Digital Imaging and Communications in Medicine (DICOM)

Supplement 37 Printer Configuration Retrieval SOP Class

and

New Optional Attributes for Basic Print

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Forward

The American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) formed a joint committee to develop a standard for Digital Imaging and Communications in Medicine (DICOM). This DICOM Standard and the corresponding Supplements to the DICOM Standard were developed according to the NEMA procedures.

DICOM is developed in liaison with other standardization organizations including CEN TC251 in Europe and JIRA in Japan, with review also by other organizations including IEEE, HL7 and ANSI in the USA.

This document is a Supplement to the DICOM Standard. It is an extension to PS 3.3, 3.4 and 3.6 of the published DICOM Standard which consists of the following parts:

PS 3.1	Introduction and Overview
PS 3.2	Conformance
PS 3.3	Information Object Definitions
PS 3.4	Service Class Specifications
PS 3.5	Data Structures and Encoding
PS 3.6	Data Dictionary
PS 3.7	Message Exchange
PS 3.8	Network Communication Support for Message Exchange
PS 3.9	Point-to-Point Communication Support for Message Exchange
PS 3.10	Media Storage and File Format
PS 3.11	Media Storage Application Profiles
PS 3.12	Media Format and Physical Media for Media Interchange
PS 3.13	Print Management Point-to-Point Communication Support

PS 3.14 Grayscale Standard Display Function

These parts are related but independent documents.

SCOPE AND FIELD OF APPLICATION

This Supplement describes the Printer Configuration Retrieval SOP Class which allows a Print Service Class SCU to retrieve information about key imaging characteristics from an SCP of the Print Management Service Class.

This SOP Class is an optional SOP Class that may be used with Basic Print SOP Classes.

This Supplement also adds two optional Attributes to Basic Print Management. They allow the SCU to specify requested printer resolution (for printers with multiple resolution capability) and specify whether images too large for the image box should be cropped, decimated, or failed.

Since this document proposes changes to existing Parts of DICOM the reader should have a working understanding of the Standard.

This Supplement includes a number of Addenda to existing Parts of DICOM:

PS 3.3 Addendum	Printer Configuration Information Object Definitions
PS 3.4 Addendum	Printer Configuration Service Class
PS 3.6 Addendum	Printer Configuration Additions to the Data Dictionary

Add the Following Sections to Part 3

B.x Printer Configuration Information Object Definition

B.x.1 IOD Description

The Printer Configuration IOD describes key imaging characteristics of the printer.

B.x.2 IOD Modules

Table B.x-1
Printer Configuration IOD Modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common Information
Printer	C13.9	Contains information about the printer
Printer Configuration	C.13.y	Contains Printer Configuration Information

C.13.y Printer Configuration Module

This Module describes Printer Configuration Information

Table C.13-z
PRINTER CONFIGURATION MODULE

Attribute Name	Tag	Attribute Description
Printer Configuration Sequence	(2000,001E)	Contains printer configuration information for a single Application Entity title. See Print Management Service Class Structure in PS 3.4. The sequence shall contain one item for each physical printer/Meta SOP Class combination supported by the Application Entity title.
>SOP Classes Supported	(0008,115A)	The Meta-SOP Class and a list of optional SOP Classes supported. It shall contain one Meta SOP Class UID and 0-n optional SOP Class UIDs.
>Maximum Memory Allocation	(2000,0062)	Maximum number of kilobytes of memory that can be allocated for a Film Session. The value shall be 0 if Memory Allocation (2000,0060) is not supported.
>Memory Bit Depth	(2000,00A0)	The maximum number of bits for each pixel that can be stored in printer memory.
>Printing Bit Depth	(2000,00A1)	The number of bits used by the print engine for internal LUT calculation and printing of each pixel.
>Media Installed Sequence	(2000,00A2)	A sequence which specifies the combinations of Medium Type and Film Size IDs available in the printer at this time and the Min and Max Densities supported by these media. The Item Number with the value of 1 is the printer default. There is no significance to other item numbers. One item for each Medium Type and Film Size ID installed shall be included.

>>Item Number	(0020,0019)	A number that labels this item. Each item in the sequence shall have a unique number.
>>Medium Type	(2000,0030)	See C.13.1
>>Film Size ID	(2010,0050)	See C.13.3
>>Min Density	(2010,0120)	Minimum density that can be printed, expressed in hundredths of OD.
>>Max Density	(2010,0130)	Maximum density that can be printed, expressed in hundredths of OD.
>Other Media Available Sequence	(2000,00A4)	A sequence which specifies combinations of Medium Type and Film Size ID for which the printer will accept an N-CREATE of a Film Box, but are not physically installed in the printer at this time. It also specifies the Min and Max Densities supported by these media. User intervention may be required to instal these media in the printer. One item for each Medium Type and Film Size ID available, but not installed shall be included.
>>Medium Type	(2000,0030)	See C.13.1
>>Film Size ID	(2010,0050)	See C.13.3
>>Min Density	(2010,0120)	Minimum density that can be printed, expressed in hundredths of OD.
>>Max Density	(2010,0130)	Maximum density that can be printed, expressed in hundredths of OD.
>Supported Image Display Formats Sequence	(2000,00A8)	A sequence which specifies the Image Display Formats supported, rows and columns in Image Boxes for each format, pixel spacing, and whether Requested Image Size is supported as a function of Film Orientation, Film Size ID, and Printer Resolution ID. One item for each display format, film orientation, film size, and printer resolution combination shall be included.
>>Rows	(0028,0010)	Number of printable rows in an Image Box.
>>Columns	(0028,0011)	Number of printable columns in an Image Box
>>Image Display Format	(2010,0010)	See C.13.3
>>Film Orientation	(2010,0040)	See C.13.3
>>Film Size ID	(2010,0050)	See C.13.3
>>Printer Resolution ID	(2010,0052)	Printer Resolution identification. Defined Terms are the same as Requested Resolution ID (2020,0050). See C.13.3.
>>Printer Pixel Spacing	(2010,0376)	Physical distance on the printed film between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.

>>Requested Image Size Flag	(2020,00A0)	Indicates whether the printer supports Requested Image Size (2020,0030) for this display format and film orientation and size combination. Enumerated Values: NO = not supported YES = supported
>Default Printer Resolution ID	(2010,0054)	The printer's default resolution identification. Defined Terms are the same as Requested Resolution ID (2020,0050). See C.13.3.
>Default Magnification Type	(2010,00A6)	Printer's default magnification type. See C.13.3 for Defined Terms.
>Other Magnification Types Available	(2010,00A7)	Other magnification types available in the printer. See C.13.3 for Defined Terms.
>Default Smoothing Type	(2010,00A8)	Printer's default smoothing type. See C.13.3.
>Other Smoothing Types Available	(2010,00A9)	Other smoothing types available in the printer. See C.13.3.
>Configuration Information Description	(2010,0152)	A free form text description of Configuration Information (2010,0150) supported by the printer.
>Maximum Collated Films	(2010,0154)	The maximum number of films that can be collated for an N-ACTION of the Film Session. The value shall be 0 if N-ACTION of the Film Session is not supported.
>Decimate/Crop Result	(2020,00A2)	Indicates whether the printer will decimate or crop image pixels if the image rows or columns is greater than the available printable pixels in an Image Box. See C.13.5. Enumerated Values when the printer does not support Requested Decimate/Crop Behavior (2020,0040): DECIMATE = image will be decimated to fit. CROP = image will be cropped to fit. FAIL = N-SET of the Image Box will fail Enumerated Values when the printer supports Requested Decimate/Crop Behavior (2020,0040): DEF DECIMATE = image will be decimated to fit. DEF CROP = image will be cropped to fit DEF FAIL = N-SET of the Image Box will fail This value indicates the printer default if the SCU does not create or set Requested Decimate/Crop Behavior for the Image Box.

C.13.3 Basic Film Box Pixel Presentation Module Modify Magnification Type and add Requested Resolution ID to the Table

Magnification Type	(2010,0060)	Interpolation type by which the printer magnifies or decimates the image in order to fit the image in the image box on film. Defined Terms: REPLICATE BILINEAR CUBIC NONE
Requested Resolution ID	(2020,0050)	Specifies the resolution at which images in this Film Box are to be printed. Defined Terms: STANDARD = approximately 4k x 5k printable pixels on a 14 x 17 inch film HIGH = Approximately twice the resolution of STANDARD.

C.13.5 Image Box Pixel Presentation Module Add the following Attribute to the Table

Requested Decimate/Crop Behavior	(2020,0040)	Specifies whether image pixels are to be decimated or cropped if the image rows or columns is greater than the available printable pixels in an Image Box. Decimation means that a magnification factor <1 is applied to the image. The method of decimation shall be that specified by Magnification Type (2010,0060) or the SCP default if not specified Cropping means that some image rows and/or columns are deleted before printing Enumerated Values: DECIMATE = a magnification factor <1 to be applied to the image. CROP = some image rows and/or columns are to be deleted before printing. The specific algorithm for cropping shall be described in the SCP Conformance Statement. FAIL = the SCP shall not crop or decimate

Make the Following changes to existing Sections in Part 4.
(Changes vs. Supplement 24 are indicated.)

H.3.1 Scope

Print Management conformance is defined in terms of supported Meta SOP Classes, which correspond with the mandatory functionality, and of supported optional SOP Classes, which correspond with additional functionality.

A Meta SOP Class corresponds with a pre-defined group of SOP Classes. The following Print Management Meta SOP Class Instances are defined:

- Basic Grayscale Print Management Meta SOP Class
- Basic Color Print Management Meta SOP Class
- Referenced Grayscale Print Management Meta SOP Class
- Referenced Color Print Management Meta SOP Class

Any implementation of the Print Management Service Class is required to support at least one of the Basic Print Management Meta SOP Classes. In addition the SCU/SCP may support optional Meta SOP and SOP Classes.

The Meta SOP Class level negotiation is used to define a minimum set of print functions; the SOP Class level negotiation is used to define additional functions.

At association setup, the negotiation process between the Print Management SCU and SCP shall occur for

- one or more of the Meta SOP Classes and zero or more of the optional SOP Classes specified in Section H.3.3.2; or
- one or more of the Printer SOP, Print Job, and Printer Configuration Retrieval SOP Classes
- ~~the Printer SOP Class only;~~
- ~~the Print Job SOP Class only; or~~
- ~~the Printer and Print Job SOP Classes.~~

If multiple Meta SOP Classes and one or more optional SOP Classes are negotiated, the SCP shall support all the optional SOP Classes in conjunction with all the Meta SOP Classes.

Note: It is possible for an SCP to support associations for printing and to also support additional associations for the sole purpose of exchanging status information about the printer.

H.3.3 Optional SOP Classes

H.3.3.1 Description

The optional SOP Classes address functionality beyond the Print Management Meta SOP Classes. One or more optional SOP Classes may be used in addition to the Print Management Meta SOP Class.

The following functionality is supported by the optional SOP Classes:

- annotation
- tracking the printing of the print session
- overlays
- retrieval of printer configuration information

H.3.3.2 List of Optional SOP Classes

The following optional SOP Classes may be used in conjunction with the Basic Print Management Meta SOP Classes specified in Section H.3.2.2.

SOP Class Name	Reference	Usage SCU/SCP
Basic Annotation Box SOP Class	H.4.4	U/U
Print Job SOP Class	H.4.5	U/U
Image Overlay Box SOP Class	H.4.8	U/U

Printer Configuration Retrieval SOP Class	H.4.x	U/U

The following optional SOP Class may be used in conjunction with the Pull Stored Print Management Meta SOP specified in Section H.3.2.2.

SOP Class Name	Reference	Usage SCU/SCP
Print Job SOP Class	H.4.5	U/U
Printer Configuration Retrieval SOP Class	H.4.x	U/U

H.3.4 Conformance Statement

The implementation Conformance Statement of these SOP Classes shall follow PS 3.2.

The SCU Conformance Statement shall specify the following items:

- maximum number of supported Associations at the same time
- list of supported SOP Classes and Meta SOP Classes
- for each of the supported SOP and Meta SOP Classes:
  - list of supported optional SOP Class Attributes and DIMSE Service Elements
- for each supported Attribute (mandatory and optional Attribute), the valid range of values

The SCP Conformance Statement shall specify the following items:

- maximum number of supported Associations at the same time
- list of supported SOP Classes and Meta SOP Classes
- minimum and maximum number of printable pixel matrix per supported film size
- for each of the supported SOP Classes:
  - list of supported optional SOP Class Attributes and DIMSE Service Elements
    - for each mandatory and optional Attribute:
    - whether the Attribute is supported and if so, the valid range of values
    - default value if no value is supplied by the SCU
    - status code (Failure or Warning) if SCU supplies a value which is out of range
- for each supported DIMSE Service, the SCP behavior for all specific status codes
- description of each supported custom Image Display Format (2010,0010) e.g., position and dimensions of each composing image box, numbering scheme of the image positions
- description of each supported Annotation Display Format ID (2010,0030) e.g., position and dimensions of annotation box, font, number of characters
- description of each supported configuration table (e.g. identification, content)
- if the SCP supports N-ACTION for the Film Session SOP Class then the SCP shall specify the maximum number of collated films
- for Referenced Meta SOP Class Implementations, the conditions under which stored Image SOP Instances are deleted.
- in the case of grayscale printers that print color images, the behavior of printing color images

— for Pull Print Request Meta SOP Class Implementors, behavior when Image Overlay, Annotation, and Presentation LUT options are contained in the Stored Print Storage SOP Class

— if cropping of images is supported, the algorithm for removing rows and columns from the image

H.4.2.2.1.1 Basic Film Box N-CREATE Attributes Add the following

Requested Resolution ID	(2020,0050)	U/U

H.4.3.1.2.1.1, H.4.3.2.2.1.1, and H.4.3.3.2.1.1 Add the following to N-SET of Image Boxes

Requested Decimate/Crop Behavior	(2020,0040	U/U

H.4.3.1.2.1.3, H.4.3.2.2.1.3, and H.4.3.3.2.1.3 Add the following to N-SET Behavior of Image Boxes

If Requested Decimate/Crop Behavior (2020,0040) specifies DECIMATE, Magnification Type (2010,0060) specifies NONE, and the image is too large to fit the Image Box, the SCP shall fail the N-SET

Add the Following Section to Part 4.

H.4.x Printer Configuration Retrieval SOP Class

H.4.x.1 IOD Description

The Printer Configuration IOD is an abstraction of the hard copy printer and is the basic Information Entity to retrieve key imaging characteristics of the printer

The Printer Configuration Retrieval SOP Instance is created by the SCP during start-up of the hard copy printer and has a well-known SOP Instance UID.

H.4.x.2 DIMSE Service Group

The DIMSE Services which are applicable to the IOD are shown below.

DIMSE Service Element	Usage SCU/SCP
N-GET	M/M

The meaning of the Usage SCU/SCP is described in Section H.2.4.

This Section describes the behavior of the DIMSE Service which are specific for this IOD. The general behavior of the DIMSE Services is specified in PS 3.7.

H.4.x.2.2 N-GET

The N-GET is used to retrieve an instance of the Printer Configuration Retrieval SOP Class.

H.4.x.2.2.1 Attributes

The Attributes which are retrieved are shown in Table H.4-x.

N-GET ATTRIBUTES

Attribute Name	Tag	Usage SCU/SCP
Printer Configuration Sequence	(2000,001E)	U/M
>SOP Classes Supported	(0008,115A)	-/M
>Maximum Memory Allocation	(2000,0062)	-/M
>Memory Bit Depth	(2000,00A0)	-/M
>Printing Bit Depth	(2000,00A1)	-/M
>Media Installed Sequence	(2000,00A2)	-/M
>>Item Number	(0020,0019)	-/M
>>Medium Type	(2000,0030)	-/M
>>Film Size ID	(2010,0050)	-/M
>>Min Density	(2010,0120)	-/MC Required if Sequence is Present and Min Density is known
>>Max Density	(2010,0130)	-/M
>Other Media Available Sequence	(2000,00A4)	-/M
>>Medium Type	(2000,0030)	-/M
>>Film Size ID	(2010,0050)	-/M
>>Min Density	(2010,0120)	-/MC Required if Sequence is Present and Min Density is known
>>Max Density	(2010,0130)	-/M
>Supported Image Display Formats Sequence	(2000,00A8)	-/M
>>Rows	(0028,0010)	-/MC Required if all Image Boxes in the Display Format have the same number of rows and columns
>>Columns	(0028,0011)	-/MC Required if all Image Boxes in the Display Format have the same number of rows and columns
>>Image Display Format	(2010,0010)	-/M
>>Film Orientation	(2010,0040)	-/M
>>Film Size ID	(2010,0050)	-/M
>>Printer Resolution ID	(2010,0052)	-/M

>>Printer Pixel Spacing	(2010,0376)	-/M
>>Requested Image Size Flag	(2020,00A0)	-/M
>Default Printer Resolution ID	(2010,0054)	-/M
>Default Magnification Type	(2010,00A6)	-/M
>Other Magnification Types Available	(2010,00A7)	-/M
>Default Smoothing Type	(2010,00A8)	-/M
>Other Smoothing Types Available	(2010,00A9)	-/M
>Configuration Information Description	(2010,0152)	-/M
>Maximum Collated Films	(2010,0154)	-/M
>Decimate/Crop Result	(2020,00A2)	-/M
>Manufacturer	(0008,0070	-/M
>Manufacturer Model Name	(0008,1090)	-/M
>Printer Name	(2110,0030)	-/M

The meaning of the Usage SCU/SCP is described in Section H.2.4.

H.4.x.2.2.2 Behavior

The SCU uses the N-GET to request the SCP to get a Printer Configuration Retrieval SOP Instance. The SCU shall specify the UID of the SOP Instance to be retrieved.

The SCP shall return the values for the specified Attributes of the specified SOP Instance.

The SCP shall return the status code of the requested SOP Instance retrieval.

A Failure status code shall indicate that the SCP has not retrieved the SOP Instance.

H.4.x.3 SOP Class Definition and UID

The Printer Configuration Retrieval SOP Class UID is "1.2.840.10008.5.1.1.16.376".

H.4.x.4 Reserved Identifications

The well-known UID of the Printer Configuration Retrieval SOP Instance is "1.2.840.10008.5.1.1.17.376".

Add the following entries to the table of PS 3.6 section 6

Tag	Name	VR	VM
(0008,115A)	SOP Classes Supported	UI	1-n
(0020,0019)	Item Number	IS	1
(2000,0062)	Maximum Memory Allocation	IS	1
(2000,001E)	Printer Configuration Sequence	SQ	1
(2000,00A0)	Memory Bit Depth	US	1
(2000,00A1)	Printing Bit Depth	US	1
(2000,00A2)	Media Installed Sequence	SQ	1
(2000,00A4)	Other Media Available Sequence	SQ	1

(2000,00A8)	Supported Image Display Formats Sequence	SQ	1
(2010,0052)	Printer Resolution ID	CS	1
(2010,00540	Default Printer Resolution ID	CS	1
(2010,00A6)	Default Magnification Type	CS	1
(2010,00A7)	Other Magnification Types Available	CS	1-n
(2010,00A8)	Default Smoothing Type	CS	1
(2010,00A9)	Other Smoothing Types Available	CS	1-n
(2010,0152)	Configuration Information Description	LT	1
(2010,0154)	Maximum Collated Films	IS	1
(2010,0376)	Printer Pixel Spacing	DS	2
(2020,0040)	Requested Decimate/Crop Behavior	CS	1
(2020,0050)	Requested Resolution ID	CS	1
(2020,00A0)	Requested Image Size Flag	CS	1
(2020,00A2)	Decimate/Crop Result	CS	1

Add the following entries to the table of PS 3.6 Annex A

UID Value	UID Name	UID Type	Part
1.2.840.10008.5.1.1.16.376	Printer Configuration Retrieval SOP Class	SOP Class	PS 3.4
1.2.840.10008.5.1.1.17.376	Printer Configuration Retrieval SOP Instance	Well-known Printer SOP Instance	PS 3.4