INTERNATIONAL TELECOMMUNICATION UNION

ITU-T T.4

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Amendment 1

(02/2000)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

Standardization of Group 3 facsimile terminals for document transmission

Amendment 1

ITU-T Recommendation T.4 – Amendment 1

(Previously CCITT Recommendation)

ITU-T T-SERIES RECOMMENDATIONS

TERMINALS FOR TELEMATIC SERVICES

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION T.4

STANDARDIZATION OF GROUP 3 FACSIMILE TERMINALS FOR DOCUMENT TRANSMISSION

AMENDMENT 1

Summary

Amendment 1 to Recommendation T.4 (1999) includes changes to:

a) Annex E/T.4 to include specification of the restriction on the use of the horizontal image size parameter of a JPEG data stream and amendment of the definition of spatial resolution to cover all standardized resolution;

b) Annex H/T.4 to cover mixed raster content black and white images.

Source

Amendment 1 to ITU-T Recommendation T.4 was prepared by ITU-T Study Group 8 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on 10 February 2000.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The 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 Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 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.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The 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, the 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.

CONTENTS

STANDARDIZATION OF GROUP 3 FACSIMILE TERMINALS FOR DOCUMENT TRANSMISSION

AMENDMENT 1

1) Subclause E.6.2

Add the following sentence at the end of this subclause:

The number of samples per line, X, shall conform to the values defined in clause 2.

2) Subclause E.6.5

Replace the "Spatial Resolution" *definition with the following:*

Spatial Resolution — (Two octets) Lightness pixel density in pels/25.4 mm. The basic value is 200. Any square resolution value (i.e. the same vertical and horizontal resolution) as defined in Table 2/T.30 may be used (e.g. 100, 200, 300, 400, etc.)

3) Subclause F.4.2.2

Remplace F.4.2.2 with the following:

F.4.2.2 D-CAPABILITY request/response APDUs conveyed by SUD in CDCL/RDCLP

```
D-CAPABILITY-REQ-RESP                ::=     CHOICE {
        applicationCapabilities              [4]  IMPLICIT ApplicationCapabilities }

ApplicationCapabilities  ::=  SET {
        documentApplicationProfileT73  [0]  IMPLICIT OCTET STRING,
                                -- '04'H document application profile Group 3 64 kbit/s option F
        documentArchitectureClass      [1]  IMPLICIT OCTET STRING,
                                -- '00'H FDA
        nonBasicDocCharacteristics     [2]  IMPLICIT NonBasicDocCharacteristics OPTIONAL }

NonBasicDocCharacteristics  ::=  SET {
        page-dimensions                [2]  IMPLICIT SET OF Dimension-pair OPTIONAL,
        ra-gr-coding-attributes        [3]  IMPLICIT SET OF Ra-Gr-Coding-Attribute OPTIONAL,
        ra-gr-presentation-features    [4]  IMPLICIT SET OF Ra-Gr-Presentation-Feature OPTIONAL,
        types-of-coding                [29] IMPLICIT SET OF Type-of-Coding OPTIONAL }

Dimension-pair               ::=  SEQUENCE {
        horizontal                     [0]  IMPLICIT INTEGER,
        vertical                            CHOICE {
            fixed                      [0]  IMPLICIT INTEGER,
            variable                   [1]  IMPLICIT INTEGER }}
                                        -- ISO B4      = (11 811, 16 677 fixed or variable)
                                        -- ISO A3      = (14 030, 19 840 fixed or variable)
                                        -- ISO A4      = (9920, 14 030 fixed or variable)
                                -- default value is ISO A4      = (9920, 14 030 fixed)
                                -- basic default value is ISO A4 = (9920, 14 030 fixed or variable)
```

```
Ra-Gr-Coding-Attribute ::=      CHOICE {
        compression                     [0]    IMPLICIT Compression }

Compression                     ::=     INTEGER { uncompressed   (0),
                                                  compressed     (1) }
                                -- default and basic value is compressed (1)

Ra-Gr-Presentation-Feature      ::=     CHOICE {
        pel-transmission-density        [11]   IMPLICIT Pel-Transmission-Density }

Pel-Transmission-Density        ::=     INTEGER { p6       (1), -- 6 BMU (200 pels/25.4 mm)
                                                  p4       (3), -- 4 BMU (300 pels/25.4 mm)
                                                  p3       (4), -- 3 BMU (400 pels/25.4 mm)
                                                  p2       (9), -- 2 BMU (600 pels/25.4 mm)
                                                  p1p5     (10), -- 1.5 BMU (800 pels/25.4 mm)
                                                  p1       (11), -- 1 BMU (1200 pels/25.4 mm)
                                                  r8x3p85  (5),
                                                  r8x7p7   (6),
                                                  r8x15p4  (7),
                                                  r16x15p4 (8) }
                                -- default and basic value is R8 × 3 .85 (5)

Type-of-Coding                  ::=     CHOICE {
                                        [0]    IMPLICIT INTEGER {  TPoint6coding (1),
                                                                   TPoint4oneDimensionalCoding (2),
                                                                   TPoint4twoDimensionalCoding (3) }
                                -- default and basic value is ITU-T T.4 one dimensional coding (2) -- }
```

Example ----------

```
A4  31   ApplicationCapabilities
    80 01 04        documentApplicationProfileT73 = Group 3 64 kbit/s option F
    81 01 00        documentArchitectureClass = FDA
    A2  29          nonBasicDocCharacteristics
    A2  14              page-dimensions
    30  08              SEQUENCE
        80 02 36CE      horizontal = 14 030 BMU
        81 02 4D80      vertical = variable 19 840 BMU (ISO A3 variable)
    30  08              SEQUENCE
        80 02 2E23      horizontal = 11 811 BMU
        81 02 4125      vertical = variable 16 677 BMU (ISO B4 variable)
    A4  09          ra-gr-presentation-features
        8B 01 01            pel-transmission-density = 1 (6 BMU)
        8B 01 03            pel-transmission-density = 3 (4 BMU)
        8B 01 06            pel-transmission-density = 6 (R8 x 7.7)
    BD  06   types-of-coding
        80 01 01        Type-of-coding = 1 (T.6 coding)
        80 01 03        Type-of-coding = 3 (T.4 two-dimensional coding)
```

---

4) Annex H

Replace the existing Annex H with the following:

Annex H

Mixed Raster Content (MRC) mode for G3 facsimile

H.1 Scope

The method for Mixed Raster Content (MRC) image representation is defined in Recommendation T.44. Together with Annex J of Recommendation T.30, this annex provides specification for the application of MRC in Group 3 facsimile. MRC defines a means to efficiently represent raster-oriented pages that contain a mixture of multi-level (e.g. continuous-tone and palletized colour) and bi-level (e.g. text and line-art) images by combining different encodings, spatial and colour resolutions on a single page. More than one of the multi-level encodings (e.g. T.81 and T.82 as per T.43) and bi-level encodings (e.g. T.6 and T.4, one and two-dimensional) that are available in Recommendation T.30 may be combined within a page, however, only bi-level encodings may be used in the MRC mask layer(s). Similarly, more than one of the square spatial resolutions (same resolution in both horizontal and vertical direction) and colour resolutions (i.e. bits/pels/component and chrominance subsampling) that are available in Recommendation T.30 may be combined within a page. This annex also defines application of MRC in black-and-white only environments, permitting implementation of bi-level coders that use meta-data, segmentation and other provisions that are accommodated by MRC's structure. This annex does not introduce new encodings or resolutions. The method of image segmentation is beyond the scope of this annex, segmentation is left to manufacturers implementation.

H.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 Recommendations 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 Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The references of Recommendation T.44 apply to this annex, along with the following additional references:

– ITU-T Recommendation T.30 (1999), *Procedures for document facsimile transmission in the general switched telephone network*.

– ITU-T Recommendation T.44 (1999), *Mixed raster content (MRC)*.

H.3 Definitions

The definitions in Recommendation T.44 apply to this annex.

H.4 Conventions

The conventions in Recommendation T.81 apply to this annex.

H.5 Image Representation

This annex includes description of a syntax for encapsulating one or more ITU-T encodings that are available in Recommendation T.30 on a single page.

A page is composed from a set of page-wide stripes of image data, which are coded independently. The stripes are transmitted sequentially from the top to the bottom of the page. Data is transmitted in a bit stream of least to most significant bit order. Bits are packed into octets starting at the most significant bit. If a decoder is reading a sequence of bits from an octet-stream, it shall first read the most significant bit of the first octet, the next most significant bit, and so on, then proceed to the next octet. All multi-octet values shall be interpreted in a most-significant-first manner: the first octet of each value is most significant, and the last octet is the least significant.

The stripes are composed of one or more layers. Each layer is coded using a recommended ITU-T coding method.

MRC's data format, as defined in T.44, consists of a series of markers, parameters, and entropy-coded data segments. Parameters and markers are often organized into marker segments. The page structure, with page header and page data, is the basic entity. The page data is subdivided into stripe structures with stripe header and stripe data. The stripe data is subdivided into layer structures. The conventions of Annex B/T.81 are used broadly. Information required to decode the page, such as coding types available for use within the layers, is specified within the page header Start of Page marker segment (SOP). Optional Marker Segments (OMSx), providing information that may be used to enhance page decode, may also be present in the page header. Presence of the first stripe header signals end of the page header. MRC Mode 1 requires the type of stripe, stripe height and a set of layer information, required in decoding the layers, to be specified within the stripe header Start of Stripe marker segment (SOSt) and the layer data stream. There is no layer header in Mode 1. Mode 2 introduces a layer header structure that is used in conjunction with the layer data stream to specify detailed layer information, required in decoding individual layers, as per Annex A/T.44. In Mode 2 and higher modes, only the type of stripe is specified within the SOSt. The layer header structure begins with a Start of Layer Coded Data (SLC) marker segment, followed by a variable number of Encoder Marker Segments (EMSe) and terminated by an End of Header (EOH) marker segment. Mode 2 introduces the SLC to clearly indicate the information required in decoding each layer. The SLC becomes even more critical when dealing with coders that do not have a comprehensive header structure. The EMSe was introduced to specify information that is dependent on individual encoders. The EOH completes the layer header structure by specifying the length of the coded data stream that follows immediately.

MRC Mode 4, defined in Annex B/T.44, introduces Shared Data Marker Segments (SDMx) that are used in accommodating data shared between multiple coded entities (i.e. between pages m and n, between stripes o and p, and/or between layers q and r – where m through r are arbitrary references to distinct entities). Due to SDMx association with pages, stripes and layer entities, SDMx may appear anywhere within the various page, stripe and layer structures. JBIG2, as defined in T.88 and the Application Profiles for Recommendation T.88, uses symbol dictionaries (i.e. meta-data) that need to be shared between page entities, and other provisions such as segmentation, to realize 2 to 3 times compression gains over JBIG1 (T.82 and its T.85 facsimile profile) and MMR (T.6). For these reasons implementations of JBIG2 in facsimile shall use Mode 4 of Black-and-White Mixed Raster Content Profile (MRCbw), as defined in this annex, or unconstraint MRC, as defined in T.44, for black-and-white only or colour applications respectively. Mode 4 further accommodates JBIG2 by defining a JBIG2 encoder marker segment (JB2e) that is used to identify the JBIG2 fax profile and any other JBIG2 options being implemented. As defined in Mode 2 rules for Encoder Marker Segments, the JB2e shall appear between the SLC and EOH.

Mode 4 also introduces provisions to use colour tags rather than conventional bitmap image coding to represent foreground colour for document regions containing only coloured text. This provision can realize more than two times the compression gains of conventional bitmap image coding of text colour. Colour tags shall only be used in the representation of foreground layers that are associated with JBIG2 encoded mask layers. Colour tags take advantage of the fact that JBIG2 codes text regions by generating discrete symbols to represent text characters and the added fact that text characters are usually a single flat colour. It uses a single colour value (i.e. colour tag) to represent the colour of each JBIG2 symbol, one colour value for each symbol and ordered identically as the symbols in the mask layer. T.45 "Run-length Colour Encoding" shall be used to code the colour values. Colour-interpreter Encoder Marker Segments (CLIe) are defined to provide information necessary to the decoding of colour values. Use of colour tags is an encoder option

that all Mode 4 decoders shall accommodate, excepting black-and-white only decoders defined in this annex, which must be able to skip the colour information.

Modes 1 and 2 shall contain a maximum of three layers. The main mask layer (layer 2) is transmitted first, followed by the background layer (layer 1), and then the foreground layer (layer 3). In Mode 3 or greater of Recommendation T.44, where there may be more than three layers, the layers above layer 3 are transmitted in increasing numerical order of mask (even layer) then image layer (odd layer). The two possible sequences are layers 2, 1, 3, 4, 5, … , N; or 2, 3, 4, 5, … , N when there is no background layer, where N is an odd numbered integer. Details of the syntax are described in Recommendation T.44.

The data stream is encoded for facsimile transfer using the error correction mode (ECM) specified in Annex A of Recommendations T.4 and T.30. Pad characters (X'00', the null character,) may be added after ending marker within the last ECM frame of the page to complete the last frame, in alignment with Annex A/T.4.

H.5.1 Spatial resolution

The square spatial resolutions (same resolution in both horizontal and vertical direction) of Recommendation T.30 are available for use in this annex. The resolution of the main mask layer is fixed for the entire page. In general it is possible to define lower spatial resolution for other layers. Within a stripe, varying spatial resolutions may be combined only when the resolutions of the other layers are integral factors of the main mask resolution. For example, if the main mask resolution is 400 pels/25.4 mm, the background and foreground layer may each be either 100, 200 or 400 pels/25.4 mm. All resolutions used must conform to ITU-T recommended values, as specified in Recommendation T.30. The main mask resolution is specified in the page header. The resolutions of other layers are specified in the layer data.

H.5.2 Stripe and layer width

Stripes always span the entire width of a page. The main mask layer must always span the entire width.

This method takes advantage of the image width and height data included in the layer data stream. Layers other than the main mask are not required to span the entire width. In addition, a horizontal offset may be used to select a starting point to the right of the left stripe boundary. This offset is expressed in the main mask pixel units. A simple stripe containing only background (e.g. JPEG data) or foreground (e.g. T.43 JBIG data) image data may also use this feature, in which case the accompanying mask layer will exist without any pixel data.

H.5.3 Stripe and layer height

Two or more layer stripes (2LS, 3LS, 4LS, 5LS, … , NLS, where N is an integer) have a default maximum height of 256 lines (in main mask layer resolution). This limits the data that must be buffered by the receiving apparatus.

Optionally, this maximum vertical stripe size may be increased to the page size.

One layer stripes (1LS) are not required to conform to a maximum stripe height, and are only limited by page size.

Stripe and main mask layer heights are always equal. Layer heights, other than the main mask, are less than or equal to stripe heights, accounting for resolution differences.

In addition, a vertical offset may be used to select a starting point below the first scan line of the stripe. This offset is expressed relative to the first scan line at the top of the stripe and in the main mask pixel units. A simple stripe containing only background (e.g. JPEG) or foreground (e.g. T.43 JBIG) data may also use this feature, in which case the accompanying mask layer will exist without any pixel data.

H.5.4 Layer combination

Bi-level mask layers select the appropriate image layer for rendering. Image layer pixels, or their default values, are combined per the value of the mask pixels. A corresponding pixel, or its default value, of the image layer directly above the mask layer is selected when a mask pixel value is "1". A corresponding pixel, or its default value, of the image layer directly below the mask layer is selected when a mask pixel value is "0".

H.5.5 Black-and-White Mixed Raster Content Profile (MRCbw)

The MRC structure proves value in accommodating next generation bi-level coders that use meta-data (i.e. coding data external to the coded data stream, which may be shared between pages and other entities), segmentation or other provisions that benefit from using the MRC structure. JBIG2, as defined in T.88 and the Application Profiles for Recommendation T.88, is one such next generation bi-level coders. JBIG2 uses symbol dictionaries (i.e. meta-data) that need to be shared between page entities, and other provisions such as segmentation to realize 2 to 3 times compression gains over JBIG1 (T.82 and its T.85 facsimile profile) and MMR (T.6). For these reasons, implementation of JBIG2 in facsimile requires the use of MRC Mode 4 and its SDMx (Shared Data Marker Segments) provisions. Requiring JBIG2 implementations to use MRC Mode 4 creates a dilemma since facsimile application requires MRC to be implemented as a colour option. This means that MRC implementations must include the JPEG coder. To overcome the MRC colour option constraints a black-and-white only profile of MRC, "Black-and-White Mixed Raster Content Profile (MRCbw)", is defined in this annex.

H.5.5.1 Principle

This annex specifies a black-and-white profile for Recommendation T.44 and its annexes based on restricting encoding schemes to bi-level coders. In other words, this annex specifies a black-and-white only version of all the Recommendation T.44 modes.

To insure that any valid Black-and-White Mixed Raster Content Profile (MRCbw) data streams are readable by a similar or higher Version and Mode T.44 reader, this annex retains all the T.44 identifiers, markers/marker segments and parameters unmodified. Consistent with the bi-level only characteristics of this annex, MRCbw writers are required to fix parameters associated with background and/or foreground layers (i.e. odd numbered layers) to values consistent with no coded image data and default colour values.

To insure that the bi-level portion of any T.44 data stream is readable by a similar or higher Version and Mode MRCbw reader, this Recommendation requires MRCbw readers to ignore coded data and parameter values associated with background and/or foreground layers (i.e. odd numbered layers). The reader uses the default colours of white and black respectively in representing background and foreground images. This means that a MRCbw reader may not faithfully reproduce colour data from a T.44 data stream, which contains multi-level data. In the worst case, the entire T.44 data stream will not be renderable if it contains only multi-level image data (i.e. no bi-level coded data). MRCbw readers can confirm this worst case situation by checking to see if the value of the SOP (start of Page maker segment) Mask Coder parameter is "0" (zero), no bi-level data present.

It is strongly recommended that MRCbw writers should use the SLC (Start of Layer Coded Data) maker segment in generating MRCbw files (i.e. use Modes 2 through N, where N is an integer greater than one).

H.5.5.2 Data format

The Recommendation T.44 data format shall be adhered to, with exception of the constraints specified within these clauses:

Start of page marker segment

The Start of Page marker segment is as defined in T.44. The constraints of MRCbw shall apply to all of the T.44 modes defined by the "Mode" parameter. The value of the Image layer coders parameter shall be set to "0" (zero). As a result, neither Layer base colour gamut range marker segment (OMSg) nor Layer base colour illuminant marker segment (OMSi) shall appear in a MRCbw data stream. MRCbw readers shall ignore any OMSg, OMSi or any other colour related optional marker segments that may appear in an MRC stream.

Stripe data structure

The Start of Stripe (SOSt) marker segment is as defined in 9.3 and A.9.3 of T.44. In MRCbw generated data streams values of the Type of stripe parameter shall correspond to odd-numbered layer bits (i.e. background and foreground layers) being set to "0" (zero). Consequently the value of the Background layer base colour and Foreground layer base colour parameters, of the SOSt defined in 9.3/T.44, are fixed to X'FF', X'80', X'60' (white) and X'00', X'80', X'60' (black) respectively. Accordingly, the values of the Offset of Background layer and Offset of Foreground layer parameters shall be set to "0" (zero). MRCbw readers shall ignore Background and Foreground layer base colour and Offset parameters. The default colours of black and white shall be used for the Background and Foreground layers respectively. MRCbw readers shall also ignore the layer data associated with odd-numbered layers.

In the inverted case where the layer base colours of background and/or foreground are reversed (i.e. the Background layer base colour is set to black and/or the Foreground layer base colour is set to white), the parameters should still be ignored by MRCbw readers.

Layer data structure

Following the SOSt will be a series of layers. For Modes 2 and above, the layer data structure is as defined in A.9.5/T.44. In MRCbw generated data streams, Start of Layer Coded Data (SLC) marker segment, Encoder related marker segments (EMSe), End of header marker segment (EOH) and any other marker segments shall only be present when the layer is a mask layer (i.e. even-numbered layers). In other words, the value of SLC Layer number parameter shall always correspond to an even number. MRCbw readers shall ignore SLC, EMSe, EOH and any other marker segments associated with odd numbered layers. The default colours of black shall be applied to all Foreground layers (i.e. odd layers greater than one) and white to the Background layer.

Shared data marker (SDMx) segment

The Shared data marker (SDMx) segments are as defined in B.6.4/T.44. In MRCbw generated data streams, SDMx shall only be present for mask layers (i.e. even-numbered layers). MRCbw readers shall ignore SDMx associated with odd numbered layers.

H.6 Layer Transmission Order

In multi-layer stripes, the bi-level main mask (layer 2) data is transmitted first, followed by the background (layer 1), the foreground (layer 3), layer 4, layer 5, … , layer N. In a multi-layer stripe without a background layer, the bi-level main mask image data is transmitted first, followed by the foreground, layer 4, layer 5, … , layer N.

In multi-layer MRCbw stripes, the bi-level main mask (layer 2) data is transmitted first, followed by layer 4, layer 6, … , layer N; where N is an even integer.

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	**Terminals for telematic services**
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems