INTERNATIONAL STANDARD

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Information technology — Computer graphics and image processing — Graphical Kernel System (GKS) —

Part 2: NDC metafile

Technologies de l'information — Infographie et traitement d'image — Système graphique Kernel (GKS) —

Partie 2: Métafichier NDC

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Contents

Foreword

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

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 7942-2 was prepared by Joint Technical Committee ISO/IEC JTC1, Information technology, Subcommittee SC24, *Computer graphics and image processing.*

ISO/IEC 7942 consists of the following parts, under the general title *Information technology – Computer graphics and image processing – Graphical Kernel System (GKS) :*

Part 1: Functional description

Part 2: NDC metafile

Part 3: Audit trail

Part 4: Picture part archive

Annexes A and B form an integral part of this part of ISO/IEC 7942.

Introduction

The NDC metafile provides a file format and encodings suitable for the storage and retrieval of picture information. The file format consists of a set of elements that can be used to describe pictures in a way that is compatible between systems of different architectures and devices of differing capabilities and design. This part of ISO/IEC 7942 extends the provisions of ISO/IEC 8632:1992/Amd.2:1995.

Information technology – Computer graphics and image processing – Graphical Kernel System (GKS) – Part 2: NDC metafile

1 Scope

This part of ISO/IEC 7942 provides a file format and encodings for the storage and retrieval of GKS-94 Normalized Device Coordinate (NDC) pictures. It is an extension of the Computer Graphics Metafile, Version 4 defined by ISO/IEC 8632:1992/Amd.2: 1995 (all parts).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 7942. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 7942 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 7942-1:1994, *Information technology - Computer graphics and image processing - Graphical Kernel System (GKS) - Part 1: Functional description.*

ISO/IEC 8632:1992/Amd.2:1995, *Information technology - Computer graphics - Metafile for transfer and storage of picture description information* (all parts).

3 Definitions

For the purposes of this part of ISO/IEC 7942, the definitions given in ISO/IEC 7942-1 and ISO/IEC 8632-1/Amd.2 apply.

4 Concepts

4.1 The structure of a GKS-94 NDC metafile

The structure of a GKS-94 NDC Metafile follows the Computer Graphics Metafile (CGM) standard (ISO/IEC 8632-1:1992). It is shown in figure 1. MF is used as an abbreviation for METAFILE.

BEGIN NDC MF	MD	<picture>...	END MF

Figure 1: General form of metafile

A Computer Graphics Metafile is a collection of elements from the standardized set. The BEGIN NDC METAFILE element is followed by the METAFILE DESCRIPTOR (MD). After this the pictures follow, each logically independent of each other. Finally the Metafile is ended with an END METAFILE element.

Apart from the BEGIN NDC METAFILE, END METAFILE and Metafile Descriptor elements, the metafile is partitioned into pictures. All pictures are mutually independent. A picture consists of a BEGIN PICTURE element, a PICTURE DESCRIPTOR (PD) element, a BEGIN PICTURE BODY element, an arbitrary number of control, graphical and attribute elements and finally an END PICTURE element (see figure 2). PIC is used as an abbreviation for PICTURE and BEGIN BODY for BEGIN PICTURE BODY.

BEGIN PIC	PD	BEGIN BODY	<element>...	END PIC

Figure 2: General form of pictures

4.2 Metafile elements

Elements in CGM Version 4 are used for the mapping of NDC picture to NDC metafile wherever possible. However, some new elements are introduced to provide functionality required by the NDC metafile which cannot be described within CGM Version 4. The new CGM elements are marked by daggers (†) in the tables in this section. The scope of some CGM Version 4 elements has been extended. These elements are marked with a double dagger (‡).

4.3 Delimiter elements

The NDC metafile includes the following delimiter elements:

BEGIN NDC METAFILE†	BEGIN PICTURE BODY
END METAFILE	BEGIN APPLICATION STRUCTURE
BEGIN PICTURE	BEGIN APPLICATION STRUCTURE BODY
END PICTURE	END APPLICATION STRUCTURE

In NDC metafiles, primitives of the same type may be grouped together to form a set of primitives. The primitives to be included in the set of primitives being defined are delimited by application structure elements as described in 6.2. Application structure elements are also used in the representation of the design primitive (see 6.2.12) and the SCISSOR SET primitive attribute (see 6.3.1).

4.4 Metafile descriptor elements

4.4.1 Elements used

The NDC metafile includes the following metafile descriptor elements:

METAFILE VERSION
VDC TYPE
MAXIMUM COLOUR INDEX
METAFILE ELEMENT LIST
MAXIMUM VDC EXTENT

The METAFILE ELEMENT LIST lists at least those standardized elements that occur in the metafile.

4.4.2 Functional capability

Following the provisions of ISO/IEC 8632-1:1992/Amd.2:1995, the contents of the Computer Graphics Metafile are defined by the METAFILE ELEMENT LIST element. These shall contain a list of the non-mandatory elements that are utilized in the metafile. Several shorthand names for CGM elements are also provided for use with the METAFILE ELEMENT LIST. The NDC metafile set is designated NDC-SET. These shorthand names shall not be considered macro names, nor shall they be construed to be levels of conformance.

4.4.3 NDC-SET

The NDC-SET includes the elements which can appear in the NDC Metafile. The elements which are not marked by daggers belong to the CGM Version-4 set. The value ranges of some of the parameters of some CGM elements have been extended. These elements are marked by double daggers. The elements included in the NDC-metafile are:

<BEGIN NDC METAFILE>†
<END METAFILE>
<BEGIN PICTURE>
<BEGIN PICTURE BODY>
<END PICTURE>
<METAFILE VERSION>
<VDC TYPE>
<METAFILE ELEMENT LIST>
<MAXIMUM COLOUR INDEX>
<FONT LIST>
<CHARACTER SET LIST>
<CHARACTER CODING ANNOUNCER>
<MAXIMUM VDC EXTENT>
<VDC EXTENT>
<CLIP INDICATOR>
<CLIP RECTANGLE>
<BEGIN APPLICATION STRUCTURE>
<APPLICATION STRUCTURE ATTRIBUTES>
<BEGIN APPLICATION STRUCTURE BODY>
<END APPLICATION STRUCTURE>
<POLYLINE>
<NON-UNIFORM RATIONAL B-SPLINE>
<CONIC SECTION>†
<POLYMARKER>
<POLYGON>
<ELLIPTIC DISC>†
<TEXT>
<COLOUR SELECTION MODE>
<COLOUR VALUE EXTENT>
<COLOUR PRECISION>
<SHIELD INDICATOR>†
<GLOBAL TRANSFORMATION>†
<LOCAL TRANSFORMATION>†
<PATTERN SIZE>
<GDP>
<FILL REFERENCE POINT>
<CHARACTER HEIGHT>
<CHARACTER ORIENTATION>
<TEXT PATH>
<TEXT ALIGNMENT>
<ASPECT SOURCE FLAGS>‡
<LINE BUNDLE INDEX>
<LINE TYPE>
<LINE WIDTH>
<LINE COLOUR>
<MARKER BUNDLE INDEX>
<MARKER TYPE>
<MARKER SIZE>
<MARKER COLOUR>
<FILL BUNDLE INDEX>
<INTERIOR STYLE>
<HATCH INDEX>
<FILL COLOUR>
<EDGE VISIBILITY>
<EDGE TYPE>
<EDGE WIDTH>
<EDGE COLOUR>
<TEXT BUNDLE INDEX>
<CHARACTER EXPANSION FACTOR>
<CHARACTER SPACING>

<COLOUR MODEL>‡
<CELL ARRAY>
<PICK IDENTIFIER>
<NAMESET>†
<SCISSOR IDENTIFIER>†
<TEXT FONT INDEX>
<TEXT PRECISION>
<TEXT COLOUR>
<PATTERN SIZE>

4.5 Control elements

In GKS-94 CLIP INDICATOR and CLIP RECTANGLE elements are the parts of the definition of an output primitive attribute, scissor set. The new control elements SCISSOR IDENTIFIER and SHIELD INDICATOR are used to provide the mapping of the GKS-94 SCISSOR SET attribute (see 4.7).

GKS elements	CGM element
CLIP INDICATOR	CLIP INDICATOR
CLIP RECTANGLE	CLIP RECTANGLE
	SCISSOR IDENTIFIER†
	SHIELD INDICATOR†

4.6 Graphical primitive elements

Graphical primitive elements are those elements that describe the visual components of a picture. Their coordinate arguments, if any, are specified in VDC units.

The mapping of GKS-94 output primitives to CGM elements is shown in the table below. An extension to CGM was needed to provide this mapping. The new CGM elements are marked by asterisks.

Each GKS-94 output primitive marked by an asterisk (*) is mapped to a set of the corresponding CGM elements delimited by BEGIN APPLICATION STRUCTURE and END APPLICATION STRUCTURE elements. The DESIGN primitive is more complicated and its mapping to the CGM elements is described in clause 6.

The CELL ARRAY primitive is mapped to a set of elements which define the way in which the colour values used in the following CELL ARRAY element are defined.

GKS elements	CGM element
SET OF POLYLINE*	POLYLINE
SET OF NURB*	NON-UNIFORM RATIONAL B-SPLINE
SET OF CONIC SECTION*	CONIC SECTION†
POLYMARKER	POLYMARKER
SET OF FILL AREA*	POLYGON
SET OF ELLIPTIC SECTOR*	CONIC SECTION†
SET OF ELLIPTIC SEGMENT*	CONIC SECTION†
SET OF ELLIPTIC DISC*	ELLIPTIC DISC†
SET OF CLOSED NURB*	NON-UNIFORM RATIONAL B-SPLINE
TEXT	TEXT
CELL ARRAY	COLOUR VALUE EXTENT
	COLOUR PRECISION
	COLOUR MODEL
	COLOUR SELECTION MODE
	CELL ARRAY
DESIGN	Several elements †
GENERALIZED DRAWING PRIMITIVE	GENERALIZED DRAWING PRIMITIVE

The CONIC SECTION element specifies a conic section defined by a 3 × 3 matrix (which specifies the conic) and two points which define the start and end points of the conic section. The last parameter of the conic

section definition is a sense flag which indicates whether it is the clockwise or anti-clockwise section that is required when the conic is closed.

The ELLIPTIC DISC element is defined by a 3 × 3 matrix which defines the ellipse.

4.7 Attribute elements

The mapping of GKS-94 output primitive attributes to CGM elements is shown in the table below. An extension to ISO/IEC 8632-1:1992/Amd.2:1995 was needed to provide this mapping. The new or revised CGM elements are marked by asterisks. The GKS-94 SCISSOR SET attribute is stored in the NDC Metafile using several elements as explained in 6.3.1.

GKS attribute	CGM elements
PICK IDENTIFIER	PICK IDENTIFIER
NAMESET	NAMESET†
SCISSOR SET	SCISSOR IDENTIFIER†
	CLIP INDICATOR
	CLIP RECTANGLE
	SHIELD INDICATOR†
GLOBAL TRANSFORMATION	GLOBAL TRANSFORMATION†
LOCAL TRANSFORMATION	LOCAL TRANSFORMATION†
PATTERN SIZE	PATTERN SIZE
PATTERN REFERENCE POINT	FILL REFERENCE POINT
TEXT HEIGHT	CHARACTER HEIGHT
TEXT UP VECTOR	CHARACTER ORIENTATION
TEXT SKEW ANGLE	CHARACTER ORIENTATION
TEXT PATH	TEXT PATH
TEXT ALIGNMENT	TEXT ALIGNMENT
CURVE INDEX	LINE BUNDLE INDEX
CURVE ASFS	ASPECT SOURCE FLAGS†
CURVE TYPE	LINE TYPE
CURVEWIDTH SCALE FACTOR	LINE WIDTH
CURVE COLOUR SPECIFIER	COLOUR SELECTION MODE
	COLOUR VALUE EXTENT
	COLOUR PRECISION
	COLOUR MODEL
	LINE COLOUR
MARKER INDEX	MARKER BUNDLE INDEX
MARKER ASFS	ASPECT SOURCE FLAGS†
MARKER TYPE	MARKER TYPE
MARKER SIZE SCALE FACTOR	MARKER SIZE
MARKER COLOUR SPECIFIER	COLOUR SELECTION MODE
	COLOUR VALUE EXTENT
	COLOUR PRECISION
	COLOUR MODEL
	MARKER COLOUR
AREA INDEX	FILL BUNDLE INDEX
AREA ASFS	ASPECT SOURCE FLAGS†
INTERIOR STYLE	INTERIOR STYLE
INTERIOR STYLE INDEX	HATCH INDEX

GKS attribute	CGM elements
INTERIOR COLOUR SPECIFIER	COLOUR SELECTION MODE
	COLOUR VALUE EXTENT
	COLOUR PRECISION
	COLOUR MODEL
	FILL COLOUR
EDGE FLAG	EDGE VISIBILITY
EDGE TYPE	EDGE TYPE
EDGEWIDTH SCALE FACTOR	EDGE WIDTH
EDGE COLOUR SPECIFIER	COLOUR SELECTION MODE
	COLOUR VALUE EXTENT
	COLOUR PRECISION
	COLOUR MODEL
	EDGE COLOUR
CHARACTER INDEX	TEXT BUNDLE INDEX
CHARACTER ASFS	ASPECT SOURCE FLAGS†
CHARACTER FONT AND PRECISION	TEXT FONT INDEX
	TEXT PRECISION
CHARACTER EXPANSION FACTOR	CHARACTER EXPANSION FACTOR
CHARACTER SPACING	CHARACTER SPACING
CHARACTER COLOUR SPECIFIER	COLOUR SELECTION MODE
	COLOUR VALUE EXTENT
	COLOUR PRECISION
	COLOUR MODEL
	TEXT COLOUR

4.8 Application structure elements

The NDC metafile uses application structure elements in Version 4 CGM to represent 'set of' output primitives, the design output primitive and scissor sets. The following application structure types are used.

<NDC SET OF POLYLINE>
<NDC SET OF NURB>
<NDC SET OF CONIC SECTION>
<NDC SET OF FILL AREA>
<NDC SET OF ELLIPTIC SECTOR>
<NDC SET OF ELLIPTIC SEGMENT>
<NDC SET OF ELLIPTIC DISC>
<NDC SET OF CLOSED NURB>
<NDC DESIGN PARAMETERS>
<NDC INSIDE RULE ENUMERATED>
<NDC STENCIL ATTRIBUTES>
<NDC SET OF PATHS>
<NDC CONTOUR ATTRIBUTES>
<NDC BOUNDARY SEQUENCE>
<NDC TILING>
<NDC TILING COMPONENT>
<NDC TILING COMPONENT ATTRIBUTES>
<NDC SCISSOR SET>

Application structure attributes are used to represent the parameters of design primitives, stencil, contour and tiling component attributes. The application structure attribute types used and the composition of their

associated structured data records are listed in the table below.

Attribute	Parameter	Type
<NDC DESIGN PARAMETERS>	Stencil origin Stencil transformation Tiling origin Tiling transformation	P (2×3)R P (2×3)R
<NDC INSIDE RULE ENUMERATED>	Inside rule	(one of: evenodd, winding)E
<NDC STENCIL ATTRIBUTES>	TOPY CAPY HALFY BASEY BOTTOMY CENTREY LEFTX RIGHTX CENTREX CENTRE ORIGIN CENTRETOP CENTREBOTTOM CENTRELEFT CENTRERIGHT TOPLEFT TOPRIGHT BOTTOMLEFT BOTTOMRIGHT	R R R R R R R R R P P P P P P P P P P
<NDC CONTOUR ATTRIBUTES>	STYLE WIDTH CAP JOIN mitred	(one of: solid, dashed, dotted, dashed-dotted, dashed-dashed-dotted)IX R (one of: butted, rounded, square)IX (one of: round, bevel, mitred)IX R
<NDC TILING COMPONENT ATTRIBUTES>	Tiling origin Replication technique Replication technique x value Replication technique y value	2×R (one of: dx, dy, dxdy, dydx)E R R

4.9 Metafile states

The table below shows the major metafile states in which the new metafile elements introduced in this International Standard are allowed. This table extends Table 8 in ISO/IEC 8632-1:1992/Amd.2:1995. The new elements are not allowed in any of the CGM minor states.