

5

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

*Supplement 223: Repository Query, Inventory IOD, and Related Services*

10

15

20

*Prepared by:*

**DICOM Standards Committee, Working Group 33 (Data Archive and Management)**

1300 N. 17th Street, Suite 900

Rosslyn, Virginia 22209 USA

25

VERSION: Final Text, 2022/06/26

Developed in accordance with: DICOM Work Item 2020-08-B

Copyright © 2022 NEMA

30

## Table of Contents

	Scope and Field of Application .....	1
	DICOM PS 3.2 Conformance .....	3
	<i>Add SOP Classes to Table A.1-2 UID Values .....</i>	<i>3</i>
	DICOM PS 3.3: Information Object Definitions .....	4
35	<i>Add ZIP, TAR, GZIP, HTTP, NFS, and IHE to Section 2 Normative References .....</i>	<i>4</i>
	2.1 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) AND INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) .....	4
	2.3 INTERNET ENGINEERING TASK FORCE (IETF) .....	4
	2.6 OTHER REFERENCES .....	4
40	<i>Add Inventory to Section 3 Definitions .....</i>	<i>5</i>
	3.8 DICOM INFORMATION OBJECT .....	5
	<i>Add new subsection for DICOM File Format to Section 3 Definitions .....</i>	<i>5</i>
	3.23 DICOM MEDIA STORAGE AND FILE FORMAT .....	5
	<i>Add Inventory to Section 7.13 DICOM Model of the Real World for Non-Patient-Related Information .....</i>	<i>6</i>
45	7.13.6 Inventory .....	6
	<i>Add Inventory IOD to Section A.1.4 summary table .....</i>	<i>7</i>
	A.1.4 Overview of the Composite IOD Module Content .....	7
	<i>Add new section for Inventory IOD to Annex A Composite Information Object Definitions .....</i>	<i>8</i>
	A.88 INVENTORY IOD .....	8
50	A.88.1 Inventory IOD Description .....	8
	A.88.2 Inventory IOD Entity-Relationship Model .....	8
	A.88.3 Inventory IOD Module Table .....	8
	<i>Add new section for Inventory Creation IOD to Annex B Normalized Information Object Definitions .....</i>	<i>9</i>
	B.30 INVENTORY CREATION IOD .....	9
55	B.30.1 Inventory Creation IOD Description .....	9
	B.30.2 Inventory Creation IOD Module Table .....	9
	<i>Add new section for Inventory Modules to Annex C Information Module Definitions .....</i>	<i>10</i>
	C.38 INVENTORY MODULES .....	10
	C.38.1 Inventory Module .....	10
60	C.38.1.1 Inventory Instance Attributes .....	20
	C.38.1.1.1 Content Date and Content Time .....	20
	C.38.1.1.2 Scope of Inventory .....	20
	C.38.1.1.3 Inventory Completion Status .....	21
65	C.38.1.1.4 Inventory Access End Points Sequence and Study Access End Points Sequence .....	21
	C.38.1.1.5 Incorporated Inventory Instance Sequence .....	21
	C.38.1.1.6 Inventoried Studies Sequence .....	22
	C.38.1.2 Inventoried Study Attributes .....	22
70	C.38.1.2.1 Study Update DateTime .....	22
	C.38.1.2.2 Removed from Operational Use and Reason for Removal Code Sequence .....	23
	C.38.1.2.3 Number of Study Related Series, and Number of Study Related Instances .....	23
	C.38.1.2.4 Anatomic Regions in Study Code Sequence .....	23
	C.38.1.2.5 Original Attributes Macro .....	24
	C.38.1.2.6 Stored Instance Base URI .....	24
75	C.38.1.2.7 Folder Access URI and File Access URI .....	25
	C.38.1.2.8 Container File Type .....	25
	C.38.1.2.9 Instance Availability .....	26
	C.38.1.3 Inventoried Series Attributes .....	26

	C.38.1.3.1 Folder Access URI and File Access URI .....	26
80	C.38.1.3.2 Body Part Examined .....	26
	C.38.1.3.3 Request Attributes Sequence .....	26
	C.38.1.4 Inventoried SOP Instance Attributes.....	27
	C.38.1.4.1 Optional Attributes .....	27
	C.38.1.4.2 File Access Sequence .....	27
85	C.38.1.4.3 Metadata from Inventory .....	27
	C.38.1.4.4 Expiration DateTime .....	28
	C.38.1.4.5 Alternate Representation Sequence .....	28
	C.38.2 Inventory Related Macros.....	28
	C.38.2.1 Scope of Inventory Macro.....	29
90	C.38.2.1.1 Scope of Inventory Macro Attributes.....	31
	C.38.2.1.1.1 Scope of Inventory Sequence .....	31
	C.38.2.1.1.2 Relational Matching.....	31
	C.38.2.1.1.3 Range Matching Sequence .....	32
	C.38.2.1.1.4 List of UID Matching Sequence.....	32
95	C.38.2.1.1.5 Empty Value Matching Sequence .....	32
	C.38.2.1.1.6 General Matching Sequence.....	32
	C.38.2.2 Stored File Access Macro.....	34
	C.38.2.2.1 Stored File Access Macro Attributes.....	35
100	C.38.2.2.1.1 File Access URI.....	35
	C.38.2.2.1.2 Filename in Container, File Offset in Container, and File Length in Container .....	35
	C.38.2.2.1.3 MAC .....	35
	C.38.2.3 Inventory Reference Macro .....	35
	C.38.2.3.1 Inventory Reference Macro Attributes .....	36
105	C.38.2.3.1.1 Inventory Access End Points Sequence .....	36
	C.38.2.3.1.2 File Access URI and Stored Instance Base URI .....	37
	C.38.2.4 Access End Points Macro.....	37
	C.38.3 Inventory Creation Module .....	38
	C.38.3.1 Inventory Creation Module Attributes .....	39
110	C.38.3.1.1 Referenced SOP Instance UID .....	39
	C.38.3.1.2 File Access URI and Stored Instance Base URI.....	39
	C.38.3.1.3 Expiration DateTime .....	39
	<i>Factor out Referenced Request Sequence Attributes from SR and KO to be referenced in Inventory .....</i>	<i>40</i>
	C.17.2 SR Document General Module.....	40
115	C.17.2.8 Referenced Request Macro.....	41
	C.17.6.2 Key Object Document Module .....	42
	<i>Add new Inventory Directory Record Type to Section F.3.2.2 .....</i>	<i>44</i>
	<i>Add new Inventory Directory Record Type to Section F.4 and update Figure.....</i>	<i>44</i>
	<i>Add new Inventory Directory Record Definition to Section F.5 .....</i>	<i>45</i>
120	F.5.48 Inventory Directory Record Definition .....	45
	<i>Add new Annex P Stored File Access Through Non-DICOM Protocols .....</i>	<i>46</i>
	Annex P Stored File Access Through Non-DICOM Protocols (Normative) .....	46
	P.1 FILES AND SETS OF FILES .....	46
	P.1.1 DICOM File Format.....	46
125	P.1.2 Container File Formats .....	46
	P.1.2.1 ZIP .....	46
	P.1.2.2 TAR.....	46
	P.1.2.3 GZIP.....	47
	P.1.2.4 TARGZIP .....	47
130	P.1.2.5 BLOB .....	47
	P.1.3 Folders for Sets of Files.....	47

	P.2 ACCESS PROTOCOLS.....	47
	P.2.1 URI Format .....	47
	P.2.2 Protocol.....	47
135	DICOM PS3.4: Service Class Specifications .....	49
	<i>Add definition for Default Character Repertoire .....</i>	<i>49</i>
	3.8 DICOM DATA STRUCTURES AND ENCODING .....	49
	<i>Add definition of Non-Patient Object.....</i>	<i>49</i>
	3.9 DICOM SERVICE CLASS DEFINITIONS .....	49
140	<i>Add empty value matching and multiple value matching to Query/Retrieve.....</i>	<i>49</i>
	C.2.2.2 Attribute Matching.....	49
	C.2.2.2.1 Single Value Matching .....	49
	C.2.2.2.7 Empty Value Matching .....	50
	C.2.2.2.8 Multiple Value Matching.....	50
145	C.2.2.3 Matching Multiple Values.....	51
	<i>Add empty value matching and multiple value matching to Query/Retrieve Extended Negotiation .....</i>	<i>51</i>
	C.5.1.1 SOP Class Extended Negotiation.....	51
	C.5.1.1.1 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-RQ).....	51
	C.5.1.1.2 SOP Class Extended Negotiation Sub-Item Structure (A-ASSOCIATE-AC).....	52
150	<i>Add empty and multiple value matching to Query/Retrieve Conformance .....</i>	<i>53</i>
	C.6.1.2.1.1 C-FIND SCU Conformance .....	53
	C.6.1.2.2.1 C-FIND SCP Conformance .....	53
	C.6.2.2.1.1 C-FIND SCU Conformance .....	53
	C.6.2.2.2.1 C-FIND SCP Conformance .....	53
155	<i>Add Study Update DateTime to common Query/Retrieve Information Model .....</i>	<i>54</i>
	C.3.4 Additional Query/Retrieve Attributes .....	54
	C.6.1.1.3 Study Level .....	54
	C.6.2.1.2 Study Level .....	54
	<i>Add Repository Query SOP Class to Annex C.6 .....</i>	<i>55</i>
160	C.6.4 Repository Query SOP Class .....	55
	C.6.4.1 Additional Query Information Model Attributes .....	55
	C.6.4.1.1 Record Key .....	58
	C.6.4.1.2 Removed from Operational Use .....	59
	C.6.4.1.3 File Set Access Sequence and File Access Sequence .....	60
165	C.6.4.1.4 Metadata Sequence and Updated Metadata Sequence .....	61
	C.6.4.2 Repository Query Request Identifier Attributes .....	61
	C.6.4.3 Status Codes .....	62
	C.6.4.4 C-FIND SCU Behavior .....	62
	C.6.4.5 C-FIND SCP Behavior .....	62
170	C.6.4.5.1 Record Key .....	62
	C.6.4.5.2 Maximum Number of Records and Incomplete Response .....	62
	C.6.4.5.3 Prior Record Key and Subsequent Response .....	63
	C.6.4.5.4 Entities Removed from Operational Use.....	63
	C.6.4.5.5 File Set Access Sequence and File Access Sequence .....	63
175	C.6.4.6 Conformance Requirements.....	64
	C.6.4.6.1 C-FIND SCU Conformance.....	64
	C.6.4.6.2 C-FIND SCP Conformance.....	64
	C.6.4.7 SOP Classes .....	65
	<i>Add Inventory to Annex GG Non-Patient Object Storage Service Class .....</i>	<i>66</i>
180	GG.1.1 Scope .....	66
	GG.3 SOP CLASSES.....	66
	<i>Add new section for Inventory requirements to Section GG.6 Application Behavior .....</i>	<i>66</i>
	GG.6.6 Inventory Storage SOP Class.....	66

	GG.6.6.1 Instance Creator .....	66
185	<i>Add Inventory Query/Retrieve Service Class.....</i>	<i>67</i>
	JJ Inventory Query/Retrieve Service Class .....	67
	JJ.1 OVERVIEW.....	67
	JJ.1.1 Scope .....	67
	JJ.1.2 Conventions.....	67
190	JJ.1.3 Service Definition.....	67
	JJ.2 INVENTORY Q/R INFORMATION MODEL.....	67
	JJ.2.1 E-R Model.....	67
	JJ.2.2 Inventory Q/R Information Model Attributes .....	68
	JJ.3 DIMSE-C SERVICE GROUPS .....	68
195	JJ.3.1 C-FIND Operation.....	68
	JJ.3.2 C-MOVE Operation .....	69
	JJ.3.3 C-GET Operation.....	69
	JJ.4 SOP CLASS DEFINITIONS.....	69
	JJ.4.1 SOP Classes .....	69
200	JJ.4.2 Conformance Requirements.....	69
	JJ.4.2.1 SCU Conformance.....	69
	JJ.4.2.1.1 C-FIND SCU Conformance.....	69
	JJ.4.2.1.2 C-MOVE SCU Conformance .....	70
	JJ.4.2.1.3 C-GET SCU Conformance.....	70
205	JJ.4.2.2 SCP Conformance.....	70
	JJ.4.2.2.1 C-FIND SCP Conformance .....	70
	JJ.4.2.2.2 C-MOVE SCP Conformance.....	71
	JJ.4.2.2.3 C-GET SCP Conformance.....	71
	<i>Add new annex for Inventory Creation SOP Class within a Storage Management Service Class .....</i>	<i>72</i>
210	Annex KK Storage Management Service Class .....	72
	KK.1 OVERVIEW .....	72
	KK.1.1 Use Cases.....	72
	KK.1.2 SOP Classes .....	72
	KK.1.2.1 DIMSE Service Group .....	72
215	KK.1.2.2 Information Object Definitions .....	72
	KK.1.3 Service Protocol .....	73
	KK.1.3.1 Association Negotiation .....	73
	KK.1.3.2 Operations and Notifications .....	73
	KK.2 INVENTORY CREATION SOP CLASS.....	74
220	KK.2.1 Overview .....	74
	KK.2.1.1 Inventory Production States .....	74
	KK.2.2 Operations.....	75
	KK.2.2.1 Action Information.....	75
	KK.2.2.1.1 Scope of Inventory Sequence.....	75
225	KK.2.2.1.2 Inventory Level .....	76
	KK.2.2.2 Service Class User Behavior.....	76
	KK.2.2.3 Service Class Provider Behavior .....	76
	KK.2.3 Notifications.....	78
	KK.2.3.1 Event Information .....	78
230	KK.2.3.1.1 Inventory Terminated with Instances .....	79
	KK.2.3.2 Service Class Provider Behavior .....	79
	KK.2.3.3 Service Class User Behavior .....	80
	KK.2.4 Conformance.....	80
	KK.2.4.1 SCU Conformance .....	80

235	KK.2.4.1.1 Operations .....	80
	KK.2.4.1.2 Notifications .....	80
	KK.2.4.2 SCP Conformance.....	80
	KK.2.4.2.1 Operations .....	80
	KK.2.4.2.2 Notifications .....	81
240	DICOM PS 3.5: Data Structures and Encoding .....	82
	<i>Add empty value matching characters for VRs DA, TM, and DT to Section 6.2.....</i>	<i>82</i>
	DICOM PS 3.6: Data Dictionary.....	84
	<i>Add new data elements to Section 6 Registry of DICOM Data Elements.....</i>	<i>84</i>
	<i>Add new UIDs to Annex A Registry of DICOM Unique Identifiers (UIDs).....</i>	<i>85</i>
245	DICOM PS 3.7: Message Exchange.....	86
	<i>Add Warning status to C-FIND .....</i>	<i>86</i>
	9.1.2.1.6 Status .....	86
	9.1.2.2 C-FIND Service Procedures.....	86
	DICOM PS 3.16: Content Mapping Resource .....	87
250	<i>Add to Section 2 Normative References.....</i>	<i>87</i>
	2.1 GENERAL .....	87
	<i>Add Context Group to Annex B DCMR Context Groups.....</i>	<i>87</i>
	CID 7031 REASON FOR REMOVAL FROM OPERATIONAL USE .....	87
	<i>Add terminology concepts to Annex D DCMR Context Groups.....</i>	<i>87</i>
255	DICOM PS 3.17: Explanatory Information .....	89
	<i>Add to Section 2 Normative References.....</i>	<i>89</i>
	2.2 OTHER REFERENCES .....	89
	<i>Add explanatory Annex.....</i>	<i>89</i>
	Annex YYYY Inventories (Informative) .....	89
260	YYYY.1 THE DICOM DATA MANAGEMENT ENVIRONMENT.....	89
	YYYY.1.1 Inventories.....	89
	YYYY.2 REPOSITORY QUERY.....	90
	YYYY.2.1 Overview.....	90
	YYYY.2.2 Record Key and Continuation.....	90
265	YYYY.2.3 Key Matching Attributes.....	90
	YYYY.2.3.1 Objects Removed from Operational Use.....	90
	YYYY.2.3.2 Access to Stored Objects .....	91
	YYYY.2.3.3 Managed Metadata and Updated Metadata .....	91
	YYYY.2.3.4 Study Update DateTime .....	91
270	YYYY.3 THE INVENTORY INFORMATION OBJECT .....	91
	YYYY.3.1 Overview.....	91
	YYYY.3.2 Scope of Inventory.....	92
	YYYY.3.3 Inventory Instance Tree.....	93
	YYYY.3.3.1 Scope and Completion Status .....	93
275	YYYY.3.3.2 Examples .....	94
	YYYY.3.3.2.1 Serial Production.....	94
	YYYY.3.3.2.2 Baseline and increment .....	94
	YYYY.3.3.2.3 Parallel Production.....	95
	YYYY.3.3.2.4 Arbitrary tree structure .....	96
280	YYYY.3.3.2.5 Empty inventory .....	96
	YYYY.3.4 Access Mechanisms for Repository Data.....	96
	YYYY.3.5 Additional Data Elements .....	97
	YYYY.3.6 Producer vs. Consumer Implementation .....	97

	YYYY.4 RELATED SERVICES FOR INVENTORY SOP INSTANCES .....	97
285	YYYY.4.1 Inventory Storage and Query/Retrieve .....	97
	YYYY.4.2 Inventory Creation Service .....	98
	YYYY.4.3 Separability of Services .....	99
	YYYY.5 USE CASES .....	100
	YYYY.5.1 Migration and Consolidation .....	100
290	YYYY.5.2 Safety backup .....	101
	YYYY.5.3 Research .....	101
	YYYY.5.4 Quality Assurance .....	102
	YYYY.5.5 Wellness Check / Continuous Testing .....	102
	YYYY.6 SECURITY CONSIDERATIONS .....	103
295	YYYY.6.1 Access Control and Secure Transport .....	103
	YYYY.6.1.1 Access Control in Production of Inventory .....	103
	YYYY.6.2 File Format .....	103
	YYYY.6.3 Network Protocols .....	104
	YYYY.6.4 Application Validation .....	104
300	YYYY.6.5 Inventory Resource Use .....	104
	YYYY.6.6 Encryption of Data at Rest .....	104
	YYYY.6.7 Message Digest .....	105
	YYYY.6.8 De-identification .....	105
	YYYY.7 OPERATIONAL CONSIDERATIONS .....	105
305	YYYY.7.1 Transforming Repository Query Responses into Inventory SOP Instances .....	105
	YYYY.7.2 Using Non-DICOM Protocols .....	106
	YYYY.7.3 Using Referenced Inventories .....	110
	YYYY.7.4 Incremental Inventories .....	111
	YYYY.7.5 Inventory Lifecycle Management .....	112
310	YYYY.7.6 Interactive Access to Inventory Content .....	112
	YYYY.7.7 Multiple Application Entity Titles .....	112
	YYYY.7.8 Multiple Patient IDs .....	113
	YYYY.7.9 Metadata Updates .....	113
	YYYY.7.9.1 Original Attributes Sequence .....	114
315	YYYY.7.10 Study Record Reconciliation .....	115
	YYYY.7.10.1 Example – Deleted Study .....	116
	YYYY.7.11 Key Attributes Unsupported for Matching .....	117
	DICOM PS 3.18: Web Services .....	118
	<i>Add Inventories to Section 12.1.1 Non-Patient Instance Service and Resources / Resource Descriptions</i>	<i>118</i>
320	12.1 OVERVIEW .....	118
	12.1.1 Resource Descriptions .....	118
	<i>Add Inventories to Section 12.6.1.2 Non-Patient Instance Service and Resources / Query Parameters..</i>	<i>119</i>
	12.6.1.2 Query Parameters .....	119
	<i>Add Inventories to Annex H Capabilities Description .....</i>	<i>119</i>

## Scope and Field of Application

### Scope

This Supplement introduces

- a new Repository Query SOP Class to obtain an inventory of a repository system,
- a composite Inventory IOD that is the equivalent persistent object instantiation of such an inventory,
- an Inventory Creation SOP Class to initiate asynchronous creation of Inventory SOP Instances, and
- SOP Classes to transfer/query/retrieve Inventory SOP Instances.

### Use cases

A use case of steadily increasing significance is porting large DICOM repositories from one image management system (PACS or VNA) to another. Users typically replace their PACS after ~12-15 years, often with change of vendor. Replacement requires migrating historical data to the new system. Thus, every year, 5-10% of user organizations may be doing a PACS data migration.

Old images are routinely retained “forever”, and data set sizes are increasing with 3D/4D and multimodality studies. Archives in many institutions store over a billion instances with data volumes over one petabyte. Migration approaches need to operate at large scales, and handle both on-premises and remote (e.g., cloud-based) storage.

Migration often occurs while either the source system or the destination, or both, are in clinical operation, but systems designed and configured to handle the throughput of regular operations might not have capacity for the additional massive input/output requirements of migration. With a data transfer rate of 1 terabyte / day (quite high for even the most advanced PACS), the time to transfer a petabyte archive is 3 years. Performance constraints exist on both the source and destination systems.

Similar needs arise when healthcare institutions merge previously disparate repositories into an enterprise repository - the old archives need to be migrated. This is an increasing need with the accelerated pace of healthcare organization consolidations. Conversely, large sets of archived data may sometimes need to be migrated out of a repository to support business divestment or realignment in a healthcare organization.

There are also research use cases, including artificial intelligence and machine learning, where bulk access to the archive is desirable, and such uses might leverage some of the same mechanisms developed for migration. PACS audit and quality control may also utilize some of the standardized functionality developed for migration, such as an archive inventory and metadata to identify the data produced by a particular unit or by a particular modality.

### Limitations of current Standard

The current DICOM Standard does not address the use case and technical interoperability requirements for migration of a full enterprise repository data set, and it is currently ill-suited for the major performance issues of migration.

The current Standard is designed for routine daily department operational workflows – acquisition, storage, analysis, and reading of imaging studies associated with individual patients. The Standard is optimized for identifying and transferring the objects for, at most, just a few studies or patients at a time. Network Query/Retrieve operations are synchronous, and the network connection must remain open until the operation is complete. The number of items in a response therefore is typically restricted to an implementation-specified



365 number appropriate for a human interface, and the Standard is silent on behavior when that number is  
exceeded. Even media-based data exchange is specified only for the use cases of limited file sets, basically  
what can fit on a DVD.

A key requirement for migration (and other use cases) is the ability to have an inventory of all studies, series,  
and instances in an archive. While the current Query Service (DIMSE or equivalent DICOMweb) could be used,  
370 limitations on number of responses and the synchronous protocol require the use of a possibly very large  
number of partial Query requests, with undefined behavior when query limits are exceeded. This makes  
producing such an inventory difficult with the current Query Service.

While the current Standard Retrieve and Storage Services make moving data possible, they require significant  
overhead for the transfer of each object. A standardized method of direct filesystem access to stored object files  
375 is needed.

### New mechanisms

Recognizing the varying technical implementations and business needs of repository manufacturers and of  
inventory users, this Supplement specifies two new mechanisms to achieve a robust inventory production and  
exchange.

380 This Supplement specifies a new **Repository Query SOP Class** that includes features supporting a sequential  
set of Queries intended to produce a complete repository inventory. These features include defined behavior for  
Queries that reach a system limit for number of responses, and an ability to resume at the next record in a  
subsequent Query. All key attribute selectors available in the current Query/Retrieve Service are also available  
in the Repository Query SOP Class, and some new selection mechanisms are defined that are useful for  
385 inventory production supporting the use cases.

This Supplement also specifies an **Inventory Information Object Definition**, and associated SOP Classes.  
capable of encoding an inventory of all studies, series, and instances in a repository as a persistent object.  
Production of this object is functionally equivalent to a Query response that returns an inventory of the entire  
repository database, or a subset thereof as specified by key attributes. SOP Instances of this Inventory IOD  
390 could be produced upon local initiation by the repository administrative controls. The Supplement further defines  
an **Inventory Creation SOP Class** mechanism to remotely initiate the production of the inventory through a  
DICOM network service, and allow production to proceed asynchronously. The inventory SOP Instance(s) would  
be available for transfer when production is complete through Store/Query/Retrieve mechanisms similar to those  
specified for other DICOM Non-Patient Object classes (such as Color Palettes).

395 Only inventory of patient-related studies, series and instances is defined. Inventory of non-patient objects is out  
of scope for this Supplement.

Since repository systems may optionally support direct filesystem access to DICOM Part 10 compliant files, for  
all or some of their stored instances, the Repository Query and the Inventory IOD allow a URI link to such  
accessible files. To support a commonly used PACS implementation design, wherein the archive may retain  
400 metadata updates (e.g., changed patient IDs) in its database and not propagate them to the stored instances,  
the inventory provides the current metadata, which may differ from the values in the stored instances.

While this Supplement defines an IOD and Services to support migration, it is not in itself a complete standard  
for migration. Migration involves many other processes, some of which may be supported by other standards  
such as HL7, and some of which are not (yet) supported by any standards.

## DICOM PS 3.2 Conformance

*Add SOP Classes to Table A.1-2 UID Values*

**Table A.1-2 UID Values**

<b>UID Value</b>	<b>UID NAME</b>	<b>Category</b>
...		
1.2.840.10008.5.1.4.1.1.201.1	Inventory Storage	Transfer
1.2.840.10008.5.1.4.1.1.201.2	Inventory FIND	Query/Retrieve
1.2.840.10008.5.1.4.1.1.201.3	Inventory MOVE	Query/Retrieve
1.2.840.10008.5.1.4.1.1.201.4	Inventory GET	Query/Retrieve
1.2.840.10008.5.1.4.1.1.201.5	Inventory Creation	Workflow Management
1.2.840.10008.5.1.4.1.1.201.6	Repository Query	Query/Retrieve

410

## DICOM PS 3.3: Information Object Definitions

Add ZIP, TAR, GZIP, HTTP, NFS, and IHE to Section 2 Normative References

### 2.1 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) AND INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

[ISO/IEC 21320-1] ISO/IEC. 2015. *Information technology – Document Container File – Part 1:Core*  
415 [https://standards.iso.org/ittf/PubliclyAvailableStandards/c060101\\_ISO\\_IEC\\_21320-1\\_2015.zip](https://standards.iso.org/ittf/PubliclyAvailableStandards/c060101_ISO_IEC_21320-1_2015.zip)

...

### 2.3 INTERNET ENGINEERING TASK FORCE (IETF)

[RFC1951] IETF. *DEFLATE Compressed Data Format Specification version 1.3*  
<https://tools.ietf.org/html/rfc1951>

420 [RFC1952] IETF. *GZIP file format specification version 4.3* <http://tools.ietf.org/html/rfc1952>

[RFC7230] IETF. *Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing.*  
<http://tools.ietf.org/html/rfc7230>

[RFC7231] IETF. *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content*  
<http://tools.ietf.org/html/rfc7231>

425 [RFC7530] IETF. *Network File System (NFS) Version 4 Protocol* <http://tools.ietf.org/html/rfc7530>

...

### 2.6 OTHER REFERENCES

[IHE RAD TF-1] IHE International. *IHE Radiology (RAD) Technical Framework, Volume 1 – Integration Profiles*  
[https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE\\_RAD\\_TF\\_Vol1.pdf](https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_TF_Vol1.pdf)

430 [IHE RAD TF-2] IHE International. *IHE Radiology (RAD) Technical Framework, Volume 2 – Transactions*  
[https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE\\_RAD\\_TF\\_Vol2.pdf](https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_TF_Vol2.pdf)

[POSIX] IEEE and The Open Group. *POSIX.1-2017 IEEE Std 1003.1™-2017*  
<https://pubs.opengroup.org/onlinepubs/9699919799/>

435 [ZIP] PKWARE, Inc. *ZIP File Format Specification*  
<http://www.pkware.com/documents/casestudies/APPNOTE.TXT>

*Add Inventory to Section 3 Definitions*

### **3.8 DICOM INFORMATION OBJECT**

440 ...

#### **Inventory**

**A listing of DICOM Studies, Series, and SOP Instances, and associated metadata, managed by a repository system.**

#### **Scope of Inventory**

445 **The parameters that select the DICOM Studies that are included in an Inventory. Parameters are specified as matching rules for Attribute values.**

*Add new subsection for DICOM File Format to Section 3 Definitions*

### **3.23 DICOM Media Storage and File Format**

450 This Part of the Standard makes use of the following terms defined in [PS3.10](#):

DICOM File Format

[DICOM File Format](#).

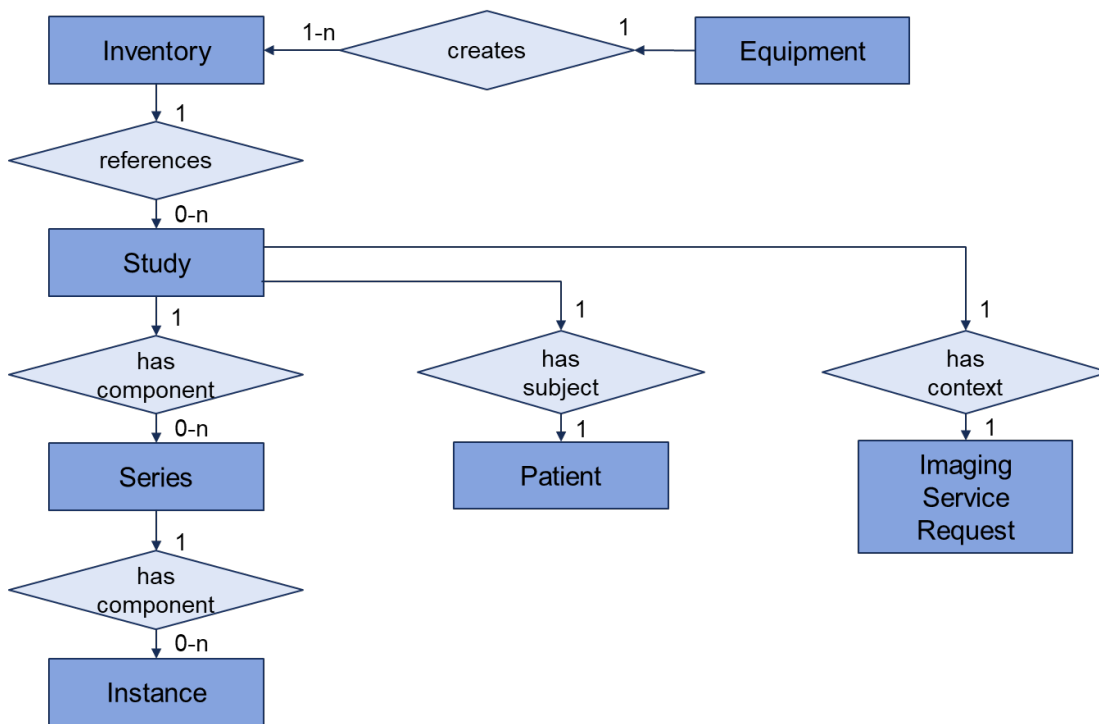
455 Add Inventory to Section 7.13 DICOM Model of the Real World for Non-Patient-Related Information

### 7.13.6 Inventory

460 Figure 7.13.6-1 shows the E-R diagram for the Inventory Information Model. The Inventory Information Entity provides an Inventory of Studies, and their component Series and SOP Instances, managed by a repository (such as a Picture Archiving and Communication System – PACS). The Inventory Information Model includes contextual information about each Study through the Patient and Imaging Service Request IEs. It includes information on the stored SOP Instances, including access mechanisms supported by the repository.

#### Notes

1. This information model is similar to the Study Root Query/Retrieve Information Model (see [PS3.4 Section C.6.2.1](#)).
- 465 2. There is a potentially complex relationship between the Study and Imaging Service Requests in the real world (e.g., see [IHE RAD TF-2](#) Section 4.6.4.1.2.3 Relationship between Scheduled and Performed Procedure Steps). However, the Inventory Information Model follows the basic Study Information Model and supports only a single Accession Number representing an Imaging Service Request (see [Section C.7.2.1](#)). Note that if a Study has multiple associated Imaging Service Requests, the request Attributes may be encoded at the Series level.



470

Figure 7.13.6-1. Inventory Information Model E-R Diagram

Add Inventory IOD to Section A.1.4 summary table

475 – DICOM editor to factor out Color Palette and Hanging Protocol from Table A.1-3 into new Non-Patient Related table)

### A.1.4 Overview of the Composite IOD Module Content

...

Table A.1-13. Composite Information Object Modules Overview – Non-Patient Related Information

<b>Module</b>	<b>IODs</b>	<b>Inventory</b>
Equipment		M
Inventory		M
SOP Common		M

480

*Add new section for Inventory IOD to Annex A Composite Information Object Definitions*

## A.88 INVENTORY IOD

### A.88.1 Inventory IOD Description

485 The Inventory IOD defines an Inventory of all Studies, Series, and SOP Instances managed by a repository, or a specified subset of those Studies, Series, and SOP Instances. It includes information about the available mechanisms to access such Studies, Series, and SOP Instances, including both DICOM and non-DICOM protocols. The Inventory provides selected Patient, Procedure, and Imaging Service Request Attribute values for the inventoried Studies.

490 For implementation-specific reasons, a complete Inventory may need to be divided across multiple SOP Instances. The Inventory IOD allows a SOP Instance to reference other SOP Instances whose content is logically included by such reference. A complete inventory thus consists of one root SOP Instance, with a tree of references to additional SOP Instances, the content of all of which comprises the Inventory.

Note:

495 See additional explanatory information in [Annex YYYY in PS3.17](#), including discussion of the use of the Repository Query SOP Class or the Inventory Creation SOP Class to produce an Inventory SOP Instance.

### A.88.2 Inventory IOD Entity-Relationship Model

The Inventory IOD uses the E-R Model specified in [Section 7.13.6](#).

### A.88.3 Inventory IOD Module Table

500 Table A.88.3-1 lists the Modules that make up the Inventory IOD.

**Table A.88.3-1. Inventory IOD Modules**

IE	Module	Reference	Usage
Equipment	General Equipment	<a href="#">C.7.5.1</a>	M
Inventory	Inventory	<a href="#">C.38.1</a>	M
	SOP Common	<a href="#">C.12.1</a>	M

Note:

505 The Attributes of the other Information Entities of the Inventory Information Model (such as Study, Series, Patient, etc.) are hierarchically encoded (within Sequence Attributes) in the Inventory Module, and thus do not appear as separate Modules in the IOD.

*Add new section for Inventory Creation IOD to Annex B Normalized Information Object Definitions*

510 **B.30 INVENTORY CREATION IOD**

**B.30.1 Inventory Creation IOD Description**

The Inventory Creation IOD describes the Attributes that may be present in an Inventory Creation Request or Response.

**B.30.2 Inventory Creation IOD Module Table**

515 **Table B.30.2-1. Inventory Creation IOD Modules**

<b>Module</b>	<b>Reference</b>	<b>Description</b>
Inventory Creation	<a href="#">C.38.3</a>	Contains parameters for initiation of inventory production
SOP Common	<a href="#">C.12.1</a>	Contains SOP common information



Add new section for Inventory Modules to Annex C Information Module Definitions

## C.38 Inventory Modules

### 520 C.38.1 Inventory Module

The Attributes of the Inventory Module are shown in Table C.38.1-1.

The Attributes of the Information Entities of the Inventory Information Model (such as Study, Series, Patient, etc. – see [Section 7.13.6](#)) are hierarchically encoded within Sequence Attributes in the Inventory Module.

**Table C.38.1-1 Inventory Module Attributes**

Attribute Name	Tag	Type	Attribute Description
Content Date	(0008,0023)	1	With Content Time (0008,0033), time point at which the Inventory creation began. See <a href="#">Section C.38.1.1.1</a> .
Content Time	(0008,0033)	1	With Content Date (0008,0023), time point at which the Inventory creation began. See <a href="#">Section C.38.1.1.1</a> .
<i>Include <a href="#">Table C.38.2-1 Scope of Inventory Macro Attributes</a></i>			Selection parameters for the studies that are included in the inventory. See <a href="#">Section C.38.1.1.2</a> .
Transaction UID	(0008,1195)	1C	UID of the transaction that initiated creation of this Inventory SOP Instance.  Required if Inventory creation was initiated by a transaction of the Inventory Creation SOP Class. May be present otherwise to identify a local user-initiated or system-initiated Inventory creation.
Inventory Purpose	(0008,0401)	2	Purpose for which the inventory was created.
Inventory Instance Description	(0008,0402)	3	Description of the content of this Inventory SOP Instance, such as limitation of the scope of this Instance within the Scope of Inventory.
Inventory Level	(0008,0403)	1	Information Entity level for records included in Inventory.  Enumerated Values: STUDY – Study records only SERIES – Study and Series records only INSTANCE – Study, Series, and Instance records
Inventory Completion Status	(0008,0426)	1	Degree of completion of Inventory with respect to the defined Scope of Inventory. See <a href="#">Section C.38.1.1.3</a> .
Number of Study Records in Instance	(0008,0427)	1	Number of Items in the Inventoried Studies Sequence (0008,0423) in this SOP Instance.

Attribute Name	Tag	Type	Attribute Description
Total Number of Study Records	(0008,0428)	1	Total number of Items in the Inventoried Studies Sequence (0008,0423) in this SOP Instance and in SOP Instances referenced in the Incorporated Inventory Instance Sequence (0008,0422).  Note A Study that appears multiple times among the Inventoried Studies Sequence (0008,0423) Items will be counted for each appearance.
Inventory Access End Points Sequence	(0008,0420)	3	Baseline end point(s) for network protocols to access incorporated Inventory SOP Instances. See <a href="#">Section C.38.1.1.4</a> .  Only a single Item is permitted in this Sequence.
>Include <a href="#">Table C.38.2-4 "Access End Points Macro"</a>			
Study Access End Points Sequence	(0008,0421)	3	Baseline end point(s) for network protocols to access inventoried Study-related SOP Instances. See <a href="#">Section C.38.1.1.4</a> .  Only a single Item is permitted in this Sequence.
>Include <a href="#">Table C.38.2-4 "Access End Points Macro"</a>			
Incorporated Inventory Instance Sequence	(0008,0422)	2	Inventory SOP Instances whose content is included by reference. See <a href="#">Section C.38.1.1.5</a> .  Zero or more Items shall be included in this Sequence.
>Include <a href="#">Table C.38.2-3 "Inventory Reference Macro"</a>			
Inventoried Studies Sequence	(0008,0423)	2	Records of Studies whose Attribute values match the Scope of Inventory. See <a href="#">Section C.38.1.1.6</a> .  Zero or more Items shall be included in this Sequence.
>Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set for this Item.  Required if an extended or replacement character set, other than those specified in the top level Data Set of the Inventory, is used in the Study level Attributes. May be present otherwise.
>Study Instance UID	(0020,000D)	1	Unique identifier for the inventoried Study.
>Modalities in Study	(0008,0061)	2	All of the distinct values used for Modality (0008,0060) in the Series of the Study.

Attribute Name	Tag	Type	Attribute Description
>Item Inventory DateTime	(0008,0404)	1	Date/Time of creation of the Inventory information for this Item. All Study Attributes in this Sequence Item are correct as of this Date/Time. The value shall be at or after the Content Date (0008,0023) and Content Time (0008,0033) of this Inventory SOP Instance.  Note This Attribute may be used for Study record reconciliation. <a href="#">See Section YYYY.7.10 in PS3.17</a>
>Removed from Operational Use	(0008,0405)	1C	Flag that this Study is not to be used for operational purposes. See <a href="#">Section C.38.1.2.2</a> .  Enumerated Values: Y Removed from use N Not removed from use  Required if this Study is not to be used for operational purposes. May be present otherwise.
>Reason for Removal Code Sequence	(0008,0406)	2C	Reason the Study was removed from operational use.  Required if Removed from Operational Use (0008,0405) value is Y.  Zero or one Item shall be included in this Sequence.
>>Include <a href="#">Table 8.8-1 "Code Sequence Macro Attributes"</a>			Defined Context Group DCID 7031 Reason for Removal from Operational Use.
>Number of Study Related Series	(0020,1206)	2	Count of stored Series in Study. See <a href="#">Section C.38.1.2.3</a> .
>Number of Study Related Instances	(0020,1208)	2	Count of stored SOP Instances in Study. See <a href="#">Section C.38.1.2.3</a> .
>Study Update DateTime	(0008,041F)	2	Date/Time of last update to Study instances or metadata managed in the storage system. See <a href="#">Section C.38.1.2.1</a> .
>Study ID	(0020,0010)	2	User or equipment generated Study identifier.
>Study Date	(0008,0020)	2	Date the Study started.
>Study Time	(0008,0030)	2	Time the Study started.
>Study Description	(0008,1030)	2	Description or classification of the Study performed.
>Anatomic Regions in Study Code Sequence	(0008,0063)	3	Anatomic regions and body parts examined in the study. See <a href="#">Section C.38.1.2.4</a> .  One or more Items are permitted in this Sequence.
>>Include <a href="#">Table 8.8-1 "Code Sequence Macro Attributes"</a>			
>Procedure Code Sequence	(0008,1032)	3	Type of procedure performed.  One or more Items are permitted in this Sequence.
>>Include <a href="#">Table 8.8-1 "Code Sequence Macro Attributes"</a>			

Attribute Name	Tag	Type	Attribute Description
>Name of Physician(s) Reading Study	(0008,1060)	3	Names of the physician(s) reading the Study.
>Physician(s) Reading Study Identification Sequence	(0008,1062)	3	Identification of the physician(s) reading the Study.  One or more Items are permitted in this Sequence. If more than one Item, the number and order shall correspond to the value of Name of Physician(s) Reading Study (0008,1060), if present.
>>Include <a href="#">Table 10-1 "Person Identification Macro Attributes"</a>			
>Consulting Physician's Name	(0008,009C)	3	Consulting physician(s) for this Patient Visit.
>Consulting Physician Identification Sequence	(0008,009D)	3	Identification of the consulting physician(s).  One or more Items are permitted in this Sequence. If more than one Item, the number and order shall correspond to the value of Consulting Physician's Name (0008,009C), if present.
>>Include <a href="#">Table 10-1 "Person Identification Macro Attributes"</a>			
>Physician(s) of Record	(0008,1048)	3	Names of the physician(s) who are responsible for overall Patient care at time of Study.
>Physician(s) of Record Identification Sequence	(0008,1049)	3	Identification of the physician(s) who are responsible for overall Patient care at time of Study.  One or more Items are permitted in this Sequence. If more than one Item, the number and order shall correspond to the value of Physician(s) of Record (0008,1048), if present.
>>Include <a href="#">Table 10-1 "Person Identification Macro Attributes"</a>			
>Include <a href="#">Table C.12.1.1.9-1 "Original Attributes Macro Attributes"</a>			Recording of prior Attribute values and provenance of metadata changes at the Study level. See <a href="#">Section C.38.1.2.5</a> .
>Retrieve AE Title	(0008,0054)	1C	AE Title from which this Study may be retrieved.  Required if Study SOP Instances may be retrieved using a C-MOVE or C-GET based SOP Class (see PS3.4) and Study Access End Points Sequence (0008,0421) does not include Retrieve AE Title (0008,0054). May be present otherwise.

Attribute Name	Tag	Type	Attribute Description
>Retrieve URL	(0008,1190)	1C	Base URI of the origin server to retrieve Study data through the Studies Service (see <a href="#">Section 10 in PS3.18</a> ).  Required if Study SOP Instances may be retrieved using the web-based Studies Service (see PS3.18) and Study Access End Points Sequence (0008,0421) does not include Retrieve URL (0008,1190). May be present otherwise.
>Stored Instance Base URI	(0008,0407)	3	Base URI for accessing Study SOP Instances through a non-DICOM protocol. See <a href="#">Section C.38.1.2.6</a> .
>Instance Availability	(0008,0056)	3	Specifies how rapidly the Study becomes available for transmission after a retrieval request. See <a href="#">Section C.38.1.2.9</a> .
>File Set Access Sequence	(0008,0419)	3	Non-DICOM protocol methods to access the set of stored SOP Instances comprising the Study.  Note  "File Set" as used here may not be identical to the File-set concept defined in PS3.10 and used in Storage Media File-set ID (0088,0130).  Only a single Item is permitted in this Sequence.
>>Folder Access URI	(0008,0408)	3	Access URI for a folder containing all SOP Instances for this Study. See <a href="#">Section C.38.1.2.7</a> .
>>File Access URI	(0008,0409)	3	Access URI for a container file containing all SOP Instances for this Study. See <a href="#">Section C.38.1.2.7</a> .
>>Container File Type	(0008,040A)	1C	Type of container file. See <a href="#">Section C.38.1.2.8</a> for Defined Terms.  Required if File Access URI (0008,0409) is present.
>Storage Media File-set ID	(0088,0130)	3	A human readable Identifier that identifies the Storage Media on which the Study resides.
>Accession Number	(0008,0050)	2	A number that identifies the order for the Study.
>Issuer of Accession Number Sequence	(0008,0051)	3	Identifier of the Assigning Authority that issued the Accession Number (0008,0050).  Only a single Item is permitted in this Sequence.
>>Include <a href="#">Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</a>			
>Referring Physician's Name	(0008,0090)	3	Name of the Patient's referring physician.
>Referring Physician Identification Sequence	(0008,0096)	3	Identification of the Patient's referring physician.  Only a single Item is permitted in this Sequence.
>>Include <a href="#">Table 10-1 "Person Identification Macro Attributes"</a>			
>Patient's Name	(0010,0010)	2	Patient's full name.

Attribute Name	Tag	Type	Attribute Description
>Patient ID	(0010,0020)	2	Primary identifier for the Patient.
>Include <a href="#">Table 10-18 "Issuer of Patient ID Macro Attributes"</a>			Identifier of the Assigning Authority that issued the Patient ID (0010,0020).
>Other Patient IDs Sequence	(0010,1002)	3	Identification numbers or codes used to identify the Patient.  One or more Items are permitted in this Sequence.
>>Patient ID	(0010,0020)	2	An identifier for the Patient.
>>Include <a href="#">Table 10-18 "Issuer of Patient ID Macro Attributes"</a>			Identifier of the Assigning Authority that issued the Patient ID (0010,0020).
>Patient's Birth Date	(0010,0030)	2	Birth date of the Patient.
>Patient's Sex	(0010,0040)	2	Sex of the named Patient.
>Other Patient Names	(0010,1001)	3	Other names used to identify the Patient.
>Inventoried Series Sequence	(0008,0424)	2C	Records of Series whose Study and Series Attribute values match the Scope of Inventory.  See <a href="#">Section C.38.2.1.1.2</a> for conditions with RELATIONAL matching for Scope of Inventory in which only matching Series will be included in the Inventory.  Required if Inventory Level (0008,0403) has value SERIES or INSTANCE.  Zero or more Items shall be included in this Sequence.
>>Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set for this Item.  Required if an extended or replacement character set, other than those specified or implied for the Study level Attributes, is used in the Series level Attributes. May be present otherwise.
>>Series Instance UID	(0020,000E)	1	Unique identifier of the inventoried Series.
>>Modality	(0008,0060)	1	Type of device, process or method that originally acquired or produced the data used to create the Instances in this Series.
>>Removed from Operational Use	(0008,0405)	1C	Flag that this Series is not to be used for operational purposes. See <a href="#">Section C.38.1.2.2</a> .  Enumerated Values: Y Removed from use N Not removed from use  Required if this Series is not to be used for operational purposes, and Removed from Operational Use (0008,0405) Attribute at Study level does not have the value Y. May be present otherwise.

Attribute Name	Tag	Type	Attribute Description
>>Reason for Removal Code Sequence	(0008,0406)	2C	Reason the Series was removed from operational use.  Required if Removed from Operational Use (0008,0405) value is Y.  Zero or one Item shall be included in this Sequence.
>>>Include <a href="#">Table 8.8-1 "Code Sequence Macro Attributes"</a>			Defined Context Group DCID 7031 Reason for Removal from Operational Use.
>>Series Number	(0020,0011)	2	A number that identifies this Series.
>>Series Description	(0008,103E)	3	Description of the Series.
>>Series Date	(0008,0021)	3	Date the Series started.
>>Series Time	(0008,0031)	3	Time the Series started.
>>Body Part Examined	(0018,0015)	3	Identification of the part of the body examined. See <a href="#">Section C.38.1.3.2</a> .
>>Laterality	(0020,0060)	3	Laterality of (paired) body part examined.
>>Request Attributes Sequence	(0040,0275)	3	Attributes from the Imaging Service Request. See <a href="#">Section C.38.1.3.3</a> .  One or more Items are permitted in this Sequence.
>>>Include <a href="#">Table 10-9 "Request Attributes Macro Attributes"</a>			
>>>Include <a href="#">Table C.12.1.1.9-1 "Original Attributes Macro Attributes"</a>			Recording of prior Attribute values and provenance of metadata changes at the Series level. See <a href="#">Section C.38.1.2.5</a> .
>>Stored Instance Base URI	(0008,0407)	3	Base URI for accessing SOP Instances within this Series through a non-DICOM protocol. See <a href="#">Section C.38.1.2.6</a> .
>>Instance Availability	(0008,0056)	3	Specifies how rapidly the Series becomes available for transmission after a retrieval request. See <a href="#">Section C.38.1.2.9</a> .
>>File Set Access Sequence	(0008,0419)	3	Non-DICOM protocol methods to access the set of stored SOP Instances comprising this Series.  Note  "File Set" as used here may not be identical to the File-set concept defined in PS3.10 and used in Storage Media File-set ID (0088,0130).  Only a single Item is permitted in this Sequence.
>>>Folder Access URI	(0008,0408)	3	Access URI for a folder containing all SOP Instances for the Series. See <a href="#">Section C.38.1.3.1</a> .
>>>File Access URI	(0008,0409)	3	Access URI for a container file containing all SOP Instances for the Series. See <a href="#">Section C.38.1.3.1</a> .
>>>Container File Type	(0008,040A)	1C	Type of container file. See <a href="#">Section C.38.1.2.8</a> for Defined Terms.  Required if File Access URI (0008,0409) is present.

Attribute Name	Tag	Type	Attribute Description
>>Storage Media File-set ID	(0088,0130)	3	A human readable Identifier that identifies the Storage Media on which the Series resides.
>>Inventoried Instances Sequence	(0008,0425)	2C	Records of SOP Instances whose Study, Series and Instance Attribute values match the Scope of Inventory.  See <a href="#">Section C.38.2.1.1.2</a> for conditions with RELATIONAL matching for Scope of Inventory in which only matching SOP Instances will be included in the Inventory.  Required if Inventory Level (0008,0403) has value INSTANCE.  Zero or more Items shall be included in this Sequence.
>>>Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set for this Item.  Required if an extended or replacement character set, other than those specified or implied for the Series level Attributes, is used in the Instance level Attributes. May be present otherwise.
>>>SOP Class UID	(0008,0016)	1	SOP Class UID of the inventoried SOP Instance.
>>>SOP Instance UID	(0008,0018)	1	SOP Instance UID of the inventoried SOP Instance.
>>>Instance Number	(0020,0013)	2	A number that identifies the inventoried SOP Instance.
>>>Related General SOP Class UID	(0008,001A)	3	Uniquely identifies a Related General SOP Class for the SOP Class of the inventoried Instance.
>>>Content Date	(0008,0023)	3	The date that creation of the content of the inventoried SOP Instance started.
>>>Content Time	(0008,0033)	3	The time that creation of the content of the inventoried SOP Instance started.
>>>Timezone Offset From UTC	(0008,0201)	3	Offset from UTC to the timezone for all DA and TM Attributes present in the inventoried Instance, and for all DT Attributes present in the inventoried Instance that do not contain an explicitly encoded timezone offset.  See <a href="#">Section C.12.1.1.8</a>
>>>Rows	(0028,0010)	3	Number of pixel matrix rows in the inventoried Image SOP Instance.
>>>Columns	(0028,0011)	3	Number of pixel matrix columns in the inventoried Image SOP Instance.
>>>Number of Frames	(0028,0008)	3	Number of frames in the inventoried Image SOP Instance.
>>>Bits Allocated	(0028,0100)	3	Number of bits allocated for each pixel sample in the inventoried Image SOP Instance.



Attribute Name	Tag	Type	Attribute Description
>>>Observation DateTime	(0040,A032)	3	The date and time at which the root Content Item of the inventoried Document SOP Instance was completed.
>>>Concept Name Code Sequence	(0040,A043)	3	A coded description of the content or type of the inventoried SOP Instance.  Only a single Item is permitted in this Sequence.
>>>>Include <a href="#">Table 8.8-1 "Code Sequence Macro Attributes"</a>			No baseline CID is defined.
>>>Content Template Sequence	(0040,A504)	3	Attributes of the Template that describes the content structure and constraints for the inventoried Document SOP Instance.  Only a single Item is permitted in this Sequence.
>>>>Template Identifier	(0040,DB00)	1	Identifier of the Template as defined by the Mapping Resource (0008.0105).
>>>>Mapping Resource	(0008,0105)	1	Resource that defines the Template.
>>>Referenced Request Sequence	(0040,A370)	3	Requested Procedures that were fulfilled (completely or partially) by the inventoried Document SOP Instance.  One or more Items are permitted in this Sequence.
>>>>Include <a href="#">Table C.17-3c "Referenced Request Macro Attributes"</a>			
>>>Container Identifier	(0040,0512)	3	Identifier for the physical container that contains the specimen(s) imaged in the inventoried SOP Instance. See <a href="#">Section C.7.6.22.1.1</a> .  Note  Not to be confused with a container file as described in <a href="#">Section P.1.2</a> .
>>>Specimen Description Sequence	(0040,0560)	3	Identifiers for the specimen(s) imaged in the inventoried SOP Instance. See <a href="#">Section C.7.6.22.1.1</a>  One or more Items are permitted in this Sequence.
>>>>Specimen Identifier	(0040,0551)	1	A departmental information system identifier for the Specimen.
>>>>Specimen UID	(0040,0554)	1	Unique Identifier for Specimen.
>>>Content Label	(0070,0080)	3	A label that is used to identify the inventoried SOP Instance.
>>>Content Description	(0070,0081)	3	A description of the content of the inventoried SOP Instance.
>>>Presentation Creation Date	(0070,0082)	3	Date on which the inventoried Presentation State SOP Instance was created.
>>>Presentation Creation Time	(0070,0083)	3	Time at which the inventoried Presentation State SOP Instance was created.

Attribute Name	Tag	Type	Attribute Description
>>>>Content Creator's Name	(0070,0084)	3	Name of operator who created the content of the inventoried SOP Instance.
>>>>Removed from Operational Use	(0008,0405)	1C	<p>Flag that the inventoried SOP Instance is not to be used for operational purposes. See <a href="#">Section C.38.1.2.2</a>.</p> <p>Enumerated Values:  Y Removed from use  N Not removed from use</p> <p>Required if this SOP Instance is not to be used for operational purposes, and Removed from Operational Use (0008,0405) Attribute at Study or Series level does not have the value Y. May be present otherwise.</p>
>>>>Reason for Removal Code Sequence	(0008,0406)	2C	<p>Reason the SOP Instance was removed from operational use.</p> <p>Required if Removed from Operational Use (0008,0405) value is Y.</p> <p>Zero or one Item shall be included in this Sequence.</p>
>>>>Include <a href="#">Table 8.8-1 "Code Sequence Macro Attributes"</a>			Defined Context Group <a href="#">DCID 7031</a> Reason for Removal from Operational Use.
>>>>Include <a href="#">Table C.12.1.1.9-1 "Original Attributes Macro Attributes"</a>			Recording of prior Attribute values and provenance of metadata changes at the Instance level. See <a href="#">Section C.38.1.2.5</a> .
>>>>Instance Availability	(0008,0056)	3	Specifies how rapidly the Instance becomes available for transmission after a retrieval request. See <a href="#">Section C.38.1.2.9</a> .
>>>>File Access Sequence	(0008,041A)	3	<p>Non-DICOM protocol methods to access the SOP Instance in the DICOM File Format. See <a href="#">Section C.38.1.4.2</a> and <a href="#">Section C.38.1.4.3</a>.</p> <p>One or more Items are permitted in this Sequence.</p>
>>>>Include <a href="#">Table C.38.2-2 "Stored File Access Macro"</a>			
>>>>>Expiration DateTime	(0008,0416)	3	The date and time until which the SOP Instance is expected to be available and after which SOP Instance is expected to be unavailable via this non-DICOM protocol URI. See <a href="#">Section C.38.1.4.4</a> .
>>>>>Storage Media File-set ID	(0088,0130)	3	A human readable Identifier that identifies the Storage Media on which the Instance resides.
>>>>>Alternate Representation Sequence	(0008,3001)	3	<p>Reference to an alternate encoding of the inventoried SOP Instance. See <a href="#">Section C.38.1.4.5</a>.</p> <p>One or more Items are permitted in this Sequence.</p>

Attribute Name	Tag	Type	Attribute Description
>>>>Series Instance UID	(0020,000E)	1C	Unique identifier of the Series of the alternate representation.  Required if the alternate representation is in a different Series than the inventoried SOP Instance.
>>>>SOP Class UID	(0008,0016)	1	SOP Class UID of the alternate representation SOP Instance.
>>>>SOP Instance UID	(0008,0018)	1	SOP Instance UID of the alternate representation SOP Instance.
>>>>Purpose of Reference Code Sequence	(0040,A170)	1	The nature of the alternate encoding.  One Item shall be included in this Sequence.
>>>>>Include <a href="#">Table 8.8-1 "Code Sequence Macro Attributes"</a>			Baseline Context Group <a href="#">BCID 7205</a> .

525

### C.38.1.1 Inventory Instance Attributes

#### C.38.1.1.1 Content Date and Content Time

Content Date (0008,0023) and Content Time (0008,0033) establish the time point at which began the creation of the Inventory for which this SOP Instance is the root. Conceptually, all Studies received by the storage system before this DateTime, and that match the specified Scope of Inventory key Attributes, are included in the Inventory, and all Patient and Study updates through this DateTime have been applied to the Attributes as recorded in the Inventory SOP Instance(s).

While Content Date and Time specify the nominal time for creation of the Inventory, each Study record has its own Item Inventory DateTime (0008,0404) that specifies the time of creation of that record, and its Attribute values are accurate as of that time.

Whether Studies and updates received after Content Date and Time might be included in the Inventory is implementation specific.

The Content Date and Time of SOP Instances included by reference in the Incorporated Inventory Instance Sequence (0008,0422) may differ from the values of this SOP Instance.

#### C.38.1.1.2 Scope of Inventory

The Scope of Inventory Sequence (0008,0400) specifies the matching rules for values of Attributes that select Studies to be included in the Inventory. It specifies the selection parameters for the current Inventory SOP Instance and all its subsidiary incorporated Instances referenced in the Incorporated Inventory Instance Sequence (0008,0422). The Scope of Inventory Sequence (0008,0400) within those subsidiary incorporated Instances is relevant only to their respective sub-trees, and may differ.

##### Note

For example, an Inventory SOP Instance may specify in its Scope of Inventory that it includes studies from the years 2015-2019, but it does that by linking five subsidiary Inventory SOP Instances, one for each year, and which each specifies in its Scope of Inventory the year to which it applies.

While all Studies included in the Inventory will be within the Scope of Inventory, there may be Studies that match the Scope of Inventory that are not included in the Inventory if the Inventory is incomplete. The content of an Inventory SOP Instance, together with its subsidiary incorporated Instances, is complete with respect to the Scope of Inventory only if Inventory Completion Status (0008,0426) has the value COMPLETE.

### C.38.1.1.3 Inventory Completion Status

555 Inventory Completion Status (0008,0426) is the status of the Inventory represented by this SOP Instance, including all SOP Instances referenced in the Incorporated Inventory Instance Sequence (0008,0422). The status is defined with respect to the Scope of Inventory as of the Content Date (0008,0023) and Content Time (0008,0033), for the repository system identified in the General Equipment Module (see [Section C.7.5.1](#)).

Enumerated Values:

560	COMPLETE	All Studies matching the Scope of Inventory are included in the Inventory SOP Instance and its subsidiary Incorporated Inventory SOP Instances
	FAILURE	Production of the Inventory failed; some Studies matching the Scope of Inventory might not be included in the Inventory
565	CANCELED	Production of the Inventory was canceled; some Studies matching the Scope of Inventory might not be included in the Inventory
	PARTIAL	Production of the inventory is incomplete; some Studies matching the Scope of Inventory might not be included in the Inventory

#### Notes

- 570 1. An Inventory may be COMPLETE and have no Study records, i.e., for the Repository identified in the Equipment Module, at the Content Date and Content Time, no Studies match the Scope of Inventory.
2. The reason for a value other than COMPLETE may be described in Inventory Instance Description (0008,0402).
3. COMPLETE, FAILURE, and CANCELED are statuses for the corresponding terminal states of the Inventory production process (see [Section KK.2.1.1 "Inventory Production States" in PS3.4](#)). PARTIAL is a status representing continuing Inventory production, and this SOP Instance might be expected to be referenced in the Incorporated Inventory Instance Sequence (0400, 06x2) of the SOP Instance at the root of an Inventory tree.
- 575 4. See additional explanatory information and examples of use in [Section YYYY.3.3.1 "Scope and Completion Status" in PS3.17](#).

### C.38.1.1.4 Inventory Access End Points Sequence and Study Access End Points Sequence

580 The Inventory includes Attributes describing the available network access protocol(s) for referenced SOP Instances. The Inventory Access End Points Sequence (0008,0420) provides the default end points, i.e., network addresses, for access to Inventory SOP Instances referenced in the Incorporated Inventory Instance Sequence (0008,0422). The Study Access End Points Sequence (0008,0421) provides the default end points for access to Study-related SOP Instances referenced in the Inventoried Studies Sequence (0008,0423).

585 These default end points apply only to references within the current SOP Instance; they do not set defaults for references within Inventory SOP Instances referenced in the Incorporated Inventory Instance Sequence (0008,0422).

### C.38.1.1.5 Incorporated Inventory Instance Sequence

590 For implementation specific reasons, the content of an Inventory may be divided into more than one Inventory SOP Instance. The Inventory SOP Instances are organized as a tree of referenced SOP Instances, with one SOP Instance as the root. The Incorporated Inventory Instance Sequence (0008,0422) specifies the links from an Inventory SOP Instance to its subsidiary Instances in the tree. The Incorporated Inventory Instance Sequence (0008,0422) definition recursively includes itself, thus allowing representation of the complete tree of referenced Inventory SOP Instances.

595 Inventory SOP Instances that are incorporated by reference shall have the same Inventory Level (0008,0403) as the current SOP Instance.

The inclusion of an Inventory SOP Instance reference in the Incorporated Inventory Instance Sequence (0008,0422) means that the Items of the Inventoried Studies Sequence (0008,0423) in that referenced SOP Instance are logically included in the current SOP Instance. Therefore, all inventoried Studies in the referenced SOP Instances shall be within the Scope of Inventory of the current SOP Instance. However, the Item Inventory  
600 DateTime (0008,0404) of those Study records may be prior to the Content Date (0008,0023) and Content Time (0008,0033) of the current SOP Instance.

#### Notes

1. Reasons for splitting an Inventory might include practical limits on the maximum size of an individual SOP Instance, parallel processing across multiple separate subsystems, or reuse of historical Inventories. See [Section  
605 YYYY.3.3 in PS3.17](#).
2. These requirements apply to every Inventory SOP Instance. Thus, each Inventory SOP Instance will include in its Incorporated Inventory Instance Sequence (0008,0422) the complete tree of references to the subtree of which it is the root.

### 610 C.38.1.1.6 Inventoried Studies Sequence

The Inventoried Studies Sequence (0008,0423) references Studies whose Attributes match the Scope of Inventory. Within the tree of incorporated Inventory SOP Instances, a given Study may be referenced multiple times among the Inventoried Studies Sequence (0008,0423) Items. The Items may have different content, but each Item shall have a complete record of the contents of the Study as known by the creator of that Item.

#### 615 Notes

1. Differences in content may occur due to changes to the metadata or content (SOP Instances) of the Study during the production of the Inventory, or due to different Series of a Study being stored on different media, or for other reasons. The application using an Inventory may need to reconcile such multiple occurrences (see [Section  
620 YYYY.7.10 "Study Record Reconciliation" in PS3.17](#)).
2. If there are multiple records for a Study among the tree of incorporated SOP Instances, the Total Number of Study Records (0008,0428) value will reflect the number of records, not the number of unique Study UIDs.

## C.38.1.2 Inventoried Study Attributes

### C.38.1.2.1 Study Update DateTime

625 Study Update DateTime (0008,041F) is the DateTime of the last update to Study contents (SOP Instances) or to Study metadata within the repository system. Metadata may change either due to coercion of Study related data (Patient ID, Study Description, Accession Number, etc.) to correspond with values set by the enterprise or department master information system (HIS / EMR / RIS), or due to other updates applied by the repository system.

630 As this is an Attribute of the Study as managed within the repository system, the initial Study Update DateTime (0008,041F) is the time that the Study was first received in the repository system, and is updated upon each new SOP Instance received for the Study, as well as for updates of patient, procedure, and other metadata.

#### Notes

1. This Attribute, like Number of Study Related Series (0020,1206) and Number of Study Related Instances (0020,1208), is defined at the Study level of the Inventory Information Model, but is not part of the Study Attributes in SOP Instances. It is an Attribute that may be managed by the repository system, and might not have a value for some or all of the Studies in the Inventory.
2. Study Update DateTime (0008,041F) is not the time of last user access to the Study contents.

### C.38.1.2.2 Removed from Operational Use and Reason for Removal Code Sequence

640 The Removed from Operational Use (0008,0405) Attribute is defined at the Study, Series, and Instance levels. A  
value of Y indicates the inventoried Study, Series, or Instance has been removed from operational use related to  
patient care, although it may be retained in the repository system for other reasons (e.g., for audit of patient  
radiation exposure). At the Study and Series level, the Attribute indicates whether the entire Study or Series has  
645 been removed from operational use. A value of Y at the Study level supersedes any value specified for  
subsidiary Series and Instances, and a value of Y at the Series level supersedes any value specified for  
subsidiary Instances.

#### Notes

- 650 1. The meaning of “operational use related to patient care” is implementation or site specific, but generally includes  
diagnostic, clinical, and therapeutic uses, as well as administrative uses necessary for providing care (e.g.,  
insurance authorization).
- 655 2. Studies, Series, or Instances might be marked as removed from operational use by actions associated with the  
processing of specific Key Object Selection Document SOP Instances, e.g., in accordance with [\[IHE RAD TF-1\]](#)  
*Image Object Change Management Integration Profile* (IOCM). Those Key Object Selection Document SOP  
Instances, and their Series, may themselves be marked as removed from operational use. The Context Group for  
Reason for Removal Code Sequence (0008,0406) includes the Key Object Selection Concept Codes specified in  
IOCM.
3. An image SOP Instance might be marked as removed from operational use because it has been replaced by a  
different (e.g., compressed) encoding of the image (see [Section C.38.1.4.5](#)).
- 660 4. The content of the Inventory might not match the information obtained through the Query/Retrieve Service since  
Studies, Series, or Instances in Inventory SOP Instances marked as removed from operational use might not  
appear in Query/Retrieve responses (e.g., see [\[IHE RAD TF-2\]](#) *Section 4.66.4.1.3.1 Access to Rejected Instances*).
- 665 5. While defined in this specification at the Study, Series, and Instance levels, an Application Entity might not manage  
this Attribute at some, or any, of those levels. E.g., an AE may only manage this Attribute at the Instance level, and  
is not required to infer a value for the Series or Study level.
6. If the Application Entity retains records of deleted Studies, Series, or Instances, even though the actual Instances  
are physically deleted, it may include those records in the Inventory with an appropriate Reason for Removal Code  
Sequence (0008,0406) value. Such instances may have an Instance Availability (0008,0056) value  
“UNAVAILABLE” (see [Section C.38.1.2.9](#)).

### 670 C.38.1.2.3 Number of Study Related Series, and Number of Study Related Instances

Number of Study Related Series (0020,1206) and Number of Study Related Instances (0020,1208) shall give  
accurate counts of Series and SOP Instances stored in the repository, respectively. The counts of Series and  
Instances shall include those that are marked as removed from operational use.

#### Note

- 675 These counts are not the number of Items in the Inventoried Series Sequence (0008,0424) and Inventoried Instances  
Sequence (0008,0425). Those Sequence Attributes may be absent depending on the value of Inventory Level  
(0008,0403). Further, if the Scope of Inventory indicates Relational matching to the Series or Instance level (see [Section](#)  
[C.38.2.1.1.2](#)), only Series and Instances matching the Scope of Inventory will be included in the Inventoried Series  
Sequence (0008,0424) and Inventoried Instances Sequence (0008,0425), and others present in the repository but not  
680 matching will not be recorded in the Inventory.

### C.38.1.2.4 Anatomic Regions in Study Code Sequence

The Anatomic Regions in Study Code Sequence (0008,0063) consolidates the values of Anatomic Region  
Sequence (0008,2218) and Body Part Examined (0018,0015) in the SOP Instances of this Study. Recognized  
values of Body Part Examined can be transcoded to equivalent codes, such as by using the tables of [Annex L](#)



685 [“Correspondence of Anatomic Region Codes and Body Part Examined Defined Terms” in PS3.16](#), or by implementation- or site-specific mappings for locally defined terms.

### C.38.1.2.5 Original Attributes Macro

The Original Attributes Sequence (0400,0561) is defined at each of the Study, Series, and Instance levels in the Inventory IOD.

690 Within the Inventoried Studies Sequence (0008,0423), i.e., at the Study level, the Original Attributes Sequence (0400,0561) may be used to record the prior values of updated Study, Patient, and Imaging Study Request Attributes for the referenced Study, and the provenance of such updates (see [Section C.12.1.1.9](#)). Within the Inventoried Series Sequence (0400, 06x4), i.e., at the Series level, and within the Inventoried Instances Sequence (0008,0425), i.e., at the Instance level, the Original Attributes Sequence may be used to record the  
695 prior values of updated Series and Instance Attributes, respectively, and the provenance of such updates (see [Section YYYY.7.9.1 “Original Attributes Sequence” in PS3.17](#)).

In the context of an Inventory SOP Instance, the “top level Data Set” in the definition of the Original Attributes Sequence (0400,0561) is the top level Data Set of the SOP Instances of the inventoried Study.

700 The Original Attributes Sequences (0400,0561) in the Inventory SOP Instance might not be identical to the Original Attributes Sequence (0400,0561) in the individual SOP Instances of the Study, and updates recorded in either location are valid (see [Section C.38.1.4.3](#)).

#### Note

705 While defined in this specification at the Study, Series, and Instance levels, an Application Entity might manage the Original Attributes Sequence (0400,0561) at only the Instance level. In such case, changes to Study, Patient, Imaging Study Request, and Series Attributes would be recorded at the Instance level for all affected SOP Instances.

### C.38.1.2.6 Stored Instance Base URI

Stored Instance Base URI (0008,0407) is defined at the Inventory, Study, and Series levels in the Inventory IOD.

710 Stored Instance Base URI (0008,0407) contains an [\[RFC3986\]](#) base URI that may be merged with relative path reference URIs for non-DICOM protocol access to SOP Instances of the Study or Series (see [Section P.2.1](#)). The Stored Instance Base URI (0008,0407) at the Study level establishes the default base URI for all relative path reference URIs in the Study, overriding a value specified at the Inventory level. Stored Instance Base URI (0008,0407) at the Series level establishes the default base URI for all relative path reference URIs in that Series overriding a value specified at the Inventory or Study level.

#### 715 Notes

1. At the Inventory level, Stored Instance Base URI (0008,0407) is specified in the Study Access End Points Sequence (0008,0421), setting the default base URI value for all Study records in the current Inventory SOP Instance. See [Section C.38.1.1.4](#).
2. Stored Instance Base URI (0008,0407) is optional, and if not present the values of Folder Access URI (0008,0408) and File Access URI (0008,0409) at the Study level must be complete URIs. If Stored Instance Base URI (0008,0407) is present, those other Attributes may still provide complete URIs, rather than relative paths to be merged with the Base URI.  
720
3. See example uses of base URI and relative path reference URI in [Section YYYY.7.2 in PS3.17](#).
4. For any relative path reference URI, the base URI is the one specified in its level, if present, or successively at the  
725 next higher levels, until a Stored Instance Base URI (0008,0407) Attribute is present with a value.

### C.38.1.2.7 Folder Access URI and File Access URI

If all of the stored SOP Instances of the Study, as identified in this Item, are in the DICOM File Format accessible through a non-DICOM protocol, and all the files are catalogued in a single folder (see [Section P.1.3](#)), Folder Access URI (0008,0408) provides the URI for protocol operations on that folder.

730 If all of the stored SOP Instances of the Study, as identified in this Item, are in a single container file as specified in [Section P.1.2](#), File Access URI (0008,0409) provides the URI for accessing that file.

Folder Access URI (0008,0408) and/or File Access URI (0008,0409) may be a relative path reference beginning with the single-dot-segment “.” (see [Section P.2.1](#)). In this case, the URI is merged with the Stored Instance Base URI (0008,0407) applicable to this Study (see [Section C.38.1.2.6](#)).

735 See [Section C.38.1.4.3](#) for requirements on applying metadata from the Inventory SOP Instance to stored SOP Instances of the Study.

#### Notes

- 740 1. The Study may be inventoried in more than one Item (see [Section C.38.1.1.6](#)). Only the SOP Instances identified within this Item (and its subsidiary Inventoried Instances Sequence (0008,0425) Attributes) need to be included in the folder or container file.
2. Stored SOP Instances from other Studies may be present in the folder or container file; the only requirement is that all of the identified SOP Instances of this Study are included.
- 745 3. If the SOP Instances of the Study are split across different container files, e.g., Series 1 and 2 in one container and Series 3 in a different container, then the conditional requirement for File Access URI (0008,0409) is not met and that Attribute is not used. However, if both of those container files are in the same folder, then Folder Access URI (0008,0408) may be present.
4. Files other than stored SOP Instances may be present in the folder or container file, e.g., reports in a non-DICOM file format.
- 750 5. These URIs provide complete access paths to the referenced folders and files, unlike the Retrieve URL (0008,1190) for the Studies Service (Section 10 in PS3.18), which requires composition of the URI using the Study, Series, and/or SOP Instance UIDs.

### C.38.1.2.8 Container File Type

Container File Type (0008,040A) identifies the type of container file accessible through the File Access URI (0008,0409).

755 The Defined Terms are:

ZIP	see <a href="#">Section P.1.2.1</a>
TAR	see <a href="#">Section P.1.2.2</a>
GZIP	see <a href="#">Section P.1.2.3</a>
TARGZIP	see <a href="#">Section P.1.2.4</a>
760 BLOB	see <a href="#">Section P.1.2.5</a>
DICM	Single SOP Instance in DICOM File Format (see <a href="#">Section 7 “DICOM File Format” in PS3.10</a> ), not in a container



### C.38.1.2.9 Instance Availability

765 Instance Availability (0008,0056) is defined at each of the Study, Series, and Instance levels in the Inventory IOD. It specifies how rapidly the Study, Series, or Instance becomes available for transmission after a retrieval request. For a Study or Series, when some Instances are less rapidly available than others, the value is the availability of the least rapidly available.

Enumerated Values:

	ONLINE	the instance is immediately available
770	NEARLINE	the instance needs to be retrieved from relatively slow media such as optical disk or tape, or requires conversion that takes time
	OFFLINE	the instance needs to be retrieved by manual intervention
	UNAVAILABLE	the instance cannot be retrieved

Notes

- 775
1. See also [PS3.4 Section C.4.1.1.3.2](#).
  2. A Study, Series, or Instance that is UNAVAILABLE may also be marked as removed from operational use with Reason for Removal Code Sequence (0008,0406) value (130752, DCM, "Data Not Accessible from Storage").

### C.38.1.3 Inventoried Series Attributes

#### C.38.1.3.1 Folder Access URI and File Access URI

780 If all of the stored SOP Instances of the Series are in the DICOM File Format accessible through a non-DICOM protocol, and all the files are catalogued in a single folder (see [Section P.1.3](#)), Folder Access URI (0008,0408) provides the URI for protocol operations on that folder.

If all of the stored SOP Instances of the Series are in a single container file as specified in [Section P.1.2](#), File Access URI (0008,0409) provides the URI for accessing that file.

785 Folder Access URI (0008,0408) and/or File Access URI (0008,0409) may be a relative path reference beginning with the single-dot-segment "." (see [Section P.2.1](#)). In this case, the URI is merged with the Stored Instance Base URI (0008,0407) applicable to this Series (see [Section C.38.1.2.6](#)).

Note

See also [Section C.38.1.2.7](#) and its associated notes.

#### 790 C.38.1.3.2 Body Part Examined

Defined Terms for Body Part Examined (0018,0015) are found in [Annex L "Correspondence of Anatomic Region Codes and Body Part Examined Defined Terms" in PS3.16](#).

795 Recognized values of Body Part Examined (0018,0015) can be transcoded to their equivalent codes, such as by using the tables of [Annex L in PS3.16](#) or by implementation- or site-specific mappings for locally defined terms. Those codes may be added to the Study level Attribute Anatomic Regions in Study Code Sequence (0008,0063) (see [Section C.38.1.2.4](#)).

#### C.38.1.3.3 Request Attributes Sequence

Request Attributes Sequence (0040,0275) may be used to support Series that are related to multiple Imaging Service Requests.

800 Note

See, for example, [\[IHE RAD TF-2\]](#) *Section 4.6.4.1.2.3 Relationship between Scheduled and Performed Procedure Steps*.

### C.38.1.4 Inventoried SOP Instance Attributes

#### C.38.1.4.1 Optional Attributes

805 This Module identifies Type 3 Attributes at the Instance level, some of which are applicable only to certain SOP Classes of inventoried SOP Instances. These Attributes may still be critical for certain repository uses, such as query for SOP Instances with certain characteristics.

##### Notes

- 810 1. Support of some IHE Profiles requires some of these Attributes. See, for example, [\[IHE RAD TF-2\]](#) *Table 4.14-2: Image Specific Query Matching and Return Keys*, *Table 4.15-1: Presentation State Specific Query Matching and Return Keys*, *Table 4.30-1: Key Image Note Instance Specific Query Matching and Return Keys*, and *Table 4.44-1: Evidence Document Instance Specific Query Matching and Return Keys*.
2. A recommended best practice is for the Inventory to include all Attributes supported by the implementation as Matching or Return Keys for Query/Retrieve SOP Classes (see Annex C in PS3.4).
- 815 3. See also Section YYYY.3.5."Additional Data Elements" in PS3.17.

#### C.38.1.4.2 File Access Sequence

A repository system may store a SOP Instance on multiple storage devices (e.g., fast short-term media and slower long-term media), or with different Transfer Syntaxes. The SOP Instance may therefore be accessible through a non-DICOM protocol at multiple URIs. The File Access Sequence (0008,041A) provides one Item for  
820 each URI (see [Section P.1.1](#)). A URI relative path reference within this Sequence shall be relative to the Stored Instance Base URI (0008,0407) applicable to the Series (see [Section C.38.1.2.6](#)).

#### C.38.1.4.3 Metadata from Inventory

A stored SOP Instance accessible through a non-DICOM protocol shall be conformant to its IOD and to the DICOM File Format. However, some Attributes might not have current values (e.g., Patient Name may have  
825 been corrected or changed after the Instance was stored). The current values are encoded in the Inventory SOP Instance. For all Attributes defined in the IOD of the stored SOP Instance, and for which values are recorded in the Inventory, the values in the Inventory are authoritative and are imputed to the SOP Instance.

Items of the Original Attributes Sequences (0400,0561) in the Inventory at the Study, Series, and Instance levels (see [Section C.38.1.2.5](#)) are additive to any Items in the Original Attributes Sequence (0400,0561) of the stored  
830 SOP Instance.

##### Notes:

1. SOP Instances accessed through DICOM protocols are expected to have current values in all Attributes.
- 835 2. Depending on its function, and application accessing a stored SOP Instance through a non-DICOM protocol may not require updated metadata, e.g., if it is only accessing the pixel data for a machine learning process. Hence, there is no normative requirement that such an application must use metadata from the Inventory SOP Instance, only that the metadata is imputed (conceptually ascribed) to the SOP Instance.
- 840 3. Attributes that are not defined in the IOD of the stored SOP Instance, but that are defined in the Inventory IOD, include Study level summary Attributes, such as Modalities in Study (0008,0061) and Number of Study Related Instances (0020,1208), and access Attributes, such as Retrieve AE Title (0008,0054), Stored Instance Base URI (0008,0407), and File Access URI (0008,0409). These Attributes are not to be imputed to the stored SOP Instance.

4. Attributes that are not defined in the Inventory IOD, but that are defined in the IOD of the stored SOP Instance, may be included in the Inventory SOP Instance, especially if they have been updated, such as change of an SR Concept Name Code Sequence (0040,A043) from a SNOMED RT to a SNOMED CT coded concept. See [Section YYYY.3.5 “Additional Data Elements” in PS3.17](#). These Attributes are to be imputed to the stored SOP Instance.
- 845 5. An Inventory SOP Instance with Inventory Level (0008,0403) STUDY or SERIES does not include potentially updated metadata for lower levels of the information model. Users of such Inventories that access stored SOP Instances using a non-DICOM protocol, e.g., through the File Set Access Sequence (0008,0419) Attributes at the Study or Series level, should ensure that potentially outdated metadata is acceptable for their purposes.
- 850 6. An empty Type 2 Attribute in an Inventory SOP Instance, e.g., Patient’s Birth Date (0010,0030), implies that an empty value should be imputed to the referenced stored SOP Instances. A creator of an Inventory SOP Instance should ensure that empty Type 2 Attributes are appropriately conveying the semantics that the value is unknown, and any value in the stored SOP Instances will be overridden.
- 855 7. As described in [Section C.12.1.1.9](#), when performing a coercion, correction or conversion of SOP Instance Attributes, the application may add an Item to the Original Attributes Sequence (0400,0561) describing the provenance of the change, but preserving any existing Items in the Sequence. Thus, changes to Study, Patient, or Imaging Service Request Attributes recorded in the Inventory may have the provenance of those changes recorded in the Original Attributes Sequence (0400,0561) at the Study level, changes to Series or Instance Attributes may have their provenance recorded in the Original Attributes Sequence (0400,0561) at the Series or Instance level, respectively. When those changes are applied to the stored SOP Instances of the Study, all Items in the Original  
860 Attributes Sequence (0400,0561) in the Inventory at the Study, Series, and Instance levels are added to the Original Attributes Sequence (0400,0561) of the stored SOP Instances. See [Section YYYY.7.9.1 “Original Attributes Sequence” in PS3.17](#).

#### C.38.1.4.4 Expiration DateTime

865 A repository system may store a SOP Instance in a temporary location (e.g., on fast short-term media). If such storage has a scheduled or expected expiration time, it may be identified in the Expiration DateTime (0008,0416) Attribute. This is not a guaranteed expiration time; the SOP Instance may become unavailable at the access URI at an earlier or later time. This Expiration DateTime (0008,0416) applies only to this non-DICOM protocol access; SOP Instances may continue to be accessible through other DICOM or non-DICOM access methods.

#### 870 C.38.1.4.5 Alternate Representation Sequence

Alternate Representation Sequence (0008,3001) encodes a reference to an alternate encoding of the inventoried SOP Instance. This alternate encoding may utilize a different SOP Class or Transfer Syntax, but the alternate encoding of an image shall be the same image although it may have different image quality characteristics.

#### 875 Notes

1. The Alternate Representation Sequence (0008,3001) allows the Inventory record of an original image to reference a lossy compressed alternate representation, and vice versa.
2. See also [PS3.4 Section C.6.1.1.5.1](#).
- 880 3. An original SOP Instance that has been operationally replaced by an alternate encoded SOP Instance, and the original then deleted, may still have its Inventory record retained to provide forward referential resolution through the Alternate Representation Sequence (0008,3001) for other SOP Instances that reference the original. This record may have Instance Availability (0008,0056) set to UNAVAILABLE (see [Section C.38.1.2.9](#)), and/or may also be marked as removed from operational use with Reason for Removal Code Sequence (0008,0406) value (130754, DCM, “Replaced by Alternate Representation”) (see [Section C.38.1.2.2](#)).

#### 885 C.38.2 Inventory Related Macros

Note

See [Section 5.5](#) for the interpretation of the Type column when these Macros are invoked in Normalized IODs.

### C.38.2.1 Scope of Inventory Macro

890 Table C.38.2-1 specifies the Key Attribute values that select the Studies included in the Inventory, i.e., the Scope of Inventory.

The full semantics of the matching process is specified in [Annex C in PS3.4](#).

**Table C.38.2-1 Scope of Inventory Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Scope of Inventory Sequence	(0008,0400)	2	Matching Key Attribute values for the Studies to be included in the Inventory. See <a href="#">Section C.38.2.1.1.1</a> .  Zero or one Item shall be included in this Sequence. An empty Sequence, or a Sequence with a single empty Item, indicates Universal Match to all Studies in the Repository.
>Extended Matching Mechanisms	(0008,040F)	1C	Extended Attribute matching mechanisms applied to the Key Attributes, equivalent to mechanisms accepted during Extended Negotiation of the Query/Retrieve Service Class as specified in <a href="#">Section C.5.1.1.2 in PS3.4</a> . See <a href="#">Section C.38.2.1.1.1</a> .  Enumerated values: RELATIONAL - Relational-queries COMBINED_DT - Date-time Matching FUZZY_SEMANTIC - Fuzzy Semantic Matching of person names TIMEZONE_ADJUST - Timezone Query Adjustment EMPTY_VALUE - Empty Value Matching MULTIPLE_VALUE - Multiple Value Matching  Required if extended matching mechanisms were applied.
>Specific Character Set	(0008,0005)	1C	Expanded or replacement character sets used in the Key Attributes. See <a href="#">Section C.12.1.1.2</a> .  Required if Attributes within the Sequence Item use an expanded or replacement character set.
>Timezone Offset from UTC	(0008,0201)	1C	Offset from UTC to the local timezone for all DA and TM Key Attributes. See <a href="#">Section C.12.1.1.8</a> .  Required if Extended Matching Mechanisms (0008,040F) includes value TIMEZONE_ADJUST

>Query/Retrieve Level	(0008,0052)	1C	<p>Matching level for Relational Matching mechanism. See <a href="#">Section C.38.2.1.1.2</a>.</p> <p>Enumerated Values:          STUDY - Study level          SERIES - Series level          IMAGE - SOP Instance level</p> <p>Required if Extended Matching Mechanisms (0008,040F) includes value RELATIONAL</p>
>Range Matching Sequence	(0008,0410)	1C	<p>The beginning and end values for Range Matching of date and time Key Attributes. See <a href="#">Section C.38.2.1.1.3</a>.</p> <p>Exactly two Items shall be included in this Sequence.</p> <p>Required if Range Matching is applied to any Key Attribute</p>
>>Any DA, DT, or TM Attributes		2	<p>Key Attribute values for matching.</p> <p>Multiple Attributes may be present.</p>
>List of UID Matching Sequence	(0008,0411)	1C	<p>Key Attribute values for List of UID Matching. See <a href="#">Section C.38.2.1.1.4</a>.</p> <p>Required if List of UID Matching is applied to any Key Attribute.</p> <p>One or more Items shall be included in this Sequence.</p>
>>Any UI Key Attribute		1	<p>Key Attribute value for matching.</p>
>Empty Value Matching Sequence	(0008,0412)	1C	<p>Key Attributes for Empty Value Matching. See <a href="#">Section C.38.2.1.1.5</a>.</p> <p>Required if Extended Matching Mechanisms (0008,040F) includes value EMPTY_VALUE and Empty Value Matching is applied to any Key Attribute.</p> <p>Only a single Item is permitted in this Sequence.</p>
>>Any Attributes		2	<p>Key Attributes with zero-length values.</p> <p>Multiple Attributes may be present.</p>
>General Matching Sequence	(0008,0413)	1C	<p>Key Attribute values for Single Value, Multiple Value, and Wild Card matching. See <a href="#">Section C.38.2.1.1.6</a></p> <p>Required if Single Value, Multiple Value, or Wild Card matching is applied to any Key Attribute.</p> <p>Only a single Item is permitted in this Sequence.</p>
>>Any Attributes		1	<p>Key Attribute values for matching.</p> <p>Multiple Attributes may be present.</p>

### C.38.2.1.1 Scope of Inventory Macro Attributes

#### 895 C.38.2.1.1.1 Scope of Inventory Sequence

The Scope of Inventory Sequence (0008,0400) specifies Key Attribute values used to select Studies to be included in an Inventory.

900 Selection of Studies is done by a matching process between Key Attribute values specified in the Scope of Inventory Sequence (0008,0400) and the corresponding values in Attributes of Studies in the repository. The matching process is identical to the Attribute matching specified for the Query/Retrieve Service Class in [Section C.2.2.2 “Attribute matching” of PS3.4](#).

Any extended matching mechanisms beyond the baseline Query/Retrieve behavior used in selection of Studies for the Inventory are identified in the Extended Matching Mechanisms (0008,040F) Attribute.

#### Notes

- 905 1. Attributes of Studies that may be matched include those additional Query/Retrieve Attributes that may be managed by the Repository system for managing stored SOP Instances, but are not specified in Composite IODs. See [Sections C.3.4](#) and [C.6.4.1 in PS3.4](#). Of particular interest for some Inventory use cases are Study Update DateTime (0008,041F), Modalities in Study (0008,0061), and Removed from Operational Use (0008,0405).
- 910 2. In the Query/Retrieve Service Class (including the Repository Query SOP Class), extended matching mechanisms are requested and agreed through SOP Class Extended Negotiation. In the Inventory Creation SOP Class (Section KK.2 in PS3.4), the use of extended mechanisms is requested using the Extended Matching Mechanisms (0008,040F) Attribute in the Initiate Action Request. In the Inventory SOP Instances, the actual use of such mechanisms is encoded in the Extended Matching Mechanisms (0008,040F) Attribute by the Instance creator.

915 Key Attributes for matching in the Query/Retrieve Service Class are allowed to have values that are exceptions to the VR for those Attributes in other contexts (see [Section 6.2 in PS3.5](#)), or to have multiplicities that are exceptions to the VM of those Attributes as specified in PS3.6. The Scope of Inventory Sequence (0008,0400) specifies Sequence Attributes that provide equivalent encoding of Key Attributes while maintaining conformance to VR and VM specifications.

920 Universal matching Key Attributes, i.e., those with zero-length value or with the value “\*”, do not select Studies, and they shall not be included in the Scope of Inventory. Zero-length values are permitted in Key Attributes of the Range Matching Sequence (0008,0410), where they represent an unbounded beginning or end of a range, and in Key Attributes of the Empty Value Matching Sequence (0008,0412).

#### C.38.2.1.1.2 Relational Matching

925 If Extended Matching Mechanisms (0008,040F) does not include the value RELATIONAL, only Key Attributes defined at the Study level, as specified in Section C.6.2.1.2 “Study Level” in PS3.4, shall be included in Scope of Inventory.

930 If Extended Matching Mechanisms (0008,040F) includes the value RELATIONAL, Studies are selected for the Inventory in accordance with the specifications for Relational-queries matching in [Section C.4.1.3.2.2 in PS3.4](#) using the Query/Retrieve Level (0008,0052) and Key Attributes specified. The Inventory Level (0008,0403) determines the level of information that is included in the Inventory and may differ from this Query/Retrieve Level (0008,0052). In the case that the Inventory Level (0008,0403) is at or lower than the Query/Retrieve Level (0008,0052), then only the records for entities matching all Key Attributes will be included in the Inventory.

#### Note

935 For example, specification of Relational Matching, Query/Retrieve Level (0008,0052) SERIES, and a Key Attribute Modality (0008,0060) with value CT will include in the Inventory all Studies that have at least one Series with Modality



CT. If the Inventory Level (0008,0403) is INSTANCE, only those Series and Instances with modality CT will be included in the Inventory; Series and Instances with Modality PR or SR, for example, in the same Study will not be included.

940 Baseline (non-relational) matching of Modalities in Study (0008,0061) with value CT will also include in the Inventory all Studies that have at least one Series with Modality CT. But since that Key Attribute performs selection at the Study level, an Inventory will include all Series of any modality for that Study.

### C.38.2.1.1.3 Range Matching Sequence

Range Matching Sequence (0008,0410) provides values for Key Attributes that use range matching of dates and times using the mechanism specified in [Section C.2.2.2.5 in PS3.4](#).

945 The same set of Key Attributes shall be present in both Items of this Sequence. For each Key Attribute, at least one Item shall have a non-zero length value.

Values in the first Item represent the beginning of the range, and values in the second Item represent the end of the range. If the first or the second value is empty, the range has an unbounded beginning or end, respectively. The range is inclusive; matched Attributes whose value is at or after the first value and before or at the second value match the range.

950 Notes

In the equivalent Query/Retrieve Service Class range matching, the beginning and end values are encoded in a single Data Element, and delimited by “-”.

955 If Extended Matching Mechanisms (0008,040F) includes the value COMBINED\_DT, related date and time Attributes, such as Study Date (0008,0020) and Study Time (0008,0030), are considered together as a datetime value for matching.

If Extended Matching Mechanisms (0008,040F) includes the value TIMEZONE\_ADJUST, dates and times are adjusted for the local timezone specified in Timezone Offset from UTC (0008,0201), as specified in [Section C.2.2.2.1.3 in PS3.4](#).

### C.38.2.1.1.4 List of UID Matching Sequence

960 List of UID Matching Sequence (0008,0411) provides a list of UIDs, one per Item, to be matched using the List of UID Matching mechanism specified in [Section C.2.2.2.2 in PS3.4](#).

Note

In the equivalent Query/Retrieve Service Class List of UID Matching, the VM=1 restriction is overridden for Key Attributes.

### 965 C.38.2.1.1.5 Empty Value Matching Sequence

Empty Value Matching Sequence (0008,0412) specifies Key Attributes that match when the corresponding Attribute in the Study has no value, as specified in [Section C.2.2.2.7 in PS3.4](#). Key Attributes identified in this Sequence shall have zero-length values.

Note

970 In the equivalent Query/Retrieve Service Class Empty Value Matching, the value consisting of exactly two QUOTATION MARK characters signifies an empty value, and its use is permitted in Key Attributes with a VR of DA, DT, or TM.

### C.38.2.1.1.6 General Matching Sequence

General Matching Sequence (0008,0413) specifies Key Attributes that are matched using Single Value and Wild Card matching, as specified in [Section C.2.2.2.1](#) and [Section C.2.2.2.4 in PS3.4](#).

975 If Extended Matching Mechanisms (0008,040F) includes the value MULTIPLE\_VALUE, General Matching Sequence (0008,0413) may also specify Key Attributes that are matched using Multiple Value matching, as specified in [Section C.2.2.2.8 in PS3.4](#).

Note

980 If Extended Matching Mechanisms (0008,040F) does not include the value MULTIPLE\_VALUE, Key Attributes with multiple values have undefined meaning.

If Extended Matching Mechanisms (0008,040F) includes the value TIMEZONE\_ADJUST, dates and time are adjusted for the local timezone specified in Timezone Offset from UTC (0008,0201), as specified in [Section C.2.2.2.1.3 in PS3.4](#).

985 If Extended Matching Mechanisms (0008,040F) includes the value FUZZY\_SEMANTIC, matching of Attributes with VR PN may be done using implementation-specific fuzzy semantic matching, as specified in [Section C.2.2.2.1.1 in PS3.4](#).



### C.38.2.2 Stored File Access Macro

990 Table C.38.2-2 specifies the Attributes that describe non-DICOM protocol access to a stored SOP Instance in the DICOM File Format, possibly contained in a container file.

**Table C.38.2-2 Stored File Access Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
File Access URI	(0008,0409)	1C	Access URI for a file containing the SOP Instance. See <a href="#">Section C.38.2.2.1.1</a> .  Required if the referenced SOP Instance is in the DICOM File Format, and is accessible through a non-DICOM protocol (see <a href="#">Annex P</a> ).
Container File Type	(0008,040A)	1C	Type of container file. See <a href="#">Section C.38.1.2.8</a> for Defined Terms.  Required if File Access URI (0008,0409) is present.
Filename in Container	(0008,040B)	1C	Filename within a container file of the file containing the SOP Instance. See <a href="#">Section C.38.2.2.1.2</a> .  Required if Container File Type (0008,040A) is ZIP, TAR, or TARGZIP.
File Offset in Container	(0008,040C)	1C	Byte offset (zero-based) within a container file for the start of the SOP Instance file. See <a href="#">Section C.38.2.2.1.2</a> .  Required if Container File Type (0008,040A) is BLOB. May be present otherwise.
File Length in Container	(0008,040D)	1C	Length in bytes of the SOP Instance file within a container file. See <a href="#">Section C.38.2.2.1.2</a> .  Required if Container File Type (0008,040A) is BLOB. May be present otherwise.
Stored Instance Transfer Syntax UID	(0008,040E)	1C	Transfer Syntax of the SOP Instance encoded in DICOM File Format. Equal to Transfer Syntax UID (0002,0010) in File Meta Information header of the stored Instance.  Required if File Access URI (0008,0409) is present.
Lossy Image Compression Ratio	(0028,2112)	3	Describes the approximate lossy compression ratio(s) that have been applied to this image.  See <a href="#">Section C.7.6.1.1.5.2</a> .
MAC Algorithm	(0400,0015)	1C	The algorithm used for generating a Message Authentication Code. See <a href="#">Table C.12.1.1.3.1.2-1</a> for Defined Terms.  Required if MAC (0400,0404) is present.
MAC	(0400,0404)	3	Message Authentication Code computed across the stored instance file for verification of file integrity. See <a href="#">Section C.38.2.2.1.3</a>

### C.38.2.2.1 Stored File Access Macro Attributes

#### C.38.2.2.1.1 File Access URI

995 File Access URI (0008,0409) provides the URI for accessing a file containing the SOP Instance in the DICOM File Format. The file may contain a single SOP Instance, or it may be a container file in which one or more SOP Instance files are included.

1000 File Access URI (0008,0409) may be a relative path reference beginning with the single-dot-segment “./” (see [Section P.2.1](#)). In this case, the value is merged with a Stored Instance Base URI (0008,0407) specified for the context of this Attribute in accordance with [Section P.2.1](#).

#### Note

1005 The merge of a relative path File Access URI (0008,0409) with a Stored Instance Base URI (0008,0407) involves only two Attribute values. For example, a relative path specified at the Instance level is not merged with any Study or Series level relative path values, but only with a base URI. This contrasts with the web-based Studies Service of PS3.18, which might require constructing a URI from a base URI In the Retrieve URL (0008,1190), DICOM-defined strings, a Study Instance UID (0020,000D), a Series Instance UID (0020,000E), and a Referenced SOP Instance UID (0008,1155).

#### C.38.2.2.1.2 Filename in Container, File Offset in Container, and File Length in Container

1010 If the stored SOP Instance is included in a ZIP, TAR, or TARGZIP container file as specified in [Section P.1.2](#), Filename in Container (0008,040B) is the filename within that container file of the file containing the SOP Instance.

If the stored SOP Instance is included in a BLOB container file, and optionally for other container formats, File Offset in Container (0008,040C) is the byte offset for the start of the file for the SOP Instance, and File Length in Container (0008,040D) is the file length. For TARGZIP container files, this is the offset within the TAR container file after extraction from the GZIP container file.

1015 Note

Locating a file by filename within a container file may require parsing the entire container file (TAR) or look up in the index (ZIP). The File Offset in Container (0008,040C) and File Length in Container (0008,040D), if provided by the SCP, allows the SCU to directly access a specific file.

#### C.38.2.2.1.3 MAC

1020 The integrity of a stored SOP Instance file may be verified by a Message Authentication Code (also known as a message digest, hash, or cryptographic checksum) computed across the SOP Instance file. The MAC (0400,0404) value is computed across the entire file as a byte stream, including the Preamble, Prefix, Meta-Information Header, and Data Set Trailing Padding (see [Section 7 “DICOM File Format” in PS3.10](#)). For files stored in container files, the MAC is computed on the file extracted from the container.

1025 Note

This differs from the MAC for Digital Signatures (see [Section C.12.1.1.3](#)), which is computed across an enumerated list of Attributes within the SOP Instance, not across the entire file.

### C.38.2.3 Inventory Reference Macro

1030 Table C.38.2-3 specifies the Attributes that describe a referenced Inventory SOP Instance, and its referenced Inventory SOP Instances in a hierarchical tree.

Note

Because each node in the tree of references includes its complete subsidiary tree, it is not possible to have cycles of references (a node being a descendent of itself). See also [Section YYYY.7.3 "Using Referenced Inventories" in PS3.17.](#)

**Table C.38.2-3 Inventory Reference Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Referenced SOP Class UID	(0008,1150)	1	SOP Class UID of the Inventory SOP Instance included by reference.
Referenced SOP Instance UID	(0008,1155)	1	SOP Instance UID of the Inventory SOP Instance included by reference.
Inventory Access End Points Sequence	(0008,0420)	3	End point(s) for network protocols to access the referenced Inventory SOP Instance, and the baseline default end point(s) to access Inventory SOP Instances in the Incorporated Inventory Instance Sequence (0008,0422). See <a href="#">Section C.38.2.3.1.1.</a>  Only a single Item is permitted in this Sequence.
>Include <a href="#">Table C.38.2-4 "Access End Points Macro"</a>			
Include <a href="#">Table C.38.2-2 "Stored File Access Macro"</a>			See <a href="#">Section C.38.2.3.1.2</a>
Incorporated Inventory Instance Sequence	(0008,0422)	1C	Inventory SOP Instances whose content is included by reference. See <a href="#">Section C.38.1.1.5.</a>  Required if the referenced Inventory SOP Instance itself includes Inventory SOP Instances by reference.  One or more Items shall be included in this Sequence.
>Include <a href="#">Table C.38.2-3 "Inventory Reference Macro"</a>			Recursive inclusion to describe a tree of referenced Inventory SOP Instances.

1035

**C.38.2.3.1 Inventory Reference Macro Attributes**

**C.38.2.3.1.1 Inventory Access End Points Sequence**

1040 The tree of referenced Inventory SOP Instances includes Attributes specifying the available network access mechanisms and protocol end point(s) for each referenced SOP Instance. As the protocol end point may be the same for all referenced SOP Instances in a tree or sub-tree, the value specified in any node in the tree sets the default value for all subsidiary nodes, except for a sub-tree whose root node sets a value. For example, if all referenced Inventory SOP Instances are accessible through the Inventory MOVE SOP Class at the same SCP AE Title, that AE Title only needs to be specified in the root node of the tree.

1045 If protocol end point values are not specified in the current Item of the Incorporated Inventory Instance Sequence (0008,0422) (which invoked the Inventory Reference Macro), the default values specified for the data set incorporating the Incorporated Inventory Instance Sequence (0008,0422) apply.

Notes

1. Access via Retrieve AE Title (0008,0054) or Retrieve URL (0008,1190) uses the Referenced SOP Instance UID (0008,1155) to identify the Inventory SOP Instance. Access via the Stored Instance Base URI (0008,0407) uses the File Access URI (0008,0409) to identify the stored Inventory SOP Instance file.
2. See Section 12 in PS3.18 for the mechanisms to construct a DICOM web-based URI from the Retrieve URL (0008,1190) and Referenced SOP Instance UID (0008,1155).
3. See also [Section YYYY.7.3 in PS3.17](#).

**C.38.2.3.1.2 File Access URI and Stored Instance Base URI**

If the referenced Inventory SOP Instance is stored in the DICOM File Format (see [Section 7 “DICOM File Format” in PS3.10](#)) and is accessible through a non-DICOM protocol (see [Annex P](#)), the File Access URI (0008,0409) contains an [RFC3986](#) URI for non-DICOM protocol access to the Inventory SOP Instance. File Access URI (0008,0409) may be a relative path reference URI, which is merged with the Stored Instance Base URI (0008,0407) from the Inventory Access End Points Sequence (0008,0420) in accordance with [Section P.2.1](#).

File Access URI (0008,0409) may reference a container file that includes the Inventory SOP Instance.

Notes

1. The File Access URI (0008,0409) is specified in the included Stored File Access Macro.
2. Storage in a container file (ZIP or GZIP) permits compression of the entire file using operating system applications, as an alternative to compression of the SOP Instance using DICOM applications (e.g., using the Deflated Little Endian Transfer Syntax defined in [Section A.5 in PS3.5](#)).

**C.38.2.4 Access End Points Macro**

Table C.38.2-4 specifies the Attributes that describe the available network access protocol end point(s), i.e., network addresses, for referenced SOP Instances.

**Table C.38.2-4 Access End Points Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Retrieve AE Title	(0008,0054)	3	AE Title end point from which SOP Instances may be retrieved using a C-MOVE or C-GET based SOP Class (see PS3.4). This AE Title is used together with one or more of Referenced SOP Instance UID (0008,1155), Study Instance UID (0020,000D), and/or and Series Instance UID (0020,000E) values.
Retrieve URL	(0008,1190)	3	Base URI end point of the origin server from which SOP Instances may be retrieved using a DICOM web-based service (see <a href="#">PS3.18</a> ). This base URI is used together with one or more of Referenced SOP Instance UID (0008,1155), Study Instance UID (0020,000D), and/or and Series Instance UID (0020,000E) values.
Stored Instance Base URI	(0008,0407)	3	Base URI end point from which SOP Instances may be retrieved using a non-DICOM protocol (see <a href="#">Section P</a> ). This base URI is used together with a relative path File Access URI (0008,0409) or a Folder Access URI (0008,0408) value.

### C.38.3 Inventory Creation Module

Table C.38.3-1 specifies the Attributes that are contained in an Inventory Creation Request/Response.

**Table C.38.3-1 Inventory Creation Module Attributes**

Attribute Name	Tag	Attribute Description
<i>Include <a href="#">Table C.38.2-1 Scope of Inventory Macro Attributes</a></i>		Key Attribute values for the Studies to be included in the Inventory.
Transaction UID	(0008,1195)	Unique identifier of a transaction initiating the production of an Inventory.
Transaction Status	(0008,0417)	Processing status for this transaction. (See <a href="#">Section KK.2.1.1 in PS3.4</a> ).  Enumerated Values: PROCESSING – Processing continuing COMPLETE – Processing complete with completed inventory FAILURE – Processing failure CANCELED – Processing canceled PAUSED – Processing paused
Transaction Status Comment	(0008,0418)	Explanation or further detail of Transaction Status (0008,0417).
Expiration DateTime	(0008,0416)	The date and time until which the Inventory SOP Instance is expected to be available. See <a href="#">Section C.38.3.1.3</a> .
Inventory Purpose	(0008,0401)	Purpose for which the Inventory is to be created.
Inventory Level	(0008,0403)	Information Entity level for records to be included in Inventory.  Enumerated Values: STUDY – Study records SERIES – Study and Series records INSTANCE – Study, Series, and Instance records
Referenced SOP Class UID	(0008,1150)	SOP Class UID of the produced Inventory SOP Instance.
Referenced SOP Instance UID	(0008,1155)	SOP Instance UID of the produced Inventory SOP Instance at the root of the tree of incorporated Inventory SOP Instances (see <a href="#">Section C.38.3.1.1</a> ).
Retrieve AE Title	(0008,0054)	AE Title from which the Inventory SOP Instance may be retrieved through Inventory MOVE or Inventory GET SOP Classes (see <a href="#">Section JJ in PS3.4</a> ).
Retrieve URL	(0008,1190)	Base URI of the origin server from which the Inventory SOP Instance may be retrieved through the Non-Patient Instance Service (see <a href="#">Section 12 in PS3.18</a> ).
Stored Instance Base URI	(0008,0407)	Base URI for accessing the Inventory SOP Instance through a non-DICOM protocol. See <a href="#">Section C.38.3.1.2</a> .
<i>Include <a href="#">Table C.38.2-2 “Stored File Access Macro”</a></i>		See <a href="#">Section C.38.3.1.2</a> .

Attribute Name	Tag	Attribute Description
Total Number of Study Records	(0008,0428)	Number of Studies found and processed into Inventory SOP Instances (as of time of message) that match Scope of Inventory.
Requested Status Interval	(0008,0414)	Requested interval, in minutes, between Inventory Status notifications. Value shall be greater than 0.
Retain Instances	(0008,0415)	Whether produced Inventory SOP Instances should be retained when Inventory production is canceled.  Enumerated Values: Y – SOP Instances are to be retained N – SOP Instances may be deleted

1075

### C.38.3.1 Inventory Creation Module Attributes

#### C.38.3.1.1 Referenced SOP Instance UID

The content of an Inventory may be divided into more than one Inventory SOP Instance, organized as a tree of SOP Instances with one SOP Instance as the root (see [Section C.38.1.1.5](#) and [Section YYYY.3.3 in PS3.17](#)).

1080 Only the root Inventory SOP Instance is identified in this data set in the Referenced SOP Instance UID (0008,1155); that SOP Instance includes the entire tree of references to SOP Instances comprising the Inventory.

#### C.38.3.1.2 File Access URI and Stored Instance Base URI

1085 If the produced Inventory SOP Instance is stored in the DICOM File Format (see [Section 7 “DICOM File Format” in PS3.10](#)) and is accessible through a non-DICOM protocol (see [Annex P](#)), the File Access URI (0008,0409) contains an [\[RFC3986\]](#) URI for non-DICOM protocol access to the Inventory SOP Instance. File Access URI (0008,0409) may be a relative path reference URI, which is merged with the Stored Instance Base URI (0008,0407) in accordance with [Section P.2.1](#).

1090 File Access URI (0008,0409) may reference a container file that includes the Inventory SOP Instance (see notes in [Section C.38.2.3.1.2](#)).

#### C.38.3.1.3 Expiration DateTime

1095 A data management system may manage the storage lifecycle of the Inventory SOP Instances (e.g., by deleting older Inventory objects after a predetermined time). If there is a scheduled or expected time for SOP Inventory Instance deletion, it may be identified in the Expiration DateTime (0008,0416) Attribute. This is not a guaranteed expiration time; the SOP Instances may become unavailable at an earlier or later time. This Expiration DateTime (0008,0416) applies to all available access methods (both DICOM and non-DICOM protocols).

Note

See [Section YYYY.7.5 “Inventory Lifecycle Management” in PS3.17](#) for further discussion.

1100 Factor out Referenced Request Sequence Attributes from SR and KO to be referenced in Inventory

### C.17.2 SR Document General Module

Table C.17-2 defines the general Attributes of an SR Document Instance. These Attributes identify the SR Document and provide context for the entire document.

**Table C.17-2. SR Document General Module Attributes**

Attribute Name	Tag	Type	Attribute Description
...			
Referenced Request Sequence	(0040,A370)	1C	Identifies Requested Procedures that are being fulfilled (completely or partially) by creation of this Document.  One or more Items shall be included in this Sequence.  Required if this Document fulfills at least one Requested Procedure. May be present otherwise.
<b>&gt;Include Table C.17-3c "Referenced Request Macro Attributes"</b>			
>Study Instance UID	(0020,000D)	1	Unique identifier for the Study.
>Referenced Study Sequence	(0008,1110)	2	Uniquely identifies the Study SOP Instance. Zero or one Item shall be included in this Sequence. See Section 10.6.1.
<b>&gt;&gt;Include Table 10-11 "SOP Instance Reference Macro Attributes"</b>			
>Accession Number	(0008,0050)	2	A departmental IS generated number that identifies the order for the Study.
>Issuer of Accession Number Sequence	(0008,0051)	3	Identifier of the Assigning Authority that issued the Accession Number. Only a single Item is permitted in this Sequence.
<b>&gt;&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</b>			
>Placer Order Number/Imaging Service Request	(0040,2016)	2	The order number assigned to the Imaging Service Request by the party placing the order.
>Order Placer Identifier Sequence	(0040,0026)	3	Identifier of the Assigning Authority that issued the Placer Order Number. Only a single Item is permitted in this Sequence.
<b>&gt;&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</b>			
>Filler Order Number/Imaging Service Request	(0040,2017)	2	The order number assigned to the Imaging Service Request by the party filling the order.
>Order Filler Identifier Sequence	(0040,0027)	3	Identifier of the Assigning Authority that issued the Filler Order Number. Only a single Item is permitted in this Sequence.
<b>&gt;&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</b>			
>Requested Procedure ID	(0040,1001)	2	Identifier of the related Requested Procedure
>Requested Procedure Description	(0032,1060)	2	Institution-generated administrative description or classification of Requested Procedure.

Attribute Name	Tag	Type	Attribute Description
>Requested Procedure Code Sequence	(0032,1064)	2	A Sequence that conveys the requested procedure. Zero or one Item shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			No Baseline CID is defined.
>Reason for the Requested Procedure	(0040,1002)	3	Reason for requesting this procedure.
>Reason for Requested Procedure Code Sequence	(0040,100A)	3	Coded Reason for requesting this procedure. One or more Items are permitted in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			No Baseline CID is defined.
...			

1105 ...

### C.17.2.8 Referenced Request Macro

**Table C.17-3c defines the Attributes of a Requested Procedure that was associated with production of a Document.**

1110

**Table C.17-3c. Referenced Request Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
<b>Study Instance UID</b>	<b>(0020,000D)</b>	<b>1</b>	<b>Unique identifier for the Study.</b>
<b>Referenced Study Sequence</b>	<b>(0008,1110)</b>	<b>2</b>	<b>Uniquely identifies the Study SOP Instance.</b> <b>Zero or one Item shall be included in this Sequence. See Section 10.6.1.</b>
<b>&gt;Include Table 10-11 "SOP Instance Reference Macro Attributes"</b>			
<b>Accession Number</b>	<b>(0008,0050)</b>	<b>2</b>	<b>A departmental identifier for the order for the Study.</b>
<b>Issuer of Accession Number Sequence</b>	<b>(0008,0051)</b>	<b>3</b>	<b>Identifier of the Assigning Authority that issued the Accession Number (0008,0050).</b> <b>Only a single Item is permitted in this Sequence.</b>
<b>&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</b>			
<b>Placer Order Number/Imaging Service Request</b>	<b>(0040,2016)</b>	<b>2</b>	<b>The order number assigned to the Imaging Service Request by the party placing the order.</b>
<b>Order Placer Identifier Sequence</b>	<b>(0040,0026)</b>	<b>3</b>	<b>Identifier of the Assigning Authority that issued the Placer Order Number (0040,2016).</b> <b>Only a single Item is permitted in this Sequence.</b>
<b>&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</b>			
<b>Filler Order Number/Imaging Service Request</b>	<b>(0040,2017)</b>	<b>2</b>	<b>The order number assigned to the Imaging Service Request by the party filling the order.</b>



Attribute Name	Tag	Type	Attribute Description
<u>Order Filler Identifier Sequence</u>	(0040,0027)	3	<u>Identifier of the Assigning Authority that issued the Filler Order Number.</u>  <u>Only a single Item is permitted in this Sequence.</u>
<b>&gt;Include Table 10-17 “HL7v2 Hierarchic Designator Macro Attributes”</b>			
<u>Requested Procedure ID</u>	(0040,1001)	2	<u>Identifier of the related Requested Procedure</u>
<u>Requested Procedure Description</u>	(0032,1060)	2	<u>Institution-generated administrative description or classification of Requested Procedure.</u>
<u>Requested Procedure Code Sequence</u>	(0032,1064)	2	<u>Coded type of the requested procedure.</u>  <u>Zero or one Item shall be included in this Sequence.</u>
<b>&gt;Include Table 8.8-1 “Code Sequence Macro Attributes”</b>			<u>No Baseline CID is defined.</u>
<u>Reason for the Requested Procedure</u>	(0040,1002)	3	<u>Reason for requesting this procedure.</u>
<u>Reason for Requested Procedure Code Sequence</u>	(0040,100A)	3	<u>Coded Reason for requesting this procedure.</u>  <u>One or more Items are permitted in this Sequence.</u>
<b>&gt;Include Table 8.8-1 “Code Sequence Macro Attributes”</b>			<u>No Baseline CID is defined.</u>

...

### C.17.6.2 Key Object Document Module

1115 Table C.17.6-2 defines the general Attributes of a Key Object Selection Document. These Attributes identify and provide context for the Key Object Selection Document.

**Table C.17.6-2. Key Object Document Module Attributes**

Attribute Name	Tag	Type	Attribute Description
...			
<u>Referenced Request Sequence</u>	(0040,A370)	1C	<u>Identifies Requested Procedures to which this Document pertains.</u>  <u>One or more Items shall be included in this Sequence.</u>  <u>Required if this Document pertains to at least one Requested Procedure.</u>
<b>&gt;Include Table C.17-3c “Referenced Request Macro Attributes”</b>			
<u>&gt;Study Instance UID</u>	(0020,000D)	1	<u>Unique identifier for the Study.</u>
<u>&gt;Referenced Study Sequence</u>	(0008,1110)	2	<u>Uniquely identifies the Study SOP Instance.</u> <u>Zero or one Item shall be included in this Sequence.</u> <u>See Section 10.6.1.</u>

Attribute Name	Tag	Type	Attribute Description
<i>&gt;&gt;Include Table 10-11 "SOP Instance Reference Macro Attributes"</i>			
>Accession Number	{0008,0050}	2	A departmental IS-generated number that identifies the order for the Study.
>Issuer of Accession Number Sequence	{0008,0051}	3	Identifier of the Assigning Authority that issued the Accession Number. Only a single Item is permitted in this Sequence.
<i>&gt;&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</i>			
>Placer Order Number/Imaging Service Request	{0040,2016}	2	The order number assigned to the Imaging Service Request by the party placing the order.
>Order Placer Identifier Sequence	{0040,0026}	3	Identifier of the Assigning Authority that issued the Placer Order Number. Only a single Item is permitted in this Sequence.
<i>&gt;&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</i>			
>Filler Order Number/Imaging Service Request	{0040,2017}	2	The order number assigned to the Imaging Service Request by the party filling the order.
>Order Filler Identifier Sequence	{0040,0027}	3	Identifier of the Assigning Authority that issued the Filler Order Number. Only a single Item is permitted in this Sequence.
<i>&gt;&gt;Include Table 10-17 "HL7v2 Hierarchic Designator Macro Attributes"</i>			
>Requested Procedure ID	{0040,1001}	2	Identifier of the related Requested Procedure
>Requested Procedure Description	{0032,1060}	2	Institution-generated administrative description or classification of Requested Procedure.
>Requested Procedure Code Sequence	{0032,1064}	2	A Sequence that conveys the requested procedure. Zero or one Item shall be included in this Sequence.
<i>&gt;&gt;Include Table 8.8-1 "Code Sequence Macro Attributes"</i>			
...			<i>No Baseline CID is defined.</i>

1120 Add new Inventory Directory Record Type to Section F.3.2.2

**Table F.3-3. Directory Information Module Attributes**

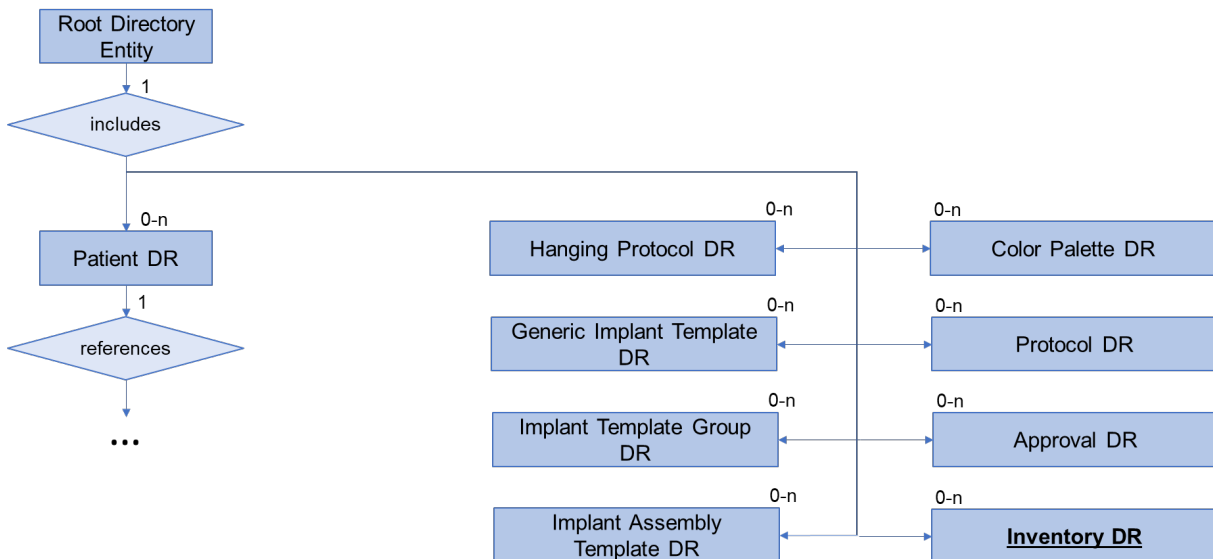
Attribute Name	Tag	Type	Attribute Description
>Directory Record Type	(0004,1430)	1	Defines a specialized type of Directory Record by reference to its position in the Media Storage Directory Information Model (see Section F.4).  Enumerated Values: <b>PATIENT</b> ... <b><u>INVENTORY</u></b> <b>PRIVATE</b>  Privately defined record hierarchy position. Type shall be defined by Private Record UID (0004,1432).

1125 Add new Inventory Directory Record Type to Section F.4 and update Figure

*- DICOM editor to design figure layout (perhaps grouping Non-Patient object records as shown here?)*

**Table F.4-1. Relationship Between Directory Records**

Directory Record Type	Section	Directory Record Types that may be included in the next lower-level directory Entity
(Root Directory Entity)		PATIENT, HANGING PROTOCOL, ... <b><u>INVENTORY</u></b> , PRIVATE
<b><u>INVENTORY</u></b>	<b><u>F.5.48</u></b>	<b><u>PRIVATE</u></b>



**Figure F.4-1. Basic Directory IOD Information Model**

*Add new Inventory Directory Record Definition to Section F.5*

**F.5.48 Inventory Directory Record Definition**

1135 The Directory Record is based on the specification of Section F.3. It is identified by a Directory Record Type of Value "INVENTORY". Table F.5-48 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Inventory IOD. This Directory Record shall be used to reference an Inventory SOP Instance. This type of Directory Record may reference a Lower-Level Directory Entity that includes one or more Directory Records as defined in Table F.4-1.

1140 **Table F.5-48. Inventory Keys**

Attribute Name	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used in one of the keys.
Content Date	(0008,0023)	1	
Content Time	(0008,0033)	1	
Inventory Purpose	(0008,0401)	2	
Inventory Level	(0008,0403)	1	
<i>Include <a href="#">Table C.38.2-1 Scope of Inventory Macro Attributes</a></i>			
Inventory Completion Status	(0008,0426)	1	
Total Number of Study Records	(0008,0428)	1	

Add new Annex P Stored File Access Through Non-DICOM Protocols

## 1145 **Annex P Stored File Access Through Non-DICOM Protocols (Normative)**

The Inventory IOD (see [Section A.88](#), and specifically the Inventory Module in [Section C.38.1](#)) includes optional Attributes providing a URI for SOP Instances stored in the DICOM File Format and accessible through a non-DICOM file access protocol. Additionally, Inventory SOP Instances themselves may be stored in the DICOM File  
1150 Format and be accessible through a non-DICOM file access protocol as specified in a URI in the Inventory Creation Response (see [Section B.30](#), and the Inventory Creation Module in [Section C.38.3](#)). This Annex specifies constraints on those URIs and their target resources (files).

Note

See also [Section YYYY.6 “Security Considerations” in PS3.17](#).

### 1155 **P.1 FILES AND SETS OF FILES**

#### **P.1.1 DICOM File Format**

Each stored SOP Instance that is a target of an Inventory URI shall be encoded in accordance with the DICOM File Format (see [Section 7 “DICOM File Format” in PS3.10](#)).

Note

1160 Depending on the storage mechanism, this target resource may be denoted a “file” or an “object”. The term “file” is used in this specification.

#### **P.1.2 Container File Formats**

SOP Instances in the DICOM File Format may be aggregated into container files in accordance with the mechanisms specified in this Section.

1165 Note

Directly or indirectly executable files within container files are a security risk. A producer of a container file should avoid including such executable files. A reader should take actions to mitigate against such executable files when reading a container file. See [Section YYYY.6.2 in PS3.17](#).

##### **P.1.2.1 ZIP**

1170 Multiple SOP Instance files may be included in a ZIP container file in accordance with [\[ISO/IEC 21320-1\]](#).

Note

[\[ISO/IEC 21320-1\]](#) is a constraint on the [\[ZIP\]](#) specification, and in particular supports only uncompressed or [\[RFC1951\]](#) DEFLATE compressed files, and does not permit encryption.

##### **P.1.2.2 TAR**

1175 Multiple SOP Instance files may be included in a TAR container file (i.e., a file in accordance with the *ustar Interchange Format*) in accordance with [\[POSIX\]](#).

Note

1180 “ustar” is the formal name, derived from “Unix Standard Tape ARchive”, although TAR is the common term and is used in this specification. The specification for *ustar Interchange Format* is in the [\[POSIX\]](#) section “pax - portable archive interchange”.

### P.1.2.3 GZIP

A single SOP Instance file may be included in a GZIP container file in accordance with [\[RFC1952\]](#).

Note

The GZIP format supports compression of the contained file using [\[RFC1951\]](#) DEFLATE compression.

### 1185 P.1.2.4 TARGZIP

Multiple SOP Instance files may be included in a TAR container file in accordance with [\[POSIX\]](#), which is then contained within a GZIP container file in accordance with [\[RFC1952\]](#).

Note

The TARGZIP format supports compression of the multiple SOP Instances in the TAR.

### 1190 P.1.2.5 BLOB

Multiple SOP Instance files may be included in a container file without standardized file delimitation, typically denoted a binary large object (BLOB) or an octet-stream. For use in DICOM, files contained in the BLOB are required to be delimited by externally managed byte offsets and file lengths.

## P.1.3 Folders for Sets of Files

1195 The file storage mechanism may support data structures that manage references to sets of files in a folder.

Note

Depending on the storage mechanism, these structures may alternately be denoted “directories”. The term “folder” is used in this specification due to potential ambiguities with the term “directory”.

1200 The storage of multiple SOP Instance files may be managed such that all SOP Instances in a Study or in a Series are contained within a single folder. Within that folder, some or all of the files may be included in a ZIP, TAR, GZIP, TARGZIP, or BLOB container file.

## P.2 ACCESS PROTOCOLS

### P.2.1 URI Format

The URI for non-DICOM protocol access to stored SOP Instances shall be in accordance with [\[RFC3986\]](#).

1205 If the URI is split between two data elements, a base URI and a relative path, the merger of those data elements in accordance with [\[RFC3986\]](#) Section 5.2.3 “Merge Paths” shall form the conformant URI. The split shall be at a path segment boundary, and if a slash (“/”) character occurs at that boundary, it shall be placed in the base URI data element only. The second data element comprising the relative path shall begin with a single-dot-segment “.”.

1210 Dot-segments shall not otherwise be used.

### P.2.2 Protocol

The non-DICOM file access protocol used in the Inventory URI link is not constrained by this Standard. The Conformance Statement for the implementation shall specify the protocol(s) in its description of conformance to the Inventory SOP Class. Some common protocols are listed in Table P.2-1.

1215 Notes

1. Conformance specification may be facilitated by reference to IANA-registered schemes <https://www.iana.org/assignments/uri-schemes/>
2. Several protocols are layered on HTTP. While the specific protocol should be specified in the Conformance Statement, the only feature required is the ability to read an object, which is generally implemented simply as an HTTP GET in such protocols, and may be implemented with only a URI.
3. An access protocol will support technical means for access control and transport security, which must be used in accordance with institutional security policies and procedures. See [Section YYYY.6.1 "Access Control and Secure Transport" in PS3.17](#).

1220

1225

**Table P.2-1. Common Non-DICOM File Access Protocols (Informative)**

IANA-registered Scheme	Protocol	Further Specification
nfs	NFS	<a href="#">[RFC7530]</a>
smb	SMB	<a href="https://docs.microsoft.com/en-us/openspecs/windows_protocols/ms-smb2">https://docs.microsoft.com/en-us/openspecs/windows_protocols/ms-smb2</a>
https	HTTP GET	<a href="#">[RFC7230]</a> , <a href="#">[RFC7231]</a> Includes various cloud storage implementations

## DICOM PS3.4: Service Class Specifications

*Add definition for Default Character Repertoire*

### 1230 3.8 DICOM DATA STRUCTURES AND ENCODING

This Part of the Standard makes use of the following terms defined in PS3.5:

...

#### **Default Character Repertoire**

[Default Character Repertoire](#)

1235

*Add definition of Non-Patient Object*

### 3.9 DICOM SERVICE CLASS DEFINITIONS

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

...

#### 1240 **Non-Patient Object**

**A SOP Instance that adheres to a Composite Instance IOD Information Model specified in PS3.3, but does not have the Patient Information Entity as its root. Non-Patient Object SOP Instances may still contain patient-related identifiable information, e.g., Inventory SOP Instances.**

1245 *Add empty value matching and multiple value matching to Query/Retrieve*

#### **C.2.2.2 Attribute Matching**

The following types of matching may be performed on Key Attributes in the Query/Retrieve Service Class:

- Single Value Matching
- List of UID Matching
- 1250 • Universal Matching
- Wild Card Matching
- Range Matching
- Sequence Matching
- **Empty Value Matching**
- 1255 • **Multiple Value Matching**

Matching requires special characters (i.e., "\*", "?", "-", "=", and "\", and **QUOTATION MARK of the Default Character Repertoire**), which need not be part of the character repertoire for the VR of the Key Attributes.

...

##### **C.2.2.2.1 Single Value Matching**

1260 If the value specified for a Key Attribute in a request is non-zero length and if it is not of VR SQ and:



- of VR of AE, CS, LO, LT, PN, SH, ST, UC, UR or UT and contains **a single value with** no wild card characters, **and if Extended Negotiation of Empty Value Matching is successful and it does not have the value of exactly two QUOTATION MARK characters,** or
- 1265 • of VR of DA, TM or DT and contains a single value with no "-" **and no QUOTATION MARK characters,** or
- of any other VR

then Single Value Matching shall be performed.

...

#### **C.2.2.2.7 Empty Value Matching**

1270 **If Extended Negotiation of Empty Value Matching is successful, and for Attributes with VR of AE, CS, DA, DT, LO, LT, PN, SH, ST, TM, UC, UR, or UT, a Key Attribute value of exactly two QUOTATION MARK characters (22H in the Default Character Repertoire) specified in a request shall indicate matching to an empty value. Such a match is successful to entities with a zero-length value for the corresponding Attribute, or for which the Attribute is not present.**

#### 1275 **Notes**

1. **Other quotation mark characters defined in an expanded or replacement character set, such as double angle quotation marks, left and right curved quotation marks, etc., are not valid for specifying empty value matching.**
- 1280 2. **VRs of AE, LO, LT, PN, SH, ST, UC, and UT allow the QUOTATION MARK character. Matching of a string of two QUOTATION MARK characters in those Attributes can be done with wild card matching using the ASTERISK character (e.g., "\*\*")**

#### **C.2.2.2.8 Multiple Value Matching**

1285 **If Extended Negotiation of Multiple Value Matching is successful, and for Attributes with VR of AE, AS, AT, CS, LO, PN, SH, or UC and a defined VM greater than 1, a Key Attribute with multiple values specified in a request shall indicate matching to a multi-valued entity Attribute. Such a match is successful only if each and every value in the Key Attribute matches a value in the corresponding Attribute in the entity.**

**Key Attribute Values shall not include wild cards.**

1290 **The order of Attribute Values in the request need not match the order in the corresponding entity Attribute.**

#### **Notes**

1. **This is a logical 'AND' function for all values in the Key Attribute. E.g., a value of CT\PT for Modalities in Study (0008,0061) in the Request Identifier will match only Studies that include both a CT Series and a PT Series.**
- 1295 2. **There may be additional values in the entity Attribute that do not match values in the Key Attribute.**
3. **Multiple Value Matching does not apply to Specific Character Set (0008,0005), which is not a Key Attribute for matching, but rather specifies the encoding of characters in the Identifier.**
4. **In the absence of successful Extended Negotiation for Multiple Value Matching, the semantics of multiple values in a Key Attribute is undefined.**

1300

### C.2.2.3 Matching Multiple Values

When **using Single Value Matching, Wild Card Matching, or Range Matching for** matching an Attribute that has a value multiplicity of greater than one, if any of the values match, then all values shall be returned.

**When using Multiple Value Matching, if matching is successful, then all values shall be returned.**

1305

*Add empty value matching and multiple value matching to Query/Retrieve Extended Negotiation*

#### C.5.1.1 SOP Class Extended Negotiation

1310 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, fuzzy semantic matching of person names, timezone query adjustment, **and** Enhanced Multi-Frame Image Conversion, **Empty Value Matching, and Multiple Value Matching.**

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

- 1315
- no relational-query support
  - separate (independent) Range Matching of date and time Attributes
  - literal matching of person names with case sensitivity unspecified
  - timezone query adjustment unspecified
  - no Enhanced Multi-Frame Image Conversion support
- 1320
- **no Empty Value Matching**
  - **no Multiple Value Matching**

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 PS3.7) followed by the Service-class-application-information field. This field defines one or more sub-fields:

- 1325
- 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
  - timezone query adjustment by the Association-requester
  - Enhanced Multi-Frame Image Conversion support by the Association-requester
- 1330
- **Empty Value Matching support by the Association-requester**
  - **Multiple Value Matching support by the Association-requester**

...

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

1335 The SOP Class Extended Negotiation Sub-Item consists of a sequence of mandatory fields as defined by PS3.7. Table C.5-1 defines the Service-class-application-information field for DICOM Query/Retrieve SOP Classes and Specialized DICOM Query/Retrieve SOP Classes that include the C-FIND operation. This field may be either one or more bytes in length (i.e., item bytes 2, ~~3, 4, and 5~~ **through 7** 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
...		
<u>6</u>	<u>Empty Value Matching</u>	<u>This byte field defines whether or not Empty Value Matching support is requested by the Association-requester. It shall be encoded as an unsigned binary integer and shall use one of the following values</u> <u>0 - Empty Value Matching not requested</u> <u>1 - Empty Value Matching requested</u>
<u>7</u>	<u>Multiple Value Matching</u>	<u>This byte field defines whether or not Multiple Value Matching support is requested by the Association-requester. It shall be encoded as an unsigned binary integer and shall use one of the following values</u> <u>0 - Multiple Value Matching not requested</u> <u>1 - Multiple Value Matching requested</u>

1340

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

The SOP Class Extended Negotiation Sub-Item is made of a sequence of mandatory fields as defined by PS3.7. Table C.5-2 defines the Service-class-application-information field for DICOM Query/Retrieve SOP Classes and Specialized DICOM Query/Retrieve SOP Classes that include the C-FIND operation. This field may be either one or more bytes in length (i.e., item bytes 2, ~~3, 4, and 5~~ through 7 are optional).

1345

**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
...		
<u>6</u>	<u>Empty Value Matching</u>	<u>This byte field defines Empty Value Matching support by the Association-acceptor. It shall be encoded as an unsigned binary integer and shall use one of the following values</u> <u>0 - Empty Value Matching not supported</u> <u>1 - Empty Value Matching supported</u>
<u>7</u>	<u>Multiple Value Matching</u>	<u>This byte field defines Multiple Value Matching support by the Association-acceptor. It shall be encoded as an unsigned binary integer and shall use one of the following values</u> <u>0 - Multiple Value Matching not supported</u> <u>1 - Multiple Value Matching supported</u>

*Add empty and multiple value matching to Query/Retrieve Conformance*

1350 **C.6.1.2.1.1 C-FIND SCU Conformance**

...

An implementation that conforms to one of the SOP Classes of the Patient Root SOP Class Group as an SCU shall state in its Conformance Statement whether or not it supports extended negotiation of combined date-time matching, ~~and/or~~ fuzzy semantic matching of person names, **Empty Value Matching, and/or Multiple Value Matching**.

1355

...

**C.6.1.2.2.1 C-FIND SCP Conformance**

...

1360 An implementation that conforms to one of the SOP Classes of the Patient Root SOP Class Group as an SCP shall state in its Conformance Statement whether or not it supports extended negotiation of combined date-time matching, ~~and/or~~ fuzzy semantic matching of person names, **Empty Value Matching, and/or Multiple Value Matching**. If fuzzy semantic matching of person names is supported, then the mechanism for fuzzy semantic matching shall be specified.

...

1365 **C.6.2.2.1.1 C-FIND SCU Conformance**

...

An implementation that conforms to one of the SOP Classes of the Study Root SOP Class Group as an SCU shall state in its Conformance Statement whether or not it supports extended negotiation of combined date-time matching, ~~and/or~~ fuzzy semantic matching of person names, **Empty Value Matching, and/or Multiple Value Matching**.

1370

...

**C.6.2.2.2.1 C-FIND SCP Conformance**

...

1375 An implementation that conforms to one of the SOP Classes of the Study Root SOP Class Group as an SCP shall state in its Conformance Statement whether or not it supports extended negotiation of combined date-time matching, ~~and/or~~ fuzzy semantic matching of person names, **Empty Value Matching, and/or Multiple Value Matching**. If fuzzy semantic matching of person names is supported, then the mechanism for fuzzy semantic matching shall be specified.

...

1380

*Add Study Update DateTime to common Query/Retrieve Information Model*

### 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 PS3.3. These Attributes are defined in Table C.3-1.

1385 1.

**Table C.3-1. Additional Query/Retrieve Attributes**

Attribute Name	Tag	Attribute Description
...		
<b><u>Study Update DateTime</u></b>	<b>(0008,041F)</b>	<b><u>Date Time of last update to Study metadata (e.g., Patient, Study or Procedure, Imaging Service Request, or Series Attributes) or to the set of SOP Instances in the Study.</u></b>  <b><u>Note</u></b>  <b><u>May also reflect Date Time of update to the storage location of Study SOP Instances if the SCP supports Attributes for stored SOP Instance access through a non-DICOM protocol (see <a href="#">Section C.6.4.1.3</a>).</u></b>

...

#### C.6.1.1.3 Study Level

1390 Table C.6-2 defines the keys at the Study Information level of the Patient Root Query/Retrieve Information Model.

**Table C.6-2. Study Level Keys for the Patient Root Query/Retrieve Information Model**

Attribute Name	Tag	Type
...		
Number of Study Related Instances	(0020,1208)	O
<b><u>Study Update DateTime</u></b>	<b>(0008,041F)</b>	<b><u>O</u></b>
<i>All other Attributes at Study Level</i>		O

...

1395

#### C.6.2.1.2 Study Level

Table C.6-5 defines the keys at the Study Information level of the Study Root Query/Retrieve Information Model.

**Table C.6-5. Study Level Keys for the Study Root Query/Retrieve Information Model**

Attribute Name	Tag	Type
...		
Number of Study Related Instances	(0020,1208)	O
<b><u>Study Update DateTime</u></b>	<b>(0008,041F)</b>	<b><u>O</u></b>
<i>All other Attributes at Study Level</i>		O

1400

*Add Repository Query SOP Class to Annex C.6*

### C.6.4 Repository Query SOP Class

The Repository Query SOP Class uses the C-FIND Service and the Study Root Query/Retrieve Information Model. The SOP Class specifies additional semantics and behaviors for the SCU and SCP beyond those defined for the Study Root Query/Retrieve Information Model – FIND SOP Class.

In particular, the Repository Query SOP Class supports incremental query/response for a large number of entities using the following features:

- Both the SCU and SCP may set limits on the number of entity records (Pending status responses) returned in a C-FIND transaction.
- If the number of responses would exceed the SCU or SCP limit, the C-FIND query processing is terminated with a defined Warning status response indicating an incomplete set of responses.
- If requested by the SCU, each response returns a unique Record Key (0008,041B) value by which the SCP orders the C-FIND responses.
- The SCU may include a Record Key (0008,041B) value it received in one C-FIND transaction as the Prior Record Key (0008,041C) in the C-FIND Request for a subsequent transaction. The SCP processes that subsequent C-FIND beginning with the record following that Prior Record Key (0008,041C).

The Repository Query SOP Class also supports return of URI links for access to stored SOP Instances using a non-DICOM file access protocol. Since stored SOP Instances accessed through a non-DICOM protocol might not include all current metadata Attributes (such as updated patient names or IDs), the Repository Query SOP Class also supports return of current metadata Attributes whose values might differ from those in the stored SOP Instance.

Note:

See additional explanatory information in [Annex YYYY in PS3.17](#), including discussion of the use of the Repository Query SOP Class to produce an Inventory SOP Instance.

#### C.6.4.1 Additional Query Information Model Attributes

The Repository Query SOP Class uses the Study Root Query/Information model specified in Section C.6.2.1, but specifies additional Key Attributes. These Key Attributes, like those defined in [Section C.3.4](#), are not specified in the Composite IODs of PS3.3, but represent information that may be used by a repository system for managing stored SOP Instances. Table C.6.4.1-1 defines the additional Key Attributes.

**Table C.6.4.1-1 Additional Keys for Repository Query**

Attribute Name	Tag	Type	Attribute Description
Record Key	(0008,041B)	R	Implementation-specific unique identifier of the entity record. This Attribute is supported only with Universal Matching. See <a href="#">Section C.6.4.1.1</a> .
Removed from Operational Use	(0008,0405)	O	Flag that the entity at the Query/Retrieve Level specified in the Identifier of the C-FIND, and its set of Composite Object Instances, have been removed from operational use related to patient care. See <a href="#">Section C.6.4.1.2</a> .

Attribute Name	Tag	Type	Attribute Description
Reason for Removal Code Sequence	(0008,0406)	O	Reason the entity at the Query/Retrieve Level specified in the Identifier of the C-FIND was removed from operational use.  Zero or one Item may be included in this Sequence.
>Include <a href="#">Table C.6-2b "Basic Code Value Keys Macro with Optional Keys"</a>			Defined Context Group is <a href="#">CID 7031</a> Reason for Removal from Operational Use.
File Set Access Sequence	(0008,0419)	O	Description of non-DICOM protocol access to sets of stored SOP Instances. This Attribute is defined only at the Study and Series levels. This Attribute is supported only with Universal Matching, i.e., if present in the Request Identifier it is zero-length or has only a zero-length Item. See <a href="#">Section C.6.4.1.3</a> .  See <a href="#">Section C.6.4.5.5</a> for additional SCP requirements.  Zero or one Item may be included in this Sequence in a Response Identifier.
>Stored Instance Base URI	(0008,0407)	-	Base URI for accessing SOP Instances through a non-DICOM protocol.
>Folder Access URI	(0008,0408)	-	Access URI for a folder containing all SOP Instances for this Study or Series.
>File Access URI	(0008,0409)	-	Access URI for a container file containing all the SOP Instances for this Study or Series.
>Container File Type	(0008,040A)	-	Type of container file.  Defined Terms: ZIP TAR GZIP TARGZIP BLOB  See <a href="#">Section P.1.2 in PS3.3</a> for definitions of Defined Terms.  Required in Response Identifier if File Access URI (0008,0409) is present.
File Access Sequence	(0008,041A)	O	Description of non-DICOM protocol access to a stored SOP Instance. This Attribute is defined only at the Composite Instance level. This Attribute is supported only with Universal Matching, i.e., if present in the Request Identifier it is zero-length or has only a zero-length Item. See <a href="#">Section C.6.4.1.3</a> .  See <a href="#">Section C.6.4.5.5</a> for additional SCP requirements.  Zero or more Items may be included in this Sequence in a Response Identifier.

Attribute Name	Tag	Type	Attribute Description
>File Access URI	(0008,0409)	-	Access URI for file containing the SOP Instance.  Required in Response Identifier if File Access Sequence (0008,041A) has an Item.
>Container File Type	(0008,040A)	-	Type of container file.  Defined Terms: ZIP TAR GZIP TARGZIP BLOB DICM - Single SOP Instance in DICOM File Format  See <a href="#">Section P.1.2 in PS3.3</a> for definitions of Defined Terms not described here.  Required in Response Identifier if File Access URI (0008,0409) is present.
>Filename in Container	(0008,040B)	-	Filename within a container file of the file containing the SOP Instance.  Required in Response Identifier if Container File Type (0008,040A) is ZIP, TAR, or TARGZIP.
>File Offset in Container	(0008,040C)	-	Byte offset (zero-based) within a container file for the start of the SOP Instance file.  Required in Response Identifier if Container File Type (0008,040A) is BLOB, may be present otherwise.
>File Length in Container	(0008,040D)	-	Length of the SOP Instance file within a container file.  Required in Response Identifier if Container File Type (0008,040A) is BLOB, may be present otherwise.
>Stored Instance Transfer Syntax UID	(0008,040E)	-	Transfer Syntax of SOP Instance encoded in DICOM File Format. Equal to Transfer Syntax UID (0002,0010) in File Meta Information header.  Required in Response Identifier if File Access Sequence (0008,041A) has an Item.
>Lossy Image Compression Ratio	(0028,2112)	-	Describes the approximate lossy compression ratio(s) that have been applied to this image.
>MAC Algorithm	(0400,0015)	-	The algorithm used for generating a Message Authentication Code. See <a href="#">Section C.12.1.1.3.1.2 in PS3.3</a> for Defined Terms.  Required in Response Identifier if MAC (0400,0404) is present.
>MAC	(0400,0404)	-	Message Authentication Code computed across stored instance file for verification of file integrity.



Attribute Name	Tag	Type	Attribute Description
Metadata Sequence	(0008,041D)	O	All non-bulk data Attributes at the Query/Retrieve Level that are managed by the SCP. See <a href="#">Section C.6.4.1.4</a> .  See <a href="#">Section C.6.4.5.5</a> for additional SCP requirements.  This Attribute is supported only with Universal Matching, i.e., if present in the Request Identifier it is zero-length or has only a zero-length Item.  Zero or one Item may be included in this Sequence in a Response Identifier.
<i>&gt;Any non-bulk data Attributes</i>		-	Multiple Attributes may be present in the Response Identifier.
Updated Metadata Sequence	(0008,041E)	O	Non-bulk data Attributes at the Query/Retrieve Level that are managed by the SCP, for which values are different from the values contained in stored SOP Instance files. See <a href="#">Section C.6.4.1.4</a> .  See <a href="#">Section C.6.4.5.5</a> for additional SCP requirements.  This Attribute is supported only with Universal Matching, i.e., if present in the Request Identifier it is zero-length or has only a zero-length Item.  Zero or one Item may be included in this Sequence in a Response Identifier.
<i>&gt;Any non-bulk data Attributes</i>		-	Multiple Attributes may be present in the Response Identifier.

Note

1435 The character “-“ in the Type column is used to indicate Attributes that are within a Sequence that is defined only with Universal Matching. These Attributes therefore will not be present in a Request Identifier; hence they are not Key Attributes for matching and the Type column does not apply. If the SCP supports the Sequence Attribute, and it is requested by the SCU, the SCP returns these “-“ Attributes in accordance with their Attribute Description.

**C.6.4.1.1 Record Key**

1440 Record Key (0008,041B) is defined at the Study, Series, and Instance query levels. It is an implementation-specific unique identifier within the level of the entity record in the SCP. The SCP of the Repository Query SOP Class shall return non-zero length values of Record Key (0008,041B). The content of Record Key (0008,041B) is opaque to applications other than the SCP.

1445 The SCP shall construct the Record Key (0008,041B) value such that for each value the SCP can determine its order with respect to all other such values. C-FIND Response Identifiers shall be returned in the ordering of Record Key (0008,041B) values. The SCP shall be able to determine from a given value the next entity record to be returned that matches the given Query Request Identifier, without repeating any records.

Record Key (0008,041B) values are used as the Prior Record Key (0008,041C) value in a subsequent Query Request (see [Section C.6.4.5.3](#)). The SCP may establish implementation specific conditions after which a Record Key (0008,041B) value is not valid, i.e., will no longer allow continuation of a sequence of Query

1450 operations. The SCP shall be able to determine from a given Prior Record Key (0008,041C) value whether that value is still valid for determining the next record to be returned.

Notes

- 1455 1. The structure, content, and ordering method of Record Key (0008,041B) values is SCP implementation-specific, and is opaque to the SCU, i.e., the SCU should not attempt to parse those values for components or semantics. Values may be permanent, or may be constructed dynamically during query processing. Only the SCP can determine from the value of one Record Key (0008,041B) what would be the next appropriate record to return. For example, an SCP may use encrypted representations of an internal database primary key as the Record Key (0008,041B), and such may appear to the SCU to be random unordered values.
- 1460 2. The intention of the ordering and use requirements for the Record Key (0008,041B) is to allow an SCU to obtain the complete inventory matching the Key Attributes in a sequence of Queries. See [Section YYYY.2.2 "Record Key and Continuation" in PS3.17.](#)

### C.6.4.1.2 Removed from Operational Use

The Removed from Operational Use (0008,0405) Attribute is defined at the Study, Series, and Instance query levels. The Enumerated Values are:

- 1465 Y the instances are not to be used for operational purposes
- N the instances may be used for operational purposes

1470 A value of Y indicates the Study, Series, or Instance has been removed from operational use related to patient care, although it may be retained in the repository system for other reasons (e.g., for audit of patient radiation exposure). At the Study and Series level, the Attribute indicates whether the entire Study or Series has been removed from operational use. A value of Y at the Study level supersedes any value specified for subsidiary Series and Instances, and a value of Y at the Series level supersedes any value specified for subsidiary Instances.

1475 While defined at the Study, Series, and Instance levels, an SCP might not support this Attribute at some, or any, of those levels. E.g., an SCP may only manage this Attribute at the Instance level, and is not required to infer a value for the Series or Study level.

Notes

- 1480 1. The meaning of "operational use related to patient care" is implementation or site specific, but generally includes diagnostic, clinical, and therapeutic uses, as well as administrative uses necessary for providing care (e.g., insurance authorization).
- 1485 2. Studies, Series, or Instances might be marked removed from operational use by actions associated with the processing of specific Key Object Selection Document SOP Instances, e.g., in accordance with [IHE RAD TF-1 Image Object Change Management Integration Profile \(IOCM\)](#). Those Key Object Selection Document SOP Instances, and their Series, may themselves be marked as removed from operational use. The Context Group for Reason for Removal Code Sequence (0008,0406) includes the Key Object Selection Concept Codes specified in IOCM.
- 1490 3. The semantics of the Removed from Operational Use (0008,0405) Attribute allows the SCP to include such entities in the Repository Query response without constraint. An SCP might exclude entities marked as removed from operational use from the C-FIND Responses of other Query/Retrieve SOP Classes (e.g., see [IHE RAD TF-2 Section 4.66.4.1.3.1 Access to Rejected Instances](#)).
4. Removed from Operational Use (0008,0405) is independent of Instance Availability (0008,0056). A composite instance may have been removed from operational use but is still accessible at the rapidity specified by Instance Availability (0008,0056). Conversely, an instance may not have been removed from operational use but is UNAVAILABLE for retrieval.

- 1495 5. If the SCP retains records of deleted Studies, Series, or Instances, even though the actual Instances are physically deleted, it may include those entities in the C-FIND Response with an appropriate Reason for Removal Code Sequence (0008,0406) value. Such instances may have an Instance Availability (0008,0056) value “UNAVAILABLE” (see [Section C.4.1.1.3.2](#)).

### C.6.4.1.3 File Set Access Sequence and File Access Sequence

1500 The SCP may support optional Attributes providing a URI link to SOP Instances stored in the DICOM File Format (see [Section 7 “DICOM File Format” in PS3.10](#)) and accessible through a non-DICOM file access protocol (see [Annex P “Stored File Access Through Non-DICOM Protocols” in PS3.3](#)).

#### Note

- 1505 1. See Section [YYYY.3.4 “Access Mechanisms for Repository Data” in PS3.17](#)
2. “File Set” as used here may not be identical to the File-set concept defined in PS3.10 and used in Storage Media File-set ID (0088,0130).

1510 For a query at the Study or Series level, Stored Instance Base URI (0008,0407) within the File Set Access Sequence (0008,0419) establishes an [\[RFC3986\]](#) base URI that is merged with relative path reference URIs for non-DICOM protocol access to SOP Instances of the Study or Series. If all of the stored SOP Instance files of that Study or Series entity are catalogued in a single folder, Folder Access URI (0008,0408) provides the URI for protocol operations on that folder. If all of the stored SOP Instance files are in a single container file, File Access URI (0008,0409) provides the URI for accessing that file. Folder Access URI (0008,0408) and/or File Access URI (0008,0409) may be a relative path reference URI beginning with the single-dot-segment “./”, and the URI is merged with the Stored Instance Base URI (0008,0407) in accordance with [Section P.2.1 “URI Format” in PS3.3](#).

1515 Note

1520 Stored Instance Base URI (0008,0407) is optional. If not present, the values of Folder Access URI (0008,0408) and File Access URI (0008,0409) will be complete URIs. If Stored Instance Base URI (0008,0407) is present, those other Attributes may still provide complete URIs, rather than relative paths to be merged with the Base URI. A complete path specified in Folder Access URI (0008,0408) or File Access URI (0008,0409) may have a different scheme and authority than is specified in Stored Instance Base URI (0008,0407).

1525 For a query at the Instance level, Items of the File Access Sequence (0008,041A) in the Response Identifier each provide an [\[RFC3986\]](#) URI to access the stored SOP Instance. File Access URI (0008,0409) may be a URI relative path reference beginning with the single-dot-segment “./”, and the URI is merged with the Stored Instance Base URI (0008,0407) specified within the File Set Access Sequence (0008,0419) at the Series level, if present, or otherwise to the Stored Instance Base URI (0008,0407) specified within the File Set Access Sequence (0008,0419) at the Study level.

#### Notes

- 1530 1. The SCP may store a SOP Instance on multiple storage devices (e.g., fast short-term media and slower long-term media), or with different Transfer Syntaxes. The SOP Instance may therefore be accessible through a non-DICOM protocol at multiple URIs.
2. If the File Access URI (0008,0409) for a SOP Instance is a relative path reference URI, the SCU will need to have obtained the Stored Instance Base URI (0008,0407) from the hierarchically superior STUDY and SERIES level queries. I.e., the Study and Series level queries will have included a request for the File Set Access Sequence (0008,0419).
- 1535 3. See [Section YYYY.7.2 “Using Non-DICOM Protocols” in PS3.17](#).

#### C.6.4.1.4 Metadata Sequence and Updated Metadata Sequence

1540 An SCP may manage a set of metadata Attributes of the SOP Instances in the repository for response to Query requests. Metadata Sequence (0008,041D) in a Response Identifier shall contain all SOP Instance Attributes at the Query level that are managed by the SCP, excluding bulk data elements (such as pixel, waveform, and surface mesh data) and non-SOP Instance Attributes specified in Section C.3.4 or in Table C.6.4.1-1.

##### Note

The set of Attributes managed by the SCP is implementation dependent. In some implementations the managed set of Attributes might include only those few required to be supported for Query Key matching, while in other implementations the set might include every non-bulk data Attribute. See [PS3.17 Section YYYY.2.3.3](#).

1545 An SCP may manage a set of metadata Attributes whose "updated" values differ from those in a stored SOP Instance accessible through a non-DICOM protocol specified in the File Access URI (0008,0409) or Folder Access URI (0008,0408). Although a stored SOP Instance shall be conformant to its IOD (per the requirements of the DICOM File Format), some Attributes in the file might not have current values (e.g., Patient Name may have been corrected or changed after the Instance was stored). Updated Metadata Sequence (0008,041E) in a  
1550 Response Identifier shall contain all Attributes at the Query level whose values are different from the values contained in the stored SOP Instance file.

An SCP that supports non-DICOM protocol URI references to stored SOP Instances shall support either the Metadata Sequence (0008,041D) or the Updated Metadata Sequence (0008,041E), or both, to provide current metadata values for SOP Instances accessed through the non-DICOM protocol.

##### 1555 Notes

1. SOP Instances accessed through DICOM protocols are expected to have current values in all Attributes.
2. The SCP might not track whether Attribute values have changed, or which specific Attributes have changed values, and would therefore not support Updated Metadata Sequence (0008,041E). In this case, the SCU may request the Metadata Sequence (0008,041D) that contains all current Attribute values managed by the SCP, whether or not  
1560 they have been updated. Determination of differences, if any, between those returned Attribute values and values in the stored SOP Instance would be the responsibility of the SCU.

At any Query level, Metadata Sequence (0008,041D) or Updated Metadata Sequence (0008,041E) may include the Original Attributes Sequence (0400,0561) describing the provenance of changes to Attributes at that level or at higher Query levels.

1565 If Metadata Sequence (0008,041D) and/or Updated Metadata Sequence (0008,041E) are present in a Request Identifier, their absence in the Response Identifier indicates they are not supported by the SCP (see [Section C.2.2.1.3](#)).

A zero-length value or a single empty Item in Updated Metadata Sequence (0008,041E) in a Response Identifier indicates support by the SCP, but that there are no differing metadata Attribute values.

#### 1570 C.6.4.2 Repository Query Request Identifier Attributes

In addition to the Attributes specified in [Section C.4.1.1.3.1](#), a Repository Query Request Identifier may contain the Attributes shown in Table C.6.4.2-1 for the SCU to request certain C-FIND response content.

**Table C.6.4.2-1. Repository Query Request Identifier Additional Attributes**

Attribute Name	Tag	Attribute Description
Prior Record Key	(0008,041C)	Entity identifier that was returned as a value in Record Key (0008,041B) in a prior request. Entities returned for the current request will begin with the first matching record with a record key subsequent to this record key. See <a href="#">Section C.6.4.5.3</a> for SCP processing requirements.
Maximum Number of Records	(0008,041E)	Maximum number of matched entities to be returned for this request. See <a href="#">Section C.6.4.5.2</a> for SCP processing requirements.

1575 **C.6.4.3 Status Codes**

The Repository Query SOP Class specifies the status code values of Table C.6.4.3-1 in addition to the statuses and related fields specified in [Section C.4.1.1.4](#) for C-FIND of the Query/Retrieve Service Class and in [Section 9.1.2.1.6 of PS3.7](#) for the C-FIND DIMSE Service.

**Table C.6.4.3-1. Repository Query Additional Status Values**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Invalid Prior Record Key	A710	None
Warning	Matching reached response limit, subsequent request may return additional matches	B001	None

1580

**C.6.4.4 C-FIND SCU Behavior**

In addition to the behaviors specified in Section C.4.1.2, the SCU shall interpret a response with a status equal to B001 “Warning” to convey the end of Pending responses, and as an indication that more responses are available, but the SCP is not further processing the request in this C-FIND operation.

1585 **C.6.4.5 C-FIND SCP Behavior**

The Repository Query SOP Class adds the following behaviors to both Baseline and Extended Behavior of the SCP as described in [Section C.4.1.3](#).

**C.6.4.5.1 Record Key**

1590 The SCP shall return C-FIND Responses according to the ordering of the values of Record Key (0008,041B), if that Attribute is included in the Request Identifier.

Note

1. If the Record Key (0008,041B) is not requested, there is no requirement on ordering, and the SCU will not be able to issue a subsequent query request with a Prior Record Key (0008,041C).
2. The structure, content, and ordering method of Record Key (0008,041B) values is SCP implementation-specific, and is opaque to the SCU (see [Section C.6.4.1.1](#)).

1595

**C.6.4.5.2 Maximum Number of Records and Incomplete Response**

The SCP shall send no more Pending responses (i.e., returned matching records) than the number specified by the SCU in the Maximum Number of Records (0008,041E) Attribute in the Repository Query Request Identifier. Further, the SCP may limit the number of in a Query transaction to its own implementation-defined resource

1600 limit. If either limit is reached, and there are additional records that satisfy the Key Attribute matching, the SCP shall send a final Status value B001 “Warning”.

Note

The SCP resource limit may be a number of records, or a time limit on database operations, or another limit that allows timely completion of a Repository Query transaction.

1605 **C.6.4.5.3 Prior Record Key and Subsequent Response**

If Prior Record Key (0008,041C) is present in the Repository Query Request Identifier, the SCP shall return entity records, continuing with the next record key, that satisfy the Key Attribute matching. The SCP shall return a Failure status code A710 if the value of Prior Record Key (0008,041C) is invalid for identifying an entity determining a point of continuation. See [Section C.6.4.1.1](#).

1610 For a sequential set of Query transactions with the same Key Attribute Values, and for which each C-FIND Request after the first includes a Prior Record Key (0008,041C) value equal to the last Record Key (0008,041B) in the C-FIND Responses of the prior Query transaction, the SCP shall return the same set of C-FIND Responses as if the entire Query would have been completed in a single transaction. Whether new entities and updates received by the SCP after the time of the initial Query transaction might be included in the C-FIND Responses is implementation specific.

Notes

1. For example, an entity added after the time of the initial Query might be assigned a Record Key (0008,041B) that precedes a Record Key (0008,041B) already sent in a C-FIND Response; that entity will not be returned in the set of Query transactions. However, an added entity whose Record Key (0008,041B) is after the last sent Record Key (0008,041B) may or may not be included in the set of Query transactions; as it was added after the initial Query transaction, the implementation determines whether such a change is included in the responses.
2. The SCP should not assume that the last Record Key (0008,041B) it sent will be used as the Prior Record Key (0008,041C) in a subsequent transaction. Error conditions may cause the SCU to need to resume from an earlier value.
3. There is no requirement for the Key Attributes in a Request Identifier to be identical to those in a prior Repository Query transaction, even though the presence of Prior Record Key (0008,041C) implies a continuation of a prior transaction. Each Repository Query transaction is independent. The SCP does not need to retain any state information between Repository Query transactions, although it may include state information in the Record Key (0008,041B).

1630 **C.6.4.5.4 Entities Removed from Operational Use**

If the SCP supports Removed from Operational Use (0008,0405) (see [Section C.6.4.1.2](#)) as a Key Attribute, query responses shall include all entities regardless of the value of that Attribute, unless the SCU has explicitly included matching against that Attribute in the C-FIND request and the SCP supports matching on that Attribute.

Note

1635 As the Study Root Query/Retrieve Information Model – FIND SOP Class is typically used for operational purposes, an SCP implementation of that SOP Class by policy might not return entities with Removed from Operational Use (0008,0405) value “Y”.

**C.6.4.5.5 File Set Access Sequence and File Access Sequence**

1640 An SCP that supports File Set Access Sequence (0008,0419) at the Study or Series query level shall support either Metadata Sequence (0008,041D) or Updated Metadata Sequence (0008,041E), or both, at the same level(s).



An SCP that supports File Access Sequence (0008,041A) at the Instance query level shall support either Metadata Sequence (0008,041D) or Updated Metadata Sequence (0008,041E), or both, at that level.

1645 The SCP may support Metadata Sequence (0008,041D) or Updated Metadata Sequence (0008,041E) without support of File Set Access Sequence (0008,0419) or File Access Sequence (0008,041A).

See [Section C.6.4.1.4](#) for further explanation.

### **C.6.4.6 Conformance Requirements**

An implementation may conform to the Repository Query SOP Class as an SCU, SCP or both. The Conformance Statement shall be in the format defined in PS3.2.

#### **1650 C.6.4.6.1 C-FIND SCU Conformance**

An implementation that conforms to the Repository Query SOP Class as an SCU shall support queries against the Study Root Query/Retrieve Information Model described in Section C.6.2.1 and Section C.6.4.1 using the C-FIND SCU behavior described in Section C.4.1.2 and Section C.6.4.4.

1655 An implementation that conforms to the Repository Query SOP Class as an SCU shall be capable of generating queries using Hierarchical Search. It shall not generate queries using Relational-queries unless the Relational-queries option has been successfully negotiated. An implementation that conforms to the Repository Query SOP Class as an SCU shall state in its Conformance Statement whether it may generate Relational-queries.

An implementation that conforms to the Repository Query SOP Class as an SCU shall state in its Conformance Statement:

- 1660 • whether or not it supports extended negotiation of combined date-time matching, fuzzy semantic matching of person names, empty value matching, and/or multiple value matching.
- how it makes use of Specific Character Set (0008,0005) and Timezone Offset From UTC (0008,0201) when encoding queries and interpreting responses.
- 1665 • any limitations it places on the number of C-FIND responses through the Maximum Number of Records (0008,041E) Attribute.

#### **C.6.4.6.2 C-FIND SCP Conformance**

An implementation that conforms to the Repository Query SOP Class as an SCP shall support queries against the Study Root Query/Retrieve Information Model described in Section C.6.2.1 and [Section C.6.4.1](#) using the C-FIND SCP behavior described in Section C.4.1.3 and [Section C.6.4.5](#).

1670 An implementation that conforms to the Repository Query SOP Class as an SCP shall state in its Conformance Statement:

- which Optional Keys it supports for existence (i.e., to be returned in responses) and which for matching.
- which Attributes it supports in Items of those Key Attributes that are Sequences.
- 1675 • whether it supports Relational Search. If it supports Relational Search, then it shall also support extended negotiation of Relational-queries as an SCP.
- whether or not it supports extended negotiation of combined date-time matching, fuzzy semantic matching of person names, empty value matching, and/or multiple value matching. If fuzzy semantic matching of person names is supported, then the mechanism for fuzzy semantic matching shall be specified.

- 1680 • whether it supports case-insensitive matching for PN VR Attributes, and list Attributes for which this applies.
- how it uses Specific Character Set (0008,0005) and Timezone Offset From UTC (0008,0201) when interpreting queries, performing matching and encoding responses.
- any limitations it places on the number of C-FIND responses.
- 1685 • the conditions after which a Record Key (0008,041B) value is not valid to allow resumption of a C-FIND operation.
- any non-DICOM mechanisms used to access SOP Instances that may be specified by a File Access URI (0008,0409), including protocols (such as NFS, SMB, or HTTP), and use of folders and/or container files (ZIP, TAR, GZIP, TARGZIP, BLOB) for the SOP Instances. If such mechanisms are used, the use of Metadata Sequence (0008,041D) or Updated Metadata Sequence (0008,041E) shall be described.
- 1690 • whether it provides responses that include entities from multiple repositories (federation), and how it handles differences in support for Attribute matching across those repositories in constructing responses.

#### C.6.4.7 SOP Classes

1695 The UID for the Repository Query SOP Class is listed in Table C.6.4.7-1.

**Table C.6.4.7-1. SOP Classes for Repository Query**

SOP Class Name	SOP Class UID
Repository Query	1.2.840.10008.5.1.4.1.1.201.6



*Add Inventory to Annex GG Non-Patient Object Storage Service Class*

1700 **GG.1.1 Scope**

The Non-Patient Object Storage Service Class defines an application-level class-of-service that allows one DICOM AE to send a SOP Instance of a non-patient-~~related~~root information object to another DICOM AE.

1705 **A Non-Patient Object SOP Instance adheres to a Composite Instance IOD Information Model specified in PS3.3 that does not have at its root the Patient Information Entity. Non-Patient Object SOP Instances may still contain patient-related identifiable information, e.g., Inventory SOP Instances.**

...

**GG.3 SOP CLASSES**

The application-level services addressed by the Non-Patient Object Storage Service Class definition are specified in the SOP Classes specified in Table GG.3-1.

1710 **Table GG.3-1. Standard SOP Classes**

SOP Class Name	SOP Class UID	IOD Specification (defined in PS3.3)
Hanging Protocol Storage	1.2.840.10008.5.1.4.38.1	Hanging Protocol IOD
Color Palette Storage	1.2.840.10008.5.1.4.39.1	Color Palette IOD
Generic Implant Template Storage	1.2.840.10008.5.1.4.43.1	Generic Implant Template IOD
Implant Assembly Template Storage	1.2.840.10008.5.1.4.44.1	Implant Assembly Template IOD
Implant Template Group Storage	1.2.840.10008.5.1.4.45.1	Implant Template Group IOD
CT Defined Procedure Protocol Storage	1.2.840.10008.5.1.4.1.1.200.1	CT Defined Procedure Protocol IOD
Protocol Approval Storage	1.2.840.10008.5.1.4.1.1.200.3	Protocol Approval IOD
XA Defined Procedure Protocol Storage	1.2.840.10008.5.1.4.1.1.200.7	XA Defined Procedure Protocol IOD
<b><u>Inventory Storage</u></b>	<b><u>1.2.840.10008.5.1.4.1.1.201.1</u></b>	<b><u>Inventory IOD</u></b>

*Add new section for Inventory requirements to Section GG.6 Application Behavior*

**GG.6.6 Inventory Storage SOP Class**

1715 **GG.6.6.1 Instance Creator**

An implementation that conforms to the Inventory Storage SOP Class as an SCU and is a SOP Instance creator shall state in its Conformance Statement:

- The mechanisms by which creation of Inventory SOP Instances is initiated.
- Policies/parameters for splitting a logical inventory across multiple Inventory SOP Instances.
- 1720 • Any limitations on the Inventory Level (0008,0403) of the Inventory SOP Instances.
- Any non-DICOM mechanisms used to access Inventoried SOP Instances that may be specified by a Stored Instance URI, including protocols (such as NFS, SMB, or HTTP), and use of folders and/or container files (ZIP, TAR, GZIP, TARGZIP, BLOB) for the SOP Instances.
- Policies/parameters for duration of retention, or for deletion, of created Inventory SOP Instances.

- 1725
- Whether it provides records for entities in multiple repositories (federation), and how it handles differences in support for Attribute matching across those repositories in constructing Inventory SOP Instances.

*Add Inventory Query/Retrieve Service Class*

1730

## **JJ Inventory Query/Retrieve Service Class**

### **JJ.1 OVERVIEW**

#### **JJ.1.1 Scope**

The Inventory Query/Retrieve Service Class defines an application-level class-of-service that facilitates discovery of and access to Inventory composite objects.

1735

#### **JJ.1.2 Conventions**

See Conventions for the Basic Worklist Management Service (see [Section K.1.2](#)).

#### **JJ.1.3 Service Definition**

The SOP Classes of the Inventory Query/Retrieve Service Class are each composed of an Information Model and a DIMSE-C Service Group.

- 1740
- In order to serve as an SCP of the Inventory Query/Retrieve Service Class, a DICOM AE possesses information about the Attributes of a number of Inventory composite SOP Instances. The information is organized into an Inventory Query/Retrieve Information Model.

- 1745
- Two peer DICOM AEs implement a SOP Class of the Inventory Query/Retrieve Service Class with one serving in the SCU role and one serving in the SCP role. SOP Classes of the Inventory Query/Retrieve Service Class are implemented using the DIMSE-C C-FIND, C-MOVE and C-GET services as defined in PS3.7.

The semantics of the C-FIND service are the same as those defined in the Service Definition of the Basic Worklist Management Service Class (see [Section K.1.4](#)).

The semantics of the C-MOVE and C-GET services are the same as those defined in the Service Definition of the Query/Retrieve Service Class (see [Section C.1.4](#)), with the exception that there is only one level of retrieval.

1750

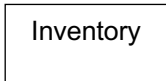
### **JJ.2 INVENTORY Q/R INFORMATION MODEL**

The Inventory Query/Retrieve (Q/R) Information Model is based on an Entity-Relationship Model Definition and a Key Attributes Definition analogous to those defined in the Worklist Information Model Definition of the Basic Worklist Management Service (see [Section K.2](#))

#### **JJ.2.1 E-R Model**

- 1755
- The Inventory Q/R Information Model is a single level entity:

- Inventory Information Entity



**Figure JJ.2-1. Inventory Q/R Information Model E-R Diagram**

1760 While the Inventory Composite SOP Instances that are the subject of this Service Class contain Attributes associated with the several IEs (see [Section 7.13.6 in PS3.3](#)), the Inventory Q/R Information Model operates only on the Attributes of the Inventory IE of the Inventory IOD.

### JJ.2.2 Inventory Q/R Information Model Attributes

Table JJ.2-1 defines the Attributes of the Inventory Q/R Information Model.

**Table JJ.2-1. Attributes for the Inventory Q/R Information Model**

1765

Name	Tag	Matching Key Type	Return Key Type	Remark / Return Key Type
SOP Class UID	(0008,0016)	R	1	
SOP Instance UID	(0008,0018)	U	1	
Transaction UID	(0008,1195)	R	1C	Required if Inventory SOP Instance was created by an Inventory Creation SOP Class transaction, may be present otherwise.
Content Date	(0008,0023)	R	1	
Content Time	(0008,0033)	O	1	
Scope of Inventory Sequence	(0008,0400)	O	2	May only be requested with Universal matching.
Inventory Purpose	(0008,0401)	O	1	
Inventory Instance Description	(0008,0402)	O	2	
Inventory Level	(0008,0403)	O	1	
Inventory Completion Status	(0008,0426)	O	1	
Total Number of Study Records	(0008,0428)	O	1	

Note

1. See also the additional returned Attributes in the Response Identifier specified in [Section JJ.4.2.2.1](#).
2. Further definition of these Attributes is specified in [Section C.38.1 in PS3.3](#)

1770

## JJ.3 DIMSE-C SERVICE GROUPS

### JJ.3.1 C-FIND Operation

See the C-FIND Operation definition for the Basic Worklist Management Service Class ([Section K.4.1](#)), and substitute "Inventory" for "Worklist". The "Worklist" Search Method shall be used.

1775 The C-FIND is to be performed against the Inventory Q/R Information Model ([Section JJ.2](#)). The Key Attributes and values allowable for the query are defined in the Inventory Q/R Information Model.

### JJ.3.2 C-MOVE Operation

See the C-MOVE Operation definition for the Query/Retrieve Service Class ([Section C.4.2](#)). No Extended Behavior or Relational-Retrieve is defined for the Inventory Query/Retrieve Service Class.

1780 Query/Retrieve Level (0008,0052) is not relevant to the Inventory Query/Retrieve Service Class, and therefore shall not be present in the Identifier. The Unique Key Attribute of the Identifier is the SOP Instance UID (0008,0018). The SCU shall supply one UID or a list of UIDs.

Note

More than one Inventory SOP Instance may be retrieved, using List of UID Matching.

1785

### JJ.3.3 C-GET Operation

See the C-GET Operation definition for the Query/Retrieve Service Class ([Section C.4.3](#)). No Extended Behavior or Relational-Retrieve is defined for the Inventory Query/Retrieve Service Class.

1790 Query/Retrieve Level (0008,0052) is not relevant to the Inventory Query/Retrieve Service Class, and therefore shall not be present in the Identifier. The Unique Key Attribute of the Identifier is the SOP Instance UID (0008,0018). The SCU shall supply one UID or a list of UIDs.

Note

More than one Inventory SOP Instance may be retrieved, using List of UID Matching.

## 1795 JJ.4 SOP CLASS DEFINITIONS

### JJ.4.1 SOP Classes

The SOP Classes of the Inventory Query/Retrieve Service Class identify the Inventory Q/R Information Model, and the DIMSE-C operations supported. The following Standard SOP Classes are identified:

**Table JJ.4-1. Inventory Q/R Service SOP Classes**

1800

SOP Class Name	SOP Class UID
Inventory FIND	1.2.840.10008.5.1.4.1.1.201.2
Inventory MOVE	1.2.840.10008.5.1.4.1.1.201.3
Inventory GET	1.2.840.10008.5.1.4.1.1.201.4

### JJ.4.2 Conformance Requirements

An implementation may conform to one of the Inventory Query/Retrieve Service SOP Classes as an SCU, SCP or both. The Conformance Statement shall be in the format defined in PS3.2.

#### 1805 JJ.4.2.1 SCU Conformance

##### JJ.4.2.1.1 C-FIND SCU Conformance

An implementation that conforms to the Inventory FIND SOP Class as an SCU shall support queries against the Inventory Q/R Information Model using the C-FIND SCU Behavior described for the Basic Worklist Management Service Class (see [Section K.4.1.2](#) and [Section JJ.3.1](#)).

1810 **JJ.4.2.1.2 C-MOVE SCU Conformance**

An implementation that conforms to the Inventory MOVE SOP Class as an SCU shall support transfers against the Inventory Q/R Information Model using the C-MOVE SCU baseline behavior described for the Query/Retrieve Service Class (see [Section C.4.2.2.1](#) and [Section JJ.3.2](#)).

**JJ.4.2.1.3 C-GET SCU Conformance**

1815 An implementation that conforms to the Inventory GET SOP Class as an SCU shall support transfers against the Inventory Q/R Information Model using the C-GET SCU baseline behavior described for the Query/Retrieve Service Class (see [Section C.4.3.2.1](#) and [Section JJ.3.3](#)).

**JJ.4.2.2 SCP Conformance**

**JJ.4.2.2.1 C-FIND SCP Conformance**

1820 An implementation that conforms to the Inventory FIND SOP Class as an SCP shall support queries against the Inventory Q/R Information Model using the C-FIND SCP Behavior described for the Basic Worklist Management Service Class (see [Section K.4.1.3](#) and [Section JJ.3.1](#)).

The implementation shall support the additional Attributes in the Response Identifier as specified in Table JJ.4-2 to support character set specification and access to Inventory SOP Instances.

1825 Note

Compare [Section C.4.1.1.3.2 "Response Identifier Structure"](#) for the similar specification of non-key Attributes that are to be returned in the Query/Retrieve C-FIND SOP Classes to support character set specification and access to the referenced SOP Instances.

1830 **Table JJ.4-2. Inventory FIND Additional Returned Attributes**

Attribute	Tag	Type	Remark
Specific Character Set	(0008,0005)	1C	Required if expanded or replacement character sets are used in any Attributes of the Query response.
Retrieve AE Title	(0008,0054)	1C	Required if Inventory SOP instance is available through Inventory MOVE or Inventory GET SOP Classes.
Retrieve URL	(0008,1190)	1C	Required if Inventory SOP instance is available through the Non-Patient Instance Service (see <a href="#">Section 12 in PS3.18</a> ).
File Access Sequence	(0008,041A)	1C	Required if Inventory SOP instance is in the DICOM File Format, and is available through a non-DICOM protocol (see <a href="#">Annex P in PS3.3</a> ).
>Stored Instance Base URI	(0008,0407)	1C	Required if File Access URI (0008,0409) is a relative path reference URI.
>File Access URI	(0008,0409)	1	
>Container File Type	(0008,040A)	1	
>Filename in Container	(0008,040B)	1C	Required if Container File Type (0008,040A) is ZIP, TAR, or TARGZIP.
>Stored Instance Transfer Syntax UID	(0008,040E)	1	

>MAC Algorithm	(0400,0015)	3	
>MAC	(0400,0404)	3	

Note

1835 Further definition of these Attributes, including Defined Terms and Enumerated Values, is specified in [Section C.38.3 in PS3.3](#). In that Section, the Attributes apply to stored patient-related Composite SOP Instances, such as images, while here they apply to Inventory SOP Instances.

**JJ.4.2.2.2 C-MOVE SCP Conformance**

1840 An implementation that conforms to the Inventory MOVE Class as an SCP shall support transfers against the Inventory Q/R Information Model using the C-MOVE SCP baseline behavior described for the Query/Retrieve Service Class (see [Section C.4.2.3.1](#)). The implementation shall support the Inventory Storage SOP Class (see [Section GG](#)) for the C-STORE sub-operations generated by the C-MOVE.

**JJ.4.2.2.3 C-GET SCP Conformance**

1845 An implementation that conforms to the Inventory GET SOP Class as an SCP shall support transfers against the Inventory Q/R Information Model using the C-GET SCP baseline behavior described for the Query/Retrieve Service Class (see [Section C.4.3.3.1](#)). The implementation shall support the Inventory Storage SOP Class (see [Section GG](#)) for the C-STORE sub-operations generated by the C-GET.

Add new annex for Inventory Creation SOP Class within a Storage Management Service Class

## Annex KK Storage Management Service Class

1850 The Storage Management Service Class defines an application-level class-of-service that facilitates peer-to-peer controls for management of persistent storage of Composite SOP Instances. The Service Class allows asynchronous operations between the Service Class User (SCU) and the Service Class Provider (SCP).

### KK.1 OVERVIEW

#### KK.1.1 Use Cases

1855 DICOM supports all manner of peer-to-peer interactions for systems within the biomedical imaging domain. In many enterprises, one or more systems are responsible for long-term management of stored SOP Instances. This Service Class supports the interoperability use cases associated with such long-term storage management.

#### KK.1.2 SOP Classes

Each SOP Class of the Storage Management Service Class is formed from a combination of a common DIMSE Service Group and a specific Information Object Definition.

##### KK.1.2.1 DIMSE Service Group

1860 The DIMSE-N Services applicable to all SOP Classes of the Storage Management Service Class are shown in Table KK.1-1.

**Table KK.1-1. DIMSE Service Group Applicable to Storage Management**

DICOM Message Service Element	Usage SCU/SCP
N-ACTION	M/M
N-EVENT-REPORT	M/M

1865 The DIMSE-N Services and Protocol are specified in [Section 10 in PS3.7](#). Additional constraints on these services, such as specific action and event types, are specified for each SOP Class.

##### KK.1.2.2 Information Object Definitions

The SOP Classes of the Storage Management Service Class are defined using the IODs specified in Table KK.1-2.

**Table KK.1-2. Storage Management Service SOP Classes**

1870

SOP Class Name	SOP Class UID	IOD Specification (defined in PS3.3)
Inventory Creation	1.2.840.10008.5.1.4.1.1.201.5	Inventory Creation IOD ( <a href="#">Section B.30 in PS3.3</a> )

Additional constraints on these IODs, such as specific Attributes required for the different action types, are specified for each SOP Class.

### KK.1.3 Service Protocol

#### 1875 **KK.1.3.1 Association Negotiation**

Association establishment is the first phase of any instance of communication between peer DICOM AEs. The Association negotiation rules as specified in [Annex D in PS3.7](#) are used to negotiate the supported SOP Classes and peer AE roles.

Note

1880 Implementations may restrict Association establishment subject to exchange of security related information, such as application identity and authorization, either within DICOM Association negotiation or outside the scope of the DICOM protocol. See [Section YYYY.6 “Security Considerations” in PS3.17](#).

Support for the SCP/SCU Role Selection Negotiation is mandatory. The SOP Class Extended Negotiation is not defined for this Service Class.

1885 The SCU will open an Association when it desires to request a storage management operation by the SCP.

The SCP will typically open an Association when it is reporting status, or has completed a requested operation or reached some other termination condition, such as a failure. This Association establishment includes negotiation of SCP/SCU role.

Note

- 1890
1. The SCP may attempt to issue an N-EVENT-REPORT on the same Association as the initiating N-ACTION, but this operation may fail because the SCU is free to release at any time the Association on which it sent the N-ACTION-Request.
  2. As DICOM defaults the Association-requestor to the SCU role, the SCP (i.e., the Association-requestor) negotiates an SCP role using the SCU/SCP role negotiation (see [Section D.3.3.4. “SCP/SCU Role Selection Negotiation” in PS3.7](#)).
  3. When responding on a different Association, the SCP uses the same AE Title as it used on the original Association, because the DICOM Standard defines a Service between two peer applications, each identified by an AE Title. Thus, the SCP should be consistently identified for all transactions with a particular peer in a SOP Class.
- 1895

#### 1900 **KK.1.3.2 Operations and Notifications**

Following Association establishment, peer-to-peer communication between the SCU and SCP uses the DIMSE N-ACTION and N-EVENT-REPORT (see [Section 10.1 “DIMSE-N Services” in PS3.7](#)).

1905 The N-ACTION and N-EVENT-REPORT primitives shall contain the well-known Storage Management SOP Instance specified in Table KK.1-3 in their Requested SOP Instance UID and Affected SOP Instance UID parameters.

Note

In the usage described here, there is no explicit creation of a SOP Instance (using N-CREATE) upon which an N-ACTION may operate. Instead, the N-ACTION operates upon a well-known SOP Instance. This SOP Instance is conceptually created during start-up of each Storage Management Service Class SCP Application.

1910 **Table KK.1-3. Storage Management SOP Instance UID**

SOP Instance UID	UID Name
1.2.840.10008.5.1.4.1.1.201.1.1	Storage Management SOP Instance



The SCP requests a storage management operation using the N-ACTION-Request primitive of one of the Storage Management Service SOP Classes. The request includes a Transaction UID for tracking purposes.

1915 If the SCP accepts the N-ACTION request for processing, it sends a Success N-ACTION Response Status Code. If it does not accept the N-ACTION request for processing, it sends an Error N-ACTION Response Status Code. The actions taken by the SCU upon receiving the status is beyond the scope of this Standard.

At any time after receipt of the N-ACTION-Response, the SCU may release the association on which it sent the N-ACTION-Request.

1920 The SCP notifies the SCU using the N-EVENT-REPORT primitive when it has completed the requested operation or reached some other termination condition, such as a failure or a time-out. The notification includes the Transaction UID of the request. Upon completion or termination, the Transaction UID is no longer active and shall not be reused.

## KK.2 INVENTORY CREATION SOP CLASS

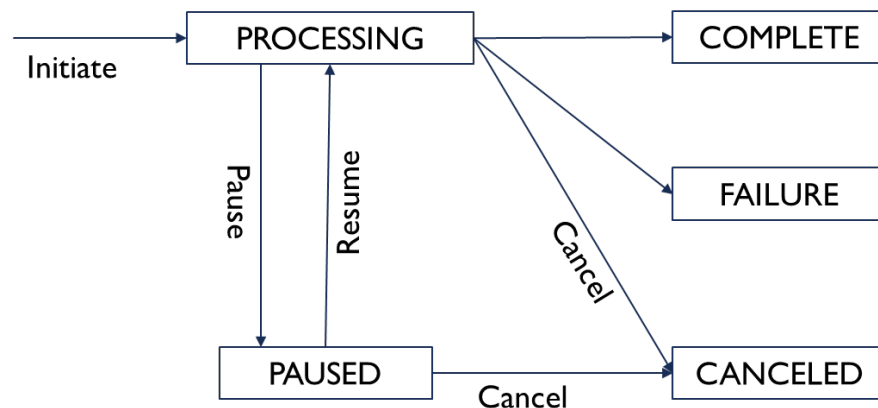
### 1925 KK.2.1 Overview

The Inventory Creation SOP Class allows an SCU Application Entity to request a peer SCP Application Entity to produce an Inventory of the Studies, Series, and Instances that it manages. The request for the Inventory may include a set of matching keys to limit the Scope of Inventory to Studies with corresponding Attribute values. The Inventory produced is encoded in one or more SOP Instances of the Inventory SOP Class (see [Annex GG](#)).

1930 Success or failure of Inventory production is indicated by a notification from the SCP to the SCU. The SCU may then access the Inventory SOP Instances by a mechanism supported by the SCP, including Query/Retrieve (see [Annex JJ](#)), Non-Patient Instance Services (see [PS3.18 Section 12](#)), or a non-DICOM file access protocol. See additional explanatory information in [Annex YYYY in PS3.17](#).

### KK.2.1.1 Inventory Production States

1935 The SOP Class defines five states for the Inventory production with associated state transitions (see Figure KK.2-1). Some of the transitions are associated with receipt and processing of N-ACTION requests (labeled arrows in the figure).



**Figure KK.2-1 Inventory Production States and State Transitions**

1940 After the Initiate request, production is in the PROCESSING state. Production will proceed and reach one of two terminal states without further N-ACTION operations – COMPLETE or FAILURE.

Production may be PAUSED, either due to an N-ACTION request or due to conditions internal to the SCP, for example, a temporary shortage of resources. Production may be returned to the PROCESSING state by a Resume request or by SCP internal actions.

1945 From either the PROCESSING or PAUSED state the production may be changed to the CANCELED terminal state by a Cancel request or by SCP internal actions.

## KK.2.2 Operations

### KK.2.2.1 Action Information

The DICOM AEs that claim conformance to this SOP Class as an SCU and/or an SCP shall support the Action Types and Action Information as specified in Table KK.2-1. Descriptions of the Attributes of the Action Information are specified in [Section B.30 "Inventory Creation IOD" in PS3.3](#).

**Table KK.2-1. Inventory Creation Requests - Action Information**

Action Type Name	Action Type ID	Attribute Name	Tag	Requirement Type SCU/SCP	
Initiate	11	Transaction UID	(0008,1195)	1/1	
		Scope of Inventory Sequence	(0008,0400)	2/2	
		>Extended Matching Mechanisms	(0008,040F)	1C/1C	
		>Specific Character Set	(0008,0005)	1C/1C	
		>Timezone Offset from UTC	(0008,0201)	1C/1C	
		>Range Matching Sequence	(0008,0410)	1C/1C	
		>>Any DA, DT, or TM Attribute			2/2
		>List of UID Matching Sequence	(0008,0411)	1C/1C	
		>>Any UI Attribute			1/1
		>Empty Value Matching Sequence	(0008,0412)	1C/1C	
		>>Any Attribute			2/2
		>General Matching Sequence	(0008,0413)	1C/1C	
		>>Any Attribute			1/1
				Inventory Purpose	(0008,0401)
		Inventory Level	(0008,0403)	1/1	
		Requested Status Interval	(0008,0414)	3/1	
Request Status	12	Transaction UID	(0008,1195)	1/1	
		Requested Status Interval	(0008,0414)	3/1	
Cancel	13	Transaction UID	(0008,1195)	1/1	
		Retain Instances	(0008,0415)	1/1	
Pause	14	Transaction UID	(0008,1195)	1/1	
Resume	15	Transaction UID	(0008,1195)	1/1	

#### 1955 KK.2.2.1.1 Scope of Inventory Sequence

The Scope of Inventory Sequence (0008,0400) specifies constraints on Studies to be included in the Inventory. See the Attribute descriptions for the Scope of Inventory Sequence (0008,0400) in [Section C.38.2.1 in PS3.3](#).

1960 The Attributes are similar to Key Attributes used for Attribute matching in the Query/Retrieve Service Class (see [Section C.2.2.2](#)). The Attribute values provided in the N-ACTION shall be matched against the values of Attributes of Studies managed by the SCP, in accordance with the requirements of this section, with matching Studies to be included in the produced Inventory. Studies that match all specified keys shall be included in the produced Inventory.

The Scope of Inventory Sequence (0008,0400) may be zero-length to indicate universal match to all Studies in the repository (i.e., a comprehensive Inventory).

### 1965 **KK.2.2.1.2 Inventory Level**

Inventory Level (0008,0403) specifies the types of records requested for inclusion in the produced Inventory SOP Instances. Inventories may be requested with Study level records, with Study and Series level records, or with Study, Series, and Instance level records.

### **KK.2.2.2 Service Class User Behavior**

1970 The SCU shall use the N-ACTION primitive containing the well-known Storage Management SOP Instance UID (defined in [Section KK.1.3.2](#)) in its Requested SOP Instance UID parameter.

1975 The SCU shall supply the Transaction UID (0008,1195) to uniquely identify each Storage Management Request. The value of the Transaction UID (0008,1195) will be included by the SCP in N-EVENT-REPORT primitives (see [Section KK.2.3.1](#)). Use of the Transaction UID (0008,1195) Attribute allows the SCU to match requests and results that may occur over the same or different Associations.

1980 The SCU shall use the N-ACTION primitive with Action Type “Initiate” (Action Type ID = 11) to request the SCP to produce an Inventory of Instances managed by the SCP. The SCU shall supply the Inventory Level (0008,0403) to indicate whether the produced Inventory should include records for Series and Instances. The SCU shall supply the Scope of Inventory Sequence (0008,0400) to specify Key Attributes for Studies to be included in the Inventory. The SCU shall specify in Extended Matching Mechanisms (0008,040F) any requested matching mechanisms or matching semantics beyond the baseline specified for Query in [Section C.2.2.2](#). The SCU may request the SCP to regularly report on the progress of producing the Inventory associated with the Transaction UID (0008,1195) at the interval specified by Requested Status Interval (0008,0414).

1985 The SCU shall use the N-ACTION primitive with Action Type “Request Status” (Action Type ID = 12) to request the SCP to report on the progress of producing the Inventory associated with the Transaction UID (0008,1195). The SCU may request the SCP to change the interval for progress reports as specified by Requested Status Interval (0008,0414).

#### Note

Status of inventory production, including failure, will be signaled by the SCP via the N-EVENT-REPORT primitive.

1990 The SCU shall use the N-ACTION primitive with Action Type “Cancel” (Action Type ID = 13) to request the SCP to stop producing the Inventory associated with the Transaction UID (0008,1195).

1995 The SCU shall use the N-ACTION primitive with Action Type “Pause” (Action Type ID = 14) to request the SCP to pause production of the Inventory associated with the Transaction UID (0008,1195). It shall use the N-ACTION primitive with Action Type “Resume” (Action Type ID = 15) to request the SCP to resume producing the Inventory from a PAUSED state.

### **KK.2.2.3 Service Class Provider Behavior**

Upon receipt of the N-ACTION request, the SCP shall return, via the N-ACTION response primitive, the N-ACTION Response Status Code applicable to the associated request (see Table KK.2.2.3-1). A success status conveys that the SCP has successfully received the request. A warning status conveys that the SCP has

2000 successfully received the request, but might not process some of the requested parameters. A failure status conveys that the SCP is not processing the request.

For Action Type “Initiate” (Action Type ID = 11), the SCP shall return a failure status 0212H (Mistyped argument) if the SCP does not support all of the character sets identified in Specific Character Set (0008,0005), or all of the matching mechanisms identified in Extended Matching Mechanisms (0008,040F), or the identified Inventory Level (0008,0403); additional explanation may be returned in Error Comment (0000,0902). The SCP shall return a warning status B010H if one or more of the Key Attributes specified in the Scope of Inventory Sequence (0008,0400) are not supported for matching, and shall return the list of unsupported Attributes in Attribute Identifier List (0000,1005).

**Table KK.2.2.3-1. N-ACTION Response Status Values**

Service Status	Further Meaning	Status Codes	Related Fields
Failure	Processing Failure	0110	(0000,0902)
	Refused: Not authorized	0124	(0000,0902)
	Mistyped argument - one of the parameters supplied has not been agreed for use	0212	(0000,0902)
	Resource Limitation	0213	(0000,0902)
	<i>Other failure status as specified in <a href="#">Section 10.1.4.1.10 in PS3.7</a></i>		
Warning	Attribute list error - One or more of Key Attributes are not supported for matching	B010	(0000,1005)
Success	Success	0000	

2010

Note

See [Section E.1 “Registry of DICOM Command Elements” in PS3.7](#) for definition of the Related Fields.

If the SCP conveys a success or warning status for Action Type “Initiate” (Action Type ID = 11), it shall initiate production of an Inventory and periodic status reporting in accordance with the parameters of the Scope of Inventory Sequence (0008,0400) and Inventory Level (0008,0403) provided in the N-ACTION request. The Scope of Inventory in the produced Inventory SOP Instances shall include only those Key Attributes that were supported for matching. Any value provided by the SCU for Inventory Purpose (0008,0401) shall be included in the produced Inventory SOP Instances. The SCP shall produce at least one Inventory SOP Instance upon reaching the COMPLETE state.

2020 If the SCP encounters a failure when producing the Inventory, it may attempt to complete the encoding into an Inventory SOP Instance of Study records already obtained, and set Inventory Completion Status (0008,0426) in that SOP Instance to “FAILURE”.

If the SCP conveys a success status for Action Type “Request Status” (Action Type ID = 12), it shall initiate sending an N-EVENT-REPORT with Event Type “Inventory Status” (Event Type ID = 12).

2025 Note

The N-EVENT-REPORT may be sent on the same or a different Association as the N-ACTION request (see [Section KK.1.3.1](#)).

If the SCP conveys a success status for Action Type “Cancel” (Action Type ID = 13), it shall stop production of the Inventory associated with the Transaction UID (0008,1195). If the Cancel request includes Retain Instances (0008,0415) with value “N”, the SCP may delete any Inventory SOP Instances associated with the Transaction UID (0008,1195). If the Cancel request includes Retain Instances (0008,0415) with value “Y”, the SCP shall

2030

2035 complete the encoding into an Inventory SOP Instance of Study records already obtained, and set Inventory Completion Status (0008,0426) to "CANCELED". Some Study records may be only partially complete at the time of the Cancel request, e.g., not all the subsidiary Series and Instance records had been compiled. Whether such partial Study records are completed and included in the Inventory SOP Instance is implementation specific. Partial Study records shall not be included in an Inventory.

If the SCP conveys a success status for Action Type "Pause" (Action Type ID = 14), it shall pause production of the Inventory associated with the Transaction UID (0008,1195). The SCP may complete any processing necessary to reach a stable state for pausing the Inventory production to allow efficient resumption.

2040 If the SCP conveys a success status for Action Type "Resume" (Action Type ID = 15), it shall resume production of the Inventory associated with the Transaction UID (0008,1195).

Note

The SCP may return an error status Refused: Not authorized (0124H) or Resource Limitation (0213H) if the conditions that caused the Pause have not been corrected and the production is not resumed.

2045 **KK.2.3 Notifications**

**KK.2.3.1 Event Information**

The DICOM AEs that claim conformance to this SOP Class as an SCU and/or an SCP shall support the Event Types and Event Information as specified in Table KK.2-2. Descriptions of the Attributes of the Event Information are specified in [Section B.30 "Inventory Creation IOD" in PS3.3](#).

2050 **Table KK.2-2. Inventory Creation Responses - Event Information**

Event Type Name	Event Type ID	Attribute Name	Tag	Requirement Type SCU/SCP
Inventory Terminated with Instances	11	Transaction UID	(0008,1195)	1/1
		Transaction Status	(0008,0417)	-1
		Transaction Status Comment	(0008,0418)	3/3
		Referenced SOP Class UID	(0008,1150)	1/1
		Referenced SOP Instance UID	(0008,1155)	1/1
		Retrieve AE Title	(0008,0054)	3/1C See <a href="#">KK.2.3.1.1</a>
		Retrieve URL	(0008,1190)	3/1C See <a href="#">KK.2.3.1.1</a>
		File Access URI	(0008,0409)	3/3
		Stored Instance Base URI	(0008,0407)	3/1C See <a href="#">KK.2.3.1.1</a>
		Container File Type	(0008,040A)	3/1C See <a href="#">KK.2.3.1.1</a>
		Filename in Container	(0008,040B)	3/1C See <a href="#">KK.2.3.1.1</a>
		File Offset in Container	(0008,040C)	3/1C See <a href="#">KK.2.3.1.1</a>
		File Length in Container	(0008,040D)	3/1C See <a href="#">KK.2.3.1.1</a>
Stored Instance Transfer Syntax UID	(0008,040E)	3/1C See <a href="#">KK.2.3.1.1</a>		

Event Type Name	Event Type ID	Attribute Name	Tag	Requirement Type SCU/SCP
		MAC Algorithm	(0400,0015)	-/3
		MAC	(0400,0404)	-/3
		Expiration DateTime	(0008,0416)	-/3
		Total Number of Study Records	(0008,0428)	-/1
Inventory Status	12	Transaction UID	(0008,1195)	1/1
		Transaction Status	(0008,0417)	-/1
		Transaction Status Comment	(0008,0418)	3/3
		Total Number of Study Records	(0008,0428)	-/1
Inventory Terminated without Instances	13	Transaction UID	(0008,1195)	1/1
		Transaction Status	(0008,0417)	-/1
		Transaction Status Comment	(0008,0418)	3/3

### KK.2.3.1.1 Inventory Terminated with Instances

2055 Within the Inventory Terminated with Instances Event Information, either Retrieve AE Title (0008,0054) or Retrieve URL (0008,1190), or both, shall be present.

2060 File Access URI (0008,0409) provides a non-DICOM Protocol access method (see [Annex P in PS3.3](#)) to a produced Inventory SOP Instance encoded in accordance with the DICOM File Format (see [Section 7 “DICOM File Format” in PS3.10](#)). Stored Instance Base URI (0008,0407) shall be present if File Access URI (0008,0409) is a relative path reference URI. Stored Instance Transfer Syntax UID (0008,040E) and Container File Type (0008,040A) shall be present if File Access URI (0008,0409) is present. Filename in Container (0008,040B) shall be present if Container File Type (0008,040A) is ZIP, TAR, or TARGZIP. File Offset in Container (0008,040C) and File Length in Container (0008,040D) shall be present if Container File Type (0008,040A) is BLOB.

### KK.2.3.2 Service Class Provider Behavior

2065 The SCP shall use the N-EVENT-REPORT primitive containing the well-known Storage Management SOP Instance UID (defined in [Section KK.1.3.2](#)) in its Affected SOP Instance UID parameter. The SCP shall supply the Transaction UID (0008,1195) corresponding to the Inventory Creation N-ACTION Initiate request.

2070 At any time during the production of the Inventory, the SCP may send an N-EVENT-REPORT primitive with Event Type “Inventory Status” (Event Type ID = 12), with an indication of process status in the Transaction Status (0008,0417) Attribute. The SCP shall send an N-EVENT-REPORT “Inventory Status” if production of the Inventory changes state. The SCP shall send an N-EVENT-REPORT “Inventory Status” in response to an N-ACTION “Request Status”.

2075 When production of the Inventory reaches a terminal state (COMPLETE, FAILURE, or CANCELED) and Inventory SOP Instances are available, the SCP shall send an N-EVENT-REPORT primitive with Event Type “Inventory Terminated with Instances” (Event Type ID = 11). The Event Information shall include Attributes specifying at least one method of accessing the root SOP Instance of the Inventory, i.e., it shall include at least one of the Attributes Retrieve AE Title (0008,0054) or Retrieve URL (0008,1190), and may optionally include File Access URI (0008,0409). See [Section KK.2.3.1.1](#) for conditionally required Attributes. The Event Information may also include an Expiration DateTime (0008,0416) Attribute to indicate the expected DateTime  
2080 until which the Inventory SOP Instance is available for access by the SCU.

If production of the inventory reaches a terminal state and Inventory SOP Instances are not available (i.e., FAILURE or CANCELED), the SCP shall send an N-EVENT-REPORT primitive with Event Type “Inventory Terminated without Instances” (Event Type ID = 13).

### **KK.2.3.3 Service Class User Behavior**

2085 Upon receipt of an N-EVENT-REPORT notification, the SCU shall return, via the N-EVENT-REPORT response primitive, the N-EVENT-REPORT Response Status Code applicable to its processing of the associated notification. A success status conveys that the SCU has successfully received the notification. An error status conveys that the SCU is not processing the notification.

Note

2090 The action of the SCP upon an error status for the N-EVENT-REPORT is outside the scope of this Standard.

### **KK.2.4 Conformance**

An implementation may claim conformance to this SOP Class as an SCU, SCP or both. The Conformance Statement shall be in the format defined in PS3.2.

#### **KK.2.4.1 SCU Conformance**

2095 An implementation that is conformant to the Inventory Creation SOP Class as an SCU shall meet conformance requirements for:

- the operations and actions that it invokes
- the notifications that it receives.

##### **KK.2.4.1.1 Operations**

2100 The SCU shall document in the SCU Operations Statement:

- the behavior and actions that cause the SCU to generate an N-ACTION primitive (Initiate, Request Status, Cancel, Pause, or Resume)
- the behavior and actions taken by the SCU upon receiving an N-ACTION error status

##### **KK.2.4.1.2 Notifications**

2105 The SCU shall document in the SCU Notifications Statement:

- the behavior and actions taken by the SCU upon receiving an N-EVENT-REPORT primitive (Inventory Terminated with Instances, Inventory Status, or Inventory Terminated without Instances).

#### **KK.2.4.2 SCP Conformance**

2110 An implementation that is conformant to the Inventory Creation SOP Class as an SCP shall meet conformance requirements for:

- the operations and actions that it performs
- the notifications that it generates.

##### **KK.2.4.2.1 Operations**

The SCP shall document in the SCP Operations Statement:



- 2115 • the behavior and actions of the SCP upon receiving an N-ACTION primitive (Initiate, Request Status, Cancel, Pause, or Resume).
- the range of values that it supports for the Requested Status Interval (0008,0414), and the default value for periodic reporting of status if that Attribute is not provided by the SCU
- 2120 • character repertoires supported in Specific Character Set (0008,0005) in the Scope of Inventory Sequence (0008,0400)
- support for Extended Matching Mechanisms (0008,040F) in the Scope of Inventory Sequence (0008,0400)
- the values supported for Inventory Level (0008,0403)
- Key Attributes supported for matching in the Scope of Inventory Sequence (0008,0400)

Note

- 2125 Conformance requirements for the SCP with respect to the created Inventory SOP Instances are detailed in [Section GG.6.6.1](#).

#### **KK.2.4.2.2 Notifications**

The SCP shall document in the SCP Notifications Statement:

- 2130 • the behavior and actions that cause the SCP to generate an N-EVENT-REPORT primitive (Inventory Terminated with Instances, Inventory Status, or Inventory Terminated without Instances), and in particular the conditions that cause a transition to the PAUSED or FAILURE processing status and the generation of the associated N-EVENT-REPORT.
- 2135 • the supported access mechanisms to Inventory SOP Instances referenced in the Inventory Terminated with Instances Notification, including the specific non-DICOM protocols (if any) referenced in the File Access URI (0008,0409).



## DICOM PS 3.5: Data Structures and Encoding

Add empty value matching characters for VRs DA, TM, and DT to Section 6.2

**Table 6.2-1. DICOM Value Representations**

2140

VR Name	Definition	Character Repertoire	Length of Value
...			
DA Date	<p>A string of characters of the format YYYYMMDD; where YYYY shall contain year, MM shall contain the month, and DD shall contain the day, interpreted as a date of the Gregorian calendar system.</p> <p>...</p> <p><b><u>Alternatively, in the context of a Query with empty value matching (see PS3.4), a string of two QUOTATION MARK characters, representing an empty key value.</u></b></p>	<p>"0"-"9" of Default Character Repertoire</p> <p>In the context of a Query with range matching (see PS3.4), the character "-" is allowed, and a trailing SPACE character is allowed for padding.</p> <p><b><u>In the context of a Query with empty value matching (see PS3.4), the QUOTATION MARK character is allowed.</u></b></p>	<p>8 bytes fixed</p> <p>In the context of a Query with range matching (see PS3.4), the length is 18 bytes maximum.</p> <p><b><u>In the context of a Query with empty value matching (see PS3.4), the length is 2 bytes fixed.</u></b></p>
...			
DT Date Time	<p>A concatenated date-time character string in the format: YYYYMMDDHHMMSS.FFFFFFFF&amp;ZZXX</p> <p>...</p> <p><b><u>Alternatively, in the context of a Query with empty value matching (see PS3.4), a string of two QUOTATION MARK characters, representing an empty key value.</u></b></p>	<p>"0"-"9", "+", "-", ".", and the SPACE character of Default Character Repertoire</p> <p><b><u>In the context of a Query with empty value matching (see PS3.4), the QUOTATION MARK character is allowed.</u></b></p>	<p>26 bytes maximum</p> <p>In the context of a Query with range matching (see PS3.4), the length is 54 bytes maximum.</p> <p><b><u>In the context of a Query with empty value matching (see PS3.4), the length is 2 bytes fixed.</u></b></p>
...			
TM Time	<p>A string of characters of the format HHMMSS.FFFFFFFF; where HH contains hours (range "00" - "23"), MM contains minutes (range "00" - "59"), SS contains seconds (range "00" - "60"), and FFFFFFFF contains a fractional part of a second as small as 1 millionth of a second (range "000000" - "999999"). A 24-hour clock is used. Midnight shall be represented by only "0000" since "2400" would violate the hour range. The string may be padded with trailing spaces. Leading and embedded spaces are not allowed.</p> <p>...</p> <p><b><u>Alternatively, in the context of a Query with empty value matching (see PS3.4), a string of two QUOTATION MARK characters, representing an empty key value.</u></b></p>	<p>"0"-"9", ".", and the SPACE character of Default Character Repertoire</p> <p>In the context of a Query with range matching (see PS3.4), the character "-" is allowed.</p> <p><b><u>In the context of a Query with empty value matching (see PS3.4), the QUOTATION MARK character is allowed.</u></b></p>	<p>14 bytes maximum</p> <p>In the context of a Query with range matching (see PS3.4), the length is 28 bytes maximum.</p> <p><b><u>In the context of a Query with empty value matching (see PS3.4), the length is 2 bytes fixed.</u></b></p>
...			

VR Name	Definition	Character Repertoire	Length of Value
...			
UR Universal Resource Identifier or Universal Resource Locator (URI/URL)	<p>A string of characters that identifies a URI or a URL as defined in [RFC3986]. Leading spaces are not allowed. Trailing spaces shall be ignored. Data Elements with this VR shall not be multi-valued.</p> <p>Note</p> <p>Both absolute and relative URIs are permitted. If the URI is relative, then it is relative to the base URI of the object within which it is contained, <b><u>or to a base URI in another Attribute as specified by the Information Object Definition.</u></b></p>		

## DICOM PS 3.6: Data Dictionary

*Add new data elements to Section 6 Registry of DICOM Data Elements*

2145

**Table 6-1. Registry of DICOM Data Elements**

Tag	Name	Keyword	VR	VM	
(0008,0400)	Scope of Inventory Sequence	ScopeOfInventorySequence	SQ	1	
(0008,0401)	Inventory Purpose	InventoryPurpose	LT	1	
(0008,0402)	Inventory Instance Description	InventoryInstanceDescription	LT	1	
(0008,0403)	Inventory Level	InventoryContentLevel	CS	1	
(0008,0404)	Item Inventory DateTime	ItemInventoryDateTime	DT	1	
(0008,0405)	Removed from Operational Use	RemovedFromOperationalUse	CS	1	
(0008,0406)	Reason for Removal Code Sequence	ReasonForRemovalCodeSequence	SQ	1	
(0008,0407)	Stored Instance Base URI	StoredInstanceBaseURI	UR	1	
(0008,0408)	Folder Access URI	FolderAccessURI	UR	1	
(0008,0409)	File Access URI	FileAccessURI	UR	1	
(0008,040A)	Container File Type	ContainerFileType	CS	1	
(0008,040B)	Filename in Container	FilenameInContainer	UR	1	
(0008,040C)	File Offset in Container	FileOffsetInContainer	UV	1	
(0008,040D)	File Length in Container	FileLengthInContainer	UV	1	
(0008,040E)	Stored Instance Transfer Syntax UID	StoredInstanceTransferSyntaxUID	UI	1	
(0008,040F)	Extended Matching Mechanisms	ExtendedMatchingMechanisms	CS	1-n	
(0008,0410)	Range Matching Sequence	RangeMatchingSequence	SQ	1	
(0008,0411)	List of UID Matching Sequence	UIDListMatchingSequence	SQ	1	
(0008,0412)	Empty Value Matching Sequence	EmptyValueMatchingSequence	SQ	1	
(0008,0413)	General Matching Sequence	GeneralMatchingSequence	SQ	1	
(0008,0414)	Requested Status Interval	RequestedStatusInterval	US	1	
(0008,0415)	Retain Instances	RetainInstances	CS	1	
(0008,0416)	Expiration DateTime	ExpirationDateTime	DT	1	
(0008,0417)	Transaction Status	TransactionStatus	CS	1	
(0008,0418)	Transaction Status Comment	TransactionStatusComment	LT	1	
(0008,0419)	File Set Access Sequence	FileSetAccessSequence	SQ	1	
(0008,041A)	File Access Sequence	FileAccessSequence	SQ	1	
(0008,041B)	Record Key	RecordKey	OB	1	
(0008,041C)	Prior Record Key	PriorRecordKey	OB	1	
(0008,041D)	Metadata Sequence	MetadataSequence	SQ	1	
(0008,041E)	Updated Metadata Sequence	UpdatedMetadataSequence	SQ	1	
(0008,041F)	Study Update DateTime	StudyUpdateDateTime	DT	1	

Tag	Name	Keyword	VR	VM	
(0008,0420)	Inventory Access End Points Sequence	InventoryAccessEndPointsSequence	SQ	1	
(0008,0421)	Study Access End Points Sequence	StudyAccessEndPointsSequence	SQ	1	
(0008,0422)	Incorporated Inventory Instance Sequence	IncorporatedInventoryInstanceSequence	SQ	1	
(0008,0423)	Inventoried Studies Sequence	InventoriedStudiesSequence	SQ	1	
(0008,0424)	Inventoried Series Sequence	InventoriedSeriesSequence	SQ	1	
(0008,0425)	Inventoried Instances Sequence	InventoriedInstancesSequence	SQ	1	
(0008,0426)	Inventory Completion Status	InventoryCompletionStatus	CS	1	
(0008,0427)	Number of Study Records in Instance	NumberOfStudyRecordsInInstance	UL	1	
(0008,0428)	Total Number of Study Records	TotalNumberOfStudyRecords	UV	1	

*Add new UIDs to Annex A Registry of DICOM Unique Identifiers (UIDs)*

**Table A-1. UID Values**

2150

UID Value	UID Name	UID Keyword	UID Type	Part
1.2.840.10008.5.1.4.1.1.201.1	Inventory Storage	InventoryStorage	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.201.2	Inventory - FIND	InventoryFind	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.201.3	Inventory - MOVE	InventoryMove	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.201.4	Inventory - GET	InventoryGet	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.201.5	Inventory Creation	InventoryCreation	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.201.6	Repository Query	RepositoryQuery	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.201.1.1	Storage Management SOP Instance	StorageManagementInstance	Well-known Instance	PS3.4

**Table A-3. Context Group UID Values**

Context UID	Context Identifier	Context Group Name	Comment
1.2.840.10008.6.1.1446	CID 7031	Reason for Removal from Operational Use	

2155

## DICOM PS 3.7: Message Exchange

*Add Warning status to C-FIND*

### 2160 9.1.2.1.6 Status

Indicates the status of the response. It may have any of the following values (see also Annex C):

- a. Success (0000H) - This indicates that processing of the matches is complete. It shall not contain a matching Identifier.

...

- 2165 f. Failed (Status value is Service Class specific) - Indicates that the C-FIND operation failed at the performing DIMSE Service User.

- g. Warning (Status value is Service Class specific) - Indicates that the performing DIMSE Service User has terminated the C-FIND operation, and the set of returned matching Identifiers may not be complete.**

2170 ...

### 9.1.2.2 C-FIND Service Procedures

...

The following C-FIND service procedures apply to the performing DIMSE Service User:

2175 ...

- f. When the C-FIND operation completes (either in success or in failure), the performing DIMSE Service User issues a C-FIND response with the status set to either Refused, Failed, **Warning**, or Success to the DIMSE Service Provider.

...

2180

## DICOM PS 3.16: Content Mapping Resource

Add to Section 2 Normative References

### 2.1 GENERAL

- 2185 [IHE RAD TF-1] IHE International. *IHE Radiology (RAD) Technical Framework, Volume 1 – Integration Profiles*  
[https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE\\_RAD\\_TF\\_Vol1.pdf](https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_TF_Vol1.pdf)

Add Context Group to Annex B DCMR Context Groups

### 2190 CID 7031 Reason for Removal from Operational Use

Type: Extensible

Version: 20220624

UID: 1.2.840.10008.6.1.1446

**Table CID 7031. Reason for Removal from Operational Use**

2195

Coding Scheme Designator	Code Value	Code Meaning
DCM	113001	Rejected for Quality Reasons
DCM	113037	Rejected for Patient Safety Reasons
DCM	113038	Incorrect Modality Worklist Entry
DCM	113039	Data Retention Policy Expired
DCM	113680	Quality Control Intent
DCM	130752	Data Not Accessible from Storage
DCM	130753	Processed Key Object Selection
DCM	130754	Replaced by Alternate Representation

Add terminology concepts to Annex D DCMR Context Groups

2200

**Table D-1. DICOM Controlled Terminology Definitions**

Code Value	Code Meaning	Definition	Notes
130752	Data Not Accessible from Storage	Requested data cannot be read from storage media, e.g., data physically deleted, or storage media no longer available	

130753	Processed Key Object Selection	The SOP Instance is a Key Object Selection Document, used for referenced object change management, that has had its directives processed and is no longer to be used (see <a href="#">[IHE RAD TF-1] Image Object Change Management Profile</a> )	
130754	Replaced by Alternate Representation	The SOP Instance has been replaced by a SOP Instance with an alternate encoding. The alternate encoding may utilize a different SOP Class or have different image quality characteristics (e.g., lossy compression).	

## DICOM PS 3.17: Explanatory Information

Add to Section 2 Normative References

### 2205 2.2 OTHER REFERENCES

[IHE RAD TF-1] IHE International. *IHE Radiology (RAD) Technical Framework, Volume 1 – Integration Profiles*  
[https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE\\_RAD\\_TF\\_Vol1.pdf](https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_TF_Vol1.pdf)

[IHE RAD TF-2] IHE International. *IHE Radiology (RAD) Technical Framework, Volume 2 – Transactions*  
[https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE\\_RAD\\_TF\\_Vol2.pdf](https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_TF_Vol2.pdf)

2210 [RFC7233] IETF. June 2014. *Hypertext Transfer Protocol (HTTP/1.1): Range Requests*  
<http://tools.ietf.org/html/rfc7233> .

Add explanatory Annex

## Annex YYYY Inventories (Informative)

### 2215 YYYY.1 THE DICOM DATA MANAGEMENT ENVIRONMENT

DICOM data in a healthcare organization is typically managed in a Picture Archiving and Communications System (PACS), which supports a repository of current and historical studies, access to those studies through DICOM standard interfaces, and often workflow management for production and interpretation of studies.

2220 Historical images are routinely retained “forever”, and data set sizes are increasing with 3D/4D and multimodality studies. Repositories in many institutions store over a billion instances across tens of millions of studies, with data volumes over one petabyte. Enterprise-scale management tools and data are required, including interoperability features that operate at large scales.

#### YYYY.1.1 Inventories

2225 An important feature supporting repository management is the ability to obtain an inventory of the repository contents in a standard format. DICOM provides two complementary methods - an interactive query-based mechanism and a persistent inventory information object. Both approaches address the issues associated with a large inventory with over a billion records.

2230 The two methods, query-based and persistent object, each satisfy distinct approaches to implementation and use of inventories. Generally, repository systems that already implement query for patient-oriented operations may find implementation of a query-based inventory to be expeditious, but there may be repository systems that may want to implement production of an inventory object. Many user applications need to have a persistent object that can be processed offline in a bulk operation, such as E/T/L (extract, transfer, and load) to a data warehouse, but some inventory using applications may desire to use an interactive query model. There may also be applications that can mediate between queries and persistent objects (see [Section YYYY.7.1](#))



2235 Note

The following sections describing the Repository Query and the Inventory Information Object, respectively, are written to be read independently of one another; there is therefore significant overlap between the sections.

## YYYY.2 REPOSITORY QUERY

### YYYY.2.1 Overview

2240 The Repository Query SOP Class is an extension of the Study Root Query/Retrieve – FIND SOP Class with features that support very large response sets. For queries that might return millions of records, it allows both the SCU and SCP to set constraints on the number of records to be returned in a single C-FIND transaction. It specifies well-defined behavior for a “partially completed” status to be returned if not all entities selected by the key matching Attributes in the request were returned, and allows the SCU to specify a “continuation point” in a  
2245 subsequent query to return responses from that point onward. This provides a mechanism to “window” through the entries in a deterministic way without overburdening either the SCU or the SCP.

### YYYY.2.2 Record Key and Continuation

Deterministic behavior is achieved by the SCP imposing a sorting order on the returned records that is based on a unique value for each entry, the Record Key (0008,041B). In the query, the SCU can request return of the  
2250 Record Key (0008,041B) in each response. When a “partially completed” status is returned, or if there is a communications failure during the transaction, the value in the last received response can be used in the next query to request the SCP to continue returning responses for matching entities with next higher unique value as per the sorting order.

The structure and content of Record Key (0008,041B) values is totally SCP implementation-specific, and  
2255 opaque to the SCU. Values may be permanent, or may be constructed dynamically during query processing. For SCPs that use a relational database, the database primary record key might be used as the unique Record Key (0008,041B) value, although an implementation might choose to use some other element or some type of session-oriented key. The intention is that the SCP manage record keys such that the SCU will be able to use them to obtain a complete inventory in a sequence of Queries in a reasonable time period, recognizing that for  
2260 large inventories that time period may be substantial. If there are limitations on the lifetime of the Record Key (0008,041B), they should be documented in the SCP Conformance Statement.

### YYYY.2.3 Key Matching Attributes

The Repository Query SOP Class uses Key Attribute matching exactly as defined for Study Root C-FIND. However, several additional Key Attributes are defined in support of repository management.

#### 2265 YYYY.2.3.1 Objects Removed from Operational Use

A repository system may manage Studies, Series, and Instances that are marked in the database as removed from operational use. The associated SOP Instances may have been physically deleted, or they may be left in storage, commonly denoted as ‘soft deleted’, ‘deprecated’ or ‘hidden’ (see [Section C.6.4.1.2 “Removed from Operational Use” in PS3.4](#)). The SCU may desire to receive records of these entities in the inventory, especially  
2270 to determine which entities were removed since the last inventory (see example in [Section YYYY.7.10.1](#)).

The Repository Query SOP Class defines Removed from Operational Use (0008,0405) and Reason for Removal Code Sequence (0008,0406) as Key Attributes. Studies, Series, or Instances might be marked removed from operational use by local user actions, or by actions associated with the processing of specific Key Object Selection Document SOP Instances, e.g., in accordance with [\[IHE RAD TF-1\] Image Object Change Management Integration Profile \(IOCM\)](#).  
2275

### YYYY.2.3.2 Access to Stored Objects

A repository system may support multiple access mechanisms for each stored instance – DIMSE C-MOVE retrieve ([Annex C in PS3.4](#)), web services-based Studies Service ([Section 10 in PS3.18](#)), and perhaps multiple non-DICOM direct file access protocols ([Annex P in PS3.3](#)). The DIMSE Retrieve AE Title (0008,0054) is returned in the query response without specific request of the SCU (see [Section C.4.1.1.3.2 in PS3.4](#)). The Repository Query SOP Class defines File Set Access Sequence (0008,0419) at the Study and Series levels and File Access Sequence (0008,041A) at the Instance level as Key Attributes. The SCU can request these Attributes to obtain a non-DICOM protocol URI link to the stored instance (see [Section C.6.4.1.3 “File Set Access Sequence and File Access Sequence” in PS3.4](#)).

2285 See [Section YYYY.7.2](#) for discussion of using non-DICOM protocols.

### YYYY.2.3.3 Managed Metadata and Updated Metadata

Many repository applications do not update stored SOP Instances with changes to metadata that occur over time (e.g., patient name and ID). Therefore, applications that use non-DICOM direct file access need to obtain the current metadata, which can be retrieved in a query using the Metadata Sequence (0008,041D) or the Updated Metadata Sequence (0008,041E) Key Attribute, defined by the Repository Query SOP Class (see [Section C.6.4.1.4 “Metadata Sequence and Updated Metadata Sequence” in PS3.4](#)). It is the responsibility of the application using direct file access to use the metadata in these returned Attributes, but recognizing that that metadata may also become outdated due to subsequent repository updates (see [Section YYYY.7.9 “Metadata Updates”](#)).

2295 To support some use cases, especially in research, the SCP may manage a broad set of metadata Attributes of the stored SOP Instances in its database for rapid response to queries. The SCP may return all of these metadata Attributes in the Metadata Sequence (0008,041D) if requested by the SCU. Because there are no limitations on the extent of this metadata, a requesting SCU must be prepared to handle a large data volume, especially for queries at the Instance query level.

### 2300 YYYY.2.3.4 Study Update DateTime

Query of the Study Update DateTime (0008,041F) Key Attribute using date and time range matching allows an SCU to identify changes that have occurred since a prior inventory was obtained. This enables incremental processing of updates to synchronize the SCU’s data to that held by the SCP, and is crucial to the migration use case. It may also support important quality assurance and other processes. In order to maintain backward compatibility with existing repository databases, this Attribute is identified as optional, but its importance to a number of use cases and its potential for significant performance improvement makes implementation highly desirable.

## YYYY.3 THE INVENTORY INFORMATION OBJECT

### YYYY.3.1 Overview

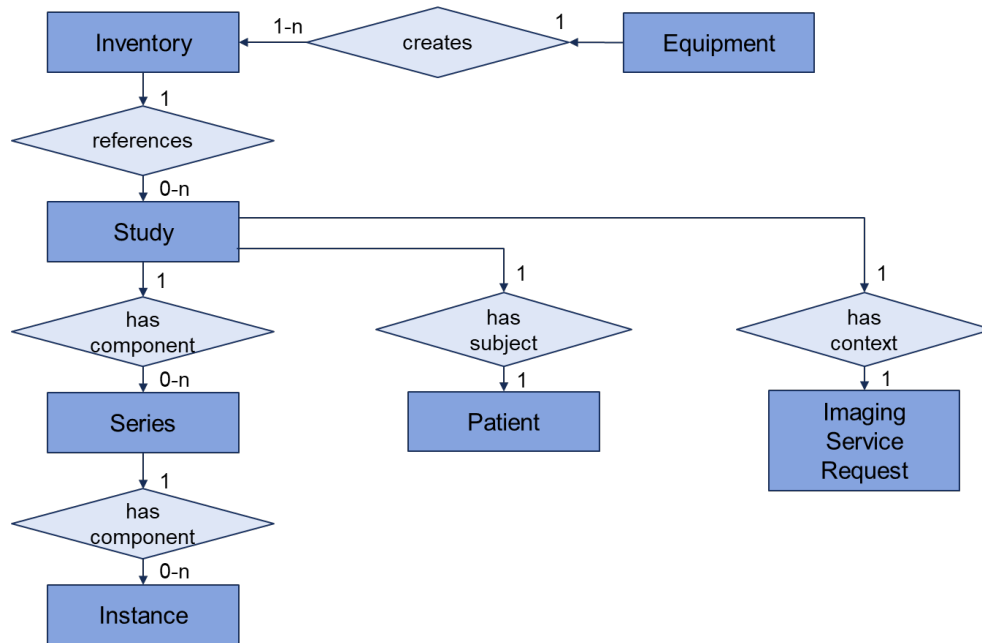
2310 The Inventory Information Object Definition ([Section A.88 “Inventory IOD” in PS3.3](#)) specifies a structure capable of encoding an Inventory of all Studies, Series, and Instances in a repository. The IOD is structured hierarchically using [Sequence Attributes](#). Within the Inventory is a sequence of Study records, within each of which is a sequence of Series records, and within each of those is a sequence of Instance records. Each “record” is a set of key Attributes describing the Studies, Series, and Instance entities in a repository, and the mechanisms for accessing the stored SOP Instances.

2315 The IOD entity-relationship model is shown in Figure YYYY.3-1. The Inventory is created by an identified piece of Equipment. The content of the Inventory follows the Study Root Query/Retrieve Information Model (see [PS3.4 Section C.6.2.1](#)), with Patient and Imaging Service Request information treated as Attributes of the Study. The Imaging Service Request Information Entity is not explicitly modeled in other Composite IOD E-R models, but it

2320 is specifically identified here as its Attributes, such as Accession Number, are typically important in repository management.

Note

2325 There is a potentially complex relationship between the Study and Imaging Service Requests in the real world (e.g., see [\[IHE RAD TF-2\] Section 4.6.4.1.2.3 Relationship between Scheduled and Performed Procedure Steps](#)). However, the Inventory Information Model follows the basic Study Information Model and supports only a single Accession Number representing an Imaging Service Request (see [Section C.7.2.1 in PS3.3](#)). Note that if a Study has multiple associated Imaging Service Requests, the request Attributes may be encoded at the Series level in the Request Attributes Sequence (0040,0275). The Inventory IOD includes the Request Attributes Sequence to support this use.



2330 **Figure YYYY.3-1. Inventory Information Model E-R Diagram**  
(reproduced from [Figure 7.13.6-1 in PS3.3](#))

These IOD Information Entities include all the required Attributes specified for Query processing by the repository system (see [Section C.6 in PS3.4](#)). An Inventory is thus a standard DICOM representation of the key content of a repository system database for DICOM SOP Instances in the repository. Other aspects of such  
2335 databases, such as data for workflow queues, are out of scope of the Inventory IOD.

The IOD allows Inventories at three Inventory Levels – with only Study records, with Study and Series records, or with Study, Series, and Instance records. While many uses will require Inventories with Instance level records, production of a Study or Series level Inventory may be significantly faster and may be sufficient for some uses.

2340 **YYYY.3.2 Scope of Inventory**

The Inventory IOD supports Inventories of subsets of the repository based on a set of Key Attributes that specify the Scope of Inventory. The values of those Key Attributes are used to match the corresponding Attributes of Studies in the repository, similar to the Key Attribute matching used in Query services, to select the Studies that are included in the Inventory (see [Section C.38.2.1 “Scope of Inventory Macro” in PS3.3](#)). Any Key Attributes  
2345 allowed for Query services can be specified in the Scope of Inventory (see [Section YYYY.2.3 Key Matching Attributes](#)).

2350 The scope is also implicitly limited to records available at the Content Date and Time when processing of the inventory began (see [Section C.38.1.1.1 in PS3.3](#)), although records received or updated during Inventory production may be included, and Studies deleted during production might not be included, at the discretion of the implementation.

### YYYY.3.3 Inventory Instance Tree

2355 With a billion instances in a repository, the Inventory itself may be on the order of 300 GB (i.e.,  $> 2^{38}$  bytes) in size. Producing and processing an Inventory of such size may exceed some resource constraints of the creator and/or user application (such as 32-bit indices). The content of an Inventory may therefore need to be divided into more than one SOP Instance.

#### Note

2360 Because an Inventory object has relatively low information entropy, compression of the Inventory object may substantially decrease its size. Such compression may be applied to the Inventory SOP Instance using the Deflated Little Endian Transfer Syntax (see [Section A.5 in PS3.5](#)), or if the Inventory is stored in a DICOM File Format, the entire file may be compressed (e.g., using ZIP or GZIP). However, generally the instance needs to be fully constructed before it is compressed, and fully uncompressed before it is processed, and inventory applications need to be designed for the full potential size.

2365 Very large repositories may also be partitioned or distributed into (semi-)independent subsystems. Production of an inventory for such distributed subsystems may be performed by parallel processes, which would be facilitated by each process producing a separate Inventory SOP Instance.

2370 The Inventory IOD supports such cases of multiple SOP Instances comprising a single logical Inventory. The IOD supports one SOP Instance incorporating the content of one or more others *by reference*. The IOD thus has the structure shown schematically in Figure YYYY.3-2. An Inventory SOP Instance may contain links to other Inventory SOP Instances whose content is incorporated by reference, or may contain inventoried Study records, or both. A set of incorporated SOP Instances form a tree structure, with one SOP Instance at the root.

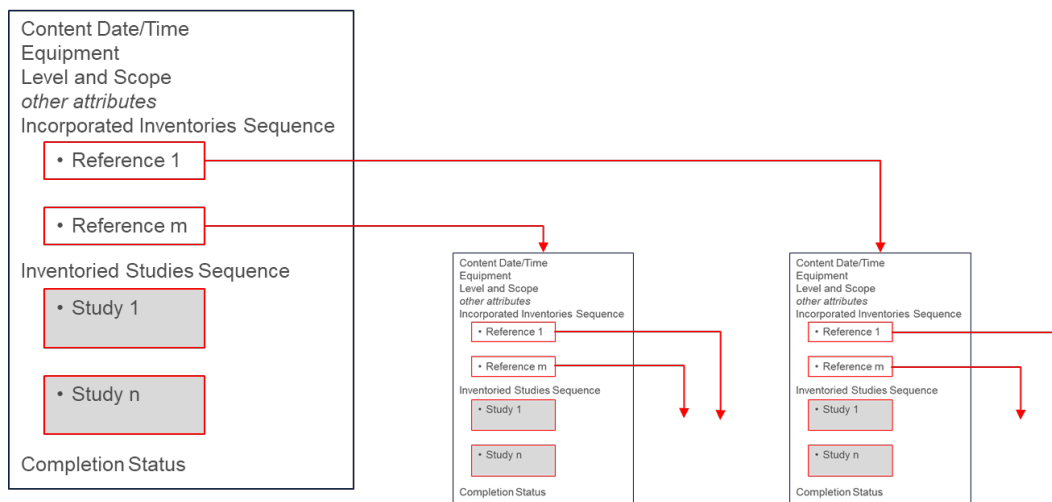


Figure YYYY.3-2. Inventory IOD Schematic Structure

#### YYYY.3.3.1 Scope and Completion Status

2375 Within any tree (or subtree) of Inventory SOP Instances, the root node specifies the Scope of Inventory and Completion Status for the entire tree, regardless of the value of those Attributes in subsidiary referenced objects. As will be seen in the examples, this is true regardless of the process used to create the Inventory, whether with new objects, or with reference to previously created objects. The root object is the last SOP Instance to be completed in a tree, and it thus contains the final Completion Status for the tree and its Scope of

2380 Inventory. Any Completion Status value other than COMPLETE implies that the defined Scope of Inventory is not satisfied with this object as the root of the tree.

It is the responsibility of the creator of the root object for a tree to ensure that the Completion Status value accurately describes the content of the tree relative to the Scope of Inventory at the Content Date and Time for the repository system identified in the General Equipment Module.

### YYYY.3.3.2 Examples

#### 2385 YYYY.3.3.2.1 Serial Production

As an example of how this tree structure might be used, consider an application producing a large Inventory. It creates an Inventory SOP Instance, and begins filling it with inventoried Study records. At some point, it reaches a size constraint, completes that object, and begins creation of a second object. That second object includes a link to the first one, and the application fills it with Study records until it, too, reaches its limit. The process  
2390 repeats with a third object, and so on until the inventory is complete (see Figure YYYY.3-3). The last object becomes the root of the tree of the complete inventory.

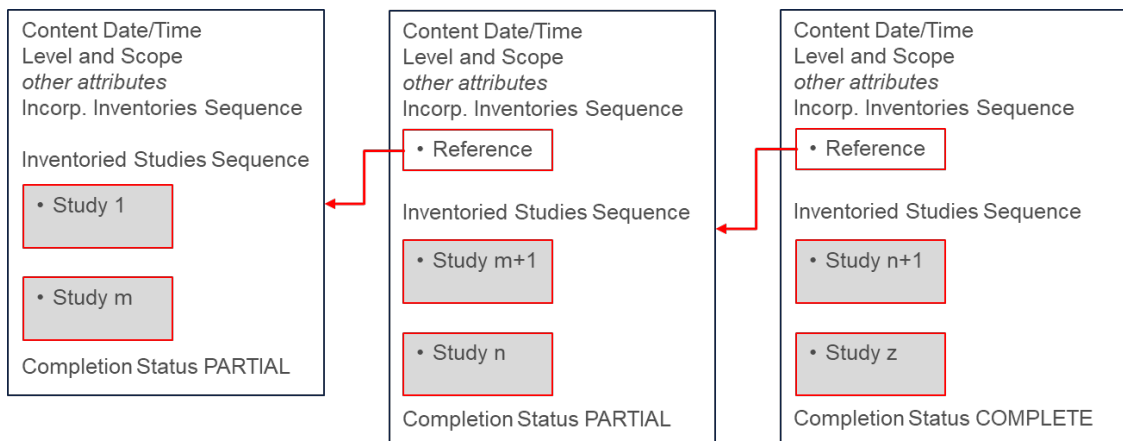
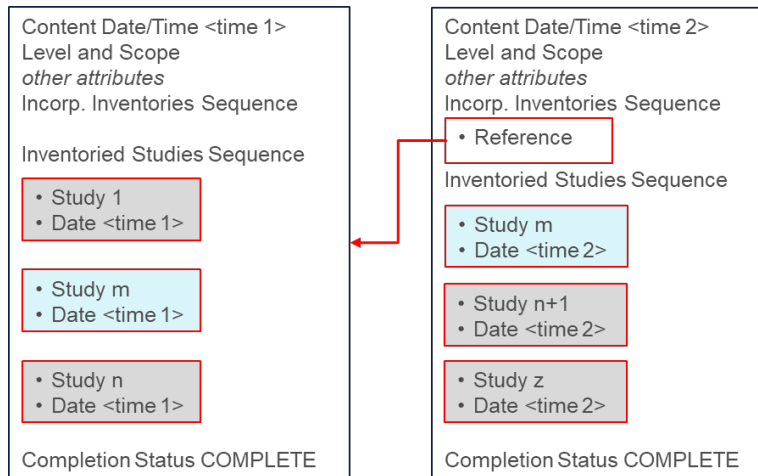


Figure YYYY.3-3. Serial production example

2395 Note that in the first and second objects, the Scope of Inventory will be the same as in the final object, but the Completion Status of PARTIAL indicates that the sets of inventoried studies in their subtrees do not fulfil that Scope. (The subtree of the first object is just itself, the subtree of the second object is itself and the first, etc.)

#### YYYY.3.3.2.2 Baseline and increment

2400 A special case of serial production is worth noting. A baseline Inventory can be updated to current values by creating an Inventory SOP Instance with the incremental updates (new and changed Study records) that includes the baseline Inventory SOP Instance by reference. The IOD allows a Study to appear more than once in the tree of Inventory SOP Instances, and reconciliation of those records is facilitated by each appearance being tagged with its DateTime of extraction from the database. Note that if an updated Study is included in the incremental change inventory object, the full Study record as known at that time needs to be encoded (not just records for new or changed Series or Instances in the Study).



2405

**Figure YYYY.3-4. Baseline with incremental update**

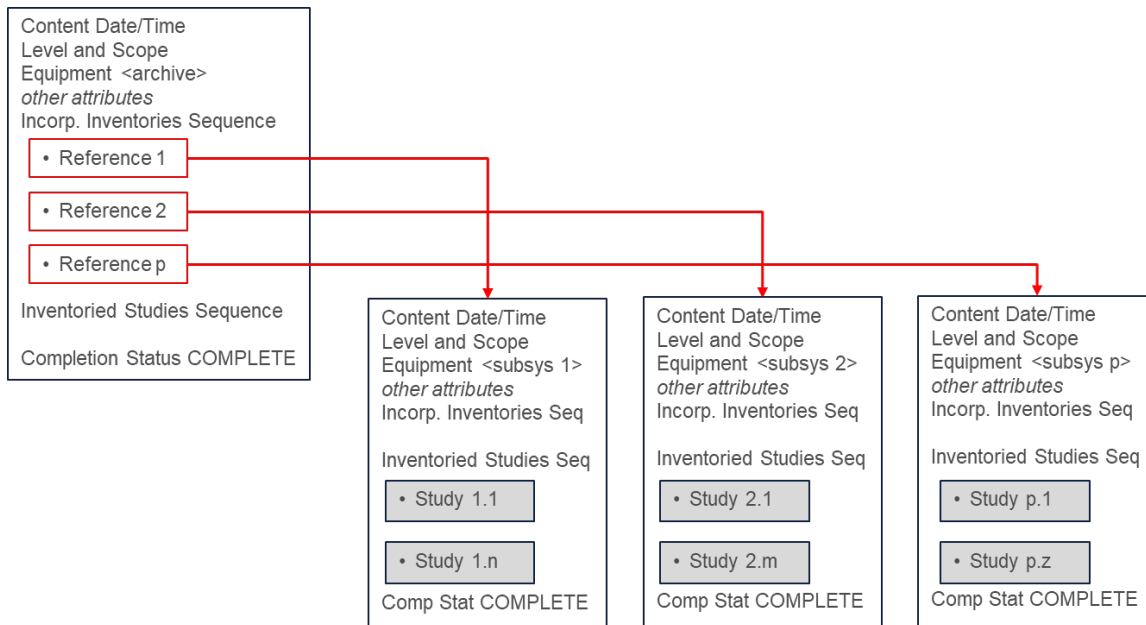
In this example, the Scope and Equipment for each object are the same, but the objects differ by their Content Date and Time. It is the responsibility of the creator to ensure that Study records in the incorporated Inventory object are either current as of the Content Date / Time, even though their time of extraction precedes that DateTime, or they are superseded by a current Study record in the incremental update inventory object.

2410

**YYYY.3.3.2.3 Parallel Production**

As another example, consider an application producing an Inventory in parallel across several independent federated storage subsystems. It tasks each subsystem to produce an Inventory SOP Instance, and itself produces a SOP Instance that links to each of the subsystem Inventories (see Figure YYYY.3-5). Note that the Scope of Inventory will be the same for all objects, but the Equipment identifiers will differ.

2415



**Figure YYYY.3-5. Federated or parallel production example**

### YYYY.3.3.2.4 Arbitrary tree structure

2420 Combining these concepts, each of the parallel subsystems may produce an Inventory which is itself a tree of Inventory SOP Instances. Each of those subtrees may follow the structures of either parallel or serial production. In general, the IOD supports an arbitrary tree structure (see Figure YYYY.3-6), where each node is the root of a subtree or a terminal leaf.

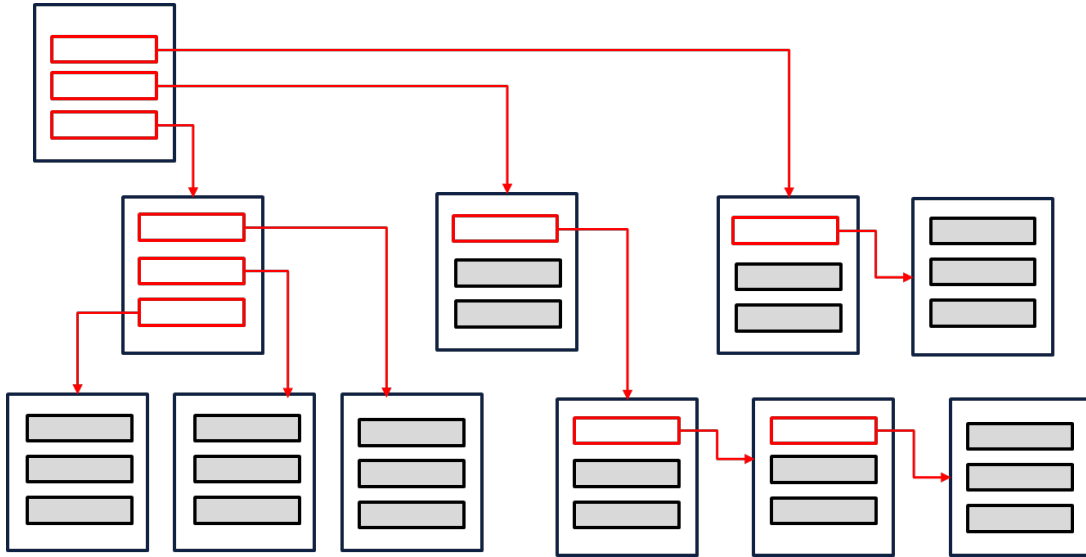


Figure YYYY.3-6. Arbitrary tree structure example

### 2425 YYYY.3.3.2.5 Empty inventory

A repository system may be tasked with producing an Inventory, but for which there are no stored studies that match the requested Scope. For instance, an organization may be producing an inventory of all nuclear medicine studies, and requests each of its several PACS and VNAs to create an Inventory with Modalities in Study = NM. A system that doesn't have any NM studies will create an empty Inventory object, which  
2430 affirmatively declares that that system does not have any matching Studies as of the Content Date / Time.

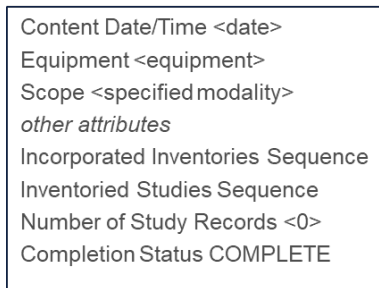


Figure YYYY.3-7. Empty inventory example

### YYYY.3.4 Access Mechanisms for Repository Data

2435 The Inventory IOD supports the recording of available access mechanisms for each repository stored instance – DIMSE Query/Retrieve ([Annex C in PS3.4](#)), web services-based Studies Service ([Section 10 in PS3.18](#)), and perhaps multiple non-DICOM direct file access protocols ([Annex P in PS3.3](#)). Either the access point for DIMSE (AE Title) or web (origin server address), or both, must be provided for each stored SOP Instance; the non-DICOM protocols are optional. See [Section YYYY.7.2](#) for discussion of using non-DICOM protocols



2440 Many repository applications do not keep the stored SOP Instances updated with metadata that may change over time (e.g., patient name and ID). Applications that use direct file access are required to use the current correct metadata, as recorded in the Inventory SOP Instance, rather than the metadata in the stored files (see [Section YYYY.7.9](#)).

### YYYY.3.5 Additional Data Elements

2445 The Inventory IOD, like all DICOM IODs, may be extended by the addition of optional Attributes that do not impact the semantics of the basic IOD. This is denoted Standard Extended Conformance (see [Section 3.11 “DICOM Conformance” in PS3.2](#)).

2450 While the IOD identifies many optional Attributes that might be managed in a repository database, the creator of an Inventory is allowed to use such Standard Extended Conformance to include any additional data elements that it manages. This may support additional use cases for the Inventory SOP Instances, or may provide direct database record keys in Private Data Elements for implementation-specific processing.

#### Note

2455 For example, the repository database may support at the Instance level the Content Label and Content Description to support queries against Presentation States in accordance with the [\[IHE RAD TF-1\] Consistent Presentation of Images Profile](#), or the Template ID and Concept Name Code Sequence to support queries against Structured Report SOP Instances in accordance with the [\[IHE RAD TF-1\] Evidence Documents Profile](#).

### YYYY.3.6 Producer vs. Consumer Implementation

2460 In all interoperability design, there is a tradeoff between ease of implementation for the producer of information versus the consumer of that information. By adding constraints on the message content to which the producer must adhere, the processing requirements for the receiver might be simplified. Fewer constraints on the producer means the consumer must account for more variability in the exchanged data.

2465 In the design of the Inventory IOD, a policy was chosen to simplify the production of the SOP Instances, even at the risk of complicating the implementation of the consumer. The goal is to allow the producer of the inventory to simply report what it has, without substantial additional processing. For example, in a repository that might distribute the SOP Instances of a Study across multiple subsystems, each subsystem can report on the SOP Instances that it knows about, and there is no requirement for the producer of the combined Inventory to consolidate or reconcile those different records. For the migration and consolidation use case (see [Section YYYY.5.1](#)), the consumer of the inventory will typically need to perform substantial reconciliation activities, which do not need to be replicated in the producer.

2470 This policy can also be seen in the approach to repository data that has been removed from operational use (deprecated, soft-deleted, or hidden). As DICOM has not established a standard approach to this type of data, storage system implementations take a variety of approaches. The Inventory IOD does not attempt to introduce a single way of managing such data. Rather, the repository system can simply report a removal status at the level(s) at which it manages that status, be it Study, Series, or Instance, with an optional reason code if it has one. If the removal was due to a directive in a Key Object Selection Document SOP Instance, e.g., in  
2475 accordance with the [\[IHE RAD TF-1\] IOCM Profile](#), the Inventory IOD makes no assumption about the presence or status of that KOS object; the system simply reports whether it is stored in the repository.

## YYYY.4 RELATED SERVICES FOR INVENTORY SOP INSTANCES

All Inventory-related network services will have associated security features that will need to be implemented in applications that use those services (see [Section YYYY.6](#)).

### 2480 YYYY.4.1 Inventory Storage and Query/Retrieve

The Inventory IOD is defined in the category of non-patient-root DICOM composite objects. As such, its basic SOP Class for DICOM network transfer is specified in the Non-Patient Object Storage Service Class ([Annex GG](#))



in [PS3.4](#) and [Section 9.1.1 “C-STORE service” in PS3.7](#)). Inventory objects may also be transferred using DICOM Media Interchange ([Annex I in PS3.4](#) and [PS3.10](#)).

2485 Query/Retrieve of Inventory SOP Instances is specified in the Inventory Query/Retrieve Service Class ([Annex JJ in PS3.4](#)). Query/Retrieve of Inventory SOP Instances uses the same C-FIND, C-MOVE, and C-GET DIMSE services as other Query/Retrieve Service Classes.

Note

2490 Be careful to distinguish between Query/Retrieve of Inventory SOP Instances, Query/Retrieve of the SOP Instances in the repository that are referenced in the Inventory, and Repository Query which gives inventory information without creating an Inventory SOP Instance.

2495 Inventory Query returns key information about available Inventory SOP Instances, including Content Date and Time, Scope of Inventory, and Completion Status. This allows the Query SCU to obtain a list of available Inventory objects and determine whether any of them meet the SCU’s needs, rather than initiating creation of a new Inventory.

Inventory SOP Instances may also be exchanged using DICOM web-based (HTTP) services. The equivalent of the Storage and Query/Retrieve Services is specified for the web through the Non-Patient Instance Services (see [Section 12 in PS3.18](#)).

2500 Due to the potentially very large size of Inventory SOP Instances, the creator may make them available through a non-DICOM file access protocol. Such a protocol may allow interactive reading of files, rather than transfer as a whole to the destination system (see [Section YYYY.7.6](#)).

## YYYY.4.2 Inventory Creation Service

2505 Creation of an inventory may be initiated by a transaction of the Inventory Creation SOP Class (see [Section KK.2 in PS3.4](#)). The initiation action for the Inventory specifies the requested Scope of Inventory and Inventory Level. Specific warnings and errors are defined for an SCP that cannot process the requested Scope of Inventory and Inventory Level (see [Section KK.2.2.3 in PS3.4](#)).

2510 The Inventory Creation SOP Class is in many ways similar to the Repository Query SOP Class (see [Section YYYY.2](#)). In both cases, the SCU requests a list of Studies, managed by the SCP, that match Key Attribute values. However, the Repository Query operates synchronously (i.e., the query and response occur on the same Association). The SCP is expected to respond within a typical transactional timeout period, and the SCU must interactively process responses and sequentially initiate queries to continue after partial completion responses (or errors).

2515 In contrast, the Inventory Creation SOP Class operates asynchronously, as production of an enterprise-scale inventory of billions of objects may take considerable time (potentially many days). As an asynchronous process, multiple approaches are available to the SCP to manage the resource demands for Inventory production across a longer time scale and with non-critical priority. The results are stored in information objects that can be accessed asynchronously at the convenience of the SCU.

2520 The mechanisms of the Inventory Creation SOP Class are similar to those of the Storage Commitment SOP Class (see [Section CC](#)). The SCU sends a request for the service to the SCP in an N-ACTION message, and the SCP asynchronously reports back status or completion using an N-EVENT-REPORT message.

2525 The Inventory Creation SOP Class provides for regular reports on the status of inventory creation, at an interval specified by the SCU (see [Section KK.2.2.2 in PS3.4](#)). This allows the SCU to ensure that the operation has not stalled. For example, such reporting might be desired for each 5% of process progress, and for an inventory that is expected to complete in one day, status reporting could be requested for 30-minute intervals. The SOP Class also allows the SCU to request a status report update at any time.

2530 The Inventory Creation SOP Class allows production of an inventory to be paused and resumed. A pause may occur when resources necessary for Inventory production (database processing cycles, disk storage space, etc.) become temporarily unavailable, or when resource usage has reached a pre-set limit. For example, a system that allows a research application to create an Inventory might limit the initial result to some maximum number of Studies, and then pause for confirmation before proceeding. It is expected that some human intervention may be required before resuming inventory production.

2535 Note that the Inventory Creation SOP Class does not use the Inventory IOD ([Section A.88 “Inventory IOD” in PS3.3](#)), but rather the Inventory Creation IOD ([Section B.30 “Inventory Creation IOD” in PS3.3](#)), which consists of the controls and statuses for production of an Inventory. However, both the Inventory IOD and the Inventory Creation IOD use many of the same Attributes, including the Scope of Inventory Sequence (0008,0400).

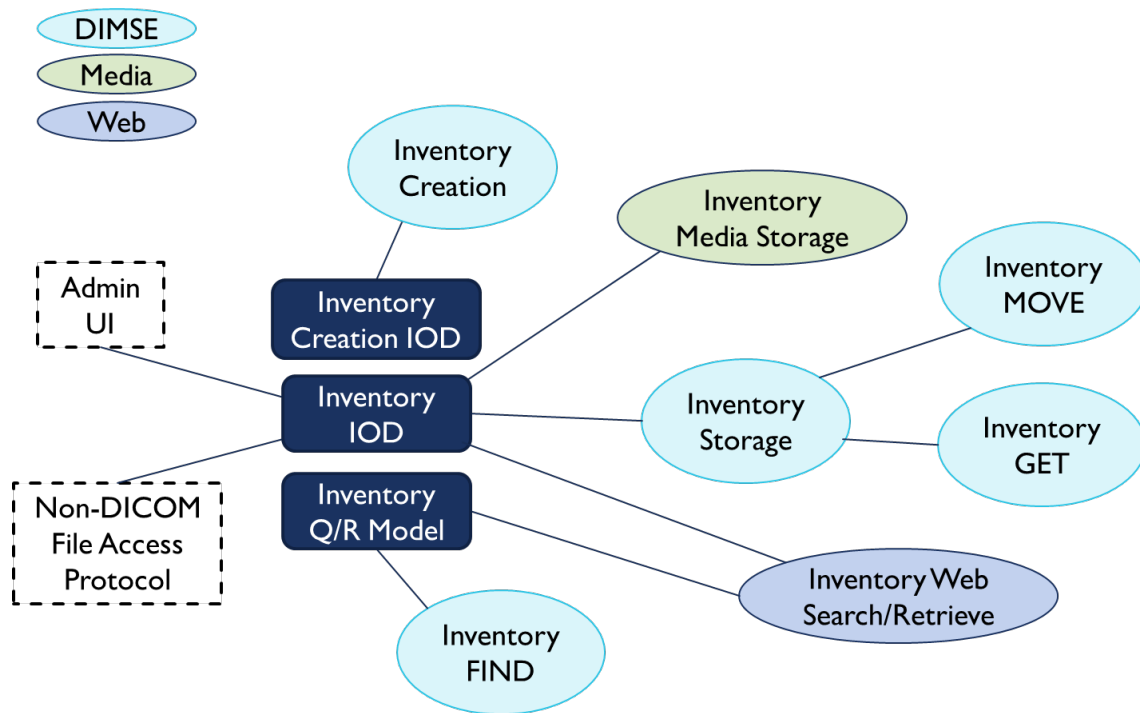
### YYYY.4.3 Separability of Services

Each defined SOP Class is a separate DICOM Conformance claim for an implementation. Generally, an implementation may implement any of the Inventory-related services without implementing others.

2540 Thus, a producer of Inventory SOP Instances may choose any method for exchange of Inventory instances. It could support DIMSE Inventory STORE (with or without Inventory MOVE or Inventory GET), DICOM Web Service Retrieve, or DICOM Media exchange, and may additionally support a non-DICOM file access protocol. However, as all DICOM Conformance is to SOP Classes, an implementation cannot claim DICOM Conformance just to the Inventory IOD; it needs to claim conformance to at least one SOP Class that exchanges the Inventory SOP Instances. Note, however, that a producer that supports the Inventory Creation SOP Class must also support one or more of Inventory MOVE, Inventory GET, or DICOM Web Service Retrieve (see [Section KK.2.3.1.1 “Inventory Terminated with Instances” in PS3.4](#)).

2550 Identification and location of Inventory instances may be supported by the Inventory FIND SOP Class or the equivalent DICOM Web Service Search Transaction, or may be done by non-DICOM means (e.g., email notification of Inventory UIDs or filenames to a client). Similarly, an application may produce Inventories under control of its local administrative user interface, and is not required to implement the Inventory Creation SOP Class for remote clients. However, if the producer does implement the Inventory Creation SOP Class, it must also implement a DICOM method for accessing the produced Inventory instances.

Figure YYYY.4-1 illustrates the relationships of the Inventory SOP Instance-related services to the Information Object Definitions.



2555

**Figure YYYY.4-1 Inventory SOP Instance-related Information Object Definitions and Services**

## YYYY.5 USE CASES

### YYYY.5.1 Migration and Consolidation

2560 A use case of increasing significance is wholesale transfer of large DICOM repositories from one image management system to another, denoted migration. As a regular part of managing IT obsolescence, users may replace their image management system after about 12-15 years, often with change of vendor and underlying hardware. Replacement requires migrating historical data to the new system. Similar transfer needs arise when healthcare institutions merge previously disparate systems into an enterprise image management system; the repositories from the old systems need to be migrated.

2565 The process of migration involves multiple phases or steps, of which an early task is obtaining an inventory of the source repository. This step is directly addressed by the Repository Query and the Inventory IOD and its related Services. Additional steps may include data reconciliation between the source repository and the databases of the radiology information system (RIS), electronic medical record system (EMR), hospital information system (HIS), and/or master patient index (MPI).

2570 A subsequent step in migration is extracting the DICOM data from the source system and transferring it to the destination system. There are two significant challenges with this data movement. First is the volume of data to be migrated, which as noted above may be a petabyte or more. Second, migration often occurs when either the source system or the destination, or both, are in clinical operation. Systems designed and configured to handle the throughput of regular operations might not have capacity in their DICOM protocol implementation for the  
 2575 additional massive input/output requirements of migration.

The Inventory, whether obtained through the Repository Query responses or through Inventory SOP Instances, indirectly supports this data movement. Many repositories store their DICOM data in the DICOM File Format (as defined in [Section 7 in PS3.10](#)), and can provide a non-DICOM direct file access protocol. By bypassing the DICOM protocol processing to access these files, significantly higher transfer rates can often be achieved, and  
 2580 there may be less impact on the resources required to support ongoing clinical operations. The Inventory

includes optional access Attributes identifying available non-DICOM file access protocols for each SOP Instance in the repository.

Non-DICOM file movement may be further streamlined if the SOP Instances of a Study or Series are combined into a single container file (ZIP or TAR). The access Attributes may identify such container files.

2585 At the destination repository, the process of building the local database for the incoming data may be facilitated by processing the Inventory, rather than parsing the migrating data one SOP Instance at a time. Image management systems commonly also require order (or imaging service request) information to be received prior to imaging data for the most efficient integration of new data into the database; the Inventory may be processed to provide that data up front before the bulk data transfer is started.

2590 A final step of verification of the migration, ensuring that all data has been transferred, may also use the Inventory. In particular, as an initial check, the count of the number of Series and Instances in a Study could be compared between the Inventories of the source and destination systems.

### YYYY.5.2 Safety backup

2595 Functions critical to the healthcare mission of an organization, such as access to archived images, should be designed to minimize single points of failure, such that there are multiple paths to accomplish the function under failure or emergency situations. Such reliable access to the images is a key element of patient safety, ensuring timely access to information needed for clinical decisions and treatments.

2600 While the database management systems used by image management systems typically have fault tolerant designs, such as redundant online storage and offline backups, the data is in a proprietary format and dependent on the DBMS software for effective use. The DBMS itself therefore becomes a single point of failure, and can become inoperable, for instance, if a license key expires, or if it is subject to a malware attack.

#### Note

2605 Malware, and in particular ransomware attacks, may initially seek to disable known DBMS backup mechanisms before attacking the main target, thus preventing alternate recovery mechanisms. DICOM Inventory objects may be sequestered in an off-line system not accessible to attack.

2610 The Inventory SOP Instances can be used as a DBMS-independent replica of the critical data content of the database for the DICOM SOP Instances it manages. Further, if the repository instances are in DICOM File Format and referenced in the Inventory, there is the possibility of a complete alternate path to access the images in the event of an image management system failure (although certainly not as efficiently as if the system were operational).

There are many ways such a regular safety backup Inventory could be organized, using combinations of complete checkpoint Inventories, incremental date range update Inventories, partition-based Inventories, patient-based Inventories, and more. The appropriate approach will vary by the particular needs and workflow of each organization.

### 2615 YYYY.5.3 Research

While imaging data may be important for research activities, it is rarely used solely by itself. It is generally used in conjunction with other aspects of the patient medical record – diagnoses, treatments, outcomes. Thus, support for imaging related research needs to support integrated activities with other healthcare informatics systems and data.

2620 Research functions must also not impact ongoing healthcare operations. Data for research is therefore typically extracted from clinical operational systems and transferred to a separate server, often with patient de-identification. These systems are sometimes denoted a “data warehouse”, an extract of operational data that can be sorted, filtered, and analyzed in any number of ways to support research questions.

2625 The Inventory might thus support research use cases in several ways. In the broadest sense, since it is a  
representation of the imaging repository database, it can be used for imaging research in conjunction with the  
image instances and the medical record data. As a DICOM object, it can be transferred to other systems for  
further processing. Since the data is in a standard format, it can be processed using readily available tools  
without having to know the proprietary table layouts of the image management system database. And as the  
Inventory has links to the stored SOP Instances, further drill down to the image instances and more detailed  
2630 metadata is facilitated.

A complete Inventory might be used for research purposes, especially if it has already been extracted for other  
purposes (such as safety backup). Such an Inventory may have its data transformed, de-identified, and loaded  
to a data warehouse. But a more focused Inventory might be produced for specific research processes. In  
particular, if searches of an EMR or data warehouse produces a census of candidate Studies, an Inventory of  
2635 for just those Studies may be created using List of UID matching on Study UID in the Scope of Inventory, and  
the Inventory content could be further constrained by other Attributes. It should be noted, however, that the  
filtering of Studies by the defined Scope of Inventory is not sufficient for most research purposes, but it may be  
sufficient as a first level selection that simplifies additional filtering by other processes.

In most research uses, data sets must be de-identified. However, as the Inventory must typically be linked (via  
2640 Patient ID) to other patient medical records, care must be taken in processing of Inventories for research to  
ensure de-identification. The approaches will vary depending on the specific research questions and data used,  
and the overall medical record architecture and systems of the organization. See [Section YYYY.6.8 “De-  
identification”](#).

2645 The Inventory IOD is defined with the data elements necessary to support the primary use case of migration.  
However, the image management system may manage additional Attributes at the Study, Series, or Instance  
levels that might be beneficial for research, and that could be included in the Inventory as Standard Extended  
Conformance.

#### **YYYY.5.4 Quality Assurance**

2650 Certain Study Attributes provide linkage to other aspects of the patient medical record. In particular, Patient ID  
links the study to the medical record, Study Date allows correlation to other patient medical events, and  
Accession Number links the Study to the relevant imaging order and study workflow. However, DICOM specifies  
these three critical Attributes as Type 2 in composite SOP Instances, and they might therefore be empty in  
Studies in the repository.

2655 As a general quality assurance principle, but especially during migration, it is important that these Attributes  
have correct values. The Repository Query SOP Class and the Inventory IOD’s Scope of Inventory allow Study  
selection using the extended (optional) capability “Empty Value Matching”. If such matching is implemented in  
the repository system, it allows creation of an Inventory of Studies with empty Attributes. As a quality assurance  
process, such inventories may be produced on a regular basis, identified studies corrected as needed, and root  
causes for missing values identified and corrected as a process improvement task.

#### **YYYY.5.5 Wellness Check / Continuous Testing**

2660 With all healthcare critical IT systems, and especially with enterprise scale systems, periodic checks for  
abnormal functioning are warranted. This includes not only monitoring and evaluation of error logs, but also  
active probing for fault conditions. In the context of an enterprise image data repository, this could include  
comparison of real-time repository system query responses with expected results, e.g., as recorded in a prior  
2665 Inventory. It might similarly include retrieving a sample set of Studies using DICOM protocols and comparing the  
results with the same Studies retrieved using a non-DICOM protocol recorded in the Inventory. This use case  
aligns with current trends in continuous testing of cloud- and premises-deployed applications.

## YYYY.6 SECURITY CONSIDERATIONS

### YYYY.6.1 Access Control and Secure Transport

2670 DICOM is not prescriptive with respect to user identification, authorization, access control, or secure transport. However, DICOM does provide enabling capabilities for security features (see [Section D.3.3.7 in PS3.7](#)), and specifies available profiles for some aspects of secure access and transport (see [Annex B “Secure Transport Connection Profiles” in PS3.15](#)). As DICOM deals with exchange of legally protected health information, every  
2675 real-world deployment must address these security features through institutional policies, procedures, and technical mechanisms. The specifics will vary with the organization and the capabilities of the technical infrastructure, including DICOM applications.

Inventories may potentially include data on all patients within a healthcare organization. Unauthorized access to inventory objects may thus potentially be a data breach affecting all patients. The breadth of the inventory makes it of particular concern for access control and transport security, and may require special attention in the  
2680 institutional security policies, procedures, and technical mechanisms.

The Standard describes the use of DICOM and non-DICOM protocols to access stored SOP Instances, both Inventory objects and DICOM data in the repository (see [Annex P “Stored File Access Through Non-DICOM Protocols” in PS3.3](#)). All such protocols support technical means for access control and transport security, which must be used in accordance with institutional security policies and procedures. Although the Inventory identifies  
2685 the available access mechanisms, there are no data elements for storing access credentials, as placing them in the Inventory would present significant security vulnerabilities. Processes for a reading application to obtain access credentials must be handled by non-DICOM mechanisms.

Access control mechanisms must also address audit logs for recording access to protected health information. Both the technical means of recording user identity and the organizational policies and procedures to effectively  
2690 use those technical means need to be considered.

#### YYYY.6.1.1 Access Control in Production of Inventory

A repository might limit disclosure or retrieval of SOP instances, studies, or patients following a variety of authorization policies and data protection rules, often based on the user’s identity and/or Attributes of the instance data. Such limits might be implemented at different layers of the repository software architecture (file  
2695 system, database management system, application, etc.).

The identity of the initiator of Inventory production might be known to the production application, e.g., if initiated from a local user interface, or if conveyed in the secure transport layer of the Inventory Creation service. That user identity might affect the content of an Inventory by triggering various data protection rules.

The Inventory IOD has no means of identifying whether such protection rules have been invoked, and thus  
2700 whether the inventory may be incomplete with respect to the restricted data. In some cases, the fact that protection rules have been invoked, or even the existence of such rules, is not disclosed to using applications.

The implementers and users of an Inventory production application should be cognizant of the potential effect of user identity and permissions on the content of the produced Inventory SOP Instances. Implementers may disclose in the product DICOM Conformance Statement section on Application Level Security any access  
2705 control features that might impact Inventory production. Users should verify that access controls are not inappropriately impacting Inventory production.

### YYYY.6.2 File Format

The DICOM File Format has security considerations that will apply whenever that format is used, e.g., for the Inventory SOP Instances or the referenced DICOM SOP Instances in the repository. See [Section 7.5. “Security Considerations for DICOM File Format” in PS3.10](#).  
2710



The ZIP and TAR container file formats, which are defined formats for DICOM data in the repository, are known to have vulnerabilities and to be the target of malware attacks. Implementations that create or read container files should utilize appropriate defenses and safeguards such as:

- 2715 - Virus scanners for container content
- Sandbox execution and processing
- Full format and content validation
- Overrun detection

2720 Applications that store container files for later use by other systems should consider the environments of those systems. This means the scanning and validation should detect attacks against at least Windows, MacOS, and Linux operating systems and applications.

Container files should not contain any directly or indirectly executable content (see [Section P.1.2 in PS3.3](#)). Container content validation should include a test for any form of executable content and consider the detection of executable content to be a risk of malicious content. The presence of malicious content may indicate a security breach of the source system or other upstream system.

### 2725 **YYYY.6.3 Network Protocols**

Aside from the access control and transport security concerns of DICOM and non-DICOM network protocols, each protocol may have additional vulnerabilities, and considerations and warnings related to the implementation and use of the protocol. The specific details of any such considerations are outside the scope of DICOM.

2730 An implementation that supports direct file access using non-DICOM protocols should incorporate mechanisms mitigating the particular risks from those protocols. This includes supply chain protection for software components, update and patching mechanisms, site-specific configuration differing from the default, and other administrative issues.

### **YYYY.6.4 Application Validation**

2735 Introduction of software applications into a healthcare organization IT network has the potential to open security vulnerabilities, and must be managed in accordance with institutional policy preventing unapproved applications being installed and obtaining access to patient data. Applications that deal with the Inventory and with its linked data (i.e., the entire DICOM repository) should be thoroughly validated with regard to appropriateness of data use, including ensuring patient data privacy, as well as conformance to the DICOM Standard.

2740 As the Inventory provides links to stored SOP Instances that may not have been updated to current metadata (e.g., Patient Name may have been corrected or changed after the Instance was stored), an application accessing those files through a non-DICOM protocol needs to obtain the current metadata values from the Inventory SOP Instance. Applications for which current metadata is required should be specifically validated to ensure current metadata is applied.

### 2745 **YYYY.6.5 Inventory Resource Use**

Inventory production may consume significant system resources, so policies and system implementations must assure that such activities do not adversely affect the clinical operations of the organization (denial of service). This may involve special authorization for initiating broad inventories, and appropriate setting of software task priorities for the Inventory application.

### 2750 **YYYY.6.6 Encryption of Data at Rest**

An organization may have policies requiring encryption of data at rest (i.e., as stored in the files of the storage system). Encryption both limits access to applications that have (securely) obtained the decryption keys, and also ensures file integrity. DICOM specifies methods for secure (encrypted) files (see [Annex D "Media Storage](#)

2755 [Security Profiles” in PS3.15](#) and [Section 7.4 "Secure DICOM File Format" in PS3.10](#)), and other file-based encryption mechanisms might be employed by a repository system. However, issues such as key management and distribution are implementation- and site-specific.

2760 Of particular interest to Inventories, the URI link to a stored SOP Instance may point to a Secure DICOM File or a file encrypted by another mechanism. There are no specifications regarding key management to access that file, but storing the key in the Inventory would present significant vulnerabilities, and would be an inappropriate mechanism unless the Inventory itself were encrypted. Processes for a reading application to access such secured files must be handled by non-DICOM mechanisms.

### YYYY.6.7 Message Digest

2765 The integrity of a stored SOP Instance file (unencrypted) may be verified by a Message Authentication Code (MAC, also known as a message digest, hash, or cryptographic checksum) computed across the file. This value may be recomputed whenever a file is accessed, and that value compared to a previously computed MAC to assure that no changes have occurred to the file.

Inventories support recording a MAC computed by the storage system (the writing application) for files in the repository that will be accessible through a non-DICOM protocol. The file reading application can independently perform the MAC computation to assure integrity of the file as read or transferred.

### 2770 YYYY.6.8 De-identification

2775 While some research use cases may involve de-identification of protected health information (PHI), where that de-identification occurs in the data processing pipeline may vary with the specific research objective and the capabilities of the systems involved. DICOM specifies a profile with many options for de-identification of SOP Instances, the Basic Application Level Confidentiality Profile (see [Annex E in PS3.15](#)). That specification is designed for patient-related SOP Instances with patient Attributes in the top-level data set, and there would be substantial technical challenges to applying that profile to an Inventory SOP Instance.

2780 However, an Inventory may be produced for a repository of de-identified Studies. That is, the SOP Instances in the repository are first de-identified in accordance with a confidentiality profile and options appropriate to the specific research use case, and then an Inventory is produced for the repository, or for a subset thereof in accordance with the Scope of Inventory. There are no specific de-identification requirements on the Inventory itself.

## YYYY.7 OPERATIONAL CONSIDERATIONS

This section describes topics relevant to implementation and use of Inventories.

### 2785 YYYY.7.1 Transforming Repository Query Responses into Inventory SOP Instances

For implementation reasons, there will be situations where the repository implements the Repository Query SOP Class, but the using application wants to work asynchronously from an Inventory SOP Instance. Because the Repository Query SOP Class and the Inventory IOD are aligned technically, it is feasible for an intermediary application to transform Repository Query responses into Inventory SOP Instances.

2790 The basic operation is for the using application to first inform the intermediary application about its desired Scope of Inventory, which can be done through the Inventory Creation SOP Class or some non-DICOM method (such as manual configuration). The intermediary application performs Repository Queries at the Study level using the desired Key Attributes, including universal matching for all Attributes that will be included in the Inventory (minimally, the Type 1 and Type 2 Attributes specified in the Inventory IOD). For each response, the application performs a query for the Series, and for each Series a query for instances, down to the level for  
2795 which the Inventory is being produced. The responses from the three hierarchical levels are encoded in the Sequence Items of an Inventory SOP Instance. A separate Inventory SOP Instance might be created for each



Study level Repository Query transaction, with the Instances chained as described in [Section YYYY.3.3.2.1 Serial Production](#).

- 2800 The intermediary application must account for Attributes not supported for matching by the SCP (see [Section YYYY.7.11](#)). Such Attributes need to be excluded from the Scope of Inventory in the produced Inventory SOP Instances as they were not used for selection of Studies.

2805 The process for transforming a Relational query to an Inventory SOP Instance is more complex, and requires knowledge of the hierarchical level of each Attribute. The initial query is not at the Study level, but rather a relational query at the Series or Instance level. Depending on the Key Attributes requested to be returned for the level(s) higher than the Query level, the application may need to perform follow-on queries at those higher levels. In particular, the Attributes defined at multiple levels (such as Removed from Operation Use (0008,0405) and File Set Access Sequence (0008,0419) ) need to be requested at each specific level.

2810 While such transforms are relatively straightforward, there are some differences between Repository Query and the Inventory IOD that need to be addressed. First, the specification of Key Attributes differs, as the Query uses constructs unavailable to SOP Instances, and the IOD uses Sequence Attributes for different types of matching. Second, the Query uses the Metadata Sequence (0008,041D) and the Updated Metadata Sequence (0008,041E) to be able to obtain metadata Attributes without needing to enumerate them, while in the Inventory IOD all Attributes are encoded in the top-level Data Set for the appropriate entity Sequence Item. Of course, the  
2815 intermediary application needs to handle error conditions that may occur, which should be expected in a process that may extend over several days, with applications that may also be involved in other tasks that may interrupt the inventory production.

## YYYY.7.2 Using Non-DICOM Protocols

2820 The direct file access URI links of the Repository Query SOP Class and the Inventory IOD do not limit the protocol used, which is specified by the scheme of the URI (e.g., “https:”, “nfs:”, “smb:”, etc.). Applications that intend to use direct file access may need to be adapted to use the protocol specified by the repository. Not all capabilities of the access mechanism may be evident from the URI scheme, e.g., HTTP is used with several different cloud-based storage protocols that differ in the ways they use HTTP headers. The specifics of the protocol are conveyed in the Conformance Statement, rather than in DICOM Attributes.

2825 The target resource of a non-DICOM protocol must be a SOP Instance stored in the DICOM File Format as specified in [Section 7 in PS3.10](#) (commonly denoted a Part 10 file). At the SOP Instance level, the link may be a complete URI conveyed in the File Access URI (0008,0409). However, many (or all) of the links for SOP Instance files of a Study or Series, or even the entire Inventory, are likely to have the same URI base. The Inventory can factor out that commonality by specifying a Stored Instance Base URI (0008,0407) at the  
2830 Inventory, Study, and/or Series level, and using relative path reference URIs (starting with ./) for the individual Instances. As specified in Section P.2.1 in PS3.3, the division between a base URI and a relative path reference URI may occur at any path segment boundary, as seen in the examples in Table YYYY.7-1.

**Table YYYY.7-1 Example Uses of Base and Relative Path URI**

Base URI	Relative Path Reference URI	Notes
https://pacs.example.org/	.JZ08555 [Folder Access URI]  .JZ08555/2.25.9104767294.dcm [File Access URI]	Protocol and host only in base URI.  Possible use for base URI default set at Inventory level, relative path specified for folder and for each SOP Instance file. Relative path for each file is merged only with base URI, and not merged with a folder URI.
nfs://pacs.example.org/JZ08555/	./2.25.9104767294.dcm	Protocol, host, and partial path in base URI.  Possible use for base URI specified for each Study, relative path for each SOP Instance file
https://pacs.example.org/	https://pacscache.example.org/JZ08555/2.25.9104767294.dcm	Relative path is a complete URI (base URI is ignored).  Possible use for default base URI overridden for specific SOP instance files.
smb://pacs.example.org/JZ08555/2.25.4037510835.zip/	./	Complete file path in base URI. Trailing / is required by RFC3986 when merging with a relative path beginning with ./  Possible use for base URI specified for each Study, with entire Study in single container file; file will be extracted from container based on filename or offset

- 2835 The Part 10 file can also be contained within a ZIP, TAR, or TARGZIP multi-file container structure. In that case, the File Access URI (0008,0409) links to the container file, and the specific Part 10 file is identified by Filename in Container (0008,040B). For Part 10 files stored in a multi-file BLOB container, as there is no filename, the file is identified by File Offset in Container (0008,040C) and File Length in Container (0008,040D); File Offset and File Length may also be provided for other container formats to provide more rapid access. For a Part 10 file stored in a single file GZIP container, neither Filename in Container (0008,040B) nor File Offset in Container (0008,040C) is required.
- 2840

If all the files for a Study or a Series are in a single container file, the Inventory Study or Series record can specify a URI link to that file. Similarly, if all the files for a Study or a Series are in a single folder (which is an operating system “container” mechanism), the Inventory can specify a URI link to that folder.

- 2845 These permutations are shown in Table YYYY.7-2, and an example is shown in Table YYYY.7-2b.

**Table YYYY.7-2 Use of URI-related Attributes**

Use	URI Attributes Used	Notes
SOP Instance in a Part 10 file, or a Part 10 file in GZIP; File URI is complete	File Access Sequence (0008,041A) >File Access URI (0008,0409)	
SOP Instance in a Part 10 file, or a Part 10 file in GZIP; File URI is relative reference	File Set Access Sequence (0008,0419) >Stored Instance Base URI (0008,0407)  File Access Sequence (0008,041A) >File Access URI (0008,0409)	Base URI specified in Series level File Set Access or, if not there, in Study level File Set Access

SOP Instance Part 10 file in a ZIP, TAR, or TARGZIP container file; File URI is complete	File Access Sequence (0008,041A) >File Access URI (0008,0409) >Filename in Container (0008,040B)	
SOP Instance Part 10 file in a BLOB container file; File URI is complete	File Access Sequence (0008,041A) >File Access URI (0008,0409) >File Offset in Container (0008,040C) >File Length in Container (0008,040D)	
SOP Instance Part 10 file in a ZIP, TAR, or TARGZIP container file; File URI is relative reference	File Set Access Sequence (0008,0419) >Stored Instance Base URI (0008,0407)  File Access Sequence (0008,041A) >File Access URI (0008,0409) >Filename in Container (0008,040B)	Base URI specified in Series level File Set Access or, if not there, in Study level File Set Access
SOP Instance Part 10 file in a BLOB container file; File URI is relative reference	File Set Access Sequence (0008,0419) >Stored Instance Base URI (0008,0407)  File Access Sequence (0008,041A) >File Access URI (0008,0409) >File Offset in Container (0008,040C) >File Length in Container (0008,040D)	Base URI specified in Series level File Set Access or, if not there, in Study level File Set Access
All files in Study or Series in a container file; File URI is complete	File Set Access Sequence (0008,0419) >File Access URI (0008,0409)	
All files in Study or Series in a container file; File URI is relative reference	File Set Access Sequence (0008,0419) >Stored Instance Base URI (0008,0407) >File Access URI (0008,0409)	For Series, if Base URI is not specified at Series level, it must be specified at Study level
All files in Study or Series in a folder; Folder Access URI is complete	File Set Access Sequence (0008,0419) >Folder Access URI (0008,0408)	
All files in Study or Series in a folder; Folder Access URI is relative reference	File Set Access Sequence (0008,0419) >Stored Instance Base URI (0008,0407) >Folder Access URI (0008,0408)	For Series, if Base URI is not specified at Series level, it must be specified at Study level

**Table YYYY.7-2b Example Use of URI-related Attributes**

Attribute		Tag	VR	Value	Notes
<i>...Inventory Attributes</i>					
Inventoried Studies Sequence		(0008,0423)	SQ		
Item Study	>... <i>Study Attributes</i>				
	>File Set Access Sequence		(0008,0419)	SQ	Note 1
Item	>>Stored Instance Base URI		(0008,0407)	UR	nfs://vna.exampleinstitution.org/JZ08555/
>Inventoried Series Sequence		(0008,0424)	SQ		
Item Series 1	>>... <i>Series Attributes</i>				
	>>File Set Access Sequence		(0008,0419)	SQ	Note 2
Item	>>>File Access URI		(0008,0409)	UR	/2.25.9104767294.zip
	>>>Container File Type		(0008,040A)	CS	ZIP
>>Inventoried Instances Sequence		(0008,0425)	SQ		
Item Inst 1.1	>>>... <i>Instance Attributes</i>				
	>>>File Access Sequence		(0008,041A)	SQ	Note 3
Item	>>>>File Access URI		(0008,0409)	UR	/2.25.9104767294.zip
	>>>>Container File Type		(0008,040A)	CS	ZIP
	>>>>Filename in Container		(0008,040B)	UR	2.25.192771000545.dcm
	>>>>Stored Instance Transfer Syntax UID		(0008,040E)	UI	1.2.840.10008.1.2.4.70
Item Inst 1.2	>>>... <i>Instance Attributes</i>				
	>>>File Access Sequence		(0008,041A)	SQ	Note 3
Item	>>>>File Access URI		(0008,0409)	UR	/2.25.9104767294.zip
	>>>>Container File Type		(0008,040A)	CS	ZIP
	>>>>Filename in Container		(0008,040B)	UR	2.25.192734871076985.dcm
	>>>>Stored Instance Transfer Syntax UID		(0008,040E)	UI	1.2.840.10008.1.2.4.70
Item Series 2	>>... <i>Series Attributes</i>				
	>>Inventoried Instances Sequence		(0008,0425)	SQ	
Item Inst 2.1	>>>... <i>Instance Attributes</i>				
	>>>File Access Sequence		(0008,041A)	SQ	Note 4
Item 1	>>>>File Access URI		(0008,0409)	UR	nfs://vna.exampleinstitution.org/JZ08555/2.25.460890520.dcm
	>>>>Stored Instance Transfer Syntax UID		(0008,040E)	UI	1.2.840.10008.1.2.4.70
Item 2	>>>>File Access URI		(0008,0409)	UR	smb://pacs.exampleinstitution.org/cachesrv/2.25.460890520.dcm
	>>>>Stored Instance Transfer Syntax UID		(0008,040E)	UI	1.2.840.10008.1.2.1

2850 Notes to Table YYYY.7-2b

1. Most of the Study content is in a ZIP file, but not all, so File Access URI cannot be used at Study level. However, the Study level sets the Base URI.
2. All of the content of Series 1 is in the ZIP file, so the Series level Item can include the File Access URI. Since the Base URI is not present at the Series level, it defaults to the Study level Base URI.
- 2855 3. Since the Base URI is not present at the Series level, the Instances of Series 1 also default to the Study level Base URI. Their filenames within the ZIP are identified.
4. The SOP Instance of Series 2 is not in the ZIP, so its File Access URI is a complete URI reference to the Part 10 file. There are two copies known to the inventory, and they are each referenced.

2860 Although the Inventory identifies the available access mechanisms for repository stored instances, the security features associated with those access mechanisms and with container file structures are outside the scope of DICOM, and will need to be implemented in applications that use the Inventory (see [Section YYYY.6](#)).

### YYYY.7.3 Using Referenced Inventories

2865 [Section YYYY.3.3](#) describes the tree of Inventory SOP Instances whose contents are included by reference in the complete Inventory described by the root SOP Instance. A user of the Inventory may retrieve referenced Inventories in the tree through the Inventory Query/Retrieve Service (see [Section YYYY.3.3](#)), or the DICOM web-based Non-Patient Instance Service, if either of those is implemented in the system. The Inventory IOD may also include alternative access information for a non-DICOM file access protocol with each link to a referenced Inventory SOP Instance.

2870 The specification of the Incorporated Inventory Instance Sequence (0008,0422), which provides the links to subsidiary SOP Instances, recursively includes itself (see [Section C.38.2.3 "Inventory Reference Macro" in PS3.3](#)). This is used to encode a tree structure containing the entire set of links for the tree of which it is the root.

2875 Therefore, when an application creates an Inventory and includes another Inventory by reference, it adds the access information to the referenced SOP Instance into the Incorporated Inventory Instance Sequence (0008,0422) together with a copy of the referenced object's Incorporated Inventory Instance Sequence (0008,0422) (see Figure YYYY.7-2). Note that including the entire tree of object references ensures that the tree is acyclic.

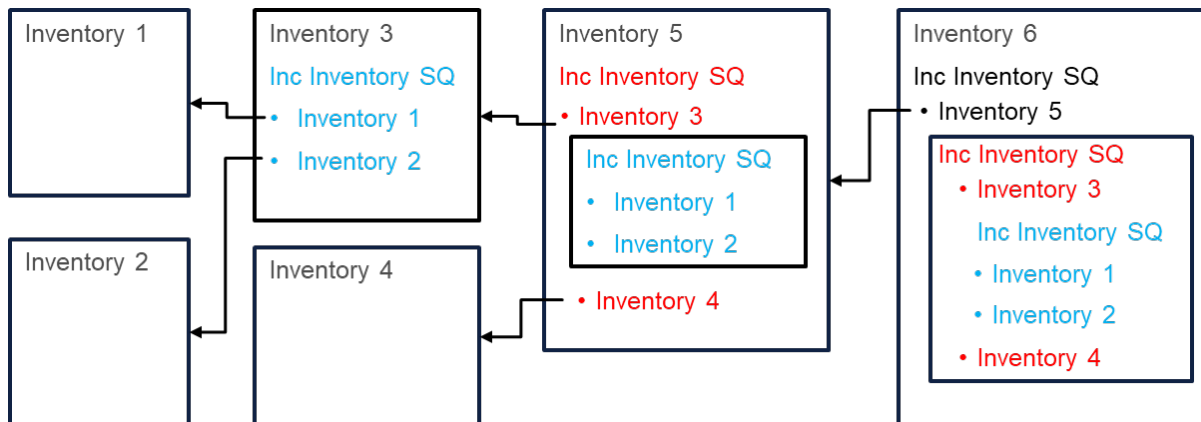


Figure YYYY.7-2 Inclusion of Inventory references

2880 As described in [Section C.38.2.3.1 in PS3.3](#), each node in the tree may set the default network access protocol end point(s) for its sub-tree. Thus when including another Inventory by reference, an application needs to

provide values for the access end points for the objects it references, and may rely on the included subtrees to provide their own access end point information. However, if the access end points are the same the application could consolidate them into the root node it creates

2885 The Inventory IOD also requires the SOP Instance to provide a count of the Total Number of Study Records (0008,0428), which includes Inventories included by reference. Since each Inventory SOP Instance computes the value for its tree in Total Number of Study Records (0008,0428), this simply means that when an instance includes others by reference the value is the sum of the Total Number of Study Records (0008,0428) for each of its immediately referenced instances plus its own value for the Number of Study Records in Instance (0008,0427).

#### YYYY.7.4 Incremental Inventories

Like all DICOM composite objects, Inventory SOP Instances are static, so an Inventory of a repository in dynamic operation can never be complete. The challenge is to obtain a close enough approximation of completeness for the purposes of continuing work for the intended task, and then to obtain the incremental update since the prior inventory if needed.

2895 The IOD design allows a full Inventory to be created with an incremental update Inventory object including a baseline Inventory by reference (see [Section YYYY.3.3.2.2](#)), thus minimizing the processing resource cost of a full Inventory. However, there is no assumption that a creating application will utilize such an approach. If it does not, the user application needs to request just an incremental update Inventory to avoid the cost of creating a full Inventory.

2900 The Attribute Study Update DateTime (0008,041F) is intended to support obtaining an Inventory of Studies that have changed since the time of the prior Inventory. However, many repository implementations do not manage this Attribute for some (or any) of the stored Studies. Although the desired functionality would be achieved by requesting a Scope of Inventory with time range for Study Update DateTime (0008,041F) beginning at the Content Date / Time of the prior inventory, the SCP might use Study Date (0008,0020) / Study Time (0008,0030) for the matched Attribute as a fall-back when there is no available Study Update DateTime (0008,041F). There are a number of reasons this is a poor approximation. First, there is an inherent delay between the Study Date (0008,0020) / Study Time (0008,0030) (typically captured on the modality as the start of data acquisition) and the time at which that Study arrives at the repository; this delay may vary depending on the workflow of the department (e.g., cardiology studies might be sent to the enterprise repository only after reading in department, with a 1-2 day delay). Second, Studies may be updated with additional analytic or annotation Series (segmentations, presentation states, reports) well after the Study Date (0008,0020) / Study Time (0008,0030). Third, Studies received from external organizations may have Study Date / Time significantly in the past, especially for imported prior exams. Fourth, patient metadata may be updated much later than the Study Date / Time based on events totally outside the imaging department. Fifth, there may be Studies added to the repository that do not have a Study Date (0008,0020) / Study Time (0008,0030) (which are Type 2 Attributes of the General Study Module).

2910 The user of the Inventory may need to mitigate this discrepancy by a variety of means in order to obtain an Inventory of the incremental changes to the repository. For instance, this may require adjusting the requested time range to account for typical workflow delays and reconciling differences from the prior Inventory. Some of these methods may require data and processes outside the scope of DICOM, such as using external sources (e.g., audit logs) to identify imported Studies and requesting Inventory on those (using List of UID Matching in the Scope of Inventory), or using external sources (e.g., HL7 ADT message logs) to identify changed metadata and requesting Inventory on those affected Studies.

2925 Comparison of the Number of Study Related Series (0020,1206) and Number of Study Related Instances (0020,1208) between a prior and a current Inventory may help identify Studies that have changed content.

## YYYY.7.5 Inventory Lifecycle Management

2930 Production and storage of Inventory objects may use significant system resources, so effective system management requires appropriate policies and controls on those services and objects to minimize necessary resources. In addition to typical authorizations or permissions allowing specific users to create Inventories, such management policies may constrain when or how often Inventories may be created, what Scopes of Inventory are permitted to which users, and when Inventory objects should be deleted.

2935 For instance, an organization that uses Inventory SOP Instances for safety backup (see Section YYYY.5.2), may have policies to create a complete Inventory each month, to maintain the two most recent Inventories, and automatically delete prior ones. Such a policy would allow the assignment of a value for Expiration DateTime (0008,0416) for the Inventory SOP Instances.

An organization might set a shorter retention period for Inventory SOP Instances associated with a canceled Inventory creation request.

2940 A system that supports the Inventory Creation SOP Class (see Section YYYY.3.2) might reject requests that duplicate the scope of an Inventory recently created and that is available through the Inventory Query/Retrieve Service. A system that produces a regular full Inventory, e.g., monthly, might allow Inventory Creation requests only with a Study Update DateTime (0008,041F) range after the last full Inventory Content Date (0008,0023) / Content Time (0008,0033).

## YYYY.7.6 Interactive Access to Inventory Content

2945 Inventory SOP Instances may be very large, and may reside on a server separate from the application that needs to use them. The objects may be transferred to the using application using the DIMSE Non-Patient Object Storage Service (see [Annex GG in PS3.4](#)), but that service transfers whole SOP Instances, and the using application may not require or want to store a whole Inventory object.

2950 If the origin and destination support the DICOM web-based Non-Patient Instance Service and Resources ([see Section 12 in PS3.18](#)), and if the origin server supports HTTP Range request headers, the destination application can interactively retrieve specific byte ranges of the SOP Instance using the mechanism of [\[RFC7233\]](#).

2955 If the Inventory SOP Instances are made available through a non-DICOM protocol, that protocol may support interactive remote application reading of the file. Support for such protocols is typically integrated into the filesystem I/O capabilities of the using application's operating system.

## YYYY.7.7 Multiple Application Entity Titles

A repository may have multiple Application Entities, with distinct DICOM protocol addresses (AE Titles). One common use is a PACS that has multiple separate archive subsystems, each of which supports DICOM protocol services (for example, as shown in Figure YYYY.3-4).

2960 Another use for multiple AE Titles may be to provide separate views of the repository, and hence separate inventory content, for restricted subsets of the stored data. For example, the repository may include data that has patient consent for research use and data without such consent. This distinction does not have an associated Key Attribute for the Scope of Inventory. The system may therefore present one AE Title for operations on the entire repository, and a different AE Title for operations only on the research qualified data.  
2965 This approach could be used for any other subsets of the repository that the system manages, but for which there is no standard Key Attribute for the Scope of Inventory.

A similar use of multiple AE Titles may provide separate views of the repository to different sets of users. An example of this is described in the next section for views of the Patient ID.

2970 If the SCP for the Inventory Creation Service (see [Section YYYY.3.2](#)) provides separate data subsets for different AE Titles, the name for the subset may be encoded in the Station Name (0008,1010) or the Inventory Instance Description (0008,0402) Attribute.

### YYYY.7.8 Multiple Patient IDs

2975 The basic DICOM Patient Information Entity, as used in the Inventory IOD, supports a primary Patient ID (0010,0020) with an optional issuer or assigning authority, plus additional IDs and issuers in the Other Patient IDs Sequence (0010,1002). The DICOM Attributes describing the assigning authority have mappings to corresponding HL7v2 CX Data Type components (see [Section 10.15 in PS3.3](#)).

2980 As PACS migration or consolidation often involves Patient IDs from multiple assigning authorities, organizations should establish well-defined assigning authority identifiers. The implementer of the Inventory production application and the user organization should consider whether to include values for Issuer of Patient ID (0010,0021) in production of an Inventory, even if those are not managed in the repository database. Such values may especially facilitate consolidation of multiple repositories.

#### Notes

1. See the [\[IHE RAD TF-1\] Scheduled Workflow.b Integration Profile](#) and its Enterprise Identity Option.
2. Similar considerations may be applied to the Issuer of Accession Number Sequence (0008,0051).

2985 Some repository management systems, particularly those that support independent but related organizations, handle multiple Patient ID schemes. In such an environment, Query/Retrieve from applications in one organization may be returned with the Patient IDs for that organization, while the same queries from a different organization will have the Patient IDs for that second organization; the same approach may be used for production of inventories that have different views of the data for different users. To distinguish queries from the different organizations, the repository management system may use Application Entity Titles in two different ways. First, it may associate the SCU's Calling AE Title with an organization context; this requires the SCP to know all SCU AE Titles. A second approach has the SCP implement multiple Called AE Titles, each assigned to a different organization; each SCU is then configured to call the SCP AE Title appropriate to its organization.

2995 If the SCP for the Inventory Creation Service provides separate data views for different organizations, the name for the view may be encoded in the Station Name (0008,1010) or the Inventory Instance Description (0008,0402) Attribute.

### YYYY.7.9 Metadata Updates

3000 To maintain synchronization between the image repository and other electronic medical record systems, the PACS may support updates to patient, order, and procedure data that correspond to data managed by those other EMR systems. The PACS may also update Series and Instance level information as part of quality control processes. Examples of metadata updates include correction of patient name, change of patient ID, update of procedure descriptions or codes to a standard format, or correction of body part laterality. Such updates are managed by processes outside the scope of the DICOM Standard.

#### Note

3005 See, for example, the [\[IHE RAD TF-1\] Patient Information Reconciliation Integration Profile](#).

A common PACS implementation stores received SOP Instances to disk in the DICOM File Format, but any metadata updates are retained in its database and not propagated to the stored instances. Applications that use non-DICOM protocols to access the files of stored SOP Instances must therefore also have access to current metadata.

3010 The Inventory SOP Instance provides the current metadata for the stored instances, and the values in the Attributes of the Inventory are considered authoritative. Therefore, the producer of the Inventory should ensure



that it is created with current values, and the Item Inventory DateTime (0008,0404) records the time at which those values were extracted from the PACS database and were correct. Note, however, that the values in the Inventory may become outdated due to updates subsequent to Item Inventory DateTime (0008,0404).

3015 **YYYY.7.9.1 Original Attributes Sequence**

An optional additional capability is for the Inventory to record the provenance of metadata updates in the Original Attributes Sequence (0400,0561). While the current correct values are in the Attributes of the Inventoried Studies Sequence (0008,0423), the Original Attributes Sequence (0400,0561) records the prior (replaced) values, the DateTime of the change, and the identity of the modifying system.

3020 In Composite IODs, Attributes of the Study, Series, and Instance levels are all encoded in the top level Data Set. The Original Attributes Sequence is defined in the SOP Common Module, and it aggregates all changes at any level of the information model. However, in the Inventory IOD the Original Attributes Sequence (0400,0561) is defined separately at the Study, Series, and Instance levels, so that it can record updates at the higher levels without needing to replicate into the records for each referenced Instance.

3025 As an example, Table YYYY.7-2c shows what would be a portion of an Inventory SOP Instance for a study where the Patient's Name (0010,0010) was updated based on a master patient index, and one series was updated with a Body Part Examined (0018,0015) that had been missing in the data received from the modality.

**Table YYYY.7-2c. Example Updated Study Record with Original Attributes Sequences**

Attribute	Tag	VR	Value	Comment
...				
Inventoried Studies Sequence	(0008,0423)	SQ		
>Study Date	(0008,0020)	DA	20190506	
>...				
>Patient's Name	(0010,0010)	PN	Smith^Jane	current name
>...				
>Item Inventory DateTime	(0008,0404)	DT	20221103000450	
>Original Attributes Sequence	(0400,0561)	SQ		
>>Source of Previous Values	(0400,0564)	LO		unknown
>>Attribute Modification DateTime	(0400,0562)	DT	20190508110956	
>>Modifying System	(0400,0563)	LO	GinHealthSystem PACS	
>>Reason for the Attribute Modification	(0400,0565)	CS	COERCE	
>>Modified Attributes Sequence	(0400,0550)	SQ		
>>>Patient's Name	(0010,0010)	PN	Doe^Jane	prior name
...				
>Inventoried Series Sequence	(0008,0424)	SQ		
>>Series Date	(0008,0021)	DA	20190506	
...				
>>Body Part Examined	(0018,0015)	CS	LIVER	current value
...				
>>Original Attributes Sequence	(0400,0561)	SQ		

Attribute	Tag	VR	Value	Comment
>>>Source of Previous Values	(0400,0564)	LO		unknown
>>>Attribute Modification DateTime	(0400,0562)	DT	20190508152157	
>>>Modifying System	(0400,0563)	LO	GinHealthSystem PACS	
>>>Reason for the Attribute Modification	(0400,0565)	CS	ADD	
>>>Modified Attributes Sequence	(0400,0550)	SQ		
>>>Body Part Examined	(0018,0015)	CS		prior value missing
...				

3030 When updating the stored SOP Instance with the metadata values from the Inventory, the items of the Original Attributes Sequences at the Study, Series, and Instance levels from the Inventory are added to the items (if any) already in the Original Attributes Sequence of the stored SOP Instance. While there may be duplication, duplicate Items are not an issue for the audit purposes of the Original Attributes Sequence.

### YYYY.7.10 Study Record Reconciliation

3035 Within the tree of linked Inventory SOP Instances, a given Study may be referenced multiple times among the Inventoried Studies Sequence Items. The Items may have different content, but each Item is a complete record of the contents of the Study as known by the creator of that Item.

3040 Differences in content may occur due to changes to the metadata or content (SOP Instances) of the Study during the production of the Inventory, or due to different Series of a Study being stored on different media or storage subsystems, or for other reasons. The application using an Inventory may need to reconcile such multiple occurrences.

3045 DICOM is not prescriptive regarding methods of reconciliation, but the Inventory IOD does provide Attributes that can assist in the process, in particular the various timestamps associated with the Study content and the process of Inventory creation, as shown in Table YYYY.7-3. These timestamp Attributes might be used to establish a timeline of changes to Study content and metadata, and of record extraction for inclusion in the Inventory. For example, a Study record may differ from a record with an earlier Item Inventory DateTime (0008,0404) only with the presence of an additional Series whose Series Date (0008,0021) is after the prior Item Inventory DateTime (0008,0404). The later record might reasonably be considered to be a more current replacement. However, two Study records might have entirely different sets of Series, and in that case simply  
3050 choosing one record based on timestamp is probably not correct; the Study records would have to be further evaluated for the underlying reason for the difference, and the records potentially merged in some way.

**Table YYYY.7-3. Timestamp Attributes Assisting in Reconciliation**

Attribute	Tag
Content Date	(0008,0023)
Content Time	(0008,0033)
<i>Inventoried Studies Sequence</i>	<i>(0008,0423)</i>
>Item Inventory DateTime	(0008,0404)
>Study Update DateTime	(0008,041F)
> <i>Original Attributes Sequence</i>	<i>(0400,0561)</i>
>>Attribute Modification DateTime	(0400,0562)
> <i>Inventoried Series Sequence</i>	<i>(0008,0424)</i>
>>Series Date	(0008,0021)
>>Series Time	(0008,0031)
>> <i>Original Attributes Sequence</i>	<i>(0400,0561)</i>
>>>Attribute Modification DateTime	(0400,0562)

3055 In general, a major factor in reconciling diverse records is a full understanding of how the repository system manages the storage of Studies, and which timestamps and change auditing data it actually records. The reconciliation process will typically need to account for such system design features, which are not conveyed in Inventory SOP Instance Attributes or in DICOM Conformance Statements.

3060 Note that a task for Study record merge is reconciliation of access paths to stored SOP Instances of the Study. This may present challenges if the Study records link to different access methods, target folders, or container files. In the case of conflicting information, it may be necessary to disregard Study or Series level access specifications, and use only the access links to each SOP Instance of the Study as recorded in the Instance level record.

### YYYY.7.10.1 Example – Deleted Study

3065 An example will show the dependency on system design for Study record reconciliation. Consider two Inventories, a baseline made at time A and an increment made at a later time B, and during the intervening time a Study is deleted (perhaps because it was assigned to the wrong patient). The migration source storage system might have taken one of several approaches, with the associated result in the time B inventory (this is not an exhaustive list):

- 3070 1) It marks the Study as deprecated, but otherwise retains the data – the time B incremental inventory includes the entire set of Study, Series, and Instance records, each with the Removed from Operational Use (0008,0405) Attribute value Y.
- 2) It marks the Study as deprecated, and deletes all the Series and Instance data – the time B incremental inventory includes only the Study record with the Removed from Operational Use (0008,0405) Attribute value Y.
- 3075 3) It deletes the references to the Series and SOP Instances of the Study in the database, retains the Study level database record, but does not support a deprecation flag – the time B incremental inventory includes a Study item, but no Series items.
- 4) It deletes all Study information, with only a record in an audit trail – the time B incremental inventory simply does not record the Study.

3080 In cases 1) and 2), the consumer application knows exactly what has happened, and can make a determination whether to move the deprecated Study data to the migration target repository. That determination would be based, among other factors, on the data retention policies of the organization, and on the technical approach the target system takes to identifying and managing deleted Studies.

3085 In case 3), it might not be clear just from the content of the Inventories what is the appropriate status of the Study. This is further complicated if the SOP Instance files listed in the time A baseline inventory are still accessible from storage, perhaps indicating that the Study was not supposed to be empty. If the consumer application knows that this is the expected behavior of the source system for Study deletion, it might proceed with migration in accordance with organizational policy. However, the application may need to consult external information, such as audit trails or human authorization, before proceeding.

3090 In case 4), without an explicit Study record indicating deletion, the incremental Inventory record for a deleted Study is identical to a record for an unchanged Study (i.e., no record in the Inventory). The migration application would have no reason to suspect that the Study was deleted until it tries to migrate the SOP Instances, and cannot find them. Studies that have gone missing are a patient safety issue, as opposed to Studies that are known to have been deleted for a valid reason, and this situation may trigger an audit investigation.

#### 3095 **YYYY.7.11 Key Attributes Unsupported for Matching**

In DICOM Query, when the SCU requests matching on optional Key Attributes that are not supported for matching by the SCP, the baseline response behavior is for the SCP to treat them as “universal match”, i.e., no filtering is performed by the SCP. In the Repository Query or Inventory Creation SOP Classes, such behavior may result in a substantial number of records not desired by the SCU being returned. For example, the SCU  
3100 may request inventory of Studies updated in the last year by specifying a date range match on Study Update DateTime. If the SCP does not support matching on that Attribute, the baseline behavior would be to return inventory of all Studies in the repository. This could have significant performance impacts on both the SCU and SCP.

3105 The Inventory Creation SOP Class specifies a Warning response to an Initiate N-ACTION request, B010 – “One or more of Key Attributes are not supported for matching”, with the list of unsupported Attributes provided in the N-ACTION response field Attribute Identifier List (0000,1005). The SCU can evaluate the Warning and, if desired, send a Cancel N-ACTION.

3110 The Repository Query SOP Class does not provide such a warning. However, the SCP’s Conformance Statement is required to identify Attributes supported for matching, although if that list is site-configurable the Conformance Statement may not provide the requisite information. The SCU could, however, request a relatively small Maximum Number of Records (0008,041E) in the initial Query, evaluate the Query responses, and check that responses do not exceed the requested match values before continuing with a subsequent Query.

3115

## DICOM PS 3.18: Web Services

*Add Inventories to Section 12.1.1 Non-Patient Instance Service and Resources / Resource Descriptions*

### 12.1 OVERVIEW

3120 The Non-Patient Instance (NPI) Storage Service enables a user agent to retrieve, store, and search an origin server for instances that are not related to an **individual** patient.

**Notes:**

1. **Non-Patient Instances adhere to a Composite Instance IOD Information Model that does not have at its root the Patient Information Entity representing an individual Patient.**
- 3125 2. **“Non-patient” does not imply that there is no patient-related identifiable information in the Instances. E.g., the Inventory IOD does include Attributes of the patient, but it does not have a Patient IE at the root of its information model.**

An NPI Storage Service manages a collection of resources belonging to the categories specified in Table 12.1.1-1.

3130 All NPI Storage Service origin servers shall support the Retrieve Capabilities, Retrieve, and Search transactions. Support for the Store transaction is optional. All NPI Storage Service user agents support one or more of the Retrieve Capabilities, Retrieve, Store, or Search transactions.

#### 12.1.1 Resource Descriptions

An NPI Service manages resources from the same NPI Category. Target URIs have the following templates:

3135 /{npi-name}  
/{npi-name}/{uid}

Where

npi-name = "color-palettes"  
/ "defined-procedure-protocols"  
3140 / "hanging-protocols"  
/ "implant-templates"  
/ **"inventories"**  
uid ; is the Unique Identifier of an NPI Instance

3145 Table 12.1.1-1 contains the templates for the NPI Resource Categories.

**Table 12.1.1-1. Resource Categories, URI Templates and Descriptions**

Resource Category	URI Template and Description	Corresponding IOD	Storage Class	Information Model
Color Palette	/color-palettes/{uid}	Section A.58 “Color Palette IOD” in PS3.3	Section GG “Non-Patient Object Storage Service Class” in PS3.4	Section X.1.3 “Query/Retrieve Information Model” in PS3.4

Resource Category	URI Template and Description	Corresponding IOD	Storage Class	Information Model
Defined Procedure Protocol	/defined-procedure-protocols{/uid}	Section A.82 "Procedure Protocol Information Object Definitions" in PS3.3	Section GG "Non-Patient Object Storage Service Class" in PS3.4	Section HH.1.3 "Query/Retrieve Information Model" in PS3.4
Hanging Protocol	/hanging-protocols{/uid}	Section A.44 "Hanging Protocol IOD" in PS3.3	Section GG "Non-Patient Object Storage Service Class" in PS3.4	Section U.1.3 "Query/Retrieve Information Model" in PS3.4
Implant Template	/implant-templates{/uid}	Section A.61 "Generic Implant Template IOD" in PS3.3	Section GG "Non-Patient Object Storage Service Class" in PS3.4	Section BB.1.3 "Query/Retrieve Information Model" in PS3.4
<b>Inventory</b>	<b>/inventories{/uid}</b>	<b><a href="#">Section A.88 "Inventory IOD" in PS3.3</a></b>	<b><a href="#">Section GG "Non-Patient Object Storage Service Class" in PS3.4</a></b>	<b><a href="#">Section JJ.2 "Inventory Q/R Information Model" in PS3.4</a></b>

The NPI SOP Classes are listed in Table GG.3-1 "Standard SOP Classes" in PS3.4.

3150 *Add Inventories to Section 12.6.1.2 Non-Patient Instance Service and Resources / Query Parameters*

### 12.6.1.2 Query Parameters

The user agent shall supply, and the origin server shall support, the Common Query Parameters in Section 12.1.2.

The origin server shall support Query Parameters as required in Table 8.3.4-1.

3155 The user agent shall supply in the request Query Parameters as required in Table 8.3.4-1.

For each Resource Category the origin server supports, it shall support the behaviors and matching key Attributes specified in the corresponding sections in Table 12.6.1-2.

**Table 12.6.1-2. NPI Resource Search Attributes**

Resource Category	Behaviors and Matching Key Attributes
Color Palette	Section X.6.1.2 "Color Palette Attributes" in PS3.4.
Defined Procedure Protocol	Section HH.6.1.2 "Defined Procedure Protocol Attributes" in PS3.4.
Hanging Protocol	Section U.6.1.2 "Hanging Protocol Attributes" in PS3.4.
Implant Template	Section BB.6.1.2 "Implant Template Attributes" in PS3.4.
<b>Inventory</b>	<b><a href="#">Section JJ.2.2 "Inventory Q/R Information Model Attributes" in PS3.4</a></b>

3160

*Add Inventories to Annex H Capabilities Description*

**Table H-1. Resources and Methods**

Service	Resource	Transactions	Reference
...			

Service	Resource	Transactions	Reference
Non-Patient Instance (see <a href="#">Section 12.1.1</a> )			
	color-palettes	N/A	N/A
	{uid}	Retrieve Store Search	Section 12.4 Section 12.5 Section 12.6
	defined-procedure-protocol	N/A	N/A
	{uid}	Retrieve Store Search	Section 12.4 Section 12.5 Section 12.6
	hanging-protocol	N/A	N/A
	{uid}	Retrieve Store Search	Section 12.4 Section 12.5 Section 12.6
	implant-templates	N/A	N/A
	{uid}	Retrieve Store Search	Section 12.4 Section 12.5 Section 12.6
	<b>inventories</b>	<b>N/A</b>	<b>N/A</b>
	<b>{uid}</b>	<b>Retrieve</b> <b>Store</b> <b>Search</b>	<b>Section 12.4</b> <b>Section 12.5</b> <b>Section 12.6</b>