Digital Imaging and Communications in Medicine (DICOM)

Supplement 57: Revised Secondary Capture Objects

DICOM Standards Committee, Working Group 6 Base Standard

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Contents

Foreword

This Supplement has been prepared by the DICOM Working Group 6 (Base Standard) according to the procedures of the DICOM Committee.

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 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 for Data Interchange
PS 3.11	-	Media Storage Application Profiles
PS 3.12	-	Media Formats and Physical Media for Data Interchange
PS 3.13	-	Print Management Point-to-Point Communication Support
PS 3.14	-	Grayscale Standard Display Function
PS 3.15	-	Security Profiles
PS 3.16	-	Content Mapping Resource

These parts are related but independent documents.

Scope and Field of Application

INTRODUCTION.

Additional DICOM Secondary Capture SOP Classes beyond the original in the existing standard are needed to support new applications (such as scanned document input) as well as to improve conformance for existing secondary capture applications.

Scanned document support is especially important to structured reporting applications that need to reference drawings, scanned forms and scanned paper documents such as hand-written requests.

LIMITATIONS OF CURRENT STANDARD.

The existing Secondary Capture object has:

- no constraints on Photometric Interpretation, especially grayscale vs. color
- no constraints on bit depth
- no compression transfer syntaxes for 1 bit
- very poor implementation support for 1 bit
- no support for scanned document concepts like page
- no multi-frame capability.

The effects of these limitations are that:

- SC SOP Class “conformance” is too vague
- there is no obvious way to determine support for:
    - grayscale or color of some form
    - typical 1 bit, 8 bits, 16 bits
    - pixel matrix size (limits to 512, 1024, etc.)
- poor 1 bit support prevents use for scanned documents

DESCRIPTION OF PROPOSAL.

A new family of Secondary Capture SOP Classes is proposed that:

- is stratified by bit depth and photometric interpretation:
    - 1 bit MONOCHROME2 single component (0 is black, 1 is white)
    - 8 bit unsigned grayscale MONOCHROME2 & VOI LUT to P-Values
    - 9-16 bit unsigned grayscale MONOCHROME2 & VOI LUT to P-Values
    - 8 bit per channel color-by-pixel RGB
- specifies SCP display/rendering conformance in more rigorous manner

This family would be applicable to the following applications:

- scanned documents
    - 1 bit grayscale
    - additional “page” descriptive attributes

- frame grab acquisitions
- screen shots
    - from grayscale with windowing intact
    - from true or indexed color
- sets of synthesized images
    - pan around 3D reconstructions (multi-frame movie)

FORM OF THIS SUPPLEMENT

The new SOP Classes essentially specialize the existing SC SOP Class, with either additional constraints on the form of the pixel data, use of additional modules to support multi-frame pixel data, and new modules to support scanned document imaging.

Since this document proposes changes to existing Parts of DICOM, the reader should have a working understanding of the Standard. This proposed Supplement includes a number of Addenda to existing Parts of DICOM :

- PS 3.3 Addendum: Information Object Definitions

- PS 3.4 Addendum: Service Class Specifications

- PS 3.6 Addendum: Data Dictionary

Changes to

NEMA Standards Publication PS 3.3-2000

Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

Add explanatory material before existing SC IOD:

A.8SECONDARY CAPTURE IMAGE INFORMATION OBJECT DEFINITIONS

The Secondary Image (SC) Image Information Object Definition (IOD) specifies images that are converted from a non-DICOM format to a modality independent DICOM format.

Examples of types of equipment that create Secondary Capture Images include:

a. Video interfaces that convert an analog video signal into a digital image

b. Digital interfaces that are commonly used to transfer non-DICOM digital images from an imaging device to a laser printer

c. Film digitizers that convert an analog film image to digital data

d. Workstations that construct images that are sent out as a screen dump

e. Scanned documents and other bitmap images including hand-drawings

f. Synthesized images that are not modality-specific, such as cine-loops of 3D reconstructions

Originally, a single, relatively unconstrained, single-frame SC Image IOD was defined in the DICOM Standard. Though this IOD is retained and not retired since it is in common use, more specific IODs for particular categories of application are also defined.

The following IODs are all multi-frame. A single frame image is encoded as a multi-frame image with only one frame. The multi-frame SC IODs consist of:

- Multi-frame Single Bit Secondary Capture Image IOD
- Multi-frame Grayscale Byte Secondary Capture Image IOD
- Multi-frame Grayscale Word Secondary Capture Image IOD
- Multi-frame True Color Secondary Capture Image IOD

Indent section numbers of existing SC IOD, remove duplicated material and deprecate:

A.8.1 SC Image Information Object Definition

A.8.1.1SC Image IOD Description

The Secondary Image (SC) Image Information Object Definition (IOD) specifies **single-frame** images that are converted from a non-DICOM format to a modality independent DICOM format**, without any contraints on pixel data format**.

~~**Examples of types of equipment that create Secondary Capture Images include:**~~

~~**a. Video interfaces that convert an analog video signal into a digital image**~~

~~**b. Digital interfaces that are commonly used to transfer non-DICOM digital images from an imaging device to a laser printer**~~

~~**c. Film digitizers that convert an analog film image to digital data**~~

~~**d. Workstations that construct images that are sent out as a screen dump**~~

Note: The use of this IOD is deprecated, and other more specific SC Image IODs should be used.

A.8.1.2SC Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model which directly reference the Secondary Capture Image IOD. The Frame of Reference IE, ~~**Overlay IE, Modality LUT IE, VOI LUT IE**~~ and Curve IE are not components of ~~**the Secondary Capture**~~ **this** IOD.

A.8.1.3SC Image IOD Module Table

Table A.8-1
SC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	U
	SC Equipment	C.8.6.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	SC Image	C.8.6.2	M
	Overlay Plane	C.9.2	U
	Modality LUT	C.11.1	U
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M

Add new SC object IODs:

A.8.2 Multi-frame Single Bit SC Image Information Object Definition

A.8.2.1Multi-frame Single Bit SC Image IOD Description

The Multi-frame Single Bit Secondary Capture (SC) Image Information Object Definition (IOD) specifies images that are converted from a non-DICOM format to a modality independent DICOM format.

This IOD is typically used for scanned documents and bitmap images of hand drawings.

A.8.2.2Multi-frame Single Bit SC Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model which directly reference the Secondary Capture Image family of IODs. The Frame of Reference IE, Overlay IE, Modality LUT IE, VOI LUT IE and Curve IE are not components of this IOD.

A.8.2.3SC Image IOD Module Table

Table A.8-2
MULTI-FRAME SINGLE BIT SC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	U
	SC Equipment	C.8.6.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Cine	C.7.6.5	C – Required if Frame Increment Pointer (0028,0009) is Frame Time (0018,1063) or Frame Time Vector (0018,1065)
	Multi-frame	C.7.6.6	M
	Frame Pointers	C.7.6.9	U
	SC Image	C.8.6.2	U
	SC Multi-frame Image	C.8.6.3	M
	SC Multi-frame Vector	C.8.6.4	C – Required if Number of Frames is greater than 1
	SOP Common	C.12.1	M

A.8.2.4Multi-frame Single Bit SC Image IOD Content Constraints

In the Image Pixel Module, the following constraints apply:

- Samples per Pixel (0028,0002) shall be 1
- Photometric Interpretation (0028,0004) shall be MONOCHROME2
- Bits Allocated (0028,0100) shall be 1
- Bits Stored (0028,0101) shall be 1
- High Bit (0028,0102) shall be 0
- Pixel Representation (0028,0103) shall be 0
- Planar Configuration (0028,0006) shall not be present

Note: As a consequence of these attribute values, single bit pixels are packed eight to a byte as defined by the encoding rules in PS 3.5.

The VOI LUT module shall not be present.

The Overlay module shall not be present.

A.8.3 Multi-frame Grayscale Byte SC Image Information Object Definition

A.8.3.1Multi-frame Grayscale Byte Image IOD Description

The Multi-frame Grayscale Byte Secondary Capture (SC) Image Information Object Definition (IOD) specifies Grayscale Byte images that are converted from a non-DICOM format to a modality independent DICOM format.

This IOD is typically used for screen captured images for modalities that have pixel values of 8 bits, but may also be appropriate for scanned grayscale documents.

A.8.3.2Multi-frame Grayscale Byte SC Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model which directly reference the Secondary Capture Image family of IODs. The Frame of Reference IE, Overlay IE, Modality LUT IE and Curve IE are not components of this IOD.

A.8.3.3Multi-frame Grayscale Byte SC Image IOD Module Table

Table A.8-3
MULTI-FRAME GRAYSCALE BYTE SC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	U
	SC Equipment	C.8.6.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Cine	C.7.6.5	C – Required if Frame Increment Pointer (0028,0009) is Frame Time (0018,1063) or Frame Time Vector (0018,1065)
	Multi-frame	C.7.6.6	M
	Frame Pointers	C.7.6.9	U
	SC Image	C.8.6.2	U
	SC Multi-frame Image	C.8.6.3	M
	SC Multi-frame Vector	C.8.6.4	C – Required if Number of Frames is greater than 1
	VOI LUT	C.11.2	C – Required if the VOI LUT stage is not an identity transformation
	SOP Common	C.12.1	M

A.8.3.4Multi-frame Grayscale Byte SC Image IOD Content Constraints

The VOI LUT module is required if the VOI LUT stage is not an identity transformation. Support for both window and LUT is mandatory. The output grayscale space is defined to be in P-Values.

Note: If the VOI LUT module is absent, then the stored pixel values are in P-Values.

In the Image Pixel Module, the following constraints apply:

- Samples per Pixel (0028,0002) shall be 1
- Photometric Interpretation (0028,0004) shall be MONOCHROME2
- Bits Allocated (0028,0100) shall be 8
- Bits Stored (0028,0101) shall be 8
- High Bit (0028,0102) shall be 7
- Pixel Representation (0028,0103) shall be 0
- Planar Configuration (0028,0006) shall not be present

The Overlay module shall not be present.

A.8.4 Multi-frame Grayscale Word SC Image Information Object Definition

A.8.4.1Multi-frame Grayscale Word SC Image IOD Description

The Multi-frame Grayscale Word Secondary Capture (SC) Image Information Object Definition (IOD) specifies Grayscale Word images that are converted from a non-DICOM format to a modality independent DICOM format.

This IOD is typically used for screen captured images for modalities that have pixel values greater than 8 bits.

A.8.4.2Multi-frame Grayscale Word SC Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model which directly reference the Secondary Capture Image family of IODs. The Frame of Reference IE, Overlay IE, Modality LUT IE and Curve IE are not components this IOD.

A.8.4.3Multi-frame Grayscale Word SC Image IOD Module Table

Table A.8-4
MULTI-FRAME GRAYSCALE WORD SC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	U
	SC Equipment	C.8.6.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Cine	C.7.6.5	C – Required if Frame Increment Pointer (0028,0009) is Frame Time (0018,1063) or Frame Time Vector (0018,1065)
	Multi-frame	C.7.6.6	M
	Frame Pointers	C.7.6.9	U
	SC Image	C.8.6.2	U
	SC Multi-frame Image	C.8.6.3	M
	SC Multi-frame Vector	C.8.6.4	C – Required if Number of Frames is greater than 1
	VOI LUT	C.11.2	C – Required if the VOI LUT stage is not an identity transformation
	SOP Common	C.12.1	M

A.8.4.4Multi-frame Grayscale Word SC Image IOD Content Constraints

The VOI LUT module is required if the VOI LUT stage is not an identity transformation. Support for both window and LUT is mandatory. The output grayscale space is defined to be in P-Values.

Note: If the VOI LUT module is absent, then the stored pixel values are in P-Values.

In the Image Pixel Module, the following constraints apply:

- Samples per Pixel (0028,0002) shall be 1
- Photometric Interpretation (0028,0004) shall be MONOCHROME2
- Bits Allocated (0028,0100) shall be 16
- Bits Stored (0028,0101) shall be greater than or equal to 9 and less than or equal to 16
- High Bit (0028,0102) shall be one less than Bits Stored (0028,0101)
- Pixel Representation (0028,0103) shall be 0
- Planar Configuration (0028,0006) shall not be present

The Overlay module shall not be present. Unused high bits shall be filled with zeroes.

A.8.5 Multi-frame True Color SC Image Information Object Definition

A.8.5.1Multi-frame True Color Image IOD Description

The Multi-frame True Color Secondary Capture (SC) Image Information Object Definition (IOD) specifies True Color images that are converted from a non-DICOM format to a modality independent DICOM format.

This IOD is typically used for screen captured or synthetic images where true color is used, but may also be appropriate for scanned color documents.

A.8.5.2Multi-frame True Color SC Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model which directly reference the Secondary Capture Image family of IODs. The Frame of Reference IE, Overlay IE, Modality LUT IE, VOI LUT IE and Curve IE are not components of the this IOD.

A.8.5.3Multi-frame True Color SC Image IOD Module Table

Table A.8-5
MULTI-FRAME TRUE COLOR SC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	U
	SC Equipment	C.8.6.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Cine	C.7.6.5	C – Required if Frame Increment Pointer (0028,0009) is Frame Time (0018,1063) or Frame Time Vector (0018,1065)
	Multi-frame	C.7.6.6	M
	Frame Pointers	C.7.6.9	U
	SC Image	C.8.6.2	U
	SC Multi-frame Image	C.8.6.3	M
	SC Multi-frame Vector	C.8.6.4	C – Required if Number of Frames is greater than 1
	SOP Common	C.12.1	M

A.8.5.4Multi-frame True Color SC Image IOD Content Constraints

The VOI LUT module shall not be present.

In the Image Pixel Module, the following constraints apply:

- Samples per Pixel (0028,0002) shall be 3
- Photometric Interpretation (0028,0004) shall be RGB for uncompressed or lossless compressed transfer syntaxes, and YBR_FULL_422 for lossy compressed transfer syntaxes

Note: Future lossless and lossy transfer syntaxes may lead to the need for new definitions and choices for Photometric Interpretation, such as the proposed RC T (Reversible Color Transformation) used in JPEG 2000.

- Bits Allocated (0028,0100) shall be 8
- Bits Stored (0028,0101) shall be 8
- High Bit (0028,0102) shall be 7
- Pixel Representation (0028,0103) shall be 0
- Planar Configuration (0028,0006) shall be 0 (color-by-pixel) if Photometric Interpretation (0028,0004) is RGB

The Overlay module shall not be present.

Modify SC Modules:

C.8.6 Secondary Capture Modules

C.8.6.1SC Equipment Module

This Module describes equipment used to convert images into a DICOM format.

Table C.8-24
SC ~~IMAGE~~ EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	Describes the kind of image conversion. Defined Terms : DV = Digitized Video DI = Digital Interface DF = Digitized Film WSD = Workstation **SD = Scanned Document** **SI = Scanned Image** **DRW = Drawing** **SYN = Synthetic Image**
Modality	(0008,0060)	3	Source equipment for the image. See C.7.3.1.1.1 for Enumerated Values.
Secondary Capture Device ID	(0018,1010)	3	User defined identification of the device that converted the image
Secondary Capture Device Manufacturer	(0018,1016)	3	Manufacturer of the Secondary Capture Device
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	3	Manufacturer's model number of the Secondary Capture Device
Secondary Capture Device Software Version	(0018,1019)	3	Manufacturer's designation of software version of the Secondary Capture Device
Video Image Format Acquired	(0018,1022)	3	Original format of the captured video image (e.g. NTSC, PAL, Videomed-H)
Digital Image Format Acquired	(0018,1023)	3	Additional information about digital interface used to acquire the image

Notes: 1. The Attributes specified in the General equipment Module (see Table C.7-6) describe the equipment which created the image being captured. The Attributes of the SC ~~**Image**~~ Equipment Module define the equipment that captured the image. The following table illustrate**s** typical scenarios for different conversion types:

Conversion Type (0008,0064)	General Equipment	Secondary Capture Equipment
Digitized Video (DV)	The equipment generating the video signal.	The equipment digitizing the video signal.
Digital Interface (DI)	The equipment on the sending side of the digital interface.	The equipment on the receiving side of the digital interface.
Digitized Film (DF)	The equipment which created the film.	The equipment digitizing the film.
Workstation (WSD)	Application dependent, but often the equipment which placed the image on the workstation screen, or created the modified image.	The equipment which captured the image from the screen, or which placed the modified image into a DICOM SOP Instance.

Scanned Document (SD)	The equipment which created the document.	The equipment digitizing the document.
Scanned Image (SI)	The equipment which created the image that was digitized.	The equipment digitizing the image.
Drawing (DRW)	The equipment which created the drawing.	The equipment digitizing (or rasterizing) the drawing.
Synthetic Image (SYN)	The equipment creating the original images from which the synthetic image was derived.	The equipment creating the synthetic image.

2. The Attribute Modality (0008,0060) specified in the General Series Module (see Table C.7-4) has been specialized by this Module and is defined as a Type 3 Attribute.

C.8.6.2SC Image Module

Table C.8-25 contains IOD Attributes that describe Secondary Capture Images.

Table C.8-25
SC IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Date of Secondary Capture	(0018,1012)	3	The date the Secondary Capture Image was captured.
Time of Secondary Capture	(0018,1014)	3	The time the Secondary Capture Image was captured.

Note: The Attributes specified in the General Image Module (see Table C.7-7) describe this image (ie. the secondary capture image). For example, Instance Number (0020,0013) is the image number of the secondary capture image. Source Image Sequence (0008,2112) may reference the DICOM image from which this image was generated.

Add new SC Modules:

C.8.6.3SC Multi-frame Image Module

Table C.8-25b contains IOD Attributes that describe SC Multi-frame images.

Table C.8-25b
SC MULTI-FRAME IMAGE MODULE ATTRIBUTES

Burned In Annotation	(0028,0301)	1	Indicates whether or not image contains sufficient burned in annotation to identify the patient and date the image was acquired. Enumerated Values: YES NO

Presentation LUT Shape	(2050,0020)	1C	Specifies an identity transformation for the Presentation LUT, such that the output of all grayscale transformations defined in the IOD containing this Module are defined to be P-Values. Enumerated Values: IDENTITY - output is in P-Values. Required if Photometric Interpretation (0028,0004) is MONOCHROME2, and BitsStored (0028,0101) is greater than 1. Note: If the VOI LUT Module is required by the IOD but no VOI LUT Sequence (0028,3010) or Window Center (0028,1050) is present, then the VOI LUT stage is an identity transformation.
Illumination	(2010,015E)	3	Luminance of a hypothetical viewing device illuminating a piece of monochrome transmissive film, or for the case of reflective media, luminance obtainable from diffuse reflection of the illumination present. Expressed as L_0, in candelas per square meter (cd/m^2). Note: May be used together with Reflected Ambient Light (2010,0160) to recover Optical Density information from P-Values. See C.8.6.3.1.
Reflected Ambient Light	(2010,0160)	3	For scanned monochrome transmissive film viewed on a hypothetical viewing device, the luminance contribution due to reflected ambient light. Expressed as L_a, in candelas per square meter (cd/m^2). Note: May be used together with Illumination (2010,015E) to recover Optical Density information from P-Values. See C.8.6.3.1.
Rescale Intercept	(0028,1052)	1C	The value b in the relationship between stored values (SV) in Pixel Data (7FE0,0010) and the output units specified in Rescale Type (0028,1054). Output units = m*SV + b. Enumerated Value: 0 Required if Photometric Interpretation (0028,0004) is MONOCHROME2, and BitsStored () is greater than 1. Note: This specifies an identity Modality LUT transformation.

Rescale Slope	(0028,1053)	1C	m in the equation specified by Rescale Intercept (0028,1052). Enumerated Value: 1 Required if Photometric Interpretation (0028,0004) is MONOCHROME2, and BitsStored (0028,0101) is greater than 1. Note: This specifies an identity Modality LUT transformation.
Rescale Type	(0028,1054)	1C	Specifies the output units of Rescale Slope (0028,1053) and Rescale Intercept (0028,1052). Enumerated Value: US = Unspecified Required if Photometric Interpretation (0028,0004) is MONOCHROME2, and BitsStored (0028,0101) is greater than 1. Note: This specifies an identity Modality LUT transformation.
Frame Increment Pointer	(0028,0009)	1C	Contains the Data Element Tag of the attribute which is used as the frame increment in Multi-frame pixel data. See C.7.6.6.1.1 for further explanation. Shall be present if Number of Frames is greater than 1, overriding (specializing) the Type 1 requirement on this attribute in the Multi-frame Module.
Nominal Scanned Pixel Spacing	(0018,2010)	1C	Physical distance on the media being digitized or scanned between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm. Required if Conversion Type (0008,0064) is DF (Digitized Film). May also be present if Conversion Type (0008,0064) is SD (Scanned Document) or SI (Scanned Image). Shall be consistent with Pixel Aspect Ratio (0028,0034), if present.
Digitizing Device Transport Direction	(0018,2020)	3	Enumerated Values: ROW COLUMN
Rotation of Scanned Film	(0018,2030)	3	Angle of the edge of the film relative to the transport direction in degrees greater than or equal to -45 and less than or equal to +45.

C.8.6.3.1 Scanned Film, Optical Density and P-Values

Illumination (2010,015E) and Reflected Ambient Light (2010,0160) may be used to recover Optical Density information from P-Values.

Monochrome media that is being digitized is often measured in Optical Density values. These values need to be converted to P-Values for storage and display. The P-Values used in an image correspond to the perception of a human observer viewing the film on a hypothetical viewing device (such as a light box), using the specified values of Illumination (2010,015E) and Reflected Ambient Light (2010,0160).

The Grayscale Standard Display Function defined in PS 3.14 is used to convert Luminance to P-Values. In the case of scanned film, the Luminance is derived from Optical Density using the specified values of Illumination (2010,015E) and Reflected Ambient Light (2010,0160). An example of this derivation, as well as typical “default” values for these parameters, is specified in PS 3.14.

C.8.6.4SC Multi-frame Vector Module

Table C.8-25c contains IOD Attributes that may be the target of the Frame Increment Pointer (0028,0009) for SC Multi-frame images.

Table C.8-25c
SC MULTI-FRAME VECTOR MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Time Vector	(0018,1065)	1C	An array which contains the real time increments (in msec) between frames for a Multi-frame image. See C.7.6.5.1.2 for further explanation. Required if Frame Increment Pointer (0028,0009) points to Frame Time Vector (0018,1065).
Page Number Vector	(0018,2001)	1C	An array which contains, for each of the image frames, the corresponding page numbers of the original document. Required if Frame Increment Pointer (0028,0009) points to Page Number Vector (0018,2001).
Frame Label Vector	(0018,2002)	1C	An array which contains, for each of the image frames, a descriptive label. Required if Frame Increment Pointer (0028,0009) points to Frame Label Vector (0018,2002).
Frame Primary Angle Vector	(0018,2003)	1C	An array which contains, for each of the image frames, the primary angle of rotation about an undefined axis, in degrees. May be used for annotative purposes for “cine loops” of 3D reprojected images Required if Frame Increment Pointer (0028,0009) points to Frame Primary Angle Vector (0018,2003).

Frame Secondary Angle Vector	(0018,2004)	1C	An array which contains, for each of the image frames, the secondary angle of rotation about an undefined axis that is orthogonal to that used for Frame Primary Angle Vector (0018,2003), in degrees. May be used for annotative purposes for “cine loops” of 3D reprojected images Required if Frame Increment Pointer (0028,0009) points to Frame Secondary Angle Vector (0018,2004).
Slice Location Vector	(0018,2005)	1C	Relative position of exposure expressed in mm, as defined for Slice Location (0020,1041). See C.7.6.2.1.2 for further explanation. Required if Frame Increment Pointer (0028,0009) points to Slice Location Vector (0018,2005).
Display Window Label Vector	(0018,2006)	1C	An array which contains, for each of the image frames, a label or number of the display window of a graphical user interface from which the frame was captured. Required if Frame Increment Pointer (0028,0009) points to Display Window Label Vector (0018,2006).

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Changes to

NEMA Standards Publication PS 3.4-2000

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Part 4: Service Class Specifications

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Add new Storage SOP Classes to Annex B:

Table B.5-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	Multi-frame Single Bit Secondary Capture Image
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Multi-frame Grayscale Byte Secondary Capture Image
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Multi-frame Grayscale Word Secondary Capture Image
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Multi-frame True Color Secondary Capture Image

Add new Media Storage SOP Classes to Annex I:

Table I.4-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	Multi-frame Single Bit Secondary Capture Image
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Multi-frame Grayscale Byte Secondary Capture Image
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Multi-frame Grayscale Word Secondary Capture Image
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Multi-frame True Color Secondary Capture Image

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Changes to

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Part 6: Data Dictionary

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Add new Data Elements to Section 6:

Tag	Name	VR	VM
(0018,2001)	Page Number Vector	IS	1-n
(0018,2002)	Frame Label Vector	SH	1-n
(0018,2003)	Frame Primary Angle Vector	DS	1-n
(0018,2004)	Frame Secondary Angle Vector	DS	1-n
(0018,2005)	Slice Location Vector	DS	1-n
(0018,2006)	Display Window Label Vector	SH	1-n
(0018,2010)	Nominal Scanned Pixel Spacing	DS	2
(0018,2020)	Digitizing Device Transport Direction	CS	1
(0018,2030)	Rotation of Scanned Film	DS	1

Add new UIDs to Annex A:

UID Value	UID Name	UID Type	Part
1.2.840.10008.5.1.4.1.1.7.1	Multi-frame Single Bit Secondary Capture Image Storage	SOP Class	Part 4
1.2.840.10008.5.1.4.1.1.7.2	Multi-frame Grayscale Byte Secondary Capture Image Storage	SOP Class	Part 4
1.2.840.10008.5.1.4.1.1.7.3	Multi-frame Grayscale Word Secondary Capture Image Storage	SOP Class	Part 4
1.2.840.10008.5.1.4.1.1.7.4	Multi-frame True Color Secondary Capture Image Storage	SOP Class	Part 4