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Information technology — JPEG 2000 image coding system: Wireless —

AMENDMENT 1: IP based wireless networks

Technologies de l'information — Système de codage d'images JPEG 2000: Transmission radioélectrique —

AMENDEMENT 1: Réseaux sans fil fondés sur le protocole Internet

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Foreword

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INTERNATIONAL STANDARD

RECOMMENDATION ITU-T

Information technology – JPEG 2000 image coding system: Wireless

Amendment 1

IP-based wireless networks

1) Annex K

Add Annex K (the current Annexes K and L become Annex L and Annex M, respectively):

Annex K

Virtual data interleaving based error protection

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

K.1 Introduction

The objective of this annex is to explain how it is possible, using the tools of JPWL, to apply a virtual interleaving for enabling robustness to data packet losses and erasures. Error protection techniques described in this Recommendation | International Standard, can be applied independently, such as Unequal Error Protection or any method described in the EPC marker segment.

K.2 Interleaving-based error protection methods description

Figure K.1 shows a detailed data flow of the processing steps required for the correction technique. Images are encoded into codestreams according to Rec. ITU-T T.800 | ISO/IEC 15444-1. After the initialization of the encoding parameters and structures, EPC and EPB markers are created. The parity bytes of the data are then computed using the virtual interleaving technique; an invertible address permutation function is used to map the original data stream (the JPEG 2000 bitstream codeblock bytes) into an interleaved one. It should be noted that this step does not change the position of the compressed data. After the parity data has been calculated, a further interleaving step can be performed on them; in this case, the interleaving depth can extend over several adjacent codestreams. Eventually, the parity data are dumped into the codestreams, which are then sent through the transmission channel. At the receiver side, the data is first interleaved according to the same permutation law adopted during the transmission; afterwards, JPWL error correction is applied and, eventually, the data is de-interleaved to re-create the ordered codestream.

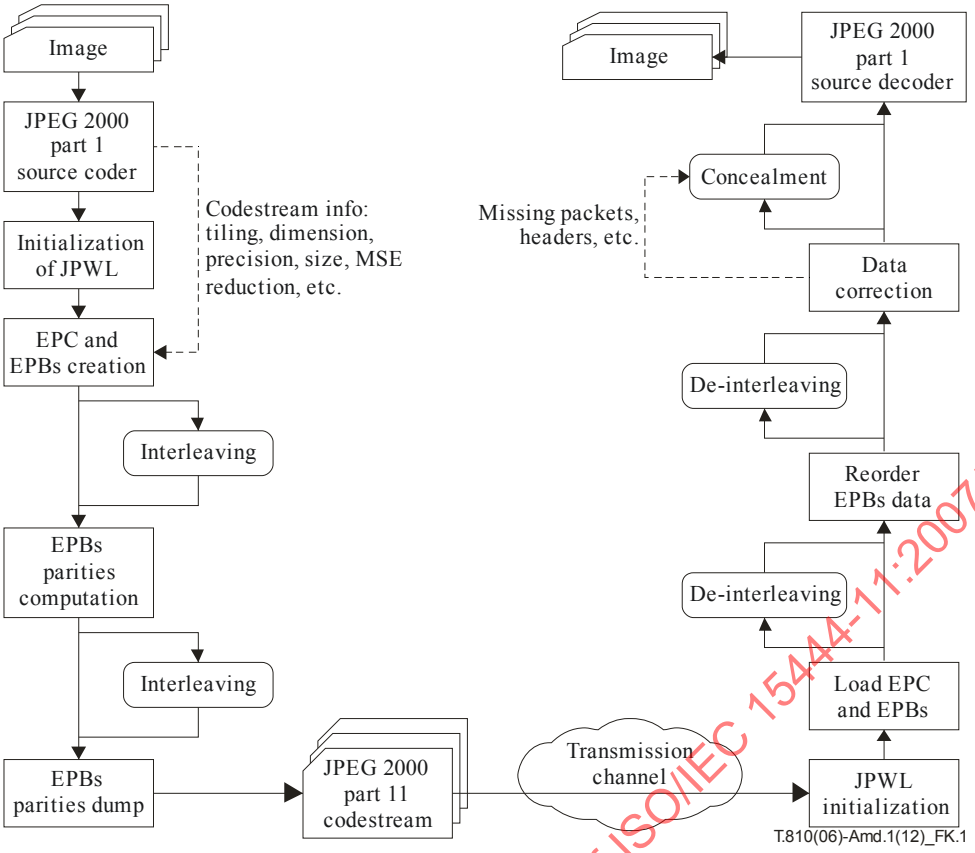

Figure K.1 – Data flow and processing used for the encoding/decoding process (rounded boxes represent optional methods)

K.2.1 Interleaving method 1: inter-frame only

This type of interleaving creates the redundancy specified in Annex B of this Recommendation | International Standard, then groups the redundancy of five consecutive codestreams, applies the interleaving, and writes the EPB data back to the codestreams.

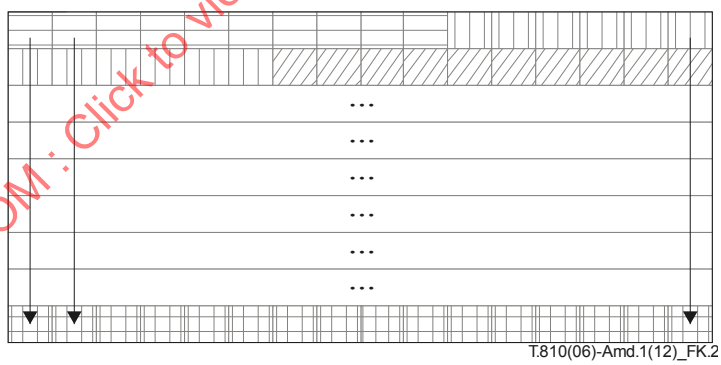

Figure K.2 – EPB interleaving matrix: EPB data from different codestreams are written consecutively along rows and read along columns, then written back to compressed files

K.2.2 Interleaving method 2: intra-frame Unequal Error Protection

This type of interleaving is applied to a single codestream: compressed bitstream data is interleaved and error protected with Reed-Solomon codes, creating parity data which is managed as in Annex B of this Recommendation | International Standard. Bitstream data is written along rows and parity symbols are computed along columns, and then written into EPBs. A different interleaving matrix can be adopted for each specified compression level, if UEP is used.

This interleaving type also supports the case where more than one tile part is present in the codestream, and it supports different error protection rates.

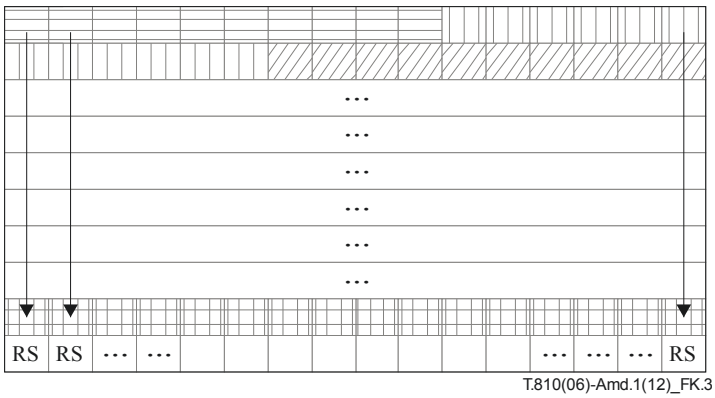

Figure K.3 – RS parity calculation using an interleaving matrix

K.2.3 Interleaving method 3

Interleaving as in method 2 is applied, and then redundancy is managed as in method 1.

K.2.4 Block-based interleaving algorithm

With reference to the interleaving methods mentioned previously, block interleaving is used to transform input addresses into destination addresses, as follows:

$$P(i) = \left\lfloor \frac{i}{N_c} \right\rfloor + \left(i - \left\lfloor \frac{i}{N_c} \right\rfloor N_c \right) N_R$$

where N_C and N_R represent the number of columns and rows, respectively, in the interleaving matrix, i is the input address of the byte to be interleaved, and $P(i)$ is the destination address of the byte to be interleaved.

The size of the interleaving matrix is chosen to make it next to square, in order to intersperse data as largely as possible. That is, if L is the length of the chunk of data to interleave, the number of rows and columns is selected as:

$$N_c = \left\lceil \sqrt{L} \right\rceil \text{ and } N_R = \left\lceil \frac{L}{N_c} \right\rceil$$

K.3 EPC parameters for virtual interleaving based error protection

An EPC marker segment as specified in Annex C of this Recommendation | International Standard signals the use of tool enabling to protect the codestream against transmission errors. The use of a virtual interleaving technique as described in this annex has to be signalled in the EPC marker segment. With reference to the Pepc field in Figure A.2, the mask defined in Table A.10 is used to set the MSB to 1.

A single $ID^{(i)}$ field shall be used, with the following values:

$ID^{(i)}$ (2 bytes) contains the interleaving method indicator, selected among 0x0100, 0x0200 and 0x0300

$L_{ID}^{(i)}$ (2 bytes) contains the length of the following $P_{ID}^{(i)}$ field, given by 2 + Nepb*10

$P_{ID}^{(i)}$ contains:

Nepb (2 bytes), the total number of EPBs used in the codestream, excluding the first EPB used in the header to protect the EPC itself

For each EPB in j=1,...,Nepb

RSepb(j) (2 bytes), RS parameter for this EPB

Lepb(j) (4 bytes), the Lepb parameter of the j-th EPB

Oepb(j) (4 bytes), the byte offset of the j-th EPB from the beginning of the codestream

2) References to Annex K

Update the following references to Annex K.

2.1) Clause 5.2

Edit the last paragraph of clause 5.2 as shown:

JPWL system has provision for future techniques, in addition to those described in this Recommendation | International Standard. The process of adding new techniques is managed by the Registration Authority as described in Annex ~~K~~ L.

2.2) Clause 6

Edit the last bullet point in clause 6 as shown:

- Registration authority (Annex ~~K~~ L): Specification of the Registration Authority (RA).

2.3) Clause A.6.1.2

Edit the second paragraph of clause A.6.1.2 as shown:

Table A.6 defines the range of values for Pepb parameter. Other codes definitions than this of Table A.6 can use an Error Management method index in the range of values, with a use and registration managed by the Registration Authority (see Annex ~~K~~ L).

2.4) Clause A.6.2

Edit the following sentence in the first paragraph of clause A.6.2 as shown:

Furthermore, EPC signals the use of informative tools which have been previously registered with the JPWL Registration Authority (JPWL RA, see Annex ~~K~~ L).

2.5) Clause C.1

Edit the following sentence in the first paragraph of clause C.1 as shown:

More information about the use of the RA can be found in Annex ~~K~~ L.

2.6) Clause C.5

Edit the first paragraph of clause C.5 as shown:

Informative tools to protect the codestream against transmission errors have to be registered with the RA (see Annex ~~K~~ L). Upon registration, each tool is assigned an ID, which uniquely identifies it.