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

**Part 2:
Video**

*Technologies de l'information — Codage générique des images
animées et du son associé —*

Partie 2: Données vidéo

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Foreword

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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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

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This third edition cancels and replaces the second edition (ISO/IEC 13818-2:2000), which has been technically revised. It also incorporates the Amendments ISO/IEC 13818-2:2000/Amd.1:2001, ISO/IEC 13818-2:2000/Amd.2:2007 and ISO/IEC 13818-2:2000/Amd.3:2010, and the Technical Corrigenda ISO/IEC 13818-2:2000/Cor.1:2002 and ISO/IEC 13818-2:2000/Cor.2:2007.

ISO/IEC 13818 consists of the following parts, under the general title *Information technology — Generic coding of moving pictures and associated audio information*:

- *Part 1: Systems*
- *Part 2: Video*
- *Part 3: Audio*
- *Part 4: Conformance testing*
- *Part 5: Software simulation*
- *Part 6: Extensions for DSM-CC*
- *Part 7: Advanced Audio Coding (AAC)*
- *Part 9: Extension for real time interface for systems decoders*
- *Part 10: Conformance extensions for Digital Storage Media Command and Control (DSM-CC)*
- *Part 11: IPMP on MPEG-2 systems*

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Introduction

Intro. 1 Purpose

This Part of this Recommendation | International Standard was developed in response to the growing need for a generic coding method of moving pictures and of associated sound for various applications such as digital storage media, television broadcasting and communication. The use of this Specification means that motion video can be manipulated as a form of computer data and can be stored on various storage media, transmitted and received over existing and future networks and distributed on existing and future broadcasting channels.

Intro. 2 Application

The applications of this Specification cover, but are not limited to, such areas as listed below:

BSS	Broadcasting Satellite Service (to the home)
CATV	Cable TV Distribution on optical networks, copper, etc.
CDAD	Cable Digital Audio Distribution
DSB	Digital Sound Broadcasting (terrestrial and satellite broadcasting)
DTTB	Digital Terrestrial Television Broadcasting
EC	Electronic Cinema
ENG	Electronic News Gathering (including SNG, Satellite News Gathering)
FSS	Fixed Satellite Service (e.g. to head ends)
HTT	Home Television Theatre
IPC	Interpersonal Communications (videoconferencing, videophone, etc.)
ISM	Interactive Storage Media (optical disks, etc.)
MMM	Multimedia Mailing
NCA	News and Current Affairs
NDB	Networked Database Services (via ATM, etc.)
RVS	Remote Video Surveillance
SSM	Serial Storage Media (digital VTR, etc.)

Intro. 3 Profiles and levels

This Specification is intended to be generic in the sense that it serves a wide range of applications, bit rates, resolutions, qualities and services. Applications should cover, among other things, digital storage media, television broadcasting and communications. In the course of creating this Specification, various requirements from typical applications have been considered, necessary algorithmic elements have been developed, and they have been integrated into a single syntax. Hence, this Specification will facilitate the bitstream interchange among different applications.

Considering the practicality of implementing the full syntax of this Specification, however, a limited number of subsets of the syntax are also stipulated by means of "profile" and "level". These and other related terms are formally defined in clause 3.

A "profile" is a defined subset of the entire bitstream syntax that is defined by this Specification. Within the bounds imposed by the syntax of a given profile it is still possible to require a very large variation in the performance of encoders and decoders depending upon the values taken by parameters in the bitstream. For instance, it is possible to specify frame sizes as large as (approximately) 2^{14} samples wide by 2^{14} lines high. It is currently neither practical nor economic to implement a decoder capable of dealing with all possible frame sizes.

In order to deal with this problem, "levels" are defined within each profile. A level is a defined set of constraints imposed on parameters in the bitstream. These constraints may be simple limits on numbers. Alternatively they may take the form of constraints on arithmetic combinations of the parameters (e.g. frame width multiplied by frame height multiplied by frame rate).

Bitstreams complying with this Specification use a common syntax. In order to achieve a subset of the complete syntax, flags and parameters are included in the bitstream that signal the presence or otherwise of syntactic elements that occur later in the bitstream. In order to specify constraints on the syntax (and hence define a profile), it is thus only necessary to constrain the values of these flags and parameters that specify the presence of later syntactic elements.

Intro. 4 The scalable and the non-scalable syntax

The full syntax can be divided into two major categories: One is the non-scalable syntax, which is structured as a super set of the syntax defined in ISO/IEC 11172-2. The main feature of the non-scalable syntax is the extra compression tools for interlaced video signals. The second is the scalable syntax, the key property of which is to enable the reconstruction of useful video from pieces of a total bitstream. This is achieved by structuring the total bitstream in two or more layers, starting from a standalone base layer and adding a number of enhancement layers. The base layer can use the non-scalable syntax, or in some situations conform to the ISO/IEC 11172-2 syntax.

Intro. 4.1 Overview of the non-scalable syntax

The coded representation defined in the non-scalable syntax achieves a high compression ratio while preserving good image quality. The algorithm is not lossless as the exact sample values are not preserved during coding. Obtaining good image quality at the bit rates of interest demands very high compression, which is not achievable with intra picture coding alone. The need for random access, however, is best satisfied with pure intra picture coding. The choice of the techniques is based on the need to balance a high image quality and compression ratio with the requirement to make random access to the coded bitstream.

A number of techniques are used to achieve high compression. The algorithm first uses block-based motion compensation to reduce the temporal redundancy. Motion compensation is used both for causal prediction of the current picture from a previous picture, and for non-causal, interpolative prediction from past and future pictures. Motion vectors are defined for each 16-sample by 16-line region of the picture. The prediction error, is further compressed using the Discrete Cosine Transform (DCT) to remove spatial correlation before it is quantized in an irreversible process that discards the less important information. Finally, the motion vectors are combined with the quantized DCT information, and encoded using variable length codes.

Intro. 4.1.1 Temporal processing

Because of the conflicting requirements of random access and highly efficient compression, three main picture types are defined. Intra-coded pictures (I-pictures) are coded without reference to other pictures. They provide access points to the coded sequence where decoding can begin, but are coded with only moderate compression. Predictive coded pictures (P-pictures) are coded more efficiently using motion compensated prediction from a past intra or predictive coded picture and are generally used as a reference for further prediction. Bidirectionally-predictive coded pictures (B-pictures) provide the highest degree of compression but require both past and future reference pictures for motion compensation. Bidirectionally-predictive coded pictures are never used as references for prediction (except in the case that the resulting picture is used as a reference in a spatially scalable enhancement layer). The organization of the three picture types in a sequence is very flexible. The choice is left to the encoder and will depend on the requirements of the application. Figure Intro. 1 illustrates an example of the relationship among the three different picture types.

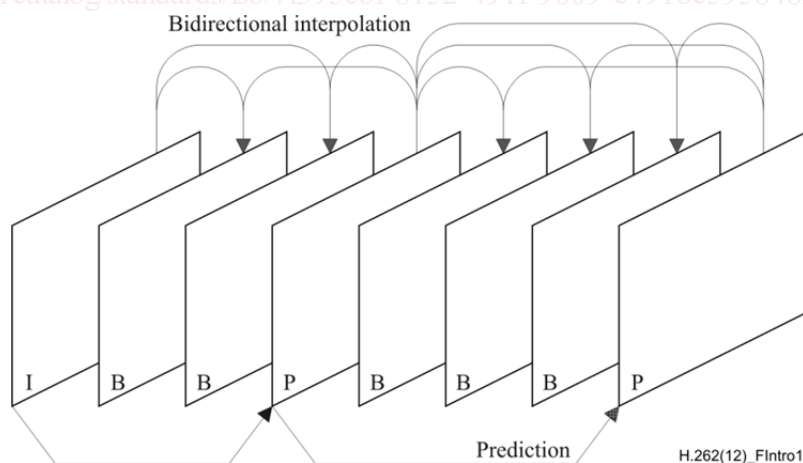


Figure Intro.1 – Example of temporal picture structure

Intro. 4.1.2 Coding interlaced video

Each frame of interlaced video consists of two fields which are separated by one field-period. The Specification allows either the frame to be encoded as picture or the two fields to be encoded as two pictures. Frame encoding or field encoding can be adaptively selected on a frame-by-frame basis. Frame encoding is typically preferred when the video scene contains significant detail with limited motion. Field encoding, in which the second field can be predicted from the first, works better when there is fast movement.

Intro. 4.1.3 Motion representation – Macroblocks

As in ISO/IEC 11172-2, the choice of 16 by 16 macroblocks for the motion-compensation unit is a result of the trade-off between the coding gain provided by using motion information and the overhead needed to represent it. Each macroblock can be temporally predicted in one of a number of different ways. For example, in frame encoding, the prediction from the previous reference frame can itself be either frame-based or field-based. Depending on the type of the macroblock, motion vector information and other side information is encoded with the compressed prediction error in each macroblock. The motion vectors are encoded differentially with respect to the last encoded motion vectors using variable length codes. The maximum length of the motion vectors that may be represented can be programmed, on a picture-by-picture basis, so that the most demanding applications can be met without compromising the performance of the system in more normal situations.

It is the responsibility of the encoder to calculate appropriate motion vectors. This Specification does not specify how this should be done.

Intro. 4.1.4 Spatial redundancy reduction

Both source pictures and prediction errors have high spatial redundancy. This Specification uses a block-based DCT method with visually weighted quantization and run-length coding. After motion compensated prediction or interpolation, the resulting prediction error is split into 8 by 8 blocks. These are transformed into the DCT domain where they are weighted before being quantized. After quantization many of the DCT coefficients are zero in value and so two-dimensional run-length and variable length coding is used to encode the remaining DCT coefficients efficiently.

Intro. 4.1.5 Chrominance formats

In addition to the 4:2:0 format supported in ISO/IEC 11172-2 this Specification supports 4:2:2 and 4:4:4 chrominance formats.

Intro. 4.2 Scalable extensions

The scalability tools in this Specification are designed to support applications beyond that supported by single layer video. Among the noteworthy applications areas addressed are video telecommunications, video on Asynchronous Transfer Mode (ATM) networks, interworking of video standards, video service hierarchies with multiple spatial, temporal and quality resolutions, HDTV with embedded TV, systems allowing migration to higher temporal resolution HDTV, etc. Although a simple solution to scalable video is the simulcast technique which is based on transmission/storage of multiple independently coded reproductions of video, a more efficient alternative is scalable video coding, in which the bandwidth allocated to a given reproduction of video can be partially re-utilized in coding of the next reproduction of video. In scalable video coding, it is assumed that given a coded bitstream, decoders of various complexities can decode and display appropriate reproductions of coded video. A scalable video encoder is likely to have increased complexity when compared to a single layer encoder. However, this Recommendation | International Standard provides several different forms of scalabilities that address non-overlapping applications with corresponding complexities. The basic scalability tools offered are:

- data partitioning;
- SNR scalability;
- spatial scalability; and
- temporal scalability.

Moreover, combinations of these basic scalability tools are also supported and are referred to as *hybrid scalability*. In the case of basic scalability, two layers of video referred to as the *lower layer* and the *enhancement layer* are allowed, whereas in hybrid scalability up to three layers are supported. Tables Intro. 1 to Intro. 3 provide a few example applications of various scalabilities.

Table Intro. 1 – Applications of SNR scalability

Lower layer	Enhancement layer	Application
Recommendation ITU-R BT.601	Same resolution and format as lower layer	Two quality service for Standard TV (SDTV)
High Definition	Same resolution and format as lower layer	Two quality service for HDTV
4:2:0 high definition	4:2:2 chroma simulcast	Video production / distribution

Table Intro. 2 – Applications of spatial scalability

Base	Enhancement	Application
Progressive (30 Hz)	Progressive (30 Hz)	Compatibility or scalability CIF/SCIF
Interlace (30 Hz)	Interlace (30 Hz)	HDTV/SDTV scalability
Progressive (30 Hz)	Interlace (30 Hz)	ISO/IEC 11172-2/compatibility with this Specification
Interlace (30 Hz)	Progressive (60 Hz)	Migration to high resolution progressive HDTV

Table Intro. 3 – Applications of temporal scalability

Base	Enhancement	Higher	Application
Progressive (30 Hz)	Progressive (30 Hz)	Progressive (60 Hz)	Migration to high resolution progressive HDTV
Interlace (30 Hz)	Interlace (30 Hz)	Progressive (60 Hz)	Migration to high resolution progressive HDTV

Intro. 4.2.1 Spatial scalable extension

Spatial scalability is a tool intended for use in video applications involving telecommunications, interworking of video standards, video database browsing, interworking of HDTV and TV, etc., i.e. video systems with the primary common feature that a minimum of two layers of spatial resolution are necessary. Spatial scalability involves generating two spatial resolution video layers from a single video source such that the lower layer is coded by itself to provide the basic spatial resolution and the enhancement layer employs the spatially interpolated lower layer and carries the full spatial resolution of the input video source. The lower and the enhancement layers may either both use the coding tools in this Specification, or the ISO/IEC 11172-2 Standard for the lower layer and this Specification for the enhancement layer. The latter case achieves a further advantage by facilitating interworking between video coding standards. Moreover, spatial scalability offers flexibility in choice of video formats to be employed in each layer. An additional advantage of spatial scalability is its ability to provide resilience to transmission errors as the more important data of the lower layer can be sent over channel with better error performance, while the less critical enhancement layer data can be sent over a channel with poor error performance.

Intro. 4.2.2 SNR scalable extension

SNR scalability is a tool intended for use in video applications involving telecommunications, video services with multiple qualities, standard TV and HDTV, i.e. video systems with the primary common feature that a minimum of two layers of video quality are necessary. SNR scalability involves generating two video layers of same spatial resolution but different video qualities from a single video source such that the lower layer is coded by itself to provide the basic video quality and the enhancement layer is coded to enhance the lower layer. The enhancement layer when added back to the lower layer regenerates a higher quality reproduction of the input video. The lower and the enhancement layers may either use this Specification or ISO/IEC 11172-2 Standard for the lower layer and this Specification for the enhancement layer. An additional advantage of SNR scalability is its ability to provide high degree of resilience to transmission errors as the more important data of the lower layer can be sent over channel with better error performance, while the less critical enhancement layer data can be sent over a channel with poor error performance.

Intro. 4.2.3 Temporal scalable extension

Temporal scalability is a tool intended for use in a range of diverse video applications from telecommunications to HDTV for which migration to higher temporal resolution systems from that of lower temporal resolution systems may be necessary. In many cases, the lower temporal resolution video systems may be either the existing systems or the less expensive early generation systems, with the motivation of introducing more sophisticated systems gradually. Temporal scalability involves partitioning of video frames into layers, whereas the lower layer is coded by itself to provide the basic temporal rate and the enhancement layer is coded with temporal prediction with respect to the lower layer, these layers when decoded and temporal multiplexed to yield full temporal resolution of the video source. The lower temporal resolution systems may only decode the lower layer to provide basic temporal resolution, whereas more sophisticated systems of the future may decode both layers and provide high temporal resolution video while maintaining interworking with earlier generation systems. An additional advantage of temporal scalability is its ability to provide resilience to transmission errors as the more important data of the lower layer can be sent over channel with better error performance, while the less critical enhancement layer can be sent over a channel with poor error performance.

Intro. 4.2.4 Data partitioning extension

Data partitioning is a tool intended for use when two channels are available for transmission and/or storage of a video bitstream, as may be the case in ATM networks, terrestrial broadcast, magnetic media, etc. The bitstream is partitioned between these channels such that more critical parts of the bitstream (such as headers, motion vectors, low frequency DCT coefficients) are transmitted in the channel with the better error performance, and less critical data (such as higher frequency DCT coefficients) is transmitted in the channel with poor error performance. Thus, degradation to channel errors are minimized since the critical parts of a bitstream are better protected. Data from neither channel may be decoded on a decoder that is not intended for decoding data partitioned bitstreams.

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**INTERNATIONAL STANDARD
ITU-T RECOMMENDATION**

**Information technology – Generic coding of moving
pictures and associated audio information: Video**

1 Scope

This Recommendation | International Standard specifies the coded representation of picture information for digital storage media and digital video communication and specifies the decoding process. The representation supports constant bit rate transmission, variable bit rate transmission, random access, channel hopping, scalable decoding, bitstream editing, as well as special functions such as fast forward playback, fast reverse playback, slow motion, pause and still pictures. This Recommendation | International Standard is forward compatible with ISO/IEC 11172-2 and upward or downward compatible with EDTV, HDTV, SDTV formats.

This Recommendation | International Standard is primarily applicable to digital storage media, video broadcast and communication. The storage media may be directly connected to the decoder, or via communications means such as busses, LANs, or telecommunications links.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of ITU maintains a list of currently valid ITU-T Recommendations.

- IEC 60461 (1986), *Time and control code for video tape recorders*.
- 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 23002-1:2006, *Information technology – MPEG video technologies – Part 1: Accuracy requirements for implementation of integer-output 8x8 inverse discrete cosine transform*.
- Recommendation ITU-R BT.470-6 (1998), *Conventional television systems*.
- Recommendation ITU-R BT.601-7 (2011), *Studio encoding parameters of digital television for standard 4:3 and wide screen 16:9 aspect ratios*.
- Recommendation ITU-T H.320 (2004), *Narrow-band visual telephone systems and terminal equipment*.

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

- 3.1 AC coefficient:** Any DCT coefficient for which the frequency in one or both dimensions is non-zero.
- 3.2 big picture:** A coded picture that would cause VBV buffer underflow as defined in C.7. Big pictures can only occur in sequences where `low_delay` is equal to 1. "Skipped picture" is a term that is sometimes used to describe the same concept.
- 3.3 B-field picture:** A field structure B-picture.
- 3.4 B-frame picture:** A frame structure B-picture.
- 3.5 B-picture; bidirectionally predictive-coded picture:** A picture that is coded using motion compensated prediction from past and/or future reference fields or frames.
- 3.6 backward compatibility:** A newer coding standard is backward compatible with an older coding standard if decoders designed to operate with the older coding standard are able to continue to operate by decoding all or part of a bitstream produced according to the newer coding standard.

- 3.7 backward motion vector:** A motion vector that is used for motion compensation from a reference frame or reference field at a later time in display order.
- 3.8 backward prediction:** Prediction from the future reference frame (field).
- 3.9 base layer:** First, independently decodable layer of a scalable hierarchy.
- 3.10 bitstream; stream:** An ordered series of bits that forms the coded representation of the data.
- 3.11 bit rate:** The rate at which the coded bitstream is delivered from the storage medium to the input of a decoder.
- 3.12 block:** An 8-row by 8-column matrix of samples, or 64 DCT coefficients (source, quantized or de-quantized).
- 3.13 bottom field:** One of two fields that comprise a frame. Each line of a bottom field is spatially located immediately below the corresponding line of the top field.
- 3.14 byte aligned:** A bit in a coded bitstream is byte-aligned if its position is a multiple of 8 bits from the first bit in the stream.
- 3.15 byte:** Sequence of 8 bits.
- 3.16 channel:** A digital medium that stores or transports a bitstream constructed according to Rec. ITU-T H.262 | ISO/IEC 13818-2.
- 3.17 chrominance format:** Defines the number of chrominance blocks in a macroblock.
- 3.18 chroma simulcast:** A type of scalability (which is a subset of SNR scalability) where the enhancement layer(s) contain only coded refinement data for the DC coefficients, and all the data for the AC coefficients, of the chrominance components.
- 3.19 chrominance component:** A matrix, block or single sample representing one of the two colour difference signals related to the primary colours in the manner defined in the bitstream. The symbols used for the chrominance signals are Cr and Cb.
- 3.20 coded B-frame:** A B-frame picture or a pair of B-field pictures.
- 3.21 coded frame:** A coded frame is a coded I-frame, a coded P-frame or a coded B-frame.
- 3.22 coded I-frame:** An I-frame picture or a pair of field pictures, where the first field picture is an I-picture and the second field picture is an I-picture or a P-picture.
- 3.23 coded P-frame:** A P-frame picture or a pair of P-field pictures.
- 3.24 coded picture:** A coded picture is made of a picture header, the optional extensions immediately following it, and the following picture data. A coded picture may be a coded frame or a coded field.
- 3.25 coded video bitstream:** A coded representation of a series of one or more pictures as defined in Rec. ITU-T H.262 | ISO/IEC 13818-2.
- 3.26 coded order:** The order in which the pictures are transmitted and decoded. This order is not necessarily the same as the display order.
- 3.27 coded representation:** A data element as represented in its encoded form.
- 3.28 coding parameters:** The set of user-definable parameters that characterize a coded video bitstream. Bitstreams are characterized by coding parameters. Decoders are characterized by the bitstreams that they are capable of decoding.
- 3.29 component:** A matrix, block or single sample from one of the three matrices (luminance and two chrominance) that make up a picture.
- 3.30 compression:** Reduction in the number of bits used to represent an item of data.
- 3.31 constant bit rate coded video:** A coded video bitstream with a constant bit rate.
- 3.32 constant bit rate:** Operation where the bit rate is constant from start to finish of the coded bitstream.
- 3.33 data element:** An item of data as represented before encoding and after decoding.
- 3.34 data partitioning:** A method for dividing a bitstream into two separate bitstreams for error resilience purposes. The two bitstreams have to be recombined before decoding.
- 3.35 D-picture:** A type of picture that shall not be used except in ISO/IEC 11172-2.
- 3.36 DC coefficient:** The DCT coefficient for which the frequency is zero in both dimensions.
- 3.37 DCT coefficient:** The amplitude of a specific cosine basis function.

- 3.38 decoder input buffer:** The First-In First-Out (FIFO) buffer specified in the video buffering verifier.
- 3.39 decoder:** An embodiment of a decoding process.
- 3.40 decoding (process):** The process defined in Rec. ITU-T H.262 | ISO/IEC 13818-2 that reads an input coded bitstream and produces decoded pictures.
- 3.41 dequantization:** The process of rescaling the quantized DCT coefficients after their representation in the bitstream has been decoded and before they are presented to the inverse DCT.
- 3.42 digital storage media (DSM):** A digital storage or transmission device or system.
- 3.43 discrete cosine transform (DCT):** Either the forward discrete cosine transform or the inverse discrete cosine transform. The DCT is an invertible, discrete orthogonal transformation. The inverse DCT is defined in Annex A of Rec. ITU-T H.262 | ISO/IEC 13818-2.
- 3.44 display aspect ratio:** The ratio of height divided by width (in spatial measurement units such as centimetres) of the intended display.
- 3.45 display order:** The order in which the decoded pictures are displayed. Normally this is the same order in which they were presented at the input of the encoder.
- 3.46 display process:** The (non-normative) process by which reconstructed frames are displayed.
- 3.47 dual-prime prediction:** A prediction mode in which two forward field-based predictions are averaged. The predicted block size is 16×16 luminance samples.
- 3.48 editing:** The process by which one or more coded bitstreams are manipulated to produce a new coded bitstream. Conforming edited bitstreams must meet the requirements defined in Rec. ITU-T H.262 | ISO/IEC 13818-2.
- 3.49 encoder:** An embodiment of an encoding process.
- 3.50 encoding (process):** A process, not specified in Rec. ITU-T H.262 | ISO/IEC 13818-2, that reads a stream of input pictures and produces a valid coded bitstream as defined in Rec. ITU-T H.262 | ISO/IEC 13818-2.
- 3.51 enhancement layer:** A relative reference to a layer (above the base layer) in a scalable hierarchy. For all forms of scalability, its decoding process can be described by reference to the lower layer decoding process and the appropriate additional decoding process for the enhancement layer itself.
- 3.52 fast forward playback:** The process of displaying a sequence, or parts of a sequence, of pictures in display-order faster than real-time.
- 3.53 fast reverse playback:** The process of displaying the picture sequence in the reverse of display order faster than real-time.
- 3.54 field:** For an interlaced video signal, a "field" is the assembly of alternate lines of a frame. Therefore an interlaced frame is composed of two fields, a top field and a bottom field.
- 3.55 field-based prediction:** A prediction mode using only one field of the reference frame. The predicted block size is 16×16 luminance samples.
- 3.56 field period:** The reciprocal of twice the frame rate.
- 3.57 field picture; field structure picture:** A field structure picture is a coded picture with picture_structure is equal to "Top field" or "Bottom field".
- 3.58 flag:** A one bit integer variable which may take one of only two values (zero and one).
- 3.59 forbidden:** The term "forbidden" when used in the clauses defining the coded bitstream indicates that the value shall never be used. This is usually to avoid emulation of start codes.
- 3.60 forced updating:** The process by which macroblocks are intra-coded from time-to-time to ensure that mismatch errors between the inverse DCT processes in encoders and decoders cannot build up excessively.
- 3.61 forward compatibility:** A newer coding standard is forward compatible with an older coding standard if decoders designed to operate with the newer coding standard are able to decode bitstreams of the older coding standard.
- 3.62 forward motion vector:** A motion vector that is used for motion compensation from a reference frame or reference field at an earlier time in display order.
- 3.63 forward prediction:** Prediction from the past reference frame (field).

- 3.64 frame:** A frame contains lines of spatial information of a video signal. For progressive video, these lines contain samples starting from one time instant and continuing through successive lines to the bottom of the frame. For interlaced video, a frame consists of two fields, a top field and a bottom field. One of these fields will commence one field period later than the other.
- 3.65 frame-based prediction:** A prediction mode using both fields of the reference frame.
- 3.66 frame period:** The reciprocal of the frame rate.
- 3.67 frame picture; frame structure picture:** A frame structure picture is a coded picture with picture_structure is equal to "Frame".
- 3.68 frame rate:** The rate at which frames are output from the decoding process.
- 3.69 future reference frame (field):** A future reference frame (field) is a reference frame (field) that occurs at a later time than the current picture in display order.
- 3.70 frame re-ordering:** The process of re-ordering the reconstructed frames when the coded order is different from the display order. Frame re-ordering occurs when B-frames are present in a bitstream. There is no frame re-ordering when decoding low delay bitstreams.
- 3.71 group of pictures:** A notion defined only in ISO/IEC 11172-2 (MPEG-1 Video). In Rec. ITU-T H.262 | ISO/IEC 13818-2, a similar functionality can be achieved by means of inserting group of pictures headers.
- 3.72 header:** A block of data in the coded bitstream containing the coded representation of a number of data elements pertaining to the coded data that follow the header in the bitstream.
- 3.73 hybrid scalability:** Hybrid scalability is the combination of two (or more) types of scalability.
- 3.74 interlace:** The property of conventional television frames where alternating lines of the frame represent different instances in time. In an interlaced frame, one of the fields is meant to be displayed first. This field is called the first field. The first field can be the top field or the bottom field of the frame.
- 3.75 I-field picture:** A field structure I-picture.
- 3.76 I-frame picture:** A frame structure I-picture.
- 3.77 I-picture; intra-coded picture:** A picture coded using information only from itself.
- 3.78 intra coding:** Coding of a macroblock or picture that uses information only from that macroblock or picture.
- 3.78.1 Inverse DCT, IDCT:** Inverse discrete cosine transform, as defined in Annex A.
- 3.79 level:** A defined set of constraints on the values which may be taken by the parameters of Rec. ITU-T H.262 | ISO/IEC 13818-2 within a particular profile. A profile may contain one or more levels. In a different context, level is the absolute value of a non-zero coefficient (see "run").
- 3.80 layer:** In a scalable hierarchy denotes one out of the ordered set of bitstreams and (the result of) its associated decoding process (implicitly including decoding of **all** layers below this layer).
- 3.81 layer bitstream:** A single bitstream associated to a specific layer (always used in conjunction with layer qualifiers, e. g. "enhancement layer bitstream").
- 3.82 lower layer:** A relative reference to the layer immediately below a given enhancement layer (implicitly including decoding of **all** layers below this enhancement layer).
- 3.83 luminance component:** A matrix, block or single sample representing a monochrome representation of the signal and related to the primary colours in the manner defined in the bitstream. The symbol used for luminance is Y.
- 3.84 Mbit:** 1 000 000 bits.
- 3.85 macroblock:** The four 8 by 8 blocks of luminance data and the two (for 4:2:0 chrominance format), four (for 4:2:2 chrominance format) or eight (for 4:4:4 chrominance format) corresponding 8 by 8 blocks of chrominance data coming from a 16 by 16 section of the luminance component of the picture. Macroblock is sometimes used to refer to the sample data and sometimes to the coded representation of the sample values and other data elements defined in the macroblock header of the syntax defined in Rec. ITU-T H.262 | ISO/IEC 13818-2. The usage is clear from the context.
- 3.86 motion compensation:** The use of motion vectors to improve the efficiency of the prediction of sample values. The prediction uses motion vectors to provide offsets into the past and/or future reference frames or reference fields containing previously decoded sample values that are used to form the prediction error.
- 3.87 motion estimation:** The process of estimating motion vectors during the encoding process.