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Information technology — Mixed Raster Content (MRC)

Technologies de l'information — Contenu des rasters-multiples (MRC)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 16485 was prepared by the International Telecommunication Union (ITU) (as ITU-T Recommendation T.44) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annex A forms a normative part of this International Standard.

Introduction and background

The Mixed Raster Content (MRC) Recommendation is a way of describing raster-oriented (scanned and/or rasterized synthetic images) documents with both bi-level (text and/or line-art) and multi-level (colour/continuous-tone) data within a page. The goal of this MRC Recommendation is to make exchange of raster-oriented mixed content colour documents among users with varied communication systems possible with higher speed, higher image quality and modest computing resources (memory, storage and processing power).

The dramatic increase in exchange of electronic documents has raised customer expectations and requirements for raster-oriented documents. Colour must be exchanged just as graceful and efficiently as black & white (bi-level) and quickly reproduce a copy of the original at the best possible image quality for that output device. The following technical relations can be associated with the customer requirements:

- efficient exchange of the raster data is directly related to the file size and compression ratios;
- image quality in a scan anywhere - print anywhere environment is directly related to the exchange of device independent data forms and the rendering compromises made by the output engine;
- fast printing with modest resources is related to low complexity of the format.

The best approach to achieve high compression ratios and retain quality is to compress the different segments of the raster data according to their individual attributes. Text and line-art data (bi-level data) would be compressed with an approach that puts high emphasis on maintaining the detail and structure of the input. Pictures and colour gradients (multi-level data) would be compressed using an approach that puts a high emphasis on maintaining the smoothness and accuracy of the colours. These different data types (bi-level and multi-level) are often conceptualized as being on separate layers/planes within the page.

This separation of the data by importance of content (spatial detail vs. colour) also directly implies that it is advantageous to use different resolutions for the different data, with a high spatial resolution used for text/line-art and high colour resolution for images/gradients.

This concept of data separation by importance of content has led to development of the base mode 3-layer model on which the MRC Recommendation is built. Provisions to extend the model beyond the base mode are defined in Annexes to this Recommendation. The base mode 3-layer model identifies three basic data types that may be contained within a page. These are multi-level data associated with contone colour (continuous-tone and/or palletized colour) image for which mid-to-low spatial and high colour resolution is typically appropriate for good reproduction; bi-level data associated with high detail of text/line-art for which high spatial and low colour resolution is typically appropriate for good reproduction; multi-level data associated with multi-level colours of the text/line-art data for which mid-to-high spatial and mid-colour resolution is typically appropriate for good reproduction. Each page within the MRC model is processed independently. The data types within each page are represented in distinct layers (also referred to as planes) to be image processed, compressed and transmitted independently. Multi-level contone data may be represented in the lower layer, bi-level in the middle layer and multi-level data of text/line-art colours in the upper layer. The lower and upper layers will from here on be referenced as the background and foreground layers respectively, see Figure 1. The process of image regeneration is controlled by the middle bi-level layer that acts as a mask or selector to select whether pixels from the background contone layer or foreground text/line-art colour layer will be reproduced. Due to its selection function this layer is referenced as the mask or selector layer, throughout this Recommendation the middle layer will be referenced as the mask layer. When the value of a mask layer pixel is one (1), the corresponding pixel from the foreground is selected and reproduced. When the value

of the mask layer pixel is zero (0) the corresponding pixel from the background is selected and reproduced, see Figure 2.

Given limited device memory in many facsimile implementations and that mixed content pages often have a mixture of: text/line-art (monochrome or coloured) regions; contone image regions; text/line-art (monochrome or coloured) and contone image regions. There are provisions to subdivide the page into horizontal stripes that span the entire width of the page and isolate individual regions, see Figure 3. Stripes are composed of one or more layers as determined by the image type within the stripe. The mask layer must span the entire width and height of the stripe. The background and foreground layers need not span the width and height of the stripe. Reduction in the amount of white space coded in the background or foreground layers can be realized by taking advantage of the image width and height data included in the layer data stream and a horizontal and vertical offset provision. The default of the foreground base colour is black (layer base colour can be changed to any colour). The base colour is defined such that at mask pixel locations (value = 1) where a corresponding foreground pixel is not present, the foreground layer base colour is applied. The default of the background base colour is white (layer base colour can be changed to any colour). The base colour is defined such that at mask pixel locations (value = 0) where a corresponding contone image is not present, the background layer base colour is applied, see Figure 4.

The 3-layer model has 3 types of horizontal stripes that are implemented according to the type of data being addressed:

- 3-layer stripe (3LS), so referenced since it contains all three of the foreground, mask and background layers as in Figure 1. The 3LS is appropriate when addressing an image that contains both multi-coloured text/line-art and contone image or monochrome text/line-art on coloured background and contone image, as in stripes 3 and 5 of Figures 3 and 8;
- 2-layer stripe (2LS), so referenced since it contains coded data for two of the three layers (the third is set to a fixed value). The two layers may be mask and background, as in Figure 6a or mask and foreground layers, as in Figure 6b. All combination of multiple layers shall include the mask layer. The 2LS is appropriate when addressing an image that contains monochrome text/line-art and contone image or coloured text/line-art and no contone image, as in stripes 2 and 7 of Figures 3 and 8;
- 1-layer stripe (1LS), so referenced since it contains coded data for only one of the three layers (the other two are set to fixed values). The one layer may be mask, as in Figure 7a, background, as in Figure 7b or foreground, as in Figure 7c. The 1LS is appropriate when addressing an image that contains one of monochrome text/line-art, contone image or possibly richly coloured graphics, as in stripes 1, 4 and 6 of Figures 3 and 8.

Figure 8 provides an illustration of the various stripe types that may apply to the various image regions within a page.

The 3-layer model requires application of a multi-level coding scheme to the background and foreground layers. Any ITU multi-level coding (such as JPEG or JBIG, as defined in Recommendation T.81 and T.43, respectively) may be used for the background or foreground. A bi-level coding scheme is required for the mask layer, any ITU bi-level coding (such as JBIG or MMR, as defined in Recommendations T.85 and T.6, respectively) may be used, see Figure 5. The specific coders used throughout the page and over the various layers are identified at the start of each page. This information is provided by parameters in a Start of Page (SOP) Marker Segment. The spatial resolution of the mask layer, to be used throughout the page, is also identified by a SOP parameter. Layers with varied spatial resolutions may be combined within a stripe, the resolution of the foreground and background layers must be integral factors of the mask resolution layer, see Figure 5. The specific resolutions being used in the foreground and background layers are identified within a marker segment at the start of each layer within a stripe. A Start of Stripe marker segment contains parameters indicating type of stripe (1LS, 2LS or 3LS), the foreground and

background layer base colour, offset of the foreground and/or background, the stripe height (number of lines) and the mask layer coded data length (number of octets).

An SOP marker segment denotes the beginning of an MRC page. This is followed by page data and terminated with a EOP (End of Page). The page data consists of stripes. During transmission, stripes are sent sequentially from the top of the page, stripe 1 through N, where N is an integer. Within a stripe, the mask layer is transmitted first, followed by the background and then the foreground as appropriate.

Information technology — Mixed Raster Content (MRC)

1 Scope

This Recommendation defines a means to efficiently represent raster-oriented pages that contain a mixture of multi-level and bi-level images. Any of the many ITU-T recommended encoding schemes, such as T.81 (JPEG) for the encoding of multi-level images and T.6 (MMR) for the encoding of bi-level images, may be combined within the context of this Recommendation. Similarly, ITU-T spatial and colour resolutions may be combined within a page. This Recommendation does not define new encodings or resolutions. The method of image segmentation is beyond the scope of this Recommendation, segmentation is left to manufacturers' implementation.

2 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 Recommendation and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendation and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

– ITU-T Recommendation T.4 (1996) - *Standardization of Group 3 facsimile terminals for document transmission.*

– CCITT Recommendation T.6 (1988) - *Facsimile coding schemes and coding control functions for Group 4 facsimile apparatus. (Commonly referred to as MMR standard.)*

– ITU-T Recommendation T. 42 (1996) - *Continuous-tone colour representation method for facsimile*.

– ITU-T Recommendation T.43 (1997) - *Colour and gray-scale image representation using lossless coding scheme for facsimile.*

– CCITT Recommendation T.81 (1992) | ISO/IEC 10918-1:1994 - *Information technology - Digital compression and coding of continuous-tone still image - Requirements and guidelines. (Commonly referred to as JPEG standard.)*

– ITU-T Recommendation T.82 (1993) | ISO/IEC 11544:1993 - *Information technology - Coded representation of picture and audio information - Progressive bi-level image compression. (Commonly referred to as JBIG standard.)*

– ITU-T Recommendation T.86 (1998) | ISO/IEC 10918-4:1999 - *Information technology - Digital compression and coding of continuous-tone still images: Registration of JPEG profiles, SPIFF profiles, SPIFF tags, SPIFF colour spaces, APPN markers, SPIFF compression types and Registration Authorities (REGAUT).*

– ITU-T Recommendation T.85 (1995) - *Application profile for Recommendation T.82 - Progressive bi-level image compression (JBIG coding scheme for facsimile apparatus).*