_video_lock_flag in subclause 2.5.3.6:

The system_video_lock_flag is a 1-bit field indicating that there is a specified, constant rational relationship between the video frame rate and the system clock frequency in the system target decoder. Subclause 2.5.2.1 defines system_clock_frequency and the video frame rate is specified in ITU-T Rec. H.262 | ISO/IEC 13818-2. The system_video_lock_flag may only be set to '1' if, for all presentation units in all video elementary streams in the ITU-T Rec. H.222.0 | ISO/IEC 13818-1 program, the ratio of system_clock_frequency to the actual video frame rate, SCFR, is constant and equal to the value indicated in the following table at the nominal frame rate indicated in the video stream.

by:

(standards.iteh.ai)

The system_video_lock_flag is a 1-bit field indicating that there is a specified, constant rational relationship between the video time base and the system clock frequency in the system target decoder. The system_video_lock_flag may only be set to '1' if, for all presentation units in all video elementary streams in the ITU-T Rec. H.222.0 | ISO/IEC 13818-1 program, the ratio of system_clock_frequency to the frequency of the actual video time base is constant.

For ISO/IEC 11172-2 and ITU-T Rec. H.262 | ISO/IEC 13818-2 video streams, if the system_video_lock_flag is set to '1', then the ratio of system_clock_frequency to the actual video frame rate, SCFR, shall be constant and equal to the value indicated in the following table at the nominal frame rate indicated in the video stream.

For ISO/IEC 14496-2 video streams, if the system_video_lock_flag is set to '1', then the time base of the ISO/IEC 14496-2 video stream, as defined by vop_time_increment_resolution, shall be locked to the STC and shall be exactly equal to N times system_clock_frequency divided by K, with N and K integers that have a fixed value within each visual object sequence, with K greater than or equal to N.

For ITU-T Rec. H.264 | ISO/IEC 14496-10 video streams, the frequency of the AVC time base is defined by the AVC parameter time_scale. If the system_video_lock_flag is set to '1' for an AVC video stream, then the frequency of the AVC time base shall be locked to the STC and shall be exactly equal to N times system_clock_frequency divided by K, with N and K integers that have a fixed value within each AVC video sequence, with K greater than or equal to N.

- b) Replace the semantics of video_bound in subclause 2.5.3.6 by:

The video_bound is a 5-bit integer in the inclusive range from 0 to 16 and is set to a value greater than or equal to the maximum number of video streams in the Program Stream of which the decoding processes are simultaneously active. For the purpose of this subclause, the decoding process of a video stream is active if one of the buffers in the P-STD model is not empty, or if a Presentation Unit is being presented in the P-STD model.

12) Subclause 2.5.5

Add the following semantics in subclause 2.5.5 "Program Stream directory" immediately after NOTE 2:

Directory entries may be required to reference IDR picture or pictures associated with a recovery point SEI message in an AVC video stream. Each such directory entry shall refer to the first byte of an AVC access unit.