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AMENDMENT 2: Extension of adaptive templates for halftone coding

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AMENDEMENT 2: Extensions des modèles adaptatifs pour le codage des demi-teintes

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INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – Lossy/lossless coding of bi-level images
Amendment 2

Extension of adaptive templates for halftone coding

1)   Subclause 4.2

a)   *Eight symbols for additional adaptive template pixels (from A_5 to A_{12}) are added after A_4 as follows (with the additions underlined):*

A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8, A_9, A_{10}, A_{11}, A_{12}
        Adaptive template pixels in the generic region decoding procedure

b)   *A new symbol "EXTTEMPLATE" is inserted after the symbol "EXRUNLENGTH" as follows (with the additions underlined):*

EXRUNLENGTH The length of a run of identical export flag values

EXTTEMPLATE   A parameter indicating whether extended reference template is used in a generic region decoding procedure

c)   *New 16 symbols "GBATX$_i$" and "GBATY$_i$" (i={5,...,12}) are inserted after "GBATY$_4$" as follows (with the additions underlined):*

GBATY$_4$ The Y location of adaptive template pixel 4 in a generic region decoding procedure

GBATX$_5$ The X location of adaptive template pixel 5 in a generic region decoding procedure

GBATY$_5$ The Y location of adaptive template pixel 5 in a generic region decoding procedure

GBATX$_6$ The X location of adaptive template pixel 6 in a generic region decoding procedure

GBATY$_6$ The Y location of adaptive template pixel 6 in a generic region decoding procedure

GBATX$_7$ The X location of adaptive template pixel 7 in a generic region decoding procedure

GBATY$_7$ The Y location of adaptive template pixel 7 in a generic region decoding procedure

GBATX$_8$ The X location of adaptive template pixel 8 in a generic region decoding procedure

GBATY$_8$ The Y location of adaptive template pixel 8 in a generic region decoding procedure

GBATX$_9$ The X location of adaptive template pixel 9 in a generic region decoding procedure

GBATY$_9$ The Y location of adaptive template pixel 9 in a generic region decoding procedure

GBATX$_{10}$ The X location of adaptive template pixel 10 in a generic region decoding procedure

GBATY$_{10}$ The Y location of adaptive template pixel 10 in a generic region decoding procedure

GBATX$_{11}$ The X location of adaptive template pixel 11 in a generic region decoding procedure

GBATY$_{11}$ The Y location of adaptive template pixel 11 in a generic region decoding procedure

GBATX$_{12}$ The X location of adaptive template pixel 12 in a generic region decoding procedure

GBATY$_{12}$ The Y location of adaptive template pixel 12 in a generic region decoding procedure

2) Subclause 6.2.2

In Table 2, new symbols "EXTTEMPLATE", "GBATX$_i$" and "GBATY$_i$" (i={5,...,12}) are inserted, and the notes of the table are revised as follows (with the additions and revisions underlined):

Table 2 – Parameters for the generic region decoding procedure

Name	Type	Size (bits)	Signed?	Description and restrictions
... (Leave untouched) ...				
TPGDON	Integer	1	N	Whether typical prediction is used. [a]
EXTTEMPLATE	Integer	1	N	Whether extended reference template is used. [e]
... (Leave untouched) ...				
GBATY$_4$	Integer	8	Y	The Y location of the adaptive template pixel A$_4$. [b]
GBATX$_5$	Integer	8	Y	The X location of the adaptive template pixel A$_5$. [d]
GBATY$_5$	Integer	8	Y	The Y location of the adaptive template pixel A$_5$. [d]
GBATX$_6$	Integer	8	Y	The X location of the adaptive template pixel A$_6$. [d]
GBATY$_6$	Integer	8	Y	The Y location of the adaptive template pixel A$_6$. [d]
GBATX$_7$	Integer	8	Y	The X location of the adaptive template pixel A$_7$. [d]
GBATY$_7$	Integer	8	Y	The Y location of the adaptive template pixel A$_7$. [d]
GBATX$_8$	Integer	8	Y	The X location of the adaptive template pixel A$_8$. [d]
GBATY$_8$	Integer	8	Y	The Y location of the adaptive template pixel A$_8$. [d]
GBATX$_9$	Integer	8	Y	The X location of the adaptive template pixel A$_9$. [d]
GBATY$_9$	Integer	8	Y	The Y location of the adaptive template pixel A$_9$. [d]
GBATX$_{10}$	Integer	8	Y	The X location of the adaptive template pixel A$_{10}$. [d]
GBATY$_{10}$	Integer	8	Y	The Y location of the adaptive template pixel A$_{10}$. [d]
GBATX$_{11}$	Integer	8	Y	The X location of the adaptive template pixel A$_{11}$. [d]
GBATY$_{11}$	Integer	8	Y	The Y location of the adaptive template pixel A$_{11}$. [d]
GBATX$_{12}$	Integer	8	Y	The X location of the adaptive template pixel A$_{12}$. [d]
GBATY$_{12}$	Integer	8	Y	The Y location of the adaptive template pixel A$_{12}$. [d]

[a] Unused if **MMR = 1**
[b] Unused if **MMR = 1** or **GBTEMPLATE ≠ 0**
[c] Unused if **USESKIP = 0** or **MMR = 1**
[d] Used only if MMR = **0** and **GBTEMPLATE = 0** and **EXTTEMPLATE = 1**
[e] Used only if **MMR = 0** and **GBTEMPLATE = 0**

3) Subclause 6.2.5.3

a)   *The identification number of Figure 3 is changed to "Figure 3(a)", and its caption is revised (with the additions and revisions underlined):*
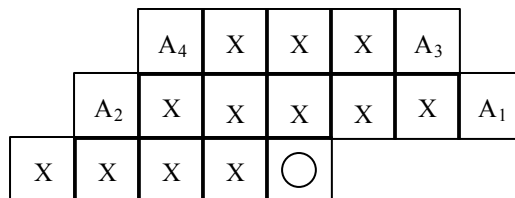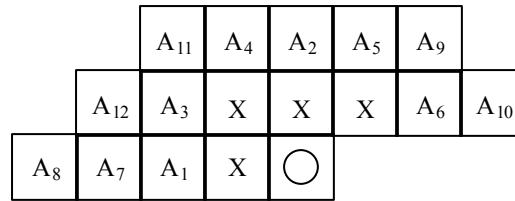

Figure 3(a) – Template when GBTEMPLATE = 0 and EXTTEMPLATE = 0, showing the AT pixels at their nominal locations

b)   *New Figure 3(b) is inserted as follows:*

		A_{11}	A_4	A_2	A_5	A_9	
	A_{12}	A_3	X	X	X	A_6	A_{10}
A_8	A_7	A_1	X	◯			

**Figure 3(b) – Template when GBTEMPLATE = 0 and EXTTEMPLATE = 1,
showing the AT pixels at their nominal locations**

c)   *The second paragraph in subclause 6.2.5.3 is revised as follows (with the additions and revisions underlined):*

Figure 3(a) shows the template which shall be used when **GBTEMPLATE** is 0 and **EXTTEMPLATE** is 0. Figure 3(b) shows the template which shall be used when **GBTEMPLATE** is 0 and **EXTTEMPLATE** is 1. Figure 4 shows the template which shall be used when **GBTEMPLATE** is 1. Figure 5 shows the template which shall be used when **GBTEMPLATE** is 2. Figure 6 shows the template which shall be used when **GBTEMPLATE** is 3. In each of these figures, the pixel denoted by a circle corresponds to the pixel to be coded and is not part of the template. The pixels denoted by 'X' correspond to ordinary pixels in the template. The pixels denoted A_1-A_{12} are special pixels in the template. They are denoted "adaptive" or AT pixels. These pixels are special in that their locations are not fixed, but can be placed at different locations. See 6.2.5.4 for a description of AT pixels. The legends A_1-A_{12} indicate the AT pixels 1 to 12. The pixels' actual locations are specified as parameters to this decoding procedure; Figures 3-6 show the nominal locations of these AT pixels for each template.

4)   Subclause 6.2.5.4

a)   *The second paragraph is revised as follows (with the additions and revisions underlined):*

The pixels that are allowed to change are called AT pixels. Their nominal locations are indicated by 'A_1', 'A_2', 'A_3', 'A_4', 'A_5', 'A_6', 'A_7', 'A_8', 'A_9', 'A_{10}', 'A_{11}', and 'A_{12}' in Figures 3(a), 3(b), 4, 5 and 6. Note that some templates have fewer than sixteen AT pixels. In general, an AT pixel can be located anywhere in the field shown in Figure 7, not including the current pixel. Hence, there is the possibility to use an effective template size of 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, or 4 pixels by having the moved location of the AT pixel overlap a regular template pixel. The actual locations of the AT pixels for any invocation of this decoding procedure are specified as parameters to the decoding procedure. The location of the pixel A_1 is given by (**GBATX$_1$**, **GBATY$_1$**). If **GBTEMPLATE** is 0, then:

- the location of the pixel A_2 is given by (**GBATX$_2$**, **GBATY$_2$**);
- the location of the pixel A_3 is given by (**GBATX$_3$**, **GBATY$_3$**);
- and the location of the pixel A_4 is given by (**GBATX$_4$**, **GBATY$_4$**).

Additionally, if **GBTEMPLATE** is 0 and **EXTTEMPLATE** is 1, then:

- the location of the pixel A_5 is given by (**GBATX$_5$**, **GBATY$_5$**);
- the location of the pixel A_6 is given by (**GBATX$_6$**, **GBATY$_6$**);
- the location of the pixel A_7 is given by (**GBATX$_7$**, **GBATY$_7$**);
- the location of the pixel A_8 is given by (**GBATX$_8$**, **GBATY$_8$**);
- the location of the pixel A_9 is given by (**GBATX$_9$**, **GBATY$_9$**);
- the location of the pixel A_{10} is given by (**GBATX$_{10}$**, **GBATY$_{10}$**);
- the location of the pixel A_{11} is given by (**GBATX$_{11}$**, **GBATY$_{11}$**);
- the location of the pixel A_{12} is given by (**GBATX$_{12}$**, **GBATY$_{12}$**).

b)   *Note 2 is revised as follows (with the additions and revisions underlined):*

NOTE 2 – The indices of the AT pixels in Figures 3(a) and 3(b) correspond to the expected goodness. If moving only one AT pixel from the nominal location shown in Figure 3(a), it is advisable to move A_4. The next pixel to move is A_3 and so on.

c)   *Table 5 is revised as follows (with the additions and revisions underlined):*

Table 5 – The nominal values of the AT pixel locations

| GBTEMPLATE		0		0		1		2		3	
EXTTEMPLATE		1		0		0		0		0	
GBATX$_1$	GBATY$_1$	−2	0	3	−1	3	−1	2	−1	2	−1
GBATX$_2$	GBATY$_2$	0	−2	−3	−1	NA	NA	NA	NA	NA	NA
GBATX$_3$	GBATY$_3$	−2	−1	2	−2	NA	NA	NA	NA	NA	NA
GBATX$_4$	GBATY$_4$	−1	−2	−2	−2	NA	NA	NA	NA	NA	NA
GBATX$_5$	GBATY$_5$	1	−2	NA	NA	NA	NA	NA	NA	NA	NA
GBATX$_6$	GBATY$_6$	2	−1	NA	NA	NA	NA	NA	NA	NA	NA
GBATX$_7$	GBATY$_7$	−3	0	NA	NA	NA	NA	NA	NA	NA	NA
GBATX$_8$	GBATY$_8$	−4	0	NA	NA	NA	NA	NA	NA	NA	NA
GBATX$_9$	GBATY$_9$	2	−2	NA	NA	NA	NA	NA	NA	NA	NA
GBATX$_{10}$	GBATY$_{10}$	3	−1	NA	NA	NA	NA	NA	NA	NA	NA
GBATX$_{11}$	GBATY$_{11}$	−2	−2	NA	NA	NA	NA	NA	NA	NA	NA
GBATX$_{12}$	GBATY$_{12}$	−3	−1	NA	NA	NA	NA	NA	NA	NA	NA
NOTE – NA means that the parameter has no nominal value.											

5)   Subclause 6.2.5.7

The step d) ii) is changed as follows (with the additions and revisions underlined):

d)   If LTP = **0** then, from left to right, decode each pixel of the current row of GBREG. The procedure for each pixel is as follows:

   i)   If **USESKIP** is **1** and the pixel in the bitmap **SKIP** at the location corresponding to the current pixel is **1**, then set the current pixel to **0**.

   ii)   Otherwise:

   - Place the template given by parameters **GBTEMPLATE**, **GBATX$_1$** through **GBATX$_{12}$** and **GBATY$_1$** through **GBATY$_{12}$** so that the current pixel is aligned with the location denoted by a circle in the figure describing the appearance of the template with identifier **GBTEMPLATE**.

6)   Subclause 7.4.6.2

a)   *Figure 46 is replaced by the following figure:*

EXTTEMPLATE							
Reserved – Must be **0**				TPGDON	GBTEMPLATE		MMR
7	6	5	4	3	2	1	0
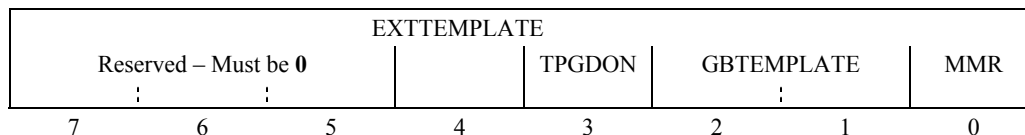
Figure 46 – Generic region segment flags field structure

7)   Subclause 7.4.6.2

The notations of Bit 4 are added for EXTTEMPLATE, and reserved bits are changed to Bits 5-7 as follows (with the additions and revisions underlined):

Bit 4   EXTTEMPLATE

This field specifies whether extended reference template is used.

**Bits 5-7** Reserved; must be zero.

8) Subclause 7.4.6.3

a)   The first paragraph is changed as follows (with the additions and revisions underlined):
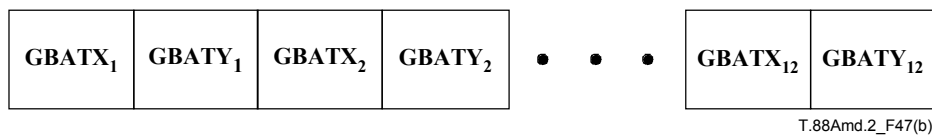
This field is only present if **MMR** is **0**. If **GBTEMPLATE** is **0** <u>and **EXTTEMPLATE** is **0**</u>, it is an eight-byte field, formatted as shown in Figure 47<u>(a)</u> and as described below.

b)   The identification number of Figure 47 is changed to Figure 47(a) as follows (with the revision underlined):

GBATX$_1$	GBATY$_1$	GBATX$_2$	GBATY$_2$	GBATX$_3$	GBATY$_3$	GBATX$_4$	GBATY$_4$
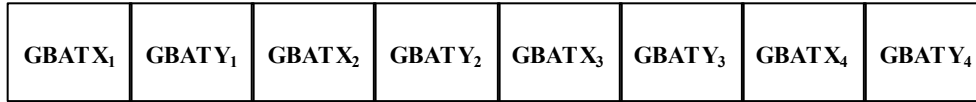
Figure 47<u>(a)</u> – Generic region AT flags field structure when GBTEMPLATE is 0 and EXTTEMPLATE is 0

c)   New Figure 47(b) is inserted immediately after as follows:

GBATX$_1$	GBATY$_1$	GBATX$_2$	GBATY$_2$	● ● ●	GBATX$_{12}$	GBATY$_{12}$

T.88Amd.2_F47(b)

Figure 47(b) – Generic region AT flags field structure when GBTEMPLATE is 0 and EXTTEMPLATE is 1

d)   The last paragraph is revised as follows (with the additions and revisions underlined):

<u>If **GBTEMPLATE** is 0 and **EXTTEMPLATE** is 1, it is a 32-byte field, formatted as shown in Figure 47(b) and as described below.</u>

<u>Byte 0</u>   **GBATX$_1$**

<u>Byte 1</u>   **GBATY$_1$**

<u>Byte 2</u>   **GBATX$_2$**

<u>Byte 3</u>   **GBATY$_2$**

<u>Byte 4</u>   **GBATX$_3$**

<u>Byte 5</u>   **GBATY$_3$**

<u>Byte 6</u>   **GBATX$_4$**

<u>Byte 7</u>   **GBATY$_4$**

<u>Byte 8</u>   **GBATX$_5$**

<u>Byte 9</u>   **GBATY$_5$**

<u>Byte 10</u>   **GBATX$_6$**

<u>Byte 11</u>   **GBATY$_6$**

<u>Byte 12</u>   **GBATX$_7$**

<u>Byte 13</u>   **GBATY$_7$**

<u>Byte 14</u>   **GBATX$_8$**

<u>Byte 15</u>   **GBATY$_8$**

<u>Byte 16</u>   **GBATX$_9$**

<u>Byte 17</u>   **GBATY$_9$**

<u>Byte 18</u>   **GBATX$_{10}$**

<u>Byte 19</u>   **GBATY$_{10}$**