International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

T.801

Amendment 4

(06/2012)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

Still-image compression – JPEG 2000

Information technology – JPEG 2000 image coding system: Extensions

Amendment 4: Block coder extension

Recommendation ITU-T T.801 (2002) – Amendment 4

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INTERNATIONAL STANDARD ISO/IEC 15444-2
RECOMMENDATION ITU-T T.801

Information technology – JPEG 2000 image coding system: Extensions

Amendment 4

Block coder extension

Summary

ITU-T T.801 | ISO/IEC 15444-2 specifies the enhancement of the selective arithmetic coding bypass (lazy mode) defined in ITU-T T.800 | ISO/IEC 15444-1.

The selective arithmetic coding bypass is the coding style which allows bypassing the arithmetic coder for the significance propagation (SP) pass and magnitude refinement (MR) passes starting in the 5th significant bit-plane of the code-block. The coding style default marker (COD), or the coding style component marker (COC), signals where or not this coding style is used. The first clean-up (CP) pass, which is the first bit-plane of a code-block with a non-zero element, and the next three sets of SP, MR, and CP coding passes, are decoded with the arithmetic coder. The fourth CP pass shall include an arithmetic coder termination.

Starting with the fourth SP and MR coding passes, the bits that would have been returned from the arithmetic coder are instead returned directly from the bit stream. After each MR pass, the bit stream has been "terminated" by padding to the byte boundary.

In this Amendment 4 to ITU-T T.801 | ISO/IEC 15444-2, the enhancement of the lazy mode (fast mode) is presented. The fast mode allows the flexible selection of the number of bit planes to be coded by normal coding passes. The fast mode takes advantage of the following points to speed up the coding time and maintain the compression efficiency.

1. The reduction of the number of bit planes to be coded by the SP pass and the MR pass with an arithmetic coder will contribute to the reduction of coding time.
2. The compression ratio of JPEG 2000 lossless is roughly 2 to 3, according to many experimental results. The compression possibility of the 2nd or 3rd bit plane, and after looking from the most significant bit (MSB), is very low in many cases because of its statistic feature of 50-50 distribution of binary data.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T T.801	2002-08-29	16	11.1002/1000/6123
1.1	ITU-T T.801 (2002) Cor. 3	2005-01-08	16	11.1002/1000/7458
1.2	ITU-T T.801 (2002) Amd. 2	2005-05-14	16	11.1002/1000/8498
1.3	ITU-T T.801 (2002) Cor. 4	2006-05-29	16	11.1002/1000/8814
1.4	ITU-T T.801 (2002) Amd. 4	2012-06-29	16	11.1002/1000/11678

* 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

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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.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

INTERNATIONAL STANDARD
RECOMMENDATION ITU-T

Information technology – JPEG 2000 image coding system: Extensions

Amendment 4

Block coder extension

1) Clause A.2.3 Coding style (COD, COC), extended

Insert the following text after the first line, which reads "Geometric manipulation is enabled with two bits in the Scod parameter shown in Table A.5.":

Block coder extensions are enabled with 1 bit in the Scod parameter, as shown in Table A.5. When this bit is set, the COD marker segment is extended to include a 16-bit parameter SXcod that follows SPcod as shown in Figure A.14. The meaning of SXcod is defined by Table A.49.

Figure A.1a) – Coding style default syntax

2) Clause A.2.3 Table A.5 – Coding style parameter values for the Scod parameter

Add the following lines to Table A.5:

xx0x xxxx	Block coder extensions not used
xx1x xxxx	Block coder extensions defined by SXcod

3) Clause A.3.13 Extended capabilities (CAP)

Add the following new table:

New Table A.51a) Quantization default, precinct (QPD)

Table A.51a) – Block coder extensions (see Annex P)

Values (bits) MSB LSB	Coding style
xxxx xxxx xxxx xx00	No modifications to selective arithmetic coder bypass mode.
xxxx xxxx xxxx xx01	Selective arithmetic coder bypass modified to start from the 2nd significant bit-plane if bit 0 of SPcod/SPcoc set.
xxxx xxxx xxxx xx10	Selective arithmetic coder bypass modified to start from the 3rd significant bit-plane if bit 0 of SPcod/SPcoc set.
xxxx xxxx xxxx xx11	Selective arithmetic coder bypass modified to start from the 4th significant bit-plane if bit 0 of SPcod/SPcoc set.
	All other values reserved.

4) Clause A.3.13

Clause A.3.13, insert the following text immediately before the paragraph commencing "Guidance on usage (informative)".

Table A.51b) defines Ccap values corresponding to k=2, i.e., extended capabilities that are defined in this Recommendation | International Standard.

Table A.51b) – Part parameter values for the Ccap parameter

Values (bits) MSB LSB	Part parameter
1xxx xxxx xxxx xxxx	Block coder extensions may be present, as defined in COD or COC marker segments
…. ….	…. ….
	All other values reserved

5) Clause M.11 – Defined boxes

In clause M.11.1 – Reader Requirements box, insert a new slot number "84" in Table M.14 (now M.15 – see Amd. 3) to identify block coder extension.

Table M.15 – Legal values of the SF^i field

Value	Meaning
84	Block coder extension

6) New Annex P

Add Annex P:

Annex P

Block coder extensions

(This annex forms an integral part of this Recommendation | International Standard.)

P.1 Selective arithmetic coding bypass (lazy mode)

Selective arithmetic coding bypass, as defined in clause D.6 of Rec. ITU-T T.800 | ISO/IEC 15444-1, is the coding style which allows bypassing the arithmetic coder for the significance propagation pass (SP) and magnitude refinement passes (MR) starting in the 5th significant bit-plane of the code-block. The COD or COC marker signals where or not this coding style is used.

The first clean-up pass (CP), which is the first bit-plane of a code-block with a non-zero element, and the next three sets of SP, MR, and CP coding passes are decoded with the arithmetic coder. The fourth CP pass shall include an arithmetic coder termination as shown in Table D.9 of Rec. ITU-T T.800 | ISO/IEC 15444-1.

Starting with the fourth SP and MR coding passes, the bits that would have been returned from the arithmetic coder are instead returned directly from the bit stream. After each MR pass, the bit stream has been "terminated" by padding to the byte boundary.

Table P.1 – Selective arithmetic coding bypass (default);
(the same as Table D.9 of ITU-T T.800 | ISO/IEC 15444-1)

Bit-plane number	Pass type	Coding operations
1	CP	Arithmetic coding (AC)
2	SP	AC
2	MR	AC
2	CP	AC
3	SP	AC
3	MR	AC
3	CP	AC
4	SP	AC
4	MR	AC
4	CP	AC, terminate
5	SP	Raw
5	MR	Raw, terminate
5	CP	AC, terminate
. . . .	. . . .	. . . .
Final	SP	Raw
Final	MR	Raw, terminate
final	CP	AC, terminate

P.2 Enhancement of selective arithmetic coding bypass (fast mode)

NOTE – The fast mode of JPEG 2000 takes advantage of the following points to speed up the coding time and maintain the compression efficiency:

– The reduction of the number of bit planes to be coded by the SP pass and MR pass with arithmetic coder can contribute to the reduction of coding time.

– The compression ratio of JPEG 2000 lossless is around 1 to 2, according to many experimental results. The compression efficiency after the 2nd or 3rd bit plane from MSB is not good in many cases, because SP and MR passes are not able to contribute to the improvement of compression efficiency.

As shown in Table P.1, the selective arithmetic coding bypass allows bypassing the arithmetic coder for SP pass and MR pass starting in the 5th significant bit-plane of the code-block. It leads to a speed-up in coding and decoding times in some implementations, because of the reduction in symbols that must be arithmetically coded.

The fast mode of JPEG 2000 allows the flexible selection of the coding passes in which the arithmetic coding is to be bypassed. Selection is performed via the least significant two bits of the SXcod parameter within the applicable COD marker segment. If the value of these two bits is 3, arithmetic coding is terminated after the third and subsequent CP passes, while arithmetic coding is bypassed during the third and subsequent SP and MR coding passes, in exactly the same way that the regular selective arithmetic coding bypass mode is applied to the fourth and subsequent SP and MR coding passes. Similarly, if the value of the least significant 2 bits of SXcod is 2, arithmetic coding is bypassed during the second and subsequent SP and MR passes, while if the value of the least significant 2 bits of SXcod is 1, arithmetic coding is bypassed during all SP and MR passes. If the least significant 2 bits of SXcod are both 0, the regular selective arithmetic bypass mode is not modified.

Regardless of the value of SXcod, if bit 0 of the applicable Scod or Scoc marker segment is 0, the selective arithmetic coding bypass mode is not employed.

Informative: Table P.2 is an example in which the least significant 2 bits of SXcod have the value 2. In this case, the most significant two bit planes are coded regularly and other bit planes are bypassed.

Table P.2 – Example of two bit planes (fast mode)

Bit-plane number	Pass type	Coding operations
1	CP	Arithmetic coding (AC)
2	SP	AC
2	MR	AC
2	CP	AC, terminate
3	SP	Raw
3	MR	Raw, terminate
3	CP	AC, terminate
. . . .	. . . .	. . . .
Final	SP	Raw
Final	MR	Raw, terminate
final	CP	AC, terminate

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