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Digital Imaging and Communications in Medicine (DICOM)

Supplement 157: Multi-Frame Converted Legacy Images

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DICOM Standards Committee, Working Group 6 (Base Standard) Ad Hoc Group

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Scope and Field of Application

This Supplement defines IODs and SOP Classes for storage, query and retrieval of legacy single frame images converted into enhanced multi-frame Images.

5 Significant barriers to the transfer, display and analysis of large CT, MR and PET cross-sectional image studies are a) the separation of per-slice meta-data on a per instance basis, and b) the separation of per-slice bulk pixel data on a per instance basis.

10 The enhanced family of CT, MR and PET IODs address these problems, but unfortunately there is a large installed base of modalities that cannot produce these and a large collection of single-frame instances in archives that may need to be used as priors for comparison. The enhanced family of modality-specific multi-frame IODs as currently defined does not permit a simple mapping of the legacy single-frame IOD attributes to the enhanced multi-frame IOD attributes, due to the requirement for much more mandatory information, and the requirement to use standard codes and pre-defined strings for many features that are unspecified or unsupported in the older IODs. The standard includes a set of multi-frame secondary capture IODs that include the ability to optionally and selectively include enhanced multi-frame features, but, there is 15 no means of controlling the “base level” of such a conversion with respect to what features a recipient could reliably expect to be implemented, and hence depend on. For cross-sectional imaging, for example, it is important to mandate the presence of reliable spatial (spacing, position and orientation) information, which is readily available in the legacy single frame modality-specific IODs.

20 This supplement addresses the practical aspects of conversion of single-frame legacy instances into enhanced multi-frame instances to enable use of the advantages of attribute and bulk pixel data consolidation and access facilities that are already present in the standard.

The use-cases within the scope of the supplement include:

- modality to PACS transfers via conversion to multi-frame by a third-party device,
- 25 • PACS to modality, display, workstation or analysis system transfers (whether via DICOM or web services, local or remote) after conversion to multi-frame within the PACS, and
- PACS to PACS (or other archive) transfers, either after conversion to multi-frame within the source PACS or by a third-party device.

30 It is NOT the expectation that modalities will generate Legacy Converted Enhanced Image Storage SOP Instances; rather, they should create True Enhanced Image Storage SOP Instances fully populated with the appropriate standard attributes and codes.

This Supplement defines new Image Storage SOP Classes and an extended negotiation option for the C-FIND, C-MOVE and C-GET SOP Classes to allow querying and retrieving a “view” of a study that is restricted to the converted multi-frame rather than the legacy single frame images, and corresponding modifications to the frame-level retrieval SOP Class.

PS 3.4 Section 3.9 DICOM Service Class Definitions: Add definitions of “classic”, “enhanced”, “true enhanced” and “legacy converted enhanced”:

- 5 **Classic Image Storage SOP Class:** an Image Storage SOP Class that is defined by an IOD that stores a single frame and defines the majority of the attributes in the top-level Data Set.
- Enhanced Image Storage SOP Class:** an Image Storage SOP Class that is defined by an IOD that stores multiple frames and defines the majority of the attributes in Functional Group Sequences.
- 10 **True Enhanced Image Storage SOP Class:** a modality-specific Enhanced Image Storage SOP Class that is defined by an IOD that defines modality-specific Functional Group Sequences, Attributes and sets of values, and which is intended for creation by acquisition devices.
- 15 **Legacy Converted Enhanced Image Storage SOP Class:** a modality-specific Enhanced Image Storage SOP Class that is defined by an IOD that defines only generic Functional Group Sequences, which does not require information that is not present in Classic Image Storage SOP Class Instances, and which is intended for storage of converted Classic Image Storage SOP Class Instances when there is insufficient information to use a True Enhanced Image Storage SOP Class.

<i>PS 3.3: Add new Legacy Converted Enhanced CT IOD:</i>
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A.N1 LEGACY CONVERTED ENHANCED CT IMAGE INFORMATION OBJECT DEFINITION

A.N1.1 Legacy Converted Enhanced CT Image Information Object Definition

A.N1.1.1 Legacy Converted Enhanced CT Image IOD Description

- 5 The Legacy Converted Enhanced Computed Tomography (CT) Image Information Object Definition (IOD) specifies an image that has been converted from images originally created by a computed tomography imaging device.

A.N1.1.2 Legacy Converted Enhanced CT Image IOD Entity-Relationship Model

- 10 The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model that directly reference the Legacy Converted Enhanced CT Image IOD.

A.N1.1.3 Legacy Converted Enhanced CT Image IOD Module Table

**Table A.N1-1
LEGACY CONVERTED ENHANCED CT IMAGE IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	CT Series	C.8.15.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	U
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	U
Image	Image Pixel	C.7.6.3	M
	Contrast/Bolus	C.7.6.4	U
	Enhanced Contrast/Bolus	C.7.6.4b	U
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	U
	Cardiac Synchronization	C.7.6.18.1	U
	Respiratory Synchronization	C.7.6.18.2	U
	Acquisition Context	C.7.6.14	M
	Device	C.7.6.12	U
	Specimen	C.7.6.22	U
	Enhanced CT Image	C.8.15.2	M
	SOP Common	C.12.1	M

	Frame Extraction	C.12.3	C – Required if the SOP Instance was created in response to a Frame-Level retrieve request
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A.N1.1.3.1 Legacy Converted Enhanced CT Image IOD Content Constraints

The General Image Module, Overlay Plane Module, VOI LUT Module, Supplemental Palette Color Lookup Table Module and Graphic Annotation Module shall not be used in a Standard Extended SOP Class of the Legacy Converted Enhanced CT Image.

Note: In order to annotate images, whether during acquisition or subsequently, SOP Instances of the Grayscale Softcopy Presentation State Storage or the Structured Report Storage SOP Classes that reference the image SOP Instance, may be used.

No standard mechanism is provided for inclusion of annotations within the image SOP Instance itself, and implementers are discouraged from using private extensions to circumvent this restriction.

Grayscale Softcopy Presentation State Storage Instances that are generated during conversion shall be referenced from the Image SOP Instance by using the Referenced Grayscale Presentation State Sequence in the Enhanced CT Image Module. See C.8.15.2.

Note: The Curve Module has been retired from DICOM. It is still not permitted to be present. See PS 3.3 2004.

A.N1.1.4 Legacy Converted Enhanced CT Image Functional Group Macros

Table A.N1-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Group Module for the Legacy Converted Enhanced CT Image IOD.

**Table A.N1-2
LEGACY CONVERTED ENHANCED CT IMAGE FUNCTIONAL GROUP MACROS**

Function Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M – May not be used as a Shared Functional Group.
Plane Position (Patient)	C.7.6.16.2.3	M
Plane Orientation (Patient)	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	C – Required if Referenced Image Sequence (0008,1140) was present in any of the Classic Images that were converted.
Derivation Image	C.7.6.16.2.6	C – Required if Source Image Sequence (0008,2112) was present in any of the Classic Images that were converted.
Cardiac Synchronization	C.7.6.16.2.7	U
Frame Anatomy	C.7.6.16.2.8	C – Required if Body Part Examined (0018,0015) is present and contains a value defined in PS 3.16 Correspondence of Anatomic Region Codes and Body Part Examined Defined Terms, or Anatomic Region Sequence (0008,2218) was present in any of the Classic Images that were converted.

Frame VOI LUT	C.7.6.16.2.10	M
Contrast/Bolus Usage	C.7.6.16.2.12	U
Respiratory Synchronization	C.7.6.16.2.17	U
Irradiation Event Identification	C.7.6.16.2.18	C – Required if Irradiation Event UID (0008,3010) was present in any of the Classic Images that were converted.
CT Image Frame Type	C.8.15.3.1	M
CT Pixel Value Transformation	C.8.15.3.10	M
Unassigned Shared Converted Attributes	C.7.6.16.2.FG.1	M – May not be used as a Per-Frame Functional Group
Unassigned Per-Frame Converted Attributes	C.7.6.16.2.FG.2	M – May not be used as a Shared Functional Group
Image Frame Conversion Source	C.7.6.16.2.FG.3	M – May not be used as a Shared Functional Group

PS 3.3: Add new Legacy Converted Enhanced MR IOD:

A.N2 LEGACY CONVERTED ENHANCED MR IMAGE INFORMATION OBJECT DEFINITION

A.N2.1 Legacy Converted Enhanced MR Image Information Object Definition

5 **A.N2.1.1 Legacy Converted Enhanced MR Image IOD Description**

The Legacy Converted Enhanced Magnetic Resonance (MR) Image Information Object Definition (IOD) specifies an image that has been converted from images originally created by a magnetic resonance imaging device.

A.N2.1.2 Legacy Converted Enhanced MR Image IOD Entity-Relationship Model

10 The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model that directly reference the Legacy Converted Enhanced MR Image IOD.

A.N2.1.3 Legacy Converted Enhanced MR Image IOD Module Table

**Table A.N2-1
LEGACY CONVERTED ENHANCED MR IMAGE IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	MR Series	C.8.13.6	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	U
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	U
Image	Image Pixel	C.7.6.3	M
	Contrast/Bolus	C.7.6.4	U
	Enhanced Contrast/Bolus	C.7.6.4b	U
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	U
	Cardiac Synchronization	C.7.6.18.1	U
	Respiratory Synchronization	C.7.6.18.2	U
	Bulk Motion Synchronization	C.7.6.18.3	U
	Acquisition Context	C.7.6.14	M
	Device	C.7.6.12	U
	Specimen	C.7.6.22	U
	Enhanced MR Image	C.8.13.1	M
	SOP Common	C.12.1	M
	Frame Extraction	C.12.3	C – Required if the SOP Instance was created in response to a Frame-Level retrieve request

5 A.N2.1.3.1 Legacy Converted Enhanced MR Image IOD Content Constraints

The General Image Module, Overlay Plane Module, VOI LUT Module, Supplemental Palette Color Lookup Table Module and Graphic Annotation Module shall not be used in a Standard Extended SOP Class of the Legacy Converted Enhanced MR Image.

10 Note: In order to annotate images, whether during acquisition or subsequently, SOP Instances of the Grayscale Softcopy Presentation State Storage or the Structured Report Storage SOP Classes that reference the image SOP Instance, may be used.

No standard mechanism is provided for inclusion of annotations within the image SOP Instance itself, and implementers are discouraged from using private extensions to circumvent this restriction.

- 5 Grayscale Softcopy Presentation State Storage Instances that are generated during conversion shall be referenced from the Image SOP Instance by using the Referenced Grayscale Presentation State Sequence in the Enhanced MR Image Module. See C.8.15.2.

Note: The Curve Module has been retired from DICOM. It is still not permitted to be present. See PS 3.3 2004.

10 **A.N2.1.4 Legacy Converted Enhanced MR Image Functional Group Macros**

Table A.N2-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Group Module for the Legacy Converted Enhanced MR Image IOD.

**Table A.N2-2
LEGACY CONVERTED ENHANCED MR IMAGE FUNCTIONAL GROUP MACROS**

Function Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M – May not be used as a Shared Functional Group.
Plane Position (Patient)	C.7.6.16.2.3	M
Plane Orientation (Patient)	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	C – Required if Referenced Image Sequence (0008,1140) was present in any of the Classic Images that were converted.
Derivation Image	C.7.6.16.2.6	C – Required if Source Image Sequence (0008,2112) was present in any of the Classic Images that were converted.
Cardiac Synchronization	C.7.6.16.2.7	U
Frame Anatomy	C.7.6.16.2.8	C – Required if Body Part Examined (0018,0015) is present and contains a value defined in PS 3.16 Correspondence of Anatomic Region Codes and Body Part Examined Defined Terms, or Anatomic Region Sequence (0008,2218) was present in any of the Classic Images that were converted.
Pixel Value Transformation	C.7.6.16.2.9	U
Frame VOI LUT	C.7.6.16.2.10	U
Real World Value Mapping	C.7.6.16.2.11	U
Contrast/Bolus Usage	C.7.6.16.2.12	U
Respiratory Synchronization	C.7.6.16.2.17	U
MR Image Frame Type	C.8.13.5.1	M
Unassigned Shared Converted Attributes	C.7.6.16.2.FG.1	M – May not be used as a Per-Frame Functional Group
Unassigned Per-Frame Converted Attributes	C.7.6.16.2.FG.2	M – May not be used as a Shared Functional Group

Image Frame Conversion Source	C.7.6.16.2.FG.3	M – May not be used as a Shared Functional Group
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PS 3.3: Add new Legacy Converted Enhanced PET IOD:

A.N3 LEGACY CONVERTED ENHANCED PET IMAGE INFORMATION OBJECT DEFINITION

5 **A.N3.1 Legacy Converted Enhanced PET Image Information Object Definition**

A.N3.1.1 Legacy Converted Enhanced PET Image IOD Description

The Legacy Converted Enhanced Positron Emission Tomography (PET) Image Information Object Definition (IOD) specifies an image that has been converted from images originally created by a positron emission tomography coincidence imaging device.

10 **A.N3.1.2 Legacy Converted Enhanced PET Image IOD Entity-Relationship Model**

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model that directly reference the Legacy Converted Enhanced PET Image IOD.

A.N3.1.3 Legacy Converted Enhanced PET Image IOD Module Table

**Table A.N3-1
LEGACY CONVERTED ENHANCED PET IMAGE IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Enhanced PET Series	C.8.22.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	U
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	U
Image	Image Pixel	C.7.6.3	M
	Intervention	C.7.6.13	U
	Acquisition Context	C.7.6.14	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	U
	Cardiac Synchronization	C.7.6.18.1	U
	Respiratory Synchronization	C.7.6.18.2	U
	Specimen	C.7.6.22	U
	Enhanced PET Image	C.8.22.3	M
	SOP Common	C.12.1	M
	Frame Extraction	C.12.3	C – Required if the SOP Instance was created in response to a Frame-Level retrieve request

5 A.N3.1.3.1 Legacy Converted Enhanced PET Image IOD Content Constraints

The General Image Module, Overlay Plane Module, VOI LUT Module, Supplemental Palette Color Lookup Table Module and Graphic Annotation Module shall not be used in a Standard Extended SOP Class of the Legacy Converted Enhanced PET Image.

10 **Note:** In order to annotate images, whether during acquisition or subsequently, SOP Instances of the Grayscale Softcopy Presentation State Storage or the Structured Report Storage SOP Classes that reference the image SOP Instance, may be used.
No standard mechanism is provided for inclusion of annotations within the image SOP Instance itself, and implementers are discouraged from using private extensions to circumvent this restriction.

15 Grayscale Softcopy Presentation State Storage Instances that are generated during conversion shall be referenced from the Image SOP Instance by using the Referenced Grayscale Presentation State Sequence in the Enhanced PET Image Module. See C.8.15.2.

Note: The Curve Module has been retired from DICOM. It is still not permitted to be present. See PS 3.3 2004.

A.N3.1.4 Legacy Converted Enhanced PET Image Functional Group Macros

- 5 Table A.N3-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Group Module for the Legacy Converted Enhanced PET Image IOD.

**Table A.N3-2
LEGACY CONVERTED ENHANCED PET IMAGE FUNCTIONAL GROUP MACROS**

Function Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M – May not be used as a Shared Functional Group.
Plane Position (Patient)	C.7.6.16.2.3	M
Plane Orientation (Patient)	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	C – Required if Referenced Image Sequence (0008,1140) was present in any of the Classic Images that were converted.
Derivation Image	C.7.6.16.2.6	C – Required if Source Image Sequence (0008,2112) was present in any of the Classic Images that were converted.
Cardiac Synchronization	C.7.6.16.2.7	U
Frame Anatomy	C.7.6.16.2.8	C – Required if Body Part Examined (0018,0015) is present and contains a value defined in PS 3.16 Correspondence of Anatomic Region Codes and Body Part Examined Defined Terms, or Anatomic Region Sequence (0008,2218) was present in any of the Classic Images that were converted.
Pixel Value Transformation	C.7.6.16.2.9	M
Frame VOI LUT	C.7.6.16.2.10	M
Real World Value Mapping	C.7.6.16.2.11	U
Respiratory Synchronization	C.7.6.16.2.17	U
Irradiation Event Identification	C.7.6.16.2.18	C – Required if Irradiation Event UID (0008,3010) was present in any of the Classic Images that were converted.
PET Frame Type	C.8.22.5.1	M
Unassigned Shared Converted Attributes	C.7.6.16.2.FG.1	M – May not be used as a Per-Frame Functional Group
Unassigned Per-Frame Converted Attributes	C.7.6.16.2.FG.2	M – May not be used as a Shared Functional Group
Image Frame Conversion Source	C.7.6.16.2.FG.3	M – May not be used as a Shared Functional Group

- 10 *PS 3.3: Amend existing Enhanced PET IOD to add new Enhanced PET Corrections Module containing factored out stuff from Enhanced PET Image Module:*

A.56 ENHANCED POSITRON EMISSION TOMOGRAPHY IMAGE INFORMATION OBJECT DEFINITION

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A.56.1.3 Enhanced PET Image IOD Module Table

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**Table A.56-1
ENHANCED PET IMAGE IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Enhanced PET Series	C.8.22.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	C- Required if time synchronization was applied.
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Image	Image Pixel	C.7.6.3	M
	Intervention	C.7.6.13	U
	Acquisition Context	C.7.6.14	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	M
	Cardiac Synchronization	C.7.6.18.1	C - Required if cardiac synchronization was applied.
	Respiratory Synchronization	C.7.6.18.2	C - Required if respiratory synchronization was applied.
	Specimen	C.7.6.22	U
	Enhanced PET Isotope Module	C.8.22.4	M
	Enhanced PET Acquisition	<u>C.8.22.2</u>	M
	Enhanced PET Image	C.8.22.3	M
	Enhanced PET Corrections	<u>C.8.22.x</u>	<u>M</u>
	SOP Common	C.12.1	M
	Frame Extraction	C.12.3	C - Required if the SOP Instance was created in response to a Frame-Level retrieve request

<i>PS 3.3: Clarify MPPS relationship to enhanced and converted images:</i>
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7.3.1.9 MODALITY PERFORMED PROCEDURE STEP

...

5 The purpose of the Modality Performed Procedure Step is to report what was performed; it does not imply any storage semantics. While the MPPS represents a unit of service within a workflow, the specification of the workflow itself is beyond the scope of the Standard, and the MPPS does not identify or control any subsequent activities to be performed.

10 Notes: 1. For example, a modality may create both “for processing” images for automated analysis and “for presentation” images for human review from the same acquisition. The Standard does not specify whether the production of these is a single unit of service, or two. A single Modality Performed Procedure Step instance could list both the “for processing” images and the “for presentation” images, regardless of whether or not both sets of images were stored to the same or different AEs, or indeed were stored at all, since the MPPS is independent of the storage semantics. Alternatively, the modality may treat these two sets of images as two separate units of service, and send two separate MPPS Instances.

15 A Radiation Dose SR from the irradiation events of an acquisition could be referenced in the same MPPS Instance as that of the acquired images, again irrespective of where such a Radiation Dose Structured Report might be sent, if at all. Alternatively, the modality may treat the production of the Radiation Dose SR as a separate unit of service, and report it in a distinct MPPS.

20 Another example is the case of thin and thick slice CT images acquired from the same acquisition (raw) data. When the reconstruction of both sets of images is prospectively defined and automatically initiated by the protocol selection, then both sets might be referenced from a single MPPS Instance. However, if the reconstruction of one or the other set is performed retrospectively by manual intervention some time after the acquisition MPPS had been completed, the subsequent instances will necessarily be referenced in a new MPPS Instance, since the acquisition MPPS cannot be modified once completed.

25 2. The completion of an MPPS may be a significant event that triggers or enables downstream activity, but it is not the intent to require the modality to be configured to “manage” such activity. The “units of service” that the modality describes in an MPPS, and how the modality relates those Performed Procedure Steps to Scheduled Procedure Steps, are implementation decisions beyond the scope of the Standard. The IHE Radiology Scheduled Workflow Profile provides additional guidance for implementation.

30 3. An MPPS may describe instances that were acquired but that have not been, nor may ever be, stored. For example, a modality may be capable of storing a CT acquisition as multiple single frame CT Image Storage SOP Instances, as a single multi-frame Enhanced CT Image Storage SOP Instance, or as several Enhanced CT Image Storage SOP Instances that together comprise a Concatenation. An MPPS may describe all three possibilities, even though only one choice may ultimately be stored, perhaps depending on the negotiated capabilities of the storage recipient. Alternatively, separate MPPS instances could be used for different storage SOP Classes.

35 **4. The MPPS contains only the instances that the modality created, not instances converted and created subsequently in response to a query (e.g., during legacy conversion).**

40 **45.** The MPPS is not a substitute for, nor is equivalent to, a Storage Commitment request, nor an Instance Availability Notification.

PS 3.3: Add new functional group macros to contain shared and per-frame unassigned standard and private attributes:

C.7.6.16.2.FG Unassigned Shared and Per-Frame Converted Attributes Macros

Attributes that are present in the Classic images to be converted but that are not defined in specific Modules or specific Functional Groups required or supported by the IOD, or which have their values changed during conversion, either may:

- be identical in all images, in which case they shall be included in the top level Data Set or in the Unassigned Shared Converted Attributes Sequence, or
- only be present in some images, or have a different number of values, or different values, in which case they shall be included in the Unassigned Per-Frame Converted Attributes Sequence.

- Notes:
1. An example of an Attribute that might be included in the Unassigned Shared Converted Attributes Macro is Filter Type (0018,1160), which typically would be the same for all Classic CT images in a set, and is not included in any modality-specific Module or Functional Group macro.
 2. An example of an Attribute that might be included in the Unassigned Per-Frame Converted Attributes Macro is Slice Location (0020,1041), which typically would be different for each Classic CT image in a set, and is not included in any modality-specific Module or Functional Group macro.
 3. An example of an Attribute that might be included in the Unassigned Shared Converted Attributes Macro is Series Number (0020,0011), which typically would be the same for all Classic CT images in a set (but is not required to be), and will be replaced with a different value in the top-level Data Set, and hence if the original is to be preserved, needs to be recorded.
 4. An example of an Attribute that might be included in the Unassigned Per-Frame Converted Attributes Macro is Instance Number (0020,0013), which typically would be different for each Classic CT image in a set, and will be replaced with a different value in the top-level Data Set, and hence if the original is to be preserved, needs to be recorded.
 5. The UIDs of the converted instances are recorded in the Conversion Source Attributes Sequence, and are not included in the Unassigned Shared and Per-Frame Converted Attributes Macros.

For the purpose of comparing values, an Attribute that is not present in a Classic image to be converted is considered the same as an Attribute that is present but has no value. Sequence Attributes match when they have the same number of Items and Item contents in the same order (irrespective of whether the Sequences or Items are encoded with fixed or variable length).

The Unassigned Shared Converted Attributes Sequence, and the Unassigned Per-Frame Converted Attributes Sequence may be absent, if there are no such Attributes available to be included. E.g., there may be no shared Attributes with the same values, all the shared Attributes may be included in the top-level Data Set, there may be no Attributes that vary per-frame or an individual frame may have no such Attribute.

The necessary Private Creator Data Element within each Sequence Item accompanies Private Data Elements. There is no requirement to preserve the private block of Data Elements used in the Classic images to be converted. Nor is there a requirement that a Private Data Element use the same private block in all of the Classic images.

Matching of Private Attribute Values for the purpose of determining whether they are shared or per-frame may be performed using the equivalent meaning if the Value Representation is Explicit and not UN, or known through other means, otherwise, byte matching of the UN VR shall be performed.

C.7.6.16.2.FG.1 Unassigned Shared Converted Attributes Macro

Table C.7.6.16.2.FG.1-1 specifies the attributes of the Unassigned Shared Converted Attributes Functional Group macro.

**Table C.7.6.16.2.FG.1-1
UNASSIGNED SHARED CONVERTED ATTRIBUTES MACRO**

Attribute Name	Tag	Type	Attribute Description
Unassigned Shared Converted Attributes Sequence	(0020,9170)	1C	Contains all of the Standard and Private Attributes that are present in all of the converted Classic images, that have the same number of values, that have the same values, and that are not in the top-level Data Set. Only a single Item shall be included in this sequence. Required if any unassigned shared attributes are present.

C.7.6.16.2.FG.2 Unassigned Per-Frame Converted Attributes Macro

Table C.7.6.16.2.FG.2-1 specifies the attributes of the Unassigned Per-Frame Converted Attributes Functional Group macro.

**Table C.7.6.16.2.FG.2-1
UNASSIGNED PER-FRAME CONVERTED ATTRIBUTES MACRO**

Attribute Name	Tag	Type	Attribute Description
Unassigned Per-Frame Converted Attributes Sequence	(0020,9171)	1C	Contains all of the Standard and Private Attributes that are present in only some of the converted Classic images, or that have a different number of values, or that have different values. Only a single Item shall be included in this sequence. Required if any unassigned per-frame attributes are present for this frame.

PS 3.3: Add new functional group macros to encode source of converted images when a legacy converted enhanced multi-frame instance:

C.7.6.16.2.FG.3 Image Frame Conversion Source Macro

Table C.7.6.16.2.FG.2-1 specifies the attributes of the Image Frame Conversion Source Functional Group macro.

**Table C.7.6.16.2.FG.3-1
IMAGE FRAME CONVERSION SOURCE MACRO**

Attribute Name	Tag	Type	Attribute Description
Conversion Source Attributes Sequence	(0020,9172)	1	The image or other composite SOP Instance that was converted to this frame. Only a single Item shall be included in this sequence.
>Include 'Image SOP Instance Reference Macro' Table 10-3			

PS 3.3: Add attributes in SOP Common Module to describe view, and to reference source of converted instances when not a legacy converted enhanced multi-frame instance:

C.12.1 SOP Common Module

5 Table C.12-1 defines the Attributes which are required for proper functioning and identification of the associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD.

**Table C.12-1
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
...
Longitudinal Temporal Information Modified	(0028,0303)	3	Indicates whether or not the date and time attributes in the instance have been modified during de-identification. Enumerated Values: UNMODIFIED MODIFIED REMOVED See PS 3.15.
<u>Query/Retrieve View</u>	<u>(0008,0053)</u>	<u>1C</u>	<u>The view requested during the C-MOVE operation that resulted in the transfer of this instance.</u> <u>Enumerated Values:</u> <u>CLASSIC</u> <u>ENHANCED</u> <u>Required if the instance has ever been converted from its source form as the result of a C-MOVE operation with a specific view.</u>
<u>Conversion Source Attributes Sequence</u>	<u>(0020,9172)</u>	<u>1C</u>	<u>The set of images or other composite SOP Instances that were converted to this instance.</u> <u>If this instance was converted from a specific frame in the source instance, the reference shall include the Frame Number.</u> <u>One or more Items shall be included in this sequence.</u> <u>Required if this instance was created by conversion, and Conversion Source Attributes Sequence (0020,9172) is not present in an Item of Shared Functional Groups Sequence (5200,9229) or Per-Frame Functional Groups Sequence (5200,9230).</u>

>Include 'Image SOP Instance Reference Macro' Table 10-3

Amend existing PS 3.3 Macros and Modules to specify conditions on those attributes that are not derivable for legacy converted images:

C.7.6.16.2.2 Frame Content Macro

Table C.7.6.16-3 specifies the attributes of the Frame Content Functional Group macro.

- 5 This Functional Group Macro may only be part of the Per-frame Functional Groups Sequence (5200,9230) attribute.

**Table C.7.6.16-3
FRAME CONTENT MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Frame Content Sequence	(0020,9111)	1	Identifies general characteristics of this frame. Only a single Item shall be included in this sequence.
>Frame Acquisition Number	(0020,9156)	3	A number identifying the single continuous gathering of data over a period of time that resulted in this frame.
>Frame Reference DateTime	(0018,9151)	1C	The point in time that is most representative of when data was acquired for this frame. See C.7.6.16.2.2.1 and C.7.6.16.2.2.2 for further explanation. Note: The synchronization of this time with an external clock is specified in the synchronization Module in Acquisition Time synchronized (0018,1800). Required if Frame Type (0008,9007) Value 1 of this frame is ORIGINAL and the SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" or "1.2.840.10008.5.1.4.1.1.4.4" or "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted) . May be present otherwise.
>Frame Acquisition DateTime	(0018,9074)	1C	The date and time that the acquisition of data that resulted in this frame started. See C.7.6.16.2.2.1 for further explanation. Required if Frame Type (0008,9007) Value 1 of this frame is ORIGINAL and the SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" or "1.2.840.10008.5.1.4.1.1.4.4" or "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted) . May be present otherwise.
>Frame Acquisition Duration	(0018,9220)	1C	The actual amount of time [in milliseconds] that was used to acquire data for this frame. See C.7.6.16.2.2.1 and C.7.6.16.2.2.3 for further explanation. Required if Frame Type (0008,9007) Value 1 of this frame is ORIGINAL and the SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" or "1.2.840.10008.5.1.4.1.1.4.4" or "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted) . May be present otherwise.

>Cardiac Cycle Position	(0018,9236)	3	Description of the position in the cardiac cycle that is most representative of this frame. Defined Terms: END_SYSTOLE END_DIASTOLE UNDETERMINED
>Respiratory Cycle Position	(0018,9214)	3	Description of the position in the respiratory cycle that is most representative of this frame. Defined Terms: START_RESPIR END_RESPIR UNDETERMINED
>Dimension Index Values	(0020,9157)	1C	Contains the values of the indices defined in the Dimension Index Sequence (0020,9222) for this multi-frame header frame. The number of values is equal to the number of Items of the Dimension Index Sequence and shall be applied in the same order. See section C.7.6.17.1 for a description. Required if the value of the Dimension Index Sequence (0020,9222) exists.
>Temporal Position Index	(0020,9128)	1C	Ordinal number (starting from 1) of the frame in the set of frames with different temporal positions. Required if the value of SOP Class UID (0008,0016) equals "1.2.840.10008.5.1.4.1.1.130". May be present otherwise. See C.7.6.16.2.2.6.
>Stack ID	(0020,9056)	1C	Identification of a group of frames, with different positions and/or orientations that belong together, within a dimension organization. See C.7.6.16.2.2.4 for further explanation. Required if the value of SOP Class UID (0008,0016) equals "1.2.840.10008.5.1.4.1.1.130". May be present otherwise. See C.7.6.16.2.2.7.
>In-Stack Position Number	(0020,9057)	1C	The ordinal number of a frame in a group of frames, with the same Stack ID Required if Stack ID (0020,9056) is present. See section C.7.6.16.2.2.4 for further explanation.
>Frame Comments	(0020,9158)	3	User-defined comments about the frame.
>Frame Label	(0020,9453)	3	Label corresponding to a specific dimension index value. Selected from a set of dimension values defined by the application. This attribute may be referenced by the Dimension Index Pointer (0020,9165)

			attribute in the Multi-frame Dimension Module. See C.7.6.16.2.2.5 for further explanation.
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C.8.13.1 Enhanced MR Image Module

This section describes the Enhanced MR Image Module.

- 5 Table C.8-79 specifies the attributes of the Enhanced MR Image module.

**Table C.8-79
ENHANCED MR IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
<i>Include 'MR Image and Spectroscopy Instance Macro' Table C.8-81</i>			
Image Type	(0008,0008)	1	Image characteristics. See C.8.16.1 and C.8.13.1.1.1.
<i>Include Common CT/MR Image Description Macro' Table C.8-131</i>			
<i>Include 'MR Image Description Macro' Table C.8.82</i>			
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. For Enumerated Values see C.8.13.1.1.2.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. Enumerated Values are specified in the IOD that invokes this Module. See C.7.6.3.1.2 for definition of this term.
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. For Enumerated Values see C.8.13.1.1.2.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. For Enumerated Values see C.8.13.1.1.2.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. Shall be one less than the value in Bits Stored (0028,0101).
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. For Enumerated Values see C.8.13.1.1.2
Planar Configuration	(0028,0006)	1C	Indicates whether the pixel data are sent color-by-plane or color-by-pixel. Required if Samples per Pixel (0028,0002) has a value greater than 1. See C.7.6.3.1.3 and C.8.13.1.1.2 for further explanation.

Spacing between Slices	(0018,0088)	3	Value of the prescribed spacing to be applied between the slices in a volume that is to be acquired. The spacing in mm is defined as the center-to-center distance of adjacent slices.
Burned In Annotation	(0028,0301)	1C	Indicates whether or not the image contains sufficient burned in annotation to identify the patient and date the image was acquired. Enumerated Values: NO This means that images that contain this Module shall not contain such burned in annotations. Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted), may be present otherwise.
Recognizable Visual Features	(0028,0302)	3	Indicates whether or not the image contains sufficiently recognizable visual features to allow the image or a reconstruction from a set of images to identify the patient. Enumerated Values: YES NO If this Attribute is absent, then the image may or may not contain recognizable visual features.
Lossy Image Compression	(0028,2110)	1C	Specifies whether an Image has undergone lossy compression. Enumerated Values: 00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression. See C.7.6.1.1.5 for further explanation. Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted), may be present otherwise.
Lossy Image Compression Ratio	(0028,2112)	1C	Describes the approximate lossy compression ratio(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied. Note: For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30. Required if Lossy Images Compression (0028,2110) is "01".
Lossy Image Compression Method	(0028,2114)	1C	A label for the lossy compression method(s) that have been applied to this

			<p>image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied; the value order shall correspond to the values of Lossy Image Compression Ratio (0028,2112). Required if Lossy Image Compression (0028,2110) is "01".</p>
Presentation LUT Shape	(2050,0020)	1C	<p>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.</p>
Icon Image Sequence	(0088,0200)	3	<p>This icon image is representative of the Image. Only a single Item is permitted in this Sequence.</p>
>Include 'Image Pixel Macro' Table C.7-11b		See Section F.7.	
Include Table 10-25 Optional View and Slice Progression Direction Macro.			

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C.8.13.2 MR Image and Spectroscopy Instance Macro

Table C.8-83 specifies the common attributes Enhanced MR Image Module and MR Spectroscopy Module.

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**Table C.8-83
MR IMAGE AND SPECTROSCOPY INSTANCE MACRO**

Attribute Name	Tag	Type	Attribute Description
Acquisition Number	(0020,0012)	3	<p>A number identifying the single continuous gathering of data over a period of time that resulted in this image. Note: This number is not required to be unique across SOP Instances in a series. See also the description of the Referenced Raw Data Sequence (0008,9121).</p>
Acquisition DateTime	(0008,002A)	1C	<p>The date and time that the acquisition of data started. Note: The synchronization of this time with an external clock is specified in the synchronization Module in Acquisition Time synchronized (0018,1800). Required if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted). May be present otherwise.</p>

Acquisition Duration	(0018,9073)	1C	The time in seconds needed to run the prescribed pulse sequence. See C.7.6.16.2.2.1 for further explanation. Required if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted) . May be present otherwise.
Referenced Raw Data Sequence	(0008,9121)	3	The Raw data that was used to derive this Image. One or more Items are permitted in this Sequence. Note: The items of in this sequence may identify raw data that has not been stored or encoded as a DICOM object. This allows recognition that images and spectra in different instances have been reconstructed from the same raw data.
<i>>Include "Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			
Referenced Waveform Sequence	(0008,113A)	3	References to waveforms acquired in conjunction with this image. These Waveforms may or may not be temporally synchronized with this image. One or more Items are permitted in this Sequence.
<i>>Include "Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			
Referenced Image Evidence Sequence	(0008,9092)	1C	Full set of Composite SOP Instances referred to inside the Referenced Image Sequences of this Enhanced MR Image SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items shall be included in this sequence. Required if the Referenced Image Sequence (0008,1140) is present.
<i>>Include "Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			
Source Image Evidence Sequence	(0008,9154)	1C	Full set of Composite SOP Instances referred to inside the Source Image Sequences of this Enhanced MR Image SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items shall be included in this sequence. Required if the Source Image Sequence (0008,2112) is present.
<i>>Include "Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			
Referenced Presentation State Sequence	(0008,9237)	1C	References to Presentation State instances acquired in conjunction with this instance.

			<p>Note: May only be used to reference Presentation States belonging to the acquired data and not to reference Presentation States generated subsequently such as during interpretation.</p> <p>One or more Items shall be included in this sequence.</p> <p>Required if Presentation State is generated during acquisition, shall not be present otherwise.</p>
>Include "Hierarchical SOP Instance Reference Macro' Table C.17-3			
Content Qualification	(0018,9004)	1C	<p>Content Qualification Indicator</p> <p>Enumerated Values: PRODUCT RESEARCH SERVICE</p> <p>See C.8.13.2.1.1 for further explanation.</p> <p>Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted), may be present otherwise.</p>
Resonant Nucleus	(0018,9100)	1C	<p>Nucleus that is resonant at the transmitter frequency.</p> <p>Defined Terms: 1H 3HE 7LI 13C 19F 23NA 31P 129XE</p> <p>Required if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted). May be present otherwise.</p>
k-space Filtering	(0018,9064)	1C	<p>Describes k-space filtering applied. Shall be NONE if no k-space filter.</p> <p>Defined Terms: COSINE COSINE_SQUARED FERMI GAUSSIAN HAMMING HANNING LORENTZIAN LRNTZ_GSS_TRNSFM RIESZ TUKEY NONE</p> <p>Required if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted). May be present otherwise.</p>

Magnetic Field Strength	(0018,0087)	1C	Nominal field strength of the MR Magnet, in Tesla. Required if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted) . May be present otherwise.
Applicable Safety Standard Agency	(0018,9174)	1C	Agency that established MR safety standard applicable to the acquisition of this Instance. Defined Terms: IEC FDA MHW Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted) . May be present otherwise.
Applicable Safety Standard Description	(0018,9175)	3	Name and Version of the applicable standard.
Image Comments	(0020,4000)	3	User-defined comments about the image.

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C.8.13.3 MR Image Description Macro

This section describes the MR Image Description Macro.

- 5 Table C.8-84 specifies the attributes of the MR Image Description Macro.

**Table C.8-84
MR IMAGE DESCRIPTION MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Complex Image Component	(0008,9208)	1C	Representation of complex data of frames in the SOP Instance. See C.8.13.3.1.1 for a description and Defined Terms. Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted), may be present otherwise.
Acquisition Contrast	(0008,9209)	1C	Indication of acquisition contrast used with frames in the SOP Instance. See C.8.13.3.1.2 for a description and Defined Terms. Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted), may be present otherwise.

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C.8.13.5.1 MR Image Frame Type Macro

Table C.8-88 specifies the attributes of the MR Image Frame Type Functional Group macro.

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**Table C.8-88
MR IMAGE FRAME TYPE MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
MR Image Frame Type Sequence	(0018,9226)	1	Identifies the characteristics of this frame. Only a single Item shall be included in this sequence.
>Frame Type	(0008,9007)	1C	Type of Frame. A multi-valued attribute analogous to the Image Type (0008,0008). Enumerated Values and Defined Terms are the same as those for the four values of the Image Type (0008,0008) attribute, except that the value MIXED is not allowed unless the SOP Class UID is "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted) . See C.8.16.1 and C.8.13.1.1.1.
>Include Common CT/MR Image Description Macro' Table C.8-131			
>Include 'MR Image Description Macro' Table C.8-82			

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C.8.15.2 Enhanced CT Image Module

10 This section describes the Enhanced CT Image Module. Table C.8-114 specifies the attributes of the Enhanced CT Image Module.

**Table C.8-114
ENHANCED CT IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image characteristics. See sections C.8.16.1 and C.8.15.2.1.1.
<i>Include Common CT/MR Image Description Macro' Table C.8-131</i>			
Acquisition Number	(0020,0012)	3	A number identifying the single continuous gathering of data over a period of time that resulted in this image. Note: This number is not required to be unique across SOP Instances in a series. See also the description of the Referenced Raw Data Sequence (0008,9121).
Acquisition DateTime	(0008,002A)	1C	The date and time that the acquisition of data started. Notes: 1. The synchronization of this time with an external clock is specified in the synchronization Module in Acquisition Time synchronized (0018,1800) . 2. See C.7.6.16.2.2.1 for an

			overview of all acquisition related timing attributes. Required if Image Type (0008,0008) Value 1 of this frame is ORIGINAL or MIXED and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted) , may be present otherwise.
Acquisition Duration	(0018,9073)	1C	The time in seconds needed to complete the acquisition of data. See C.7.6.16.2.2.1 for further explanation. Required if Image Type (0008,0008) Value 1 of this frame is ORIGINAL or MIXED and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted) , may be present otherwise.
Referenced Raw Data Sequence	(0008,9121)	3	The Raw data that was used to derive this Image. One or more Items are permitted in this Sequence. Note: The items of in this sequence may identify raw data that has not been stored or encoded as a DICOM object. This allows recognition that images in different instances have been reconstructed from the same raw data.
<i>>Include "Hierarchical SOP Instance Reference Macro" Table C.17-3</i>			
Referenced Waveform Sequence	(0008,113A)	3	References to waveforms acquired in conjunction with this image. These Waveforms may or may not be temporally synchronized with this image. One or more Items are permitted in this sequence.
<i>>Include "Hierarchical SOP Instance Reference Macro" Table C.17-3</i>			
Referenced Image Evidence Sequence	(0008,9092)	1C	Full set of Composite SOP Instances referring to image SOP Instances inside the frames of this Enhanced CT Image SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items shall be included in this sequence. Required if the Referenced Image Sequence (0008,1140) is present.
<i>>Include "Hierarchical SOP Instance Reference Macro" Table C.17-3</i>			
Source Image Evidence Sequence	(0008,9154)	1C	Full set of Composite SOP Instances used as source image SOP Instances inside the frames of this Enhanced CT Image SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items shall be included in this sequence. Required if the Source Image Sequence (0008,2112) is present.

<i>>Include "Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			
Referenced Presentation State Sequence	(0008,9237)	1C	<p>References to Presentation State instances acquired in conjunction with this instance.</p> <p>Note: May only be used to reference Presentation States belonging to the acquired data and not to reference Presentation States generated subsequently such as during interpretation.</p> <p>One or more Items shall be included in this sequence.</p> <p>Required if Presentation State is generated during acquisition, shall not be present otherwise.</p>
<i>>Include "Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. This value shall be 1.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. Enumerated Value: MONOCHROME2. See C.7.6.3.1.2 for definition of this term.
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. This value shall be 16.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. This value shall be 12 or 16.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. Shall be one less than the value in Bits Stored (0028,0101).
Content Qualification	(0018,9004)	1C	<p>Content Qualification Indicator</p> <p>Enumerated Values: PRODUCT RESEARCH SERVICE</p> <p>See C.8.13.2.1.1 for further explanation.</p> <p>Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted), may be present otherwise.</p>
Image Comments	(0020,4000)	3	User-defined comments about the image
Burned In Annotation	(0028,0301)	1C	<p>Indicates whether or not the image contains sufficient burned in annotation to identify the patient and date the image was acquired.</p> <p>Enumerated Values: NO</p> <p>This means that images that contain this Module shall not contain such burned in annotations.</p>

			Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted), may be present otherwise.
Recognizable Visual Features	(0028,0302)	3	Indicates whether or not the image contains sufficiently recognizable visual features to allow the image or a reconstruction from a set of images to identify the patient. Enumerated Values: YES NO If this Attribute is absent, then the image may or may not contain recognizable visual features.
Lossy Image Compression	(0028,2110)	1C	Specifies whether an Image has undergone lossy compression. Enumerated Values: 00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression. See C.7.6.1.1.5 for further explanation. Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted), may be present otherwise.
Lossy Image Compression Ratio	(0028,2112)	1C	Describes the approximate lossy compression ratio(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied. Note: For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30. Required if Lossy Images Compression (0028,2110) is "01".
Lossy Image Compression Method	(0028,2114)	1C	A label for the lossy compression method(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied; the value order shall correspond to the values of Lossy Image Compression Ratio (0028,2112). Required if Lossy Image Compression (0028,2110) is "01".
Presentation LUT Shape	(2050,0020)	1	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.
Icon Image Sequence	(0088,0200)	3	This icon image is representative of the Image. Only a single Item is permitted in this Sequence.
>Include 'Image Pixel Macro' Table C.7-11b		See Section F.7.	

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C.8.15.3.1 CT Image Frame Type Macro

Table C.8-117 specifies the attributes of the CT Image Frame Type Functional Group macro.

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**Table C.8-117
CT IMAGE FRAME TYPE MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
CT Image Frame Type Sequence	(0018,9329)	1	Identifies the characteristics of this frame. Only a single Item shall be included in this sequence.
>Frame Type	(0008,9007)	1	Type of Frame. A multi-valued attribute analogous to the Image Type (0008,0008). Enumerated Values and Defined Terms are the same as those for the four values of the Image Type (0008,0008) attribute, except that the value MIXED is not allowed unless the SOP Class UID is "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted) . See sections C.8.16.1 and C.8.15.2.1.1.1.
>Include Common CT/MR Image Description Macro' Table C.8-131			

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C.8.16 Common CT and MR Descriptions

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C.8.16.1.4 Derived Pixel Contrast

Value 4 shall be used to indicate derived pixel contrast - generally, contrast created by combining or processing images with the same geometry. Value 4 shall have a value of NONE when Value 1 is ORIGINAL.

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Note: If more than one of the following derived types is applicable, then it is up to the generating application to specify the value that best characterizes the derived image.

Value 4 of Image Type (0008,0008) and Value 4 of Frame Type (0008,9007) shall not be zero length **unless the SOP Class UID is "1.2.840.10008.5.1.4.1.1.2.2" or "1.2.840.10008.5.1.4.1.1.4.4" or "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted)**.

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Table C.8-130 specifies the Defined Terms for Value 4 for Image Type (0008,0008) and Frame Type (0008,9007) that are common to CT and MR. Additional defined terms are defined in the modality-specific Module and Macro definitions.

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C.8.16.2 Common CT/MR Image Description Macro

This section describes the Common CT/MR Image Description Macro.

Table C.8-131 specifies the attributes of the Common CT/MR Image Description Macro.

**Table C.8-131
COMMON CT/MR IMAGE DESCRIPTION MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Pixel Presentation	(0008,9205)	1	Indication of the presence or absence of color information that may be used during rendering. See C.8.16.2.1.1 for a description and Enumerated Values.
Volumetric Properties	(0008,9206)	1	Indication if geometric manipulations are possible with frames in the SOP Instance. See C.8.16.2.1.2 for a description and Enumerated Values.
Volume Based Calculation Technique	(0008,9207)	1	Method used for volume calculations with frames in the SOP Instance. See C.8.16.2.1.3 for a description and Defined Terms.

C.8.16.2.1 Common CT/MR Image Description Attribute Description

C.8.16.2.1.1 Pixel Presentation

**Table C.8-132
PIXEL PRESENTATION ATTRIBUTE VALUES**

Enumerated Value Name	Enumerated Value Description
COLOR	Image is best displayed in color using Supplemental Palette Color LUTs, but can be displayed in grayscale if current display does not support color. See section C.8.16.2.1.1.1.
MONOCHROME	Image is intended to be displayed in grayscale only. No Supplemental Palette Color LUTs are supplied.
MIXED	Used only as a value in Pixel Presentation (0008,9205) in the Enhanced MR Image Module or Enhanced CT Image Module if frames within the image SOP Instance contain different values for the Pixel Presentation attribute in the MR Image Frame Type Functional Group or CT Image Frame Type Functional Group.
TRUE_COLOR	Image can be displayed in color only

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C.8.16.2.1.2 Volumetric Properties

The value of the Volumetric Properties attribute (0008,9206) allows applications doing geometric manipulations (e.g., MAX_IP or MPR or planning) to determine if the image is an appropriate candidate for an operation without having to know all the details of the generating application.

Table C.8-133 specifies the Enumerated Values for the Volumetric Properties (0008,9206) attribute.

**Table C.8-133
VOLUMETRIC PROPERTIES ATTRIBUTE VALUES**

Enumerated Value Name	Enumerated Value Description
VOLUME	Image contains pixels that represent the volume specified for

	the image (Examples: Volume Based Calculation Technique (0008,9207) is NONE or MPR).
SAMPLED	<p>The specified frame or each frame within the image will not contain a representation of the average information in the slice direction because the frame was calculated by the non-linear re-sampling of a volume where each pixels of the resulting frame does not contain an average representation of the voxel represented by the frame's pixel.</p> <p>For example a projection (MAX_IP) frame uses the maximum value along a ray for each pixel rather than the average value of the represented voxel.</p>
DISTORTED	Image contains significantly distorted information from what is specified by the image volume attributes. For example this image should not be used in planning or for 3D volume. An example of this image type is a curved reformatted image (CURVED_MPR).
MIXED	Used only as a value in the Volumetric Properties (0008,9206) attribute in the Enhanced MR Image Type Module or Enhanced CT Image Type Module if frames within the image SOP Instance contain different values for the Volumetric Properties (0008,9206) attributes in the MR Image Frame Type Functional Group or CT Frame Type Functional Group.

Note: A value of MIXED may be necessary if creating a Legacy Converted Enhanced image and insufficient information is present to specify a more specific value.

C.8.16.2.1.3 Volume Based Calculation Technique Attribute

The value of the Volume Based Calculation Technique attribute (0008,9207) shall be used to indicate the method used for calculating pixels based on geometry.

5 Shall have a value of NONE when Value 1 of Image Type (0008,0008) or Value 1 of Frame Type (0008,9007) is ORIGINAL.

Table C.8-134 specifies the Defined Terms for the Volume Based Calculation Technique (0008,9207) attribute.

Table C.8-134
VOLUME BASED CALCULATION TECHNIQUE ATTRIBUTE VALUES

Defined Term Name	Defined Term Description
MAX_IP	Maximum Intensity Projection
MIN_IP	Minimum Intensity Projection
VOLUME_RENDER	Volume Rendering Projection Volume Rendering Image represents 3D voluminar information constructed from measured voxel intensities covering a 3D volume.
SURFACE_RENDER	Surface Rendering Projection Surface Rendering Image represents 3D surface information constructed from measured voxel intensities covering a 3D volume.
MPR	Multi-Planar Reformat
CURVED_MPR	Curved Multi-Planar Reformat
NONE	Pixels not derived geometrically
MIXED	Used only as a value in Volume Based Calculation Technique (0008,9207) attribute in the Enhanced MR Image Module or MR Spectroscopy Module if frames within the image SOP Instance contain different terms for the Volume Based Calculation Technique attribute in MR Frame Type Functional Group or MR Spectroscopy Frame Type Functional Group.

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Note: A value of MIXED may be necessary if creating a Legacy Converted Enhanced image and insufficient information is present to specify a more specific value.

15 **C.8.22.1 Enhanced PET Series Module**

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Table C.8.22-1
ENHANCED PET SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. Enumerated Values: PT See section C.7.3.1.1.1 for further explanation.

Referenced Performed Procedure Step Sequence	(0008,1111)	1C	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related (e.g. a Modality or General-Purpose Performed Procedure Step SOP Instance). Only a single Item shall be included in this sequence. Required if the Modality Performed Procedure Step SOP Class or General Purpose Performed Procedure Step SOP Class is supported.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
Related Series Sequence	(0008,1250)	1C	Identifying the series that was used for attenuation purposes. See C.7.3.1 Required if another series was used to perform attenuation correction and the SOP Class UID is not "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted). May be present otherwise. One or more Items shall be included in this sequence.
>Study Instance UID	(0020,000D)	1	Instance UID of Study to which the related Series belongs
>Series Instance UID	(0020,000E)	1	Instance UID of Related Series
>Purpose of Reference Code Sequence	(0040,A170)	2	Describes the purpose for which the reference is made. Zero or more Items shall be included in this sequence. When absent, implies that the reason for the reference is unknown.
<i>>>Include Code Sequence Macro Table 8.8-1</i>			<i>Defined CID 7210.</i>

C.8.22.3 Enhanced PET Image Module

Table C.8.22-3 specifies the attributes of the Enhanced PET Image Module.

**Table C.8.22-3
ENHANCED PET IMAGE MODULE ATTRIBUTES**

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Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image characteristics. See sections C.8.22.3.1.1.
<i>Include 'Common CT/MR Image Description Macro' Table C.8-131</i>			
Acquisition Number	(0020,0012)	3	A number identifying the single continuous gathering of data over a period of time that resulted in this image, which may include multiple bed positions. Note: This number is not required to be unique across SOP Instances in a series. See also the description of the Referenced Raw Data Sequence (0008,9121).

Acquisition Datetime	(0008,002A)	1C	<p>The date and time that the acquisition of data started.</p> <p>Notes: 1. The synchronization of this time with an external clock is specified in the synchronization Module in Acquisition Time synchronized (0018,1800) .</p> <p>2. See C.7.6.16.2.2.1 for an overview of all acquisition related timing attributes.</p> <p>Required if Image Type (0008,0008) Value 1 of this frame is ORIGINAL and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted), may be present otherwise.</p>
Acquisition Duration	(0018,9073)	1C	<p>The time in seconds needed to complete the acquisition of data. See C.7.6.16.2.2.1 for further explanation.</p> <p>Required if Image Type (0008,0008) Value 1 of this frame is ORIGINAL and SOP Class UID is not "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted), may be present otherwise.</p>
Counts Source	(0054,1002)	1	<p>The primary source of counts. Enumerated Values: <input type="checkbox"/> EMISSION <input type="checkbox"/> TRANSMISSION</p>
Decay Corrected	(0018,9758)	1	<p>Decay (DECY) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO</p>
Attenuation Corrected	(0018,9759)	1	<p>Attenuation (ATTN) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO</p>
Scatter Corrected	(0018,9760)	1	<p>Scatter (SCAT) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO</p>
Dead Time Corrected	(0018,9761)	1	<p>Dead time (DTIM) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO</p>
Gantry Motion Corrected	(0018,9762)	1	<p>Gantry motion (MOTN) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO</p>
Patient Motion Corrected	(0018,9763)	1	<p>Patient motion (PMOT) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO</p>

Count Loss Normalization Corrected	(0018,9764)	1	Count loss (CLN) normalization correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO
Randoms Corrected	(0018,9765)	1	Randoms (RAN) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO
Non-uniform Radial Sampling Corrected	(0018,9766)	1	Non-uniform radial sampling (RADL) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO
Sensitivity Calibrated	(0018,9767)	1	Image is sensitivity calibrated using a dose calibrator (DCAL). Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO
Detector Normalization Correction	(0018,9768)	1	Detector normalization (NORM) correction has been applied to image. Enumerated Values: <input type="checkbox"/> YES <input type="checkbox"/> NO
Randoms Correction Method	(0054,1100)	1C	Type of randoms correction processing. Defined terms: DLYD = delayed event subtraction SING = singles estimation PDDL = Processed Delays, which is a correction based on a processed (filtered) version of the data acquired from the delayed coincidence channel. Required if Randoms Corrected (0018,9765) equals YES.
Attenuation Correction Source	(0018,9738)	1C	Contains the source of the attenuation map information used for attenuation correction. See C.8.22.3.1.2 Required if Attenuation Corrected (0018,9759) equals YES.
Attenuation Correction Temporal Relationship	(0018,9770)	1C	Contains the temporal relationship between the attenuation correction source image and the PET image data. See C.8.22.3.1.3 Required if Attenuation Corrected (0018,9759) equals YES.

Scatter Correction Method	(0054,1105)	1C	A textual description of the scatter correction processing. e.g. convolution-subtraction, dual energy window, model-based, use of attenuation data. Required if Scatter Corrected (0018,9760) equals YES.
Decay Correction DateTime	(0018,9701)	1C	The date and time to which all frames in this Image were decay corrected. Required if Decay Corrected (0018,9758) equals YES.
Referenced Raw Data Sequence	(0008,9121)	3	A sequence that identifies the set of Raw Data SOP Class/Instance pairs of the Raw data that were used to derive this Image. One or more Items are permitted in this Sequence. Note: The items of in this sequence may identify raw data that has not been stored or encoded as a DICOM object. This allows recognition that images and spectra in different instances have been reconstructed from the same raw data. For such items the SOP Class UID would be "1.2.840.10008.5.1.4.1.1.66" (Raw Data SOP Class) and the SOP Instance UID would be any appropriate UID.
<i>>Include 'Image SOP Instance Reference Macro' Table 10-3</i>			
Referenced Waveform Sequence	(0008,113A)	3	References to waveforms acquired in conjunction with this image. These Waveforms may or may not be temporally synchronized with this image. One or more Items are permitted in this sequence.
<i>>Include "'Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			<i>Defined CID 7004.</i>
Referenced Image Evidence Sequence	(0008,9092)	1C	Full set of Composite SOP Instances referring to image SOP Instances inside the frames of this Enhanced PET Image SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items shall be included in this sequence. Required if the Referenced Image Sequence (0008,1140) is present.
<i>>Include "'Hierarchical SOP Instance Reference Macro' Table C.17-3</i>			

Source Image Evidence Sequence	(0008,9154)	1C	<p>Full set of Composite SOP Instances used as source image SOP Instances inside the frames of this Enhanced PET Image SOP Instance. See C.8.13.2.1.2 for further explanation.</p> <p>One or more Items shall be included in this sequence.</p> <p>Required if the Source Image Sequence (0008,2112) is present.</p>
<i>>Include "Hierarchical SOP Instance Reference Macro" Table C.17-3</i>			
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. This value shall be 1.
Photometric Interpretation	(0028,0004)	1	<p>Specifies the intended interpretation of the pixel data. Enumerated Value: MONOCHROME2.</p> <p>See C.7.6.3.1.2 for definition of this term.</p>
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. This value shall be 16.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. This value shall be 16.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. Shall be one less than the value in Bits Stored (0028,0101).
Content Qualification	(0018,9004)	1	<p>Content Qualification Indicator</p> <p>Enumerated Values: PRODUCT RESEARCH SERVICE</p> <p>See C.8.13.2.1.1 for further explanation.</p>
Image Comments	(0020,4000)	3	User-defined comments about the image
Burned in Annotation	(0028,0301)	1C	<p>Indicates that the image does not contain burned in annotations.</p> <p>Enumerated Values: NO</p> <p>This means that images that contain this Module shall not contain burned in annotations.</p> <p>Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted), may be present otherwise.</p>

Recognizable Visual Features	(0028,0302)	3	<p>Indicates whether or not the image contains sufficiently recognizable visual features to allow the image or a reconstruction from a set of images to identify the patient.</p> <p>Enumerated Values:</p> <p>YES NO</p> <p>If this Attribute is absent, then the image may or may not contain recognizable visual features.</p>
Lossy Image Compression	(0028,2110)	1C	<p>Specifies whether an Image has undergone lossy compression.</p> <p>Enumerated Values:</p> <p>00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression.</p> <p>See C.7.6.1.1.5 for further explanation.</p> <p>Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted), may be present otherwise.</p>
Lossy Image Compression Ratio	(0028,2112)	1C	<p>Describes the approximate lossy compression ratio(s) that have been applied to this image.</p> <p>See C.7.6.1.1.5 for further explanation.</p> <p>May be multivalued if successive lossy compression steps have been applied.</p> <p>Note: For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30.</p> <p>Required if Lossy Image Compression (0028,2110) equals 01.</p>
Lossy Image Compression Method	(0028,2114)	1C	<p>A label for the lossy compression method(s) that have been applied to this image.</p> <p>See C.7.6.1.1.5 for further explanation.</p> <p>May be multi-valued if successive lossy compression steps have been applied; the value order shall correspond to the values of the Lossy Compression Ratio (0028,2112).</p> <p>Note: For historical reasons, the lossy compression method may also be described in Derivation Description (0008,2111).</p> <p>Required if Lossy Image Compression (0028,2110) equals 01.</p>

Presentation LUT Shape	(2050,0020)	1	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.
Icon Image Sequence	(0088,0200)	3	This icon image is representative of the Image. Only a single item is permitted in this sequence.
>Include 'Image Pixel Macro' Table C.7-11b			See C.7.6.1.1.6 for further explanation.

...

...

C.8.22.5.1 PET Frame Type Macro

- 5 Table C.8.22-10 specifies the attributes of the PET Frame Type Functional Group macro.

**Table C.8.22-10
PET FRAME TYPE MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
PET Frame Type Sequence	(0018,9751)	1	A sequence that describes general characteristics of this frame. Only a single Item shall be included in this sequence.
>Frame Type	(0008,9007)	1	Type of Frame. A multi-valued attribute analogous to the Image Type (0008,0008). Enumerated Values and Defined Terms are the same as those for the four values of the Image Type (0008,0008) attribute, except that the value MIXED is not allowed unless the SOP Class UID is "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted) . See C.8.16.1 and C.8.22.3.1.
>Include 'Common CT/MR Image Description Macro' Table C.8-131			

PS 3.3 Add new Enhanced PET Corrections Module containing attributes factored out of Enhanced PET Image Module:

C.8.22.x Enhanced PET Corrections Module

Table C.8.22-3 specifies the attributes of the Enhanced PET Corrections Module.

5

**Table C.8.22-y
ENHANCED PET CORRECTIONS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Counts Source	(0054,1002)	1	The primary source of counts. Enumerated Values: EMISSION TRANSMISSION
Decay Corrected	(0018,9758)	1	Decay (DECY) correction has been applied to image. Enumerated Values: YES NO
Attenuation Corrected	(0018,9759)	1	Attenuation (ATTN) correction has been applied to image. Enumerated Values: YES NO
Scatter Corrected	(0018,9760)	1	Scatter (SCAT) correction has been applied to image. Enumerated Values: YES NO
Dead Time Corrected	(0018,9761)	1	Dead time (DTIM) correction has been applied to image. Enumerated Values: YES NO
Gantry Motion Corrected	(0018,9762)	1	Gantry motion (MOTN) correction has been applied to image. Enumerated Values: YES NO
Patient Motion Corrected	(0018,9763)	1	Patient motion (PMOT) correction has been applied to image. Enumerated Values: YES NO
Count Loss Normalization Corrected	(0018,9764)	1	Count loss (CLN) normalization correction has been applied to image. Enumerated Values: YES NO
Randoms Corrected	(0018,9765)	1	Randoms (RAN) correction has been applied to image. Enumerated Values: YES NO
Non-uniform Radial Sampling Corrected	(0018,9766)	1	Non-uniform radial sampling (RADL) correction has been applied to image. Enumerated Values: YES NO

Sensitivity Calibrated	(0018,9767)	1	Image is sensitivity calibrated using a dose calibrator (DCAL). Enumerated Values: YES NO
Detector Normalization Correction	(0018,9768)	1	Detector normalization (NORM) correction has been applied to image. Enumerated Values: YES NO
Randoms Correction Method	(0054,1100)	1C	Type of randoms correction processing. Defined terms: DLYD = delayed event subtraction SING = singles estimation PDDL = Processed Delays, which is a correction based on a processed (filtered) version of the data acquired from the delayed coincidence channel. Required if Randoms Corrected (0018,9765) equals YES.
Attenuation Correction Source	(0018,9738)	1C	Contains the source of the attenuation map information used for attenuation correction. See C.8.22.3.1.2 Required if Attenuation Corrected (0018,9759) equals YES.
Attenuation Correction Temporal Relationship	(0018,9770)	1C	Contains the temporal relationship between the attenuation correction source image and the PET image data. See C.8.22.3.1.3 Required if Attenuation Corrected (0018,9759) equals YES.
Scatter Correction Method	(0054,1105)	1C	A textual description of the scatter correction processing. e.g. convolution-subtraction, dual energy window, model-based, use of attenuation data. Required if Scatter Corrected (0018,9760) equals YES.
Decay Correction DateTime	(0018,9701)	1C	The date and time to which all frames in this Image were decay corrected. Required if Decay Corrected (0018,9758) equals YES.

PS 3.4: Add related general SOP Class information, between the true and legacy converted SOP Classes:

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B.3.1.4 Related General SOP Classes (A-ASSOCIATE-RQ)

5 A limited set of Standard SOP Classes in the Storage Service Class are defined to have one or more Related General SOP Classes. The Related General SOP Classes may be conveyed using the SOP Class Relationship Extended Negotiation during association establishment as defined in PS 3.7. Table B.3-3 identifies which Standard SOP Classes participate in this mechanism. If a Standard SOP Class is not listed in this table, Related General SOP Classes shall not be included in a Related Storage SOP Class Extended Negotiation Sub-Item.

10 Note: Implementation-defined Specialized SOP Classes (see PS3.2) of the Storage Service Class may convey a Related General SOP Class.

**Table B.3-3
STANDARD AND RELATED GENERAL SOP CLASSES**

SOP Class Name	Related General SOP Class Name
12-lead ECG Waveform Storage	General ECG Waveform Storage
Digital Mammography Image Storage - For Presentation	Digital X-Ray Image Storage - For Presentation
Digital Mammography Image Storage - For Processing	Digital X-Ray Image Storage - For Processing
Digital Intra-oral X-Ray Image Storage - For Presentation	Digital X-Ray Image Storage - For Presentation
Digital Intra-oral X-Ray Image Storage - For Processing	Digital X-Ray Image Storage - For Processing
Basic Text SR	Enhanced SR
	Comprehensive SR
Enhanced SR	Comprehensive SR
Procedure Log	Enhanced SR
	Comprehensive SR
X-Ray Radiation Dose SR	Enhanced SR
	Comprehensive SR
Spectacle Prescription Report	Enhanced SR
Macular Grid Thickness and Volume Report	Enhanced SR
Enhanced CT Image Storage	Legacy Converted Enhanced CT Image Storage
Enhanced MR Image Storage	Legacy Converted Enhanced MR Image Storage
Enhanced PET Image Storage	Legacy Converted Enhanced PET Image Storage

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PS 3.4: Add clarification of Storage SCP "level" as it pertains to conversion of legacy images – the only thing to state is that Level 2 conformance is required:

B.4.1 Conformance as an SCP

Three levels of conformance to the Storage SOP Classes as an SCP may be provided:

- Level 0 (Local). Level 0 conformance indicates that a user-defined subset of the Attributes of the image will be stored, and all others will be discarded. This subset of the Attributes shall be defined in the Conformance Statement of the implementer.
- Level 1 (Base). Level 1 conformance indicates that all Type 1 and 2 Attributes defined in the IOD associated with the SOP Class will be stored, and may be accessed. All other elements may be discarded. The SCP may, but is not required to validate that the Attributes of the SOP Instance meets the requirements of the IOD.
- Level 2 (Full). Level 2 conformance indicates that all Type 1, Type 2, and Type 3 Attributes defined in the Information Object Definition associated with the SOP Class, as well as any Standard Extended attributes (including Private Attributes) included in the SOP Instance, will be stored and may be accessed. The SCP may, but is not required to validate that the Attributes of the SOP Instance meet the requirements of the IOD.

Note: A Level 2 SCP may discard (not store) Type 3 attributes that are empty (zero length and no Value), since the meaning of an empty Type 3 attribute is the same as absence of the attribute. See PS 3.5 definition of "Type 3 Optional Data Elements".

An SCP that claims conformance to Level 2 (Full) support of the Storage Service Class may accept any Presentation Context negotiation of a SOP Class that specifies the Storage Service Class during the SOP Class Common Extended Negotiation, without asserting conformance to that SOP Class in its Conformance Statement.

Note: The SCP may support storage of all SOP Classes of the Storage Service Class, preserving all attributes as a Level 2 SCP.

An SCP that claims conformance to Level 2 (Full) support of a Related General SOP Class may accept any Presentation Context negotiation of a SOP Class that specifies that Related General SOP Class during the SOP Class Common Extended Negotiation, without asserting conformance to that specialized SOP Class in its Conformance Statement.

- Notes:
1. The term "specialized" in this section is used generically, including both Implementation-defined Specialized SOP Classes and Standard SOP Classes specified in Table B.3-3.
 2. The SCP may handle instances of such specialized SOP Classes using the semantics of the Related General SOP Class, but preserving all additional (potentially Type 1 or 2) attributes as a Level 2 SCP.

Level 2 (Full) Storage SCP Conformance is required for support of the Enhanced Multi-Frame Image Conversion Extended Negotiation of the Query/Retrieve Service Class, since effective use of that option requires the storage of Type 3 attributes. See C.3.5 New Instance Creation for Enhanced Multi-frame Image Conversion.

At any level of conformance, the SCP of the Storage Service Class may modify the values of certain Attributes in order to coerce the SOP Instance into the Query Model of the SCP. The Attributes that may be modified are shown in Table B.4-1.

**Table B.4-1
Attributes Subject to Coercion**

Attribute	Tag
Patient ID	(0010,0020)
Study Instance UID	(0020,000D)
Series Instance UID	(0020,000E)

The SCP of the Storage Service Class may modify the values of Code Sequence attributes to convert from one coding scheme into another. This includes changing from deprecated values of Coding Scheme Designator (0008,0102) or Code Value (0008,0100) to currently valid values.

If an SCP performs such a modification, it shall return a C-STORE response with a status of Warning.

- Notes:
1. Modification of these Attributes may be necessary if the SCP is also an SCP of a Query/Retrieve SOP Classes. These SOP Classes are described in this Standard. For example, an MR scanner may be implemented to generate Study Instance UIDs for images generated on the MR. When these images are sent to an archive which is HIS/RIS aware, it may choose to change the UID of the study assigned to the study by the PACS. The mechanism by which it performs this coercion is implementation dependent.
 2. An SCP may, for instance, convert Coding Scheme Designator values "SNM3" to "SRT", in accordance with the DICOM conventions for SNOMED (see PS3.16).
 3. Modification of Attributes that may be used to reference a SOP Instance by another SOP Instance (such as Study Instance UID and Series Instance UID attributes) will make that reference invalid. Modification of these Attributes is strongly discouraged.
 4. Other Attributes may be modified/corrected by an SCP of a Storage SOP Class.
 5. Modification of Attributes may affect digital signatures referencing the content of the SOP Instance.

Three levels of Digital Signature support are defined for an SCP which claims conformance to Level 2 (Full) storage support:

Signature Level 1. SCP may not preserve Digital Signatures and does not replace them.

Signature Level 2. SCP does not preserve the integrity of incoming Digital Signatures, but does validate the signatures of SOP Instances being stored, takes implementation-specific measures for insuring the integrity of data stored, and will add replacement Digital Signatures before sending SOP Instances elsewhere.

Signature Level 3. SCP does preserve the integrity of incoming Digital Signatures (i.e. is bit-preserving and stores and retrieves all Attributes regardless of whether they are defined in the IOD).

B.4.2 Conformance as An SCU

The SCU shall generate only C-STORE requests with SOP Instances that meet the requirements of the IOD associated with the SOP Class.

B.4.2.1 SCU Fall-Back Behavior

During Association Negotiation, an application may propose a specialized SOP Class and its related general SOP Class in separate Presentation Contexts as a Storage SCU. If the Association Acceptor rejects the specialized SOP Class Presentation Context, but accepts the related general SOP Class Presentation Context, the application may send instances of the specialized SOP Class as instances of the related general SOP Class. In this fall-back behavior, the SOP Class UID of the instance shall be the UID of the related general SOP Class, and any special semantics associated with the specialized SOP Class may be lost; the SOP Instance UID shall remain the same.

Note: The SCU may include the SOP Class UID of the original intended specialized SOP Class in the attribute Original Specialized SOP Class UID (0008,001B) of the instance sent under the related general SOP Class. In some cases, e.g., when all intermediate storage applications are Level 2 SCPs, this may allow an ultimate receiver of the instance to recast it as an instance of the specialized SOP Class IOD. However, this transformation is not guaranteed.

PS 3.4: Add new SOP Classes to Storage Service Class with no specific behavior (which is instead addressed in Query/Retrieve Service Class):

B.5 STANDARD SOP CLASSES

5 The SOP Classes in the Storage Service Class identify the Composite IODs to be stored. Table B.5-1 identifies Standard SOP Classes.

**Table B.5-1
STANDARD SOP CLASSES**

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
...
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	Enhanced CT Image (see B.5.1.7)
<u>Legacy Converted Enhanced CT Image Storage</u>	<u>1.2.840.10008.5.1.4.1.1.2.2</u>	<u>Legacy Converted Enhanced CT Image (see B.5.1.7)</u>
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Enhanced MR Image (see B.5.1.6)
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	MR Spectroscopy
Enhanced MR Color Image Storage	1.2.840.10008.5.1.4.1.1.4.3	Enhanced MR Color Image
<u>Legacy Converted Enhanced MR Image Storage</u>	<u>1.2.840.10008.5.1.4.1.1.4.4</u>	<u>Legacy Converted Enhanced MR Image (see B.5.1.6)</u>
...
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	
Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.130	Enhanced PET Image
<u>Legacy Converted Enhanced PET Image Storage</u>	<u>1.2.840.10008.5.1.4.1.1.128.1</u>	<u>Legacy Converted Enhanced PET Image</u>

...

10 B.5.1.6 **Enhanced MR Image Storage SOP Class and Legacy Converted Enhanced MR Image Storage SOP Class**

An SCP of the Enhanced MR Image Storage **or Legacy Converted Enhanced MR Image Storage** SOP Class shall also support the Grayscale Softcopy Presentation State Storage SOP Class.

15 Note: This requirement is present in order to allow the exchange of graphical annotations created by an acquisition **or conversion** device.

20 B.5.1.7 **Enhanced CT Image Storage and Legacy Converted Enhanced CT Image Storage SOP Class**

An SCP of the Enhanced CT Image Storage **or Legacy Converted Enhanced CT Image Storage** SOP Class shall also support the Grayscale Softcopy Presentation State Storage SOP Class.

Note: This requirement is present in order to allow the exchange of graphical annotations created by an acquisition **or conversion** device.

B.5.1.9 Enhanced PET Image Storage and Legacy Converted Enhanced PET Image Storage SOP Class

5 An SCP of the Enhanced PET Image Storage or Legacy Converted Enhanced PET Image Storage SOP Class shall also support the Grayscale Softcopy Presentation State Storage SOP Class.

Note: This requirement is present in order to allow the exchange of graphical annotations created by an acquisition or conversion device.

PS 3.4: Add new SOP Classes to Media Storage SOP Classes:

10 I.4 MEDIA STORAGE STANDARD SOP CLASSES

The SOP Classes in the Media Storage Service Class identify the Composite and Normalized IODs to be stored. The following Standard SOP Classes are identified in Table I.4-1

**Table I.4-1
Media Storage Standard SOP Classes**

SOP Class Name	SOP Class UID	IOD Specification
...
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	IOD defined in PS 3.3
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	IOD defined in PS 3.3
Legacy Converted Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.2	IOD defined in PS 3.3
...
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	IOD defined in PS 3.3
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	IOD defined in PS 3.3
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	IOD defined in PS 3.3
Enhanced MR Color Image Storage	1.2.840.10008.5.1.4.1.1.4.3	Enhanced MR Color Image
Legacy Converted Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.4	IOD defined in PS 3.3
...
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	IOD defined in PS 3.3
Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.130	IOD defined in PS 3.3
Legacy Converted Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.128.1	IOD defined in PS 3.3
...

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PS 3.4: Add new Extended Negotiation and behavior to Query/Retrieve Service Class:

C.1 OVERVIEW

C.1.1 Scope

5 The Query/Retrieve Service Class defines an application-level class-of-service that facilitates the simple management of composite object instances in a manner functionally similar to ACR-NEMA 300-1988. The types of queries that are allowed are not complex. This Service Class is not intended to provide a comprehensive generalized database query mechanism such as SQL. Instead, the Query/Retrieve Service Class is focused towards basic composite object instance information queries using a small set of common
10 Key Attributes.

In addition, the Query/Retrieve Service Class provides the ability to retrieve/transfer a well-identified set of composite object instances. The retrieve/transfer capability allows a DICOM AE to retrieve composite object instances from a remote DICOM AE or request the remote DICOM AE to initiate a transfer of composite object instances to another DICOM AE.

15 Note: Functional similarity to ACR-NEMA 300-1988 facilitates the migration to DICOM.

An Enhanced Multi-Frame Image Conversion Extended Negotiation option allows the Query/Retrieve Service Class to access Classic single-frame images that have been converted to Enhanced multi-frame images, or vice-versa. This is achieved by providing alternative “views” of studies, such that:

- **the default view provides the images in the form they were received,**
- **a Classic single-frame “view” provides images as Classic single frame (that were received that way or have been converted from Enhanced multi-frame),**
- **an Enhanced multi-frame “view” provides images as Enhanced multi-frame (that were received that way or have been converted to Enhanced multi-frame).**

A query or retrieval above the IMAGE level does not show or return duplicate information (two sets of images). The SCU may request the default, enhanced multi-frame or Classic single frame view. For each view, referential integrity is required to be consistent within the scope of the Patient and that view; i.e., references to UIDs will be converted in all Instances, not only within converted images.

Notes: 1. The Classic single-frame view is not intended as an alternative to the Frame Level Retrieve SOP Classes defined in Annex Y. Enhanced Image Storage SOP Classes and Frame Level Retrieve SOP Classes should be used together since they support a unified view of the relationships between instances through a common set of UIDs.

2. In the Enhanced view, Instances that have no Enhanced equivalent will be returned in their original form but with referential integrity related changes.

...

C.1.3 Query/retrieve Information Model

40 In order to serve as an SCP of the Query/Retrieve Service Class, a DICOM AE possesses information about the Attributes of a number of stored composite object SOP Instances. This information is organized into a well defined Query/Retrieve Information Model. The Query/Retrieve Information Model shall be a standard Query/Retrieve Information Model, as defined in this Annex of the DICOM Standard.

45 Queries and Retrievals are implemented against well defined Information Models. A specific SOP Class of the Query/Retrieve Service Class consists of an Information Model Definition and a DIMSE-C Service Group. In this Service Class, the Information Model plays a role similar to an Information Object Definition (IOD) of most other DICOM Service Classes.

C.1.4 Service Definition

Two peer DICOM AEs implement a SOP Class of the Query/Retrieve Service Class with one serving in the SCU role and one serving in the SCP role. SOP Classes of the Query/Retrieve Service Class are implemented using the DIMSE-C C-FIND, C-MOVE, and C-GET services as defined in PS 3.7.

- 5 Both a baseline and extended behavior is defined for the DIMSE-C C-FIND, C-MOVE, and C-GET services. Baseline behavior specifies a minimum level of conformance for all implementations to facilitate interoperability. Extended behavior enhances the baseline behavior to provide additional features which may be negotiated independently at Association establishment time.

10 The following descriptions of the DIMSE-C C-FIND, C-MOVE, and C-GET services provide a brief overview of the SCU/SCP semantics:

a) A C-FIND service conveys the following semantics:

- The SCU requests that the SCP perform a match of all the keys specified in the Identifier of the request, against the information it possesses, to the level (E.g. Patient, Study, Series, or Composite object instance) specified in the request.

15 Note: In this Annex, the term “Identifier” refers to the Identifier service parameter of the C-FIND, C-MOVE, or C-GET service as defined in PS 3.7.

- The SCP generates a C-FIND response for each match with an Identifier containing the values of all key fields and all known Attributes requested. All such responses will contain a status of Pending. A status of Pending indicates that the process of matching is not complete.
- When the process of matching is complete a C-FIND response is sent with a status of Success and no Identifier.
- A Refused or Failed response to a C-FIND request indicates that the SCP is unable to process the request.
- The SCU may cancel the C-FIND service by issuing a C-FIND-CANCEL request at any time during the processing of the C-FIND service. The SCP will interrupt all matching and return a status of Canceled.

b) A C-MOVE service conveys the following semantics:

- The SCU supplies Unique Key values to identify an entity at the level of the retrieval. The SCP of the C-MOVE initiates C-STORE sub-operations for the corresponding storage SOP Instances identified by Unique Key values. These C-STORE sub-operations occur on a different Association than the C-MOVE service. The SCP role of the Query/Retrieve SOP Class and the SCU role of the Storage SOP Class may be performed by different applications which may or may not reside on the same system. Initiation mechanism of C-STORE sub-operations is outside of the scope of DICOM standard.

40 Note: This does not imply that they use the same AE Title. See C.6.1.2.2.2, C.6.2.2.2.2 and C.6.3.2.2.2 for the requirements to the C-MOVE SCP conformance.

- The SCP may optionally generate responses to the C-MOVE with status equal to Pending during the processing of the C-STORE sub-operations. These C-MOVE responses indicate the number of Remaining C-STORE sub-operations and the number of C-STORE sub-operations returning the status of Success, Warning, and Failed.
- When the number of Remaining C-STORE sub-operations reaches zero, the SCP generates a final response with a status equal to Success, Warning, Failed, or Refused. This response may indicate the number of C-STORE sub-operations returning the status of Success, Warning, and Failed. If the status of a C-STORE sub-operation was Failed a UID List will be returned.
- The SCU may cancel the C-MOVE service by issuing a C-MOVE-CANCEL request at any time during the processing of the C-MOVE. The SCP terminates all incomplete C-STORE

sub-operations and returns a status of Canceled.

c) A C-GET service conveys the following semantics:

- 5 — The SCU supplies Unique Key values to identify an entity at the level of the retrieval. The SCP generates C-STORE sub-operations for the corresponding storage SOP Instances identified by the Unique Key values. These C-STORE sub-operations occur on the same Association as the C-GET service and the SCU/SCP roles will be reversed for the C-STORE.
- 10 — The SCP may optionally generate responses to the C-GET with status equal to Pending during the processing of the C-STORE sub-operations. These C-GET responses indicate the number of Remaining C-STORE sub-operations and the number of C-STORE sub-operations returning the status of Success, Warning, and Failed.
- 15 — When the number of Remaining C-STORE sub-operations reaches zero, the SCP generates a final response with a status equal to Success, Warning, Failed, or Refused. This response may indicate the number of C-STORE sub-operations returning the status of Success, Warning, and Failed. If the status of a C-STORE sub-operation was Failed a UID List will be returned.
- 20 — The SCU may cancel the C-GET service by issuing a C-GET-CANCEL request at any time during the processing of the C-GET. The SCP terminates all incomplete C-STORE sub-operations and returns a status of Canceled.

C.2 QUERY/RETRIEVE INFORMATION MODEL DEFINITION

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C.3 STANDARD QUERY/RETRIEVE INFORMATION MODELS

25 Three standard Query/Retrieve Information Models are defined in this Annex. Each Query/Retrieve Information Model is associated with a number of SOP Classes. The following three hierarchical Query/Retrieve Information Models are defined:

- Patient Root
- Study Root
- 30 — Patient/Study Only

C.3.1 Patient Root Query/Retrieve Information Model

The Patient Root Query/Retrieve Information Model is based upon a four level hierarchy:

- Patient
- 35 — Study
- Series
- Composite object instance

40 The patient level is the top level and contains Attributes associated with the Patient Information Entity (IE) of the Composite IODs as defined in PS 3.3. Patients IEs are modality independent.

The study level is below the patient level and contains Attributes associated with the Study IE of the Composite IODs as defined in PS 3.3. A study belongs to a single patient. A single patient may have multiple studies. Study IEs are modality independent.

45 The series level is below the study level and contains Attributes associated with the Series, Frame of Reference and Equipment IEs of the Composite IODs as defined in PS 3.3. A series belongs to a single study. A single study may have multiple series. Series IEs are modality dependent. To accommodate this modality dependence, the set of Optional Keys at the series level includes all Attributes defined at the series level from any Composite IOD defined in PS 3.3.

The lowest level is the composite object instance level and contains Attributes associated with the Composite object IE of the Composite IODs as defined in PS 3.3. A composite object instance belongs to a single series. A single series may contain multiple composite object instances. Most composite object IEs are modality dependent. To accommodate this potential modality dependence, the set of Optional Keys at the composite object instance level includes all Attributes defined at the composite object instance level from any Composite IOD defined in PS 3.3.

C.3.2 Study Root Query/Retrieve Information Model

The Study Root Query/Retrieve Information Model is identical to the Patient Root Query/Retrieve Information Model except the top level is the study level. Attributes of patients are considered to be Attributes of studies.

C.3.3 Patient/Study Only Query/Retrieve Information Model

Retired. See PS 3.4 2004.

C.3.4 Additional Query/Retrieve Attributes

Some optional attributes that may be used in Query/Retrieve Information Models that are not Attributes of an Information Object Definition and, therefore, are not defined in PS 3.3. These attributes are defined in Table C.3-1.

**Table C.3-1
ADDITIONAL QUERY/RETRIEVE ATTRIBUTES**

Attribute Name	Tag	Attribute Description
Number of Patient Related Studies	(0020,1200)	The number of studies that match the Patient level Query/Retrieve search criteria
Number of Patient Related Series	(0020,1202)	The number of series that match the Patient level Query/Retrieve search criteria
Number of Patient Related Instances	(0020,1204)	The number of composite object instances that match the Patient level Query/Retrieve search criteria
Number of Study Related Series	(0020,1206)	The number of series that match the Study level Query/Retrieve search criteria
Number of Series Related Instances	(0020,1209)	The number of composite object instances in a Series that match the Series level Query/Retrieve search criteria
Number of Study Related Instances	(0020,1208)	The number of composite object instances that match the Study level Query/Retrieve search criteria
Modalities in Study	(0008,0061)	All of the distinct values used for Modality (0008,0060) in the Series of the Study.
SOP Classes in Study	(0008,0062)	The SOP Classes contained in the Study.
Alternate Representation Sequence	(0008,3001)	A Sequence of Items, each identifying an alternate encoding of an image that matches the Instance level Query/Retrieve search criteria (see C.6.1.1.5.1)

If the SCP manages images in multiple alternate encodings, only one of the alternate encodings of an image is included in the number of object instances.

C.3.5 New Instance Creation for Enhanced Multi-Frame Image Conversion

When Query/Retrieve View (0008,0053) is present with a value of “CLASSIC” or “ENHANCED” in a C-FIND, C-MOVE or C-GET Request Identifier, then the Information Model against which the query or retrieval is performed and any SOP Instances that are retrieved shall be returned, constructed or converted according to the requirements in this section.

There are no requirements with respect to when such instances are actually created or persisted, only that they be available on request. I.e., they may be created in advance (cached) or they may be created dynamically as required, as long as the process is deterministic in the sense that the same Attributes will be populated with the same values on successive queries and retrievals (including UIDs).

- Notes:**
1. The UID generation process is required to be deterministic but it is important to remember that appending a suffix to an existing UID is not a valid approach to generating a new UID, unless the converter is the producer (owner of the root) of the original UID and knows that this is safe and the result will be unique.
 2. The cross-references between original and converted instances contain sufficient information to recover UIDs in the alternative form.

All instances for a Patient known to the SCP shall be converted as necessary to maintain referential integrity and to avoid information loss.

- Notes:**
1. It is not permitted to fail to include a subset of instances within this scope, for example, the presentation states or key object selection documents, in the "ENHANCED" view, in order to avoid the effort of creating new instances with updated references required to maintain referential integrity. In other words, the total "information content" of any view will be no less than that of the default view.
 2. This does not mean that all instances need to be converted, since if they contain no such references, they can be left alone and included in the view. For example, a Classic single slice CT localizer image with no references can remain unchanged in the view as a CT Image Storage SOP Class with its existing SOP Instance UID and SOP Class and in its existing Series, and be referenced from converted instances, such as the axial images prescribed from it. An SCU cannot make any assumptions about what will or will not be converted, or in what order.
 3. It is understood that the requirements of this section are applicable to a single SCP; it is not possible to require all SCPs that perform conversion to perform it the same way, or create the same UIDs, etc.

In addition to the general requirements in this section, specific requirements apply to the following types of instance created:

- Enhanced (true or legacy converted) multi-frame images that are created from Classic single frame images
- Classic single frame images that are created from Enhanced (true or legacy converted) multi-frame images
- Instances that contain references to the SOP Instance UIDs or Series Instance UIDs corresponding to either the converted single frame images, or other instances with such references

The general requirements are that:

- The new Composite Instance shall have a new SOP Instance UID.
- The new Composite Instance shall be a valid SOP Instance (i.e., will comply with the IOD, Module and Attribute requirements for the Storage SOP Class).
- The new Composite Instance shall contain the Contributing Equipment Sequence (0018,A001). If the source Composite Instances already contain the Contributing Equipment Sequence with a consistent set of Item values (excluding Contribution DateTime (0018,A002)), then a new Item shall be appended to the copy of the sequence in the new Composite Instance; if the source Composite Instance does not contain the Contributing Equipment Sequence or the Item values (excluding Contribution DateTime (0018,A002)) differ between source instances, then Contributing Equipment Sequence shall be created, containing one new Item. In either case, the new Item shall describe the equipment that is

creating the new Composite Instance, and the Purpose of Reference Code Sequence (0040,A170) within the Item shall be (dddd1, DCM, “Enhanced Multi-frame Conversion Equipment”) and the Contribution Description (0018,A003) shall be “Legacy Enhanced Image created from Classic Images”, “Classic Image created from Enhanced Image”, or “Updated UID references during Legacy Enhanced Classic conversion” as appropriate.

- The new Composite Instance shall have the same Patient and Study level information as the source Instance, including the same Study Instance UID.
- The new Composite Instance shall have the same spatial and temporal Frame of Reference information as the source instance, if present (e.g., the Frame of Reference UID shall be the same).
- The new Composite Instance shall be placed in a new Series (together with other new Composite Instances that share the same, new Series level information), with a new Series Instance UID. The Series Date (0008,0021) and Series Time (0008,0031) of all the Instances in the new Series shall be the earliest of the values in the source Composite Instances, if present.

Notes: 1. The new Series Date and Time shall NOT be that of when the conversion was performed, but shall reflect the values in the source images.
2. There is no standard requirement or mechanism defined to change or preserve other Series level Attributes, such as Series Number or Series Description. This is left to the discretion of the implementer, particularly in cases where instances from different Series are merged.

- The new Composite Instance shall have the same Items and Values of Request Attributes Sequence (0040,0275) as the source Composite Instances, if Request Attributes Sequence (0040,0275) is present in any of the source Composite Instances.
- If the new Composite Instance contains references to another entity for the same Patient (including, but not limited to, references to SOP Instances, Series, Studies or Frames of Reference), and the target of those references is also converted, then the references shall be changed to refer to the converted entity.

Notes: 1. For example, if the source instance refers to an instance in a Series, and the referenced instance is also converted, and hence placed in a new Series, then both the SOP Instance UID and the Series Reference UID in the hierarchical reference to the instance will need to be updated, as will the SOP Class UID of the referenced instance, if that has changed, as it likely will have.
2. The overall intent is to maintain referential integrity within the converted set of instances, within the scope of the same Patient. Since it is likely that most if not all non-image instances for a patient will reference images that will be converted, this means that most if not all non-image instances will also have to be “converted”, for the purpose of updating such references. This referential integrity is required regardless of whether the initial request is for a subset of instances for the patient only, or not.
3. The UIDs referenced in Conversion Source Attributes Sequence (0020,9172) are not converted, since by definition, these reference instances in the “other” view; they should not exist in the source, but will be inserted (or be replaced, if previously converted) during conversion.

The specific requirements for the conversion of single frame images to Enhanced Multi-frame images are:

- The SOP Class of the new Composite Instance shall be the appropriate modality-specific Enhanced Image Storage SOP Class that is intended for de novo creation by an acquisition or post-processing device, unless the source images do not contain sufficient information to populate mandatory Attributes with standard Enumerated Values and Defined Terms or Coded Sequence Item values, in which case the appropriate modality-specific Legacy

Converted Enhanced Image Storage SOP Class shall be used. The appropriate SOP Classes are defined in Table C.3.5-1.

Notes: 1. For example, if the source images to be converted are of the CT Image Storage SOP Class, then the preferred new SOP Class is the Enhanced CT Image Storage SOP Class, but if this is not possible, the Legacy Converted Enhanced CT Image Storage SOP Class is used.

2. It is not intended that images from different modalities be combined in the same new Composite Instance. For example, it is not expected that CT and PET images would be combined in the same Instance, since the technique attributes and the pixel data characteristics are quite distinct.

3. It is expected that as many single frame images will be combined into a single multi-frame image as is sensible, given the constraints on what Attributes must be identical as defined in this section, and depending on the type of images and the size of the resulting object. Different implementations may make different choices in this respect. For example, an application might choose to combine only images in the same Series, or with the same slice spacing, or the same values for Image Type, or with the same Image Orientation (Patient).

- The new Composite Instance shall not be contained in a Concatenation. This means that it shall not contain a Concatenation UID (0020,9161) attribute or other Concatenation attributes. If the existing Composite Instance contains such attributes, they shall not be included in the new Composite Instance.

- The new Composite Instance contains only one set of Attributes for the Image Pixel Module, hence the contents of the Image Pixel Module shall either be identical in all source images, or the Pixel Data for each frame shall be converted as necessary to match the Image Pixel Module of the new Composite Instance.

Notes: 1. In particular this means that the values of Rows, Columns, Bits Stored, Bits Allocated, High Bit, Pixel Representation, Samples per Pixel, Photometric Interpretation and Planar Configuration applicable to all of the frames needs to be the same. In special cases, such as where Bits Stored is less than Bits Allocated but varies per frame, it may be safe to use the largest value for all the frames and ensure that any unused high bits are appropriately masked before encoding. It is not expected that source images with different numbers of Rows and Columns will be combined (by padding the periphery of images smaller than the largest); quite apart from not being the intended use case, this has the potential to greatly expand the size of the instance, and might also require adjustment of the Image Position (Patient) values.

2. Special attention should be given to the Pixel Padding Value and associated attributes, in case these vary per frame in the source images, in which case the Pixel Data for some frames may need to be modified to be consistent with all the other frames.

3. It is possible to change the Image Pixel Module Attributes related to compressed Transfer Syntaxes (including lossy or irreversible compression) during conversion.

- All mandatory Attributes of all mandatory Modules and Functional Group Macros of the SOP Class of the new Composite Instance shall be populated as required by the IOD. In this context, "mandatory" means either required or conditional where the condition is satisfied.

Note: For example, if the source images to be converted are of the CT Image Storage SOP Class, and the new Composite Instance is of the Legacy Converted Enhanced CT Image Storage SOP Class, then it is required that the Pixel Measures Functional Group be populated from Pixel Spacing, that the Plane Position (Patient) Functional Group be populated from Image Position (Patient), etc. In addition, if Body Part Examined is present in the source images with a standard value, then the condition for the inclusion of the Frame Anatomy Functional Group is satisfied, and the value therein needs to be converted to the appropriate Anatomic Region Sequence code.

- All optional Attributes, Modules and Functional Group Macros for which corresponding information is present in the source images in standard Attributes shall also be populated.

- All Attributes of the Overlay Module shall be removed and converted into a Grayscale or Color Softcopy Presentation State (depending on the value of Photometric Interpretation); if the Overlay uses high bits in the Pixel Data (7FE0,0010) these shall be extracted and

encoded in Overlay Data (60xx,3000) in the Presentation State and shall be set to zero in the Pixel Data (7FE0,0010) attribute in the converted image.

Note: The extraction of Overlays from multiple frames may lead to a proliferation of GSPS Instances (one per converted frame), unless the converter recognizes commonality in the binary values of overlay bit planes and factors it out into fewer GSPS objects that each apply to multiple frames.

- All Attributes of the Curve Module (retired, but formerly defined in DICOM) shall be removed; they may be converted into a Grayscale or Color Softcopy Presentation State (depending on the value of Photometric Interpretation) or a Waveform as appropriate, but this is not required.
- All Attributes of the Graphic Annotation Sequence (0070,0001) (not defined in Classic image IODs, but sometimes used in a Standard Extended SOP Class) shall be removed; they may be converted into a Grayscale or Color Softcopy Presentation State (depending on the value of Photometric Interpretation), but this is not required.
- All remaining Attributes in the source images (i.e., those that have not been used to populate mandatory or optional Attributes in Modules and Functional Groups), including Private Attributes, shall be copied into the top-level Data Set or the Unassigned Shared Converted Attributes Sequence (0020,9170) if they are present in all of the source images for the new Composite Instance, have the same number of values, and have the same values, otherwise they shall be copied into the Unassigned Per-Frame Converted Attributes Sequence (0020,9171).

Note: The semantics of Private Attributes, or Standard Attributes used in a Standard Extended SOP Class, might not be maintained, being unknown to the converting application; for example, referential integrity of UIDs in Private Attributes might not be updated.

- The new Composite Instance shall contain references to the source Instances from which it was converted, encoded in the Conversion Source Reference Functional Group Macro.

The specific requirements for the conversion of Enhanced Multi-frame images to Classic single frame images are:

- The SOP Class of the new Composite Instance shall be the appropriate modality-specific (Classic) Image Storage SOP Class that is intended for de novo creation by an acquisition or post-processing device.

Note: For example, if the source images to be converted are of the Enhanced CT Image Storage SOP Class or the Legacy Converted Enhanced CT Image Storage SOP Class, then the new SOP Class is the CT Image Storage SOP Class.

- All mandatory Attributes of the IOD of the SOP Class of the new Composite Instance shall be populated. In this context, “mandatory” means either required or conditional where the condition is satisfied.

Note: For example, if the source images to be converted are of the Legacy Converted Enhanced CT Image Storage SOP Class, and the new Composite Instance is of the CT Image Storage SOP Class, then it is required that Pixel Spacing be populated from the Pixel Measures Functional Group, that Image Position (Patient) be populated from the Plane Position (Patient) Functional Group, etc.

- All optional Attributes in Modules of the IOD for which corresponding information is present in the source images shall also be populated.

- All remaining Attributes in the source images (i.e., those that have not been used to populate mandatory or optional Attributes in Modules), including Private Attributes, shall be copied from the top-level Data Set and the Shared Functional Group Macro and the corresponding Item of the Per-Frame Functional Group Macro into the top-level Data Set of the new Composite Instance, including those in the Unassigned Shared Converted Attributes Sequence (0020,9170) and the corresponding Item of the Unassigned Per-Frame Converted Attributes Sequence (0020,9171) (which will result in a Standard Extended SOP Class).

Notes: 1. Identifying Attributes, such as Series Number or Series Description, will be present in the Unassigned functional groups, and UIDs will be present in the Conversion Source Attributes Sequence, allowing, for example, the original Series organization to be recovered, whether or not a single Series was previously converted into a single Legacy Converted instance or it was split or merged with other Series.

2. The integrity of the set of Private Attributes recovered in this manner cannot be guaranteed to result in the correct function of any applications that depend on them, but the expectation is that this will be no better or worse than the impact of storing instances with private attributes on any Storage SCP that may or may not reorganize and/or selectively preserve Private Attributes.

- The new Composite Instance shall contain references to the source Instances from which it was converted, encoded in the Conversion Source Attributes Sequence (0020,9172) in the SOP Common Module.

The specific requirements for the conversion of other instances are:

- The new Composite Instance shall be an instance of the same SOP Class as the source Composite Instance.
- The new Composite Instance shall contain references to the source Instances from which it was converted, encoded in the Conversion Source Attributes Sequence (0020,9172) in the SOP Common Module.

Table C.3.5-1
MODALITY-SPECIFIC SOP CLASS CONVERSIONS

Classic	True Enhanced	Legacy Converted Enhanced
<u>CT Image Storage</u>	<u>Enhanced CT Image Storage</u>	<u>Legacy Converted Enhanced CT Image Storage</u>
<u>MR Image Storage</u>	<u>Enhanced MR Image Storage</u>	<u>Legacy Converted Enhanced MR Image Storage</u>
<u>PET Image Storage</u>	<u>Enhanced PET Image Storage</u>	<u>Legacy Converted Enhanced PET Image Storage</u>

C.4 DIMSE-C SERVICE GROUPS

Three DIMSE-C Services are used in the construction of SOP Classes of the Query/Retrieve Service Class. The following DIMSE-C operations are used:

- C-FIND
- C-MOVE

— C-GET

C.4.1 C-FIND Operation

...

5 C.4.1.1.3 Identifier

Both the C-FIND request and response contain an Identifier encoded as a Data Set (see PS 3.5).

10 Note: The definition of a Data Set in PS 3.5 specifically excludes the range of groups below group 0008, and this includes in particular Meta Information Header elements such as Transfer Syntax UID (0002,0010). The C-FIND request and identifier do not support a mechanism for ascertaining the manner in which an SCP might have encoded a stored image whether it be by requesting Transfer Syntax UID (0002,0010) or by any other mechanism.

C.4.1.1.3.1 Request Identifier Structure

An Identifier in a C-FIND request shall contain:

- 15 — Key Attributes values to be matched against the values of storage SOP Instances managed by the SCP.
- Query/Retrieve Level, element (0008,0052) which defines the level of the query.
- 20 — **Conditionally, the Attribute Query/Retrieve View (0008,0053). This Attribute may be included if Enhanced Multi-Frame Image Conversion has been accepted during Association Extended Negotiation. It shall not be included otherwise.**
- Conditionally, the Attribute Specific Character Set (0008,0005). This Attribute shall be included if expanded or replacement character sets may be used in any of the Attributes in the Request Identifier. It shall not be included otherwise.
- 25 — Conditionally, the Attribute Timezone Offset From UTC (0008,0201). This Attribute shall be included if Key Attributes of time are to be interpreted explicitly in the designated local time zone. It shall not be present otherwise, i.e., it shall not be sent with a zero-length value.

30 The Key Attributes and values allowable for the level of the query shall be defined in the SOP Class definition for the Query/Retrieve Information Model.

C.4.1.1.3.2 Response Identifier Structure

The C-FIND response shall not contain Attributes that were not in the request or specified in this section.

An Identifier in a C-FIND response shall contain:

- 35 — Key Attributes with values corresponding to Key Attributes contained in the Identifier of the request.
- Notes:
1. All Required Keys in the Request Identifier, as well as all Optional Keys in the Request Identifier that are supported by the SCP, will therefore be present in the Response Identifier.
 2. Required Keys and supported Optional Keys in the Response Identifier will have zero length if the SCP has no value to send; i.e., there is no requirement that the SCP have a value for these, or create a dummy value.
 3. The requirement that unsupported Optional Keys present in the Request Identifier not be included in the Response Identifier is specified in C.2.2.1.3.
- 45 — Query/Retrieve Level, element (0008,0052) which defines the level of the query. The Query/Retrieve level shall be equal to the level specified in the request.
 - Conditionally, the Attribute Specific Character Set (0008,0005). This Attribute shall be included if expanded or replacement character sets may be used in any of the Attributes in the Response Identifier. It shall not be included otherwise. The C-FIND SCP is not required to return responses in the Specific Character Set requested by the

SCU if that character set is not supported by the SCP. The SCP may return responses with a different Specific Character Set.

- Conditionally, the Attribute Timezone Offset From UTC (0008,0201). This Attribute shall be included if any Attributes of time in the Response Identifier are to be interpreted explicitly in the designated local time zone. It shall not be present otherwise, i.e., it shall not be sent with a zero-length value.

The C-FIND SCP is required to support either or both the Retrieve AE Title Data Element or the Storage Media File-Set ID/Storage Media File Set UID Data Elements. An Identifier in a C-FIND response shall contain:

- Storage Media File-Set ID (0088,0130) which defines a user or implementation specific human readable Identifier that identifies the Storage Media on which the composite object instance(s) reside. This element pertains to the set of composite object instances available at the Query/Retrieve Level specified in the Identifier of the C-FIND request (e.g. Patient, Study, Series, Composite object instance). This Attribute shall be present if the Retrieve AE Title Data Element is not present. A null value (Data Element length of 0) is valid for all levels except the lowest level in the Information Model as defined by the SOP Class.

- Storage Media File-Set UID (0088,0140) which uniquely identifies the Storage Media on which the composite object instance(s) reside. This element pertains to the set of composite object instances available at the Query/Retrieve Level specified in the Identifier of the C-FIND request (e.g. Patient, Study, Series, Composite object instance). This Attribute shall be present if the Retrieve AE Title Data Element is not present. A null value (Data Element length of 0) is valid for all levels except the lowest level in the Information Model as defined by the SOP Class.

Note: The File-Set concepts are used in PS 3.10.

- Retrieve AE Title (0008,0054) which defines a list of DICOM Application Entity Title(s) that identify the location from which the composite object instance(s) may be retrieved on the network. This element pertains to the set of composite object instances available at the Query/Retrieve Level specified in the Identifier of the C-FIND request (e.g. Patient, Study, Series, Composite object instance). This Attribute shall be present if the Storage Media File-Set ID and Storage Media File-Set UID elements are not present. The Application Entity named in this field shall support either the C-GET or C-MOVE SOP Class of the Query/Retrieve Service Class. A null value (Data Element length of 0) is valid for all levels except the lowest level in the Information Model as defined by the SOP Class.

Notes: 1. For example, a DICOM AE with the AE Title of "A" performs a C-FIND request to a DICOM AE with the AE Title of "B" with the Query/Retrieve level set to "STUDY". DICOM AE "B" determines that the composite object instances for each matching study may be retrieved by itself and sets the Data Element Retrieve AE Title to "B".

2. File-Sets may not be defined at every Query/Retrieve Level. If the SCP supports the File-Set ID/File-Set UID option but does not define these Attributes at the Query/Retrieve Level specified in the C-FIND request it may return these Data Elements with a length of 0 to signify that the value is unknown. An SCU should reissue a C-FIND at a Query/Retrieve Level lower in the hierarchy.

3. The fact that the value of the Key Attribute is unknown to the SCP of the Query/Retrieve Service Class does not imply that it is not present in the underlying Information Object. Thus, a subsequent retrieval may cause a Storage of a SOP Instance which contains the value of the Attribute.

The C-FIND SCP may also, but is not required to, support the Instance Availability (0008,0056) Data Element. This Data Element shall not be included in a C-FIND request. An Identifier in a C-FIND response may contain:

- Instance Availability (0008,0056) which defines how rapidly composite object instance(s); become available for transmission after a C-MOVE or C-GET retrieval request. This element pertains to the set of composite object instances available at the Query/Retrieve Level specified in the Identifier of the C-FIND request (e.g. Patient,

Study, Series, Composite object instance). When some composite instances are less rapidly available than others, the availability of the least rapidly available shall be returned. If this Data Element is not returned, the availability is unknown or unspecified. A null value (Data Element length of 0) is not permitted. The Enumerated Values for this Data Element are:

- “ONLINE” which means the instances are immediately available,
- “NEARLINE” which means the instances need to be retrieved from relatively slow media such as optical disk or tape, **or require conversion that takes time**
- “OFFLINE” which means the instances need to be retrieved by manual intervention,
- “UNAVAILABLE”, which means the instances cannot be retrieved. Note that SOP Instances that are unavailable may have an alternate representation that is available (see section C.6.1.1.5.1).

C.4.1.1.4 Status

Table C.4-1 defines the specific status code values which might be returned in a C-FIND response. General status code values and fields related to status code values are defined in PS 3.7.

**Table C.4-1
C-FIND RESPONSE STATUS VALUES**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Refused: Out of Resources	A700	(0000,0902)
	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	Cxxx	(0000,0901) (0000,0902)
Cancel	Matching terminated due to Cancel request	FE00	None
Success	Matching is complete – No final Identifier is supplied.	0000	None
Pending	Matches are continuing – Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	FF00	Identifier
	Matches are continuing – Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier.	FF01	Identifier

C.4.1.2 C-FIND SCU Behavior

This Section discusses both the baseline and extended behavior of the C-FIND SCU.

C.4.1.2.1 Baseline Behavior of SCU

All C-FIND SCUs shall be capable of generating query requests which meet the requirements of the Hierarchical Search.

The Identifier contained in a C-FIND request shall contain a single value in the Unique Key Attribute for each level above the Query/Retrieve level. No Required or Optional Keys shall be specified which are associated with levels above the Query/Retrieve level.

The Unique Key Attribute associated with the Query/Retrieve level shall be contained in the C-FIND request and may specify Single Value Matching, Universal Value Matching, or List of UID Matching. In addition, Required and Optional Keys associated with the Query/Retrieve level may be contained in the Identifier.

An SCU conveys the following semantics using the C-FIND request:

- 5 — The SCU requests that the SCP perform a match of all keys specified in the Identifier of the request against the information it possesses down to the Query/Retrieve level specified in the request.

- 10 Notes: 1. The SCU may not assume the SCP supports any Optional Keys. Hence, Optional Keys serve only to reduce network related overhead when they are supported by the SCP.
 2. The SCU must be prepared to filter C-FIND responses when the SCP fails to support an Optional Key specified in the C-FIND request.

- 15 — The SCU shall interpret Pending responses to convey the Attributes of a match of an Entity at the level of the query.
- The SCU shall interpret a response with a status equal to Success, Failed or Refused to convey the end of Pending responses.
- The SCU shall interpret a Refused or Failed response to a C-FIND request as an indication that the SCP is unable to process the request.
- 20 — The SCU may cancel the C-FIND service by issuing a C-FIND-CANCEL request at any time during the processing of the C-FIND. The SCU shall recognize a status of Canceled to indicate that the C-FIND-CANCEL was successful.

C.4.1.2.2 **Extended Behavior of SCU**

25 Extended SCU behavior shall be negotiated at Association establishment time. If an option within the extended behavior is not agreed upon in the negotiation, then only baseline SCU behavior shall be performed with respect to that option. Extended SCU behavior includes all baseline behavior with the following options:

- Relational-queries
- 30 — **Enhanced Multi-Frame Image Conversion**

More than one option may be agreed upon.

C.4.1.2.2.1 **Relational-Queries**

35 The C-FIND Service with relational-queries allows any combination of keys at any level in the hierarchy. The Unique Key Attribute associated with the Query/Retrieve level shall be contained in the C-FIND request and may specify Single Value Matching, Universal Value Matching, or List of UID Matching. Support for relational-queries removes the baseline restriction that a Unique Key shall be specified for all levels above the Query/Retrieve level in the C-FIND request.

C.4.1.2.2.2 **Enhanced Multi-Frame Image Conversion**

40 **The C-FIND Service with Enhanced Multi-Frame Image Conversion allows for selection of the default or an alternative view of the instances represented by the Information Model.**

Support for Enhanced Multi-Frame Image Conversion allows the SCU to specify the Query/Retrieve View (0008,0053) in the Request Identifier with a value of either “CLASSIC” or “ENHANCED”.

45 **If Query/Retrieve View (0008,0053) is not present in the Request Identifier, then the SCU requests that the SCP perform a match of all keys specified in the Identifier of the request against the information about the instances that it possesses, as received.**

If Query/Retrieve View (0008,0053) is present with a value of “CLASSIC”, then the SCU requests that the SCP perform a match of all keys specified in the Identifier of the request against the information about Classic single frame Instances (converted from Enhanced multi-frame Instances

if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.

If Query/Retrieve View (0008,0053) is present with a value of "ENHANCED", then the SCU requests that the SCP perform a match of all keys specified in the Identifier of the request against the information about Enhanced multi-frame Instances (converted from Classic single frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.

Notes: 1. The SCU may assume that no duplicate information will be returned. For example, if an entire series of single frame instances can be converted to a separate series of converted instances, a STUDY level C-FIND will not return both series.

2. The Query Information Model is unchanged, and the same unique, required and optional keys are equally applicable to both views, except that the values for the SERIES and IMAGE level queries will be different and will depend on the converted instance content.

3. Unconverted instances, such as for other modalities like Ultrasound, will appear identical regardless of view.

4. Implementations may apply performance optimizations, such as pre-computing or caching the potential information against which CLASSIC and ENHANCED queries may be performed, in order to minimize significant delays between the query request and response caused by converting "on demand", but SCUs may need to consider the potential for a delayed response when configuring timeouts, etc.

C.4.1.3 C-FIND SCP Behavior

This Section discusses both the baseline and extended behavior of the C-FIND SCP.

C.4.1.3.1 Baseline behavior of SCP

All C-FIND SCPs shall be capable of processing queries which meet the requirements of the Hierarchical Search.

An SCP conveys the following semantics with a C-FIND response:

- The SCP is requested to perform a match of all the keys specified in the Identifier of the request, against the information it possesses, to the level specified in the request. Attribute matching is performed using the key values specified in the Identifier of the C-FIND request as defined in Section C.2.
 - The SCP generates a C-FIND response for each match using the Hierarchical Search method. All such responses shall contain an Identifier whose Attributes contain values from a single match. All such responses shall contain a status of Pending.
 - When all matches have been sent, the SCP generates a C-FIND response which contains a status of Success. A status of Success shall indicate that a response has been sent for each match known to the SCP.
- Note: When there are no matches, then no responses with a status of Pending are sent, only a single response with a status of Success.
- The SCP shall generate a response with a status of Refused or Failed if it is unable to process the request. A Refused or Failed response shall contain no Identifier.
 - If the SCP receives C-FIND-CANCEL indication before it has completed the processing of the matches it shall interrupt the matching process and return a status of Canceled.
 - If the SCP manages images in multiple alternate encodings (see C.6.1.1.5.1), only one of the alternate encodings of an image shall be included in the set of matches for a C-FIND request at the Instance level.

Note: For query of images with alternate encodings, the SCP may select the appropriately encoded Instance for the request response based on identity of the SCU or other factors.

C.4.1.3.1.1 Hierarchical Search Method

Starting at the top level in the Query/Retrieve Information Model, continuing until the level specified in the C-FIND request is reached, the following procedures are used to generate matches:

- 5 a) If the current level is the level specified in the C-FIND request, then the key match strings contained in the Identifier of the C-FIND request are matched against the values of the Key Attributes for each entity at the current level. For each entity for which the Attributes match all of the specified match strings, construct an Identifier. This Identifier shall contain all of the Unique Keys at higher levels and all of the values of the Attributes for this entity which match those in the C-FIND request. Return a response for each such Identifier. If there are no matching keys, then there are no matches, return a response with a status equal to Success and with no Identifier.
- 10 b) Otherwise, if the current level is not the level specified in the C-FIND request and there is an entity matching the Unique Key Attribute value for this level specified in the C-FIND request, perform this procedure at the next level down in the hierarchy.
- 15 c) Otherwise there are no matches; return a response with a status equal to Success.

Note: The above description specifies a recursive procedure. It may recur upon itself multiple times as it goes down the hierarchical levels, but at each level it recurs only once.

C.4.1.3.2 Extended Behavior of SCP

20 Extended SCP behavior shall be negotiated at Association establishment time. If an option within the extended behavior is not agreed upon in the negotiation, then only baseline SCP behavior shall be performed with respect to that option. Extended SCP behavior includes all baseline behavior with the following options:

- Relational-queries
- 25 — **Enhanced Multi-Frame Image Conversion**

More than one option may be agreed upon.

C.4.1.3.2.1 Relational-Queries

30 The C-FIND Service with relational-queries allows any combination of keys at any level in the hierarchy. At the lowest level, a query using the relational-queries shall contain the Unique Key for that level with either a single value match, a wild card match, or a universal match. Support for relational-queries removes the baseline restriction that a Unique Key shall be specified for all levels above the Query/Retrieve level in the C-FIND request.

35 The C-FIND SCP shall perform matching based on all keys specified in the C-FIND request regardless of the Query/Retrieve level.

C.4.1.3.2.2 Relational Search Method

A query using the relational method may contain any combination of keys at any level in the hierarchy. Starting at the top level in the Query/Retrieve Information Model, continuing until the Query/Retrieve level specified in the C-FIND request is reached, the following procedures are used to generate matches:

- 40 a) The key match strings contained in the Identifier of the C-FIND request are matched against the values of the Key Attributes for each entity at the current level.
- b) If no Key Attribute is specified at the current level and the current level is not the level specified in the C-FIND request, the match shall be performed as if a wild card were specified for the Unique Key Attribute for the current level (i.e. all entities at the current level shall match).
- 45 c) If the current level is the level specified in the C-FIND request, then for each matching entity (a matching entity is one for which the Attributes match all of the specified match strings in the Key Attributes), construct an Identifier. This Identifier shall contain all of the Attributes generated by this procedure at higher levels on this recursion path and all of the values of the Key Attributes for this entity which match those in the C-FIND request.
- 50 d) Otherwise, if the current level is not the level specified in the C-FIND request, then for each matching entity construct a list of Attributes containing all of the matching Key Attributes and all

Attributes which were prepared at the previous level for this entity. Then perform this procedure at the next level down in the hierarchy for each matching entity.

- e) Otherwise, if there are no matches, return a response with status equal to Success and no Identifier.

Notes: 1. The above description specifies a recursive procedure. It may recur upon itself multiple times as it goes down the hierarchical levels, and at each level, it may recur multiple times (one for each matching entity). This may result in a large number of Identifiers being generated.
2. It is not required that the above defined procedure be used to generate matches. It is expected that implementations will incorporate different algorithms for performing searches of the databases. For a given query, the set of matches shall be equivalent to that which would be generated by the above procedure.

C.4.1.3.2.3 Enhanced Multi-Frame Image Conversion

If Query/Retrieve View (0008,0053) is not present in the Request Identifier, then the SCP shall perform a match of all keys specified in the Identifier of the request against the information about the instances that it possesses, as received.

If Query/Retrieve View (0008,0053) is present with a value of "CLASSIC", then the SCP shall perform a match of all keys specified in the Identifier of the request against the information about Classic single frame Instances (converted from Enhanced multi-frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.

If Query/Retrieve View (0008,0053) is present with a value of "ENHANCED", then the SCP shall perform a match of all keys specified in the Identifier of the request against the information about Enhanced multi-frame Instances (converted from Classic single frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.

Notes: 1. The SCP will not return information that is duplicated. For example, if an entire series of single frame instances can be converted to a separate series of converted instances, a STUDY level C-FIND will not return both series.
2. The Query Information Model is unchanged, and the same unique, required and optional keys are equally applicable to both views, except that the values for the SERIES and IMAGE level queries will be different and will depend on the converted instance content.
3. Unconverted instances, such as for other modalities like Ultrasound, will appear identical regardless of view.

C.4.2 C-MOVE Operation

SCUs of some SOP Classes of the Query/Retrieve Service Class may generate retrievals using the C-MOVE operation as described in PS 3.7. The C-MOVE operation allows an application entity to instruct another application entity to transfer stored SOP Instances to another application entity using the C-STORE operation. Support for the C-MOVE service shall be agreed upon at Association establishment time by both the SCU and SCP of the C-MOVE in order for a C-MOVE operation to occur over the Association. The C-STORE sub-operations shall always be accomplished over an Association different from the Association which accomplishes the C-MOVE operation. Hence, the SCP of the Query/Retrieve Service Class serves as the SCU of the Storage Service Class.

Note: The application entity which receives the stored SOP Instances may or may not be the originator of the C-MOVE operation.

A C-MOVE request may be performed to any level of the Query/Retrieve Information Model. However, the transfer of stored SOP Instances may not be performed at this level. The level at which the transfer is performed depends upon the SOP Class (See Section C.6).

C.4.2.1 C-MOVE Service Parameters

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C.4.2.1.4 Identifier

The C-MOVE request shall contain an Identifier. The C-MOVE response shall conditionally contain an Identifier as required in C.4.2.1.4.2.

5 Note: The Identifier is specified as U in the definition of the C-MOVE primitive in PS 3.7 but is specialized for use with this service.

C.4.2.1.4.1 Request Identifier Structure

An Identifier in a C-MOVE request shall contain:

- the Query/Retrieve Level (0008,0052) which defines the level of the retrieval
- 10 — Unique Key Attributes which may include Patient ID (0010,0020), Study Instance UIDs (0020,000D), Series Instance UIDs (0020,000E), and the SOP Instance UIDs (0008,0018)
- 15 — **Conditionally, the Attribute Query/Retrieve View (0008,0053). This Attribute may be included if Enhanced Multi-Frame Image Conversion has been accepted during Association Extended Negotiation. It shall not be included otherwise.**

Specific Character Set (0008,0005) shall be present if Patient ID (0010,0020) is using a character set other than the default character repertoire.

20 The Unique Keys at each level of the hierarchy and the values allowable for the level of the retrieval shall be defined in the SOP Class definition for the Query/Retrieve Information Model.

Note: In the **Baseline non-Relational** behavior, more than one entity may be retrieved if the Query/Retrieve Level is IMAGE, SERIES or STUDY, using List of UID matching, but only Single Value Matching value may be specified for Patient ID (0010,0020).

25 **C.4.2.1.4.2 Response Identifier Structure**

The Failed SOP Instance UID List (0008,0058) specifies a list of UIDs of the C-STORE sub-operation SOP Instances for which this C-MOVE operation has failed. An Identifier in a C-MOVE response shall conditionally contain the Failed SOP Instance UID List (0008,0058) based on the C-MOVE response status value. If no C-STORE sub-operation failed, Failed SOP Instance UID List (0008,0058) is absent and therefore no Data Set shall be sent in the C-MOVE response.

30 Specific Character Set (0008,0005) shall not be present.

The Identifier in a C-MOVE response with a status of:

- Canceled, Failure, Refused, or Warning shall contain the Failed SOP Instance UID List Attribute
- 35 — Pending shall not contain the Failed SOP Instance UID List Attribute (no Data Set)

C.4.2.1.5 Status

Table C.4-2 defines the specific status code values which might be returned in a C-MOVE response. General status code values and fields related to status code values are defined in PS 3.7.

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**Table C.4-2
C-MOVE RESPONSE STATUS VALUES**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Refused: Out of Resources – Unable to calculate number of matches	A701	(0000,0902)
	Refused: Out of Resources – Unable to perform sub-operations	A702	(0000,1021) (0000,1022)

			(0000,1023)
	Refused: Move Destination unknown	A801	(0000,0902)
	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to Process	Cxxx	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete – One or more Failures	B000	(0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete – No Failures	0000	(0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

C.4.2.1.6 Number of Remaining Sub-Operations

Inclusion of the Number of Remaining Sub-operations is conditional based upon the status in the C-MOVE response. The Number of Remaining Sub-operations specifies the number of Remaining C-STORE sub-operations necessary to complete the C-MOVE operation.

A C-MOVE response with a status of:

- Pending shall contain the Number of Remaining Sub-operations Attribute
- Canceled may contain the Number of Remaining Sub-operations Attribute
- Warning, Failure, or Success shall not contain the Number of Remaining Sub-operations Attribute

C.4.2.1.7 Number of Completed Sub-Operations

Inclusion of the Number of Completed Sub-operations is conditional based upon the status in the C-MOVE response. The Number of Completed sub-operations specifies the number of C-STORE sub-operations generated by the requested transfer which have completed successfully.

A C-MOVE response with a status of:

- Pending shall contain the Number of Completed Sub-operations Attribute
- Canceled, Warning, Failure, or Success may contain the Number of Completed Sub-operations Attribute

C.4.2.1.8 Number of Failed Sub-Operations

Inclusion of the Number of Failed Sub-operations is conditional based upon the status in the C-MOVE response. The Number of Failed sub-operations specifies the number of C-STORE sub-operations generated by the requested transfer which have Failed.

A C-MOVE response with a status of:

- Pending shall contain the Number of Failed Sub-operations Attribute

- Canceled, Warning, Failure, or Success may contain the Number of Failed Sub-operations Attribute

C.4.2.1.9 Number of Warning Sub-Operations

5 Inclusion of the Number of Warning Sub-operations is conditional based upon the status in the C-MOVE response. The Number of Warning sub-operations specifies the number of C-STORE sub-operations generated by the requested transfer which had a status of warning.

A C-MOVE response with a status of:

- Pending shall contain the Number of Warnings Sub-operations Attribute
- 10 — Canceled, Warning, Failure, or Success may contain the Number of Warning Sub-operations Attribute

C.4.2.2 C-MOVE SCU Behavior

This Section discusses both the baseline and extended behavior of the C-MOVE SCU.

C.4.2.2.1 Baseline Behavior of SCU

15 An SCU conveys the following semantics with a C-MOVE request:

- The SCU shall supply a single value in the Unique Key Attribute for each level above the Query/Retrieve level. For the level of retrieve, the SCU shall supply a single value for one unique key if the level of retrieve is above the STUDY level and shall supply one 20 UID, or a list of UIDs if a retrieval of several items is desired and the retrieve level is STUDY, SERIES or IMAGE. The SCU shall also supply a move destination. The move destination shall be the DICOM Application Entity Title of a DICOM Application Entity capable of serving as the SCP of the Storage Service Class.
- The SCU shall interpret responses to the C-MOVE with status equal to Pending during the processing of the C-STORE sub-operations. These responses shall indicate the 25 number of Remaining, Completed, Failed, and Warning C-STORE sub-operations.
- The SCU shall interpret responses with a status equal to Success, Warning, Failure, or Refused as final responses. The final response shall indicate the number of 30 Successful C-STORE sub-operations and the number of Failed C-STORE sub-operations resulting from the C-MOVE operation. The SCU shall interpret a status of:
 - o Success to indicate that all sub-operations were successfully completed
 - o Warning to indicate one or more sub-operations were successfully completed 35 and one or more sub-operations were unsuccessful or had a status of warning, or all sub-operations had a status of warning
 - o Failure or Refused to indicate all sub-operations were unsuccessful.
- The SCU may cancel the C-MOVE service by issuing a C-MOVE-CANCEL request at any time during the processing of the C-MOVE. The SCU shall interpret a C-MOVE 40 response with a status of Canceled to indicate the transfer was canceled. The C-MOVE response with a status of Canceled shall contain the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations which were not initiated due to the C-MOVE-CANCEL request.

C.4.2.2.2 Extended Behavior of SCU

45 Extended SCU behavior shall be negotiated at Association establishment time. If an option within the extended behavior is not agreed upon in the negotiation, then only baseline SCU behavior shall be performed with respect to that option. Extended SCU behavior includes all baseline behavior with the following options:

- 50 — Relational-retrieve

— Enhanced Multi-Frame Image Conversion

More than one option may be agreed upon.

C.4.2.2.2.1 Relational-Retrieve

5 The C-MOVE Service with relational-retrieve removes the restriction that the SCU supply Unique Key values for levels above the Query/Retrieve level to identify an entity at the level of the retrieval. Hence, the Identifier of a C-MOVE request may transfer:

- all composite object instances related to a study by only providing a Study Instance UID (0020,000D)
- 10 — all composite object instances related to a series by only providing a Series Instance UID (0020,000E)
- individual composite object instances by only providing a list of SOP Instance UIDs (0008,0018)

15 **C.4.2.2.2.2 Enhanced Multi-Frame Image Conversion**

The C-MOVE Service with Enhanced Multi-Frame Image Conversion allows for selection of the default or an alternative view of the instances represented by the Information Model, and hence the retrieval of either the legacy or the converted images, together with any unconverted instances, all of which are required to be processed to maintain referential integrity within the scope of the Patient.

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Support for Enhanced Multi-Frame Image Conversion allows the SCU to specify the Attribute Query/Retrieve View (0008,0053) in the Request Identifier with a value of either “CLASSIC” or “ENHANCED”.

25 **If Query/Retrieve View (0008,0053) is not present in the Request Identifier, then the SCU requests that the SCP provide all the requested instances it possesses, as received.**

If Query/Retrieve View (0008,0053) is present with a value of “CLASSIC”, then the SCU requests that the SCP provide all the Classic single frame Instances (converted from Enhanced multi-frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.

30 **If Query/Retrieve View (0008,0053) is present with a value of “ENHANCED”, then the SCU requests that the SCP provide all the Enhanced multi-frame Instances (converted from Classic single frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.**

- 35 **Notes:**
- 1. The SCU may assume that no duplicate information will be provided. For example, if an entire series of single frame instances can be converted to a separate series of converted instances, a STUDY level C-MOVE will not provide both series.**
 - 2. The Query Information Model is unchanged, and the same unique keys are equally applicable to both views, except that the values for the SERIES and IMAGE level queries will be different and will depend on the converted instance content.**
 - 3. The Query/Retrieve View is still required in an IMAGE or SERIES level request identifier, even though the requested unique key(s) are unambiguous, and the view is in a sense “redundant”, because the conversion that created the requested instances may not have been executed yet. It is not permitted to specify a view that is inconsistent with the requested unique key(s).**
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45 **C.4.2.3 C-MOVE SCP Behavior**

This section discusses both the baseline and extended behavior of the C-MOVE SCP.

C.4.2.3.1 Baseline Behavior of SCP

An SCP conveys the following semantics with a C-MOVE response:

- The SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-MOVE request. The SCP shall initiate C-STORE sub-operations for the corresponding storage SOP Instances. These C-STORE sub-operations shall occur on a different Association (that may already exist) from the C-MOVE operation. The SCP of the Query/Retrieve Service Class shall serve as an SCU of the Storage Service Class.
- The SCP shall either reuse an established and compatible Association or establish a new Association for the C-STORE sub-operations. The SCP shall initiate C-STORE sub-operations over that Association for all stored SOP Instances related to the Patient ID, List of Study Instance UIDs, List of Series Instance UIDs, or List of SOP Instance UIDs depending on the Query/Retrieve level specified in the C-MOVE request. A sub-operation is considered Failed if the SCP is unable to negotiate an appropriate presentation context for a given stored SOP Instance.
- Optionally, the SCP may generate responses to the C-MOVE with status equal to Pending during the processing of the C-STORE sub-operations. These responses shall indicate the Remaining, Completed, Failed, and Warning C-STORE sub-operations.
- When the number of Remaining sub-operations reaches zero, the SCP shall generate a final response with a status equal to Success, Warning, Failure, or Refused. This response shall indicate the number of Completed sub-operations, the number of Failed sub-operations, and the number of sub-operations with Warning Status. The status contained in the C-MOVE response shall contain:
 - Success if all sub-operations were successfully completed
 - Warning if one or more sub-operations were successfully completed and one or more sub-operations were unsuccessful or had a warning status
 - Warning if all sub-operations had a warning status
 - Failure or Refused if all sub-operations were unsuccessful
- The SCP may receive a C-MOVE-CANCEL request at any time during the processing of the C-MOVE. The SCP shall interrupt all C-STORE sub-operation processing and return a status of Canceled in the C-MOVE response. The C-MOVE response with a status of Canceled shall contain the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations which were not initiated due to the C-MOVE-CANCEL request.
- If the SCP manages images in multiple alternate encodings (see C.6.1.1.5.1), only one of the alternate encodings of an image shall be included in the set of object instances retrieved by a C-MOVE request at the Patient, Study, or Series level.

- Notes:
1. For retrieval of images with alternate encodings using a C-MOVE request at the Patient, Study, or Series level, the SCP may select the appropriately encoded Instance for the retrieval based on identity of the SCU, transfer syntaxes accepted in the C-STORE Association Negotiation, or other factors.
 2. If the association on which the C-MOVE operation was issued is abnormally terminated, then it will not be possible to issue any further pending responses nor a final response, nor will C-MOVE-CANCEL requests be received. The behavior of the C-MOVE SCP acting as a C-STORE SCU is undefined in this condition. Specifically, whether or not any uncompleted C-STORE sub-operations continue is undefined.

C.4.2.3.2 Extended Behavior of SCP

Extended SCP behavior shall be negotiated at Association establishment time. If an option within the extended behavior is not agreed upon in the negotiation, then only baseline SCP behavior shall be performed with respect to that option. Extended SCP behavior includes all baseline behavior with the following options:

- Relational-retrieve
- **Enhanced Multi-Frame Image Conversion**

More than one option may be agreed upon.

C.4.2.3.2.1 Relational-Retrieve

The C-MOVE Service with relational-retrieve removes the restriction that the SCU supply Unique Key values for levels above the Query/Retrieve level to help identify an entity at the level of the retrieval. Hence, the Identifier of a C-MOVE request may specify the transfer of:

- 5 — all composite object instances related to a study by only providing a Study Instance UID (0020,000D)
- all composite object instances related to a series by only providing a Series Instance UID (0020,000E)
- 10 — individual composite object instances by only providing a list of SOP Instance UIDs (0008,0018)

C.4.2.3.2.2 Enhanced Multi-Frame Image Conversion

15 **If Query/Retrieve View (0008,0053) is not present in the Request Identifier, then the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-MOVE request that correspond to the instances it possesses, as received, and shall initiate C-STORE sub-operations for all the corresponding storage SOP Instances.**

20 **If Query/Retrieve View (0008,0053) is present with a value of “CLASSIC”, then the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-MOVE request that correspond to the Classic single frame Instances (converted from Enhanced multi-frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted, and shall initiate C-STORE sub-operations for all the corresponding storage SOP Instances.**

25 **If Query/Retrieve View (0008,0053) is present with a value of “ENHANCED”, then the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-MOVE request that correspond to the Enhanced multi-frame Instances (converted from Classic single frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted, and shall initiate C-STORE sub-operations for all the corresponding storage SOP Instances.**

- 30 **Notes:**
1. The SCP will not send information that is duplicated to the C-STORE SCP. For example, if an entire series of single frame instances can be converted to a separate series of converted instances, a STUDY level C-MOVE will not send both series.
 2. The C-STORE SCP will need to support the necessary SOP Classes for converted instances, otherwise the C-STORE sub-operations will fail in the normal manner and this will be reflected in the C-MOVE responses.
 - 35 3. The Query Information Model is unchanged, and the same unique, required and optional keys are equally applicable to both views, except that the values for the SERIES and IMAGE level queries will be different and will depend on the converted instance content.
 - 40 4. The Query/Retrieve View is still required in an IMAGE or SERIES level request identifier, even though the requested unique key(s) are unambiguous.

C.4.3 C-GET Operation

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C.4.3.1 C-GET Service Parameters

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45 C.4.3.1.3 Identifier

The C-GET request shall contain an Identifier. The C-GET response shall conditionally contain an Identifier as required in C.4.3.1.3.2.

Note: The Identifier is specified as U in the definition of the C-GET primitive in PS 3.7 but is specialized for use with this service.

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C.4.3.1.3.1 Request Identifier Structure

An Identifier in a C-GET request shall contain:

- the Query/Retrieve Level (0008,0052) which defines the level of the retrieval
- Unique Key Attributes which may include Patient ID (0010,0020), Study Instance UIDs (0020,000D) Series Instance UIDs (0020,000E), and SOP Instance UIDs (0008,0018)
- **Conditionally, the Attribute Query/Retrieve View (0008,0053). This Attribute may be included if Enhanced Multi-Frame Image Conversion has been accepted during Association Extended Negotiation. It shall not be included otherwise.**

Specific Character Set (0008,0005) shall be present if Patient ID (0010,0020) is using a character set other than the default character repertoire.

The Unique Keys at each level of the hierarchy and the values allowable for the level of the retrieval shall be defined in the SOP Class definition for the Query/Retrieve Information Model.

Note: In the ~~Baseline non-Relational~~ behavior, more than one entity may be retrieved if the Query/Retrieve Level is IMAGE, SERIES or STUDY, using List of UID matching, but only Single Value Matching value may be specified for Patient ID (0010,0020).

C.4.3.1.3.2 Response Identifier Structure

The Failed SOP Instance UID List (0008,0058) specifies a list of UIDs of the C-STORE sub-operation SOP Instances for which this C-GET operation has failed. An Identifier in a C-GET response shall conditionally contain the Failed SOP Instance UID List (0008,0058) based on the C-GET response. If no C-STORE sub-operation failed, Failed SOP Instance UID List (0008,0058) is absent and therefore no Data Set shall be sent in the C-GET response.

Specific Character Set (0008,0005) shall not be present.

The Identifier in a C-GET response with a status of:

- Canceled, Failure, Refused, or Warning shall contain the Failed SOP Instance UID List Attribute
- Pending shall not contain the Failed SOP Instance UID List Attribute (no Data Set)

C.4.3.1.4 Status

Table C.4-3 defines the specific status code values which might be returned in a C-GET response. General status code values and fields related to status code values are defined in PS 3.7.

**Table C.4-3
C-GET RESPONSE STATUS VALUES**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Refused: Out of Resources – Unable to calculate number of matches	A701	(0000,0902)
	Refused: Out of Resources – Unable to perform sub-operations	A702	(0000,1021) (0000,1022) (0000,1023)
	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	Cxxx	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022)

			(0000,1023)
Warning	Sub-operations Complete – One or more Failures or Warnings	B000	(0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete – No Failures or Warnings	0000	(0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

C.4.3.1.5 Number of Remaining Sub-Operations

Inclusion of the Number of Remaining Sub-operations is conditional based upon the status in the C-GET response. The Number of Remaining Sub-operations specifies the number of Remaining C-STORE sub-operations necessary to complete the C-GET operation.

A C-GET response with a status of:

- Pending shall contain the Number of Remaining Sub-operations Attribute
- Canceled may contain the Number of Remaining Sub-operations Attribute
- Warning, Failure, or Success shall not contain the Number of Remaining Sub-operations Attribute.

C.4.3.1.6 Number of Completed Sub-Operations

Inclusion of the Number of Completed Sub-operations is conditional based upon the status in the C-GET response. The Number of Completed Sub-operations specifies the number of C-STORE sub-operations generated by the requested transfer which have completed successfully.

A C-GET response with a status of:

- Pending shall contain the Number of Completed Sub-operations Attribute
- Canceled, Warning, Failure, or Success may contain the Number of Completed Sub-operations Attribute

C.4.3.1.7 Number of Failed Sub-Operations

Inclusion of the Number of Failed Sub-operations is conditional based upon the status in the C-GET response. The Number of Failed Sub-operations specifies the number of C-STORE sub-operations generated by the requested transfer which have Failed.

A C-GET response with a status of:

- Pending shall contain the Number of Failed Sub-operations Attribute
- Canceled, Warning, Failure, or Success may contain the Number of Failed Sub-operations Attribute

C.4.3.1.8 Number of Warning Sub-Operations

Inclusion of the Number of Warning Sub-operations is conditional based upon the status in the C-GET response. The Number of Warning Sub-operations specifies the number of C-STORE sub-operations generated by the requested transfer which had a status of Warning.

A C-GET response with a status of:

- Pending shall contain the Number of Warning Sub-operations Attribute

- Canceled, Warning, Failure, or Success may contain the Number of Warning Sub-operations Attribute

C.4.3.2 C-GET SCU Behavior

5 This Section discusses both the baseline and extended behavior of the C-GET SCU.

C.4.3.2.1 Baseline Behavior of SCU

An SCU conveys the following semantics with a C-GET request:

- 10 — The SCU shall have proposed sufficient presentation contexts at Association establishment time to accommodate expected C-STORE sub-operations which shall occur over the same Association. The SCU of the Query/Retrieve Service Class shall serve as the SCP of the Storage Service Class.
- 15 — The SCU shall supply a single value in the Unique Key Attribute for each level above the Query/Retrieve level. For the level of retrieve, the SCU shall supply a single value for one unique key if the level of the retrieve is above the STUDY level and shall supply one UID, or a list of UIDs if a retrieval of several items is desired and the retrieve level is STUDY, SERIES or IMAGE.
- 20 — The SCU shall interpret C-GET responses with status equal to Pending during the processing of the C-STORE sub-operations. These responses shall indicate the number of Remaining, Completed, Failed, Warning C-STORE sub-operations.
- 25 — The SCU shall interpret a C-GET response with a status equal to Success, Warning, Failure, or Refused as a final response. The final response shall indicate the number of Completed sub-operations and the number of Failed C-STORE sub-operations resulting from the C-GET operation. The SCU shall interpret a status of:
 - o Success to indicate that all sub-operations were successfully completed
 - o Warning to indicate one or more sub-operations were successfully completed and one or more unsuccessful or all sub-operations had a status of warning
 - o Failure or Refused to indicate all sub-operations were unsuccessful
- 30 — The SCU may cancel the C-GET operation by issuing a C-GET-CANCEL request at any time during the processing of the C-GET request. A C-GET response with a status of Canceled shall indicate to the SCU that the retrieve was canceled. Optionally, the C-GET response with a status of Canceled shall indicate the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations which were not initiated due to the C-GET-CANCEL request.

C.4.3.2.2 Extended Behavior of SCU

40 Extended SCU behavior shall be negotiated at Association establishment time. If an option within the extended behavior is not agreed upon in the negotiation, then only baseline SCU behavior shall be supported with respect to that option. Extended SCU behavior includes all baseline behavior with the following options:

- Relational-retrieve
- **Enhanced Multi-Frame Image Conversion**

More than one option may be agreed upon.

45 C.4.3.2.2.1 Relational-Retrieve

The C-GET Service with relational-retrieve removes the restriction that the SCU supply Unique Key values for levels above the Query/Retrieve level to help identify an entity at the level of the retrieval. Hence, the Identifier of a C-GET request may retrieve:

- 50 — all composite object instances related to a study by providing a Study Instance UID (0020,000D)

- all composite object instances related to a series by providing a Series Instance UID (0020,000E)
- individual composite object instances by providing a list of SOP Instance UIDs (0008,0018)

5

C.4.3.2.2.2 Enhanced Multi-Frame Image Conversion

The C-GET Service with Enhanced Multi-Frame Image Conversion allows for selection of the default or an alternative view of the instances represented by the Information Model, and hence the retrieval of either the legacy or the converted images, together with any unconverted instances, all of which are required to be processed to maintain referential integrity within the scope of the Patient.

10

Support for Enhanced Multi-Frame Image Conversion allows the SCU to specify the Attribute Query/Retrieve View (0008,0053) in the Request Identifier with a value of either “CLASSIC” or “ENHANCED”.

15

If Query/Retrieve View (0008,0053) is not present in the Request Identifier, then the SCU requests that the SCP retrieve all the requested instances it possesses, as received.

20

If Query/Retrieve View (0008,0053) is present with a value of “CLASSIC”, then the SCU requests that the SCP retrieve all the Classic single frame Instances (converted from Enhanced multi-frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.

25

If Query/Retrieve View (0008,0053) is present with a value of “ENHANCED”, then the SCU requests that the SCP retrieve all the Enhanced multi-frame Instances (converted from Classic single frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted.

30

- Notes:**
- 1. The C-GET SCU acting as a C-STORE SCP may assume that no duplicate information will be provided. For example, if an entire series of single frame instances can be converted to a separate series of converted instances, a STUDY level C-GET will not return both series.**
 - 2. The C-GET SCU acting as a C-STORE SCP will need to support the necessary SOP Classes for converted instances, otherwise the C-STORE sub-operations will fail in the normal manner and this will be reflected in the C-GET responses.**
 - 3. The Query Information Model is unchanged, and the same unique, required and optional keys are equally applicable to both views, except that the values for the SERIES and IMAGE level queries will be different and will depend on the converted instance content.**
 - 4. The Query/Retrieve View is still required in an IMAGE or SERIES level request identifier, even though the requested unique key (s) are unambiguous, and the view is in a sense “redundant”, because the conversion that created the requested instances may not have been executed yet. It is not permitted to specify a view that is inconsistent with the requested unique key(s).**

35

C.4.3.3 C-GET SCP Behavior

40

This Section discusses both the baseline and extended behavior of the C-GET SCP.

C.4.3.3.1 Baseline Behavior of SCP

An SCP conveys the following semantics with a C-GET response:

45

- The SCP shall identify a set of Entities at the level of the retrieval based upon the values in the Unique Keys in the Identifier of the C-GET request. The SCP shall initiate C-STORE sub-operations for the corresponding storage SOP Instances. The SCP of the Query/Retrieve Service Class shall serve as an SCU of the Storage Service Class.
- The SCP shall initiate C-STORE sub-operations over the same Association for all stored SOP Instances related to the Patient ID, List of Study Instance UIDs, List of Series Instance UIDs, or List of SOP Instance UIDs depending on the Query/Retrieve level specified in the C-GET request

50

- A sub-operation is considered Failed if the SCP is unable to initiate a C-STORE sub-operation because the Query/Retrieve SCU did not offer an appropriate presentation context for a given stored SOP Instance.
- 5 — Optionally, the SCP may generate responses to the C-GET with status equal to Pending during the processing of the C-STORE sub-operations. These responses shall indicate the number of Remaining, Completed, Failure, and Warning C-STORE sub-operations.
- 10 — When the number of Remaining sub-operations reaches zero, the SCP shall generate a final response with a status equal to Success, Warning, Failed, or Refused. The status contained in the C-GET response shall contain:
 - o Success if all sub-operations were successfully completed
 - o Warning if one or more sub-operations were successfully completed and one or more sub-operations were unsuccessful or had a status of warning
 - 15 o Warning if all sub-operations had a status of Warning
 - o Failure or Refused if all sub-operations were unsuccessful
- 20 — The SCP may receive a C-GET-CANCEL request at any time during the processing of the C-GET request. The SCP shall interrupt all C-STORE sub-operation processing and return a status of Canceled in the C-GET response. The C-GET response with a status of Canceled shall contain the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations which were not initiated due to the C-GET-CANCEL request.
- 25 — If the SCP manages images in multiple alternate encodings (see C.6.1.1.5.1), only one of the alternate encodings of an image shall be included in the set of object instances retrieved by a C-GET request at the Patient, Study, or Series level.

Note: For retrieval of images with alternate encodings using a C-GET request at the Patient, Study, or Series level, the SCP may select the appropriately encoded Instance for the retrieval based on identity of the SCU, transfer syntaxes accepted in the C-STORE Association Negotiation, or other factors.

30 **C.4.3.3.2 Extended Behavior of SCP**

Extended SCP behavior shall be negotiated at Association establishment time. If an option within the extended behavior is not agreed upon in the negotiation, then only baseline SCP behavior shall be performed with respect to that option. Extended SCP behavior includes all baseline behavior with the following options:

- Relational-retrieve
- **Enhanced Multi-Frame Image Conversion**

More than one option may be agreed upon.

40 **C.4.3.3.2.1 Relational-Retrieve**

The C-GET Service with relational-retrieve removes the restriction that the SCU supply Unique Key values for levels above the Query/Retrieve level to help identify an entity at the level of the retrieval. Hence, the Identifier of a C-GET request may retrieve:

- all composite object instances related to a study by providing a Study Instance UID
- 45 — all composite object instances related to a series by providing a Series Instance UID
- individual composite object instances by providing a list of SOP Instance UIDs

C.4.3.3.2.2 Enhanced Multi-Frame Image Conversion

50 **If Query/Retrieve View (0008,0053) is not present in the Request Identifier, then the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in**

the Identifier of the C-GET request that correspond to the instances it possesses, as received, and shall initiate C-STORE sub-operations for all the corresponding storage SOP Instances.

5 If Query/Retrieve View (0008,0053) is present with a value of “CLASSIC”, then the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-GET request that correspond to the Classic single frame Instances (converted from Enhanced multi-frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted, and shall initiate C-STORE sub-operations for all the corresponding storage SOP Instances.

10 If Query/Retrieve View (0008,0053) is present with a value of “ENHANCED”, then the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-GET request that correspond to the Enhanced multi-frame Instances (converted from Classic single frame Instances if required), as well as any instances that were converted to preserve referential integrity, and any that did not need to be converted, and shall initiate C-STORE sub-operations for all the corresponding storage SOP Instances.

15 Notes: 1. The C-GET SCP acting as a C-STORE SCU will not send information that is duplicated to the C-GET SCU acting as a C-STORE SCP. For example, if an entire series of single frame instances can be converted to a separate series of converted instances, a STUDY level C-GET will not send both series.

20 2. The Query Information Model is unchanged, and the same unique, required and optional keys are equally applicable to both views, except that the values for the SERIES and IMAGE level queries will be different and will depend on the converted instance content.

3. The Query/Retrieve View is still required in an IMAGE or SERIES level request identifier, even though the requested unique key(s) are unambiguous.

25 C.5 ASSOCIATION NEGOTIATION

Association establishment is the first phase of any instance of communication between peer DICOM AEs. AEs supporting DICOM Query/Retrieve SOP Classes utilize Association establishment negotiation by defining the use of Application Association Information. See PS 3.7 for an overview of Association negotiation.

30 SOP Classes of the Query/Retrieve Service Class, which include query services based on the C-FIND operation, may use SOP Class Extended Negotiation Sub-Item to negotiate options such as Relational-queries **and Enhanced Multi-Frame Image Conversion**.

35 SOP Classes of the Query/Retrieve Service Class, which include retrieval services based on the C-MOVE and C-GET operations, may use the SOP Class Extended Negotiation Sub-Item to negotiate relational-retrieval **and Enhanced Multi-Frame Image Conversion**.

SOP Classes of the Query/Retrieve Service Class, which include retrieval services based on the C-GET operation, use the SCP/SCU Role Selection Sub-Item to identify the SOP Classes which may be used for retrieval.

40 C.5.1 Association Negotiation for C-FIND SOP Classes

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C.5.1.1 SOP Class Extended Negotiation

45 The SOP Class Extended Negotiation allows, at Association establishment, peer DICOM AEs to exchange application Association information defined by specific SOP Classes. This is achieved by defining the Service-class-application-information field. The Service-class-application-information field is used to define support for relational-queries, combined date time matching, **and** fuzzy semantic matching of person names **and Enhanced Multi-Frame Image Conversion**.

This negotiation is optional. If absent, the default conditions shall be:

- no relational-query support

- separate (independent) range matching of date and time attributes
- literal matching of person names with case sensitivity unspecified
- **no Enhanced Multi-Frame Image Conversion support**

5 The Association-requester, for each SOP Class, may use one SOP Class Extended Negotiation Sub-Item. The SOP Class is identified by the corresponding Abstract Syntax Name (as defined by PS 3.7) followed by the Service-class-application-information field. This field defines **either a single one or more** sub-fields:

— **relational-query support by the Association-requester**

10 **or three sub-fields:**

- relational-query support by the Association-requester
- combined date and time range matching by the Association-requester
- literal or fuzzy semantic matching of person names by the Association-requester
- **Enhanced Multi-Frame Image Conversion support by the Association-requester**

15 The Association-acceptor shall return a single byte field (single sub-field) if offered a single byte field (single sub-field) by the Association-requester. The Association-acceptor may return either a single byte field (single sub-field) or a **three multiple** byte field (~~three sub-fields~~) if offered a **three multiple** byte field (~~three sub-fields~~) by the Association-requester. A one byte response to a **three multiple** byte request means that the missing sub-fields shall be treated as 0 values.

Note: The restriction to return only a single byte field if that was all that was offered is because the original DICOM standard only contained one byte and older systems may not be expecting more.

25 The Association-acceptor, for each sub-field of the SOP Class Extended Negotiation Sub-Item offered, either accepts the Association-requester proposal by returning the same value (1) or turns down the proposal by returning the value (0)

If the SOP Class Extended Negotiation Sub-Item is not returned by the Association-acceptor then relational-queries are not supported over the Association (default condition).

30 If the SOP Class Extended Negotiation Sub-Items do not exist in the A-ASSOCIATE indication they shall be omitted in the A-ASSOCIATE response.

C.5.1.1.1 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-RQ)

35 The SOP Class Extended Negotiation Sub-Item consists of a sequence of mandatory fields as defined by PS 3.7. Table C.5-1 defines the Service-class-application-information field for DICOM Query/Retrieve SOP Classes and Specialized DICOM Query/Retrieve SOP Classes which include the C-FIND operation. This field may be either one or **more three** bytes in length (i.e., item bytes 2, **and 3, 4 and 5** are optional).

Table C.5-1 – SOP CLASS EXTENDED NEGOTIATION SUB-ITEM (service-class-application-information field) – A-ASSOCIATE-RQ

Item Bytes	Field Name	Description of Field
1	Relational-queries	This byte field defines relational-query support by the Association-requester. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – relational queries not supported 1 – relational queries supported

2	Date-time matching	This byte field defines whether or not combined date and time attribute range matching is requested by the Association-requester. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – combined matching not requested 1 – combined matching requested
3	Fuzzy semantic matching of person names	This byte field defines whether or not fuzzy semantic person name attribute matching is requested by the Association-requester. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – fuzzy semantic matching not requested 1 – fuzzy semantic matching requested
4	Timezone query adjustment	This byte field defines whether or not the Attribute Timezone Offset From UTC (0008,0201) shall be used to adjust the query meaning for time and datetime fields in queries. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 - Timezone query adjustment not requested 1 – Timezone query adjustment requested
5	Enhanced Multi-Frame Image Conversion	This byte field defines whether or not the Attribute Query/Retrieve View (0008,0053) shall be used to adjust the view returned in queries to consider conversion to or from Enhanced Multi-Frame Images. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – Query/Retrieve View not supported 1 – Query/Retrieve View supported

C.5.1.1.2 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-AC)

5 The SOP Class Extended Negotiation Sub-Item is made of a sequence of mandatory fields as defined by PS 3.7. Table C.5-2 defines the Service-class-application-information field for DICOM Query/Retrieve SOP Classes and Specialized DICOM Query/Retrieve SOP Classes which include the C-FIND operation. This field may be either one or **more three** bytes in length (i.e., item bytes 2, **and** 3, **4 and** 5 are optional).

Table C.5-2—SOP CLASS EXTENDED NEGOTIATION SUB-ITEM (service-class-application-information field)—A-ASSOCIATE-AC

Item Bytes	Field Name	Description of Field
1	Relational-queries	This byte field defines relational-query support for the Association-acceptor. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – relational-queries not supported 1 – relational-queries supported

2	Date-time matching	This byte field defines whether or not combined date and time attribute range matching will be performed by the Association-acceptor. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – combined matching not performed 1 – combined matching performed
3	Fuzzy semantic matching of person names	This byte field defines whether or not fuzzy semantic person name attribute matching will be performed by the Association-acceptor. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – fuzzy semantic matching not performed 1 – fuzzy semantic matching performed
4	Timezone query adjustment	This byte field defines whether or not the Attribute Timezone Offset From UTC (0008,0201) shall be used to adjust the query meaning for time and datetime fields in queries. <u>It shall be encoded as an unsigned binary integer and shall use one of the following values</u> 0 – Timezone adjustment of queries not performed 1 – Timezone adjustment of queries performed
<u>5</u>	<u>Enhanced Multi-Frame Image Conversion</u>	<u>This byte field defines whether or not the Attribute Query/Retrieve View (0008,0053) shall be used to adjust the view returned in queries to consider conversion to or from Enhanced Multi-Frame Images. It shall be encoded as an unsigned binary integer and shall use one of the following values</u> <u>0 – Query/Retrieve View not supported</u> <u>1 – Query/Retrieve View supported</u>

C.5.2 Association Negotiation for C-MOVE SOP Classes

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C.5.2.1 SOP Class Extended Negotiation

- 5 The SOP Class Extended Negotiation allows, at Association establishment, peer DICOM AEs to exchange application Association information defined by specific SOP Classes. This is achieved by defining the Service-class-application-information field. The Service-class-application-information field is used to define support for relational-retrievals.

This negotiation is optional. If absent, the default condition shall be:

- 10
- no relational-retrieval support
 - **no Enhanced Multi-Frame Image Conversion support**

- 15 The Association-requester, for each SOP Class, may use one SOP Class Extended Negotiation Sub-Item. The SOP Class is identified by the corresponding Abstract Syntax Name (as defined by PS 3.7) followed by the Service-class-application-information field. This field defines:

- relational-retrieval support by the Association-requester
- **Enhanced Multi-Frame Image Conversion support by the Association-requester**

The Association-acceptor shall return a single byte field (single sub-field) if offered a single byte field (single sub-field) by the Association-requester. The Association-acceptor may return either a single byte field (single sub-field) or a multiple byte field if offered a multiple byte field by the Association-requester. A one byte response to a multiple byte request means that the missing sub-fields shall be treated as 0 values.

Note: The restriction to return only a single byte field if that was all that was offered is because the original DICOM standard only contained one byte and older systems may not be expecting more.

The Association-acceptor, for each SOP Class Extended Negotiation Sub-Item offered, either accepts the Association-requester proposal by returning the same value (1) or turns down the proposal by returning the value (0).

If the SOP Class Extended Negotiation Sub-Item is not returned by the Association-acceptor then relational-retrievals **and Enhanced Multi-Frame Image Conversion** are not supported (default condition)

If the SOP Class Extended Negotiation Sub-Items do not exist in the A-ASSOCIATE indication they shall be omitted in the A-ASSOCIATE response.

C.5.2.1.1 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-RQ)

The SOP Class Extended Negotiation Sub-Item consists of a sequence of mandatory fields as defined by PS 3.7. Table C.5-3 defines the Service-class-application-information field for DICOM Query/Retrieve SOP Classes and Specialized DICOM Query/Retrieve SOP Classes which include the C-MOVE and C-GET operations.

Table C.5-3—SOP CLASS EXTENDED NEGOTIATION SUB-ITEM (service-class-application-information field)—A-ASSOCIATE-RQ

Item Bytes	Field Name	Description of Field
1	Relational-retrieval	This byte field defines relational-retrieval support by the Association-requester. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – relational-retrieval not supported 1 – relational-retrieval supported
2	Enhanced Multi-Frame Image Conversion	This byte field defines whether or not the Attribute Query/Retrieve View (0008,0053) shall be used to adjust the view returned in queries to consider conversion to or from Enhanced Multi-Frame Images. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – Query/Retrieve View not supported 1 – Query/Retrieve View supported

C.5.2.1.2 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-AC)

The SOP Class Extended Negotiation Sub-Item consists of a sequence of mandatory fields as defined by PS 3.7. Table C.5-4 defines the Service-class-application-information field for DICOM Query/Retrieve SOP Classes and Specialized DICOM Query/Retrieve SOP Classes which include the C-MOVE and C-GET operations.

Table C.5-4—SOP CLASS EXTENDED NEGOTIATION SUB-ITEM (service-class-application-information field)—A-ASSOCIATE-AC

Item Bytes	Field Name	Description of Field
1	Relational-retrieval	This byte field defines relational-retrieval support for the Association-acceptor. It shall be encoded as an

		unsigned binary integer and shall use one of the following values 0 – relational-retrievals not supported 1 – relational-retrievals supported
<u>2</u>	<u>Enhanced Multi-Frame Image Conversion</u>	<u>This byte field defines whether or not the Attribute Query/Retrieve View (0008,0053) shall be used to adjust the view returned in queries to consider conversion to or from Enhanced Multi-Frame Images. It shall be encoded as an unsigned binary integer and shall use one of the following values</u> <u>0 – Query/Retrieve View not supported</u> <u>1 – Query/Retrieve View supported</u>

C.5.3 Association Negotiation for C-GET SOP Classes

...

C.5.3.1 SOP Class Extended Negotiation

- 5 The SOP Class Extended Negotiation allows, at Association establishment, peer DICOM AEs to exchange application Association information defined by specific SOP Classes.

This is achieved by defining the Service-class-application-information field. The Service-class-application-information field is used to define support for relational-retrievals **and alternative views for Enhanced Multi-Frame Image Conversion.**

10 ...

Extended negotiation for SOP Classes based on the retrieval services which include C-GET operations is identical to the negotiation defined for C-MOVE which is defined in Section C.5.2.1 of this Annex.

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PS 3.4: Add behavior to Instance and Frame Level Retrieve SOP Classes:
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Y.1 OVERVIEW

Y.1.1 Scope

Composite Instance Root Retrieve Service is a service within the DICOM Query/Retrieve Service class defined in Annex C. The retrieve capability of this service allows a DICOM AE to retrieve Composite Instances or selected frames from a remote DICOM AE over a single Association or request the remote DICOM AE to initiate a transfer of Composite Object Instances or selected frames from image objects to another DICOM AE.

The Enhanced Multi-Frame Image Conversion Extended Negotiation Option of the DICOM Query/Retrieve Service class defined in Annex C is also supported for the Composite Instance Root Retrieve Service.

Y.1.2 Composite Instance Root Retrieve Information Model

Retrievals are implemented against the Composite Instance Root Retrieve Information Model, as defined in this Annex of the DICOM Standard. A specific SOP Class of the Query/Retrieve Service Class consists of an Information Model Definition and a DIMSE-C Service Group.

Y.1.3 Service Definition

Two peer DICOM AEs implement a SOP Class of the Composite Instance Root Retrieve Service with one serving in the SCU role and one serving in the SCP role. SOP Classes of the Composite Instance Root Retrieve Service are implemented using the DIMSE-C C-MOVE and C-GET services as defined in PS 3.7.

The following descriptions of the DIMSE-C C-GET and C-MOVE services provide a brief overview of the SCU/SCP semantics:

a) A C-MOVE service conveys the following semantics:

- The SCU supplies Unique and Frame Range Key values to identify the requested SOP Instance(s). The SCP creates new SOP instances if necessary and then initiates C-STORE sub-operations for the corresponding storage SOP Instances. These C-STORE sub-operations occur on a different Association than the C-MOVE service. The SCP role of the Retrieve SOP Class and the SCU role of the Storage SOP Class may be performed by different applications that may or may not reside on the same system. Initiation mechanism of C-STORE sub-operations is outside of the scope of DICOM standard.
- The SCP may optionally generate responses to the C-MOVE with status equal to Pending during the processing of the C-STORE sub-operations. These C-MOVE responses indicate the number of Remaining C-STORE sub-operations and the number of C-STORE sub-operations returning the status of Success, Warning, and Failed.
- When the number of Remaining C-STORE sub-operations reaches zero, the SCP generates a final response with a status equal to Success, Warning, Failed, or Refused. This response shall indicate the number of C-STORE sub-operations returning the status of Success, Warning, and Failed. If any of the sub-operations was successful then a Successful UID list shall be returned. If the status of a C-STORE sub-operation was Failed a UID List shall be returned.
- The SCU may cancel the C-MOVE service by issuing a C-MOVE-CANCEL request at any time during the processing of the C-MOVE. The SCP terminates all incomplete C-STORE sub-operations and returns a status of Canceled.

b) A C-GET service conveys the following semantics:

- The SCU supplies Unique and Frame Range Key values to identify the requested SOP Instance(s). The SCP creates new SOP instances if necessary and then generates C-STORE sub-operations for the corresponding storage SOP Instances. These C-STORE sub-operations

occur on the same Association as the C-GET service and the SCU/SCP roles are reversed for the C-STORE.

- The SCP may optionally generate responses to the C-GET with status equal to Pending during the processing of the C-STORE sub-operations. These C-GET responses indicate the number of remaining C-STORE sub-operations and the number of C-STORE sub-operations returning the status of Success, Warning, and Failed.
- When the number of Remaining C-STORE sub-operations reaches zero, the SCP generates a final response with a status equal to Success, Warning, Failed, or Refused. This response shall indicate the number of C-STORE sub-operations returning the status of Success, Warning, and Failed. If the status of any C-STORE sub-operation was Failed a UID List shall be returned.
- The SCU may cancel the C-GET service by issuing a C-GET-CANCEL request at any time during the processing of the C-GET. The SCP terminates all incomplete C-STORE sub-operations and returns a status of Canceled.

Y.2 COMPOSITE INSTANCE ROOT RETRIEVE INFORMATION MODEL DEFINITION

The Composite Instance Root Retrieve Information Model is identified by the SOP Class negotiated at Association establishment time. The SOP Class is composed of both an Information Model and a DIMSE-C Service Group.

Note: This SOP Class identifies the class of the Composite Instance Root Retrieve Information Model (i.e. not the SOP Class of the stored SOP Instances for which the SCP has information)

Information Model Definitions for standard SOP Classes of the Composite Instance Root Retrieve Service are defined in this Annex. A Composite Instance Root Retrieve Information Model Definition contains:

- Entity-Relationship Model Definition
- Key Attributes Definition

Y.2.1 Entity-Relationship Model Definition

For any Composite Instance Root Retrieve Information Model, an Entity-Relationship Model defines a hierarchy of entities, with Attributes defined for each level in the hierarchy (e.g. Composite Instance, Frame).

Y.2.2 Attributes Definition

Attributes and matching shall be as defined in section C.2.2

Y.3 STANDARD COMPOSITE INSTANCE ROOT RETRIEVE INFORMATION MODEL

One standard Composite Instance Root Retrieve Information Model is defined in this Annex. The Composite Instance Root Retrieve Information Model is associated with a number of SOP Classes. The following hierarchical Composite Instance Root Retrieve Information Model is defined:

- Composite Instance Root

Y.3.1 Composite Instance Root Information Model

The Composite Instance Root Information Model is based upon a two level hierarchy:

- Composite Instance
- Frame

...

Y.3.3 New Object Instance Creation at the FRAME level

When a **C-MOVE** or C-GET operation is performed on a source Composite Instance at the FRAME level then the SCP shall create a new Composite Instance according to the following rules:

- The new Composite Instance shall be extracted from the source Composite Instance specified by the SOP Instance UID Unique Key present at the Composite Instance Level.
- The new Composite Instance shall be an instance of the same SOP Class as the source Composite Instance.
- 5 ▪ The new Composite Instance shall have a new SOP Instance UID.
- The new Composite Instance shall be a valid SOP Instance.

Note: The new Composite Instance is required to be internally consistent and valid. This may require the SCP to make consistent modification of any attributes that reference frames or the relationship between them such as start time, time offsets, and modifying the Per-frame Functional Group Sequence (5200,9230).

- 10 ▪ The new Composite Instance shall contain the frames from the source Composite Object as requested in the Requested Frame List. The Requested Frame List shall be interpreted according to the rules in Section Y.3.2. The frames shall be in the same order as in the source Composite Instance.
- 15 ▪ The new Composite Instance shall include the Frame Extraction Module, which shall contain appropriate Attributes from the identifier of the C-GET or C-MOVE request that caused this instance to be created. If the Frame Extraction Module already exists in the source Composite Instance, then a new item shall be appended as an additional item into the Frame Extraction Sequence.
- 20 ▪ The new Composite Instance shall contain the Contributing Equipment Sequence (0018,A001). If the source Composite Object contains the Contributing Equipment Sequence, then a new Item shall be appended to the copy of the sequence in the new Composite Instance, and if the source Composite Object does not contain the Contributing Equipment Sequence, then it shall be created, containing one new Item. In either case, the new Item shall describe the equipment that is
- 25 extracting the frames, and the Purpose of Reference Code Sequence (0040,A170) within the Item shall be (109105, DCM, "Frame Extracting Equipment").

Note: The existing General Equipment module cannot be used to hold details of the creating equipment, as it is a Series level module. The new Composite Instance is part of the same Series as the source Instance, and therefore the Series level information cannot be altered.

- 30 ▪ The new Composite Instance shall have the same Patient, Study and Series level information as the source Instance, including Study and Series Instance UIDs.
- 35 ▪ The new Composite Instance shall have the same values for the Attributes of the Image Pixel Module of the source Composite Instance except that the Pixel Data URL (0028,7FE0) attribute shall not be present, Pixel Data (7FE0,0010) shall be replaced by the subset of frames, as specified in section Y.3.3, and Number of Frames (0028,0008) shall contain the number of frames in the new Composite Instance.
- 40 ▪ The new Composite Instance shall have the same values for other Type 1 and Type 2 Image level attributes that are not otherwise specified. Other attributes may be included in the new Composite Instance if consistent with the new Composite Instance.

Note: In most cases private attributes should not be copied unless their full significance is known. See Annex ZZ in Part 17 for more guidance.

- 45 ▪ The new Composite Instance shall not be contained in a Concatenation. This means that it shall not contain a Concatenation UID (0020,9161) attribute or other Concatenation attributes. If the

existing Composite Instance contains such attributes, they shall not be included in the new Composite Instance.

Y.4 DIMSE-C SERVICE GROUPS

5 A single DIMSE-C Service is used in the construction of SOP Classes of the Composite Instance Root Retrieve Service. The following DIMSE-C operation is used:

- C-MOVE
- C-GET

10 Y.4.1 C-MOVE Operation

SCUs of the Composite Instance Root Retrieve Service shall generate retrievals using the C-MOVE operation as described in PS 3.7. The C-MOVE operation allows an application entity to instruct another application entity to transfer stored SOP Instances or new SOP Instances extracted from such stored SOP Instances to another application entity using the C-STORE operation. Support for the C-MOVE service shall be agreed upon at Association establishment time by both the SCU and SCP of the C-MOVE in order for a C-MOVE operation to occur over the Association. The C-STORE sub-operations shall always be accomplished over an Association different from the Association that accomplishes the CMOVE operation. Hence, the SCP of the Query/Retrieve Service Class serves as the SCU of the Storage Service Class.

20 Note: The application entity that receives the stored SOP Instances may or may not be the originator of the C-MOVE operation.

A C-MOVE request may be performed to any level of the Composite Object Instance Root Retrieve Information Model, and the expected SCP behavior depends on the level selected.

Y.4.1.1 C-MOVE Service Parameters

25 ...

Y.4.1.1.3 Identifier

The C-MOVE request shall contain an Identifier. The C-MOVE response shall conditionally contain an Identifier as required in C.4.3.1.3.2.

30 Note: The Identifier is specified as U in the definition of the C-MOVE primitive in PS 3.7 but is specialized for use with this service.

Y.4.1.1.3.1 Request Identifier Structure

An Identifier in a C-MOVE request shall contain:

- the Query/Retrieve Level (0008,0052) that defines the level of the retrieval
- SOP Instance UID(s) (0008,0018)
- One of the Frame Range Keys if present in the Information Model for the level of the Retrieval
- **Conditionally, the Attribute Query/Retrieve View (0008,0053). This Attribute may be included if Enhanced Multi-Frame Image Conversion has accepted during Association Extended Negotiation. It shall not be included otherwise.**

40 Specific Character Set (0008,0005) shall not be present.

The Keys at each level of the hierarchy and the values allowable for the level of the retrieval shall be defined in the SOP Class definition for the Query/Retrieve Information Model.

Y.4.1.1.4 Status

The status code values that might be returned in a C-MOVE response shall be as specified in Table Y.4-1

**Table Y.4-1
C-MOVE RESPONSE STATUS VALUES FOR INSTANCE ROOT RETRIEVE**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Refused: Out of Resources – Unable to calculate number of matches	A701	(0000,0902)
	Refused: Out of Resources – Unable to perform sub-operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
	Refused: Move Destination unknown	A801	(0000,0902)
	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	Cxxx	(0000,0901) (0000,0902)
	None of the frames requested were found in the SOP Instance	AA00	(0000,0902)
	Unable to create new object for this SOP class	AA01	(0000,0902)
	Unable to extract frames	AA02	(0000,0902)
	Time-based request received for a non-time-based original SOP Instance.	AA03	(0000,0902)
	Invalid Request	AA04	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete – One or more Failures or Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete – No Failures or Warnings	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

Y.4.1.1.5 Number of Remaining Sub-Operations

5 Inclusion of the Number of Remaining Sub-operations shall be as specified in C.4.2.1.6

Y.4.1.1.6 Number of Completed Sub-Operations

Inclusion of the Number of Completed Sub-operations shall be as specified in C.4.2.1.7

Y.4.1.1.7 Number of Failed Sub-Operations

Inclusion of the Number of Failed Sub-operations shall be as specified in C.4.2.1.8

10 **Y.4.1.1.8 Number of Warning Sub-Operations**

Inclusion of the Number of Warning Sub-operations shall be as specified in C.4.2.1.9.

Y.4.1.2 C-MOVE SCU Behavior

Y.4.1.2.1 Baseline Behavior of SCU

An SCU conveys the following semantics with a C-MOVE request:

- 5 – If the Retrieve Level (0000,0052) is IMAGE, the SCU shall specify one SOP Instance UID or a list of SOP Instance UIDs.
- If the Retrieve Level (0000,0052) is FRAME, the SCU shall specify the single SOP Instance UID of the item from which the new Composite SOP Instance should be extracted and the requested Frame List. The Requested Frame List shall be constructed as defined in Y.3.2.
- 10 – The SCU shall accept C-MOVE responses with status equal to Pending during the processing of the C-STORE sub-operations. These responses indicate the number of Remaining, Completed, Failed and Warning C-STORE sub-operations.
- The SCU shall interpret a C-MOVE response with a status equal to Success, Warning, Failure, or Refused as a final response. The final response indicates the number of Completed sub-operations and the number of Failed C-STORE sub-operations resulting from the C-MOVE operation. The SCU shall interpret a status of:
 - 15 • Success to indicate that all sub-operations were successfully completed
 - Failure or Refused to indicate all sub-operations were unsuccessful
 - 20 • Warning in all other cases. The Number of Completed Sub-Operations (0000,1021), Number of Warning Sub-Operations (0000,1023), Number of Failed Sub-Operations (0000,1022) can be used to obtain more detailed information.
- 25 – The SCU may cancel the C-MOVE operation by issuing a C-MOVE-CANCEL request at any time during the processing of the C-MOVE request. A C-MOVE response with a status of Canceled shall indicate to the SCU that the retrieve was canceled. Optionally, the C-MOVE response with a status of Canceled shall indicate the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations that were not initiated due to the C-MOVE-CANCEL request.

30 Note: For FRAME level C-MOVE operations, the application receiving the C-STORE sub-operations will receive a new SOP Instance with a different SOP Instance UID from the one included in the C-MOVE request. If it is required to link the received instance to the request, then it may be necessary to inspect the Frame Extraction Sequence of the instance received, to compare the original Instance UID and Requested Frame List to those in the request.

35 **Y.4.1.2.2 Extended Behavior of SCU**

The extended behavior of the SCU shall be as specified in C.4.2.2.2, except that Relational-retrieve shall not be supported.

Y.4.1.3 C-MOVE SCP Behavior

Y.4.1.3.1 Baseline Behavior of SCP

40 An SCP conveys the following semantics with a C-MOVE response:

- If the Retrieve Level (0000,0052) is IMAGE the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-MOVE request.
- 45 – If the Retrieve Level (0000,0052) is FRAME, the SCP shall create a new Composite Instance according to the rules in section Y.3.2. The newly created SOP Instance shall be treated in the same manner as the set of Entities identified above.
- The SCP shall either re-use an established and compatible Association or establish a new Association for the C-STORE sub-operations
- The SCP shall initiate C-STORE sub-operations over the Association for the identified or newly created SOP Instances.
- 50 – A sub-operation is considered a Failure if the SCP is required to create new SOP Instance, but is unable to do so due to inconsistencies in the Frame Range Keys, or if the resulting SOP Instance would not be valid.

- Optionally, the SCP may generate responses to the C-MOVE with status equal to Pending during the processing of the C-STORE sub-operations. These responses shall indicate the number of Remaining, Completed, Failure, and Warning C-STORE sub-operations.
- When the number of Remaining sub-operations reaches zero, the SCP shall generate a final response with a status equal to Success, Warning or Failed. The status contained in the C-MOVE response shall contain:
 - Success if all sub-operations were successfully completed
 - Failure if all sub-operations were unsuccessful
 - Warning in all other cases.
- The SCP may receive a C-MOVE-CANCEL request at any time during the processing of the C-MOVE request. The SCP shall interrupt all C-STORE sub-operation processing and return a status of Canceled in the C-MOVE response. The C-MOVE response with a status of Canceled shall contain the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations that were not initiated due to the C-MOVE-CANCEL request.
- If the SCP manages images in multiple alternate encodings (see C.6.1.1.5.1), only one of the alternate encodings of an image shall be used as the existing SOP Instance from which frames are to be extracted.

Y.4.1.3.2 Extended Behavior of SCP

The extended behavior of the SCP shall be as specified in C.4.2.3.2, except that Relational-retrieve shall not be supported.

Y.4.2 C-GET Operation

SCUs of the Composite Instance Root Retrieve Service shall generate retrievals using the C-GET operation as described in PS 3.7. The C-GET operation allows an application entity to instruct another application entity to transfer stored SOP Instances or new SOP Instances derived from such stored SOP Instances to the initiating application entity using the C-STORE operation. Support for the C-GET service shall be agreed upon at Association establishment time by both the SCU and SCP of the C-GET in order for a C-GET operation to occur over the Association. The C-STORE Sub-operations shall be accomplished on the same Association as the C-GET operation. Hence, the SCP of the Query/Retrieve Service Class serves as the SCU of the Storage Service Class.

Note: The Application Entity that receives the stored SOP Instances is always the originator of the C-GET operation.

A C-GET request may be performed to any level of the Composite Instance Root Retrieve Information Model, and the expected SCP behavior depends on the level selected.

Y.4.2.1 C-GET Service Parameters

...

Y.4.2.1.3 Identifier

The C-GET request shall contain an Identifier. The C-GET response shall conditionally contain an Identifier as required in C.4.3.1.3.2.

Note: The Identifier is specified as U in the definition of the C-GET primitive in PS 3.7 but is specialized for use with this service.

Y.4.2.1.3.1 Request Identifier Structure

An Identifier in a C-GET request shall contain:

- the Query/Retrieve Level (0008,0052) that defines the level of the retrieval
- SOP Instance UID(s) (0008,0018)
- One of the Frame Range Keys if present in the Information Model for the level of the Retrieval

- **Conditionally, the Attribute Query/Retrieve View (0008,0053). This Attribute may be included if Enhanced Multi-Frame Image Conversion has accepted during Association Extended Negotiation. It shall not be included otherwise.**

5 Specific Character Set (0008,0005) shall not be present.

The Keys at each level of the hierarchy and the values allowable for the level of the retrieval shall be defined in the SOP Class definition for the Query/Retrieve Information Model.

Y.4.2.1.4 Status

The status code values that might be returned in a C-GET response shall be as specified in Table Y.4-1

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**Table Y.4-1
C-GET RESPONSE STATUS VALUES FOR INSTANCE ROOT RETRIEVE**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Refused: Out of Resources – Unable to calculate number of matches	A701	(0000,0902)
	Refused: Out of Resources – Unable to perform sub-operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	Cxxx	(0000,0901) (0000,0902)
	None of the frames requested were found in the SOP Instance	AA00	(0000,0902)
	Unable to create new object for this SOP class	AA01	(0000,0902)
	Unable to extract frames	AA02	(0000,0902)
	Time-based request received for a non-time-based original SOP Instance.	AA03	(0000,0902)
	Invalid Request	AA04	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete – One or more Failures or Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete – No Failures or Warnings	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

Y.4.2.1.5 Number of Remaining Sub-Operations

Inclusion of the Number of Remaining Sub-operations shall be as specified in C.4.3.1.5

Y.4.2.1.6 Number of Completed Sub-Operations

Inclusion of the Number of Completed Sub-operations shall be as specified in C.4.3.1.6

Y.4.2.1.7 Number of Failed Sub-Operations

Inclusion of the Number of Failed Sub-operations shall be as specified in C.4.3.1.7

5 **Y.4.2.1.8 Number of Warning Sub-Operations**

Inclusion of the Number of Warning Sub-operations shall be as specified in C.4.3.1.8.

Y.4.2.2 C-GET SCU Behavior**Y.4.2.2.1 Baseline Behavior of SCU**

An SCU conveys the following semantics with a C-GET request:

- 10
- If the Retrieve Level (0000,0052) is IMAGE, the SCU shall specify one SOP Instance UID or a list of SOP Instance UIDs.
 - If the Retrieve Level (0000,0052) is FRAME, the SCU shall specify the single SOP Instance UID of the item from which the new Composite SOP Instance should be extracted and the Requested Frame List. The Requested Frame List shall be constructed as a Frame List as defined in Y.3.2.

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 - The SCU shall have proposed sufficient presentation contexts at Association establishment time to accommodate expected C-STORE sub-operations that will occur over the same Association. The SCU of the Query/Retrieve Service Class shall serve as the SCP of the Storage Service Class.

20

 - The SCU shall accept C-GET responses with status equal to Pending during the processing of the C-STORE sub-operations. These responses indicate the number of Remaining, Completed, Failed and Warning C-STORE sub-operations.
 - The SCU shall interpret a C-GET response with a status equal to Success, Warning, Failure, or Refused as a final response. The final response indicates the number of Completed sub-operations and the number of Failed C-STORE sub-operations resulting from the C-GET operation. The SCU shall interpret a status of:

25

 - Success to indicate that all sub-operations were successfully completed
 - Failure or Refused to indicate all sub-operations were unsuccessful

30

 - Warning in all other cases. The Number of Completed Sub-Operations (0000,1021), Number of Warning Sub-Operations (0000,1023), Number of Failed Sub-Operations (0000,1022) can be used to obtain more detailed information. - The SCU may cancel the C-GET operation by issuing a C-GET-CANCEL request at any time during the processing of the C-GET request. A C-GET response with a status of Canceled shall indicate to the SCU that the retrieve was canceled. Optionally, the C-GET response with a status of Canceled shall indicate the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations that were not initiated due to the C-GET-CANCEL request.

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Y.4.2.2.2 Extended Behavior of SCU

40 **The extended behavior of the SCU shall be as specified in C.4.3.2.2, except that Relational-retrieve shall not be supported.**

Y.4.2.3 C-GET SCP Behavior**Y.4.2.3.1 Baseline Behavior of SCP**

An SCP conveys the following semantics with a C-GET response:

- 45
- If the Retrieve Level (0000,0052) is IMAGE the SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-GET request.
 - If the Retrieve Level (0000,0052) is FRAME, the SCP shall create a new Composite Instance according to the rules in section Y.3.3. The newly created SOP Instance shall be treated in the same manner as the set of Entities identified above.

- The SCP shall initiate C-STORE sub-operations for the identified or newly created SOP Instances. The SCP of the Query/Retrieve Service Class shall serve as an SCU of the Storage Service Class.
- The SCP shall initiate C-STORE sub-operations over the same Association for all identified or newly created SOP Instances specified in the C-GET request.
- A sub-operation is considered a Failure if the SCP is required to create new SOP Instance, but is unable to do so due to inconsistencies in the Frame Range Keys, or if the resulting SOP Instance would not be valid.
- A sub-operation is considered a Failure if the SCP is unable to initiate a C-STORE sub-operation because the Query/Retrieve SCU did not offer an appropriate presentation context for a given stored SOP Instance.
- Optionally, the SCP may generate responses to the C-GET with status equal to Pending during the processing of the C-STORE sub-operations. These responses shall indicate the number of Remaining, Completed, Failure, and Warning C-STORE sub-operations.
- When the number of Remaining sub-operations reaches zero, the SCP shall generate a final response with a status equal to Success, Warning or Failed. The status contained in the C-GET response shall contain:
 - Success if all sub-operations were successfully completed
 - Failure if all sub-operations were unsuccessful
 - Warning in all other cases.
- The SCP may receive a C-GET-CANCEL request at any time during the processing of the C-GET request. The SCP shall interrupt all C-STORE sub-operation processing and return a status of Canceled in the C-GET response. The C-GET response with a status of Canceled shall contain the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations that were not initiated due to the C-GET-CANCEL request.
- If the SCP manages images in multiple alternate encodings (see C.6.1.1.5.1), only one of the alternate encodings of an image shall be used as the existing SOP Instance from which frames are to be extracted.

Y.4.2.3.2 Extended Behavior of SCP

The extended behavior of the SCP shall be as specified in C.4.3.3.2, except that Relational-retrieve shall not be supported.

Y.5 ASSOCIATION NEGOTIATION

Association establishment is the first phase of any instance of communication between peer DICOM AEs. AEs supporting DICOM Query/Retrieve SOP Classes utilize Association establishment negotiation by defining the use of Application Association Information. See PS 3.7 for an overview of Association negotiation.

SOP Classes of the Composite Instance Root Retrieve Service, which include retrieval services based on the **C-MOVE and C-GET operations**, use the SCP/SCU Role Selection Sub-Item to identify the SOP Classes that may be used for retrieval.

Y.5.1 Association Negotiation for C-MOVE and C-GET SOP Classes

Rules are as specified in C.5.3, except that the ~~Relational-retrieve~~ extended negotiation sub-item, **if used, shall be used as defined in Y.5.1.1**~~shall not be used for this service class.~~

Notes: 1. Though converted images may be specified by their SOP Instance UID in the Request Identifier, which is always at or below the instance level, there remains a need for extended negotiation and specification of the Query/Retrieve View in order to assure that referential integrity is maintained within the returned SOP Instances (e.g., that a reference to a SOP Instance UID is to a converted image or not, as appropriate).

2. Relational-retrieve is not applicable to these SOP Classes, hence the Extended Negotiation Sub-Item does not include the use of that byte.

Y.5.1.1 SOP Class Extended Negotiation

The SOP Class Extended Negotiation allows, at Association establishment, peer DICOM AEs to exchange application Association information defined by specific SOP Classes. This is achieved by defining the Service-class-application-information field. The Service-class-application-information field is used to define support for Enhanced Multi-Frame Image Conversion.

This negotiation is optional. If absent, the default condition shall be:

- no Enhanced Multi-Frame Image Conversion support

The Association-requester, for each SOP Class, may use one SOP Class Extended Negotiation Sub-Item. The SOP Class is identified by the corresponding Abstract Syntax Name (as defined by PS 3.7) followed by the Service-class-application-information field. This field defines:

- Enhanced Multi-Frame Image Conversion support by the Association-requester

The Association-acceptor, for each SOP Class Extended Negotiation Sub-Item offered, either accepts the Association-requester proposal by returning the same value (1) or turns down the proposal by returning the value (0).

If the SOP Class Extended Negotiation Sub-Item is not returned by the Association-acceptor then Enhanced Multi-Frame Image Conversion is not supported (default condition)

If the SOP Class Extended Negotiation Sub-Items do not exist in the A-ASSOCIATE indication they shall be omitted in the A-ASSOCIATE response.

Y.5.1.1.1 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-RQ)

The SOP Class Extended Negotiation Sub-Item consists of a sequence of mandatory fields as defined by PS 3.7. Table Y.5.1-1 defines the Service-class-application-information field for the C-MOVE and C-GET operations.

Table Y.5.1-1—SOP CLASS EXTENDED NEGOTIATION SUB-ITEM (service-class-application-information field)—A-ASSOCIATE-RQ

Item Bytes	Field Name	Description of Field
1	Unused	Reserved – shall be 0
2	Enhanced Multi-Frame Image Conversion	This byte field defines whether or not the Attribute Query/Retrieve View (0008,0053) shall be used to adjust the view returned in queries to consider conversion to or from Enhanced Multi-Frame Images. It shall be encoded as an unsigned binary integer and shall use one of the following values 0 – Query/Retrieve View not supported 1 – Query/Retrieve View supported

Y.5.1.1.2 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-AC)

The SOP Class Extended Negotiation Sub-Item consists of a sequence of mandatory fields as defined by PS 3.7. Table Y.5.1-2 defines the Service-class-application-information field for the C-MOVE and C-GET operations.

Table Y.5.1-2—SOP CLASS EXTENDED NEGOTIATION SUB-ITEM (service-class-application-information field)—A-ASSOCIATE-AC

Item Bytes	Field Name	Description of Field
1	Unused	Reserved – shall not be tested.

<u>2</u>	<u>Enhanced Multi-Frame Image Conversion</u>	<u>This byte field defines whether or not the Attribute Query/Retrieve View (0008,0053) shall be used to adjust the view returned in queries to consider conversion to or from Enhanced Multi-Frame Images. It shall be encoded as an unsigned binary integer and shall use one of the following values</u> <u>0 – Query/Retrieve View not supported</u> <u>1 – Query/Retrieve View supported</u>
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PS 3.4: Add behavior to Composite Instance Retrieve Without Bulk Data SOP Classes:

Z.1 OVERVIEW

5 Z.1.1 Scope

Composite Instance Retrieve Without Bulk Data Service is a service within the DICOM Query/Retrieve Service class defined in Annex C. The retrieve capability of this service allows a DICOM AE to retrieve Composite Instances without retrieving their pixel data or other potentially large attributes as defined in Section Z.1.3.

10 **The Enhanced Multi-Frame Image Conversion Extended Negotiation Option of the DICOM Query/Retrieve Service class defined in Annex C is also supported for the Composite Instance Root Retrieve Service.**

Z.1.2 Composite Instance Retrieve Without Bulk Data Information Model

...

15 Z.1.4 Service Definition

Two peer DICOM AEs implement a SOP Class of the Composite Instance Retrieve Without Bulk Data Service with one serving in the SCU role and one serving in the SCP role. SOP Classes of the Composite Instance Retrieve Without Bulk Data Service are implemented using the DIMSE-C C-GET service as defined in PS 3.7.

20 The following descriptions of the DIMSE-C C-GET service provide a brief overview of the SCU/SCP semantics:

a) A C-GET service conveys the following semantics:

- 25 – The SCP shall identify a set of Entities at the level of the retrieval based upon the values in the Unique Keys in the Identifier of the C-GET request. The SCP shall then generate C-STORE sub-operations for the corresponding storage SOP Instances, but shall not include attributes as described in Section Z.1.3 in the data sent during those sub-operations. These C-STORE sub-operations occur on the same Association as the C-GET service and the SCU/SCP roles are reversed for the C-STORE.

30 Note: If the source instance does not contain any of the attributes described in Section Z.1.3 then, the version sent via the C-STORE sub-operation would be identical to the original data. This is not an error.

- The SCP may optionally generate responses to the C-GET with status equal to Pending during the processing of the C-STORE sub-operations. These C-GET responses indicate the number of remaining C-STORE sub-operations and the number of C-STORE sub-operations returning the status of Success, Warning, and Failed.
- 35 – When the number of Remaining C-STORE sub-operations reaches zero, the SCP generates a final response with a status equal to Success, Warning, Failed, or Refused. This response shall indicate the number of C-STORE sub-operations returning the status of Success, Warning, and Failed. If the status of any C-STORE sub-operation was Failed a UID List shall be returned.
- 40 – The SCU may cancel the C-GET service by issuing a C-GET-CANCEL request at any time during the processing of the C-GET. The SCP terminates all incomplete C-STORE sub-operations and returns a status of Canceled.

...

45 Z.4 DIMSE-C SERVICE GROUPS

A single DIMSE-C Service is used in the construction of SOP Classes of the Composite Instance Retrieve Without Bulk Data Service. The following DIMSE-C operation is used:

– C-GET

Z.4.1 C-GET Operation

5 SCUs of the Composite Instance Retrieve Without Bulk Data Service shall generate retrievals using the C-GET operation as described in PS 3.7. The C-GET operation allows an application entity to instruct another application entity to transfer SOP Instances without the Attributes as described in Section Z.1.3 to the initiating application entity using the C-STORE operation. Support for the C-GET service shall be agreed upon at Association establishment time by both the SCU and SCP of the C-GET in order for a C-GET operation to occur over the Association. The C-STORE Sub-operations shall be accomplished on 10 the same Association as the C-GET operation. Hence, the SCP of the Query/Retrieve Service Class serves as the SCU of the Storage Service Class.

Note: The Application Entity that receives the stored SOP Instances is always the originator of the C-GET operation.

15 **Z.4.2.1 C-GET Service Parameters**

...

Z.4.2.1.3 Identifier

The C-GET request shall contain an Identifier. The C-GET response shall conditionally contain an Identifier as required in C.4.3.1.3.2.

20 Note: The Identifier is specified as U in the definition of the C-GET primitive in PS 3.7 but is specialized for use with this service.

Z.4.2.1.3.1 Request Identifier Structure

An Identifier in a C-GET request shall contain:

- 25 – the Query/Retrieve Level (0008,0052) that defines the level of the retrieval
- SOP Instance UID(s) (0008,0018)
- **Conditionally, the Attribute Query/Retrieve View (0008,0053). This Attribute may be included if Enhanced Multi-Frame Image Conversion has accepted during Association Extended Negotiation. It shall not be included otherwise.**

30 Query/Retrieve Level (0008,0052) shall be IMAGE.

Specific Character Set (0008,0005) shall not be present.

The Keys at each level of the hierarchy and the values allowable for the level of the retrieval are defined in the SOP Class definition for the Query/Retrieve Information Model.

35 **Z.4.2.1.4 Status**

The status code values that might be returned in a C-GET response shall be as specified in Table Z.4-1

**Table Z.4-1
C-GET RESPONSE STATUS VALUES FOR INSTANCE ROOT RETRIEVE**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Refused: Out of Resources – Unable to calculate number of matches	A701	(0000,0902)
	Refused: Out of Resources – Unable to perform sub-operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)

	Unable to process	Cxxx	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete – One or more Failures or Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete – No Failures or Warnings	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

Z.4.2.1.5 Number of Remaining Sub-Operations

Inclusion of the Number of Remaining Sub-operations shall be as specified in C.4.3.1.5

Z.4.2.1.6 Number of Completed Sub-Operations

5 Inclusion of the Number of Completed Sub-operations shall be as specified in C.4.3.1.6

Z.4.2.1.7 Number of Failed Sub-Operations

Inclusion of the Number of Failed Sub-operations shall be as specified in C.4.3.1.7

Z.4.2.1.8 Number of Warning Sub-Operations

Inclusion of the Number of Warning Sub-operations shall be as specified in C.4.3.1.8.

10 Z.4.2.2 C-GET SCU and C-STORE SCP Behavior

Z.4.2.2.1 Baseline Behavior of SCU

An SCU conveys the following semantics with a C-GET request:

- The SCU shall specify one Instance UID or a list of Instance UIDs.
- The SCU shall have proposed sufficient presentation contexts at Association establishment time to accommodate expected C-STORE sub-operations that will occur over the same Association. The SCU of the Query/Retrieve Service Class shall serve as the SCP of the Storage Service Class.
- The SCP of the Storage Service Class shall not store the incomplete SOP Instance; rather the behavior is implementation defined.
- The SCU shall accept C-GET responses with status equal to Pending during the processing of the C-STORE sub-operations. These responses indicate the number of Remaining, Completed, Failed and Warning C-STORE sub-operations.
- The SCU shall interpret a C-GET response with a status equal to Success, Warning, Failure, or Refused as a final response. The final response indicates the number of Completed sub-operations and the number of Failed C-STORE sub-operations resulting from the C-GET operation. The SCU shall interpret a status of:
 - Success to indicate that all sub-operations were successfully completed
 - Failure or Refused to indicate all sub-operations were unsuccessful

- Warning in all other cases. The Number of Completed Sub-Operations (0000,1021), Number of Warning Sub-Operations (0000,1023), Number of Failed Sub-Operations (0000,1022) can be used to obtain more detailed information.
- The SCU may cancel the C-GET operation by issuing a C-GET-CANCEL request at any time during the processing of the C-GET request. A C-GET response with a status of Canceled shall indicate to the SCU that the retrieve was canceled. Optionally, the C-GET response with a status of Canceled shall indicate the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations that were not initiated due to the C-GET-CANCEL request.
- The SCP of the Storage Service Class shall not return a status of “Error: Dataset does not match SOP Class” (A9xx) or “Warning: Dataset does not match SOP Class” (B007) due to the absence of the Attributes described in Section Z.1.3.

Z.4.2.2.2 Extended Behavior of SCU

The extended behavior of the SCU shall be as specified in C.4.3.2.2, except that Relational-retrieve shall not be supported.

Z.4.2.3 C-GET SCP and C-STORE SCU Behavior

Y.4.2.3.1 Baseline Behavior of SCP

An SCP conveys the following semantics with a C-GET response:

- The SCP shall identify a set of Entities at the level of the transfer based upon the values in the Unique Keys in the Identifier of the C-GET request.
- The SCP shall initiate C-STORE sub-operations for the identified SOP Instances, but shall not include in this C-STORE sub-operation the Attributes described in section Z.1.3. The SCP of the Query/Retrieve Service Class shall serve as an SCU of the Storage Service Class.
- Apart from the Attributes listed in section Z.1.3, the SOP Instance sent via the C-STORE sub-operation shall be unchanged, and no corresponding changes to other attributes shall be made.
Note: In particular, the Study, Series and SOP Instance UIDs and SOP Class UID will not be altered.
- The SCP shall initiate C-STORE sub-operations over the same Association for all SOP Instances specified in the C-GET request.
- A sub-operation is considered a Failure if the SCP is unable to initiate a C-STORE sub-operation because the Query/Retrieve SCU did not offer an appropriate presentation context for a given stored SOP Instance.
- Optionally, the SCP may generate responses to the C-GET with status equal to Pending during the processing of the C-STORE sub-operations. These responses shall indicate the number of Remaining, Completed, Failure, and Warning C-STORE sub-operations.
- When the number of Remaining sub-operations reaches zero, the SCP shall generate a final response with a status equal to Success, Warning or Failed. The status contained in the C-GET response shall contain:
 - Success if all sub-operations were successfully completed
 - Failure if all sub-operations were unsuccessful
 - Warning in all other cases.
- The SCP may receive a C-GET-CANCEL request at any time during the processing of the C-GET request. The SCP shall interrupt all C-STORE sub-operation processing and return a status of Canceled in the C-GET response. The C-GET response with a status of Canceled shall contain the number of Completed, Failed, and Warning C-STORE sub-operations. If present, the Remaining sub-operations count shall contain the number of C-STORE sub-operations that were not initiated due to the C-GET-CANCEL request.
- If the SCP manages images in multiple alternate encodings (see C.6.1.1.5.1), only one of the alternate encodings of an image shall be used as the existing SOP Instance from which frames are to be extracted.

Z.4.2.3.2 Extended Behavior of SCP

The extended behavior of the SCP shall be as specified in C.4.3.3.2, except that Relational-retrieve shall not be supported.

Z.5 ASSOCIATION NEGOTIATION

5 Association establishment is the first phase of any instance of communication between peer DICOM AEs. AEs supporting DICOM Query/Retrieve SOP Classes utilize Association establishment negotiation by defining the use of Application Association Information. See PS 3.7 for an overview of Association negotiation.

10 SOP Classes of the Composite Instance Retrieve Without Bulk Data Service, which include retrieval services based on the C-GET operation, use the SCP/SCU Role Selection Sub-Item to identify the SOP Classes that may be used for retrieval.

Z.5.1 Association Negotiation for C-GET SOP Classes

Rules are as specified in C.5.3, except that the ~~Relational-retrieve~~ extended negotiation sub-item, **if used, shall be used as defined in Y.5.1.1**~~shall not be used for this service class.~~

15 **Notes: 1. Though converted images may be specified by their SOP Instance UID in the Request Identifier, which is always at the instance level, there remains a need for extended negotiation and specification of the Query/Retrieve View in order to assure that referential integrity is maintained within the returned SOP Instances (e.g., that a reference to a SOP Instance UID is to a converted image or not, as appropriate).**

20 **2. Relational-retrieve is not applicable to this SOP Class, hence the Extended Negotiation Sub-Item does not include the use of that byte.**

PS 3.6: Add new Data Elements:

(0008,0053)	<u>Query/Retrieve View</u>	<u>QueryRetrieveView</u>	<u>CS</u>	<u>1</u>
(0020,9170)	<u>Unassigned Shared Converted Attributes Sequence</u>	<u>UnassignedSharedConvertedAttributesSequence</u>	<u>SQ</u>	<u>1</u>
(0020,9171)	<u>Unassigned Per-Frame Converted Attributes Sequence</u>	<u>UnassignedPerFrameConvertedAttributesSequence</u>	<u>SQ</u>	<u>1</u>
(0020,9172)	<u>Conversion Source Attributes Sequence</u>	<u>ConversionSourceAttributesSequence</u>	<u>SQ</u>	<u>1</u>

PS 3.6: Add new SOP Classes:

5

**Table A-1
UID VALUES**

UID Value	UID NAME	UID TYPE	Part
...
<u>1.2.840.10008.5.1.4.1.1.2.2</u>	<u>Legacy Converted Enhanced CT Image Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.1.1.4.4</u>	<u>Legacy Converted Enhanced MR Image Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.1.1.128.1</u>	<u>Legacy Converted Enhanced PET Image Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>

PS 3.16: Add additional codes:

CID 7005 Contributing Equipment Purposes of Reference

**Context ID 7005
Contributing Equipment Purposes of Reference
Type: Extensible Version: 20090120 20130617**

5

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	109101	Acquisition Equipment
DCM	109102	Processing Equipment
DCM	109103	Modifying Equipment
DCM	109104	De-identifying Equipment
DCM	109105	Frame Extracting Equipment
<u>DCM</u>	<u>109106</u>	<u>Enhanced Multi-frame Conversion Equipment</u>
DCM	MEDIM	Portable Media Importer Equipment
DCM	FILMD	Film Digitizer
DCM	DOCD	Document Digitizer Equipment
DCM	VIDD	Video Tape Digitizer Equipment

<u>109106</u>	<u>Enhanced Multi-frame Conversion Equipment</u>	<u>Equipment that has processed composite instances to create new composite instances by converting classic single frame images to enhanced multi-frame image, or vice versa and updating other instances to maintain referential integrity.</u>	
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Annex ZZZA Use-Cases for Conversion of Classic Single Frame Images to Legacy Converted Enhanced Multi-frame Images (INFORMATIVE)

ZZZA.1 INTRODUCTION

5 Traditionally, images from cross-sectional modalities like CT, MR and PET have been stored with one reconstructed slice in a single frame instance. Large studies with a large number of slices potentially pose a problem for many existing implementations, both for efficient transfer from the central store to the user's desktop for viewing or analysis, and for bulk transfer between two stores (e.g., between a PACS and another archive or a regional image repository).

10 There are two primary issues:

1. Transporting large numbers of slices as separate single instances (files) is potentially extremely inefficient due to the overhead associated with each transfer (such as C-STORE acknowledgement and database insertion).
- 15 2. Replicating the Attributes describing the entire patient/study/series/acquisition in every separate single instance is also potentially extremely inefficient, and though the size of the this information is trivial by comparison with the bulk data, the effort to repeatedly parse it and sort out what it means as a whole on the receiving end is not trivial.

The Enhanced family of modality-specific multi-frame IODs is intended to address both these concerns, but there is a large installed base of older equipment that does not yet support these, both on the sending and receiving end, and a large archive of single frame instances.

An interim step, a legacy transition strategy for a mixed environment containing older and newer modalities, PACS and workstations, is described here. It is predicated on the ability to “convert” single frame instances into new “enhanced multi-frame instances”.

ZZZA.2 ENHANCED LEGACY CONVERTED IMAGE STORAGE IODS

25 The Enhanced family of modality-specific multi-frame IODs contain many requirements that cannot be satisfied by the limited information typically available in the older single frame objects. A family of Multi-frame Secondary Capture IODs is available, but their use would mean that a recipient could not depend on the presence of important cross-sectional information like spacing, position and orientation. Accordingly, a new family of modality-specific Legacy Converted Enhanced Image Storage IODs has been defined that bridge the gap in conversion complexity and usability between these two extremes.

ZZZA.3 HETEROGENEOUS ENVIRONMENT

Figure ZZZA-1 illustrates the approach to enabling a heterogeneous environment with conversion from single to multi-frame objects as appropriate. In this figure, modalities that generate single or enhanced images peacefully co-exist with PACS or workstations that support either or both.

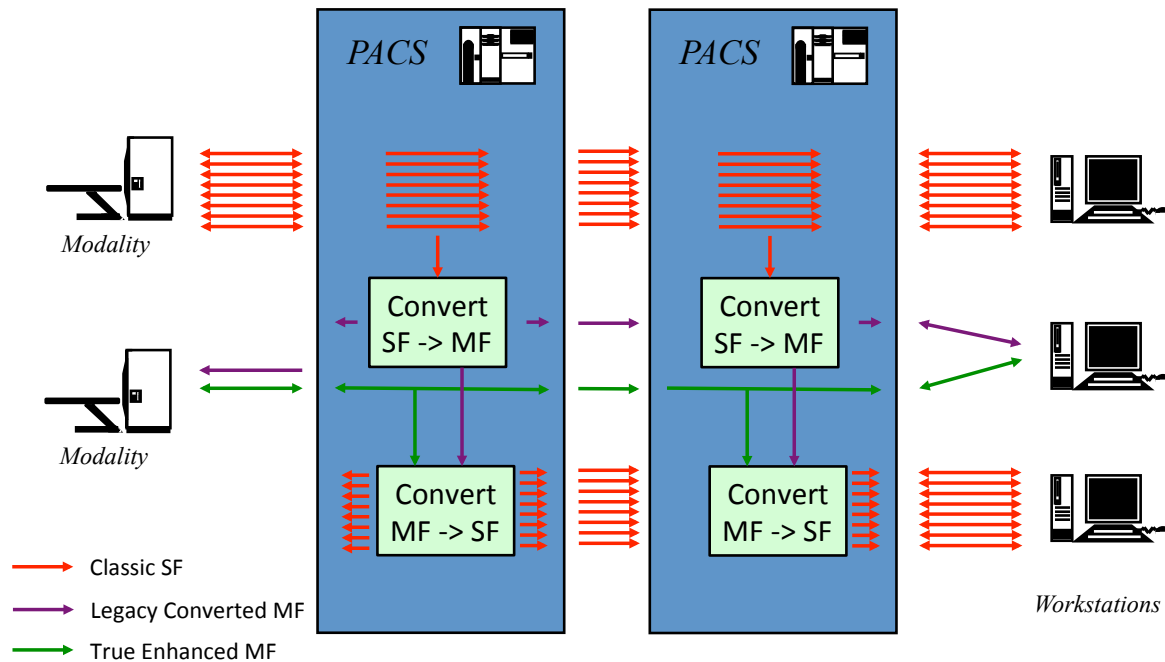


Figure ZZZA-1. Heterogeneous environment with conversion between single and multi-frame objects

The following use-cases are explicitly supported:

- 5 1. A PACS that accepts single frame images, and converts them to multi-frame images for its own internal use
2. A PACS that accepts single frame images, and converts them to multi-frame images for externalization via DICOM services (Query/Retrieval) so that they can be used by external workstations (or other processing applications) that support multi-frame images.
- 10 3. A PACS that accepts multi-frame images from a modality, and converts them to single frame images for its own internal use.
4. A PACS that accepts true and/or legacy converted enhanced multi-frame images, and converts them to single frame images for externalization via DICOM services (Query/Retrieval) so that they can be used by external workstations (or other processing applications) that do not support multi-frame images.
- 15 5. A modality that can create true enhanced multi-frame images, as well as receive true (+/- legacy converted) enhanced multi-frame images.

6. Return of results from workstations in either single frame or true or legacy converted enhanced multi-frame form.

5 The amount of standard information is the same in single frame and transitional legacy-converted multi-frame images, but greater in the true enhanced multi-frame images, and this affects the level of functionality obtainable within the PACS or with an external workstation (without depending on private information).

Since the transitional legacy-converted and true enhanced multi-frame images share a common structure and common functional group macros, this scalability can be implemented incrementally.

10 It is NOT the expectation that modalities will generate Legacy Converted Enhanced Image Storage SOP Instances; rather, they should create True Enhanced Image Storage SOP Instances fully populated with the appropriate standard attributes and codes.

ZZZA.3 COMPATIBILITY WITH MODALITY ASSOCIATION NEGOTIATION

This strategy is compatible with an approach commonly implemented on acquisition modalities when deciding which SOP Class to use to encode images.

15 Normally a modality will propose in the Association that images be transferred using the SOP Class for which the IOD provides the richest set of information (i.e., the True Enhanced Image Storage SOP Class), and will choose the corresponding Abstract Syntax for C-STORE Operations if the Association Acceptor accepts multiple choices of SOP Class.

20 Consider a modality that supports the appropriate modality-specific Enhanced Image Storage SOP Class, but which is faced with the dilemma of a PACS that does not. In this case, it will commonly “fall back” to sending images the “old” way as single-frame SOP Class Instances, either because it has been pre-configured that way by service personnel, or because it discovers this limitation during Association Negotiation. This strategy is also common amongst modalities for which there are different choices of single frame SOP Class (e.g., DX versus CR versus Secondary Capture, for Digital X-Rays). In some cases, this may be implemented formally using the ability during Association Negotiation to specify a Related General SOP Class (see PS 3.4 B.4.2.1 SCU Fall-back Behavior).

30 If the PACS is upgraded to include multi-frame conversion capability, and no change is made in the configuration of the modality, or in the SOP Classes accepted by the PACS, then in this scenario, the PACS can potentially convert the single-frame instances into Legacy Converted Enhanced instances. The net result is continuing sacrifice of information compared to what the modality is actually capable of.

35 A better choice, since the PACS is now capable of handling multi-frame images, is to also reconfigure it to also accept the “true” Enhanced Image rather than just “transitional” Legacy Converted Enhanced Storage SOP Classes. Since the two SOP Class families use the same structure and common important Functional Groups, in all likelihood the PACS will be able to use either class of objects, and in a future upgrade take advantage of the additional information in the superior object (perhaps for more complex processing or annotation or rendering). In any case, storing the modality’s best output in the archive will benefit future re-use as priors and may enable greater functionality in external workstations.

40 A special consideration is when prior images need to be displayed on the modality before starting a new study (perhaps to setup a comparable protocol or better understand the request). In this case, care needs to be taken with respect to which images are accessible to the modality (either pushed to it or retrieved by it), and the question of “round trip fidelity” of conversion arises.

ZZZA.4 QUERY AND RETRIEVAL

The coexistence (either actually or logically) of two different representations of the same information creates a potential challenge in that the user must not be presented with both sets simultaneously.

45 A naïve conversion that added converted images to the study without an ability to distinguish or “filter” them from view would not only be confusing but would potentially result in twice as much data to transfer.

Accordingly, the Query/Retrieve mechanism is extended with an optional extended negotiation capability to specify which “view” of the information is required by the SCU:

1. A “classic” view, which includes either original (as received) classic single frame images or enhanced multi-frame images converted to single frame.
2. An “enhanced” view, which includes either original (as received) enhanced multi-frame images, or classic single frame images converted to true or legacy converted enhanced multi-frame.

5

ZZZA.5 REFERENTIAL INTEGRITY

Often instances within a Study will cross-reference each other. For example, a Presentation State or a Structured Report or an RT Structure Set will reference the images to which they apply, cross-sectional images may reference localizer images, and images that were acquired with annotations may contain references to Presentation States encoding those annotations.

Accordingly, when there are multiple “views” of the same study content (classic or enhanced), the instances will have different SOP Instance and Series Instance UIDs for converted content in each view. Hence any references within an instance to a converted instance needs to be updated as well. In doing such an update of references to UIDs, instances that might not otherwise have needed to be converted do need to be converted, and so on, until the entire set of instances within the scope of the conversion for the view has referential integrity.

In practice, the only instances that do not need to be converted (and assigned new UIDs) are those that contain no references and are not classic or enhanced images to be converted.

Whether or not assignment of a converted instance to a new Series triggers the need to convert all instances in that Series to the new Series, even if they would not otherwise be converted, is not defined (i.e., it is neither required nor prohibited, and hence a Series can be “split” as a consequence of conversion).

The scope of referential integrity required is defined to be the Patient. Instances in one Study may be referenced from another (e.g., as prior images).

ZZZA.6 PERSISTENCE AND DETERMINISM

The rules for conversion specify that the SOP Instance and Series Instance UIDs of converted images be changed, and that the same UIDs be used each time that a query or retrieval is performed. The strict separation of the two “views” of the same information, coupled with the “determinism” that results in the same identification and organization of each view every time, are required for stability across successive operations.

Were this not to be the case, for example, the results of a query (C-FIND) might be different from the results of a subsequent retrieval (C-MOVE or C-GET), or for that matter, successive queries. Further, references to specific instance UID in either view may be recorded in external systems (e.g., in an EMR), hence it is important that these remain stable and accessible.

This places a burden on the Q/R SCP to either retain a record of the mapping of UIDs from one view to the other, or to use some deterministic process that results in the same UIDs (one could envisage some hashing scheme, for instance). How this is implemented is beyond the scope of the standard to define. The determinism requirement does not remove the uniqueness requirement; in particular it is not appropriate to attempt to derive new UIDs by adding a suffix to a UID generated by a different application, for example.

There is no time limit placed on the determinism; it is expected to be indefinite, at least within the control of the system. This is a factor that should be taken into account both in the design of federated Q/R SCPs that may integrate subsidiary SCPs that support this mechanism. It should also be considered during migration to a new Q/R SCP, which ideally should support the mechanism, and should support the same mapping from one view to another as was provided by the Q/R SCP being migrated. This may be non-trivial, since the algorithm for conversion may be different between the two systems. It may be necessary to define some persistent, standard, serialized mapping of one set of UIDs to the other.

ZZZA.7 SOURCE REFERENCES

It is also useful to save references in converted SOP instances to their source. Accordingly, converted instances are required to contain such references, both for image conversions as well as for ancillary instances that may be updated, such as Presentation States and Structured Reports.

5 Obviously, the references to the source instances for the conversion are excluded from conversion themselves. If the instances have been converted on different systems, however, there is a possibility that the source references will be “replaced” and a record of the “chain” of multiple conversions will not be persisted.

10 There is no mechanism to define forward references in the source to the converted instances, since that would imply changing the source instances from their original form, and while this is acceptable within the scope of the normal “coercion” that a Storage SCP is permitted to perform, it is probably not sufficiently useful to justify the effort. This does imply some asymmetry however, depending on the direction of conversion (classic to enhanced or vice versa); only one set will contain the references.

15 In performing round trip conversion, without access to the source instances, the referenced source UIDs can be used as the UIDs for the newly created converted instances.

ZZZA.8 UNCERTAINTY PRINCIPLE

When does a converted view come into existence? By definition, when it is “observed”. However, a practical question is when to start conversion. A Study is never, theoretically, complete, yet the semantics for conversion and consistency are defined at the Study level.

20 Another practical question is whether or not to make the received instances available, even though the converted ones may not yet have been created.

25 In the absence of the concept of “study completion” in DICOM, no firm rules can be defined. However, in practice, most systems have an internal “completion” concept, which may or may not be related to the completion of the Performed Procedure Steps that are related to the sets of instances in question, or may be established through some other mechanism, such as operator intervention, possibly via a RIS message (e.g., after QC checks are signed off as complete, or after a Study has been declared as “ready to read”).

30 A system may elect to “dynamically” begin conversion as instances arrive and update the information in the conversion as new instances are encountered, or it may wait until some state is established that allows it to perform the conversion “statically”. In either case, the information in the converted view via the query/retrieval mechanisms should be immutable once made available. I.e., once a conversion has been “distributed”, it would be desirable for the system to block subsequent changes to the Study, except to the extent that there is a need for correction and management of errors (in which case mechanisms such as IHE Image Object Change Management (IOCM) may be appropriate).

35

<i>PS 3.17: Add new informative Annex describing legacy conversion</i>
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Annex ZZZB Conversion of Single Frame Images to Legacy Converted Enhanced Multi-frame Images (INFORMATIVE)

5 ZZZB.1 INTRODUCTION

ZZZB.2 SIMPLE CT EXAMPLE

10 In this example, two consecutive transverse CT slices encoded as CT Image SOP Class Instances are shown, with a Grayscale Softcopy Presentation State reference to one of them, compared to the converted Legacy Converted Enhanced CT Image SOP Class Instance and a revised Grayscale Softcopy Presentation State that applies to it.

ZZZB.2.1 Images

ZZZB.2.1.1 First Slice as Classic Image

15

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Specific Character Set	(0008,0005)	CS	000a	ISO_IR 100
	Image Type	(0008,0008)	CS	0016	ORIGINAL\PRIMARY\AXIAL
	Instance Creation Date	(0008,0012)	DA	0008	20061230
	Instance Creation Time	(0008,0013)	TM	0006	094053
	SOP Class UID	(0008,0016)	UI	001a	1.2.840.10008.5.1.4.1.1.2
	SOP Instance UID	(0008,0018)	UI	003c	1.3.6.1.4.1.9328.50.1.21169049221871725649891126757390969029
	Study Date	(0008,0020)	DA	0008	20061230
	Content Date	(0008,0023)	DA	0008	20061230
	Study Time	(0008,0030)	TM	0006	100000
	Content Time	(0008,0033)	TM	0000	
	Accession Number	(0008,0050)	SH	0010	2263295914110886
	Modality	(0008,0060)	CS	0002	CT
	Manufacturer	(0008,0070)	LO	0000	
	Referring Physician's Name	(0008,0090)	PN	0000	
	Patient's Name	(0010,0010)	PN	0008	277654^
	Patient ID	(0010,0020)	LO	0010	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	0008	19301018
	Patient's Sex	(0010,0040)	CS	0000	

	Patient Identity Removed	(0012,0062)	CS	0004	YES
	De-identification Method	(0012,0063)	LO	002a	CTP: DICOM-S142-Baseline: 20090627:021422
	Contrast/Bolus Agent	(0018,0010)	LO	0000	
	Body Part Examined	(0018,0015)	CS	0006	CHEST
	Scan Options	(0018,0022)	CS	000c	HELICAL MODE
	Slice Thickness	(0018,0050)	DS	0008	1.250000
	KVP	(0018,0060)	DS	0004	120
	Data Collection Diameter	(0018,0090)	DS	000a	500.000000
	Reconstruction Diameter	(0018,1100)	DS	000a	375.000000
	Distance Source to Detector	(0018,1110)	DS	000a	949.075012
	Distance Source to Patient	(0018,1111)	DS	000a	541.000000
	Gantry/Detector Tilt	(0018,1120)	DS	0008	0.000000
	Table Height	(0018,1130)	DS	000a	170.500000
	Rotation Direction	(0018,1140)	CS	0002	CW
	Exposure Time	(0018,1150)	IS	0004	500
	X-Ray Tube Current	(0018,1151)	IS	0004	298
	Exposure	(0018,1152)	IS	0002	4
	Filter Type	(0018,1160)	SH	000c	BODY FILTER
	Generator Power	(0018,1170)	IS	0006	36000
	Focal Spot(s)	(0018,1190)	DS	0008	0.700000
	Convolution Kernel	(0018,1210)	SH	0004	LUNG
	Patient Position	(0018,5100)	CS	0004	FFS
	Revolution Time	(0018,9305)	FD	0008	0.5
	Single Collimation Width	(0018,9306)	FD	0008	0.625
	Total Collimation Width	(0018,9307)	FD	0008	40
	Table Speed	(0018,9309)	FD	0008	78.75
	Table Feed per Rotation	(0018,9310)	FD	0008	39.375
	Spiral Pitch Factor	(0018,9311)	FD	0008	0.984375
	Contributing Equipment Sequence	(0018,a001)	SQ	ffffff	
%item					
	Manufacturer	(0008,0070)	LO	0008	Acme Corp
	Contribution DateTime	(0018,a002)	DT	0018	20110710084725.070-0400
	Contribution Description	(0018,a003)	ST	0016	Merged patient context
	Purpose of Reference Code Sequence	(0040,a170)	SQ	ffffff	
%item					
	Code Value	(0008,0100)	SH	0006	109103
	Coding Scheme Designator	(0008,0102)	SH	0004	DCM
	Code Meaning	(0008,0104)	LO	0014	Modifying Equipment
%enditem					
%endseq					
%enditem					

%endseq					
	Study Instance UID	(0020,000d)	UI	003e	1.3.6.1.4.1.9328.50.1.3 314291219905667794 753890494847167759 37
	Series Instance UID	(0020,000e)	UI	003e	1.3.6.1.4.1.9328.50.1.1 605255912281029996 160195627581044125 05
	Study ID	(0020,0010)	SH	0004	1234
	Series Number	(0020,0011)	IS	0002	8
	Acquisition Number	(0020,0012)	IS	0002	1
	Instance Number	(0020,0013)	IS	0002	43
	Image Position (Patient)	(0020,0032)	DS	0022	-197.899994\ -195.8000 03\ -81.750000
	Image Orientation (Patient)	(0020,0037)	DS	0036	1.000000\0.000000\0.0 00000\0.000000\1.000 000\0.000000
	Frame of Reference UID	(0020,0052)	UI	003c	1.3.6.1.4.1.9328.50.1.6 990528655935821266 490175619989852704 4
	Position Reference Indicator	(0020,1040)	LO	0002	SN
	Slice Location	(0020,1041)	DS	000a	-81.750000
	Samples per Pixel	(0028,0002)	US	0002	0001
	Photometric Interpretation	(0028,0004)	CS	000c	MONOCHROME2
	Rows	(0028,0010)	US	0002	0200
	Columns	(0028,0011)	US	0002	0200
	Pixel Spacing	(0028,0030)	DS	0012	0.732422\0.732422
	Bits Allocated	(0028,0100)	US	0002	0010
	Bits Stored	(0028,0101)	US	0002	0010
	High Bit	(0028,0102)	US	0002	000f
	Pixel Representation	(0028,0103)	US	0002	0001
	Pixel Padding Value	(0028,0120)	SS	0002	f830
	Window Center	(0028,1050)	DS	0002	40
	Window Width	(0028,1051)	DS	0004	400
	Rescale Intercept	(0028,1052)	DS	0006	-1024
	Rescale Slope	(0028,1053)	DS	0002	1
	Rescale Type	(0028,1054)	LO	0002	HU
	Performed Procedure Step Start Date	(0040,0244)	DA	0008	20061230
	Performed Procedure Step Start Time	(0040,0245)	TM	0006	092119
	Private Creator	(01F1,0010)	LO	0008	ACMEVEND
	Private Acme Acquisition Type	(01F1,1001)	CS	0006	SPIRAL
	Private Acme Scan Parameter	(01F1,1002)	FL	0006	39.2

ZZZB.2.1.2 Second Slice as Classic Image

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Specific Character Set	(0008,0005)	CS	000a	ISO_IR 100
	Image Type	(0008,0008)	CS	0016	ORIGINAL\PRIMARY\AXIAL
	Instance Creation Date	(0008,0012)	DA	0008	20061230
	Instance Creation Time	(0008,0013)	TM	0006	094053
	SOP Class UID	(0008,0016)	UI	001a	1.2.840.10008.5.1.4.1.1.2
	SOP Instance UID	(0008,0018)	UI	003e	1.3.6.1.4.1.9328.50.1.118458571690318148036673922876743615666
	Study Date	(0008,0020)	DA	0008	20061230
	Content Date	(0008,0023)	DA	0008	20061230
	Study Time	(0008,0030)	TM	0006	100000
	Content Time	(0008,0033)	TM	0000	
	Accession Number	(0008,0050)	SH	0010	2263295914110886
	Modality	(0008,0060)	CS	0002	CT
	Manufacturer	(0008,0070)	LO	0000	
	Referring Physician's Name	(0008,0090)	PN	0000	
	Patient's Name	(0010,0010)	PN	0008	277654^
	Patient ID	(0010,0020)	LO	0010	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	0008	19301018
	Patient's Sex	(0010,0040)	CS	0000	
	Patient Identity Removed	(0012,0062)	CS	0004	YES
	De-identification Method	(0012,0063)	LO	002a	CTP: DICOM-S142-Baseline: 20090627:021422
	Contrast/Bolus Agent	(0018,0010)	LO	0000	
	Body Part Examined	(0018,0015)	CS	0006	CHEST
	Scan Options	(0018,0022)	CS	000c	HELICAL MODE
	Slice Thickness	(0018,0050)	DS	0008	1.250000
	KVP	(0018,0060)	DS	0004	120
	Data Collection Diameter	(0018,0090)	DS	000a	500.000000
	Reconstruction Diameter	(0018,1100)	DS	000a	375.000000
	Distance Source to Detector	(0018,1110)	DS	000a	949.075012
	Distance Source to Patient	(0018,1111)	DS	000a	541.000000
	Gantry/Detector Tilt	(0018,1120)	DS	0008	0.000000
	Table Height	(0018,1130)	DS	000a	170.500000
	Rotation Direction	(0018,1140)	CS	0002	CW
	Exposure Time	(0018,1150)	IS	0004	500
	X-Ray Tube Current	(0018,1151)	IS	0004	298
	Exposure	(0018,1152)	IS	0002	4
	Filter Type	(0018,1160)	SH	000c	BODY FILTER
	Generator Power	(0018,1170)	IS	0006	36000

	Focal Spot(s)	(0018,1190)	DS	0008	0.700000
	Convolution Kernel	(0018,1210)	SH	0004	LUNG
	Patient Position	(0018,5100)	CS	0004	FFS
	Revolution Time	(0018,9305)	FD	0008	0.5
	Single Collimation Width	(0018,9306)	FD	0008	0.625
	Total Collimation Width	(0018,9307)	FD	0008	40
	Table Speed	(0018,9309)	FD	0008	78.75
	Table Feed per Rotation	(0018,9310)	FD	0008	39.375
	Spiral Pitch Factor	(0018,9311)	FD	0008	0.984375
	Contributing Equipment Sequence	(0018,a001)	SQ	ffffff	
%item					
	Manufacturer	(0008,0070)	LO	0008	Acme Corp
	Contribution DateTime	(0018,a002)	DT	0018	20110710084722.235-0400
	Contribution Description	(0018,a003)	ST	0016	Merged patient context
	Purpose of Reference Code Sequence	(0040,a170)	SQ	ffffff	
%item					
	Code Value	(0008,0100)	SH	0006	109103
	Coding Scheme Designator	(0008,0102)	SH	0004	DCM
	Code Meaning	(0008,0104)	LO	0014	Modifying Equipment
%enditem					
%endseq					
%enditem					
%endseq					
	Study Instance UID	(0020,000d)	UI	003e	1.3.6.1.4.1.9328.50.1.3 314291219905667794 753890494847167759 37
	Series Instance UID	(0020,000e)	UI	003e	1.3.6.1.4.1.9328.50.1.1 605255912281029996 160195627581044125 05
	Study ID	(0020,0010)	SH	0004	1234
	Series Number	(0020,0011)	IS	0002	8
	Acquisition Number	(0020,0012)	IS	0002	1
	Instance Number	(0020,0013)	IS	0002	42
	Image Position (Patient)	(0020,0032)	DS	0022	-197.899994\195.8000 03\80.500000
	Image Orientation (Patient)	(0020,0037)	DS	0036	1.000000\0.000000\0.0 000000\0.000000\1.000 000\0.000000
	Frame of Reference UID	(0020,0052)	UI	003c	1.3.6.1.4.1.9328.50.1.6 990528655935821266 490175619989852704 4
	Position Reference Indicator	(0020,1040)	LO	0002	SN
	Slice Location	(0020,1041)	DS	000a	-80.500000
	Samples per Pixel	(0028,0002)	US	0002	0001

	Photometric Interpretation	(0028,0004)	CS	000c	MONOCHROME2
	Rows	(0028,0010)	US	0002	0200
	Columns	(0028,0011)	US	0002	0200
	Pixel Spacing	(0028,0030)	DS	0012	0.732422\0.732422
	Bits Allocated	(0028,0100)	US	0002	0010
	Bits Stored	(0028,0101)	US	0002	0010
	High Bit	(0028,0102)	US	0002	000f
	Pixel Representation	(0028,0103)	US	0002	0001
	Pixel Padding Value	(0028,0120)	SS	0002	f830
	Window Center	(0028,1050)	DS	0002	40
	Window Width	(0028,1051)	DS	0004	400
	Rescale Intercept	(0028,1052)	DS	0006	-1024
	Rescale Slope	(0028,1053)	DS	0002	1
	Rescale Type	(0028,1054)	LO	0002	HU
	Performed Procedure Step Start Date	(0040,0244)	DA	0008	20061230
	Performed Procedure Step Start Time	(0040,0245)	TM	0006	092119
	Private Creator	(01F1,0010)	LO	0008	ACMEVEND
	Private Acme Acquisition Type	(01F1,1001)	CS	0006	SPIRAL
	Private Acme Scan Parameter	(01F1,1002)	FL	0006	40.1

ZZZB.2.1.3 Legacy Converted Enhanced Image containing both slices

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Image Type	(0008,0008)	CS	001c	ORIGINAL\PRIMARY\AXIAL\NONE
	Instance Creation Date	(0008,0012)	DA	0008	20061230
	Instance Creation Time	(0008,0013)	TM	0006	094053
	SOP Class UID	(0008,0016)	UI	0016	1.2.840.10008.5.1.4.1.1.2.2
	SOP Instance UID	(0008,0018)	UI	003a	1.3.6.1.4.1.5962.99.1.2830.2144.1344607895685.1.1.1234.8.1
	Study Date	(0008,0020)	DA	0008	20061230
	Content Date	(0008,0023)	DA	0008	20061230
	Study Time	(0008,0030)	TM	0006	100000
	Content Time	(0008,0033)	TM	0000	
	Accession Number	(0008,0050)	SH	0010	2263295914110886
	Modality	(0008,0060)	CS	0002	CT
	Manufacturer	(0008,0070)	LO	0000	
	Referring Physician's Name	(0008,0090)	PN	0000	
	Pixel Presentation	(0008,9205)	CS	000a	MONOCHROME
	Volumetric Properties	(0008,9206)	CS	0006	VOLUME
	Volume Based Calculation Technique	(0008,9207)	CS	0004	NONE

	Query/Retrieve View	(0008,0053)	CS	0008	ENHANCED
	Patient's Name	(0010,0010)	PN	0008	277654^
	Patient ID	(0010,0020)	LO	0010	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	0008	19301018
	Patient's Sex	(0010,0040)	CS	0000	
	Patient Identity Removed	(0012,0062)	CS	0004	YES
	De-identification Method	(0012,0063)	LO	002a	CTP: DICOM-S142-Baseline: 20090627:021422
	Body Part Examined	(0018,0015)	CS	0006	CHEST
	Patient Position	(0018,5100)	CS	0004	FFS
	Content Qualification	(0018,9004)	CS	0008	PRODUCT
	Contributing Equipment Sequence	(0018,a001)	SQ	ffffff	
%item					
	Manufacturer	(0008,0070)	LO	0008	Acme Corp
	Contribution DateTime	(0018,a002)	DT	0018	20110710084722.235- 0400
	Contribution Description	(0018,a003)	ST	0016	Merged patient context
	Purpose of Reference Code Sequence	(0040,a170)	SQ	ffffff	
%item					
	Code Value	(0008,0100)	SH	0006	109103
	Coding Scheme Designator	(0008,0102)	SH	0004	DCM
	Code Meaning	(0008,0104)	LO	0014	Modifying Equipment
%enditem					
%endseq					
%enditem					
%item					
	Manufacturer	(0008,0070)	LO	0008	PixelMed
	Institution Name	(0008,0080)	LO	0008	PixelMed
	Institution Address	(0008,0081)	ST	000a	Bangor, PA
	Institutional Department Name	(0008,1040)	LO	0014	Software Development
	Manufacturer's Model Name	(0008,1090)	LO	0028	com.pixelmed.dicom.S etWithEnhancedImage s
	Software Version(s)	(0018,1020)	LO	0022	Vers. Fri Aug 10 06:56:43 EDT 2012
	Contribution DateTime	(0018,a002)	DT	0018	20120810101135.692- 0400
	Contribution Description	(0018,a003)	ST	0032	Legacy Enhanced Image created from Classic Images
	Purpose of Reference Code Sequence	(0040,a170)	SQ	ffffff	
%item					
	Code Value	(0008,0100)	SH	0006	dddd1
	Coding Scheme Designator	(0008,0102)	SH	0006	DCM
	Code Meaning	(0008,0104)	LO	002a	Enhanced Multi-frame Conversion Equipment

%enditem					
%endseq					
%enditem					
%endseq					
	Study Instance UID	(0020,000d)	UI	003e	1.3.6.1.4.1.9328.50.1.3 314291219905667794 753890494847167759 37
	Series Instance UID	(0020,000e)	UI	0038	1.3.6.1.4.1.5962.99.1.2 830.2144.1344607895 685.1.3.1234.8
	Study ID	(0020,0010)	SH	0004	1234
	Series Number	(0020,0011)	IS	0002	8
	Instance Number	(0020,0013)	IS	0002	1
	Frame of Reference UID	(0020,0052)	UI	003c	1.3.6.1.4.1.9328.50.1.6 990528655935821266 490175619989852704 4
	Position Reference Indicator	(0020,1040)	LO	0002	SN
	Samples per Pixel	(0028,0002)	US	0002	0001
	Photometric Interpretation	(0028,0004)	CS	000c	MONOCHROME2
	Number of Frames	(0028,0008)	IS	0002	2
	Rows	(0028,0010)	US	0002	0200
	Columns	(0028,0011)	US	0002	0200
	Bits Allocated	(0028,0100)	US	0002	0010
	Bits Stored	(0028,0101)	US	0002	0010
	High Bit	(0028,0102)	US	0002	000f
	Pixel Representation	(0028,0103)	US	0002	0001
	Pixel Padding Value	(0028,0120)	SS	0002	f830
	Burned In Annotation	(0028,0301)	CS	0002	NO
	Lossy Image Compression	(0028,2110)	CS	0002	00
	Performed Procedure Step Start Date	(0040,0244)	DA	0008	20061230
	Performed Procedure Step Start Time	(0040,0245)	TM	0006	092119
	Acquisition Context Sequence	(0040,0555)	SQ	ffffff	
%endseq					
	Presentation LUT Shape	(2050,0020)	CS	0008	IDENTITY
	Shared Functional Groups Sequence	(5200,9229)	SQ	ffffff	
%item					
	CT Image Frame Type Sequence	(0018,9329)	SQ	ffffff	
%item					
	Frame Type	(0008,9007)	CS	001c	ORIGINAL\PRIMARY\ AXIAL\NONE
	Pixel Presentation	(0008,9205)	CS	000a	MONOCHROME
	Volumetric Properties	(0008,9206)	CS	0006	VOLUME
	Volume Based Calculation Technique	(0008,9207)	CS	0004	NONE
%enditem					

%endseq					
	Plane Orientation Sequence	(0020,9116)	SQ	ffffff	
%item					
	Image Orientation (Patient)	(0020,0037)	DS	0036	1.000000\0.000000\0.000000\0.000000\0.000000\1.000000\0.000000
%enditem					
%endseq					
	Unassigned Shared Converted Attributes Sequence	(0020,9170)	SQ	ffffff	
%item					
	Scan Options	(0018,0022)	CS	000c	HELICAL MODE
	KVP	(0018,0060)	DS	0004	120
	Data Collection Diameter	(0018,0090)	DS	000a	500.000000
	Reconstruction Diameter	(0018,1100)	DS	000a	375.000000
	Distance Source to Detector	(0018,1110)	DS	000a	949.075012
	Distance Source to Patient	(0018,1111)	DS	000a	541.000000
	Gantry/Detector Tilt	(0018,1120)	DS	0008	0.000000
	Table Height	(0018,1130)	DS	000a	170.500000
	Rotation Direction	(0018,1140)	CS	0002	CW
	Exposure Time	(0018,1150)	IS	0004	500
	X-Ray Tube Current	(0018,1151)	IS	0004	298
	Exposure	(0018,1152)	IS	0002	4
	Filter Type	(0018,1160)	SH	000c	BODY FILTER
	Generator Power	(0018,1170)	IS	0006	36000
	Focal Spot(s)	(0018,1190)	DS	0008	0.700000
	Convolution Kernel	(0018,1210)	SH	0004	LUNG
	Revolution Time	(0018,9305)	FD	0008	0.5
	Single Collimation Width	(0018,9306)	FD	0008	0.625
	Total Collimation Width	(0018,9307)	FD	0008	40
	Table Speed	(0018,9309)	FD	0008	78.75
	Table Feed per Rotation	(0018,9310)	FD	0008	39.375
	Spiral Pitch Factor	(0018,9311)	FD	0008	0.984375
	Acquisition Number	(0020,0012)	IS	0002	1
	Private Creator	(01F1,0010)	LO	0008	ACMEVEND
	Private Acme Acquisition Type	(01F1,1001)	CS	0006	SPIRAL
%enditem					
%endseq					
	Pixel Measures Sequence	(0028,9110)	SQ	ffffff	
%item					
	Slice Thickness	(0018,0050)	DS	0008	1.250000
	Pixel Spacing	(0028,0030)	DS	0012	0.732422\0.732422
%enditem					
%endseq					

	Frame VOI LUT Sequence	(0028,9132)	SQ	ffffff	
%item					
	Window Center	(0028,1050)	DS	0002	40
	Window Width	(0028,1051)	DS	0004	400
%enditem					
%endseq					
	Pixel Value Transformation Sequence	(0028,9145)	SQ	ffffff	
%item					
	Rescale Intercept	(0028,1052)	DS	0006	-1024
	Rescale Slope	(0028,1053)	DS	0002	1
	Rescale Type	(0028,1054)	LO	0002	HU
%enditem					
%endseq					
%enditem					
%endseq					
	Per-frame Functional Groups Sequence	(5200,9230)	SQ	ffffff	
%item					
	Frame Content Sequence	(0020,9111)	SQ	ffffff	
%item					
	Frame Acquisition Number	(0020,9156)	US	0002	0001
%enditem					
%endseq					
	Plane Position Sequence	(0020,9113)	SQ	ffffff	
%item					
	Image Position (Patient)	(0020,0032)	DS	0022	-197.899994\ -195.800003\ -80.500000
%enditem					
%endseq					
	Unassigned Per-Frame Converted Attributes Sequence	(0020,9171)	SQ	ffffff	
%item					
	Instance Number	(0020,0013)	IS	0002	42
	Slice Location	(0020,1041)	DS	000a	-80.500000
	Private Creator	(01F1,0010)	LO	0008	ACMEVEND
	Private Acme Scan Parameter	(01F1,1002)	FL	0006	39.2
%enditem					
%endseq					
	Conversion Source Attributes Sequence	(0020,9172)	SQ	ffffff	
%item					
	Referenced SOP Class UID	(0008,1150)	UI	001a	1.2.840.10008.5.1.4.1.1.2
	Referenced SOP Instance UID	(0008,1155)	UI	003e	1.3.6.1.4.1.19328.50.1.1184585716903181480366739228767436156

					66
%enditem					
%endseq					
%enditem					
%item					
	Frame Content Sequence	(0020,9111)	SQ	ffffff	
%item					
	Frame Acquisition Number	(0020,9156)	US	0002	0001
%enditem					
%endseq					
	Plane Position Sequence	(0020,9113)	SQ	ffffff	
%item					
	Image Position (Patient)	(0020,0032)	DS	0022	-197.899994\ -195.800003\ -81.750000
%enditem					
%endseq					
	Unassigned Per-Frame Converted Attributes Sequence	(0020,9171)	SQ	ffffff	
%item					
	Instance Number	(0020,0013)	IS	0002	43
	Slice Location	(0020,1041)	DS	000a	-81.750000
	Private Creator	(01F1,0010)	LO	0008	ACMEVEND
	Private Acme Scan Parameter	(01F1,1002)	FL	0006	40.1
%enditem					
%endseq					
	Conversion Source Attributes Sequence	(0020,9172)	SQ	ffffff	
%item					
	Referenced SOP Class UID	(0008,1150)	UI	001a	1.2.840.10008.5.1.4.1.1.2
	Referenced SOP Instance UID	(0008,1155)	UI	003c	1.3.6.1.4.1.9328.50.1.21169049221871725649891126757390969029
%enditem					
%endseq					
%enditem					
%endseq					

ZZZB.2.2 Presentation States

5 ZZZB.2.2.1 Presentation State referencing Classic Image that contains the First Slice

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Specific Character Set	(0008,0005)	CS	000a	ISO_IR 100
	SOP Class UID	(0008,0016)	UI	001c	1.2.840.10008.5.1.4.1.1.11.1
	SOP Instance UID	(0008,0018)	UI	0038	1.2.276.0.7230010.3.1.4.2989371993.3196.1272478982.1246
	Study Date	(0008,0020)	DA	0008	20061230
	Study Time	(0008,0030)	TM	0006	100000
	Accession Number	(0008,0050)	SH	0010	2263295914110886
	Modality	(0008,0060)	CS	0002	PR
	Manufacturer	(0008,0070)	LO	0000	
	Referring Physician's Name	(0008,0090)	PN	0000	
	Referenced Series Sequence	(0008,1115)	SQ	ffffff	
%item					
	Referenced Image Sequence	(0008,1140)	SQ	ffffff	
%item					
	Referenced SOP Class UID	(0008,1150)	UI	001a	1.2.840.10008.5.1.4.1.1.2
	Referenced SOP Instance UID	(0008,1155)	UI	003c	1.3.6.1.4.1.9328.50.1.21169049221871725649891126757390969029
%enditem					
%endseq					
	Series Instance UID	(0020,000e)	UI	003e	1.3.6.1.4.1.9328.50.1.160525591228102999616019562758104412505
%enditem					
%endseq					
	Patient's Name	(0010,0010)	PN	0008	277654^
	Patient ID	(0010,0020)	LO	0010	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	0008	19301018
	Patient's Sex	(0010,0040)	CS	0000	
	Patient Identity Removed	(0012,0062)	CS	0004	YES
	De-identification Method	(0012,0063)	LO	002a	CTP: DICOM-S142-Baseline: 20090627:021422
	Body Part Examined	(0018,0015)	CS	0006	CHEST
	Study Instance UID	(0020,000d)	UI	003e	1.3.6.1.4.1.9328.50.1.331429121990566779475389049484716775937
	Series Instance UID	(0020,000e)	UI	0038	1.2.276.0.7230010.3.1.3.2989371993.3196.1272478982.1245
	Study ID	(0020,0010)	SH	0004	1234

	Series Number	(0020,0011)	IS	0002	1
	Instance Number	(0020,0013)	IS	0002	1
	Rescale Intercept	(0028,1052)	DS	0006	-1024
	Rescale Slope	(0028,1053)	DS	0002	1
	Rescale Type	(0028,1054)	LO	0002	US
	Softcopy VOI LUT Sequence	(0028,3110)	SQ	ffffff	
%item					
	Window Center	(0028,1050)	DS	0008	-600
	Window Width	(0028,1051)	DS	0004	1200
%enditem					
%endseq					
	Displayed Area Selection Sequence	(0070,005a)	SQ	ffffff	
%item					
	Displayed Area Top Left Hand Corner	(0070,0052)	SL	0008	000000b3,000000c9
	Displayed Area Bottom Right Hand Corner	(0070,0053)	SL	0008	0000018c,000001a2
	Presentation Size Mode	(0070,0100)	CS	0008	MAGNIFY
	Presentation Pixel Spacing	(0070,0101)	DS	0012	0.732422\0.732422
	Presentation Pixel Magnification Ratio	(0070,0103)	FL	0004	2.36742
%enditem					
%endseq					
	Content Label	(0070,0080)	CS	0008	UNNAMED
	Content Description	(0070,0081)	LO	0000	
	Presentation Creation Date	(0070,0082)	DA	0008	20100428
	Presentation Creation Time	(0070,0083)	TM	0006	142302
	Content Creator's Name	(0070,0084)	PN	0000	
	Presentation LUT Shape	(2050,0020)	CS	0008	IDENTITY

ZZZB.2.2.2 Presentation State referencing First Slice in Legacy Converted Enhanced Image

Nesting	Attribute	Tag	VR	VL (hex)	Value
	SOP Class UID	(0008,0016)	UI	001c	1.2.840.10008.5.1.4.1.1.11.1
	SOP Instance UID	(0008,0018)	UI	0038	1.3.6.1.4.1.5962.1.1.0.0.0.1344614718.10917.0
	Study Date	(0008,0020)	DA	0008	20061230
	Study Time	(0008,0030)	TM	0006	100000
	Accession Number	(0008,0050)	SH	0010	2263295914110886
	Modality	(0008,0060)	CS	0002	PR
	Manufacturer	(0008,0070)	LO	0000	
	Referring Physician's Name	(0008,0090)	PN	0000	
	Referenced Series Sequence	(0008,1115)	SQ	ffffff	
%item					

	Referenced Image Sequence	(0008,1140)	SQ	ffffff	
%item					
	Referenced SOP Class UID	(0008,1150)	UI	001a	1.2.840.10008.5.1.4.1.1.2.2
	Referenced SOP Instance UID	(0008,1155)	UI	003c	1.3.6.1.4.1.5962.99.1.2.830.2144.1344607895.685.1.1.1234.8.1
	Referenced Frame Number	(0008,1160)	IS	0002	1
%enditem					
%endseq					
	Query/Retrieve View	(0008,0053)	CS	0008	ENHANCED
	Series Instance UID	(0020,000e)	UI	003e	1.3.6.1.4.1.5962.99.1.2.830.2144.1344607895.685.1.3.1234.8
%enditem					
%endseq					
	Patient's Name	(0010,0010)	PN	0008	277654^
	Patient ID	(0010,0020)	LO	0010	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	0008	19301018
	Patient's Sex	(0010,0040)	CS	0000	
	Patient Identity Removed	(0012,0062)	CS	0004	YES
	De-identification Method	(0012,0063)	LO	002a	CTP: DICOM-S142-Baseline: 20090627:021422
	Body Part Examined	(0018,0015)	CS	0006	CHEST
	Contributing Equipment Sequence	(0018,a001)	SQ	ffffff	
%item					
	Manufacturer	(0008,0070)	LO	0008	Acme Corp
	Contribution DateTime	(0018,a002)	DT	0018	20120810101135.692-0400
	Contribution Description	(0018,a003)	ST	0040	Updated UID references during Legacy Enhanced Classic conversion
	Purpose of Reference Code Sequence	(0040,a170)	SQ	ffffff	
%item					
	Code Value	(0008,0100)	SH	0006	dddd1
	Coding Scheme Designator	(0008,0102)	SH	0006	DCM
	Code Meaning	(0008,0104)	LO	002a	Enhanced Multi-frame Conversion Equipment
%enditem					
%endseq					
%enditem					
%endseq					
	Study Instance UID	(0020,000d)	UI	003e	1.3.6.1.4.1.9328.50.1.3.314291219905667794.753890494847167759.37

	Series Instance UID	(0020,000e)	UI	0038	1.3.6.1.4.1.5962.1.3.0.0.1344614718.10917.0
	Study ID	(0020,0010)	SH	0004	1234
	Series Number	(0020,0011)	IS	0002	1
	Instance Number	(0020,0013)	IS	0002	1
	Conversion Source Attributes Sequence	(0020,9172)	SQ	ffffff	
%item					
	Referenced SOP Class UID	(0008,1150)	UI	001a	1.2.840.10008.5.1.4.1.1.11.1
	Referenced SOP Instance UID	(0008,1155)	UI	003e	1.2.276.0.7230010.3.1.4.2989371993.3196.1272478982.1246
%enditem					
%endseq					
	Rescale Intercept	(0028,1052)	DS	0006	-1024
	Rescale Slope	(0028,1053)	DS	0002	1
	Rescale Type	(0028,1054)	LO	0002	US
	Softcopy VOI LUT Sequence	(0028,3110)	SQ	ffffff	
%item					
	Window Center	(0028,1050)	DS	0008	-600
	Window Width	(0028,1051)	DS	0004	1200
%enditem					
%endseq					
	Displayed Area Selection Sequence	(0070,005a)	SQ	ffffff	
%item					
	Displayed Area Top Left Hand Corner	(0070,0052)	SL	0008	000000b3,000000c9
	Displayed Area Bottom Right Hand Corner	(0070,0053)	SL	0008	0000018c,000001a2
	Presentation Size Mode	(0070,0100)	CS	0008	MAGNIFY
	Presentation Pixel Spacing	(0070,0101)	DS	0012	0.732422\0.732422
	Presentation Pixel Magnification Ratio	(0070,0103)	FL	0004	2.36742
%enditem					
%endseq					
	Content Label	(0070,0080)	CS	0008	UNNAMED
	Content Description	(0070,0081)	LO	0000	
	Presentation Creation Date	(0070,0082)	DA	0008	20100428
	Presentation Creation Time	(0070,0083)	TM	0006	142302
	Content Creator's Name	(0070,0084)	PN	0000	
	Presentation LUT Shape	(2050,0020)	CS	0008	IDENTITY

PS 3.17: Add new informative Annex describing query and retrieval with conversion

Annex ZZZC Query and Retrieval of Legacy Converted Enhanced Multi-frame Images (INFORMATIVE)

ZZZC.1 INTRODUCTION

- 5 This Annex contains examples of query and retrieval when the images are supplied in one form, and both forms are accessible via the two alternative CLASSIC and ENHANCED views.

Baseline (non-extended negotiation) is not illustrated, since the instances were supplied to the SCP in their Classic form, and hence the responses would be identical to those illustrated for the CLASSIC view, except for the presence of or value returned in Query/Retrieve View (0008,0053).

10 ZZZC.2 CT EXAMPLE WITH IMAGES AND PRESENTATION STATES

This example presumes that the Q/R SCP contains the same images and presentation states described in Annex ZZZB.

ZZZC.2.1 C-FIND and C-MOVE at STUDY Level With CLASSIC View

Study Root Study Level C-FIND Request with Patient ID and Accession Number as keys:

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Study Date	(0008,0020)	DA	0	
	Study Time	(0008,0030)	TM	0	
	Accession Number	(0008,0050)	SH	10	2263295914110886
	Query/Retrieve Level	(0008,0052)	CS	6	STUDY
	Query/Retrieve View	(0008,0053)	CS	8	CLASSIC
	Modalities in Study	(0008,0061)	CS	0	
	SOP Classes in Study	(0008,0062)	UI	0	
	Referring Physician's Name	(0008,0090)	PN	0	
	Study Description	(0008,1030)	LO	0	
	Physicians of Record	(0008,1048)	PN	0	
	Name of Physicians Reading Study	(0008,1060)	PN	0	
	Admitting Diagnoses Description	(0008,1080)	LO	0	
	Patient's Name	(0010,0010)	PN	0	
	Patient's ID	(0010,0020)	LO	10	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	0	
	Patient's Birth Time	(0010,0032)	TM	0	
	Patient's Sex	(0010,0040)	CS	0	
	Patient's Age	(0010,1010)	AS	0	
	Patient's Size	(0010,1020)	DS	0	
	Patient's Weight	(0010,1030)	DS	0	
	Occupation	(0010,2180)	SH	0	
	Additional Patient History	(0010,21b0)	LT	0	
	Patient Comments	(0010,4000)	LT	0	
	Study Instance UID	(0020,000d)	UI	0	

	Study ID	(0020,0010)	SH	0	
	Other Study Numbers	(0020,1070)	IS	0	
	Number of Study Related Series	(0020,1206)	IS	0	
	Number of Study Related Instances	(0020,1208)	IS	0	

Study Root Study Level C-FIND Response:

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Study Date	(0008,0020)	DA	8	20061230
	Study Time	(0008,0030)	TM	6	100000
	Accession Number	(0008,0050)	SH	10	2263295914110886
	Query/Retrieve Level	(0008,0052)	CS	6	STUDY
	Query/Retrieve View	(0008,0053)	CS	8	CLASSIC
	Modalities in Study	(0008,0061)	CS	6	CT\PR
	SOP Classes in Study	(0008,0062)	UI	36	1.2.840.10008.5.1.4.1. 1.11.1\1.2.840.10008.5 .1.4.1.1.2
	Referring Physician's Name	(0008,0090)	PN	0	
	Study Description	(0008,1030)	LO	0	
	Physicians of Record	(0008,1048)	PN	0	
	Name of Physicians Reading Study	(0008,1060)	PN	0	
	Admitting Diagnoses Description	(0008,1080)	LO	0	
	Patient's Name	(0010,0010)	PN	6	277654
	Patient's ID	(0010,0020)	LO	10	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	8	19301018
	Patient's Birth Time	(0010,0032)	TM	0	
	Patient's Sex	(0010,0040)	CS	0	
	Patient's Age	(0010,1010)	AS	0	
	Patient's Size	(0010,1020)	DS	0	
	Patient's Weight	(0010,1030)	DS	0	
	Occupation	(0010,2180)	SH	0	
	Additional Patient History	(0010,21b0)	LT	0	
	Patient Comments	(0010,4000)	LT	0	
	Study Instance UID	(0020,000d)	UI	3e	1.3.6.1.4.1.9328.50.1.3 314291219905667794 753890494847167759 37
	Study ID	(0020,0010)	SH	4	1234
	Other Study Numbers	(0020,1070)	IS	0	
	Number of Study Related Series	(0020,1206)	IS	2	2
	Number of Study Related Instances	(0020,1208)	IS	2	3

Study Root Study Level C-MOVE Request with Study Instance UID as unique key:

Nesting	Attribute	Tag	VR	VL (hex)	Value
---------	-----------	-----	----	-------------	-------

	Query/Retrieve Level	(0008,0052)	CS	6	STUDY
	Query/Retrieve View	(0008,0053)	CS	8	CLASSIC
	Study Instance UID	(0020,000d)	UI	3e	1.3.6.1.4.1.9328.50.1.3 314291219905667794 753890494847167759 37

Study Root Study Level C-MOVE Pending Responses illustrating SOP Instances retrieved:

Nesting	Attribute	Tag	VR	VL (hex)	Value

	Affected SOP Class UID	(0000,0002)	UI	1c	1.2.840.10008.5.1.4.1. 1.11.1

	Affected SOP Instance UID	(0000,1000)	UI	38	1.2.276.0.7230010.3.1. 4.2989371993.3196.12 72478982.1246

	Affected SOP Class UID	(0000,0002)	UI	1a	1.2.840.10008.5.1.4.1. 1.2

	Affected SOP Instance UID	(0000,1000)	UI	3e	1.3.6.1.4.1.9328.50.1.1 184585716903181480 366739228767436156 66

	Affected SOP Class UID	(0000,0002)	UI	1a	1.2.840.10008.5.1.4.1. 1.2

	Affected SOP Instance UID	(0000,1000)	UI	3c	1.3.6.1.4.1.9328.50.1.2 116904922187172564 989112675739096902 9

5 Note: Only the Classic image instances and the original Presentation State that refers to it are transferred with this STUDY level request.

ZZZC.2.1 C-FIND and C-MOVE at STUDY Level With ENHANCED View

Study Root Study Level C-FIND Request with Patient ID and Accession Number as keys:

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Study Date	(0008,0020)	DA	0	
	Study Time	(0008,0030)	TM	0	
	Accession Number	(0008,0050)	SH	10	2263295914110886
	Query/Retrieve Level	(0008,0052)	CS	6	STUDY
	Query/Retrieve View	(0008,0053)	CS	a	ENHANCED
	Modalities in Study	(0008,0061)	CS	0	

	SOP Classes in Study	(0008,0062)	UI	0	
	Referring Physician's Name	(0008,0090)	PN	0	
	Study Description	(0008,1030)	LO	0	
	Physicians of Record	(0008,1048)	PN	0	
	Name of Physicians Reading Study	(0008,1060)	PN	0	
	Admitting Diagnoses Description	(0008,1080)	LO	0	
	Patient's Name	(0010,0010)	PN	0	
	Patient's ID	(0010,0020)	LO	10	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	0	
	Patient's Birth Time	(0010,0032)	TM	0	
	Patient's Sex	(0010,0040)	CS	0	
	Patient's Age	(0010,1010)	AS	0	
	Patient's Size	(0010,1020)	DS	0	
	Patient's Weight	(0010,1030)	DS	0	
	Occupation	(0010,2180)	SH	0	
	Additional Patient History	(0010,21b0)	LT	0	
	Patient Comments	(0010,4000)	LT	0	
	Study Instance UID	(0020,000d)	UI	0	
	Study ID	(0020,0010)	SH	0	
	Other Study Numbers	(0020,1070)	IS	0	
	Number of Study Related Series	(0020,1206)	IS	0	
	Number of Study Related Instances	(0020,1208)	IS	0	

Note: This is exactly the same as for the CLASSIC view, except that Query/Retrieve View (0008,0053) has a value of ENHANCED rather than CLASSIC.

5 Study Root Study Level C-FIND Response:

Nesting	Attribute	Tag	VR	VL (hex)	Value
	Study Date	(0008,0020)	DA	8	20061230
	Study Time	(0008,0030)	TM	6	100000
	Accession Number	(0008,0050)	SH	10	2263295914110886
	Query/Retrieve Level	(0008,0052)	CS	6	STUDY
	Query/Retrieve View	(0008,0053)	CS	a	ENHANCED
	Modalities in Study	(0008,0061)	CS	6	CT\PR
	SOP Classes in Study	(0008,0062)	UI	3a	1.2.840.10008.5.1.4.1.1.11.1\1.2.840.10008.5.1.4.1.1.2.2
	Referring Physician's Name	(0008,0090)	PN	0	
	Study Description	(0008,1030)	LO	0	
	Physicians of Record	(0008,1048)	PN	0	
	Name of Physicians Reading Study	(0008,1060)	PN	0	
	Admitting Diagnoses Description	(0008,1080)	LO	0	
	Patient's Name	(0010,0010)	PN	6	277654

	Patient's ID	(0010,0020)	LO	10	RIDER-2357766186
	Patient's Birth Date	(0010,0030)	DA	8	19301018
	Patient's Birth Time	(0010,0032)	TM	0	
	Patient's Sex	(0010,0040)	CS	0	
	Patient's Age	(0010,1010)	AS	0	
	Patient's Size	(0010,1020)	DS	0	
	Patient's Weight	(0010,1030)	DS	0	
	Occupation	(0010,2180)	SH	0	
	Additional Patient History	(0010,21b0)	LT	0	
	Patient Comments	(0010,4000)	LT	0	
	Study Instance UID	(0020,000d)	UI	3e	1.3.6.1.4.1.9328.50.1.3 314291219905667794 753890494847167759 37
	Study ID	(0020,0010)	SH	4	1234
	Other Study Numbers	(0020,1070)	IS	0	
	Number of Study Related Series	(0020,1206)	IS	2	2
	Number of Study Related Instances	(0020,1208)	IS	2	2

Note: This is the same as for the CLASSIC view, except that Query/Retrieve View (0008,0053) has a value of ENHANCED rather than CLASSIC, the SOP Classes in Study (0008,0062) has a different value for the Image Storage SOP Class, and the Number of Study Related Instances (0020,1208) is fewer.

5

Study Root Study Level C-MOVE Request with Study Instance UID as unique key:

Nesting	Attribute	Tag	VR	VL (hex)	Value
	QueryRetrieve Level	(0008,0052)	CS	6	STUDY
	Query/Retrieve View	(0008,0053)	CS	a	ENHANCED
	Study Instance UID	(0020,000d)	UI	3e	1.3.6.1.4.1.9328.50.1.3 314291219905667794 753890494847167759 37

Note: This is exactly the same as for the CLASSIC view, except that Query/Retrieve View (0008,0053) has a value of ENHANCED rather than CLASSIC. In particular, the same Study Instance UID is retrieved.

10

Study Root Study Level C-MOVE Pending Responses illustrating SOP Instances retrieved:

Nesting	Attribute	Tag	VR	VL (hex)	Value

	Affected SOP Class UID	(0000,0002)	UI	1c	1.2.840.10008.5.1.4.1. 1.11.1

	Affected SOP Instance UID	(0000,1000)	UI	38	1.3.6.1.4.1.5962.1.1.0. 0.0.1344614718.10917 .0

	Affected SOP Class UID	(0000,0002)	UI	1a	1.2.840.10008.5.1.4.1.1.2.2

	Affected SOP Instance UID	(0000,1000)	UI	3c	1.3.6.1.4.1.5962.99.1.2.830.2144.1344607895.685.1.1.1234.8.1

Note: Only the converted instances are transferred with this STUDY level request, including the Legacy Enhanced image and the converted Presentation State with updated UID references.