

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

T.851
(09/2005)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

ITU-T T.81 (JPEG-1)-based still-image coding using an alternative arithmetic coder

ITU-T Recommendation T.851

ITU-T Recommendation T.851

ITU-T T.81 (JPEG-1)-based still-image coding using an alternative arithmetic coder

Summary

This Recommendation defines a format for digital compression and coding of still images supporting the use of an alternative arithmetic coder called the "Q15-coder" and an alternative baseline compared to ITU-T Rec. T.81 | ISO/IEC 10918-1 (JPEG-1). Support of the Huffman entropy coding method specified in ITU-T Rec. T.81 (JPEG-1) is not required in this Recommendation.

The Q15-coder resolves the carry in the decoder instead of in the encoder, and so has a low latency compared to the QM-coder arithmetic coder incorporated in T.81, which has a potential latency of the rest of the entire entropy-coded segment.

This Recommendation also specifies a DCT with input precision of 16 bits, which is greater than the precision of the T.81 (JPEG-1) DCT.

Source

ITU-T Recommendation T.851 was approved on 13 September 2005 by ITU-T Study Group 16 (2005-2008) under the ITU-T Recommendation A.8 procedure.

Keywords

Alternative baseline, Q15-coder, still-image coding, still-image compression, still images.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. 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.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

© ITU 2005

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

CONTENTS

Page

1	Scope	1
2	References.....	1
2.1	Normative references.....	1
2.2	Informative references.....	1
3	Definitions	2
4	Abbreviations.....	2
5	Conventions	2
6	General.....	2
7	Alternative baseline	3
8	Compressed data formats.....	4
8.1	JPG extensions marker syntax.....	4
8.2	Extended DCT precision	5
8.3	Summary.....	6
9	Huffman coding	6
10	Arithmetic coders.....	6
10.1	Encoder procedures	7
10.2	Decoder procedures	11
10.3	Probability estimation.....	14
11	Encoder and decoder control procedures.....	16

Introduction

ITU-T Rec. T.81 | ISO/IEC 10918-1 (T.81) specifies a process for digital compression and coding of continuous-tone still images.

T.81 contains two entropy coders: Huffman coding and an arithmetic coder called the "QM-coder". The Huffman coding method is required in the T.81 baseline. For all other encoding processes (extended sequential, progressive, hierarchical, and lossless), the use of all defined entropy coders is allowed.

This Recommendation defines a still-image coding method based on ITU-T Rec. T.81 (JPEG-1) which makes use of an alternative arithmetic encoder called the "Q15-coder", and defines an "alternative baseline" compared to ITU-T Rec. T.81. In this Recommendation, support for Huffman coding is not required.

NOTE – Images encoded according to this Recommendation can be losslessly transcoded to or from any of the entropy coding methods of ITU-T Rec. T.81, including the baseline Huffman coding of ITU-T Rec. T.81.

All decoders which support any DCT-based process defined in Table 1 shall also be capable of decoding bitstream conforming to the alternative baseline.

Interoperability with the Huffman-based baseline of T.81 is not required by this Recommendation, but might be required by an application incorporating this Recommendation. An application specification might require a dual-mode entropy codec, or a server-based transcoding facility.

iv

ITU-T Recommendation T.851

ITU-T T.81 (JPEG-1)-based still-image coding using an alternative arithmetic coder

1 Scope

This Recommendation is applicable to continuous-tone, greyscale or colour, digital still-image data. According to the principles of ITU-T Rec. T.80, it enhances T.81 technologies by providing an additional arithmetic coder.

This Recommendation:

- defines an arithmetic coder ("Q15-coder") for use with T.81 technologies;
- extends the DCT input precision to 16 bits;
- provides an alternative baseline in which no Huffman coding is required.

The provisions of ITU-T Rec. T.81 | ISO/IEC 10918-1 shall apply to this Recommendation with the exceptions, additions, and deletions given in this Recommendation.

2 References

2.1 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- ITU-T Recommendation T.80 (1992), *Common components for image compression and communication – Basic Principles*.
- 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 (often called "JPEG-1")*.

2.2 Informative references

Additional arithmetic coding references:

- MARKS (K.M.): A JBIG-ABIC compression engine for digital document processing, *IBM J. Res. Develop.*, Vol. 42, No. 6, pp. 753-758, 1998.
- KAMPF (F.A.): Performance as a function of compression, *IBM J. Res. Develop.*, Vol. 42, No. 6, pp. 759-766, 1998.
- SLATTERY (M.S.) and MITCHELL (J.L.): The Qx-coder, *IBM J. Res. Develop.*, Vol. 42, No. 6, pp. 767-784, 1998.

3 Definitions

This Recommendation defines the following terms:

3.1 alternative baseline (sequential): A particular sequential DCT-based encoding and decoding process specified in this Recommendation.

3.2 bit stuffing: A procedure in which the arithmetic encoder inserts a bit in the next byte into the entropy-coded segment following the generation of an encoded hexadecimal X'FF' byte. This procedure replaces byte stuffing.

4 Abbreviations

This Recommendation uses the following abbreviations:

IEC International Electrotechnical Commission

ISO International Organization for Standardization

JPEG Joint Photographic Experts Group (The joint ITU-T | ISO/IEC committee responsible for developing joint text standards for continuous-tone still picture coding)

5 Conventions

In this Recommendation the following conventions are used:

- "shall" indicates a mandatory requirement.
- "should" indicates a suggested but optional course of action.
- "may" indicates an optional course of action rather than a recommendation that something take place.

For the purposes of this Recommendation, the following additional symbols apply:

a the ASCII text letter "a" (X'61')

c the ASCII text letter "c" (X'63')

JPG marker used for JPEG extensions including Q15-coding

Lj length of parameters in the JPG segment for JPEG extensions

2 the ASCII text number "2" (X'32')

6 General

The provisions of ITU-T Rec. T.81 | ISO/IEC 10918-1 shall apply to this Recommendation with the exceptions, additions, and deletions given in this Recommendation.

Every instance where an arithmetic coder is used in ITU-T Rec. T.81 | ISO/IEC 10918-1, the arithmetic coder defined in this Recommendation shall be used instead. For the purposes of this Recommendation, Table 1/T.81 | ISO/IEC 10918-1 shall be considered to be extended with the additions in Table 1 below, in which an alternative baseline and a set of alternative processes are defined.