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Information technology — Digital compression and coding of continuous-tone still images —

Part 7:
Reference software

Technologies de l'information — Compression numérique et codage des images fixes à modelé continu —

Partie 7: Logiciel de référence

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Foreword

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This document was prepared by ITU-T (as ITU-T Rec T.873) and drafted in accordance with its editorial rules, in collaboration with Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This third edition cancels and replaces the second edition (ISO/IEC 10918-7:2021), which has been technically revised.

The main changes are as follows:

— update of reference software A to version 1.65 and reference software B to version 2.1.3.

A list of all parts in the ISO/IEC 10918 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

INTERNATIONAL STANDARD ISO/IEC 10918-7
RECOMMENDATION ITU-T T.873

Information technology – Digital compression and coding of continuous-tone still images: Reference software

Summary

The ISO/IEC 10918-x series establishes guidelines and specifies requirements for coding of continuous-tone still images. Rec. ITU-T T.81 | ISO/IEC 10918-1, also known under the name JPEG, specifies the codestream format and the decoding process. It is designed primarily for compression of continuous-tone photographic content.

Rec. ITU-T T.873 | ISO/IEC 10918-7 provides reference software for Rec. ITU-T T.81 | ISO/IEC 10918-1. The software has been successfully compiled and tested on Linux and Windows operating systems and conforms to the decoder requirements specified in Recommendation ITU-T T.83 | ISO/IEC 10918-2. It has also been tested for conformance to Rec. ITU-T T.86 | ISO/IEC 10918-4 and ISO/IEC 18477-4.

This third edition updates reference software A to version 1.65 and reference software B to version 2.1.3. These versions do not include any new features; they correct implementation errors and improve the overall stability of the software.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T T.873	2019-05-14	16	11.1002/1000/13915
2.0	ITU-T T.873 (V2)	2021-06-13	16	11.1002/1000/14693

Keywords

JPEG, reference software.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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Electronic attachment with two reference implementations of Rec. ITU-T T.81 | ISO/IEC 10918-1.

Introduction

Rec. ITU-T T.81 | ISO/IEC 10918-1 specifies the codestream format and the decoding process, and is designed primarily for compression of continuous-tone photographic content.

This Recommendation | International Standard provides reference software for Rec. ITU-T T.81 | ISO/IEC 10918-1. The software has been successfully compiled and tested on Linux and Windows operating systems and conforms to the decoder requirements set forth in Rec. ITU-T T.83 | ISO/IEC 10918-2. It has also been tested for conformance to Rec. ITU-T T.86 | ISO/IEC 10918-4 and ISO/IEC 18477-4.

Instructions for unpacking and building the software are found in Annexes A and C. Instructions for its use are listed in Annexes B and D.

INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – Digital compression and coding of continuous-tone still images: Reference software

1 Scope

This Specification provides reference software for the coding technology specified in Recommendation ITU-T T.81 | ISO/IEC 10918-1. While the reference implementations also provide an encoder, conformance testing of their encoding process is beyond the scope of this Specification.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. At the time of publication, the editions indicated in dated references 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.

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

3 Definitions

For the purposes of this Specification, the terms and definitions specified in Rec. ITU-T T.81 | ISO/IEC 10918-1 and the following apply.

3.1 **codestream; JPEG file**: Sequence of bytes.

3.2 **pgx format; portable graphics format**: Image format describing integer-based continuous-tone images.

NOTE – For the purposes of this Specification, the image format is as specified in Rec. ITU-T T.803 | ISO/IEC 15444-4.

3.3 **pnm format; portable any map format**: Image format describing integer-based continuous-tone images of either one or three components consisting of a header determining image dimensions and sample precision and component-interleaved image samples encoded as 8-bit or 16-bit big-endian integers.

NOTE – For a specification of the pnm format, see Bourke (1997).

3.4 **R′G′B′**: Colour space that describes a colour by three gamma-corrected coordinates relative to three colour primaries.

3.5 **upsampling**: Procedure that increases the spatial or temporal sampling rate of a time-discretely sampled signal.

3.6 **$Y'C_BC_R$**: Colour space that describes a colour by 1 luma coordinate and 2 chroma coordinates derived from a gamma-corrected R′G′B′ colour space by a linear transformation.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

DCT Discrete Cosine Transform

DNL Define Number of Lines

IDCT Inverse Discrete Cosine Transform

MCU Minimum Coded Unit

POSIX Portable Operating System Interface

5 Conventions

Text in Times New Roman provides instructions, comments or details for the reader.

Text in `Courier New` indicates program input or output as necessary to either run the software or as generated by the software on the console.

6 Reference software

6.1 Purpose

The purpose of this Specification is to provide:

– a reference decoder software capable of decoding codestreams that conform to Rec. ITU-T T.81 | ISO/IEC 10918-1;

– a sample encoder software capable of producing codestreams that conform to Rec. ITU-T T.81 | ISO/IEC 10918-1.

The use of the reference software is not required to implement an encoder or decoder in conformance to Rec. ITU-T T.81 | ISO/IEC 10918-1. Requirements established in Rec. ITU-T T.81 | ISO/IEC 10918-1 take precedence over the behaviour of the reference software.

6.2 Examples of use

Some examples of use for the reference decoder software implementations are:

– as an illustration of how to perform the decoding processes specified in Rec. ITU-T T.81 | ISO/IEC 10918-1;

– as the starting basis for the implementation of a decoder that conforms to Rec. ITU-T T.81 | ISO/IEC 10918-1;

– for (non-exhaustive) testing of the conformance of a codestream (or file) to the constraints specified in Rec. ITU-T T.81 | ISO/IEC 10918-1.

NOTE 1 – The lack of detection of any conformance violation by any reference software implementation cannot be considered as a definitive proof that the codestream under test conforms to Rec. ITU-T T.81 | ISO/IEC 10918-1.

Some examples of use for reference encoder software are as:

– an illustration of how to implement an encoding process that produces codestreams that conform to Rec. ITU-T T.81 | ISO/IEC 10918-1;

– a starting point for an implementation of an encoder that conforms to Rec. ITU-T T.81 | ISO/IEC 10918-1;

– a means of generating codestreams conforming to Rec. ITU-T T.81 | ISO/IEC 10918-1 for testing purposes;

– a means of demonstrating and evaluating examples of the quality that can be achieved by an encoding process that conforms to Rec. ITU-T T.81 | ISO/IEC 10918-1.

NOTE 2 – No guarantee of the quality that will be achieved by an encoder is provided by its conformance to Rec. ITU-T T.81 | ISO/IEC 10918-1, as the conformance is only defined in terms of specific constraints imposed on the syntax of the generated codestream and maximum tolerable errors of the discrete cosine transform (DCT) coefficients after reconstruction. In particular, while sample encoder software implementations could suffice to provide some illustrative examples of which quality can be achieved within Rec. ITU-T T.81 | ISO/IEC 10918-1, they provide neither an assurance of minimum guaranteed image encoding quality nor maximum achievable image encoding quality.

NOTE 3 – The computation resource characteristics in terms of program or data memory usage, execution speed, etc. of sample software encoder or decoder implementations cannot be construed as representative of the typical, minimal or maximal computational resource characteristics to be exhibited by implementations of some parts of Rec. ITU-T T.81 | ISO/IEC 10918-1.

6.3 General

The reference software implementations for Rec. ITU-T T.81 | ISO/IEC 10918-1 are available from ISO at https://standards.iso.org/iso-iec/10918/-7/ed-3/en and also from ITU at https://www.itu.int/rec/T-REC-T.873/en. Each of the two zip archives contains one reference software implementation.

– The file "referenceA.zip" contains a reference implementation for all processes of Rec. ITU-T T.81 | ISO/IEC 10918-1. Unpacking and compilation of this software is explained in Annex A. Guidance on how to use this software is given in Annex B.

– The file "referenceB.zip" contains a reference implementation for the baseline and extended Huffman and arithmetic coding DCT processes of Rec. ITU-T T.81 | ISO/IEC 10918-1. This software does not implement the hierarchical processes of Rec. ITU-T T.81 | ISO/IEC 10918-1. Unpacking and compilation of this software is explained in Annex C. Guidance on how to use this software is given in Annex D.