
**Information technology — JPEG 2000
image coding system: Extensions**

*Technologies de l'information — Système de codage d'image
JPEG 2000: Extensions*

Withdrawn

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

Withdrawn

© ISO/IEC 2004

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

CONTENTS

	<i>Page</i>
1 Scope	1
2 References	1
2.1 Identical Recommendations International Standards	1
2.2 Additional references	2
3 Definitions	3
4 Abbreviations	4
5 Symbols	4
6 General description	5
6.1 Extensions specified by this Recommendation International Standard	5
6.1.1 Syntax	5
6.1.2 Variable DC offset	5
6.1.3 Variable scalar quantization	5
6.1.4 Trellis coded quantization	5
6.1.5 Visual masking	5
6.1.6 Arbitrary decomposition	5
6.1.7 Arbitrary wavelet transformation	6
6.1.8 Single sample overlap discrete wavelet transformations	6
6.1.9 Multiple component transformations	6
6.1.10 Non-linear transformation	6
6.1.11 Region of interest	6
6.1.12 File format	6
6.1.13 Metadata definitions	6
6.2 Relation between extensions	7
Annex A – Compressed data syntax, extension	8
A.1 Extended capabilities	8
A.2 Extensions to ITU-T Rec. T.800 ISO/IEC 15444-1 marker segment parameters	8
A.2.1 Image and tile size (SIZ), extended	9
A.2.2 Start of tile-part (SOT) extended	9
A.2.3 Coding style (COD, COC), extended	10
A.2.4 Quantization (QCD, QCC), extended	12
A.2.5 Region of interest (RGN), extended	14
A.3 Extended marker segments	15
A.3.1 Variable DC offset (DCO)	15
A.3.2 Visual masking (VMS)	16
A.3.3 Downsampling factor styles (DFS)	17
A.3.4 Arbitrary decomposition styles (ADS)	18
A.3.5 Arbitrary transformation kernels (ATK)	19
A.3.6 Component bit depth definition (CBD)	21
A.3.7 Multiple component transformation definition (MCT)	22
A.3.8 Multiple component transform collection (MCC)	23
A.3.9 Multiple component transform ordering (MCO)	26
A.3.10 Non-linearity point transformation (NLT)	27
A.3.11 Quantization default, precinct (QPD)	29
A.3.12 Quantization precinct component (QPC)	30
Annex B – Variable DC offset, extension	33
B.1 Variable DC offset flow	33
B.2 Inverse DC offset	33
B.3 Forward DC offset (informative)	33
Annex C – Variable scalar quantization, extension	35
C.1 Variable scalar quantization	35
C.2 Variable scalar dequantization for irreversible filters	35
C.3 Variable scalar quantization for irreversible filters (informative)	36

	<i>Page</i>
Annex D – Trellis coded quantization extensions	37
D.1 Introduction to TCQ.....	37
D.2 Sequence definition	39
D.3 Forward TCQ quantization (informative)	39
D.4 Inverse quantization (normative)	41
D.4.1 Full TCQ dequantization.....	41
D.4.2 Approximate dequantization	43
D.5 Lagrangian rate allocation (informative).....	44
Annex E – Visual masking, extensions.....	49
E.1 Introduction to visual masking (informative).....	49
E.2 Point-wise extended non-linearity (informative).....	49
E.3 Decoding with visual masking	51
E.4 Encoding with visual masking (informative)	52
E.5 Setting parameters (informative).....	52
E.6 Compatibility with other technologies (informative).....	53
Annex F – Arbitrary decomposition of tile-components, extensions.....	54
F.1 Wavelet sub-bands	54
F.1.1 Tier 1: Number of decomposition levels.....	54
F.1.2 Tier 2: Resolution formation.....	54
F.1.3 Tier 3: Sub-level decompositions.....	54
F.1.4 Tier 4: Horizontal and vertical splits to variable sub-level depths.....	54
F.1.5 Complete sub-band notation	55
F.1.6 HorOrient, VerOrient and PrimeOrient sub-band operators	55
F.2 Equation, text and decomposition updates.....	55
F.2.1 Updates to N_{LL} references	56
F.2.2 Context updates.....	56
F.2.3 Extension to ITU-T Rec. T.800 ISO/IEC 15444-1 Equation B-14.....	56
F.2.4 Remaining updates.....	57
F.2.5 Updates to decomposition structure	61
F.3 Inverse discrete wavelet transformation for general decompositions.....	66
F.3.1 Modified IDWT procedure.....	67
F.3.2 Modified 2D_SR procedure.....	68
F.3.3 Modified 2D_INTERLEAVE procedure	69
F.4 Forward discrete wavelet transformation for general decompositions (informative).....	73
F.4.1 Modified FDWT procedure.....	73
F.4.2 Modified 2D_SD procedure.....	74
F.4.3 Modified 2D_DEINTERLEAVE procedure	75
Annex G – Whole-sample symmetric transformation of images, extensions	80
G.1 Wavelet transformation parameters, definitions and normalizations	80
G.2 Whole-sample symmetric (WS) wavelet transformations reconstruction	80
G.2.1 Normalization of WS wavelet transformations	80
G.2.2 One-dimensional sub-band reconstruction procedure for WS wavelet transformations.....	81
G.3 Whole-sample symmetric (WS) wavelet transformation decomposition (informative).....	84
G.3.1 The 1D_SD_WS procedure (informative)	84
G.3.2 The 1D_FILTD_WS one-dimensional decomposition procedure (informative)	84
G.4 Examples of WS wavelet transformations (informative)	86
G.4.1 Reversible WS wavelet transformations ($WT_Typ = REV$) (informative)	86
G.4.2 Irreversible WS wavelet transformations ($WT_Typ = IRR$) (informative).....	87
Annex H – Transformation of images using arbitrary wavelet transformations.....	89
H.1 Wavelet transformation parameters and normalizations	89
H.1.1 Normalization of ARB wavelet transformations.....	89
H.1.2 Compatibility of ARB and WS wavelet transformations	89

	<i>Page</i>	
H.2	Arbitrary (ARB) wavelet transformation reconstruction procedures	90
H.2.1	The extended 1D_SR_ARB procedure	90
H.2.2	The 1D_SCALER procedure	91
H.2.3	The 1D_STEPR procedure.....	92
H.2.4	Extension procedures	92
H.2.5	One-dimensional reconstruction update filtering procedures.....	94
H.3	Arbitrary (ARB) wavelet transformation decomposition procedures (informative)	95
H.3.1	Extended 1D_SD_ARB procedure (informative)	95
H.3.2	The 1D_STEPR procedure (informative)	96
H.3.3	Extension procedures (informative).....	97
H.3.4	One-dimensional decomposition update procedures (informative).....	97
H.3.5	1D_SCALED procedure (informative)	98
H.4	Examples of ARB wavelet transformations (informative).....	99
H.4.1	Examples of arbitrary wavelet transformations (Filt_Cat = ARB) (informative)	99
H.4.2	Example of a structure for lifting implementation of half-sample symmetric wavelet transformations (informative)	101
Annex I – Single sample overlap discrete wavelet transform, extensions	103	
I.1	Introduction to single sample overlapping	103
I.2	The code-block anchor points (CBAP) extension	103
I.2.1	Division of resolution levels in precincts	103
I.2.2	Division of the sub-bands into codeblocks.....	104
I.2.3	Resolution level-position-component-layer progression.....	105
I.2.4	Position-component-resolution level-layer progression.....	106
I.2.5	Component-position-resolution level-layer progression.....	106
I.3	The SSO extension.....	107
I.3.1	Single sample overlap inverse discrete wavelet transformation (SSO-IDWT)	107
I.3.2	Single sample overlap forward discrete wavelet transformation (informative)	110
I.3.3	Selection of single sample overlap parameters (informative)	112
I.3.4	SSO examples (informative).....	113
I.4	The TSSO extension	115
I.4.1	Signalling for the TSSO	115
I.4.2	Partitioning of the image into single-sample overlapping tiles	115
I.4.3	Reconstruction of images samples from reconstructed tiles	116
I.5	Combining the SSO and TSSO extensions (informative).....	116
Annex J – Multiple component transformations, extension.....	117	
J.1	Introduction to multiple component transformation concepts.....	117
J.2	Overview of inverse processing	117
J.2.1	Inverse multiple component transformation (MCO_TRANSFORM).....	118
J.2.2	Multiple component transformation stage (MCC_TRANS)	119
J.2.3	Transformation component collection (CC_TRANS).....	121
J.3	Transformations	123
J.3.1	Array-based transforms	124
J.3.2	Wavelet-based transformation.....	132
Annex K – Non-linear transformation	134	
K.1	Signalling the use of the non-linear transformations.....	134
K.1.1	Decoded component reconstruction	134
K.1.2	Bit depth and interaction with the multiple component transformation	134
K.1.3	Marker interpretation	135
K.2	Non-linear transformation specifications	135
K.2.1	Gamma-style non-linearity.....	135
K.2.2	LUT-style reverse non-linearity transformation.....	137
Annex L – Region of interest coding and extraction, extensions.....	139	
L.1	Decoding of ROI	139
L.2	Description of the Scaling based method	139
L.2.1	Encoding with ROI (informative)	139

	<i>Page</i>
L.3 Region of interest mask generation.....	140
L.3.1 Rectangular mask generation on the reference grid.....	141
L.3.2 Elliptic mask generation on the reference grid.....	141
L.3.3 Region of Interest mask generation of whole-sample symmetric filter banks.....	142
L.3.4 Region of Interest mask generation of arbitrary optional filter banks.....	142
L.3.5 Fast generation of a rectangular mask (informative).....	143
L.4 Remarks on region of interest coding.....	145
L.4.1 Usage together with Maxshift method described in ITU-T T.800 ISO/IEC 15444-1.....	145
L.4.2 Multi-component remark (informative).....	145
L.4.3 Implementation Precision remark (informative).....	145
Annex M – JPX extended file format syntax.....	146
M.1 File format scope.....	146
M.2 Introduction to JPX.....	146
M.2.1 File identification.....	146
M.2.2 File organization.....	146
M.2.3 Greyscale/Colour/multi-component specification.....	147
M.2.4 Specification of opacity information.....	147
M.2.5 Metadata.....	147
M.2.6 Storage of a codestream within JPX.....	147
M.2.7 Combining multiple codestreams.....	147
M.3 Greyscale/Colour/Palette/multi-component specification architecture.....	148
M.3.1 Extensions to the Colour Specification box header.....	148
M.3.2 Extensions to the Enumerated method.....	148
M.3.3 Any ICC method.....	148
M.3.4 Vendor Colour method.....	148
M.3.5 Palettized colour.....	149
M.3.6 Using multiple methods.....	149
M.3.7 Interactions with the decorrelating multiple component transformation.....	149
M.4 Fragmenting the codestream between one or more files.....	149
M.5 Combining multiple codestreams.....	151
M.5.1 Mapping codestreams to compositing layers.....	151
M.5.2 Sharing header and metadata information between codestreams and compositing layers.....	152
M.5.3 Composition.....	152
M.6 Using reader requirements masks to determine how a file can be used.....	154
M.6.1 Types of expressions.....	155
M.6.2 Expression representation.....	155
M.6.3 Testing an Implementation against Requirements Expressions.....	160
M.7 Extensions to the JPX file format and the registration of extensions.....	161
M.7.1 Registration elements.....	161
M.7.2 Differentiation between publication and registration.....	162
M.7.3 Items which can be extended by registration.....	162
M.7.4 Published items.....	164
M.7.5 Registration process.....	165
M.7.6 Timeframes for the registration process.....	165
M.8 Differences from the JP2 binary definition.....	165
M.9 Conformance.....	166
M.9.1 Interpretation of JPX data structures.....	166
M.9.2 Support for JPX feature set.....	166
M.10 Key to graphical descriptions (informative).....	168
M.11 Defined boxes.....	168
M.11.1 Reader Requirements box.....	171
M.11.2 Data Reference box.....	174
M.11.3 Fragment Table box (superbox).....	174
M.11.4 Cross-Reference box.....	175
M.11.5 JP2 Header box (superbox).....	176
M.11.6 Codestream Header box (superbox).....	178
M.11.7 Compositing Layer Header box (superbox).....	179
M.11.8 Contiguous Codestream box.....	190
M.11.9 Media Data box.....	191

	<i>Page</i>
M.11.10 Composition box (superbox).....	191
M.11.11 Association box (superbox).....	194
M.11.12 Number List box	196
M.11.13 Label box	197
M.11.14 Binary Filter box	197
M.11.15 Desired Reproductions box (superbox).....	198
M.11.16 ROI Description box	199
M.11.17 Digital Signature box	200
M.11.18 XML box	202
M.11.19 MPEG-7 Binary box	203
M.11.20 Free box	203
M.12 Dealing with unknown boxes.....	203
M.13 Using the JPX file format in conjunction with other multi-media standards (informative).....	203
Annex N – JPX file format extended metadata definition and syntax	204
N.1 Introduction to extended metadata	204
N.2 Additional references for extended metadata	204
N.3 Scope of metadata definitions	204
N.3.1 Image Creation metadata.....	205
N.3.2 Content Description metadata	205
N.3.3 History metadata	205
N.3.4 Intellectual Property Rights metadata	205
N.3.5 Fundamental metadata types and elements.....	205
N.4 Metadata syntax	205
N.4.1 Metadata schema definition language.....	205
N.4.2 Namespace	205
N.4.3 Document type definition information.....	206
N.4.4 XML Schema information	206
N.5 Defined boxes	206
N.5.1 Image Creation metadata box.....	206
N.5.2 Content Description metadata box	207
N.5.3 History box.....	207
N.5.4 Intellectual Property Rights box.....	208
N.5.5 Image Identifier box.....	208
N.6 Metadata definitions.....	208
N.6.1 Image Creation metadata.....	209
N.6.2 Content Description metadata	220
N.6.3 History metadata	226
N.6.4 Intellectual Property Rights metadata	229
N.6.5 Image Identifier metadata	236
N.7 Fundamental type and element definitions.....	237
N.7.1 Defined types	237
N.7.2 Defined attributes.....	254
N.7.3 Defined elements.....	255
N.8 JPX extended metadata document type definition	255
N.9 JPX extended metadata XML Schema.....	265
Annex O – Examples and guidelines, extensions	281
O.1 Arbitrary decomposition examples	281
O.2 Odd Tile Low Pass First (OTLPPF) convention	303
O.2.1 Example one (even tile sizes).....	304
O.2.2 Example two (odd tile sizes).....	304
O.2.3 Example three (TSSO/OTLPPF).....	304
O.3 Multiple component collection example	305
O.3.1 Array-based multiple component transform example	305
O.3.2 Unitary decorrelation transformation factorization and reversible decorrelation transformation.....	311
O.3.3 Dependency transformation, irreversible and reversible.....	315
O.4 Background to enhancement of quantization	317

This is a preview - [click here to buy the full publication](#)

	<i>Page</i>
Bibliography	317
Index	319
Patent statement	321

Withdrawn

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.

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.

ISO/IEC 15444-2:2004 was prepared jointly 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. T.801.

ISO/IEC 15444 consists of the following parts, under the general title *Information technology — JPEG 2000 image coding system*:

- *Part 1: Core coding system*
- *Part 2: Extensions*
- *Part 3: Motion JPEG 2000*
- *Part 4: Conformance testing*
- *Part 5: Reference software*
- *Part 6: Compound image file format*
- *Part 9: Interactivity tools, APIs and protocols*
- *Part 12: ISO base media file format*

The following parts are under preparation:

- *Part 8: Secure JPEG 2000*
- *Part 10: Extensions for three-dimensional data and floating point data*
- *Part 11: Wireless JPEG 2000*

**INTERNATIONAL STANDARD
ITU-T RECOMMENDATION****Information technology – JPEG 2000 image coding system: Extensions****1 Scope**

This Recommendation | International Standard defines a set of lossless (bit-preserving) and lossy compression methods for coding continuous-tone, bi-level, grey-scale, colour digital still images, or multi-component images.

This Recommendation | International Standard:

- specifies extended decoding processes for converting compressed image data to reconstructed image data;
- specifies an extended codestream syntax containing information for interpreting the compressed image data;
- specifies an extended file format;
- specifies a container to store image metadata;
- defines a standard set of image metadata;
- provides guidance on extended encoding processes for converting source image data to compressed image data;
- provides guidance on how to implement these processes in practice.

2 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 listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines.*
- ITU-T Recommendation T.82 (1993) | ISO/IEC 11544:1993, *Information technology – Coded representation of picture and audio information – Progressive bi-level image compression.*
- ITU-T Recommendation T.83 (1994) | ISO/IEC 10918-2:1995, *Information technology – Digital compression and coding of continuous-tone still images: Compliance testing.*
- ITU-T Recommendation T.84 (1996) | ISO/IEC 10918-3:1997, *Information technology – Digital compression and coding of continuous-tone still images: Extensions.*
- ITU-T Recommendation T.84 (1996)/Amd.1 (1999) | ISO/IEC 10918-3:1997/Amd.1:1999, *Information technology – Digital compression and coding of continuous-tone still images: Extensions – Amendment 1: Provisions to allow registration of new compression types and versions in the SPIFF header.*
- ITU-T Recommendation T.86 (1998) | ISO/IEC 10918-4:1999, *Information technology – Digital compression and coding of continuous-tone still images: Registration of JPEG Profiles, SPIFF Profiles, SPIFF Tags, SPIFF colour Spaces, APPn Markers, SPIFF Compression types and Registration Authorities (REGAUT).*
- ITU-T Recommendation T.87 (1998) | ISO/IEC 14495-1:2000, *Information technology – Lossless and near-lossless compression of continuous-tone still images – Baseline.*

ISO/IEC 15444-2:2004 (E)

- ITU-T Recommendation T.88 (2000) | ISO/IEC 14492:2001, *Information technology – Lossy/lossless coding of bi-level images.*
- ITU-T Recommendation T.800 (2002) | ISO/IEC 15444-1:2003, *Information technology – JPEG 2000 image coding system: Core coding system.*

2.2 Additional references

- ITU-T Recommendation T.42 (1996), *Continuous-tone colour representation method for facsimile.*
- ISO/IEC 8859-1:1998, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1.*
- ISO 8601:2000, *Data elements and interchange formats – Information interchange – Representation of dates and times.*
- ISO 3166-1:1997, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes.*
- ISO 3166-2:1998, *Codes for the representation of names of countries and their subdivisions – Part 2: Country subdivision code.*
- ISO/IEC 11578:1996, *Information technology – Open Systems Interconnection – Remote Procedure Call (RPC).*
- ISO/IEC 646:1991, *Information technology – ISO 7-bit coded character set for information interchange.*
- ISO 5807:1985, *Information processing – Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resources charts.*
- ISO/IEC 15938, *MPEG-7.*
- ISO 10126-2:1991, *Banking – Procedures for message encipherment (wholesale) – Part 2: DEA algorithm.*
- IEEE Standard 754-1985 R1990, *IEEE Standard for Binary Floating-Point Arithmetic.*
- IETF RFC 1321 (1992), *The MD5 Message-Digest Algorithm.*
- IETF RFC 1766 (1995), *Tags for the Identification of Languages.*
- IETF RFC 2279 (1998), *UTF-8, A transformation format of ISO 10646.*
- IETF RFC 2630 (1999), *Cryptographic Message Syntax.*
- IETF RFC 2313 (1998), *PKCS #1: RSA Encryption, Version 1.5.*
- International Color Consortium, ICC profile format specification. ICC.1.
- IEC 61966-2-1:1999, *Multimedia systems and equipment – Colour measurement and management: Part 2-1: Colour management – Default RGB colour space – sRGB, plus its Amendment 1: 2003.*
- Digital Imaging Group, Flashpix digital image file format. Version 1.0.1, 10 July 1997.
- PIMA 7666, *Photography-Electronics still picture imaging-Reference Output Medium Metric RGB Color encoding: RQMM-RGB.*
- PIMA 7667:2001, *Photography-Electronics still picture imaging-Extended sRGB color encoding e-sRGB.*
- Federal Information Processing Standard Publication (FIPS PUB) 186-2, Digital Signature Standard (DSS). <<http://www.itl.nist.gov/fipspubs/fip186-2.pdf>>
- ANSI X9.30.2-1997, *Public Key Cryptography for the Financial Services Industry – Part 2: The Secure Hash Algorithm (SHA-1).* <<http://www.itl.nist.gov/fipspubs/fip180-1.htm>>
- W3C. Extensible Markup Language (XML 1.0), 2nd edition Rec-xml-2000106, <<http://www.w3.org/TR/REC-xml>>.
- W3C. Namespaces in XML, Rec-xml-names-19990114, <<http://www.w3.org/TR/1999/REC-xml-names>>.
- W3C. XML Schema Part 1: Structures, Rec-xmldata-1-20010502, <<http://www.w3.org/TR/xmldata-1>>.
- W3C. XML Schema Part 2: Datatypes, Rec-xmldata-2-20010502, <<http://www.w3.org/TR/xmldata-2>>.