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Annex B

T.503

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

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TERMINALS FOR TELEMATIC SERVICES

EXTENSION FOR CONTINUOUS-TONE COLOUR AND GRAY-SCALE IMAGE DOCUMENTS

Annex B to ITU-T Recommendation T.503

(Previously “CCITT Recommendation”)

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (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 (Helsinki, March 1-12, 1993).

Annex B to ITU-T Recommendation T.503 was prepared by ITU-T Study Group 8 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 11th of November 1994.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

SUMMARY

Recommendation T.503 defines a document application profile for the interchange of Group 4 facsimile documents. The definition of a document application profile for interchange of continuous-tone colour and gray-scale image is added as an option by this Annex B/T.503.

ANNEX B

(to Recommendation T.503)

Extension for continuous-tone colour and gray-scale image documents

B.1 Introduction

This annex defines a document application profile in order to interchange continuous-tone colour and gray-scale image documents as an option of Group 4 facsimile documents.

Its purpose is to specify an interchange format suitable for the interchange of Group 4 continuous-tone image facsimile documents that contain only continuous-tone raster graphics.

Continuous-tone image documents are interchanged in a formatted form, which enables the receiver to display or print the document as intended by the originator.

It is assumed that, when negotiation is performed by the service using this document application profile, all non-basic and additional features are subject to negotiation.

B.2 References

In addition to the references of the Recommendation T.503, the following references are required in order to implement this annex.

- CCITT Rec. T.81 | ISO/IEC 10918-1, *Information Technology – Digital compression and coding of continuous-tone still images – Part 1: Requirements and guidelines*. (Commonly referred to as JPEG standard)
- ITU-T Recommendation T.42, *Continuous-tone colour representation method for facsimile.*

B.3 Definitions

The definitions in ITU-T Recommendations T.411, T.81 and T.42 apply to this annex, unless explicitly amended.

B.3.1 **JPEG**: Joint Photographic Experts Group, and also shorthand for the encoding method, described in Recommendation T.81, which was defined by this group.

B.4 Characteristics supported by this document application profile

B.4.1 Overview

A Group 4 continuous-tone image facsimile document is the result of a formatting process and therefore, the purpose of this document application profile is to allow transfer of the complete layout of the document.

Only one category of content is allowed within the same page, namely: raster graphics content as used by facsimile Group 4 apparatus.

The purpose of this document application profile is to allow transfer of the complete colour and gray-scale information of the continuous-tone image document.

This subclause specifies the functional description of colour and gray-scale related features supported by this document application profile. Other functional descriptions are specified in Recommendation T.503.

B.4.2 Colour representation

Colour representation defines colour specification method, for example, direct or indexed expression, colour space, scale and offset, and illuminant/white point. These are aligned to Recommendation T.42.

The basic value is direct expression in CIE 1976 (L* a* b*) colour space (CIELAB). It is also the default value.

The basic values for scale and offset are as follows:

L, a, b: 8- or 12-bits integer value;

L*, a*, b*: real value colour coordinates in CIELAB space,

– 8 bits/colour component case;

$L = (255/100) * L^*$

$a = (255/170) * a^* + 128$

$b = (255/200) * b^* + 96$

Rounding to the nearest integer is performed. If L, a, or b fall outside the range [0, 255], they are truncated to 0 or 255 as appropriate.

– 12 bits/colour component case;

$L = (4095/100) * L^*$

$a = (4095/170) * a^* + 2048$

$b = (4095/200) * b^* + 1536$

Rounding to the nearest integer is performed. If L, a, and b fall outside the range [0, 4095], they are truncated to 0 or 4095 as appropriate.

These are also the default values, and aligned to the following gamut range;

$L^* = [0, 100]$

$a^* = [-85, 85]$

$b^* = [-75, 125]$

Other values are non-basic value.

The basic illuminant is "CIE Illuminant D50 and its perfectly diffuse reflecting white point ($X_0 = 96.422$, $Y_0 = 100.000$, $Z_0 = 82.521$)". It is also the default value. Non-basic values are for further study.

Bits per colour component attribute defines the number of bits used to represent each colour component of the image. Bits per colour component of gray-scale image is represented by three integers such as (8,0,0), that means L* is eight bits and other components are not present. Bits per colour components of colour image is represented by three positive integers such as (8,8,8) that means L*, a* and b* are eight bits.

The basic and default value is eight bits gray-scale. The optional values are twelve bits gray-scale, eight bits colour, and twelve bits colour. The twelve bits colour is an optional feature of eight bits colour. If the receiver indicates the twelve bits color, it shall manage the eight bits colour and twelve bits gray-scale.

Implementation of more than twelve bits is for further study.

B.5 Definition of the document application profile

B.5.1 Overview

The document architecture level is defined as in Recommendation T.503.

The content architecture level is raster graphics formatted content architecture level as it is defined in Table 5/T.503 and Table B.3.

The coding method to be used is Recommendation T.81 (JPEG) encoding method, provided that it is indicated in the document profile. Application of Recommendation T.82 (JBIG) is for further study.

The document profile level used in this document application profile is defined in Table B.1. Every document interchanged in accordance with this document application profile must include a document profile. Every non-basic and additional attribute value used in a document must be indicated in the document profile.

The interchange format class used in this document application profile is "B", as defined in Recommendation T.415.

Document structure, the attributes applicable to layout components, and the allowable attribute values for object descriptions are defined in Table 3/T.503.

B.5.2 Content architecture for continuous-tone image

The following raster graphics content architecture level is used in this document application profile.

B.5.2.1 Raster graphic content architecture level

The type of coding to be used is as defined in Recommendation T.81 (JPEG).

Its use is agreed by prior negotiation and is indicated in the document profile.

The presentation attributes that may be used are defined in Recommendation T.503.

B.5.2.2 Coding attributes

Attributes applicable to content portions are defined in Tables B.3 and B.4.

A continuous-tone colour raster graphic content is coded by T.81 encodings. Recommendation T.81 is the permissible value.

For T.81 encoding, basic value is baseline mode with transmitted quantization and Huffman tables. Other modes, for example, extended sequential DCT, progressive DCT, Spatial lossless and using Arithmetic coding for entropy coding, are optional. The usage of this T.81 encoding is shown in B.8.

The transmission of quantization and Huffman tables is mandatory. The attribute, "use of preferred Huffman table" is provided to indicate to the receiver that the preferred Huffman tables are used. In this case, the use of the preferred Huffman tables is indicated, the receiver can use the pre-installed preferred Huffman tables. Receiver must recognize Restart marker code and work appropriately. Hierarchical mode is for further study.

B.6 Definition of the document application profile for soft-copy communication

For further study.

B.7 Preferred Huffman tables for T.81 encoding

The preferred Huffman tables are Tables K.3/T.81 to K.6/T.81.

B.8 JPEG data structure on continuous-tone image

B.8.1 Overview

JPEG data consists of Marker Codes, Frame Header, Scan Header and Compressed image data. In order to simplify Colour Facsimile Standard, Baseline JPEG and, optionally, certain JPEG extensions are supported. This subclause gives a description of the JPEG data structure.

B.8.2 Marker classification

1) Encoder shall insert these Markers.

   Decoder shall be able to carry out a corresponding process to these Marker segments:

   SOI, APP1, DQT, DHT**,** SOF0, SOS, EOI

2) Encoder may insert this Marker without negotiation.

   Decoder should be able to carry out a corresponding process to this Marker segments:

   DRI, RSTn, DNL

3) Encoder may insert these Marker without negotiation.

   Decoder should be able to skip these Marker segments and continue decoding process:

   COM, APPn (n not 1)

4) Encoder may insert these Marker when Decoder has the ability to carry out a process corresponding to these Marker segments: (Negotiation is necessary)

SOFn (n not 0)

B.8.3 Definition of the APP markers defined for Group 4 Colour Fax

The application code APP1 will initiate identification of the image as a G4FAX application and define the spatial resolution. This code appears directly after the SOI maker. The data format is as follows:

X'FFE1'(APP1), length, G4FAX identifier, version, spatial resolution

The above terms are defined as follows:

– *Length*: (2 octets) Total APP1 field octet count including the octet count itself, but excluding the APP1 marker.

– *FAX identifier*: (6 octets) X'47', X'34', X'46', X'41', X'58', X'00'. This X'00'-terminated string "G4FAX" uniquely identifies this APP1 marker.

– *Version*: (2 octets) X'07CA'. This string specifies the year of approval of the standard, for identification in the case of future revision (for example, 1994).

– *Spatial resolution*: (2 octets) Lightness pixel density in pels/25.4 mm. The basic value is 200. Allowed values are 200, 240, 300, and 400.

This is an example of the string including the SOI and APP1 codes for a baseline JPEG encoded 1994 G4FAX application at 200 pels/25.4 mm:

X'FFD8', X'FFE1', X'000C', X'47', X'34', X'46', X'41', X'58', X'00', X'07CA', X'00C8'

B.8.3.1 FAX option identifier – G4FAX1 for gamut range

X'FFE1' (APP1), length, G4FAX option identifier, gamut range data

The above terms are defined as follows:

– *Length*: 2 octets) Total APP1 field octet count including the octet count itself, but excluding the APP1 marker.

– *FAX identifier*: (6 octets) X'47',X'34',X'46',X'41',X'58',X'01'. This X'01'-terminated string "G4FAX" uniquely identifies this APP1 marker as containing FAX information about optional gamut range data. (The FAX option identifiers are referred to as G4FAX1 – G4FAX255, meaning the octet-terminated string, "G4FAX", X'nn').

– *Gamut range data*: (12 octets) The data field contains six two-octet signed integers. For example: X'0064" represents 100. The calculation from a real value L* to an eight bit value, L, is made as follows;

$$L = (255/Q) * L^* + P,$$

where the first integer of the first pair, P, contains the offset of the zero point in L* in the eight most significant bits. The second integer of the first pair, Q, contains the span of the gamut range in L*. Rounding to the nearest integer is performed. The second pair contains offset and range values for a*. The third pair contains offset and range values for b*. If the image is gray-scale (L* only), the field still contains six integers, but the last four integers are ignored.

NOTE – This representation is in accord with Recommendation T.42. when the twelve bits/pel/component option is used, the range and offset are represented as above in eight bits. These represent the eight most significant bits of the zero-padded twelve-bit number in the offset, and the eight-bit integer range data as above. Appropriately higher precision calculation should be used.

For example, the gamut range L* = [0, 100], a* = [–85, 85], and b* = [–75, 125] would be selected by the code;

X'FFE1', X'0014', X'47', X'34', X'46', X'41' X'58', X'01', X'0000', X'0064', X'0080', X'00AA', X'0060', X'00C8'.

B.8.3.2 FAX option identifier – G4FAX2 for illuminant data

X'FFE1' (APP1), length, G4FAX option identifier, illuminant data. This option is for further study with the exception of the default case; the specification of the default illuminant, CIE Illuminant D50, may be added for information.

- *Length:* (2 octets) Total APP1 field octet count including the octet count itself, but excluding the APP1 marker.
- *FAX identifier:* (6 octets) X'47', X'34', X'46', X'41', X'58', X'02'. This X'02'-terminated string "G4FAX" uniquely identifies this APP1 marker as containing optional illuminant data.
- *Illuminant data:* (4 octets) The data consist of a four octet code identifying the illuminant. In the case of a CIE standard illuminant, the four octet code is one of the following:

CIE Illuminant D50:	X'00', X'44', X'35', X'30'
CIE Illuminant D65:	X'00', X'44', X'36', X'35'
CIE Illuminant D75:	X'00', X'44', X'37', X'35'
CIE Illuminant SA:	X'00', X'00', X'53', X'41'
CIE Illuminant SC:	X'00', X'00', X'53', X'43'
CIE Illuminant F2:	X'00', X'00', X'46', X'32'
CIE Illuminant F7:	X'00', X'00', X'46', X'37'
CIE Illuminant F11:	X'00', X'46', X'31', X'31'

In the case of a colour temperature alone, the four octets code consists of the string "CT", followed by the temperature of the source in degrees K represented by an unsigned two-octet integer. For example, a 7500 K illuminant is indicated by the code:

X'FFE1', X'000C', X'47', X'34', X'46', X'41', X'58', X'02', X'43', X'54', X'1D4C'

B.8.3.3 Future option identifiers – G4FAX3 to G4FAX255

In addition to the G4FAX1 and G4FAX2 identifiers used for specifying optional parameters, the identifiers from G4FAX3 to G4FAX255 are to be reserved for future use.

B.8.4 Example of JPEG data structure for a 4:1:1 sub-sampled baseline mode

SOI	(start of image marker)
APP1, Lp	(application marker one, marker segment length)
Api	(application data octets: "G4FAX", X'00', X'07CA'(version), X'00C8' (200 dpi))
(APP1, Lp)	((application marker one, marker segment length)
Api	(application data octets: "G4FAX", X'01', X'0000', X'0064', X'0080', X'00AA', X'0060', X'00C8' (gamut range)))
(COM, Lc, Cmi)	(comment marker, marker segment length, comment octets)
DHT, Lh	(define Huffman table marker, Huffman table length definition)
Tc, Th	(table class Tc = 0 for DC, destination identifier Th = 0 for L*)
Li, Vij	(number of codes for each of the 16-allowed code lengths, code values)
Tc, Th	(table class Tc = 1 for AC, destination identifier Th = 0 for L*)
Li, Vij	(number of codes for each of the 16-allowed code lengths, code values)
Tc, Th	(table class Tc = 0 for DC, destination identifier Th = 1 for a*, b*)
Li, Vij	(number of codes for each of the 16-allowed code lengths, code values)
Tc, Th	(table class Tc = 1 for AC, destination identifier Th = 1 for a*, b*)
Li, Vij	(number of codes for each of the 16-allowed code lengths, code values)

DQT, Lq	(define quantization table marker, quantization table length definition)
Pq, Tq	(element precision Pq = 0 for 8 bit, destination identifier Tq = 0 for lightness)
Qk	(64 quantization table elements for quantization table 0 (lightness))
Pq, Tq	(element precision Pq = 0 for 8 bit, destination identifier Tq = 1 for chrominance)
Qk	(64 quantization table elements for quantization table 1 (chrominance))
(DRI, Lr, Ri)	(define restart interval marker, marker segment length, restart interval in MCUs)
SOF0, Lf	(Start of frame marker for baseline, frame header length)
P, Y, X	(sample precision P = 8, number of lines Y, number of samples per line X)
Nf	(number of image components Nf = 3 for colour)
C1	(component identifier C1 = 0 for L* component)
H1, V1	(horizontal and vertical sampling factors: H1 = 2, V1 = 2 for L* in colour 4:1:1)
Tq1	(quantization table selector: Tq1 = 0)
C2	(component identifier C2 = 1 for a* component)
H2, V2	(horizontal and vertical sampling factors: H2 = 1, V2 = 1 for a* in colour 4:1:1)
Tq2	(quantization table selector: Tq2 = 1)
C3	(component identifier C3 = 2 for b* component)
H3, V3	(horizontal and vertical sampling factors: H3 = 1, V3 = 1 for b* in colour 4:1:1)
Tq3	(quantization table selector: Tq3 = 1)
SOS, Ls, Ns	(Start of scan marker, scan header length, number of components Ns = 3 for colour)
Cs1	(scan component selector Cs1 = 0 for L*)
Td1, Ta1	(DC entropy coding table selector Td1 = 0, AC table selector Ta1 = 0 for L*)
Cs2	(scan component selector Cs2 = 1 for a*)
Td2, Ta2	(DC entropy coding table selector Td2 = 1, AC table selector Ta2 = 1 for a*)
Cs3	(scan component selector Cs3 = 2 for b*)
Td3, Ta3	(DC entropy coding table selector Td3 = 1, AC table selector Ta3 = 1 for b*)

Ss, Se	(Ss = 0 for sequential DCT, Se = 63 for sequential DCT)
Ah, Al	(Ah = 0 for sequential DCT, Al = 0 for sequential DCT)
Scan data	(compressed image data)
(with RSTn)	(restart marker between image data segments, with n = 0-7 repeating in sequence)
(DNL, Ld, Y)	(define number of lines marker, marker segment length, number of lines)
EOI	(End of Image Marker)

NOTE – Parentheses around a marker indicate the marker is classified to (2), (3) or (4).

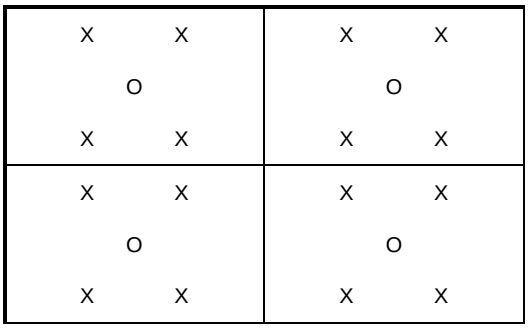
B.8.5 Scan data structure

The scan data of the baseline mode consist of block interleaved L*, a*, and b* data. Blocks are entropy-encoded DCT-transformed 8 × 8 arrays of image data from a single image component. The L*, a* and b* components are assigned indices zero, one, and two respectively in the frame header. When a gray-scale image is transmitted, only the L* component is represented in the data structure. The number of image components is either one (for a gray-scale image) or three (for a colour image).

The data are block-interleaved when a colour image is transmitted, and only one scan is contained within the image data. The blocks are organized in minimum coding units (MCU) such that an MCU contains a minimum integral number of all image components. The interleaving has the following form in the default (4:1:1) subsampling case, as defined in A.2.3/T.81. In this case an MCU consists of four blocks of L* data, one block of a* data, and one block of b* data. The data are ordered L*, L*, L*, L*, a*, b* in the MCU. The four L* blocks proceed in the same scan order as the page: left to right and top to bottom. Therefore the L* blocks are transmitted first upper left, then upper right, then lower left, then lower right.

B.8.6 Sub-sampling method

The default (4:1:1) sub-sampling is specified as a four-tap symmetric filter. Thus a* and b* are computed from non-sub-sampled data by averaging the four values of chrominance at the lightness locations. The location of the sub-sampled chrominance pixel is shown in Figure B.1.



X Represents lightness pel center
O Represents chrominance pel center

FIGURE B.1/T.503

Position of lightness and chrominance samples (4:1:1 sub-sampling) within the MCU's

TABLE B.1/T.503

Document profile attributes

Attribute	Class	Permissible value	Default
Document profile descriptor	M		
Specific layout structure	m	Present	–
Document characteristics	M		
Document application profile	m	Group 4 fax colour extension (Note)	–
Document architecture class	m	Formatted	–
Non-basic document characteristics	M		
Type of coding	m	JPEG (T.81)	
Page dimensions	nm	(Table 1/T.503)	ISO A4 (9920, 14 030 fixed or variable)
Raster graphics coding attributes	NM		
Bit per colour component	nm	Gray-scale 12 bits Colour 8 bits Colour 12 bits	Gray-scale 8 bits
Sub-sampling	nm	2:1:1, 1:1:1	4:1:1
JPEG coding mode	nm	(Table B.4) (without baseline)	Baseline
Raster graphics presentation attributes	NM		
Pel transmission density	nm	(Table 1/T.503)	6 BMU
Additional Document characteristics	NM		
Colour space list	NM		
Colour space	NM		
Colour space id	m	1	–
Colour space type	m	CIELAB	–
Colour data scaling	nm	(Table B.2)	(Table B.2)
Calibration data	nm	(Table B.2)	(Table B.2)

NOTE – The identifier 05H means continuous-tone colour and gray-scale extension for Group 4 facsimile, and it shall be used as 0205H.

TABLE B.2/T.503

Colour data scaling and calibration data

Item	Basic value	Default value	Non-basic value
Colour data scaling	Scale Offset L* 255/100, 0 a* 255/170, 128 b* 255/200, 96	Scale Offset L* 255/100, 0 a* 255/170, 128 b* 255/200, 96	Possible real or integer values described in Rec. T.42
Calibration data	White reference point X_0 = 96.422 Y_0 = 100.00 Z_0 = 82.521	White reference point X_0 = 96.422 Y_0 = 100.00 Z_0 = 82.521	For further study

TABLE B.3/T.503

Attributes applicable to content portions

Attribute	Qualifier	Basic value	Default value	Non-basic value
Content identifier	nm	As defined in Recs. T.412 and T.81	None	None
Type of coding	m			
Raster graphics coding attribute				
Number of pels per line	d	As defined in Table 3/T.563	As defined in Table 3/T.563	None
Number of discarded pels	d	As defined in Table 3/T.563	As defined in Table 3/T.563	None
Bit per colour component	d	Gray-scale 8 bits	Gray-scale 8 bits	Gray-scale 12 bits colour 8 bits colour 12 bits
Sub-sampling	d	4:1:1	4:1:1	2:1:1 1:1:1
JPEG coding mode	d	Baseline	Baseline	Table B.4 (except baseline)
Use of preferred Huffman table	d	No	No	Yes
Content information	m	Octet strings (Rec. T.81)	None	None

TABLE B.4/T.503

JPEG coding mode for Annex B/T.503

Mode ID	Encoding mode	JPEG marker
	Non-hierarchical Huffman coding	
0	Baseline	X'FFC0'
1	Extended sequential DCT	X'FFC1'
2	Progressive DCT	X'FFC2'
3	Spatial (sequential) lossless	X'FFC3'
	Non-hierarchical arithmetic coding	
9	Extended sequential DCT	X'FFC9'
10	Progressive DCT	X'FFCA'
11	Spatial (sequential) lossless	X'FFCB'

B.9 ASN.1 definition for Annex B/T.503

This abstract syntax definition of user data conveyed by session PDU is used for Group 4 continuous-tone colour and gray-scale facsimile document communication, using this Annex, Recommendation T.521 "Communication Application Profile BT.0 for Document Bulk Transfer based on The Session service", and Recommendation T.563 "Terminal Characteristics for Group 4 Facsimile Apparatus".

B.9.1 User data conveyed by SUD in CSS/RSSP

```
APDU            ::= CHOICE  {
                        [4] IMPLICIT ApplicationCapabilities }

ApplicationCapabilities ::= SET  {

documentApplicationProfile [0] IMPLICIT OCTET STRING,
      ---'0205'H document application profile for T.503 and this annex
      ---'02'H indicates T.503 capability,
      ---'05'H indicates Annex "Extension For Continuous-Tone Colour and Gray-scale
      --- Image Documents" capability.
documentArchitectureClass  [1] IMPLICIT OCTET STRING     }
      ---'00'H FDA 'Formatted Document Architecture'---
--- Coded example ----------------
      A4    07          ApplicationCapabilities
            80    02    02    05    documentApplicationProfile = T.503 and this annex
            81    01    00    documentArchitectureClass = FDA
```

B.9.2 User data conveyed by SUD in CDCL/RDCLP

```
APDU                    ::= CHOICE  {
                                [4] IMPLICIT ApplicationCapabilities }

ApplicationCapabilities ::= SET  {
   documentApplicationProfile       [0] IMPLICIT OCTET STRING,
         ---'0205'H document application profile for T.503 and this annex
   documentArchitectureClass        [1] IMPLICIT OCTET STRING,
         ---'00'H FDA ---
   nonBasicDocCharacteristics       [2] IMPLICIT NonBasicDocCharacteristics,     --- (see Note)
   additional-doc-characteristics   [9] IMPLICIT Additional-Doc-Characteristics  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-Features     OPTIONAL,
    types-of-coding                 [29] IMPLICIT SET OF Type-of-Coding                 }   --- (see Note)
```

NOTE – These attributes one mandatory for this annex.

```
Dimension-Pair          : := SEQUENCE {
    horizontal                      [0] IMPLICIT INTEGER,
    vertical                        CHOICE {
        fixed                               [0] IMPLICIT INTEGER,
        variable                            [1] IMPLICIT INTEGER } }
                --- North American letter          = (10200,13200 fixed or variable)
                --- ISO B4                        = (11811,16677 fixed or variable)
                --- ISO A3                        = (14030,19840 fixed or variable)
                --- Japanese legal               = (12141,17196 fixed or variable)
                --- Japanese letter              = ( 8598,12141 fixed or variable)
                --- North American legal         = (10200,16800 fixed or variable)
                --- North American ledger        = (13200,20400 fixed or variable)
                (--- ISO A4                      = ( 9920,14030 fixed or variable))
     -- default value is ISO A4                 = ( 9920,14030 fixed)
     -- basic value is  ISO A4                  = ( 9920,14030 fixed or variable)

Ra-Gr-Coding-Attribute   ::= CHOICE {
    bit-per-colour-component        [4] Bit-Per-Colour-Component            OPTIONAL,
    subsampling                     [10] IMPLICIT Subsampling               OPTIONAL,
    jpeg-coding-mode                [11] IMPLICIT INTEGER {
                                    ---- Huffman coding
                                            extended-sequential-DCT  (1),
                                            progressive-DCT          (2),
                                            spatial-lossless         (3),
                                    ---- arithmetic coding
                                            extended-sequential-DCT  (9),
                                            progressive-DCT          (10),
                                            spatial-lossless         (11)}  OPTIONAL }
                    --- default and basic value is baseline (0)

Bit-Per-Colour-Component ::= CHOICE  {
    component-list                  SEQUENCE OF INTEGER }
                ---     gray-scale 12 bits      = (12, 0, 0)
                ---     colour 8 bits           = (8, 8, 8)
                ---     colour 12 bits          = (12, 12, 12)
        --- default and basic value is gray-scale 8 bits (8, 0, 0) for this annex

Sub-sampling            ::= OCTET STRINGS
        ---     2:1:1 or 4:2:2      ((2,1),(1,1),(1,1))     :   '21 11 11'H
        ---     1:1:1               ((1,1),(1,1),(1,1))     :   '11 11 11'H
        ---     (4:1:1              ((2,2),(1,1),(1,1))     :   '22 11 11'H  )
    --- default and basic value is 4:1:1    ((2,2),(1,1),(1,1))

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

Pel-Transmission-Density  ::= INTEGER {
                                        p5 (2),     -- 5BMU (240pels/25.4mm)
                                        p4 (3),     -- 4BMU (300pels/25.4mm)
                                        p3 (4),     -- 3BMU (400pels/25.4mm)
                                (       p6 (1))}    -- 6BMU (200pels/25.4mm)
                    -- default and basic value is p6 (1)

Type-of-Coding          ::= CHOICE { [6]IMPLICIT OBJECT IDENTIFIER }
                                ----    {2 8 3 7 13} for 'JPEG' encoding
        -- basic value is t.81"JPEG"  {2 8 3 7 13} for this annex
        -- t.82"JBIG" is for further study.
```

```
Additional-Doc-Characteristics ::= SET  {
    colour-spaces-list      [1] IMPLICIT SET OF Colour-Spaces OPTIONAL}

Colour-Space            ::= SET    {
    colour-space-id             [0] IMPLICIT INTEGER,
    colour-space-type           [1] IMPLICIT Colour-Space-Type,
    colour-data-scaling         [4] IMPLICIT Colour-Data-Scaling OPTIONAL }

Colour-Space-Type       ::= INTEGER  { cielab(4)}

Colour-Data-Scaling     ::= SET    {
    first-component             [0] IMPLICIT Scale-and-Offset,
    second-component            [1] IMPLICIT Scale-and-Offset,
    third-component             [2] IMPLICIT Scale-and-Offset }

Scale-and-Offset        ::= SET  {
    colour-scale            [0] REAL,
    colour-offset           [1] REAL }
```

--- default and basic values for CIELAB components are as follows;

	scale	*offset*
first-component	**2.55(255/100)**	**0**
second-component	**1.5(255/170)**	**128**
third-component	**1.275(255/200)**	**96**

--- Coded example ----------

```
A4  LL                  ApplicationCapabilities
    80  02  02  05      documentApplicationProfile = T.503 and this annex
    81  01  00          documentArchitectureClass = FDA
    A2  3D                  nonBasicDocCharacteristics
        A2  14                  page-dimensions
        30  08                      SEQUENCE                    (ISO B4 variable)
            80  02  2E23               horizontal = 11811 BMU
            81  02  4125               vertical = variable 16677 BMU
        30  08                      SEQUENCE                    (ISO A3variable)
            80  02  36CE               horizontal = 14030 BMU
            81  02  4D80               vertical = variable 19840 BMU
        A3  15                      ra-gr-coding-attributes
        A4  0B  30  09
                02  01  08      bit-per-colour-component = 8 (colour 8 bits)
                02  01  08
                02  01  08
        8A  03  111111      sub-sampling = '11 11 11'H  ((1,1),(1,1),(1,1))
        8B  01  01              jpeg-coding-mode = 1 (extended-sequential-DCT)
    A4  06                  ra-gr-presentation-features
        8B  01  03              peltransmission-density = 3  (300pels/25.4mm)
        8B  01  04              peltransmission-density = 4  (400pels/25.4mm)
        BD  06                  type-of coding
            86  04  58 03 07 0D        = {2 8 3 7 13} (T.81"JPEG")
    A9  3C                  additional-doc-characteristics
        A1  3A                  colour-space-list
            31  38                  colour space SET
            80  01  01              colour-space-id = 1
            81  01  04              colour-space-type = 4 (CIELAB)
            A4  30                      colour-data-scaling     (non basic value case)
                A0  0C                      first-component   L* = [0, 95]
                    A0  06                  colour-scale = 2.684 (255/95)
                        09  04  A0  FD  2AF2
    --- REAL length=4 binary encoding(base=16) exponent=-3 mantissa='2AF2'H
                    A1  02                  colour-offset = 0
                        09  00
```

--- REAL length=0 (this means real value is '0')

A1 0F second-component a* = [-85, 85]
A0 06 colour-scale = 1.5 (255/170)
09 04 A0 FD 18 00
A1 05 colour-offset = 128
09 03 A0 00 80
A2 0F third-component b* = [-75, 125]
A0 06 colour-scale = 1.275 (255/200)
09 04 A0 FD 14 66
A1 05 colour-offset = 96
09 03 A0 00 60

B.9.3 User data conveyed by SUD in CDS

```
S-ACTIVITY-START-user-data ::= CHOICE {
                              [4] IMPLICIT DocumentCharacteristics }

DocumentCharacteristics  ::= SET  {
    documentApplicationProfile      [0] IMPLICIT OCTET STRING,
        ---'05'H for T.503/annex
    documentArchitectureClass       [1] IMPLICIT OCTET STRING,
        ---'00'H FDA
    nonBasicDocCharacteristics      [2] IMPLICIT NonBasicDocCharacteristics,
    additional-doc-characteristics  [9] IMPLICIT Additional-Doc-Characteristics OPTIONAL}
                                    ---  See B.9.2 (except document Application Profile)
```

B.9.4 Layout Object Descriptor (document layout root) conveyed by CSUI/CDUI

ASN.1 definition of Layout Object Descriptor (document layout root) conveyed by CSUI/CDUI is identical with conventional Group 4 facsimile. Followings are only example.

```
Interchange-Data-Element        ::= CHOICE {
    layout-object               [2] IMPLICIT Layout-Object-Descriptor }

Layout-Object-Descriptor        := SEQUENCE {
    object-type                 Layout-Object-Type,
    descriptor-body             Layout-Object-Descriptor-Body OPTIONAL }

Layout-Object-Type              := INTEGER  {document-layout-root (0) }

Layout-Object-Descriptor-Body ::= SET  {
    object-identifier           Object-or-Class-Identifier                  OPTIONAL,
    subordinates                [0] IMPLICIT SEQUENCE OF NumericString      OPTIONAL,
    default-value-lists         [7] IMPLICIT Default-Value-Lists-Layout     OPTIONAL}

Object-or-Class-Identifier ::= [APPLICATION 1]IMPLICIT PrintableString
        --- only digits and space are used in the present version
        --- of the standard; other characters are reserved for extensions;
        --- a "null" value is represented by an empty string.

Default-Value-Lists-Layout ::= SET {
    page-attributes             [2] IMPLICIT Page-Attributes OPTIONAL }

Page-Attributes         ::= SET {
    dimensions                  < Attributes  OPTIONAL,
    presentation-attributes     < Attributes  OPTIONAL}

Attributes              ::= CHOICE  {
    dimensions                  [1] IMPLICIT Dimension-Pair }
    presentation-attributes     [3] IMPLICIT Presentation-Attributes}

Dimension-Pair          ::= SEQUENCE {
    horizontal                  [0] IMPLICIT INTEGER,
    vertical                    CHOICE {
        fixed                           [0] IMPLICIT INTEGER,
        variable                        [1] IMPLICIT INTEGER } }
```

--- Coded example is shown in Appendix II/T.563 ----------

B.9.5 Layout Object Descriptor (page) conveyed by CSUI/CDUI

ASN.1 definition of Layout Object Descriptor (page) conveyed by CSUI/CDUI is identical to conventional Group 4 facsimile. Followings are only example.

```
Interchange-Data-Element ::= CHOICE  {
    layout-object                   [2] IMPLICIT Layout-Object-Descriptor }

Layout-Object-Descriptor    ::= SEQUENCE  {
    object-type                     Layout-Object-Type,
    descriptor-body                 Layout-Object-Descriptor-Body          OPTIONAL }

Layout-Object-Type          ::= INTEGER {  page (2)  }

Layout-Object-Descriptor-Body  ::= SET {
    object-identifier               Object-or-Class-Identifier                  OPTIONAL,
    content-portions                [1] IMPLICIT SEQUENCE OF NumericString      OPTIONAL,
    dimensions                      [4] IMPLICIT Dimension-Pair                 OPTIONAL,
    presentation-attributes         [6] IMPLICIT Presentation-Attributes        OPTIONAL}

Presentation-Attributes     ::= SET {
    content-type                    Content-Type  OPTIONAL,
    raster-graphics-attributes      [1] IMPLICIT Raster-Graphics- Attributes    OPTIONAL}

Content-Type                    := [APPLICATION 2]IMPLICIT INTEGER
                                        {formatted-raster-graphics (1) }

Raster-Graphics-Attributes      ::= SET {
    pel-path                        [0] IMPLICIT One-of-Four-Angles             OPTIONAL,
    line-progression                [1] IMPLICIT One-of-Two-Angles              OPTIONAL,
    pel-transmission-density        [2] IMPLICIT Pel-Transmission- Density      OPTIONAL}

One-of-Four-Angles          ::= INTEGER  {d0 (0)}      --- 0 ---
        --- default and basic value is d0 (0) ----
One-of-Two-Angles           ::= INTEGER  {d270 (3)}    ---270 ---
        --- default and basic value is d270 (0) ---

 --- Coded example is shown in Appendix II/T.563  ----------------
```

B.9.6 Content Portion conveyed by CSUI/CDUI

```
Interchange-Data-Element        ::= CHOICE  {
    content-portion                 [3] IMPLICIT Text-Unit  }

Text-Unit                       ::= SEQUENCE  {
    content-portion-attributes      Content-Portion-Attributes                  OPTIONAL,
    content-information             Content-Information}

Content-Portion-Attributes      ::= SET {
    content-identifier-layout       Content-Portion-Identifier                  OPTIONAL,
    type-of-coding                  Type-of-Coding,         -- mandatory for this annex
    coding-attributes               CHOICE  {
        raster-gr-coding-attributes     [2] IMPLICIT Raster-Gr-Coding-Attributes}
                                                                                OPTIONAL}

Content-Portion-Identifier  ::= [APPLICATION 0]IMPLICIT PrintableString
        -- only digits and space are used in the present version of the
        -- standard; other characters are reserved for extensions.
Type-of-Coding      ::=CHOICE       {
                                    [6] IMPLICIT OBJECT IDENTIFIER }
                                    --- { 2 8 3 7 13 } for 'JPEG'encoding
                                    --- t.82 "JBIG" is for further study.
```

```
Raster-Gr-Coding-Attributes  ::= SET {
    number-of-pels-per-line                 [0] IMPLICIT INTEGER                    OPTIONAL,
    compression                             [2] IMPLICIT Compression                OPTIONAL,
    number-of-discarded-pels                [3] IMPLICIT INTEGER                    OPTIONAL,
    bit-per-colour-component                [4] Bit-Per-Colour-Component            OPTIONAL,
    sub-sampling                            [10] IMPLICIT Sub-sampling              OPTIONAL,
    jpeg-coding-mode                        [11] IMPLICIT INTEGER {
                                        ---- Huffman coding
                                                baseline                            (0),
                                                extended-sequential-DCT             (1),
                                                progressive-DCT                     (2),
                                                spatial-lossless                    (3),
                                        ---- Arithmetic coding
                                                extended-sequential-DCT             (9),
                                                progressive-DCT                     (10),
                                                spatial-lossless                    (11)}  OPTIONAL,
    use-of-preferred-huffman-table      [14] IMPLICIT INTEGER {
                                                no                                  (0),
                                                yes                                 (1)} OPTIONAL}
                                        ----basic and default value is "no".

Bit-Per-Colour-Component ::= CHOICE  {
    component-list                              SEQUENCE OF INTEGER }
                --- gray-scale 12 bits          = (12, 0, 0)
                --- colour 8 bits               = (8, 8, 8)
                --- colour 12 bits              = (12, 12, 12)
        --- default and basic value is gray-scale 8 bits  (8, 0, 0)

Sub-sampling            ::= OCTET STRINGS
          -- 4:1:1              ((2,2),(1,1),(1,1))   :     '22 11 11'H
          -- 1:1:1              ((1,1),(1,1),(1,1))   :     '11 11 11'H
          -- 2:1:1 or 4:2:2     ((2,1),(1,1),(1,1))   :     '21 11 11'H

Content-Information     ::= OCTET STRINGS
                                -- t.81 string --
        --- Coded example ----------------
            A3  LL      content-portion  Text-Unit
                31  LL      content-portion-attributes
                    40  LL  (XX YY)  content-identifier-layout = (XX YY)
                    86  04  58 03 07 0D                  = { 2 8 3 7 13 } (T.81 "JPEG")
                    A2  1C      coding-attributes
                        80  02  09  80      number-of-pels-per-line = 2432   (ISO A3)
                        83  01  2F          number-of-discarded-pels = 47        (ISO A3)
                        A4  0B  30  09
                                02  01  08  bit-per-colour-component = (8,8,8) (colour 8 bits)
                                02  01  08
                                02  01  08
                        8A  03  11  11  11  sub-sampling = '11 11 11'H (1:1:1)
                        8B  01  01          jpeg-coding-mode = 1 (extended-sequential-DCT)
                24  80      content-information  OCTET STRING (constructed)
                    04  LL      XXXXXXXXXX(t.81 string)XXXXXXXXX      OCTET STRING (primitive)
                    04  LL      XXXXXXXXXX(t.81 string)XXXXXXXXX      OCTET STRING (primitive)
                    00  00      EOC
                00  00      EOC
        ---------------------------------------------------------------
        ---------------------------------------------------------------
            A3  LL      content-portion  Text-Unit
                31  15          content-portion-attributes
                    86  04  58 03 07 0D                  = { 2 8 3 7 13 } (T.81 "JPEG")
                    A2  0D          coding-attributes
                        A4  0B  30  09
                                02  01  08  bit-per-colour-component = (8,8,8)  (colour 8 bits)
                                02  01  08
                                02  01  08
                04  LL      XXXXXXXXXX(t.81 string)XXXXXXXXX      OCTET STRING (primitive)
                                                    (4:1:1 sub-sample JPEG data)
        ---------------------------------------------------------------
```