5 **Digital Imaging and Communications in Medicine (DICOM)**

Supplement 119: Frame Level Retrieve SOP Classes

10

15

20 *Prepared by: Working Group 6*

DICOM Standards Committee, Working Group 6

1300 N. 17th Street, Suite 1752

Rosslyn, Virginia 22209 USA

25

VERSION: Final Text, 20 Jan 2009

Developed pursuant to DICOM Work Item 2005-12-A

Table of Contents

Scope & Field of Application

This Supplement describes extensions to the existing Query/Retrieve Service Class to support retrieval of:

- individual frames and ranges of frames from multi-frame image objects.

170

- an extract of any composite storage instance without the pixel data or other bulk attributes.

- composite instances based only on their SOP Instance UID without requiring knowledge of the Study and Series Instance UIDs.

With the introduction of potentially very large multi-frame objects such as enhanced CT & MR there is a need to selectively extract referenced frames without having to retrieve the entire large object.

175　The retrieval of instances with selected frames is implemented using the C-GET and C-MOVE operations . The SOP instances sent are complete and valid, and therefore usable by both the requester and other C-MOVE recipients

The retrieval of instances without bulk data is implemented using only the C-GET operation since:

- the use cases all require the data to be sent to the originator of the request

180

- the data sent is not a complete valid SOP instance, and should not be sent using a standard C-STORE operation.

Changes to NEMA Standards Publication PS 3.2-2008

185 ## Digital Imaging and Communications in Medicine (DICOM)

Part 2: Information Object Definitions

Add SOP Class to PS 3.2 Table A.1-2 UID VALUES

190 **Table A.1-2**

UID Value	UID NAME	Category
1.2.840.10008.5.1.4.1.2.4.2	**Composite Instance Root Retrieve – MOVE**	**Query/Retrieve**
1.2.840.10008.5.1.4.1.2.4.3	**Composite Instance Root Retrieve – GET**	**Query/Retrieve**
1.2.840.10008.5.1.4.1.2.5.3	**Composite Instance Retrieve Without Bulk Data – GET**	**Query/Retrieve**

Changes to NEMA Standards Publication PS 3.3-2008

Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

195 | **PS 3.3 Add new Table C.12-x in New Section C.12.3**
EDITORIAL NOTE: This module needs to be added to ALL multi-frame IODs as conditional,
"Required if the SOP Instance was created in response to a Frame-Level retrieve request."

Table C.12-x
FRAME EXTRACTION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Extraction Sequence	**(0008,1164)**	**1**	**Sequence containing details of how this SOP Instance was extracted from a source multi-frame SOP Instance.** **If this instance was created from an instance that contains a Frame Extraction Sequence, then this sequence shall contain all of the items from the parent's Frame Extraction Sequence and a new item that describes this extraction.** **One or more items shall be present.**
>Multi-Frame Source SOP Instance UID	**(0008,1167)**	**1**	**SOP Instance from which the frames of this instance are extracted.**
>Simple Frame List	**(0008,1161)**	**1C**	**A list of Frames that were extracted in the form of a simple list.** **Required if object extraction is based on a Frame Level Retrieve using the Simple Frame List (0008,1161) attribute.** **See PS3.4 "Instance and Frame Level Retrieve SOP Classes"**
>Calculated Frame List	**(0008,1162)**	**1C**	**A list of Frames that were extracted in the form of one or more triplets** **Required if object extraction is based on a Frame Level Retrieve using the Calculated Frame List (0008,1162) attribute.** **See PS3.4 "Instance and Frame Level Retrieve SOP Classes"**
>Time Range	**(0008,1163)**	**1C**	**The start and end times of the frames that were extracted.** **Required if object extraction is based on a Frame Level Retrieve using the Time Range (0008,1163) attribute.** **See PS3.4 "Instance and Frame Level Retrieve SOP Classes"**

200 **Changes to NEMA Standards Publication PS 3.4-2008**

Digital Imaging and Communications in Medicine (DICOM)

Part 4: Service Class Specifications

PS 3.4 Insert New Annex X as follows

Annex X   Instance and Frame Level Retrieve SOP Classes
205 **(Normative)**

X.1   OVERVIEW

X.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
210 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.

X.1.2   Composite Instance Root Retrieve Information Model

Retrievals are implemented against the Composite Instance Root Retrieve Information Model, as defined
215 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.

X.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
220 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
225   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
230   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.

X.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

X.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).

X.2.2 Attributes Definition

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

X.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

X.3.1 Composite Instance Root Information Model

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

— Composite Instance
— Frame

The Composite Instance level is the top level and contains only the SOP Instance UID. The Frame level is below the Composite Instance level and contains only the Attributes that refer to a selection of the frames from a single multi-frame image object.

X.3.2 Construction and Interpretation of Frame Range Keys

The following rules for the use of Frame Range Keys apply to both an SCU creating such keys and to an SCP interpreting them.

X.3.2.1 Frame List Definitions

The selection of frames to be included in a new created SOP Instance made in response to a FRAME level Composite Instance Root Retrieve request shall be defined by one of the mechanisms defined in this section, and the list of frames so specified shall be referred to as the "Frame List".

Notes: 1. Re-ordering of frames is not supported, and order of the frames in the Frame List will always be the same as in the original SOP Instance.

2. New allowable frame selection mechanisms may be defined in the future by the addition of new SOP classes

X.3.2.1.1 Simple Frame List

Simple Frame List (0008,1161) is a multi-valued attribute containing a list of frame numbers, each specifying a frame to be included in the returned object. The first frame of the source instance shall be denoted as frame number 1.

The frame numbers in the list shall not contain any duplicates, and shall increase monotonically.

Note: Due to the use of UL for this element, a maximum of 16383 values may be specified, as only a 2 byte length is available when an explicit VR Transfer Syntax is used.

X.3.2.1.2 Calculated Frame List

320 Calculated Frame List (0008,1162) is a multi-valued attribute containing a list of 3-tuples, each representing a sub-range of frames to be included in the returned object. The first frame of the source instance shall be denoted as frame number 1.For each 3-tuple: .

— The first number shall be the frame number of the first frame of the sub-range.
325 — The second number shall be the upper limit of the sub-range, and shall be greater than or equal to the first number.
— The third number shall be the increment between requested frames of the sub-range. This shall be greater than zero.

The difference between the first and second numbers is not required to be an exact multiple of the
330 increment.

If the difference between the first and second numbers is an exact multiple of the increment, then the last frame of the sub-range shall be the second number.

If the first number is greater than the number of frames in the referenced SOP Instance then that sub-range shall be ignored.

335 The sub-ranges shall be non-overlapping such that the sequence of frame numbers determined by concatenating all the sub-ranges shall not contain any duplicates, and shall increase monotonically. A value of FFFFFFFFH or any value greater than the number of frames in the referenced SOP Instance as the second value shall denote the end of the set of frames in the referenced SOP Instance, and may only occur in the last 3-tuple.

340 Note: For example, if the Calculated Frame List contains 6 values, 2, 9, 3, 12, FFFFFFFFH, 5 and is applied to an Instance containing 25 frames. The resulting Frame List will contain the values 2, 5, 8, 12, 17 and 22.

X.3.2.1.3 Time Range

Time Range (0008,1163) contains the start and end times to be included in the returned object. Times are in seconds, relative to the value of the Content Time (0008,0033) in the parent object.

345 The range shall include all frames between the specified times including any frames at the specified times.

The range may be expanded as a consequence of the format in which the information is stored. Where such expansion occurs, any embedded audio data shall be similarly selected. Under all circumstances, the returned Composite SOP Instance shall retain the relationship between image and audio data.

Note: For MPEG-2 this would be to the nearest surrounding Key Frames
350 For JPEG 2000 Part 2, this would be to nearest surrounding precinct or tile boundary

Time Range shall only be used to specify extraction from SOP instances where the times of frames can be ascertained using one or more of the following attributes:

• Frame Time (0018,1063)

355
- Frame Time Vector (0018,1065)

- Frame Reference DateTime (0018,9151) in the Frame Content Sequence (0020,9111)

X.3.3 New Object Creation at the FRAME level

360 When a 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
365 Composite Instance.

- 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
370 such as start time, time offsets, and modifying the Per-frame Functional Group Sequence (5200,9230).

- 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 X.3.2. The frames shall be in the same order as in the source Composite
375 Instance.

- 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
380 Sequence.

- 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,
385 containing one new Item. In either case, the new Item shall describe the equipment that is 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,
390 and therefore the Series level information cannot be altered.

- The new Composite Instance shall have the same Patient, Study and Series level information as the source Instance, including Study and Series Instance UIDs.

395

- ▪ 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 X.3.3, and Number of Frames (0028,0008) shall contain the number of frames in the new Composite Instance.

400

- ▪ 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.

405

- ▪ 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.

410 ## X.4   DIMSE-C SERVICE GROUPS

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

415

X.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

420 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.

425 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.

430 ### X.4.1.1   C-MOVE Service Parameters

X.4.1.1.1   SOP Class UID

The SOP Class UID identifies the Query/Retrieve Information Model against which the C-MOVE is to be performed. Support for the SOP Class UID is implied by the Abstract Syntax UID of the Presentation Context used by this C-MOVE operation.

435 **X.4.1.1.2   Priority**

The Priority Attribute defines the requested priority of the C-MOVE operation and corresponding C-STORE sub-operations with respect to other DIMSE operations being performed by the same SCP.

Processing of priority requests is not required of SCPs. Whether or not an SCP supports priority processing, and the meaning of the different priority levels shall be stated in the Conformance Statement
440 of the SCP. The same priority shall be used for all C-STORE sub-operations.

X.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.

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

X.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
450 — SOP Instance UID(s) (0008,0018)
— One of the Frame Range Keys if present in the Information Model for the level of the Retrieval

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
455 defined in the SOP Class definition for the Query/Retrieve Information Model.

X.4.1.1.4   Status

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

Table X.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	AA00	(0000,0902)

	SOP Instance		
	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)

460

X.4.1.1.5 Number of Remaining Sub-Operations

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

X.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

465 ### X.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

X.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.

X.4.1.2 C-MOVE SCU Behavior

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

— 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
475 requested Frame List. The Requested Frame List shall be constructed as defined in X.3.2.

— 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.

480

— 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:

o Success to indicate that all sub-operations were successfully completed

o Failure or Refused to indicate all sub-operations were unsuccessful

485

o 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-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.

490

495

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.

500

X.4.1.3 C-MOVE SCP Behavior

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

505

— 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.

— If the Retrieve Level (0000,0052) is FRAME, the SCP shall create a new Composite Instance according to the rules in section X.3.2. The newly created SOP Instance shall be treated in the same manner as the set of Entities identified above.

510

— 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.

515

— 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.

520   — 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:

        o Success if all sub-operations were successfully completed

        o Failure if all sub-operations were unsuccessful

525   o 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-

530   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.

535

X.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

540 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.

545   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.

550 ### X.4.2.1   C-GET Service Parameters

X.4.2.1.1   SOP Class UID

The SOP Class UID identifies the Query/Retrieve Information Model against which the C-GET is to be performed. Support for the SOP Class UID is implied by the Abstract Syntax UID of the Presentation Context used by this C-GET operation.

555 ### X.4.2.1.2   Priority

The Priority Attribute defines the requested priority of the C-GET operation and corresponding C-STORE sub-operations with respect to other DIMSE operations being performed by the same SCP.

Processing of priority requests is not required of SCPs. Whether or not an SCP supports priority processing, and the meaning of the different priority levels shall be stated in the Conformance Statement

560 of the SCP. The same priority shall be used for all C-STORE sub-operations.

X.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.

X.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

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.

X.4.2.1.4 Status

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

Table X.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)

580

X.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

X.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

585 ### X.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

X.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.

X.4.2.2   C-GET SCU Behavior

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

— 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 595 Requested Frame List. The Requested Frame List shall be constructed as a Frame List as defined in X.3.2.

— 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 600 Storage Service Class.

— 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.

605 — 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:

- o Success to indicate that all sub-operations were successfully completed

- o Failure or Refused to indicate all sub-operations were unsuccessful

610 — o 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 615 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.

620 **X.4.2.3   C-GET SCP Behavior**

An SCP conveys the following semantics with a C-GET 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-GET request.

625 — If the Retrieve Level (0000,0052) is FRAME, the SCP shall create a new Composite Instance according to the rules in section X.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 630 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 635 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 640 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:

645 — o Success if all sub-operations were successfully completed

- o Failure if all sub-operations were unsuccessful

- o Warning in all other cases.

650

— 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.

655

— 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.

X.5 ASSOCIATION NEGOTIATION

660

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-GET operation, use the SCP/SCU Role Selection Sub-Item to identify the SOP Classes that may be used for retrieval.

665

X.5.1 Association Negotiation for C-GET SOP Classes

— Rules are as specified in C.5.3, except that the Relational-retrieval extended negotiation sub-item shall not be used for this service class.

670 ## X.6 SOP CLASS DEFINITIONS

X.6.1 Composite Instance Root SOP Class Group

— In the Composite Instance Root Retrieve Only Information Model, the information is arranged into two levels that correspond to one of the two values in element (0008,0052) shown in Table X.6.1-1.

675

Table X.6.1-1
Retrieve Level Values for Composite Instance Root

Retrieve Level	Value in (0008,0052)
Composite Instance	IMAGE
Frame	FRAME

680 Note: The use of the word "IMAGE" rather than "Composite Instance" is historical to allow backward compatibility with previous versions of the standard. It should not be taken to mean that Composite Instances of other than image type are not included at the level indicated by the value IMAGE.

X.6.1.1   Composite Instance Root Retrieve Only Information Model

685 **X.6.1.1.1   E/R Model**

The Composite Instance Root Retrieve Only Information Model may be represented by the entity relationship diagram shown in Figure X.6.1-1
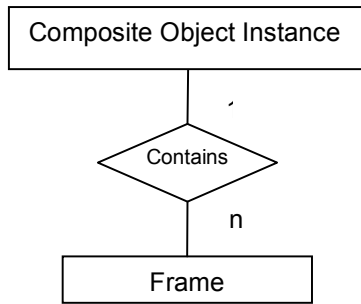
FIGURE X.6-1 COMPOSITE INSTANCE ROOT INFORMATION MODEL E/R DIAGRAM

690 **X.6.1.1.2   Composite Instance Level**

Table X.6-1 defines the keys at the Composite Instance level of the Composite Instance Root Query/Retrieve Information model.

Table X.6-1
COMPOSITE INSTANCE LEVEL KEYS FOR THE COMPOSITE INSTANCE ROOT QUERY/RETRIEVE
695 **INFORMATION MODEL**

Description	Tag	Matching Key Type
SOP Instance UID	(0008,0018)	U

X.6.1.1.3   Frame Level

Table X.6-2 defines the keys at the Frame level of the Composite Instance Root Query/Retrieve
700 Information Model. One and only one of the frame level keys listed in Table X.6-2 shall be present in a FRAME level request

Table X.6-2
FRAME LEVEL KEYS FOR THE COMPOSITE INSTANCE
ROOT QUERY/RETRIEVE INFORMATION MODEL

Description	Tag	Condition
Simple Frame List	(0008,1161)	Required if Calculated Frame List and Time Range are not present

Calculated Frame List	(0008,1162)	Required if Simple Frame List and Approximate Frame Range are not present
Time Range	(0008,1163)	Required if Simple Frame List and Calculated Frame List are not present

705

X.6.1.1.4 Scope of the C-MOVE or C-GET Commands and Sub-Operations

A C-MOVE or C-GET request may be performed to any level of the Query/Retrieve Model. A C-MOVE or C-GET where the Query/Retrieve level is the:

710
  — IMAGE level indicates that selected individual Composite Instances shall be transferred
  — FRAME level indicates that a single new Composite Instance shall be created and transferred

  Note: More than one entity may be retrieved if the Query/Retrieve Level is IMAGE using List of UID matching, but if the Query/Retrieve Level is FRAME then only a single entity may be retrieved.

715

X.6.1.2 Conformance Requirements

An implementation may conform to one of the Composite Instance Root Retrieve SOP Classes as an SCU, SCP or both. The Conformance Statement shall be in the format defined in PS 3.2.

X.6.1.2.1 SCU Conformance

720 **X.6.1.2.1.1 C-MOVE SCU Conformance**

An implementation that conforms to one of the Composite Instance Root Retrieve SOP Classes as an SCU shall support transfers against the Retrieve Information Model described in Section X.6.1.1 using the C-MOVE SCU Behavior described in Section X.4.1.2. An implementation that conforms to one of the SOP Classes of the Composite Instance Root SOP Class Group as an SCU, and which generates retrievals
725 using the C-MOVE operation shall state in its Conformance Statement the Storage Service Class SOP Classes under which it shall support the C-STORE sub-operations generated by the C- MOVE.

X.6.1.2.1.2 C-GET SCU Conformance

An implementation that conforms to one of the Composite Instance Root Retrieve SOP Classes as an SCU shall support retrievals against the Retrieve Information Model described in Section X.6.1.1 using the
730 C-GET SCU Behavior described in Section X.4.2.2. An implementation that conforms to one of the SOP Classes of the Composite Instance Root SOP Class Group as an SCU, which generates retrievals using the C-GET operation shall state in its Conformance Statement the Storage Service Class SOP Classes under which it shall support the C-STORE sub-operations generated by the C-GET.

X.6.1.2.2 SCP Conformance

735 An implementation that conforms to one of the Composite Instance Root Retrieve SOP Classes as an SCP for C-GET operations shall:

1) support both levels of the Composite Instance Root Retrieve Only Information Model

2) support all three Frame Level keys

740 3) describe in its conformance statement the transformations it applies to a multi-frame Composite Instance when creating a new Composite Instance as defined in Section X.3.3.

X.6.1.2.2.1 C-MOVE SCP Conformance

An implementation that conforms to one of the Composite Instance Root Retrieve SOP Classes as an SCP shall support retrievals against both levels of the Retrieve Information Model described in Section X.6.1.1 using the C-MOVE SCP Behavior described in Section X.4.1.3. An implementation that conforms to one of the SOP Classes of the Composite Instance Root SOP Class Group as an SCP, which satisfies retrievals using the C- MOVE operation shall state in its Conformance Statement the Storage Service Class SOP Classes under which it shall support the C-STORE sub-operations generated by the C- MOVE.

X.6.1.2.2.2 C-GET SCP Conformance

An implementation that conforms to one of the Composite Instance Root Retrieve SOP Classes as an SCP shall support retrievals against both levels of the Retrieve Information Model described in Section X.6.1.1 using the C-GET SCP Behavior described in Section X.4.2.3. An implementation that conforms to one of the SOP Classes of the Composite Instance Root SOP Class Group as an SCP, and which satisfies retrievals using the C-GET operation shall state in its Conformance Statement the Storage Service Class SOP Classes under which it shall support the C-STORE sub-operations generated by the C-GET.

X.6.1.3 SOP Classes

The SOP Classes in the Composite Instance Root SOP Class Group of the Query/Retrieve Service Class identify the Composite Instance Root Retrieve Only Information Model, and the DIMSE-C operations supported. The Standard SOP Classes are listed in Table X.6.1.3-1.

Table X.6.1.3-1
SOP Classes for Composite Instance Query/Retrieve Root

UID NAME	UID Value
Composite Instance Root Retrieve – MOVE	1.2.840.10008.5.1.4.1.2.4.2
Composite Instance Root Retrieve – GET	1.2.840.10008.5.1.4.1.2.4.3

PS 3.4 Insert New Annex Y as follows

765 ## Annex Y   Composite Instance Retrieve Without Bulk Data SOP Classes (Normative)

Y.1   OVERVIEW

Y.1.1   Scope

Composite Instance Retrieve Without Bulk Data Service is a service within the DICOM Query/Retrieve
770 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 Y.1.3.

Y.1.2   Composite Instance Retrieve Without Bulk Data Information Model

Retrievals are implemented against the Composite Instance Retrieve Without Bulk Data Information
775 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   Attributes Not Included

The attributes that shall not be included in the top level of the Dataset sent by an SCP of this Service are
as defined in Table Y.1-1

780 **Table Y.1-1**
Attributes not to be Included in Instances Sent

Attribute	Tag
Pixel Data	(7FE0,0010)
Pixel Data URL	(7FE0,0120)
Spectroscopy Data	(5600,0020)
Overlay Data	(60xx,3000)
Curve Data	(50xx,3000)
Audio Sample Data	(50xx,200C)

Note: This implies that the pixel data within Icon Image Sequence (0088,0200) Items will be preserved.
785 The Waveform Data (5400,1010) attribute shall not be included within the Waveform Sequence
(5400,0100).

Y.1.4   Service Definition

Two peer DICOM AEs implement a SOP Class of the Composite Instance Retrieve Without Bulk Data
790 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.

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

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

— 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 Y.1.3 in the data sent during those sub-operations. These C-STORE 800 sub-operations occur on the same Association as the C-GET service and the SCU/SCP roles are reversed for the C-STORE.

Note: If the source instance does not contain any of the attributes described in Section Y.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 805 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 810 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- 815 operations and returns a status of Canceled.

Y.2   COMPOSITE INSTANCE RETRIEVE WITHOUT BULK DATA INFORMATION MODEL DEFINITION

The Composite Instance Retrieve Without Bulk Data Information Model is identified by the SOP Class 820 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 Retrieve Without Bulk Data Information Model (i.e. not the SOP Class of the stored SOP Instances for which the SCP has information)

825 Information Model Definitions for standard SOP Classes of the Composite Instance Retrieve Without Bulk Data Service are defined in this Annex. A Composite Instance Retrieve Without Bulk Data Information Model Definition contains:

— Entity-Relationship Model Definition
— Key Attributes Definition

830

Y.2.1 Entity-Relationship Model Definition

For any Composite Instance Retrieve Without Bulk Data 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).

835 ### Y.2.2 Attributes Definition

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

Y.3 STANDARD COMPOSITE INSTANCE RETRIEVE WITHOUT BULK DATA INFORMATION MODEL

One standard Composite Instance Retrieve Without Bulk Data Information Model is defined in this Annex.
840 The Composite Instance Retrieve Without Bulk Data Information Model is associated with a single SOP Class. The following Composite Instance Retrieve Without Bulk Data Information Model is defined:

— Retrieve Without Bulk Data

Y.3.1 Composite Instance Retrieve Without Bulk Data Information Model

845 The Composite Instance Retrieve Without Bulk Data Information Model is based upon a one level hierarchy:

— Composite Instance

The Retrieve Without Bulk Data Information Model may be represented by the entity relationship diagram
850 shown in Figure Y.3.1-1.

```
┌─────────────────────────┐
│ Composite Object Instance │
└─────────────────────────┘
```
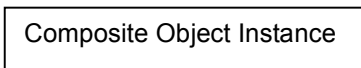
FIGURE Y.3.1-1 RETRIEVE WITHOUT BULK DATA INFORMATION MODEL E/R DIAGRAM

The Composite Instance level is the only level and contains only the SOP Instance UID.
855

Y.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
860

Y.4.1 C-GET Operation

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 Y.1.3 to
865 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.

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

Y.4.2.1   C-GET Service Parameters

Y.4.2.1.1   SOP Class UID

875 The SOP Class UID identifies the Query/Retrieve Information Model against which the C-GET is to be performed. Support for the SOP Class UID is implied by the Abstract Syntax UID of the Presentation Context used by this C-GET operation.

Y.4.2.1.2   Priority

The Priority Attribute defines the requested priority of the C-GET operation and corresponding C-STORE
880 sub-operations with respect to other DIMSE operations being performed by the same SCP.

Processing of priority requests is not required of SCPs. Whether or not an SCP supports priority processing, and the meaning of the different priority levels shall be stated in the Conformance Statement of the SCP. The same priority shall be used for all C-STORE sub-operations.

Y.4.2.1.3   Identifier

885 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.

890 ### 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)

895 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.

Y.4.2.1.4   Status

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

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

Service	Further Meaning	Status	Related

Status		Codes	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)

Y.4.2.1.5 Number of Remaining Sub-Operations

905 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

910 ### 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 and C-STORE SCP Behavior

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

— The SCU shall specify one Instance UID or a list of Instance UIDs.

915   — 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
920   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,
925   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:

     o   Success to indicate that all sub-operations were successfully completed

     o   Failure or Refused to indicate all sub-operations were unsuccessful

930   o   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
935   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
940   match SOP Class" (A9xx) or "Warning: Dataset does not match SOP Class" (B007) due to the absence of the Attributes described in Section Y.1.3.

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

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

945   — 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 Y.1.3. The SCP of the Query/Retrieve Service Class shall serve as an SCU of the Storage Service Class.

950   — Apart from the Attributes listed in section Y.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
955   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.

960

— 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:

965

    o   Success if all sub-operations were successfully completed

    o   Failure if all sub-operations were unsuccessful

    o   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.

970

— 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.

975

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.

980

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.

985

Y.5.1   Association Negotiation for C-GET SOP Classes

— Rules are as specified in C.5.3, except that the Relational-retrieval extended negotiation sub-item shall not be used for this service class.

990

Y.6   SOP CLASS DEFINITIONS

Y.6.1   Composite Instance Retrieve Without Bulk Data SOP Class Group

— In the Composite Instance Retrieve Without Bulk Data Only Information Model, only a single Retrieve Level is used.

995

Table Y.6.1-1
Retrieve Level Value for Retrieve Without Bulk Data

Retrieve Level	Value in (0008,0052)
Composite Instance	IMAGE

Note: The use of the word "IMAGE" rather than "Composite Instance" is historical to allow backward compatibility with previous versions of the standard. It should not be taken to mean that Composite Instances of other than image type are not included at the level indicated by the value IMAGE.

Y.6.1.1 Composite Instance Retrieve Without Bulk Data Information Model

Y.6.1.1.1 E/R Model

The Composite Instance Retrieve Without Bulk Data Only Information Model has only a single level: IMAGE.

Y.6.1.1.2 Composite Instance Level

Table Y.6-1 defines the keys at the Composite Instance level of the Composite Instance Retrieve Without Bulk Data Query/Retrieve Information model.

Table Y.6-1

COMPOSITE INSTANCE LEVEL KEYS FOR THE COMPOSITE INSTANCE ROOT QUERY/RETRIEVE INFORMATION MODEL

Description	Tag	Matching Key Type
SOP Instance UID	(0008,0018)	U

Y.6.1.1.3 Scope of the C-GET Commands and Sub-Operations

A C-GET request may only be performed at the IMAGE level of the Query/Retrieve Model. A C-GET indicates that selected individual Composite Instances, without bulk data attributes shall be transferred.

Y.6.1.2 Conformance Requirements

An implementation may conform to one of the SOP Classes of the Composite Instance Retrieve Without Bulk Data SOP Class Group as an SCU, SCP or both. The Conformance Statement shall be in the format defined in PS 3.2.

Y.6.1.2.1 SCU Conformance

An implementation that conforms to one of the SOP Classes of the Composite Instance Retrieve Without Bulk Data SOP Class Group as an SCU shall support retrievals against the Query/Retrieve Information Model described in Section Y.6.1.1 using the C-GET SCU Behavior described in Section Y.4.2.2. An implementation that conforms to one of the SOP Classes of the Composite Instance Retrieve Without Bulk Data SOP Class Group as an SCU, and which generates retrievals using the C-GET operation shall state in its Conformance Statement the Storage Service Class SOP Classes under which it shall support the C-STORE sub-operations generated by the C-GET.

Y.6.1.2.2 SCP Conformance

An implementation that conforms to one of the SOP Classes of the Composite Instance Retrieve Without Bulk Data SOP Class Group as an SCP shall support retrievals against both levels of the Retrieve Information Model described in Section Y.6.1.1 using the C-GET SCP Behavior described in Section Y.4.2.3. An implementation that conforms to one of the SOP Classes of the Composite Instance Retrieve Without Bulk Data SOP Class Group as an SCP, and which satisfies retrievals using the C-GET operation shall state in its Conformance Statement the Storage Service Class SOP Classes under which it shall support the C-STORE sub-operations generated by the C-GET.

Y.6.1.3 SOP Classes

The SOP Classes in the Composite Instance Retrieve Without Bulk Data SOP Class Group of the Query/Retrieve Service Class identify the Composite Instance Retrieve Without Bulk Data Only Information Model, and the DIMSE-C operations supported. The Standard SOP Classes are listed in Table Y.6.1.3-1.

Table Y.6.1.3-1
SOP Classes for Composite Instance Query/Retrieve Root

UID NAME	UID Value
Composite Instance Retrieve Without Bulk Data – GET	1.2.840.10008.5.1.4.1.2.5.3

1045 **Changes to NEMA Standards Publication PS 3.6-2008**

Digital Imaging and Communications in Medicine (DICOM)

Part 6: Data Dictionary

PS 3.6: Add the following data elements to Section 6:

Tag	Name	VR	VM
(0008,1161)	Simple Frame List	UL	1-n
(0008,1162)	Calculated Frame List	UL	3-3n
(0008,1163)	Time Range	FD	2
(0008,1164)	Frame Extraction Sequence	SQ	1
(0008,1167)	Multi-Frame Source SOP Instance UID	UI	1

1050

PS 3.6: Add the following UIDs to Annex A:

UID Value	UID NAME	Category	
1.2.840.10008.5.1.4.1.2.4.2	Composite Instance Root Retrieve – MOVE	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.2.4.3	Composite Instance Root Retrieve – GET	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.2.5.3	Composite Instance Retrieve Without Bulk Data – GET	SOP Class	PS3.4

1055 **Changes to NEMA Standards Publication PS 3.16-2008**

Digital Imaging and Communications in Medicine (DICOM)

Part 16: Explanatory Information

Append to CID 7005 Contributing Equipment Purposes of Reference
Context ID 7005 : Contributing Equipment Purposes of Reference

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	109105	Frame Extracting Equipment

1060 | Add to the Table in Annex D |
| --- |

109105	Frame Extracting Equipment	Equipment that has processed composite instances to create new composite instances by extracting selected frames from the original instance.	

Changes to NEMA Standards Publication PS 3.17-2008

Digital Imaging and Communications in Medicine (DICOM)

Part 17: Explanatory Information

PS 3.17: Add the following Annexes:

Annex ZX Use Cases for the Composite Instance Root Retrieval Classes

The use cases fall into five broad groups:

ZX.1 CLINICAL REVIEW

ZX.1.1 Retrieval based on report references

A referring physician receives radiological diagnostic reports on CT or MRI examinations. These reports contain references to specific images. He chooses to review these specific images himself and/or show the patient. The references in the report point to particular slices. If the slices are individual images, then they may be obtained individually. If the slices are part of an enhanced multi-frame CT/MR object, then retrieval of the whole multi-frame object might take too long. The Composite Instance Root Retrieve Service allows retrieval of only the selected frames.

The source of the image and frame references in the report could be KOS, CDA, SR, presentation states or other sources.

Selective retrieval can also be used to retrieve 2 or more arbitrary frames, as may be used for digital subtraction (masking), and may be used with any multi-frame objects, including multi-frame ultrasound, XR etc.

Features of interest in many long "video" examinations (e.g. endoscopy) are commonly referenced as times from the start of the examination. The same benefits of reduced WAN bandwidth use could be obtained by shortening the MPEG-2 or JPEG 2000 Part 2 Multi-component based stream prior to transmission.

ZX.1.2 Selective retrieval without references to specific slices

Retrieval using the Composite Instance Retrieve Without Bulk Data Retrieve Service allows determination and retrieval of a suitable subset of frames. This could for instance be used to retrieve only the slices with particular imaging characteristics (e.g. T2 weighting from an enhanced MR object).

ZX.2 LOCAL USE – "RELEVANT PRIORS"

ZX.2.1 Anatomic sub-region

A multi-frame CT or MR may cover a larger area of anatomy than is required for use as a relevant prior. How the SCU determines which frames are relevant is outside the scope of the standard.

ZX.2.2   Worklists

Relevant priors may be specified by instance and frame references in a worklist and benefit from the same facilities.

ZX.3   ATTRIBUTE BASED RETRIEVAL

1100   There are times when it would be useful to retrieve from a multi-frame image only those frames satisfying certain dimensionality criteria, such as those CT slices fitting within a chosen volume. Initial retrieval of the image using the Composite Instance Retrieve Without Bulk Data Retrieve Service allows determination and retrieval of a suitable sub-set of frames.

ZX.4   CAD & DATA MINING APPLICATIONS

1105   Given the massively enhanced amount of dimensional information in the new CT/MR objects, applications could be developed that would use this for statistical purposes without needing to fetch the whole (correspondingly large) pixel data set. The Composite Instance Retrieve Without Bulk Data Retrieve Service permits this.

ZX.5   INDEPENDENT WADO SERVER

1110   A hospital has a large PACS (that supports multi-frame objects) that does not support WADO. The hospital installs a separate WADO server that obtains images from the PACS using DICOM. WADO has the means to request individual frames, supporting many of the above use cases.

Annex ZY Example SCU use of the Composite Instance Root Retrieval Classes

ZY.1 RETRIEVAL OF ENTIRE COMPOSITE INSTANCES

1115   There are many modules in DICOM that use the Image SOP Instance Reference Macro (PS 3.4 Table 10-3), which includes the SOP Instance UID and SOP class UID, but not the Series Instance UID and Study Instance UID.   Using the Composite Instance Root Retrieval Classes however, retrieval of such instances is simple, as a direct retrieval may be requested, including only the SOP Instance UID in the Identifier of the C-GET request.

1120   **ZY.2 RETRIEVAL OF SELECTED FRAME COMPOSITE INSTANCES FROM MULTI-FRAME OBJECTS**

Where the frames to be retrieved and viewed are known in advance, - e.g. when they are referenced by an Image Reference Macro in a structured report, then they may be retrieved directly using either of the Composite Instance Root Retrieval Classes.

1125   **ZY.3 RETRIEVAL OF SELECTED FRAME COMPOSITE INSTANCES FROM MPEG-2 VIDEO**

If the image has been stored in MPEG-2 format, and if the SCU has knowledge independent of DICOM as to which section of a "video" is required for viewing (e.g. perhaps notes from an endoscopy) then the SCU can perform the following steps:

1)   Use known configuration information to identify the available transfer syntaxes

1130   2)   If MPEG-2 or JPEG 2000 Part 2 Multi-component transfer syntaxes are available, then issue a request to retrieve the required section.

The data received may be slightly longer than that requested, depending on the position of key frames in the data.

3)   If only other transfer syntaxes are available, then the SCU may need to retrieve most of the object
1135   using Composite Instance Retrieve Without Bulk Data Retrieve Service to find the frame rate or frame time vector, and then calculate a list of frames to retrieve as in the previous sections.

Annex ZZ Considerations for Applications Creating New Images from Multi-Frame Images

ZZ.1 SCOPE

The purpose of this annex is to aid those developing SCPs of the Composite Instance Root Retrieve Service Class. The behavior of the application when making any of the changes discussed in this annex should be documented in the conformance statement of the application.

ZZ.2 FRAME EXTRACTION ISSUES

There are many different aspects to consider when extracting frames to make a new object, to ensure that the new image remains a fully valid SOP Instance, and the following is a non-exhaustive list of important issues

ZZ.2.1 Number of Frames

The Number of Frames (0028,0008) attribute will need to be updated.

ZZ.2.2 Start and End Times

Any attributes that refer to start and end times such as Acquisition Time (0008,0032) and Content Time (0008,0033) must be updated to reflect the new start time if the first frame is not the same as the original. This is typically the case where the multi-frame object is a "video" and where the first frame is not included. Likewise, Image Trigger Delay(0018,1067) may need to be updated.

ZZ.2.3 Time Interval vs. Frame Increment Vector

The Frame Time (0018,1063) may need to be modified if frames in the new image are not a simple contiguous sequence from the original, and if they are irregular, then the Frame Time Vector (0018,1065) will need to be used in its place, with a corresponding change to the Frame Increment Pointer (0028,0009). This also needs careful consideration if non-consecutive frames are requested from an image with non-linearly spaced frames.

ZZ.2.4 MPEG-2

Identifying the location of the requested frames within an MPEG-2 data stream is non-trivial, but if achieved, then little else other than changes to the starting times are likely to be required for MPEG-2 encoded data, as the use-cases for such encoded data (e.g. endoscopy) are unlikely to include explicit frame related data. See the note below however for comments on "single-frame" results.

An application holding data in MPEG-2 format is unlikely to be able to create a range with a frame increment of greater than one (a calculated frame list with a 3rd value greater than one), and if such a request is made, it might return a status of AA02 : Unable to extract Frames.

The approximation feature of the Time Range form of request is especially suitable for data held in MPEG-2 form, as it allows the application to find the nearest surrounding key frames, which greatly simplifies editing and improves quality.

ZZ.2.5 JPEG 2000 Part 2 Multi-Component Transform

Similar issues exist as for MPEG-2 data and similar solutions apply.

ZZ.2.6 Functional Groups for enhanced CT, MR etc.

It is very important that functional groups for enhanced image objects are properly re-created to reflect the reduced set of frames, as they include important clinical information. The requirement in the standard that the resulting object be a valid SOP instance does make such re-creations mandatory.

ZZ.2.7 Nuclear Medicine Images

Images of the Nuclear Medicine SOP class are described by the Frame Increment Pointer (0028,0009) which in turn references a number of different "Vectors" as defined in Table C.8-7 in PS3.3. Like the Functional Groups above, these Vectors are required to contain one value for each frame in the Image, and so their contents must be modified to match the list of frames extracted, ensuring that the values retained are those corresponding to the extracted frames.

ZZ.2.8 A "Single-Frame" Multi-Frame Image

The requirement that the newly created image object generated in response to a Frame level retrieve request must be the same as the SOP class will frequently result in the need to create a single frame instance of an object that is more commonly a multi-frame object, but this should not cause any problems with the IOD rules, as all such objects may quite legally have Number of Frames = 1.

However, a single frame may well cause problems for a transfer syntax based on "video" such as those using MPEG-2, and therefore the SCU when negotiating a C-GET should consider this problem, and include one or more transfer syntaxes suitable for holding single or non-contiguous frames where such a retrieval request is being made.

ZZ.3 FRAME NUMBERS

Frame numbers are indexes, not identifiers for frames. In every object, the frame numbers always start at 1 and increment by 1, and therefore they will not be the same after extraction into a new SOP Instance.

A SOP Instance may contain internal references to its own frames such as mask frames. These may need to be corrected.

ZZ.4 CONSISTENCY

There is no requirement in the Frame Level Retrieve Service for the SCP to cache or otherwise retain any of the information it uses to create the new SOP Instance, and therefore, an SCU submitting multiple requests for the same information cannot expect to receive the "same" object with the same Instance and Series UIDs each time. However, an SCP may choose to cache such instances, and if returning an instance identical to one previously created, then the same Instance and Series UIDs may be used. The newly created object is however guaranteed to be a valid SOP instance and an SCU may therefore choose to send such an instance to an SCP using C-STORE, in which case it should be handled exactly as any other Composite Instance of that SOP class.

ZZ.5 TIME SYNCHRONIZATION

The time base for the new composite instance should be the same as for the source image and should use the same time synchronization frame of reference. This allows the object to retain synchronization to any simultaneously acquired waveform data

ZZ.6 AUDIO

1215 Where the original object is MPEG-2 with interleaved audio data in the MPEG-2 data stream, and where the retrieved object is also MPEG-2 encoded, then audio could normally be preserved and maintain synchronization, but in other cases, the audio may be lost.

ZZ.7 PRIVATE ATTRIBUTES

1220 As with all modifications to existing SOP instances, an application should remove any data that it cannot guarantee to make consistent with the modifications it is making. Therefore, an application creating new images from multi-frame images should remove any private attributes about which it lacks sufficient information to allow safe and consistent modification. This behavior should be documented in the conformance statement.