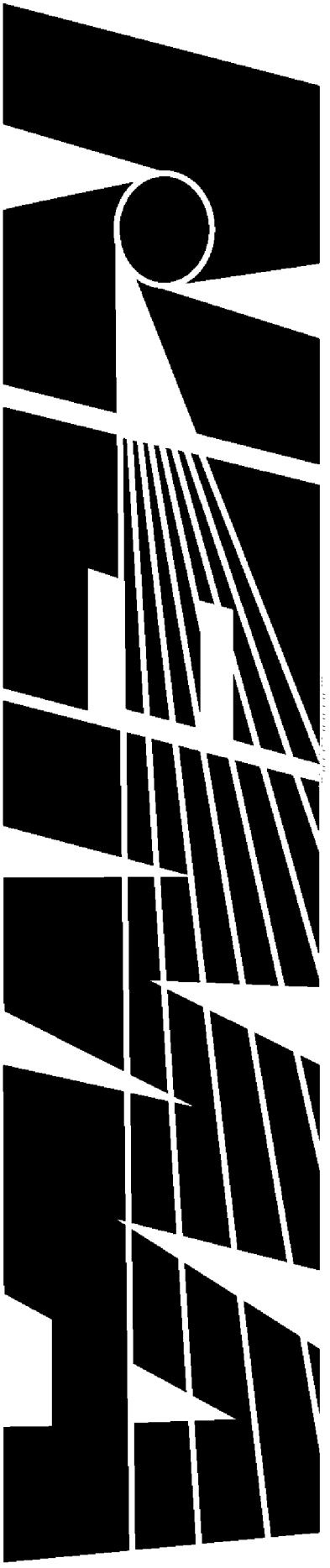
DICOM

Part 13

Print Management Point-to-Point Communication Support



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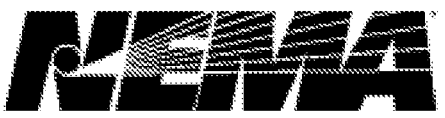

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Digital Imaging and Communications in Medicine (DICOM)

Part 13: Print Management Point-to-Point Communication Support

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FOREWORD

The American College of Radiology ACRand 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 was developed according to the NEMA procedures.

This Standard 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.

The DICOM Standard is structured as a multi-part document using the guidelines established in the following document:

– ISO/IEC Directives, 1989 Part 3 : Drafting and Presentation of International Standards

This document is one part of the 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 for Media Interchange
PS 3.11	Media Storage Application Profiles
PS 3.12	Media Formats and Physical Media for Media Interchange
PS 3.13	Print Management Point-to-Point Communication Support
PS 3.14	Grayscale Display Function Standard
PS 3.15	Security Profiles

These parts are related but independent documents. Their development level and approval status may differ. Additional parts may be added to this multi-part standard.

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1 SCOPE AND FIELD OF APPLICATION

This part specifies the services and protocol necessary to support the communication of DICOM Print Management Application Entities over point-to-point links between print users and print providers.

The Point-to-Point Print Management Communication Support specified in this part of the DICOM standard fits the ISO Open Systems Interconnection Basic Reference Model ISO 7498-1.

The Point-to-Point Communication Profile offers the same upper layer services as the Network Communication Profile, specified in PS 3.8. As a result, similar Print Management Application Entities can be used over a point-to-point link and a network link.

The Point-to-Point Print Management Communication Profile uses lower layer protocols that are compatible with existing hardcopy communication hardware parallel image path, serial control path.

2 NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibilities of applying the most recent editions of the standards indicated below.

ISO 7498-1, Information Processing Systems–Open Systems Interconnection–Basic Reference Model

ISO 8649, Information Processing Systems–Open Systems Interconnection–Service Definition for the Association Control Service Element

ANSI X3.28-1976 R1992, American National Standard Procedures for the Use of the Communication Control characters of American National Standard Code for Information Interchange in Specified Data Communication Links

EIA 232-D, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

EIA RS-422-A, Electrical Characteristics of Balanced Voltage Digital Interface Circuits

3 DEFINITIONS

For the purposes of this Standard the following definitions apply.

3.1 REFERENCE MODEL DEFINITIONS

This Part of the Standard makes use of the following terms defined in ISO 7498-1:

a Application Entity

b Service or Layer Service

c Protocol Data Unit or Layer Protocol Data Unit

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3.2 ACSE SERVICE DEFINITIONS

This Part of the Standard makes use of the following terms defined in ISO 8649:

a Association or Application Association

3.3 DICOM INTRODUCTION AND OVERVIEW DEFINITIONS

This Part of the Standard makes use of the following terms defined in PS 3.1:

a Attribute
b Message

3.4 DICOM UPPER LAYER SERVICE DEFINITIONS

This Part of the Standard makes use of the following terms defined in PS 3.8:

a Unique Identifier UID
b DICOM Upper Layer Service

3.5 DICOM MESSAGE EXCHANGE DEFINITIONS

This Part of the Standard makes use of the following terms defined in PS 3.7:

a DICOM Message Service Element DIMSE
b DIMSE-N Services

3.6 DICOM INFORMATION OBJECT DEFINITIONS

This Part of the Standard makes use of the following terms defined in PS 3.3:

a Information Object Definition
b Normalized IOD

3.7 DICOM CONFORMANCE

This Part of the Standard makes use of the following terms defined in PS 3.2:

a Conformance Statement

3.8 DICOM SERVICE CLASS DEFINITIONS

This Part of the Standard makes use of the following terms defined in PS 3.4:

a Meta Service-Object Pair SOP Class
b Service Class User
c Service Class Provider
d Service Class
e Service-Object Pair SOP Class
f Service-Object Pair SOP Instance

3.9 DICOM POINT-TO-POINT PRINT MANAGEMENT COMMUNICATIONS SUPPORT DEFINITIONS

The following definitions are commonly used in this part of the DICOM Standard:

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The Strobe width T3 is referenced to the actual T4 period used.

T4 and T7 Timeouts apply only during an image transfer.

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Annex E POINT-TO-POINT PRINT MANAGEMENT SERVICE CLASS OVERVIEW (Informative)

E.1 SCOPE

The Point-to-Point Print Management Service Class describes the exchange of information between two devices to cause images to be printed on film or paper.

This Annex illustrates the key points of the Service Class. These are only examples. In many cases, the same functions could be accomplished by other series of commands. The specification of the Service Class is contained in Annex A of this Part.

References to specific Sections in other Parts of the DICOM Standard in this Annex are specifically to the following versions:

a Part 3 PS 3.3-1993
b Part 4 PS 3.4-1993
c Part 7 PS 3.7-1993
d Part 8 PS 3.8-1993

In future versions of these Parts, the specific section references may no longer be valid.

E.2 SUMMARY

E.2.1 Roles of the Devices

Each of the two devices plays one of two roles during a print session. The device that provides the image data and desires to have the prints made is referred to as the Service Class User SCU. The device that receives the image data and makes the prints is the Service Class Provider SCP.

E.2.2 Information Structure

Information exchanged between the SCU and SCP is represented by Service-Object Pair Instances SOP Instances. These are a combination of object instances and services performed on the objects.

There are three general types of Attributes for SOP Instances.

a Mandatory for both the SCU and SCP. These are designated as M/M.
b Optional for the SCU, but mandatory for the SCP. If the SCU provides these Attributes, the SCP must act on them. In addition, the SCP will have defaults for each of these Attributes and stated the defaults and the valid range of values in its Conformance Statement. These are designated as U/M.
c Optional for both the SCU and SCP. If the SCU provides these Attributes, the SCP may ignore them. These are designated as U/U.

Usage is further defined in Sections 5.4 and H.2.4 of PS 3.4.

The information needed by the SCP to print the films is contained in a three layer hierarchy of four SOP Instances. In general, the Attributes of these SOP Instances are provided by the SCU.

Information needed by the SCU about the status of the SCP or the Print Job is contained in one of two other SOP Instances. In general, the Attributes of the SOP Instances are provided by the SCP.

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E.2.2.1 Information Needed by the SCP

a The Basic Film Session contains Attributes that apply to all films in an entire film session. The SCU determines what constitutes a film session. It may be a single film, or multiple films from the same patient, study, etc. A single Film Session SOP Instance is required for the film session.

b The Basic Film Box contains Attributes that apply to all images on a single film. A film contains one or more images and optionally text annotation. One Film Box SOP Instance is required for each page in the film session.

c The Point-to-Point Image Box contains Attributes that apply to a single image on the film. One image box is required for each image in each film box in the film session.

d The Basic Annotation Box contains information needed to add text information to the printed film. The use of the Annotation Box is optional and is negotiated when the Association is established. If used, there is one Annotation Box SOP Instance for each text string to be printed on all film boxes in the film session.

E.2.2.2 Information Needed by the SCU

a The Printer SOP Class contains information about the printer. These include SCP status information and the name of the printer. Support of this SOP Class is required for all devices.

b The Print Job contains Attributes that may be needed by the SCU to determine the status of the print job after it has been sent to the print queue by the printer. The use of the Print Job is optional and is negotiated when the Association is established.

E.3 EXAMPLES OF POSSIBLE FILM SESSIONS

E.3.1 Simple Example

In this simple example, none of the optional SOP Classes are supported. The SCU simply instructs the SCP to print sequential pages of images all with the same format. A single Film Session SOP Instance is created and it contains a Film Box SOP Instance.

E.3.1.1 Summary of Simple Example

a Establish the Association. This is done once and remains open indefinitely.

b Create the film session the same film session is used for all pages

c Create the film box

d Acquire each image for the page

e Print the page

f Notify that printer film supply becomes Low

g Delete the film box deletes images from previous page

h Create a new film box

i Acquire new images for a new page

j Print the new page

k Repeat g—j for each subsequent page

E.3.1.2 Establish the Association

The first step is the establishment of an Association by the SCU. This is performed by the SCU issuing an A-ASSOCIATE-REQUEST and is described in PS 3.7 and PS 3.8.

In this example, the Association remains open indefinitely.

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E.3.1.3 Create the Film Session

The SCU initiates the transaction by sending film session attributes to the printer. This is done through an N-CREATE of a Basic Film Session SOP Instance. This is described in Section H.4.1 in PS 3.4.

a The film session is required to have a Unique Identifier UID. This UID may be provided by the SCU as an Attribute of the N-CREATE. Otherwise, the SCU asks the SCP to specify a UID by sending the UID Attribute in the N-CREATE with a zero length value.

b U/M Attributes
- Number of copies for each film in the session
- Priority low, medium, high of the session
- Type of medium to be printed on clear or blue film or paper
- Destination of the printed film processor or magazine

c U/U Attributes
- An SCU defined label for the session
- An amount of memory the SCU expects to need to store all images in the session

d In the response to the N-CREATE, the SCP is required to provide the UID of the created film session and the status of the command

e These Attributes apply to all pages in the film session.

E.3.1.4 Create the Film Box

The SCU then sends attributes of the first page in the film session to the printer. This is done through an N-CREATE of a Basic Film Box SOP Instance. This is described in Section H.4.2 in PS 3.4.

a The film box is required to have a Unique Identifier UID. This UID may be provided by the SCU as an Attribute of the N-CREATE. Otherwise, the SCU asks the SCP to specify a UID by sending the UID Attribute in the N-CREATE with a zero length value.

b M/M Attributes
- The image display format, typically the number of rows and columns of images to be printed on the page
- The UID of the film session to which this page belongs

c U/M Attributes
- Film orientation landscape or portrait
- The size of the film to be used
- Type of magnification to be used to print the images
- Maximum density to which images are to be printed
- Special configuration information that is specific to one or more particular printers. The nature of this information is provided by the SCP in its Conformance Statement.

d U/U Attributes
- Additional information about smoothing options to the magnification type
- Density that the border around individual images is to be printed
- Density that empty image area is to be printed
- Minimum density to which images are to be printed
- Whether or not trim is to be printed around each image

e In the response to the N-CREATE, the SCP is required to provide the UID of the created film box and the status of the command.

In addition, the N-CREATE of the film box instructs the SCP to create one or more Image Box SOP Instances. The number to be created equals the number of images to be printed on the page as specified by the Attribute Display Format.

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In the response to the N-CREATE of the film box, the SCP also returns the UIDs of the image boxes that it created.

E.3.1.5 Acquire Each Image for the Page

The SCU then sends attributes of the first image on the page. This is done through an N-SET of a Point-to-Point Image Box SOP Instance. This is described in Annex A in this Part.

a The SCU makes the pixel data available on the Image Path.

b The SCU then issues an N-SET command. This command contains attributes of the particular image to be printed.

c M/M Attributes
- Image Position which specifies the position on the page on which this image is to be placed
- UID of the film box to which this image belongs

d U/M Attributes
- Polarity at which the image is to be printed
- Image pixel Aspect Ratio

e U/U Attributes
- Magnification Type
- Smoothing Type
- Requested Image Size

f After receiving the N-SET, the SCP acquires the image pixel data through the Image Path Physical Layer

g The SCP then returns an N-SET response that specifies the status of the command.

h This process is repeated for each image to be printed on the page.

E.3.1.6 Print the Page

After all images to be printed have been acquired, the SCU instructs to SCP to print the specified number of copies of the page by issuing an N-ACTION on the film box. This is described in Section H.4.2.2.4 in PS 3.4.

a The N-ACTION contains only the Film Box Class and Instance UIDs.

b The N-ACTION response is required to contain only the status of the command.

c The result of the N-ACTION is that pixel data for the page is entered into the print queue. There is no effect on the Attributes of the Film Box SOP Instance itself. The SCU could cause additional copies to be printed by reissuing an N-ACTION command.

E.3.1.7 Printer Film Supply Becomes Low.

The SCP is close to running out of film and notifies the user.

The SCP initiates an N-EVENT-REPORT of type WARNING. This command contains the printer name and its status. The Attribute Printer Status Info (2110,0020) contains the defined term SUPPLY LOW.

The PRINTER SOP Class is described in Section H.4.6 of PS 3.4. The possible values for printer Status Info are described in Table C.13.9-1 of PS 3.3.

E.3.1.8 Delete the Film Box

The SCU issues an N-DELETE of the film box. This indicates to the SCP that no further printing of these images will be requested.

N-DELETE of the film box is described in Section H.4.2.2.3 of PS 3.4.

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E.3.1.9 Create a New Film Box

The SCU issues an N-CREATE for a new film box.

E.3.1.10 Acquire New Images for the New Page

The SCU now makes available the image pixel data for the next page to be printed. This is done by issuing N-SET commands that instruct the SCP to acquire the image pixel data.

This process is repeated for each image to be printed on the new page.

E.3.1.11 Print the New Page

The SCU issues an N-ACTION on the film box.

E.3.1.12 Repeat

The steps in Sections E.3.1.8 through E.3.1.11 are repeated for each new page to be printed. New values for the film box Attributes may be specified by the SCU each time the film box N-CREATE is issued.

E.3.2 Options to the Simple Example

E.3.2.1 Change the Number of Copies

Suppose one copy of each page is being printed, but the SCU wishes to have the next three pages printed with two copies.

Any time between the N-ACTION for the previous page and the N-ACTION for the next page, the SCU issues an N-SET on the film session with number of copies of 2. Subsequent N-ACTIONs will cause 2 copies of the page to be printed.

After the third page is printed, the SCU issues another N-SET on the film session with number of copies of 1.

N-SET on the film session is described in Section H.4.1.2.2 in PS 3.4.

E.3.2.2 Image Stored in Error

In this case, a page has been printed, but the SCU realizes that the image in position 5 should not be on the page. Before the N-DELETE is issued, the Film Box SOP still exists on the SCP with all the images. These images can be changed with N-SETs and then reprinted with a new N-ACTION.

If this image is to be replaced with another image, the SCU places the new image on the Image Path and issues an N-SET for position 5. This instructs the SCP to replace the old image in position 5 with the new image.

Optionally, the image in error could be replaced with a blank space in position 5. The SCU issues an N-SET for position 5 with Attribute Preformatted Grayscale Image Sequence (2020,0110) with zero length value. This instructs the SCP to erase the image previously placed in this position.

E.3.2.3 Summary of Simple Example with Options Exercised

Establish the Association with A-ASSOCIATE REQUEST

a Create the film session with N-CREATE
b Create the film box with N-CREATE
c Acquire each image for the page with N-SETs
d Print the first page with N-ACTION
e Notify that Printer Film Supply Becomes Low with N-EVENT
f Delete the film box with N-DELETE
g Create a new film box with N-CREATE

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h Acquire new images for a new page with N-SETs
i Print the second page with N-ACTION
j Delete the film box with N-DELETE
k Create a new film box with N-CREATE
l Acquire new images for a new page with N-SETs
m Change copies to 2 with N-SET on the film session
n Print 2 copies of the third page with N-ACTION
o Change image in position 5 with N-SET on the image box
p Reprint 2 copies of the third page with N-ACTION
q Change copies to 1 with N-SET on the film session

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E.3.3 Embellished Example

Following is an example that utilizes some of the optional features of the Service Class.

a printing at the film session level
b annotation on the films
c print job status notification

The advantage of printing at the film session level is that all pages in the session will be printed sequentially. In addition, if multiple copies are requested they will be collated. For example, 2 copies of a 4 film session would be printed 12341234. Pages from other print jobs from other SCUs supported by the same printer on other Physical Links that may be active on the same printer will not be interspersed between these pages. N-ACTION on the film session is described in Section H.4.1.2.4 in PS 3.4.

Annotation allows the printing of text on a film page. It is negotiated when the Association is established. This is accomplished by the SCU specifying an Annotation Display Format ID in the N-CREATE of the film box. This instructs the SCP to create Annotation Boxes. The SCU then does N-SETs on the Annotation Boxes. Annotation formats provided by the SCP are specified in its Conformance Statement. Annotation is described in Sections H.4.2.2.1 and H.4.4 in PS 3.4.

The Print Job SOP Class provides notification to the SCU of changes in the status of the films in the printing process. It is negotiated when the Association is established. The Print Job SOP Instance is created by the SCP as a result of an N-ACTION on the film session or film box initiated by the SCU. If this SOP is supported, the SCP reports changes in the status of the print job to the SCU with N-EVENT REPORTs. In addition, the SCU may request information on the status with an N-GET. The Print Job SOP Class is described in Section H.4.5 in PS 3.4. Specific status information is described in Section C.13.8 in PS 3.3.

In the following example, films from two film sessions are printed and collated. Each session is the films from a single study. Each study contain three films. Annotation is placed on the first and third films.

Actions are initiated by the SCU except as specifically noted.

Establish the Association with A-ASSOCIATE

a Create the film session with N-CREATE
  – Create the first film box with N-CREATE
  – Place annotation text string with N-SET
  – Place each image for the page with N-SETs
  – Create the second film box with N-CREATE
  – Place each image for the page with N-SETs
  – Create the third film box with N-CREATE
  – Place annotation text string with N-SET
  – Place each image for the page with N-SETs
b Request film session be printed with N-ACTION
c SCP Notifies SCU that print job is pending with N-EVENT-REPORT
d Delete the film session with N-DELETE
e Request update on print job status with N-GET
f Create new film session with N-CREATE
g Create the first film box with N-CREATE
h SCP Notifies SCU that print job is printing with N-EVENT-REPORT
i SCP Notifies SCU that print job is done with N-EVENT-REPORT

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{Complete second film session in similar manner}

Release the Association with A-RELEASE.

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Annex F INDEX TO ATTRIBUTE TAGS AND UIDs (Informative)

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