Technical Report

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Information technology — JPEG Systems —

Part 9: JPEG extensions mechanisms to facilitate forwards and backwards compatibility

Technologies de l'information — Systèmes JPEG —

Partie 9: Mécanismes d'extension JPEG pour faciliter la compatibilité ascendante et descendante

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A list of all parts in the ISO/IEC 19566 series can be found on the ISO and IEC websites.

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Introduction

This document collects guiding principles on how standards discussed in ISO/IEC TR 19566-1 provide mechanisms for forwards compatibility, so called extension mechanisms, both on the basis of the codestream and the file format and lists specific implementations of these guiding principles in particular standards.

The purpose of this document is to provide documentation on these principles for the preparation of future extensions of these standards, and to ensure consistency of extension principles amongst standards.

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Information technology — JPEG Systems —

Part 9: JPEG extensions mechanisms to facilitate forwards and backwards compatibility

1 Scope

This document summarizes mechanisms by which existing file formats and codestreams, such as those specified in ISO/IEC TR 19566-1, can be extended in a forward and backward-compatible way.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Rec. ITU-T T.800 | ISO/IEC 15444-1, *Information technology — JPEG 2000 image coding system — Part 1: Core coding system*

Rec. ITU-T T.801 | ISO/IEC 15444-2, *Information technology — JPEG 2000 image coding system — Part 2: Extensions*

Rec. ITU-T T.802 | ISO/IEC 15444-3, *Information technology — JPEG 2000 image coding system — Part 3: Motion JPEG 2000*

ISO/IEC 18181-1, *Information technology — JPEG XL image coding system — Part 1: Core coding system*

ISO/IEC TR 19566-1, *Information technology — JPEG Systems — Part 1: Packaging of information using codestreams and file formats*

ISO/IEC 21122-1, *Information technology — JPEG XS low-latency lightweight image coding system — Part 1: Core coding system*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in Rec. ITU-T T.800 | ISO/IEC 15444-1, Rec. ITU-T T.801 | ISO/IEC 15444-2, Rec. ITU-T T.802 | ISO/IEC 15444-3, ISO/IEC 18181-1, ISO/IEC TR 19566-1, ISO/IEC 21122-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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3.1.1
codestream
compressed image data representation which includes all necessary data to allow a (full or approximate) reconstruction of the sample values of a digital image, which can require additional data to define the interpretation of the sample data, such as colour space or the spatial dimensions of the samples

3.1.2
file format
encapsulation of a *codestream* (3.1.1) in a file, that is in a form that allows random access from a file system of a computer system, along with additional metadata that define the interpretation of the samples reconstructed by the codestream within

3.1.3
encoder
embodiment of an encoding process, which takes digital source image data and encoder specifications as input and, by means of a specified set of procedures, generates *a codestream* (3.1.1) or a file as output

3.1.4
data producer
encoder generating *file formats* (3.1.2)

3.1.5
decoder
embodiment of a *decoding process*, which takes a *codestream* or a *file* as input and, by means of a specified set of procedures, generates *digital reconstructed image data* as output

3.1.6
data consumer
decoder capable of parsing file formats

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3.1.7
forward compatibility
design principle allowing future extensions in existing codestreams or files

3.1.8
backward compatibility
design principle for extensions which allows existing decoders to successfully reconstruct data (i.e. images) from extended codestreams and files, albeit some information embedded in these codestreams or files are potentially not be fully accessible to them

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3.2 Abbreviated terms

ID	Identifier
JP2	JPEG 2000 file format
JPEG	Joint Photographic Experts Group
JPIP	JPEG 2000 Interactive Protocol
XML	Extensible Markup Language

4 Conventions - Operators

NOTE Many of the operators used in this document are similar to those used in the C programming language.

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4.1 Arithmetic operators

+	Addition
–	Subtraction (as a binary operator) or negation (as a unary prefix operator)
*	Multiplication
/	Division without truncation or rounding.
smod	x smod a is the unique value y between $-\lceil (a-1)/2 \rceil$ and $\lfloor (a-1)/2 \rfloor$ for which y+Na = x with a suitable integer N.
umod	x mod a is the unique value y between 0 and a-1 for which y+Na = y with a suitable integer N.

4.2 Logical operators

||	Logical OR
&&	Logical AND
!	Logical NOT
∈	x ∈ {A, B} is defined as (x == A || x == B)
∉	x ∉ {A, B} is defined as (x != A && x != B)

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4.3 Relational operators

>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to
==	Equal to
!=	Not equal to

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4.4 Precedence order of operators

Operators are listed below in descending order of precedence. If several operators appear in the same line, they have equal precedence. When several operators of equal precedence appear at the same level in an expression, evaluation proceeds according to the associativity of the operator, either from right to left or from left to right.

Operators	Type of operation	Associativity
(), [ ], .	Expression	Left to Right
–	Unary negation	
*, /	Multiplication	Left to Right
umod, smod	Modulo (remainder)	Left to Right
+, –	Addition and Subtraction	Left to Right
< , >, <=, >=	Relational	Left to Right

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4.5 Mathematical functions

$\lceil x \rceil$	Ceil of x. Returns the smallest integer that is greater than or equal to x.
$\lfloor x \rfloor$	Floor of x. Returns the largest integer that is lesser than or equal to x.
$\lvert x \rvert$	Absolute value, is –x for x < 0, otherwise x.
sign(x)	Sign of x, zero if x is zero, +1 if x is positive, -1 if x is negative.
clamp(x,min,max)	Clamps x to the range [min,max]: returns min if x < min, max if x > max or otherwise x.
power(x,a)	Raises the value of x to the power of a. x is a non-negative real number, a is a real number. Power(x,a) is equal to exp(a×log(x)) where exp is the exponential function and log() the natural logarithm. If x is zero and a is positive, power(x,a) is defined to be zero.

5 General extensions mechanisms

5.1 General

This clause lists general best practices for cross-standard extensions mechanism on the codestream and on the file format level.

5.2 Extensions mechanisms for codestreams

As specified in ISO/IEC TR 19566-1, codestreams consist of multiple markers and marker segments. While markers stand alone, marker segments include a size and following data that allow readers of such codestreams to skip over data they do not intend to interpret or do not understand.

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Generally, the following two types of marker segments are present:

— A *capability marker segment* that allows registrations of future extensions. Such a marker segment allows a reader of a particular codestream to identify which extensions are required for a successful decode, and to abort decoding if it cannot provide the required extensions. That is, capability marker segments provide *early-out* conditions to decoders.

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— Purely informative *comment marker segments* that contain additional information a decoder can safely skip over without compromising the decoding process, but that can be informative to the user of the media reconstructed by the codestream. Such marker sequences can, for example, embed information on the software used to create the codestream. A decoder can potentially use this information to enable workarounds for known vendor-specific defects or display such information upon request of its user.

— Comment markers can be further classified into vendor-specific information, and vendor neutral information.

Marker sequences often contain bit-fields that enable or disable particular functionalities of a decoder. As the size of such bit fields is often aligned to multiples of 8 bits, a particular edition of a standard will not always not require all such bits. Unused bits are reserved for future use by ITU-T/ISO/IEC purposes, and require encoders to write them as 0. Depending on application, decoders can be either required to abort on bits that are defined as reserved or ignore them. It can be advisable to reserve one bit (e.g. the topmost bit of such a bit field) to extend the size of the bit field in future generations of a standard.

The same bitfield can be defined within multiple parts of a series of standards, with some bits only applicable to a specific part of a standard. It is advisable that those bits within the bitfield that are not used within a particular standard are marked as “Reserved for ISO/IEC purposes”, and that their default values are selected as 0 such that an encoder conforming to a part of a standard series writes them as 0 without compromising the codestream for decoders that support multiple parts of the same series.

The following example lists a bitfield whose topmost bit is used to signal a syntax extension whose origin is signalled by bits 2 and 3, if it is set, and which is 0 if base signalling is used. For base signalling, bits 6 to 2

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