



INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

T.418

(11/1988)

SERIES T: TERMINAL EQUIPMENT AND PROTOCOLS
FOR TELEMATIC SERVICES

**OPEN DOCUMENT ARCHITECTURE (ODA)
AND INTERCHANGE FORMAT -
GEOMETRIC GRAPHICS CONTENT
ARCHITECTURE**

Reedition of CCITT Recommendation T.418 published in
the Blue Book, Fascicle VII.6 (1988)

NOTES

- 1 CCITT Recommendation T.418 was published in Fascicle VII.6 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).
- 2 In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation T.418

**OPEN DOCUMENT ARCHITECTURE (ODA) AND INTERCHANGE FORMAT -
GEOMETRIC GRAPHICS CONTENT ARCHITECTURE¹⁾**

CONTENT

- 1 *Scope*
- 2 *Normative references*
- 3 *Definitions, symbols, abbreviations and conventions*
 - 3.1 Definitions
 - 3.2 Symbols, abbreviations and conventions
- 4 *General principles*
 - 4.1 Content architecture classes
 - 4.2 Content
 - 4.3 Presentation attributes
 - 4.4 Coding of content information
 - 4.5 Layout and imaging of the content
- 5 *Positioning*
 - 5.1 Introduction
 - 5.2 Measurement units and directions
 - 5.3 The relationship between the region of interest and the basic layout object
- 6 *Definition of geometric graphics presentation attributes*
 - 6.1 Shared presentation attributes
 - 6.2 Layout presentation attributes
 - 6.3 Logical presentation attributes
 - 6.4 Content architecture class attributes
 - 6.5 Interaction with document architecture attributes
- 7 *Geometric graphics content portions attributes*
 - 7.1 Common coding attributes
 - 7.2 Content information
 - 7.3 Other coding attributes
- 8 *Formal definitions of geometric graphics content architecture dependent data types*
 - 8.1 Introduction
 - 8.2 Representation of geometric graphics presentation attributes
 - 8.3 Representation of coding attributes
 - 8.4 Representation of non-basic features and non-standard defaults
- 9 *Content layout process*
 - 9.1 Introduction
 - 9.2 Content layout process for formatted processable content architecture class

¹⁾ This text is aligned with the final text of the corresponding International Standard ISO 8613-2.

10 *Content imaging process*

10.1 Introduction

10.2 Content imaging process for formatted processable form content architecture class

11 *Definition of geometric graphics content architecture classes*

Annex A - Summary of ASN.1 object identifiers

Annex B - Recommendation for the development of geometric graphics content architecture levels in document application profiles

Annex C - Basic differences between character primitives in the geometric graphics and the content of a basic component structured according to the character content architectures defined in Recommendation T.416

1 Scope

1.1 The purpose of the T.410-Series of Recommendations is to facilitate the interchange of documents.

In the context of the T.410-Series, documents are considered to be items such as memoranda, letters, invoices, forms and reports, which may include pictures and tabular material. The content elements used within the documents may include graphic characters, geometric graphics elements and raster graphics elements, all potentially within one document.

Note - The T.410-Series is designed to allow for extensions, including typographical features, colour, spreadsheets and additional types of content such as sound.

1.2 The T.410-Series applies to the interchange of documents by means of data communication or the exchange of storage media.

The T.410-Series provides for the interchange of documents for either or both of the following purposes:

- to allow presentation as intended by the originator;
- to allow processing such as editing and reformatting.

The composition of a document in interchange can take several forms:

- formatted form, allowing presentation of the document;
- processable form, allowing processing of the document;
- formatted processable form, allowing both presentation and processing.

The T.410-Series also provides for the interchange of ODA information structures used for the processing of interchanged documents.

Furthermore, the T.410-Series allows for the interchange of documents containing one or more different types of content such as character text, images, graphics and sound.

1.3 This Recommendation

- a) defines a geometric graphics content architecture that can be used in conjunction with the document architecture defined in the Recommendation T.412;
- b) defines an interface which allows the use of content structured according to ISO 8632 within documents structured according to the Recommendation T.412;
- c) defines those aspects of positioning and imaging applicable to the presentation of this geometric graphics content architecture in a basic layout object;
- d) defines the presentation attributes applicable to this geometric graphics content architecture;
- e) describes a content layout process, which together with the document layout process described in the Recommendation T.412, describes the layout of geometric graphics content in basic layout and determines the dimensions of these basic layout objects.

2 Normative references

The following Recommendations and International Standards contain provision which, through reference in the text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Recommendation are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

- Rec. T.50 (1984), International Alphabet No. 5.
- Rec. X.208 (1988), Specification of abstract syntax notation one (ASN.1).
- ISO 8632-1: 1987, Information processing systems - Computer graphics - Metafile for the storage and transfer of picture description information - Part 1: Functional specification.
- ISO 8632-3: 1987, Information processing systems - Computer graphics - Metafile for the storage and transfer of picture description information - Part 3: Binary encoding.

3 Definitions, symbols, abbreviations and conventions

3.1 Definitions

For the purpose of this Recommendation, the definitions given in Recommendation T.411 apply. In addition, the definitions given in ISO 8632 apply to this Recommendation.

3.2 Symbols, abbreviations and conventions

3.2.1 CGM

This term is used to reference the Computer Graphics Metafile defined in ISO 8632. It is used as a qualifier for terms defined in ISO 8632 (for example, CGM elements).

3.2.2 Individual CGM elements

Throughout this part whenever individual CGM elements are referred to they are written in uppercase; for example, SCALING MODE.

3.2.3 CGM concepts

Whenever the concepts defined in CGM are referred to they are written in mixed upper and lower case as appropriate; for example, Scaling Mode or Virtual Device Coordinates.

3.2.4 Width and height

Width is used throughout this Recommendation to express the extent of a 2-dimensional area in the direction given by the counter-clockwise rotation from the horizontal direction as specified by the geometric graphics presentation attribute "orientation".

Height is used throughout this Recommendation to express the extent of a 2-dimensional area orthogonal to its width.

Note - Width or height are mostly used in combination with a reference to an area; for example, width of the available area.

4 General principles

4.1 Content architecture classes

This Recommendation defines one class of geometric graphics content architectures:

- a formatted processable form, which allows for document content to be processed and also to be presented as intended by the originator. Formatted processable form content can be associated with any basic component.

4.2 *Content*

A content portion that is structured according to a geometric graphics content architecture represents a single pictorial image. The representation is based on the Computer Graphics Metafile (CGM) defined in ISO 8632 (see § 7.2).

The CGM provides a format suitable for the storage, retrieval and interchange of picture description information. The format consists of an ordered set of elements. These elements are split into groups that:

- a) structure the information in the metafile;
- b) specify the precision of the values used within the metafile;
- c) control the display of the picture;
- d) perform basic drawing actions;
- e) control the attributes of the basic drawing actions;
- f) provide access to non-standard device capabilities.

ISO 8632 defines the form (syntax) and the functional behaviour (semantics) of these elements.

4.3 *Presentation attributes*

The geometric graphics content architecture defines geometric graphics presentation attributes applicable to basic layout and basic logical components. The geometric graphics presentation attributes direct the content layout process and specify the initial conditions at the start of the presentation of the content associated with a basic object.

Only the geometric graphics presentation attributes specifying CGM defaults (see § 6.1.1) can be overwritten by CGM elements in the content of the basic component to which they apply.

4.4 *Coding of content information*

The ordered set of elements of the content portion is encoded according to the "binary" encoding defined in ISO 8632-3 and constitutes a complete CGM.

The functionality represented by the geometric graphics presentation attributes specifying CGM defaults (see § 6.1.1) and CGM element groups is that defined by ISO 8632-1 and ISO 8632-3, except that:

- a) the defaulting rules are modified (see § 10.2.1);
- b) the CGM shall contain only one picture.

4.5 *Layout and imaging of the content*

The geometric graphics content architecture describes a content layout process which creates a basic layout object and determines the dimensions of this object into which the content associated with a basic logical object is to be laid out.

It also describes a content imaging process which determines the image of the content.

5 **Positioning**

5.1 *Introduction*

This clause describes the general principles concerning the positioning of a part of the VDC Space within basic layout objects.

This part is known as the region of interest. It is a rectangular region within the VDC Space, and is defined by two Virtual Device Coordinate pairs termed "first corner" and "second corner".

Note - The VDC Space is used within ISO 8632 for positioning geometric graphics elements, specifying directions, specifying dimensions etc.

5.2 *Measurement units and directions*

The positioning of geometric graphics content within a basic layout object is specified with relation to an orthogonal coordinate system.

The definition of the region of interest specifies the origin and directions of the axes of the coordinate system, with respect to the basic layout object.

Figure 1/T.418 illustrates that depending on which coordinates of the VDC Space are referenced by "first corner" and "second corner" the region of interest can affect the orientation of the axes used when imaging the geometric graphics content.

The measurement units for the x- and y-axis of the coordinate system are determined by the relationship of the dimensions of the region of interest to the dimensions of the basic layout object.

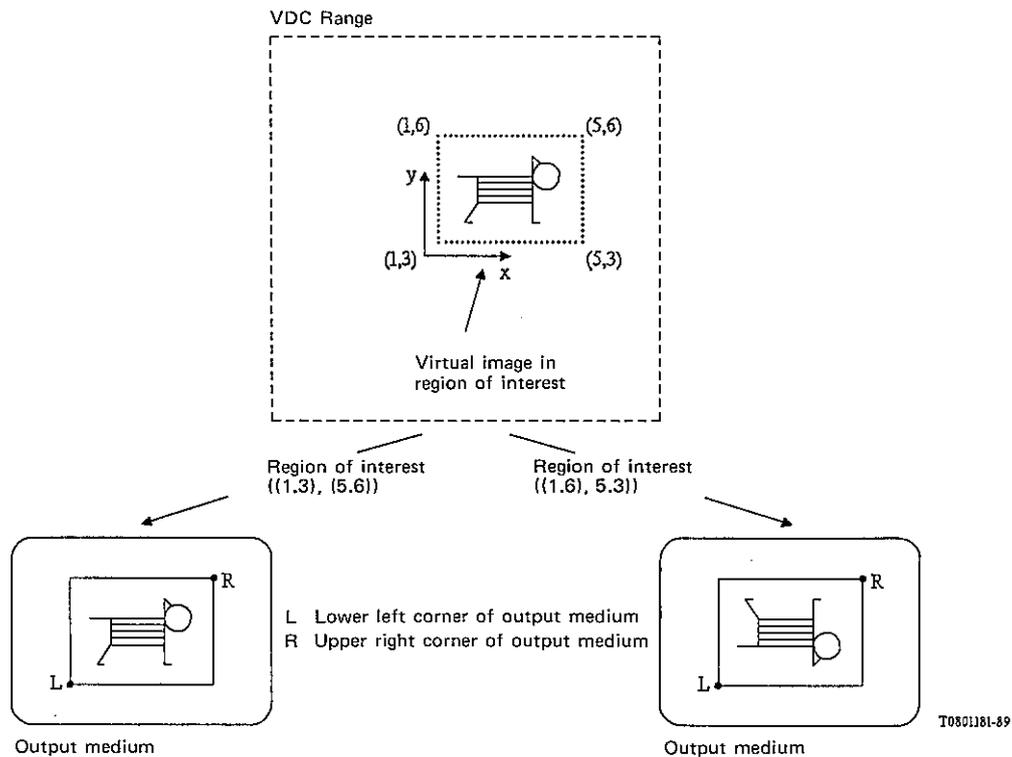


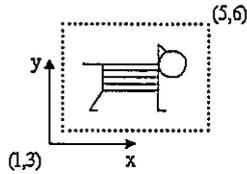
FIGURE 1/T.418
Mapping of a virtual image defined in the VDC Space to an output medium (e.g. a softcopy device) using different region of interest specifications

5.3 *The relationship between the region of interest and the basic layout object*

When imaging geometric graphics content, the geometric graphics presentation attribute "picture orientation" determines the relationship of the "first corner" of the region of interest to the corners of the basic layout object (see § 7.1.3).

The "first corner" of the region of interest is coincident with the corner of the basic layout object defined by the geometric graphics presentation attribute "picture orientation" (for example, the bottom left corner if the presentation attribute "picture orientation" has value '0°', see § 6.1.3). The "second corner" of the region of interest is coincident with the diagonally opposite corner of the basic layout object. It is implied that the x-axis of the VDC Space always maps to the direction parallel to the width of the basic layout object. Figures 2/T.418 and 3/T.418 illustrate this mapping.

CGM picture with region of interest $((1,3), (5,6))$ as normally mapped to an output medium the dotted line represents the region of interest, the arrows indicate the direction of increasing coordinate values



The picture above is imaged into the basic layout object as shown. The heavy border represents the boundary of the basic layout object

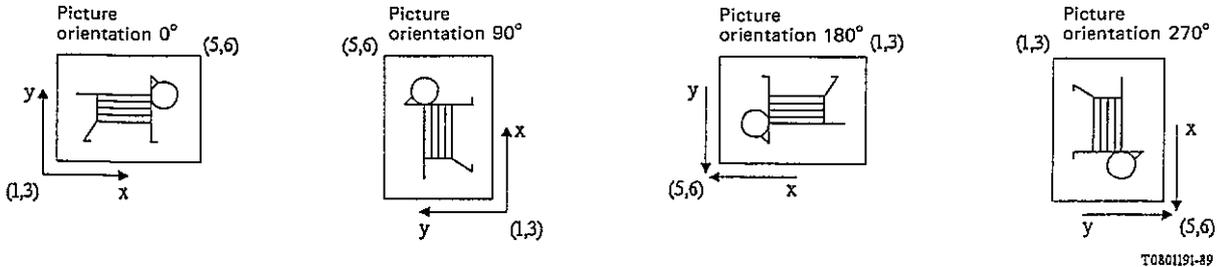
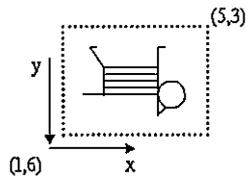


FIGURE 2/T.418

Relationship of region of interest to the basic layout object (right handed axes)

CGM picture with region of interest $((1,6), (5,3))$ as normally mapped to an output medium the dotted line represents the region of interest, the arrows indicate the direction of increasing coordinate values



The picture above is imaged into the layout object as shown. The heavy border represents the boundary of the basic layout object

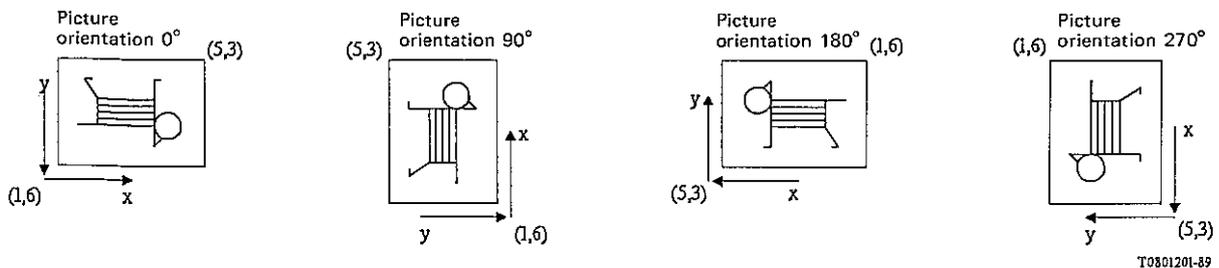


FIGURE 3/T.418

Relationship of region of interest to the basic layout object (left handed axes)

6 Definition of geometric graphics presentation attributes

Presentation attributes specify the constraints and initial conditions relating to the layout and imaging of a basic component. They may be specified for basic layout components, presentation styles and default value lists.

The following categories of presentation attributes are defined:

- a) logical presentation attributes which take effect during the content layout process but are ignored during the content imaging process;
- b) layout presentation attributes which take effect during the content imaging process. Their values are either determined by a content layout process or specified by a process that creates or edits the content;
- c) shared presentation attributes which take effect during both the content layout and imaging processes.

The geometric graphics presentation attributes are summarized in Table 1/T.418.

TABLE 1/T.418
Geometric graphics presentation attributes

Shared attributes	Layout attributes
Geometric graphics encoding announcer	No layout presentation attributes are specified for this content architecture
Line rendition	
Marker rendition	Logical attributes
Text rendition	
Filled area rendition	Picture dimensions
Edge rendition	
Colour representation	
Transparency specification	
Transformation specification	
Region of interest specification	
Picture orientation	

For each presentation attribute, a default value is defined. This value is used in the defaulting rules as defined in the Recommendation T.412.

This section also defines values specific to the geometric graphics content architecture for the content architecture class attributes. These attributes are defined in the Recommendation T.412.

6.1 Shared presentation attributes

6.1.1 Attributes specifying CGM defaults

The following presentation attributes provided information used for the construction and interpretation of the CGM defaults. They provide information used by the layout and imaging processes.

Note - This Recommendation uses the term "CGM defaults" whenever ISO 8632 uses the term "metafile defaults". This is intended to indicate the different semantics, in conformance with § 3.2.1, of "defaults" when used in the context of the T.410-Series of Recommendations (ODA) or ISO 8632 (CGM).

The default values given for the parameters of these presentation attributes have been derived from the defaults of the corresponding CGM elements as given in ISO 8632-1 and ISO 86323.

Note - Defaults for parameters specifying Direct Colour Values are given either as "foreground" representing the foreground colour, or "background" representing the background colour. The choice of foreground and background colour is implementation dependent. For reproduction on paper the background colour will normally be the colour of the paper, for instance white, and the foreground colour a contrasting colour, for instance black.

The presentation attribute "geometric graphics encoding announcer" specifies the encoding of parameters of the remaining CGM defaults attributes and specifies default values for the corresponding CGM elements.

The values of the CGM defaults attributes applicable to a basic object are determined by the defaulting rules defined in the Recommendation T.412.

The values of each parameters of a CGM defaults attribute is:

- a) the value specified;
- b) if not specified, the value defined in the specification of the default values for the attribute applicable to this parameter.

This Recommendation does not contain definitions of parameters of presentation attributes specifying CGM defaults which have the same definitions and semantics as CGM elements or parameters of these CGM elements with corresponding names defined in ISO 8632-1. This clause and its sub-clauses contain definitions of parameters for which the definitions differ from the definitions given in ISO 8632-1 and those parameters which are not defined in ISO 8632-1.

For certain parameters the CGM defines value ranges as being reserved for registration. The meaning of these values will be defined using the established procedures of the ISO International Registration Authority for Graphical Items.

The specification of the parameters of the CGM defaults attributes, their permissible and default values is made in tabular form. Some of these parameters have values composed of several sub-parameters. They are shown intended beyond the parameters using a smaller sized font. The sub-parameters may be further substructured. This is shown by further indentation.

Tables 2/T.418, 3/T.418 and 4/T.418 define the default values for the bundle representations, the pattern representations and colour representations, respectively. These tables are used when determining the default state of the imaging process (see § 10.2.1).

TABLE 2/T.418
Default bundle representations

Representations	Bundle index				
	1	2	3	4	5
Line					
Line type	1 (solid)	2 (dash)	3 (dot)	4 (dash-dot)	5 (dash-dot-dot)
Line Width (if scaled)	1,0	1,0	1,0	1,0	1,0
(if absolute)	0,001 × length of longest side of default VDC Extent	0,001 × length of longest side of default VDC Extent	0,001 × length of longest side of default VDC Extent	0,001 × length of longest side of default VDC Extent	0,001 × length of longest side of default VDC Extent
Line Colour (if indexed) (if direct)	1 foreground	1 foreground	1 foreground	1 foreground	1 foreground
Marker					
Marker type	1 (dot)	2 (plus)	3 (asterisk)	4 (circle)	5 (cross)
Marker size (if scaled)	1,0	1,0	1,0	1,0	1,0
(if absolute)	0,01 × length of longest side of default VDC Extent	0,01 × length of longest side of default VDC Extent	0,01 × length of longest side of default VDC Extent	0,01 × length of longest side of default VDC Extent	0,01 × length of longest side of default VDC Extent
Marker colour (if indexed) (if direct)	1 foreground	1 foreground	1 foreground	1 foreground	1 foreground

TABLE 2/T.418 (cont.)

Representations	Bundle index				
	1	2	3	4	5
Text					
Font index	1	1	none defined	none defined	none defined
Text precision	string	character	none defined	none defined	none defined
Character expansion factor	1,0	0,7	none defined	none defined	none defined
Character spacing	0,0	0,0	none defined	none defined	none defined
Text colour (if indexed) (if direct)	1 foreground	1 foreground	none defined none defined	none defined none defined	none defined none defined
Filled area					
Interior style	hollow	hatch	hatch	hatch	hatch
Fill colour (if indexed) (if direct)	1 foreground	1 foreground	1 foreground	1 foreground	1 foreground
Hatch index	1 (horizontal equally spaced parallel lines)	1 (horizontal equally spaced parallel lines)	2 (vertical equally spaced parallel lines)	3 (positive slope equally spaced parallel lines)	4 (negative slope equally spaced parallel lines)
Pattern index	1	1	1	1	1
Edge					
Edge type	1 (solid)	2 (dash)	3 (dot)	4 (dash-dot)	5 (dash-dot-dot)
Edge width (if scaled) (if absolute)	1,0 0,001 × length of longest side of default VDC Extent				
Edge colour (if indexed) (if direct)	1 foreground	1 foreground	1 foreground	1 foreground	1 foreground

TABLE 3/T.418

Default pattern representations

Pattern table entry	Pattern table index	
	0	1
NX (number of columns in pattern array)		1
NY (number of rows in pattern array)		1
Local colour precision	0	
Colour Index array (if indexed)		{1}
Value array (if direct)		{foreground}

TABLE 4/T.418

Default colour representations

Colour table entry	Colour table index	
	0	1
Direct colour value	background	foreground

6.1.1.1 Geometric graphics encoding announcer

Parameter	Permissible values	Default
VDC type	integer, real	integer
Integer precision	8, 16, 24, 32	16
Real precision	(floating point format, 9, 23) (floating point format, 12, 52) (fixed point format, 16, 16) (fixed point format, 32, 32)	(fixed point format, 16,16)
Index precision	8, 16, 24, 32	16
Colour precision	8, 16, 24, 32	8
Colour index precision	8, 16, 24, 32	8
Maximum Colour index	any integer ≥ 0	63
Colour value extent	any pair of direct colour values	((0,0,0), (255,255,255))
Colour selection mode	indexed - direct	indexed
VDC integer precision	16, 24, 32	16
VDC real precision	(floating point format, 9, 23) (floating point format, 12, 52) (fixed point format, 16, 16) (fixed point format, 16, 16)	(fixed point format 16,16)

This presentation attribute specifies default values for VDC Type, Integer Precision, Real Precision, Index Precision, Colour Precision, Colour Index Precision, Maximum Colour Index, Colour Value Extent, Colour Selection Mode, VDC Integer Precision and VDC Real Precision.

This presentation attribute also determines the encoding of parameters of the remainder of the CGM default attributes.

6.1.1.2 Line rendition

Parameter	Permissible values	Default
Line width specification mode	absolute, scaled	scaled
Line bundle index	any integer > 0	1
Line type	1 through 5 plus any registered line type > 5 (see Note)	1 (solid)
Line width (if scaled) (if absolute)	any real $\geq 0,0$ any non-negative VDC Value	1,0 0,001 x length of longest side of default VDC extent
Line colour (if indexed) (if direct)	any integer ≥ 0 any Direct Colour Value	1 foreground
Line aspect source flags	any three-tuple of (line type asf, line width asf, line colour asf)	(individual, individual, individual)
line type asf	bundled, individual	
line width asf	bundled, individual	
line colour asf	bundled, individual	
Line bundle specifications	any list containing zero, one or more elements	empty list
line bundle index	any integer > 0	
line bundle representation	any three-tuple of (line type, line width, line colour)	
line type	as for individual	
line width (if scaled) (if absolute)	as for individual as for individual	
line colour (if indexed) (if direct)	as for individual as for individual	

Note - The permissible values of the parameter are restricted to values which are standardized and registered. Private values are not permitted.

This presentation attribute sets default values used for the presentation of the line primitives in the geometric graphics content portion. It specifies the default values for the Line Width Specification Mode, the Line Bundle Index, the individual CGM line attributes, the line aspect source flags and specifies the default line bundle representations.

The line bundle specifications parameter defines the initial line representations to be used for imaging a basic object. For each unspecified representation the values in Table 2/T.418 apply.

This parameter consists of a list of zero, one or more pairs. Each pair consists of:

- a) line bundle index;
- b) line bundle representation, which supplies values for the bundled CGM line attributes.

6.1.1.3 Marker rendition

Parameter	Permissible values	Default
Marker size specification mode	absolute, scaled	scaled
Marker bundle index	any integer > 0	1
Marker type	1 to 5 plus any registered marker type > 5 (see Note)	3 (asterisk)
Marker size (if scaled) (if absolute)	any real $\geq 0,0$ any non-negative VDC value	1,0 0,01 \times length of longest side of default VDC extent
Marker colour (if indexed) (if direct)	any integer ≥ 0 any Direct Colour Value	1 foreground
Marker aspect source flags marker type asf marker size asf marker colour asf	any three-tuple of (marker-type asf, marker size asf, marker colour asf) bundled, individual bundled, individual bundled, individual	(individual, individual, individual)
Marker bundle specifications marker bundle index marker bundle representation marker type marker size (if scaled) (if absolute) marker colour (if indexed) (if direct)	any list containing zero, one or more elements any integer > 0 any three-tuple of (marker type, marker size, marker colour) as for individual as for individual as for individual as for individual as for individual	empty list

Note - The permissible values of the parameter are restricted to values which are standardized and registered. Private values are not permitted.

This presentation attribute sets default values used for the rendition of the marker primitives in the geometric graphics content portion. It specifies the default values for the Marker Size Specification Mode, the Marker Bundle Index, the individual CGM marker attributes, the marker aspect source flags and specifies the default marker bundle representations.

The marker bundle specifications parameter defines the initial marker representations to be used for imaging a basic object. For each unspecified representation the values in Table 2/T.418 apply.

This parameter consists of a list of zero, one or more pairs. Each pair consists of:

- a) marker bundle index;
- b) marker bundle representation, which supplies values for the bundled CGM marker attributes.

6.1.1.4 *Text rendition*

Parameter	Permissible values	Default
Font list	any list of registered font names (see Note)	List containing one element: the registered name of any font that can represent the nationality-independent character subset of Recommendation T.50
Character set list	any list of (character set type, designation sequence tail)	(94-character sets, designation sequence tail that is registered for a character set which includes the nationality-independent subset of Recommendation T.50 in the positions specified in Recommendation T.50)
Character set type	94-character sets, 96-character sets, 94-character multibyte sets, 96-character multibyte sets, complete code	
Designation sequence tail	any registered designation sequence tail (see Note)	
Character coding announcer	basic 7-bit, basic 8-bit, extended 7-bit, extended 8-bit (see Note)	basic 7-bit
Text bundle index	any integer > 0	1
Text font index	any integer > 0	1
Text precision	string, character, stroke	string
Character expansion factor	any real > 0,0	1.0
Character spacing	any real	0.0
Text colour (if indexed) (if direct)	any integer ≥ 0 any direct colour value	1 foreground
Character height	any non-negative VDC value	0.1 \times length of the longest side of the default VDC extent
Character orientation	any pair of VDC Vectors which have non-zero length and are not collinear	((0;1), (1;0))
Text path	right, left, up, down	right

Parameter	Permissible values	Default
Text alignment	any four-tuple of (horizontal alignment, vertical alignment, continuous horizontal alignment, continuous vertical alignment)	(normal horizontal, normal vertical n/a, n/a)
horizontal alignment	normal horizontal, left, centre, right, continuous horizontal	
vertical alignment	normal vertical, top, cap, half, base, bottom, continuous vertical	
continuous horizontal alignment	any real	
continuous vertical alignment	any real	
Character set index	any integer > 0	1
Alternate character set index	any integer > 0	1
Text aspect source flags	any five-tuple of (text font index asf, text precision asf, character expansion factor asf, character spacing asf, text colour asf)	(individual, individual, individual, individual, individual)
text font asf	bundled, individual	
text precision asf	bundled, individual	
character expansion factor asf	bundled, individual	
character spacing asf	bundled, individual	
text colour asf	bundled, individual	
Text bundle specifications	any list containing zero, one or more elements	empty list
Text bundle index	any integer > 0	
text bundle representation	any five-tuple of (text font index, text precision, character expansion factor, character spacing, text colour)	

Parameter	Permissible values	Default
Text font index	as for individual	
Text precision	as for individual	
Character expansion factor	as for individual	
Character spacing	as for individual	
Text colour (if indexed)	as for individual	
(if direct)	as for individual	

Note - The permissible values of the parameter are restricted to values which are standardized and registered. Private values are not permitted.

This presentation attribute sets default values used for the rendition of the text primitives in the geometric graphics content portion. It specifies the default values for the Font List, Character Set List, Character Coding Announcer, the Text Bundle Index, the individual CGM text attributes, the text aspect source flags and specifies the default text bundle representations.

The text bundle specifications parameter defines the initial text representations to be used for imaging a basic object. For each unspecified representation the values in Table 2/T.418 apply.

This parameter consists of a list of zero, one or more pairs. Each pair consists of:

- a) text bundle index;
- b) text bundle representation, which supplies values for the bundled CGM text attributes.

6.1.1.5 Filled area rendition

Parameter	Permissible values	Default
Fill bundle index	any integer > 0	1
Interior style	hollow, solid, pattern, hatch, empty	hollow
Fill colour (if indexed)	any integer \geq 0	1
(if direct)	any direct colour value	foreground
Hatch index	1 through 6 plus any registered hatch index > 6 (see Note)	1 (horizontal equally spaced parallel lines)
Pattern index	any integer > 0	1
Fill reference point	any virtual device coordinate	First corner of default VDC Extent

Parameter	Permissible values	Default
Pattern size	any four-tuple of (height vector x component, height vector y component, width vector x component, width vector y component)	(0, height of default VDC Extent, width of default VDC Extent, 0)
height vector x component	any VDC value	
height vector y component	any VDC value	
width vector x component	any VDC value	
width vector y component	any VDC value	
Pattern table specifications	any list containing zero, one or more pattern table elements	empty list
pattern table index	any integer > 0	
nx (number of columns in pattern)	any integer > 0	
ny (number of rows in pattern)	any integer > 0	
local colour recision	0, 1, 2, 4, 8, 16, 24, 32	
Colour index array (if indexed)	nx * ny cells of any integer ≥ 0	
value array (if direct)	nx * ny cells of any direct colour Value	
Fill aspect source flags	any four-tuple of (interior style asf, fill colour asf, hatch index asf, patter index asf)	(individual, individual individual, individual)
interior style asf	bundled, individual	
fill colour asf	bundled, individual	
hatch index asf	bundled, individual	
pattern index asf	bundled, individual	
Fill bundle specifications	any list containing zero, one or more elements	empty list

Parameter	Permissible values	Default
Fill bundle index Fill bundle representation	any integer > 0 any four-tuple of (interior style, fill colour, hatch index, pattern index)	
Interior style	as for individual	
Fill colour (if indexed) (if direct)	as for individual as for individual	
Hatch index	as for individual	
Pattern index	as for individual	

Note - The permissible values for the parameter are restricted to values which are standardized and registered. Private values are not permitted.

This presentation attribute sets default values used for the presentation of the interior of filled area primitives of a geometric graphics content portion. It specifies the default values for the Fill Bundle Index, the individual CGM filled area attributes, the pattern representations, the filled area aspect source flags and default fill bundle representations, applicable to the interior region of the filled area.

The pattern table specifications parameter is a list which supplies a complete set of values for zero, one or more pattern table entries. For each unspecified pattern table entry the values in Table 3/T.418 apply.

The fill bundle specifications parameter defines the initial bundle representations to be used for imaging a basic objet. For each unspecified representation the values in Table 2/T.418 apply.

This parameter consists of a list of zero, one or more pairs. Each pair consists of:

- a) fill bundle index;
- b) fill bundle representation, which supplies values for the bundled CGM filled area attributes.

6.1.1.6 *Edge rendition*

Parameter	Permissible values	Default
Edge width specification mode	absolute, scaled	scaled
Edge visibility	off, on	off
Edge bundle index	any integer > 0	1
Edge type	1 through 5 plus any registered line type (see Note)	1 (solid)
Edge width (if scaled) (if absolute)	any real $\geq 0,0$ any non-negative VDC value	1.0 0.001 \times length of longest side of default VDC extent

Parameter	Permissible values	Default
Edge colour (if indexed) (if direct)	any integer > 0 any direct colour value	1 foreground
Edge aspect source flag edge type asf edge width asf edge colour asf	any three-tuple of (edge type asf, edge width asf, edge colour asf) bundled, individual bundled, individual bundled, individual	(individual, individual, individual)
Edge bundle specifications Edge bundle index Edge bundle representation Edge type Edge width (if scaled) (if absolute) Edge colour (if indexed) (if direct)	any list containing zero, one or more elements any integer > 0 any three-tuple of (edge type, edge width, edge colour) as for individual as for individual as for individual as for individual as for individual	empty list

Note - The permissible values of the parameter are restricted to values which are standardized and registered. Private values are not permitted.

This presentation attribute sets default values used for the presentation of the edges of the filled area primitives in the geometric graphics content portion. It specifies the default values for the Edge Width Specification Mode, the Edge Visibility, the Edge Bundle Index, the individual CGM edge attributes, the edge aspect source flags and specifies the default edge bundle representations, applicable to the boundary of the filled area.

The edge bundle specifications parameter defines the initial edge representations to be used for imaging a basic object. For each unspecified representation the values in Table 2/T.418 apply.

This parameter consists of a list of zero, one or more pairs. Each pair consists of:

- a) edge bundle index;
- b) edge bundle representation, which supplies values for the bundled CGM edge attributes.

6.1.1.7 Colour representations

Parameter	Permissible values	Default
Background colour	any direct colour value	background
Colour table specifications	any list containing zero, one or more colour table elements	empty list
Starting index	any integer ≥ 0	
Colour list	any list containing one or more direct colour values	

This presentation attribute sets the default value for Background Colour and defines the initial colour representations to be used for imaging a basic object.

The parameter colour table specifications is a list which supplies a complete set of values for zero, one or more elements each of which supplies a list of Direct Colour Value specifications together with the index of the starting colour table entry for a continuous interval of one or more colour table entries. For each unspecified colour representations the values of Table 4/T.418 apply.

6.1.1.8 *Transparency specification*

Parameter	Permissible values	Default
Transparency	off, on	on
Auxiliary colour (if indexed) (if direct)	any integer ≥ 0 any direct colour value	0 background

This presentation attribute sets the default values for Transparency and Auxiliary Colour.

Note 1 - The default values of AUXILIARY COLOUR given in ISO 8632-1:1987(E) and ISO 8632-3:1987(E) are inconsistent. Due to these inconsistencies an arbitrary choice of 'background' was made.

Note 2 - Auxiliary Colour as defined in ISO 8632 is intended to address hardware features commonly available in raster devices. Some devices may have no such capabilities, or may have a subset of these capabilities to which this parameter pertains. Simulations of such a feature may be very complex. ISO 8632 does not require that a CGM interpreter need simulate the feature when it is not available in the hardware or firmware.

6.1.1.9 *Transformation specification*

Parameter	Permissible values	Default
VDC extent	any pair of Virtual Device Coordinates defining a rectangle	((0;0), (1;1))
Clip rectangle	any pair of Virtual Device Coordinates defining a rectangle	same as VDC extent
Clip indicator	off, on	on

This presentation attribute sets the default values for VDC extent, Clip rectangle and Clip indicator.

The Virtual Device Coordinate (0; 0) is the symbolic value of the origin of the coordinate system of the VDC Space. The Virtual Device Coordinate (1; 1) is the symbolic value of:

- a) (1,0; 1,0) for VDC Type 'real'
- b) (32767, 32767) if VDC Type is 'integer'.

Note - The default values for VDC EXTENT for VDC Type 'real' given in ISO 8632-1:1987(E) and ISO 8632-3:1987(E) are inconsistent. Due to these inconsistencies an arbitrary choice of '(1,0; 1,0)' was made for the Second Corner.

6.1.2 *Region of interest specification*

This presentation attribute specifies the region of interest used when laying out and imaging the content of the basic object.

This presentation attribute consists of one of the following parameters:

- a) "rectangle", consisting of two sub-parameters specifying the Virtual Device Coordinates for the first corner and the Virtual Device Coordinates for the second corner of the region of interest;
- b) "automatic", not comprising any sub-parameters and its value is 'null'.

The default value is the parameter "automatic".

If the parameter "automatic" is specified the region of interest is the same as the VDC Extent.

If coordinate pairs for the first corner and second corner are specified using the parameter "rectangle", then the region of interest is specified by these values.

6.1.3 *Picture orientation*

This presentation attribute specifies with which corner of the basic layout object the first corner of the region of interest is to be made coincident.

This presentation attribute specifies one of the four corners of a basic layout object:

- 0° bottom left corner;
- 90° bottom right corner;
- 180° top right corner;
- 270° top left corner.

The default value is 0° (bottom left corner).

6.2 *Layout presentation attributes*

No layout presentation attributes are specified for this content architecture.

6.3 *Logical presentation attributes*

6.3.1 *Picture dimensions*

This presentation attribute specifies the intended dimensions of the basic layout object that is to contain the image defined by the geometric graphics content portion.

The value of this attribute consists of one of four parameters:

- a) "width controlled";
- b) "height controlled";
- c) "area controlled";
- d) "automatic".

The parameter "width controlled" has two sub-parameters "minimum width" and "preferred width".

The parameter "height controlled" has two sub-parameters "minimum height" and "preferred height".

The parameter "area controlled" has five sub-parameters:

- a) "minimum width";
- b) "preferred width";
- c) "minimum height";
- d) "preferred height";
- e) "aspect ratio flag".

The parameter "automatic" has no sub-parameter and its value is 'null'.

The sub-parameter "aspect ratio flag" has the value 'fixed' or 'variable'. All other sub-parameters have non-negative integer values in SMUs.

The default value of this attribute is the parameter "automatic".

The values of "minimum width" and "preferred width" specify the lower limit and the upper limit of the allowed widths of the basic layout object. The value of the "minimum width" shall not be greater than the value of the "preferred value".

The values of "minimum height" and "preferred height" specify the lower limit and the upper limit of the allowed heights of the basic layout object. The value of the "minimum height" shall not be greater than the value of the "preferred height".

If either or both of the values for "preferred width" and "preferred height" are specified the dimensions of the basic layout object shall be as close to the corresponding specified values as possible.

"Aspect ratio flag" has one of the values 'fixed' or 'variable', specifying whether or not the aspect ratio of the basic layout object shall be equal to that of the region of interest.

If only the range of allowed widths for the basic layout object is specified (case a), this attribute specifies that the height of the basic layout object shall be such that the aspect ratio of the region of interest is maintained.

If only the range of allowed heights for the basic layout object is specified (case b), this attribute specifies that the width of the basic layout object shall be such that the aspect ratio of the region of interest is maintained.

If both the ranges of allowed width and heights are specified (case c) the value of "aspect ratio flag" determines whether or not the aspect ratio of the region of interest shall be maintained during the determination of the dimensions of the basic layout object.

If neither the range of allowed heights nor the range of allowed widths is specified (case d), this attribute specifies that the width of the basic layout object shall be equal to the dimension of the available area in that direction and that the height is constrained to maintain the aspect ratio of the region of interest.

6.4 *Content architecture class attributes*

6.4.1 *Content architecture class*

The value of the attribute "content architecture class" of a basic component description that conforms to this Recommendation is an ASN.1 object identifier with the value

{ 2 8 2 8 0 }

6.4.2 *Content type*

The attribute "content type" cannot be used to specify the content architecture defined in this Recommendation.

6.5 *Interaction with document architecture attributes*

The value 'concatenate' of the layout directive attribute "concatenation" is ignored. This attribute is not taken into account during the layout of the geometric graphics content.

The layout directive attribute "indivisibility" may be ignored. It provides no additional constraint for the geometric graphics content layout process.

7 **Geometric graphics content portions attributes**

7.1 *Common coding attributes*

The value of the content portion attribute "type of coding" of a content portion description that conforms to this Recommendation is an ASN.1 object identifier with the value

{ 2 8 3 8 0 }.

7.2 *Content information*

The value of the content portion attribute "content information" of a content portion description that conforms to this Recommendation is an ASN.1 octet string representing a CGM conforming to the rules defined in ISO 8632-1 with the binary encoding defined in ISO 8632-3.

The relationship between this Recommendation and ISO 8632 is such that:

- a) the string specified by the attribute "content information" in a geometric graphics content portion is a complete CGM as defined in ISO 8632-1 and ISO 8632-3;
- b) any CGM as defined in ISO 8632-1 and ISO 8632-3 containing a single picture may be used as the value of a string specified by the attribute "content information" in a geometric graphics content portion.

Note - The presentation attributes specifying CGM defaults (see § 6.1.1) are provided for applying the factorization mechanism of an ODA environment to data that may be shared among several geometric graphics content portions. If a geometric graphics content portion is provided by importing a CGM into the ODA environment, then extreme care should be used in any attempt to assign this CGM as a data value for the content portion attribute "content information" and using the presentation attributes to change the default values of the CGM. The effects of changing the default values of such an imported CGM could quite possibly make the interpretation of the CGM non-sensible or impossible. The presentation attributes that should especially be considered are those that would cause a misunderstanding of the CGM data (for example, the presentation attribute "geometric graphics encoding announcer").

7.3 *Other coding attributes*

No other coding attributes are defined in this Recommendation.

8 Formal definitions of geometric graphics content architecture dependent data types

8.1 Introduction

This section contains the formal definitions, in ASN.1 notation (defined in Recommendation X.208), of data types corresponding to presentation and coding attributes that are applicable to geometric graphics content architectures.

These data types are:

- a) the data type to represent the geometric graphics content architecture specific presentation attributes in basic layout components, presentation styles and default value lists;
- b) the data type to represent the geometric graphics content architecture specific coding attributes in content portions;
- c) the data type to represent the non-basic values of the geometric graphics content architecture presentation attributes in the document profile;
- d) the data type to represent the non-basic values of the geometric graphics content architecture coding attributes in the document profiles;
- e) the data type to represent the non-standard default values of geometric graphics content architecture presentation and coding attributes in the document profile.

8.2 Representation of geometric graphics presentation attributes

The data type "Geometric-Graphics-Attributes" contains a set of subordinate data types that specify the geometric graphics presentation attributes. Some of these subordinate data types are elementary but others are structured and themselves made up of subordinate data types. The format of these data types is given below.

The subset of subordinate data types that may occur within a particular instance of the data type "Geometric-Graphics-Attributes" depends upon the particular geometric graphics content architecture level that is specified.

```

Geo-Gr-Presentation-Attributes          { 2 8 1 8 2 }
DEFINITIONS                             ::= BEGIN
    EXPORTS                              Geometric-Graphics-Attributes, Encoding-Announcer,
                                          Line-Rendition, Marker-Rendition, Text-Rendition,
                                          Filled-Area-Rendition, Edge-Rendition,
                                          Colour-Representations, Transparency-Specification
                                          Transformation-Specification,
                                          Region-Of-Interest, Picture-Orientation, Picture-Dimensions,
                                          ASF-Type, VDC-Pair, One-Of-Four-Angles;

    Geometric-Graphics-Attributes        ::= SET {
        encoding-announcer                [0] IMPLICIT Encoding-Announcer OPTIONAL,
        line-rendition                    [1] IMPLICIT Line-Rendition OPTIONAL,
        marker-rendition                  [2] IMPLICIT Marker-Rendition OPTIONAL,
        text-rendition                    [3] IMPLICIT Text-Rendition OPTIONAL,
        filled-area-rendition             [4] IMPLICIT Filled-Area-Rendition OPTIONAL,
        edge-rendition                    [5] IMPLICIT Edge-Rendition OPTIONAL,
        colour-representations            [6] IMPLICIT Colour-Representations OPTIONAL,
        transparency-specification         [7] IMPLICIT Transparency-Specification OPTIONAL,
        transformation-specification       [8] IMPLICIT Transformation-Specification OPTIONAL,
        region-of-interest                 [9] Region-Of-Interest OPTIONAL,
        picture-orientation                [10] IMPLICIT Picture-Orientation OPTIONAL,
        picture-dimensions                 [11] Picture-Dimensions OPTIONAL }

    Encoding-Announcer                    ::= OCTET STRING
                                          -- octet string representing the binary
                                          -- encoding of any ordered set of CGM elements
                                          -- identified in § 6.1.1.1

    Line-Rendition                         ::= SEQUENCE {
        individual-part                    [0] IMPLICIT OCTET STRING OPTIONAL,
                                          -- octet string representing the binary
                                          -- encoding of any ordered set of CGM elements
                                          -- identified in § 6.1.1.2 up to parameter
                                          -- "line aspect source flags"
    }

```

asf-part line-type-asf line-width-asf line-colour-asf	[1]	IMPLICIT SEQUENCE{ ASF-Type, ASF-Type, ASF-Type } OPTIONAL,
bundle-part bundle-index bundle-representation	[2]	IMPLICIT SEQUENCE OF SEQUENCE { INTEGER OCTET STRING } OPTIONAL <i>-- octet string representing the binary encoding</i> <i>-- of the CGM elements</i> <i>-- LINE TYPE, LINE WIDTH and</i> <i>-- LINE COLOUR, as identified in § 6.1.1.2</i> }
Marker-Rendition individual-part	::=	SEQUENCE{ [0] IMPLICIT OCTET STRING OPTIONAL, <i>-- octet string representing the binary encoding</i> <i>-- of any ordered set of CGM elements</i> <i>-- identified in § 6.1.1.3 up to parameter</i> <i>-- "marker aspect source flags"</i>
asf-part marker-type-asf marker-size-asf marker-colour-asf	[1]	IMPLICIT SEQUENCE{ ASF-Type, ASF-Type, ASF-Type } OPTIONAL,
bundle-part bundle-index bundle-representation	[2]	IMPLICIT SEQUENCE OF SEQUENCE { INTEGER OCTET STRING } OPTIONAL <i>-- octet string representing the binary</i> <i>-- encoding of the CGM elements</i> <i>-- MARKER TYPE</i> <i>-- MARKER SIZE and MARKER COLOUR,</i> <i>-- as identified in § 6.1.1.3</i> }
Text-Rendition individual-part	::=	SEQUENCE { [0] IMPLICIT OCTET STRING OPTIONAL, <i>-- octet string representing the binary</i> <i>-- encoding of any ordered set of CGM elements</i> <i>-- identified in § 6.1.1.4 up to</i> <i>-- parameter "text aspect source flags"</i>
asf-part text-font-asf text-precision-asf character-expansion-factor-asf character-spacing-asf text-colour-asf	[1]	IMPLICIT SEQUENCE { ASF-Type, ASF-Type, ASF-Type, ASF-Type, ASF-Type } OPTIONAL,
bundle-part bundle-index bundle-representation	[2]	IMPLICIT SEQUENCE OF SEQUENCE { INTEGER OCTET STRING } OPTIONAL <i>-- octet string representing the binary</i> <i>-- encoding of the CGM elements</i> <i>-- TEXT FONT INDEX, TEXT PRECISION</i> <i>-- CHARACTER EXPANSION FACTOR,</i> <i>-- CHARACTER SPACING and</i> <i>-- TEXT COLOUR,</i> <i>-- as identified in § 6.1.1.4</i>

```

Filled-Area-Rendition ::= SEQUENCE {
    individual-part [0] IMPLICIT OCTET STRING OPTIONAL,
    -- octet string representing the binary
    -- encoding of any ordered set of CGM
    -- elements identified in § 6.1.1.5,
    -- up to parameter "pattern table specifications"
    pattern-table-part [1] IMPLICIT SEQUENCE OF
        Pattern-Table-Element OPTIONAL

Pattern-Table-Element ::= -- octet string representing the binary encoding
    -- of the CGM elements
    -- PATTERN TABLE, as identified in § 6.1.1.5
    asf-part [2] IMPLICIT SEQUENCE{
        interior-style-asf ASF-Type,
        fill-colour-asf ASF-Type,
        hatch-index-asf ASF-Type,
        pattern-index-asf ASF-Type
    } OPTIONAL,
    bundle-part [3] IMPLICIT SEQUENCE OF SEQUENCE{
        bundle-index INTEGER
        bundle-representation OCTET STRING } OPTIONAL

    -- octet string representing the binary encoding
    -- of the CGM elements INTERIOR STYLE
    -- FILL COLOUR,
    -- HATCH INDEX and PATTERN INDEX as
    -- identified in § 6.1.1.5
    }

Edge-Rendition ::= SEQUENCE {
    individual-part [0] IMPLICIT OCTET STRING OPTIONAL,
    -- octet string representing the binary encoding
    -- of any ordered set of CGM elements
    -- identified in § 6.1.1.6 up to parameter
    -- "edge aspect source flags"
    asf-part [1] IMPLICIT SEQUENCE {
        edge-type-asf ASF-Type,
        edge-width-asf ASF-Type,
        edge-colour-asf ASF-Type
    } OPTIONAL,
    bundle-part [2] IMPLICIT SEQUENCE OF SEQUENCE {
        bundle-index INTEGER,
        bundle-representation OCTET STRING } OPTIONAL

    -- octet string representing the binary encoding
    -- of the CGM elements EDGE TYPE,
    -- EDGE WIDTH and EDGE COLOUR as
    -- identified in § 6.1.1.6
    }

ASF-Type ::= INTEGER { bundle(0), individual(1) }
Colour-Representations ::= SEQUENCE {
    background-colour [0] IMPLICIT OCTET STRING OPTIONAL,
    -- octet string representing the binary encoding
    -- of the CGM element BACKGROUND COLOUR
    -- as identified in § 6.1.1.7
    colour-table-part [1] IMPLICIT SEQUENCE OF {
        Colour-Table-Element OPTIONAL

Colour-Table-Element ::= -- octet string representing the binary encoding
    -- of the CGM element COLOUR TABLE, as
    -- identified in § 6.1.1.7
    }

```

```

Transparency-Specification ::= OCTET STRING
-- octet string representing the binary encoding
-- of any ordered set of the CGM elements
-- identified in § 6.1.1.8

Transformation-Specification ::= OCTET STRING
-- octet string representing the binary encoding
-- of any ordered set of CGM elements
-- identified in § 6.1.1.9

Region-Of-Interest ::= CHOICE {
    automatic
    rectangle
    [0] IMPLICIT NULL,
    [1] IMPLICIT SEQUENCE { VDC-Pair, VDC-Pair }
}

VDC-Pair ::= OCTET STRING
-- octet string representing the binary encoding
-- of a CGM Virtual Device Coordinate pair

Picture-Orientation ::= One-Of-Four-Angles

One-Of-Four-Angles ::= INTEGER{
    d0(0),
    d90(1),
    d180(2),
    d270(3) }

Picture-Dimensions ::= CHOICE {
    width-controlled
        minimum-width
        preferred-width
    height-controlled
        minimum-height
        preferred-height
    area-controlled
        minimum-width
        preferred-width
        minimum-height
        preferred-height
        aspect-ratio-flag
    automatic
    [0] IMPLICIT SEQUENCE {
        INTEGER,
        INTEGER },
    [1] IMPLICIT SEQUENCE {
        INTEGER,
        INTEGER },
    [2] IMPLICIT SEQUENCE {
        INTEGER,
        INTEGER,
        INTEGER,
        INTEGER,
        INTEGER { fixed(0), variable(1) }},
    [3] IMPLICIT NULL
}

END

```

8.3 Representation of coding attributes

```

Geo-Gr-Coding-Attributes { 2 8 1 8 3 }

DEFINITIONS ::= BEGIN
    EXPORTS
        Geo-Gr-Coding-Attributes;
Geo-Gr-Coding-Attributes ::= SET { }
-- no geometric graphics coding attributes
-- are defined in this Recommendation

END

```

8.4 Representation of non-basic features and non-standard defaults

```

Geo-Gr-Profile-Attributes { 2 8 1 8 4 }

DEFINITION ::= BEGIN
    EXPORTS
        Geo-Gr-Presentation-Feature,
        Geo-Gr-Coding-Attributes,
        Geo-Gr-Content-Defaults;
    IMPORTS
        Encoding-Announcer, Line-Rendition, Marker-Rendition,
        Text-Rendition, Filled-Area-Rendition, Edge-Rendition,

```

Colour-Representations, Transparency-Specification,
Transformation-Specification, Region-Of-Interest,
Picture-Orientation, Picture-Dimensions, ASF-Type,
VDC-Pair, One-Of-Four-Angles
FROM Geo-Gr-Presentation-Attributes;
-- see § 8.2

```
Geo-Gr-Presentation-Feature ::= NULL
-- no non-basic values are expected to be defined
-- for the geometric graphics presentation attributes
-- in this Recommendation

Geo-Gr-Coding-Attribute ::= NULL
-- no non-basic values are expected to be defined for
-- the geometric graphics coding attributes
-- in this Recommendation

Geo-Gr-Content-Defaults ::= SET {
    encoding-announcer [0] IMPLICIT Encoding-Announcer OPTIONAL,
    line-rendition [1] IMPLICIT Line-Rendition OPTIONAL,
    marker-rendition [2] IMPLICIT Marker-Rendition OPTIONAL,
    text-rendition [3] IMPLICIT Text-Rendition OPTIONAL,
    filled-area-rendition [4] IMPLICIT Filled-Area-Rendition OPTIONAL,
    edge-rendition [5] IMPLICIT Edge-Rendition OPTIONAL,
    colour-representations [6] IMPLICIT Colour-Representations OPTIONAL,
    transparency-specification [7] IMPLICIT Transparency-Specification OPTIONAL,
    transformation-specification [8] IMPLICIT Transformation-Specification OPTIONAL,
    region-of-interest [9] IMPLICIT Region-Of-Interest OPTIONAL,
    picture-orientation [10] IMPLICIT Picture-Orientation OPTIONAL,
    picture-dimensions [11] IMPLICIT Picture-Dimensions OPTIONAL }

END
```

9 Content layout process

This section describes a content layout process for basic logical objects associated with content architectures of type geometric graphics.

Its purpose is to aid understanding of the semantics of the presentation attributes by describing the required results of such a process. However, it is not intended to specify any process that might be carried out in a particular implementation to achieve these results.

9.1 Introduction

9.1.1 Purpose

The content layout process describes a process of laying out the geometric graphics content into an allocated area. This area is referred to as the available area and is determined by the document layout process described in the Recommendation T.412.

The purpose of the content layout process is to convert content associated with basic logical components into content associated with basic layout objects.

The content layout process results in the creation of a basic layout object into which the content shall be positioned. The dimensions of the basic layout object are returned to the document layout process which determines the precise position of that basic layout object within the available area.

9.1.2 Available area

The content layout process is constrained by the available area. The maximum dimensions that a basic layout object can take are constrained by the dimensions of the available area.

During the layout of content associated with a basic logical component into a basic layout object, the following cases can occur:

- a) the formatted processable content fits into the dimensions of the available area;
- b) the formatted processable content does not fit into the dimensions of the available area; in this case, a new available area is required.

9.1.3 *Presentation attributes*

The content layout process takes into account the presentation attributes applying to the basic logical object with which the content is associated. The content layout process takes also into account the region of interest that may depend on CGM elements in the content portion.

The presentation attributes applying to the content layout process can be specified in the generic layout structure and presentation styles. The values of these presentation attributes are determined according to the defaulting rules specified in the Recommendation T.412.

9.1.4 *Geometric graphics content architecture classes*

The content layout process is specified for basic logical objects associated with the formatted processable form geometric graphics content architecture class. The content layout process does not modify the form of the content.

9.1.5 *Layout of the content*

For the geometric graphics content architecture class, one case of laying out the content of basic logical objects into layout objects is possible:

- single basic logical object to single basic layout object: the content associated with a single basic logical object can be laid out into a single basic layout object and is the only content associated with this basic layout object.

9.2 *Content layout process for formatted processable content architecture class*

Determination of the dimensions of the basic layout object depends on the value of the presentation attribute "picture dimensions" (the four possible cases are illustrated in Figures 4/T.418 to 7/T.418):

- a) The presentation attribute "picture dimensions" specifies a value for the parameter "width controlled".

In this case the width of the picture will be within the range specified by the originator.

The determination of the basic layout object dimensions is constrained by the range of allowed widths given by the value of the parameter "width controlled", the dimensions of the available area and the aspect ratio of the region of interest.

The dimensions of the basic layout object shall be determined such that: the basic layout object fits into the available area; the aspect ratio of the basic layout object is the same as that of the region of interest; and the width of the basic layout object has a value that is within the range of allowed widths. The width of the basic layout object shall in addition be determined such that the deviation from the value of "preferred width", specified by the parameter "width controlled" is as small as possible.

- b) The presentation attribute "picture dimensions" specifies a value for the parameter "height controlled".

In this case the height of the picture will be within the range specified by the originator.

The determination of the basic layout object dimensions is constrained by the range of allowed heights given by the value of the parameter "height controlled", the dimensions of the available area and the aspect ratio of the region of interest.

The dimensions of the basic layout object shall be determined such that: the basic layout object fits into the available area; the aspect ratio of the basic layout object is the same as that of the region of interest; and the height of the basic layout object has a value that is within the range of allowed heights. The height of the basic layout object shall in addition be determined such that the deviation from the value of "preferred height", specified by the parameter "height controlled" is as small as possible.

- c) The presentation attribute "picture dimensions" specifies a value for the parameter "area controlled".

In this case the dimensions of the picture will be within the range specified by the originator. In particular, this can be used to ensure that a picture will have a fixed size.

The determination of the basic layout object dimensions is constrained by the range of allowed heights and widths given by the value of the parameter "area controlled", the dimensions of the available area and,

depending on the value of the sub-parameter "aspect ratio flag" of the parameter "area controlled", by the aspect ratio of the region of interest.

The dimensions of the basic layout object shall be determined such that: the basic layout object fits into the available area; the width of the basic layout object has a value that is within the range of allowed widths; and the height of the basic layout object has a value that is within the range of allowed heights. If the value of the sub-parameter "aspect ratio flag" is 'fixed' there is the further constraint to the basic layout object dimensions, that the aspect ratio of the basic layout object shall be the same as that of the region of interest. Both the width and height of the basic layout object shall additionally be chosen such, that their deviations from their preferred values, specified by the parameter "area controlled" are both as small as possible.

- d) The presentation attribute "picture dimensions" specifies a value for the parameter "automatic".

In this case the picture dimensions are automatically adjusted to the page layout.

The determination of the basic layout object dimensions is constrained by the dimensions of the available area and the aspect ratio of the region of interest.

The dimensions of the basic layout object shall be determined such that: the basic layout object fits into the available area; the width of the basic layout object is given the same value as the dimension of the available area in that direction; and the height of the basic layout object is determined such, that the aspect ratio of the basic layout object dimensions is the same as that of the region of interest.

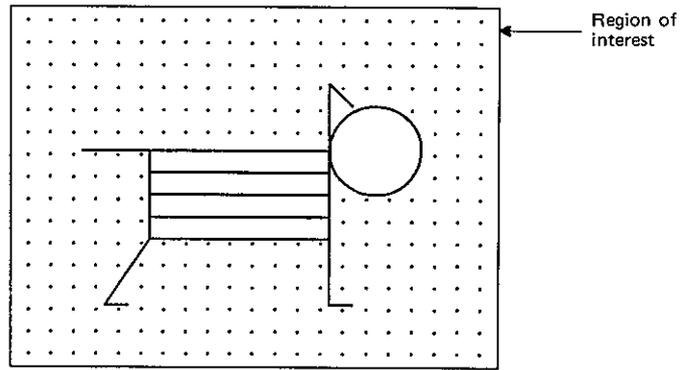
If the given constraints cannot be met, then no dimensions of the basic layout object are determined.

If the SCALING MODE is 'metric', it is required that the values of the parameter set "picture size" is the equivalent value in SMUs of the specified metric size, taking into account the document profile attribute "unit scaling".

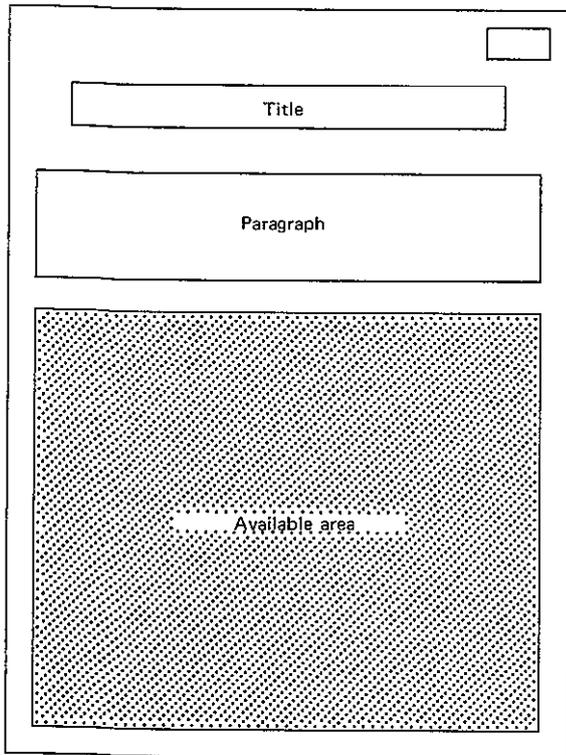
The dimensions of a basic layout object are restricted to integral multiples of 1 SMU.

The presentation attribute "picture orientation" may rotate the region of interest. The rotated region of interest is used for the calculation of the basic layout object dimensions.

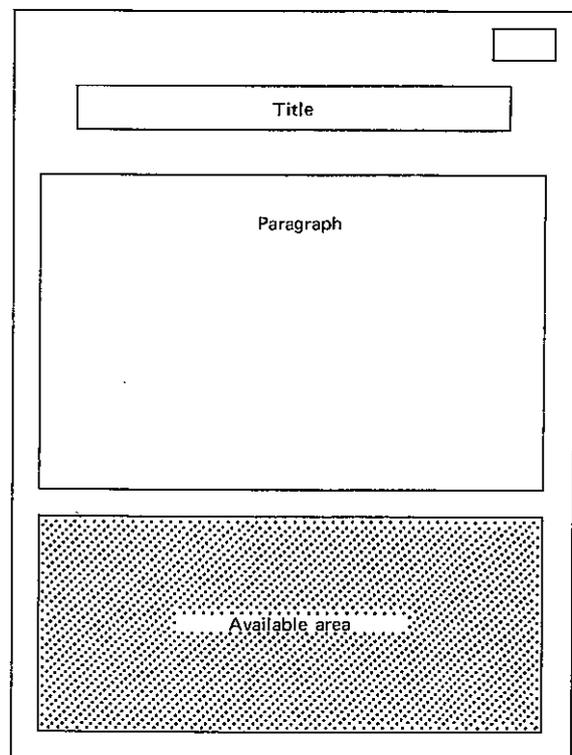
The geometric graphics content



Assumed page layout A



Alternate assumed page layout B



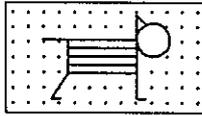
T0807660-89

FIGURE 4/T.418

Diagrams used to illustrate the process of determining the basic layout object dimensions

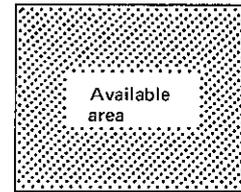
Value of presentation attribute "picture dimensions": automatic

- Initial constraints



Aspect ratio of region interest

(Page layout A)



Width of available area

Dimensions of available area

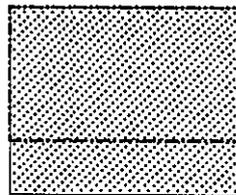
- Allowable picture dimensions



Height = width of available area / aspect ratio

Width = width of available area

- Basic layout object dimensions determined

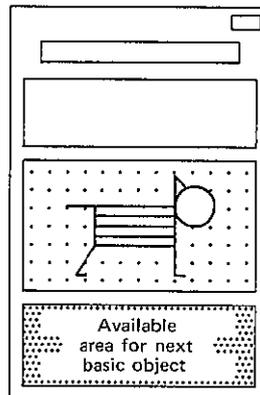


Dimensions of the basic layout object

Dimensions of the available area

- Basic objects laid out, positioned and imaged

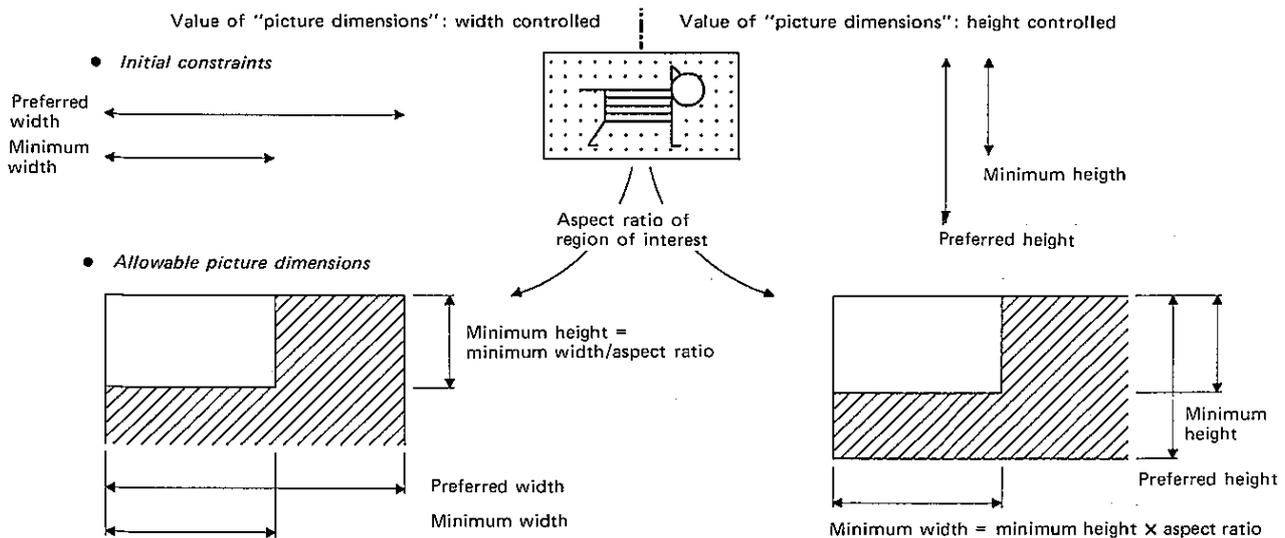
Note — In this example, the positioning of these basic layout objects assumes normal fill order, the attribute "block alignment" has value 'centered' and a certain separation between two consecutive blocks.



T0802670-89

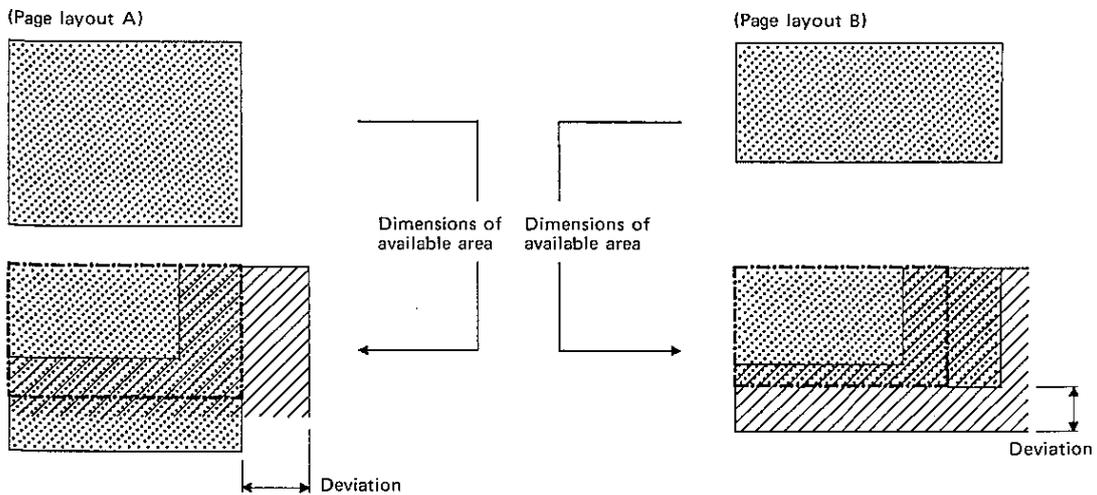
FIGURE 5/T.418

Layout process for the presentation attribute "picture dimensions" when a value is specified for the parameter "automatic"



Note – The hatched areas show a range of allowable picture dimensions.

• **Basic layout object dimensions determined**



Note 1 – The basic layout object is indicated by the dashed-dotted boundary.

Note 2 – For specifying range of allowed picture widths and layout A the preferred width cannot be satisfied due to the available width.

Note 3 – For specifying range of allowed picture heights and layout B the major constraint is the height of the available area.

• **Basic objects laid out, positioned and imaged**

Note – In this example, the positioning of these basic layout objects assumes normal fill order, the attribute "block alignment" has value 'centered' and a certain separation between two consecutive blocks.

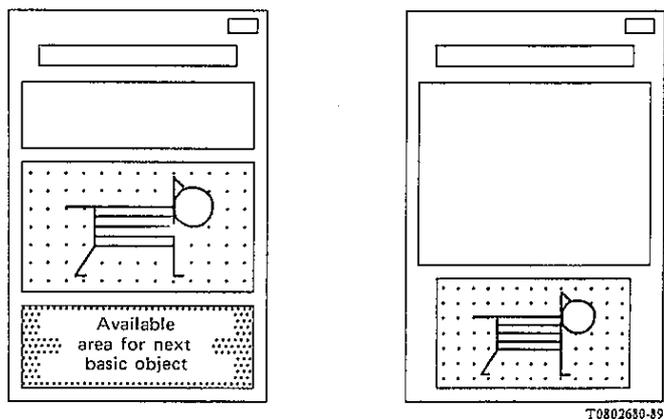
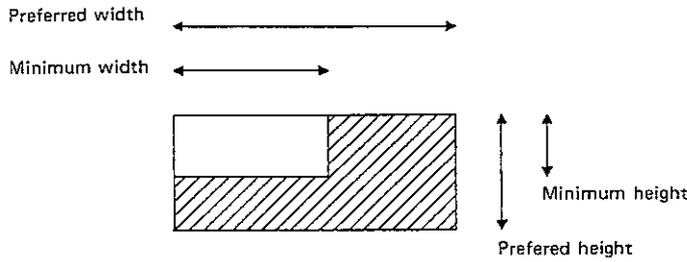


FIGURE 6/T.418

Layout process for the presentation attribute "picture dimensions" when a value is specified for the parameter "width controlled" or "height controlled"

Value of presentation attribute "picture dimensions": area controlled

- Initial constraints

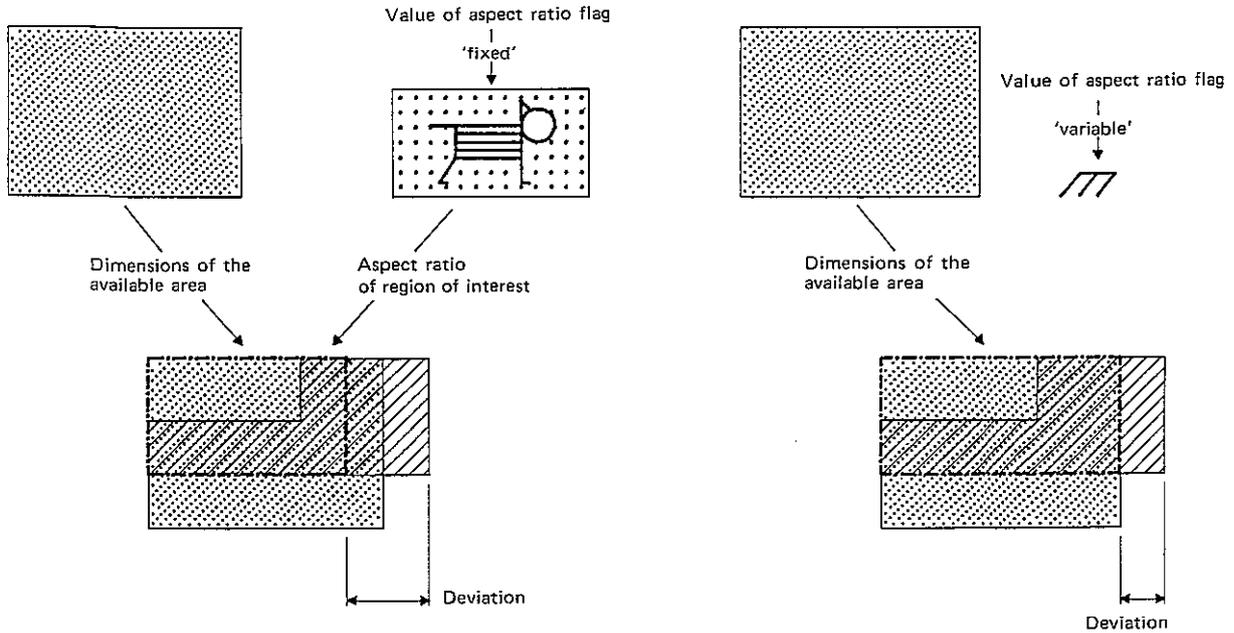


Note – The hatched area shows a range of allowable picture dimensions.

- Allowable picture dimensions

The allowable picture dimensions are completely determined by the initial constraints.

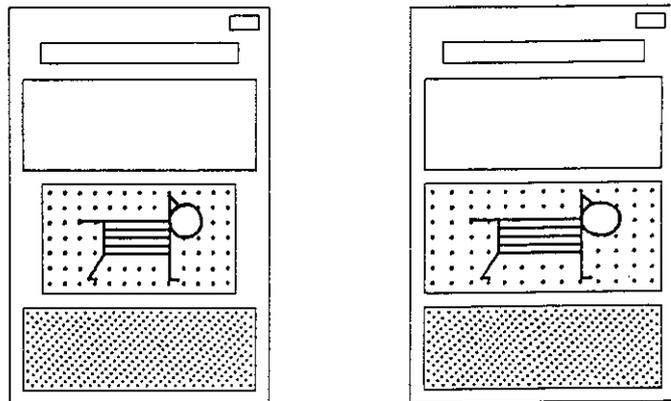
- Basic layout dimensions determined (page layout A is used)



Note – The basic layout objects is indicated by the dashed-dotted boundary.

- Basic objects positioned, laid out and imaged

Note – In this example, the positioning of these basic layout objects assumes normal fill order, the attribute "block alignment" has value 'centered' and a certain separation between two consecutive blocks.



T0802690-89

FIGURE 7/T.418

Layout process for the presentation attribute "picture dimensions" when a value is specified for the parameter "area controlled"

10 Content imaging process

This section describes a content imaging process for basic layout objects associated with content architectures of type geometric graphics.

Its purpose is to aid understanding of the semantics of the presentation attributes by describing the required results of such a process. However, it is not intended to specify any process that might be carried out in a particular implementation to achieve these results.

10.1 Introduction

The content imaging process is only concerned with the layout structures, the presentation styles and the content of basic layout components conforming to this Recommendation.

The content imaging process is applicable to the formatted processable form geometric graphics content architecture class.

10.2 Content imaging process for formatted processable form content architecture class

This section describes how the various shared presentation attributes and CGM elements determine the image of the content.

The imaging process is divided into two parts:

- a) initialization;
- b) imaging.

10.2.1 Initialization of the imaging process

At the start of the imaging of a geometric graphics content portion the imaging process is set to a default state. The default state of the imaging process is defined by the presentation attributes specifying CGM defaults (see § 6.1.1) except those parameters overwritten by CGM elements explicitly specified in the geometric graphics content portion.

The imaging process uses bundle representations, pattern representations and colour representations specified by the bundle specification, pattern table specification and colour table specification parameter values, respectively, of the geometric graphics presentation attributes "line rendition", "marker rendition", "text rendition", "filled area rendition", "edge rendition" and "colour representations" in conjunction with the defaults for these representations defined in Table 2/T.418, 3/T.418 and 4/T.418. After being set to its default state, the imaging process proceeds as if the CGM default have been explicitly specified in the content portion by CGM elements.

10.2.2 Imaging

Within geometric graphics content, geometric graphics elements are positioned in a Virtual Device Coordinate Space using a Virtual Device Coordinate system. For each basic layout object a part of the Virtual Device Coordinate Space specified by the region of interest is imaged according to the geometric graphics positioning principles (see § 5). No part of the graphical image which extends beyond the boundaries of the basic layout object is imaged.

The imaging process ignores the elements SCALING MODE as the required dimensions, and hence the aspect ratio, of the basic layout object have already been determined appropriately by the layout process.

In the case that the layout texture of the basic layout object specifies the combination "colourless, transparent" the picture descriptor element BACKGROUND COLOUR is ignored.

The support of external and escape elements is not required. A valid interpretation is to ignore them. The use of private unregistered escapes is not supported in open systems interchange.

Negative values of parameters of CGM elements are allowed. However, a valid interpretation is to ignore them; i.e. the use of private unregistered values is not supported in open systems interchange.

The image of the graphic elements is as specified by ISO 8632-1.

11 Definition of geometric graphics content architecture classes

There is only one geometric graphics content architecture class. This content architecture class provides for formatted processable form content. It is characterized as follows:

Content architecture class:	Formatted processable form
CGM elements:	All defined in ISO 8632-1 and ISO 8632-3,
Type of coding:	As defined in ISO 8632-3,
Geometric graphics presentation attributes:	All listed in § 6,
CGM attributes:	All CGM attributes.

ANNEX A

(to Recommendation T.418)

(Informative)

Summary of ASN.1 object identifiers

Values of ASN.1 object identifiers are assigned in various sections of this Recommendation. These assignments are summarized in Table A-1/T.418.

TABLE A-1/T.418

Summary of ASN.1 object identifiers

ASN.1 object identifier value	Description	Paragraph
{ 2 8 2 8 0 }	Value of attribute "content architecture class"	6.4.1
{ 2 8 3 8 0 }	Value of attribute "type of coding"	7.1
{ 2 8 1 8 2 }	Identifies module Geometric graphics presentation attributes	8.2
{ 2 8 1 8 3 }	Identifies module Geometric graphics coding attributes	8.3
{ 2 8 1 8 4 }	Identifies module Non-basic features and non-standard defaults	8.4

ANNEX B

(to Recommendation T.418)

(Informative)

Recommendations for the development of geometric graphics content architecture levels in document application profiles

This Annex provides an example of the definition of a geometric graphics content architecture level. This content architecture level has been defined in accordance with the rules specified in Recommendation T.411:

- GFP-0 is an example of a content architecture level belonging to the formatted processable form content architecture class. GFP-0 is mainly based on the minimum capabilities suggested in ISO 8632-1 and ISO 8632-3.

Note - The document application profile may have to specify additional rules for the use of these content architecture levels in particular applications. In particular, it may specify constraints to the values of parameters of CGM elements.

B.1 *Geometric graphics content architecture level GFP-0*

B.1.1 *Content architecture class*

GFP-0 is a content architecture level derived from the formatted processable form content architecture class.

B.1.2 *Presentation attributes*

Attribute	Basic values	Non-basic values	Default values
Geometric graphics encoding announcer	see Table B-1/T.418	none	standard default value
Line rendition	see Table B-2/T.418	none	standard default value
Marker rendition	see Table B-3/T.418	none	standard default value
Text rendition	see Table B-4/T.418	none	standard default value
Filled area rendition	see Table B-5/T.418	none	standard default value
Edge rendition	see Table B-6/T.418	none	standard default value
Colour specification	see Table B-7/T.418	none	standard default value
Transparency specification	see Table B-8/T.418	none	standard default value
Transformation specification	see Table B-9/T.418	none	standard default value
Region of interest specification	rectangle, automatic	none	standard default value
Picture orientation	0°, 90°, 180°, 270°	none	standard default value
Picture dimensions	width controlled, height controlled, area controlled, automatic	none	standard default value

Tables B-1/T.418 to B-9/T.418 provide the BASIC values of the parameters of the presentation attributes specifying CGM default.

The third column of each table shows the relationship of the basic values to the complete set of permissible values as defined in the main body of this Recommendation. In those cases where the basic values include all possible values allowed by this Recommendation the entry in the third column is labelled 'none'. For structured parameters the basic values and the relation to the complete set of permissible values of their components are given to indicate that all possible combinations of its components form the basic values and the complete set of permissible values of a parameter respectively.

TABLE B-1/T.418

Geometric graphics encoding announcer

Parameter	Basic values	Values not in the set of basic values
VDC type	integer, real	none
Integer precision	8, 16, 24, 32	none
Real precision	(floating point format, 9, 23), (floating point format, 12, 52), (fixed point format, 16, 16), (fixed point format, 32, 32)	none
Index precision	8, 16, 24, 32	none
Colour precision	8, 16, 24, 32	none
Colour index precision	8, 16, 24, 32	none
Maximum colour index	any integer ≥ 0 and ≤ 63	all other permissible values
Colour value extent	((0, 0, 0), (255, 255, 255))	all other permissible values
Colour selection mode	indexed, direct	none
VDC integer precision	16, 24, 32	none
VDC real precision	(floating point format, 9, 23), (floating point format, 12, 52), (fixed point format, 16, 16), (fixed point format, 32, 32)	none

TABLE B-2/T.418

Line rendition

Parameter	Basic values	Values not in the set of basic values
Line width specification mode	absolute, scaled	none
Line bundle index	1, 2, 3, 4, 5	all other permissible values
Line type	1(solid), 2(dash), 3(dot), 4(dash-dot), 5(dash-dot-dot)	all other permissible values
Line width (if scaled) (if absolute)	1, 0 0,001 × length of longest side VDC extent	all other permissible values all other permissible values
Line colour (if indexed) (if direct)	1 foreground	all other permissible values all other permissible values
Line aspect source flags line type ASF line width ASF line colour ASF	bundled, individual bundled, individual bundled, individual	none none none
Line bundle specifications line bundle index	as for individual	all other permissible values
line bundle representation line type (if scaled) (if absolute)	as for individual as for individual as for individual	all other permissible values all other permissible values all other permissible values
Line colour (if indexed) (if direct)	as for individual as for individual	all other permissible values all other permissible values

TABLE B-3/T.418

Marker rendition

Parameter	Basic values	Values not in the set of basic values
Marker size specification Mode	Absolute, scaled	none
Marker bundle index	1,2,3,4,5	all other permissible values
Marker type	1(dot), 2(plus), 3(asterisk), 4(circle), 5(cross)	all other permissible values
Marker size (if scaled)	1, 0	all other permissible values
(if absolute)	0,01 × length of longest side of VDC extent	all other permissible values
Marker colour (if indexed)	1	all other permissible values
(if direct)	foreground	all other permissible values
Marker aspect source flags		
marker type ASF	bundled, individual	none
marker size ASF	bundled, individual	none
marker colour ASF	bundled, individual	none
Marker bundle specifications		
marker bundle index	as for individual	all other permissible values
Marker bundle representation		
marker type	as for individual	all other permissible values
marker size (if scaled)	as for individual	all other permissible values
(if absolute)	as for individual	all other permissible values
Marker colour (if indexed)	as for individual	all other permissible values
(if direct)	as for individual	all other permissible values

TABLE B-4/T.418

Text rendition

Parameter	Basic values	Values not in the set of basic values
Font list	list containing one element: any registered font capable of representing the nationality-independent character subset of Recommendation T.50	all other permissible values
Character set list character set type	94-character sets	all other permissible values
designation sequence tail	designation sequence tail that is registered for a character set which includes the nationality-independent subset of Recommendation T.50 in the positions specified in Recommendation T.50	all other permissible values
Character coding announcer	basic 7-bit	all other permissible values
Text bundle index	1, 2	all other permissible values
Text font index	1	all other permissible values
Text precision	string, character	all other permissible values
Character expansion factor	0,7 and 1,0	all other permissible values
Character spacing	0,0	all other permissible values
Text colour (if indexed)	1	all other permissible values
(if direct)	foreground	all other permissible values
Character height	0,01 × length of the longest side of VDC extent	all other permissible values
Character orientation	any pair of VDC vectors which have non-zero length, are not collinear and are parallel to the axes of the VDC space	all other permissible values

TABLE B-4/T.418 (cont.)

Parameter	Basic values	Values not in the set of basic values
Text path	right, left, up, down	none
Text alignment horizontal alignment	normal horizontal, left, centre, right	all other permissible values
vertical alignment	normal vertical, top, base, bottom	all other permissible values
continuous horizontal alignment	n/a	all other permissible values
continuous vertical alignment	n/a	all other permissible values
Character set index	1	all other permissible values
Alternate character set index	1	all other permissible values
Text aspect source flags text font ASF	bundled, individual	none
text precision ASF	bundled, individual	none
character expansion factor ASF	bundled, individual	none
character spacing ASF	bundled, individual	none
text colour ASF	bundled, individual	none
Text bundle specifications		
Text bundle index	as for individual	all other permissible values
Text bundle representation		
Text font index	as for individual	all other permissible values
Text precision	as for individual	all other permissible values
Character expansion factor	as for individual	all other permissible values
Character spacing	as for individual	all other permissible values
Text colour (if indexed)	as for individual	all other permissible values
(if direct)	as for individual	all other permissible values

TABLE B-5/T.418

Filled area rendition

Parameter	Basic values	Values not in the set of basic values
Fill bundle index	1, 2, 3, 4, 5	all other permissible values
Interior style	hollow, solid, pattern, hatch, empty	none
Fill colour (if indexed)	1	all other permissible values
(if direct)	foreground	all other permissible values
Hatch index	1 (horizontal equally spaced parallel lines) 2 (vertical equally spaced parallel lines) 3 (positive slope equally spaced parallel lines) 4 (negative slope equally spaced parallel lines) 5 (horizontal/vertical crosshatch) 6 (positive slope/negative slope crosshatch)	all other permissible values
Pattern index	1	all other permissible values
Fill reference point	(0;0)	all other permissible values
Pattern size height vector x component	0	all other permissible values
height vector y component	height of default VDC extent	all other permissible values
width vector x component	width of default VDC extent	all other permissible values
width vector y component	0	all other permissible values
Pattern table specifications pattern table index	1	all other permissible values
nx (number of columns in pattern)	1	all other permissible values
ny (number of rows in pattern)	1	all other permissible values
local colour precision	0	all other permissible values

TABLEAU B-5/T.418 (cont.)

Parameter	Basic values	Values not in the set of basic values
colour index array (if indexed) value array (if direct)	one cell containing colour index 1 one cell containing direct colour value 'foreground'	all other permissible values all other permissible values
Fill aspect source flags interior style ASF fill colour ASF hatch index ASF pattern index ASF	bundled, individual bundled, individual bundled, individual bundled, individual	none none none none
Fill bundle specifications Fill bundle index	as for individual	all other permissible values
Fill bundle representation interior style	as for individual	all other permissible values
Fill colour (if indexed) (if direct)	as for individual as for individual	all other permissible values all other permissible values
Hatch index	as for individual	all other permissible values
Pattern index	as for individual	all other permissible values

TABLE B-6/T.418

Edge rendition

Parameter	Basic values	Values not in the set of basic values
Edge width specification mode	absolute, scaled	none
Edge visibility	off	all other permissible values
Edge bundle index	1, 2, 3, 4, 5	all other permissible values
Edge type	1(solid), 2(dash), 3(dot), 4(dash-dot), 5(dash-dot-dot)	all other permissible values
Edge width (if scaled)	1,0	all other permissible values
(if absolute)	0,001 × length of longest side of VDC extent	all other permissible values
Edge colour (if indexed)	1	all other permissible values
(if direct)	foreground	all other permissible values
Edge aspect source flags edge type ASF	bundled, individual	none
edge width ASF	bundled, individual	none
edge colour ASF	bundled, individual	none
Edge bundle specifications edge bundle index	as for individual	all other permissible values
Edge bundle representation edge type	as for individual	all other permissible values
edge width (if scaled)	as for individual	all other permissible values
(if absolute)	as for individual	all other permissible values
Edge colour (if indexed)	as for individual	all other permissible values
(if direct)	as for individual	all other permissible values

TABLE B-7/T.418

Colour representations

Parameter	Basic values	Values not in the set of basic values
Background colour	background	all other permissible values
Colour table specifications starting index	0,1	all other permissible values
colour list	any list containing one or two (only if starting colour index = 0) direct colour values each either 0 or foreground if replacing colour table entry 1	all other permissible values.

TABLE B-8/T.418

Transparency specification

Parameter	Basic values	Values not in the set of basic values
Transparency	on	all other permissible values
Auxiliary colour (if indexed)	n/a	all other permissible values
(if direct)	n/a	all other permissible values

TABLE B-9/T.418

Transformation specification

Parameter	Basic values	Values not in the set of basic values
VDC extent	any pair of virtual device coordinates defining a rectangle	none
Clip indicator	off, on	none
Clip rectangle	any pair of virtual device coordinates defining a rectangle	none

B.1.3 Content portion attributes

No content portion attributes other than the document architecture attributes "type of coding" and "content information" are defined in this Recommendation.

ANNEX C

(to Recommendation T.418)

(Informative)

**Basic differences between character primitives in the geometric graphics
and the content of a basic component structured according to
the character content architectures defined in
Recommendation T.416**

This Annex identifies the basic differences between character strings regarded as graphical primitives and character content.

Within the geometric graphics content architecture (GGCA) the graphical primitive elements which may be used to describe a picture, include a text primitive. The text primitive permits the inclusion of textual information in geometric graphics pictures.

The most important basic differences between the text within the two different content architectures are as follows:

- a) within GGCA each primitive is conceptually independent of any other within the same content portion. Within the character content architecture (CCA) all content is a single text string;
- b) within GGCA a text primitive may be positioned anywhere in the VDC Space. Within CCA the positioning of characters is sequential in nature and, therefore, the position at which a character is imaged is derived from the position at which the predecessor was imaged;
- c) within GGCA the size of the basic layout object is not affected by the text within the content portion. Within CCA the size of the basic layout object is totally dependent on the amount of text within the content portion;

- d) within GGCA the orientation of a text primitive may be set to any angle relative to the Virtual Device Coordinate system first axis. Within CCA the character path must be at 0° , 90° , 180° or 270° relative to the horizontal axis of the layout object;
- e) within GGCA the character size is specified by the CGM attribute elements CHARACTER HEIGHT and CHARACTER EXPANSION FACTOR and is conceptually independent of the font. This allows the aspect ratio of the character to be changed. Within CCA the character size is defined by the font;
- f) within GGCA a text primitive is a geometric element and may undergo geometric transformation such as scaling and arbitrary rotation. Within CCA no such functionality exists;
- g) within GGCA text primitives the effect of embedded control functions are not standardized (eg: <CR>, <LF>, <HT>). These control functions may occur but there is no definition of their semantics. Within CCA such control functions have a standardized effect;
- h) within GGCA there is a character attribute which permits the under-character space to be set or changed without constraint to a particular string of characters or a given line length. This permits the justification of either monospaced or proportionally spaced fonts. Within CCA, such justification can be specified as a requirement in the logical text, but resolves to embedded control functions working in unit of SMU in the laid out (formatted) text.

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