DICOM Conformance Statement

for Semperdata® v4.10

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1 CONFORMANCE STATEMENT OVERVIEW

Semperdata® (SDA) is a product family for archiving, transfer, and migration of diagnostic medical image data:

- Semperdata® Atrium
- Semperdata® Study Importer
- Semperdata® Router
- Semperdata® Migration Manager (SMM)
- Migratek™ Advanced Data Migration (MADM)

Each table below lists the DICOM network services for each SDA product.

Table 1-1
NETWORK SERVICES FOR SEMPERDATA ATRIUM

SOP Classes	Service Class User (SCU)	Service Class Provider (SCP)
Verification		
C-ECHO	Yes	Yes
Transfer		
All storage SOP Classes, as included in Table 3.2-1 or as configured	Yes	Yes
Storage Commitment	No	Yes
Query/Retrieve		
Patient Root Q/R - FIND	No	Yes
Patient Root Q/R - MOVE	No	Yes
Study Root Q/R - FIND	No	Yes
Study Root Q/R - MOVE	No	Yes
Workflow Management		

SOP Classes	Service Class User (SCU)	Service Class Provider (SCP)
Modality Worklist Information Model – FIND	No	No

Table 1-2
NETWORK SERVICES FOR SEMPERDATA STUDY IMPORTER

SOP Classes	Service Class User (SCU)	Service Class Provider (SCP)
Verification		
C-ECHO	Yes	Yes
Transfer		
All storage SOP Classes, as included in Table 3.2-1 or as configured	Yes	Yes
Storage Commitment Push Model	No	No
Query/Retrieve		
Patient Root Q/R - FIND	No	Yes
Patient Root Q/R - MOVE	No	Yes
Study Root Q/R - FIND	No	Yes
Study Root Q/R - MOVE	No	Yes
Workflow Management		
Modality Worklist Information Model – FIND	No	No

Table 1-3
NETWORK SERVICES FOR SEMPERDATA ROUTER

SOP Classes	Service Class User (SCU)	Service Class Provider (SCP)
Verification		
C-ECHO	Yes	Yes
Transfer		
All storage SOP Classes, as included in Table 3.2-1 or as configured	Yes	Yes
Storage Commitment Push Model	No	No
Query/Retrieve		
Patient Root Q/R - FIND	No	No
Patient Root Q/R - MOVE	No	No
Study Root Q/R - FIND	No	No
Study Root Q/R - MOVE	No	No
Workflow Management		
Modality Worklist Information Model – FIND	Yes	Yes

Table 1-4
NETWORK SERVICES FOR MADM and SMM

SOP Classes	Service Class User (SCU)	Service Class Provider (SCP)
Verification		
Verification (C-ECHO)	Yes	Yes
Transfer		

SOP Classes	Service Class User (SCU)	Service Class Provider (SCP)
All storage SOP Classes, as included in Table 3.2-1 or as configured	Yes	Yes
Storage Commitment Push Model	No	Yes
Query/Retrieve		
Patient Root Q/R - FIND	Yes	Yes
Patient Root Q/R - MOVE	Yes	Yes
Study Root Q/R - FIND	Yes	Yes
Study Root Q/R - MOVE	Yes	Yes
Workflow Management		
Modality Worklist Information Model – FIND	Yes	No

2 INTRODUCTION

2.1 Audience

The reader of this document is concerned with IT planning, product purchasing, integrating systems, designing a compatible product, and troubleshooting connections and connected devices and systems. The reader must have a working understanding of DICOM.

2.2 Remarks

This DICOM Conformance statement assists customer tasks:

- Assessment of product conformance for planning device interconnection
- Cross-product validation and testing
- Installation and configuration of Semperdata® and connected products
- Troubleshooting connection-related behaviors

- Customer planning to meet new site requirements and products. Laitek participates in the evolution of the DICOM Standard to align DICOM and Semperdata with changes in clinical technology and customer requirements.

Coercions and transformations for DICOM compliance, local site requirements, and migration are reversible and auditable. The DICOM Original Attributes Sequence stores the original values of modified data elements.

3 NETWORKING

3.1 Implementation Model

3.1.1 Application Data Flow

By default, all of the defined Application Entities have different AE Titles. However, SDA can be configured so that the QUERY-RETRIEVE-SCP AE and STORAGE-SCP AE share the same Application Entity Title.

Figure 3.1-1
Data Flow Diagram for Query Retrieve and Storage

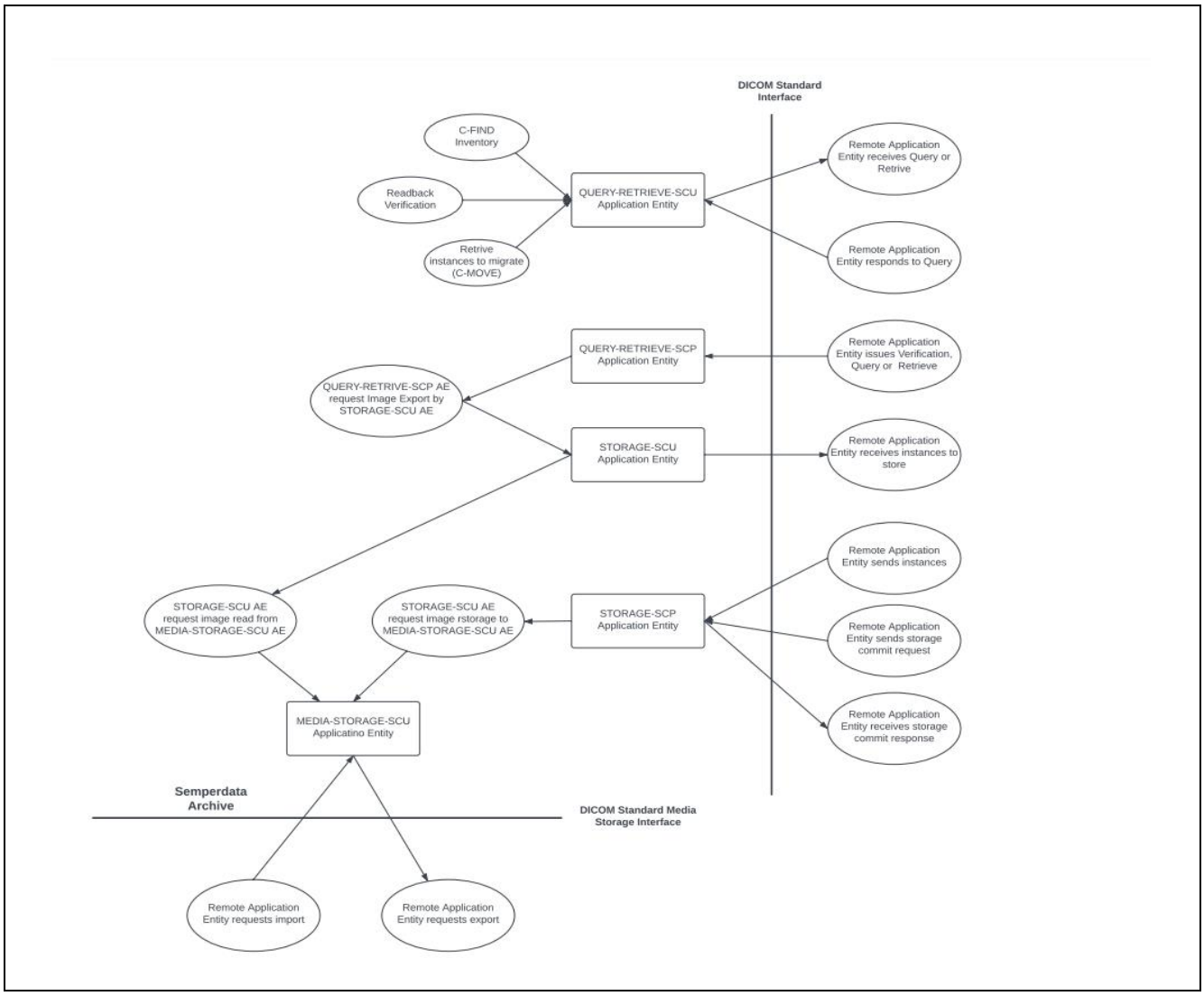


Figure 3.1-2
Data Flow Diagram for Router

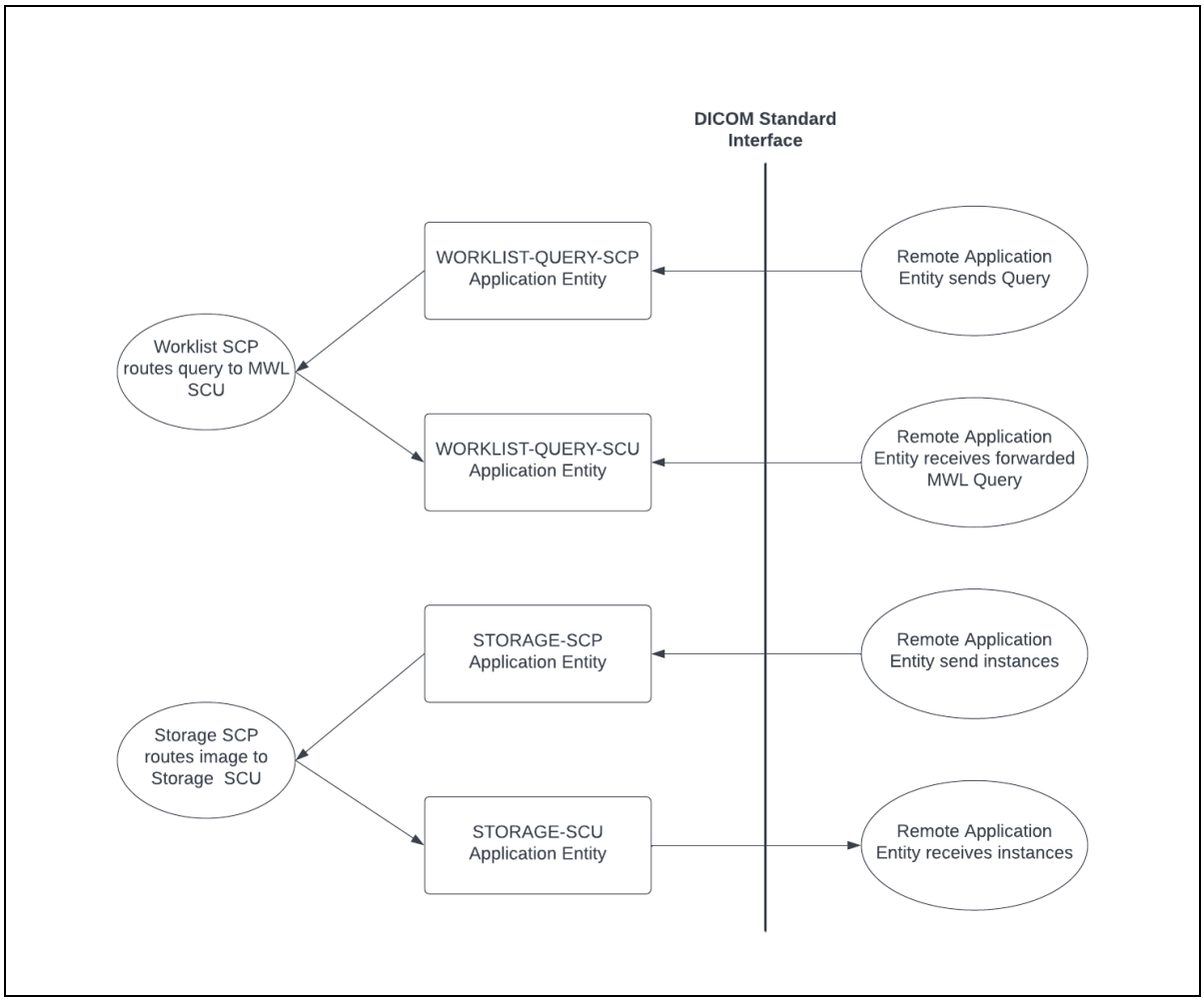


Figure 3.1-3
Data Flow Diagram for Prefetch

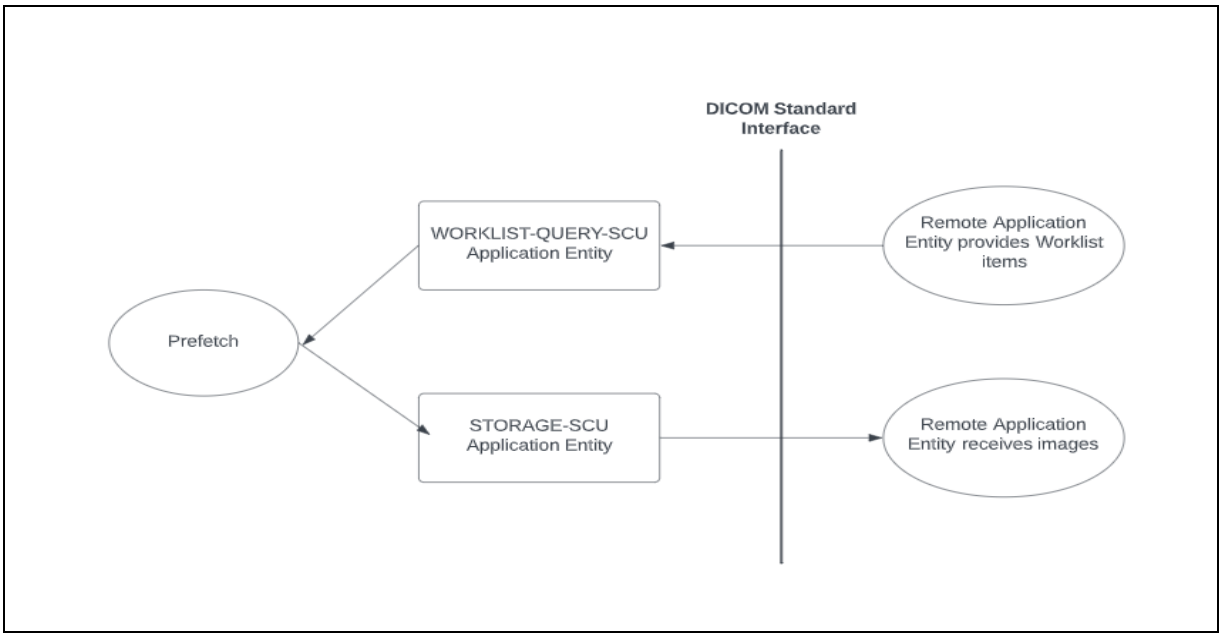


Figure 3.1-4
Data Flow Diagram for Query-Retrieve *(see first data flow diagram)*

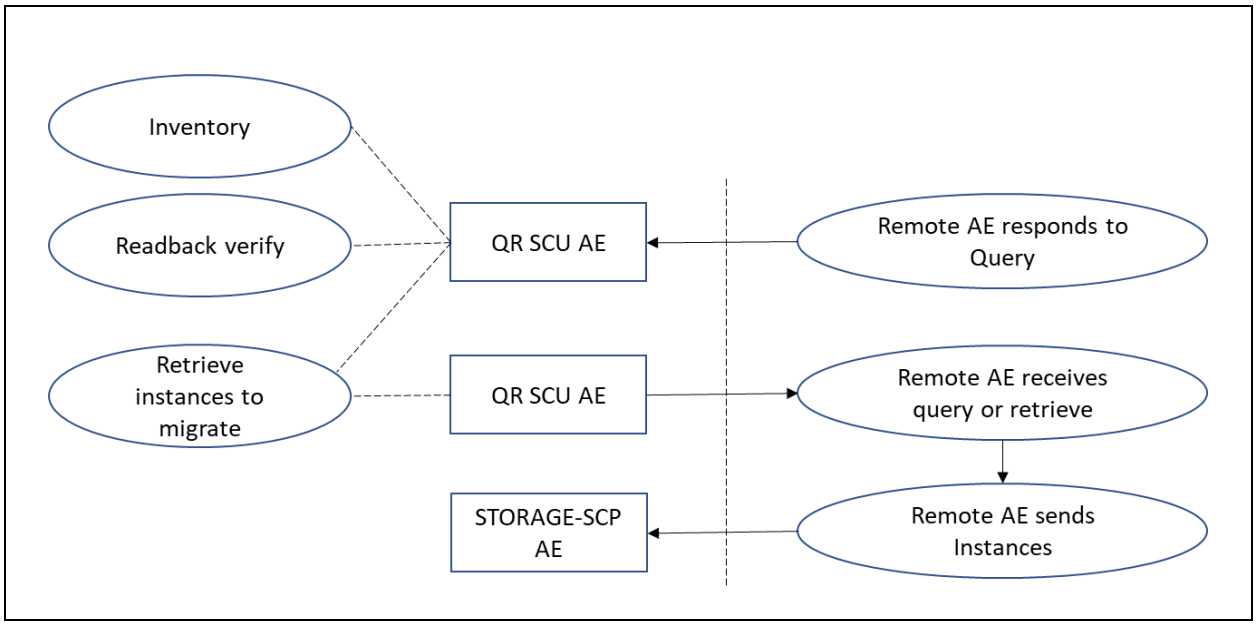
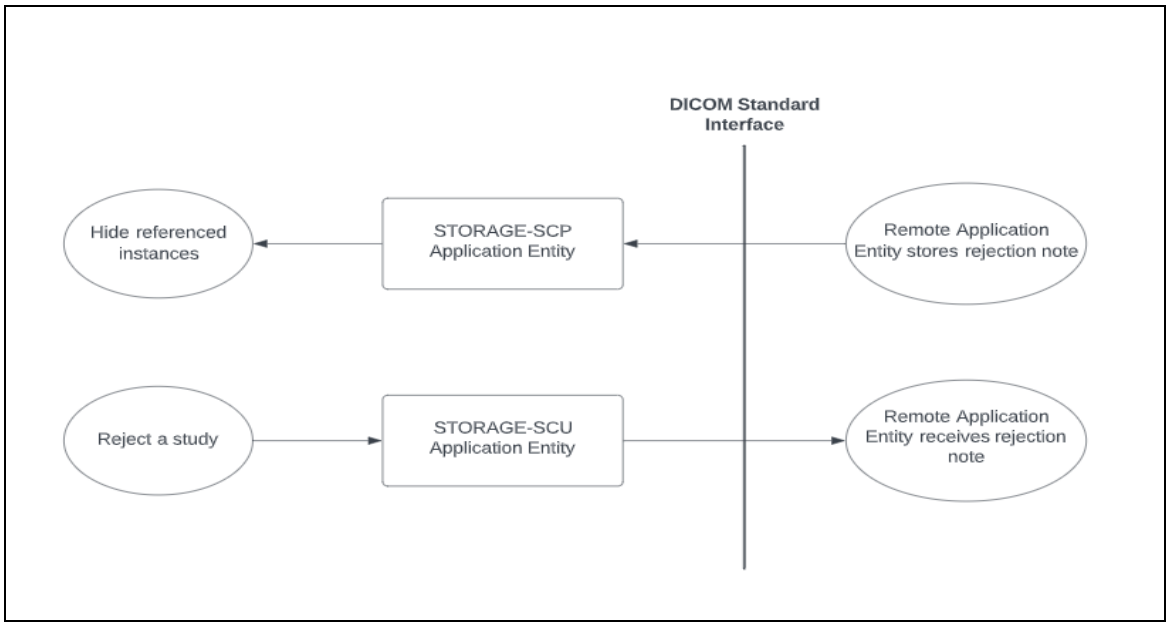


Figure 3.1-5
Data Flow Diagram for Rejection Notes



3.1.2 Functional Definition of AEs

3.1.2.1 Functional Definition of STORAGE-SCU Application Entity

The STORAGE-SCU AE sends Composite SOP Instances to other systems using DICOM C-STORE in response to:

- Route instances sent to the STORAGE-SCP AE to the configured destinations.
- To prefetch studies of patients in the Modality Worklist to the configured destination. Prefetch is configurable to trigger on periodic Modality Worklist query or by HL7 messages.
- To fulfill a C-MOVE command from a Query-Retrieve SCU.
- To push imported data to a configured Remote Storage SCP.

The STORAGE-SCU AE must be correctly configured with the host and port number of any external DICOM AE's to be C-MOVE retrieval destinations. The Presentation Context is determined from the headers of the DICOM files to be transferred, together with configured presentation context constraints. This AE converts the transfer syntax of the DICOM image object if the original Presentation Context is not supported by the remote destination AE or when compression is preferred. The STORAGE-SCU AE chooses by referring to a configurable transfer syntax map that constrains the transfer syntax to the Storage SCP. The map specifies the transfer syntax map for each connected Storage SCP and SOP Class (abstract syntax).

3.1.2.2 Functional Definition of STORAGE-SCU Application Entity for Rejection Notes

Semperdata hides instances in the archive when it receives a Rejection Note (a document type of Key Object Selection SOP Class) from an Application Entity configured with permission to update or hide. The Rejection Note is stored, and the instances listed in the rejection note are marked in the database as hidden from queries and prevented from retrieval. For details, see section *SOP Specific Conformance for Rejection in Key Object Selection SOP Class*.

3.1.2.3 Functional Definition of STORAGE-SCP Application Entity

The STORAGE-SCP AE receives incoming DICOM images and adds them to the database. It responds to external Storage and Verification Requests as a Service Class Provider (SCP) for C-STORE and C-ECHO requests. Upon receiving a Storage Commitment Push Model N-ACTION, the SCP immediately checks if the referenced SOP Instances are present and return the appropriate N-EVENT-REPORT Notification.

3.1.2.4 Functional Definition of QUERY-RETRIEVE-SCP Application Entity

The QUERY-RETRIEVE-SCP AE:

- Handles incoming queries and retrieval requests. It handles external queries for Patient, Study, Series, Image data, and Image retrieval requests.
- Functions as a SCP for C-FIND and C-MOVE of Query-Retrieve Service Class and the C-ECHO Verification Service.
- Handles retrieval requests by issuing a command to the STORAGE-SCU AE to send the requested Images to the destination specified by the Remote AE.

3.1.2.5 Functional Definition of QUERY-RETRIEVE-SCU Application Entity

The QUERY-RETRIEVE-SCU is activated from:

- Inventory assessments to catalog the patients, studies, series, and instances on a PACS using C-FIND.
- The Migration Controller's inbound and outbound streaming processes to move studies into and out of the Semperdata local archive using C-MOVE.
- Migration verification operations that verify that each instance transfer can be queried (C-FIND) and that selected instances read back correctly by comparing retrieved (C-MOVE) and archived instances.

3.1.2.6 Functional Definition of the WORKLIST-QUERY-SCU Application Entity

The WORKLIST-QUERY-SCU periodically queries the worklist to find the patients scheduled. A configurable filter selects relevant studies by matching worklist attributes to prior studies and adds them to the prefetch queue to send to the destination so that studies are available as priors during interpretation. For studies not yet migrated into the Semperdata archive, those are retrieved, processed, and placed into the prefetch queue.

3.1.2.7 Functional Definition of the WORKLIST-QUERY-SCP Application Entity

The Router WORKLIST-QUERY-SCP listens to incoming queries and forwards them to the configured list of external WORKLSIT-QUERY-SCPs (using an internal WORKLIST-QUERY-SCU). The responses received are sent back to the original requester.

3.1.2.8 Functional Definition of MEDIA-STORAGE-SCU Application Entity

The MEDIA-STORAGE-SCU AE transfers composite instances received by the STORAGE-SCP AE and retrieves images for the STORAGE-SCU AE to send in response to C-MOVE Requests. The instances are stored in a DICOM medical storage format.

3.1.3 Sequencing of Real-World Activities

The only sequencing constraint that exists across all the Semperdata® Application Entities is the fact that a Composite SOP Instance must be entirely received by the STORAGE-SCP AE before Query-Retrieve Requests related to this SOP Instance can be successfully handled.

Figure 3.1-6
Sequencing Activity for Store and Query Retrieve

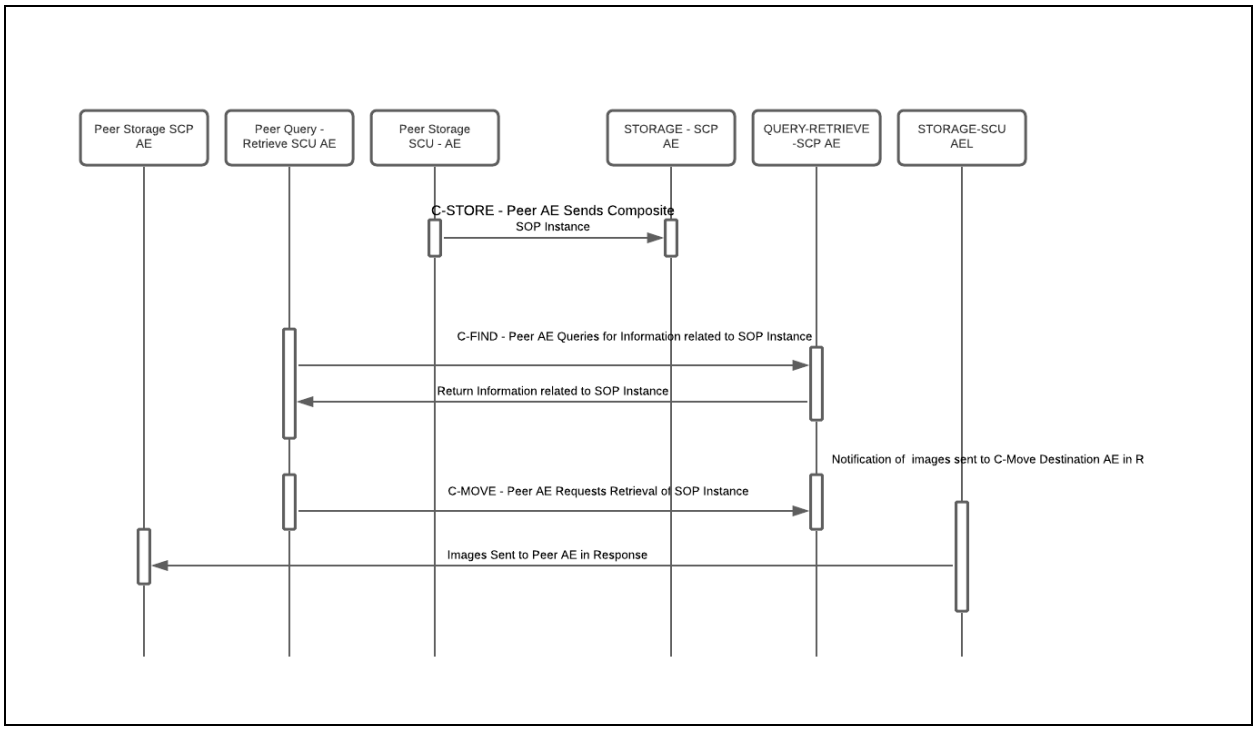


Figure 3.1-7
Sequencing Activity for STORE Routing

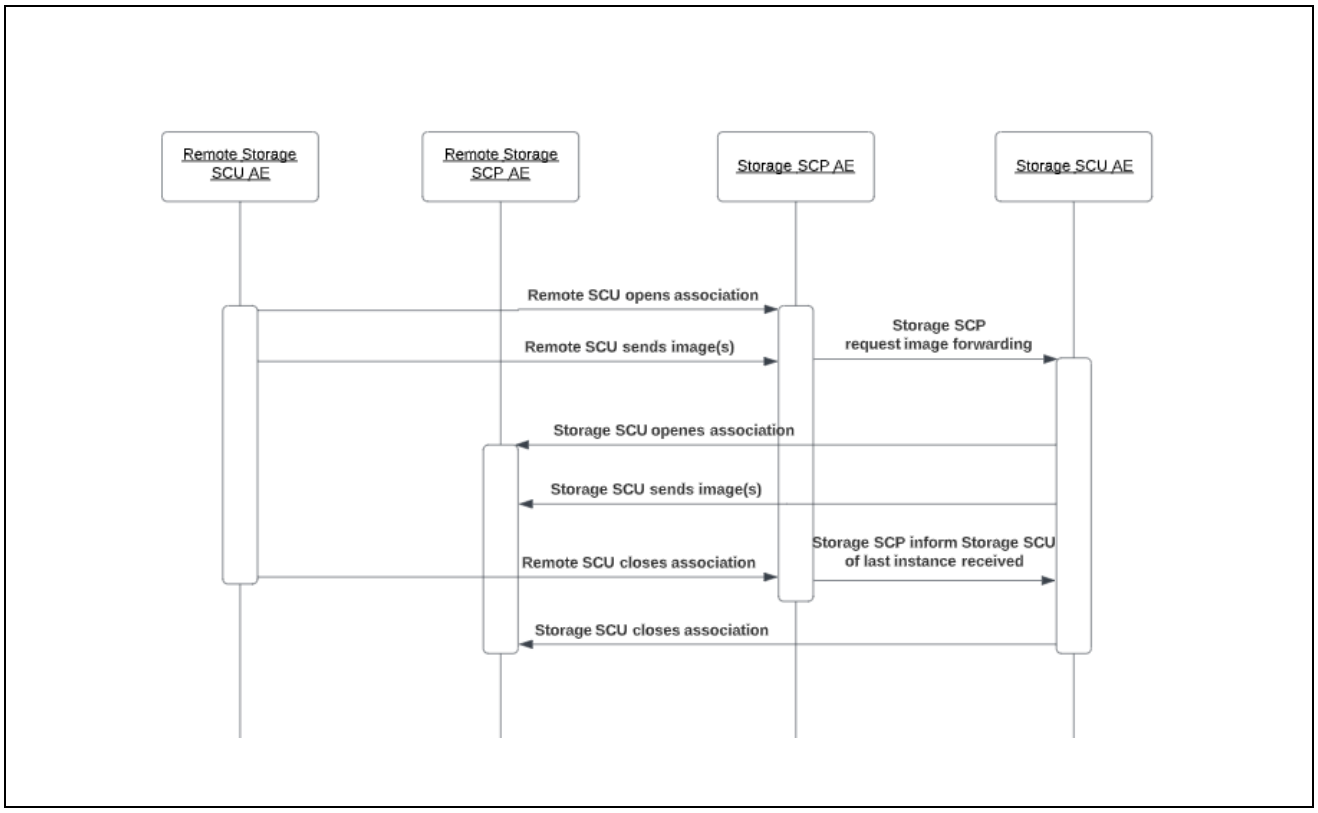
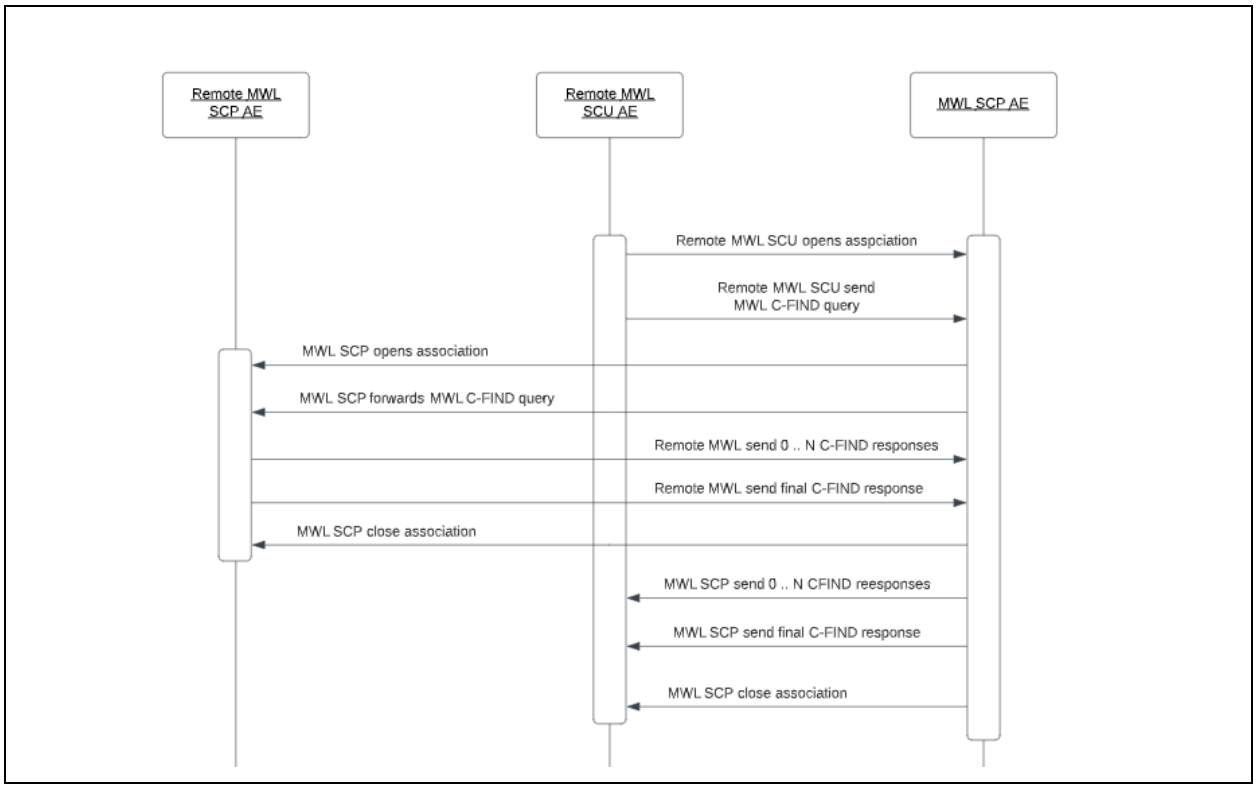


Figure 3.1-8
Sequencing Activity for Routing MWL Queries



3.2 AE Specifications

3.2.1 STORAGE-SCU Application Entity Specification

3.2.1.1 SOP Classes

The STORAGE-SCU AE provides Standard Conformance to the DICOM V3.0 SOP Classes[1] with "Yes" in the SCU column:

[1] The archive supports all DICOM Storage SOP Classes as they are added to the DICOM Standard.

Table 3.2-1
STANDARD STORAGE SOP CLASSES

SOP Class Name	SOP Class UID	SCU	SCP
1.2.840.10008.5.1.4.1.1.1	Computed Radiography Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.1	Digital X-Ray Image Storage – For Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.1.1	Digital X-Ray Image Storage – For Processing	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage – For Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage – For Processing	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.3	Digital Intra-oral X-Ray Image Storage – For Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.3.1	Digital Intra-oral X-Ray Image Storage – For Processing	Yes	Yes
1.2.840.10008.5.1.4.1.1.2	CT Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.2.1	Enhanced CT Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.2.2	Legacy Converted Enhanced CT Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.3	Ultrasound Multi-frame Image Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.3.1	Ultrasound Multi-frame Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.4	MR Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.4.1	Enhanced MR Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.4.2	MR Spectroscopy Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.4.3	Enhanced MR Color Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.4.4	Legacy Converted Enhanced CT Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.5	Nuclear Medicine Image Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.6	Ultrasound Image Storage (Retired)	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.6.2	Enhanced US Volume Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.7.1	Multi-frame Single Bit Secondary Capture Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.7.2	Multi-frame Grayscale Byte Secondary Capture Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.7.3	Multi-frame Grayscale Word Secondary Capture Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.7.4	Multi-frame True Color Secondary Capture Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.8	Standalone Overlay Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.9	Standalone Curve Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.1.1	12-lead ECG Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.1.2	General ECG Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.1.3	Ambulatory ECG Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.2.1	Hemodynamic Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.3.1	Cardiac Electrophysiology Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.4.1	Basic Voice Audio Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.10	Standalone Modality LUT Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.11	Standalone VOI LUT Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.1	Grayscale Softcopy Presentation State Storage SOP Class	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.2	Color Softcopy Presentation State Storage SOP Class	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.3	Pseudo-Color Softcopy Presentation State Storage SOP Class	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.4	Blending Softcopy Presentation State Storage	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
1.2.840.10008.5.1.4.1.1.12.1	X-Ray Angiographic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.12.1.1	Enhanced XA Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.12.2	X-Ray Radiofluoroscopic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.12.2.1	Enhanced XRF Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.12.3	X-Ray Angiographic Bi-Plane Image Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.13.1.1	X-Ray 3D Angiographic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.13.1.2	X-Ray 3D Craniofacial Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.13.1.3	Breast Tomosynthesis Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.13.1.4	Breast Projection X-Ray Image Storage – For Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.13.1.5	Breast Projection X-Ray Image Storage – For Processing	Yes	Yes
1.2.840.10008.5.1.4.1.1.14.1	Intravascular Optical Coherence Tomography Image Storage - For Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.14.2	Intravascular Optical Coherence Tomography Image Storage - For Processing	Yes	Yes
1.2.840.10008.5.1.4.1.1.20	Nuclear Medicine Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.30	Parametric Map Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.66	Raw Data Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.66.1	Spatial Registration Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.66.2	Spatial Fiducials Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.66.3	Deformable Spatial Registration Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.66.4	Segmentation Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.66.6	Tractography Results Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.67	Real World Value Mapping Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.68.1	Surface Scan Mesh Storage	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
1.2.840.10008.5.1.4.1.1.68.2	Surface Scan Point Cloud Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1	VL Image Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.2	VL Multi-frame Image Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.1	VL Endoscopic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.1.1	Video Endoscopic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.2	VL Microscopic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.2.1	Video Microscopic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.3	VL Slide-Coordinates Microscopic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.4	VL Photographic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.4.1	Video Photographic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.5.1	Ophthalmic Photography 8 Bit Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.5.2	Ophthalmic Photography 16 Bit Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.5.3	Stereometric Relationship Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.5.4	Ophthalmic Tomography Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.5.5	Wide Field Ophthalmic Photography Stereographic Projection Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.5.6	Wide Field Ophthalmic Photography 3D Coordinates Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1.6	VL Whole Slide Microscopy Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.78.1	Lensometry Measurements Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.78.2	Autorefraction Measurements Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.78.3	Keratometry Measurements Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.78.4	Subjective Refraction Measurements Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.78.5	Visual Acuity Measurements Storage	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
1.2.840.10008.5.1.4.1.1.78.6	Spectacle Prescription Report Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.78.7	Ophthalmic Axial Measurements Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.78.8	Intraocular Lens Calculations Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.79.1	Macular Grid Thickness and Volume Report	Yes	Yes
1.2.840.10008.5.1.4.1.1.80.1	Ophthalmic Visual Field Static Perimetry Measurements Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.81.1	Ophthalmic Thickness Map Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.82.1	Corneal Topography Map Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.11	Basic Text SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.22	Enhanced SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.34	Comprehensive 3D SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.35	Extensible SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.40	Procedure Log Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.50	Mammography CAD SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.59	Key Object Selection Document	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.65	Chest CAD SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.68	Radiopharmaceutical Radiation Dose SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.69	Colon CAD SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.70	Implantation Plan SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.71	Acquisition Context SR Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.104.1	Encapsulated PDF Storage	Yes	Yes

SOP Class Name	SOP Class UID	SCU	SCP
1.2.840.10008.5.1.4.1.1.104.2	Encapsulated CDA Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.128	Positron Emission Tomography Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.128.1	Legacy Converted Enhanced PET Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.129	Standalone PET Curve Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.130	Enhanced PET Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.131	Basic Structured Display Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.1	RT Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.2	RT Dose Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.3	RT Structure Set Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.4	RT Beams Treatment Record Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.5	RT Plan Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.6	RT Brachy Treatment Record Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.7	RT Treatment Summary Record Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.8	RT Ion Plan Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.481.9	RT Ion Beams Treatment Record Storage	Yes	Yes
1.2.840.10008.5.1.4.34.7	RT Beams Delivery Instruction Storage	Yes	Yes
1.2.840.10008.5.1.4.34.10	RT Brachy Application Setup Delivery Instruction Storage	Yes	Yes
1.2.840.10008.5.1.4.43.1	Generic Implant Template Storage	Yes	Yes
1.2.840.10008.5.1.4.44.1	Implant Assembly Template Storage	Yes	Yes
1.2.840.10008.5.1.4.45.1	Implant Template Group Storage	Yes	Yes

Note: This is the default list that comes with the Semperdata installation kit, and it can be extended depending on the Semperdata product/service installed. The set of SOP Classes is configurable to exclude or support additional SOP Classes. See section *PRIVATE SOP CLASSES* for the Semperdata Private Change Object Storage SOP Class definition.

Table 3.2-2
PRIVATE STORAGE SOP CLASSES

SOP Class	UID	SCU	SCP
Change Object Storage	1.3.6.1.4.1.16592.2.1977	Yes	Yes

3.2.1.2 Association Policies

3.2.1.2.1 General

The STORAGE-SCU AE can only form Associations when requested to do so by the QUERY-RETRIEVE-SCP AE or by commands entered into the administrative user interface. The STORAGE-SCU AE can only request the opening of an Association. It cannot accept requests to open Associations from external Application Entities.

The DICOM standard Application Context Name for DICOM is always proposed:

Table 3.2-3
DICOM Application Context for STORAGE-SCU AE

Application Context Name	1.2.840.10008.3.1.1.1

Semperdata® rejects association requests from applications when the AE Title is not listed within the configuration unless configured to accept any AE Title.

3.2.1.2.2 Number of Associations

The AE sets no limit to the maximum number of simultaneous Associations.

Table 3.2-4
Number of Associations as a SCU for STORAGE-SCU AE

Maximum number of simultaneous Associations	No set limit

Asynchronous Nature

The STORAGE-SCU AE does not support asynchronous communication (multiple outstanding transactions over a single Association). All Association requests must be completed and acknowledged before a new operation can be initiated.

Table 3.2-5
ASYNCHRONOUS NATURE AS A SCU FOR STORAGE-SCU AE

Maximum number of outstanding asynchronous transactions	0

3.2.1.2.3 Implementation Identifying Information

Table 3.2-6
DICOM IMPLEMENTATION CLASS AND VERSION FOR STORAGE-SCU AE

Implementation Class UID	1.3.6.1.4.1.16592.1.3
Implementation Version Name	Semperdata_1.0

Note that this AE uses the same Implementation Class UID as the other network AEs. All SEMPERDATA® AEs use the same Implementation Version Name. The Version Name is updated with each new software product release that changes DICOM behavior.

3.2.1.3 Association Initiation Policy

3.2.1.3.1 Activity – Send Images

The primary activity triggering a send is a move request from an external Application Entity. Additional activities include:

- The user selects studies to send from the user interface
- An archive plug-in requests studies for sending (see the manuals associated with those plugins)
- Outbound migration
- Prefetch
- Transfer and updates to a remote SEMPERDATA® for replication

TABLE 3.2-7
TRANSFER SYNTAXES FOR SEND INSTANCES

Name	UID	Notes
Implicit VR Little Endian	1.2.840.10008.1.2	

Name	UID	Notes
Explicit VR Little Endian	1.2.840.10008.1.2.1	
Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99	
Big Endian Explicit	1.2.840.10008.1.2.2	
JPEG Baseline, Lossy JPEG 8-Bit Image Compression	1.2.840.10008.1.2.4.50	What Semperdata® receives on DICOM C-STORE in a compressed format it stores it as received. **Note:** The user has the option to define a lossless preferred compression in Semperdata storage. At the Association level, the STORAGE-SCU proposes and tries to send the compressed form as Semperdata® received it.
JPEG Extended, Lossy JPEG 12-Bit Image Compression	1.2.840.10008.1.2.4.51	
JPEG syntaxes (Retired)	*1.2.840.10008.1.2.4.52 through 1.2.840.10008.1.2.4.66*	*Retired JPEG syntaxes from C-STORE SCP and SCU.*
JPEG Lossless, Non-Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	
JPEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80	
JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81	
JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90	
JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91	
MPEG2 Main Profile / Main Level	1.2.840.10008.1.2.4.100	
RLE Lossless	1.2.840.10008.1.2.5	

TABLE 3.2-8
ADDITIONAL TRANSFER SYNTAXES FOR SEMPERDATA® ROUTER SEND INSTANCES

Name	UID	Notes
JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)	1.2.840.10008.1.2.4.92	This listed Transfer Syntaxes are accepted by the Semperdata® Router C-STORE Service Class Provider and proposed at send instance. No Transfer Syntax transformations are supported, meaning that the Semperdata® Router will forward each dataset exactly as received.
JPEG 2000 Part 2 Multi-component Image Compression (Lossless or Lossy)	1.2.840.10008.1.2.4.93	
JPIP Referenced	1.2.840.10008.1.2.4.94	
JPIP Referenced Deflate	1.2.840.10008.1.2.4.95	
Fragmentable MPEG2 Main Profile / Main Level	1.2.840.10008.1.2.4.100.1	
MPEG2 Main Profile / High Level	1.2.840.10008.1.2.4.101	
Fragmentable MPEG-4 AVC/H.264 High Profile / Level 4.1	1.2.840.10008.1.2.4.101.1	
MPEG-4 AVC/H.264 High Profile / Level 4.1	1.2.840.10008.1.2.4.102	
Fragmentable MPEG-4 AVC/H.264 High Profile / Level 4.1	1.2.840.10008.1.2.4.102.1	
MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1	1.2.840.10008.1.2.4.103	
Fragmentable MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1	1.2.840.10008.1.2.4.103.1	
MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	1.2.840.10008.1.2.4.104	
Fragmentable MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	1.2.840.10008.1.2.4.104.1	
MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video	1.2.840.10008.1.2.4.105	
Fragmentable MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video	1.2.840.10008.1.2.4.105.1	
MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	1.2.840.10008.1.2.4.106	

Name	UID	Notes
Fragmentable MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	1.2.840.10008.1.2.4.106.1	
HEVC/H.265 Main Profile / Level 5.1	1.2.840.10008.1.2.4.107	
HEVC/H.265 Main 10 Profile / Level 5.1	1.2.840.10008.1.2.4.108	
RFC 2557 MIME Encapsulation (RETIRED)	1.2.840.10008.1.2.6.1	
XML Encoding (RETIRED)	1.2.840.10008.1.2.6.2	
SMPTE ST 2110-20 Uncompressed Progressive Active Video	1.2.840.10008.1.2.7.1	
SMPTE ST 2110-20 Uncompressed Interlaced Active Video	1.2.840.10008.1.2.7.2	
SMPTE ST 2110-30 PCM Digital Audio	1.2.840.10008.1.2.7.3	

Semperdata provides full (level 2) conformance. This means that upon sending an instance received via DICOM, it sends all received attributes, including private attributes from other manufacturers (though private attributes can be excluded in the configuration).

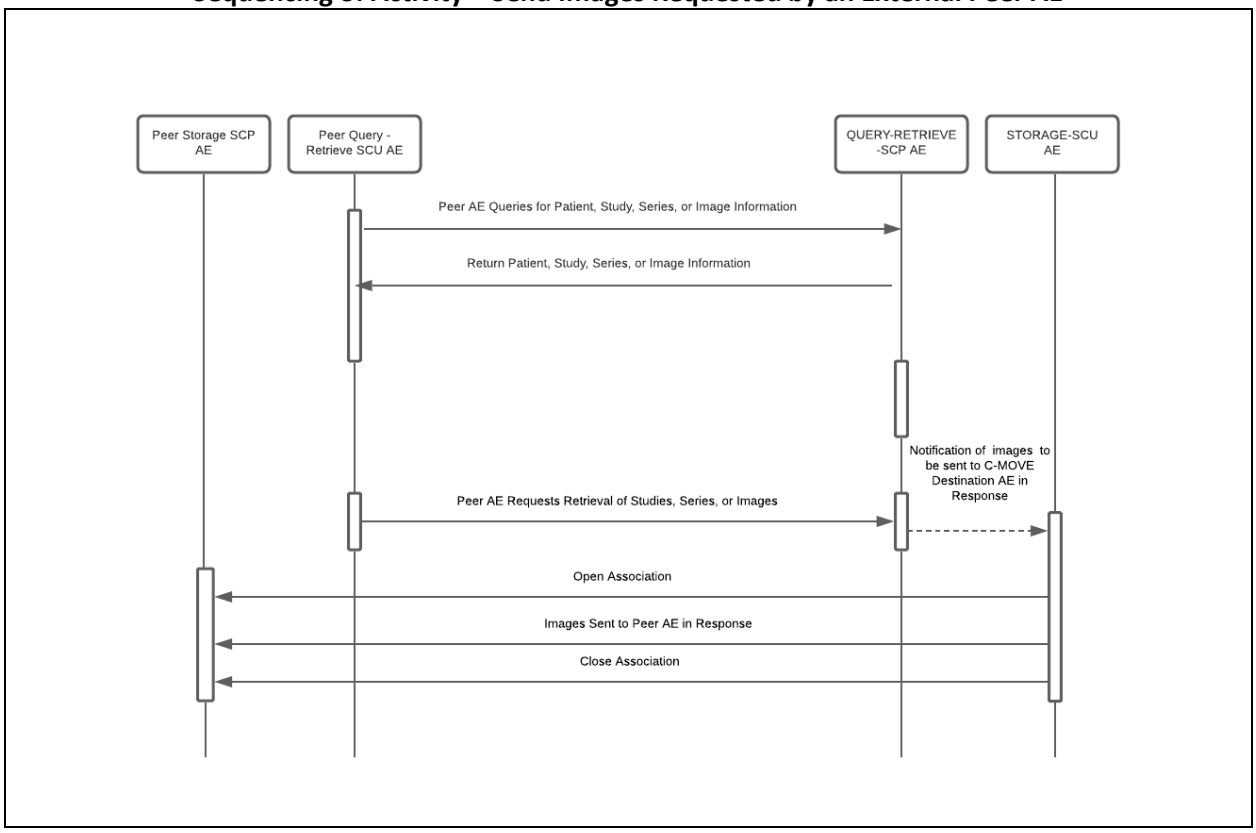
The Semperdata association policy is to transfer with no information loss. Semperdata negotiates to accept and send images in a lossless transfer syntax. In general, Semperdata stores images in a variety of transfer syntaxes, even lossy ones, when the source sends lossy compressed images. When the image in the archive is lossy compressed, Semperdata negotiates for the same lossy transfer syntax to avoid an irreversible transformation. Therefore, Semperdata proposes the transfer syntax of the stored instance and proposes ILE and ELE only when the stored instance is lossless, though this is configurable. When sending an image to the remote Storage SCP AE, the Storage SCU converts the image to a transfer syntax chosen from a configurable map. Each AE may have its own configurable map that specifies the transfer syntax to present for the abstract syntax to store.

3.2.1.3.1.1 Description and Sequencing of Activity

The STORAGE-SCU AE initiates a new Association when the QUERY-RETRIEVE-SCP AE invokes the STORAGE-SCU AE to transmit images. The QUERY-RETRIEVE-SCP AE issues the store command whenever a valid C-MOVE request is received. An Association request is sent to the specified C-MOVE Destination AE, and upon successful negotiation of the required Presentation Context, the image transfer is started. In all cases an attempt is made to transmit all the indicated images in a single Association, but this may not always be

possible. The Association is released when all the images have been sent. If an error occurs during transmission over an open Association, the image transfer is halted. The STORAGE-SCU AE does not attempt to retry the image export independently.

Figure 3.2-1
Sequencing of Activity – Send Images Requested by an External Peer AE



The following sequencing constraints illustrated in *Figure 3.2-1* apply to the STORAGE-SCU AE:

1. Peer AE requests retrieval of Study, Series, or Images from QUERY-RETRIEVE-SCP AE (C-MOVE-RQ).

Note: QUERY-RETRIEVE-SCP AE signals STORAGE-SCU AE to send the image Composite SOP Instances are indicated in the C-MOVE-RQ to the C-MOVE Destination AE.

2. STORAGE-SCU AE opens a new Association with the indicated C-MOVE Destination AE.
3. STORAGE-SCU AE sends the indicated Composite SOP Instances.
4. STORAGE-SCU AE closes the Association.
5. Prior to opening the Association to the peer STORAGE-SCP AE, a DICOM Connectivity check verifies the connection with the C-ECHO service after successfully verifying the IP, host, and port.

3.2.1.3.1.2 Proposed Presentation Contexts

STORAGE-SCU AE proposes Presentation Contexts as shown in the following table:

Table 3.2-9
PROPOSED PRESENTATION CONTEXTS BY THE STORAGE-SCU AE

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**UID**			
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1		Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1		Big Endian Explicit	1.2.840.10008.1.2.2	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]): Default Transfer Syntax for Lossless JPEG Image Compression	1.2.840.10008.1.2.4.70	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1		JPEG Baseline (Process 1): Default Transfer Syntax for	1.2.840.10008.1.2.4.50	SCU	None

Presentation Context Table				
	Lossy JPEG 8 Bit Image Compression			
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	JPEG Extended (Process 2 & 4): Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)	1.2.840.10008.1.2.4.51	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	RLE Lossless	1.2.840.10008.1.2.5	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	JPEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	MPEG2 Main Profile / Main Level	1.2.840.10008.1.2.4.100	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 3.2-1	JPEG syntaxes (Retired)	1.2.840.10008.1.2.4.52 through 1.2.840.10008.1.2.4.66	SCU	None

Note: By default, even retired JPEG Transfer Syntaxes will be proposed in the association negotiated with an external Storage Service Class Provider. Application will try to apply no Transfer Syntax transformation to the processed data if not specifically instructed to do so.

Note: For Semperdata® Router the list of proposed Presentation Context in case of Storage SCU Send Instances includes additional Transfer Syntaxes from TABLE 3.2-8 section *Activity – Send Images.* (ADDITIONAL TRANSFER SYNTAXES FOR ROUTER SEND INSTANCES). The Router will not add any of these transfer syntaxes to the presentation context transfer syntax list as an alternative representation. The Router will simply forward the received datasets in the exact same representation as received on the DICOM C-STORE SCP interface from an external application entity.

When establishing the association, the set of DICOM objects to send is known. The policy goal is to send each object in the transfer syntax as originally accepted and stored, or alternatively, a transfer syntax that can be reversibly converted from the stored one to prevent information loss. For example, a study may contain ultrasound multi-frame images of JPEG lossy, JPEG lossless, and RLE. Five Presentation Contexts are proposed, the three compressed just cited, ELE and ILE[2].

- If all are accepted, the stored images export with transfer syntax as stored.
- If the JEPG lossless transfer syntax is not accepted, Semperdata converts and sends as ELE.

If the JPEG lossy transfer syntax or RLE is not accepted, Semperdata transfers as ELE or JPEG lossless, depending on the configuration. This situation results in unavoidable information loss since it is not reversible.

Upon receiving a C-MOVE request, Semperdata identifies the location of all the objects in the request. The objects can be resident (as part of Semperdata archive storage) or remote – when Semperdata is configured with connectors to other systems.

Regardless of the location of the objects, these are retrieved one by one:

- If the data is resident, object ordering logic ensures that the IODs are produced in an orderly sequence, one series at a time[3].
- If data is stored remotely in other PACS systems, the order of the objects sent is not guaranteed.

Transfer Syntax and SOP Class information are therefore known before sending each image. The internal algorithm first identifies whether the specific presentation context, once the defined transformation rules were applied (e.g., enforced conversion to Jpeg 2000 for All Mammography Data), is found in the accepted presentation context list. If not, the new presentation context is added, and the association is re-negotiated.

[2] Explicit Big Endian is absent by default but can be added if configured.

[3] There is no implied ordering of the series however, nor of the instances within a series (no Series number/Instance number ordering).

By default, the ILE and ELE transfer syntaxes are proposed for each SOP Class in a certain transfer. The usage of Transfer Syntax Maps overrides this setting. If a transfer syntax map has been defined for a certain SOP Class, only the defined transfer syntaxes are proposed in the presentation context list[4].

Semperdata does not flood the target system with the entire set of SOP classes in its presentation context list. Semperdata proposes at most 127 presentation contexts, oddly numbered.

3.2.1.3.1.3 SOP Specific Conformance for Verification SOP Class

Standard conformance is provided to the DICOM Verification Service Class as an SCU. The Verification Service as an SCU is intended only as a diagnostic service tool for network communication.

3.2.1.3.1.4 SOP Specific Conformance for Rejection in Key Object Selection SOP Class

Rejection Notes as Key object selection can be generated by Semperdata for the full set of known SOP Instances of a study. The trigger for the generation is based on a user request (a rejection note stream configured and started by a user). Rejection reason can be configured.

3.2.1.3.1.5 SOP Specific Conformance for Image SOP Classes

Composite DICOM SOP Instances are maintained as DICOM Part 10 compliant files in the database. The entire set of tags received with the image is stored, including Private and SOP Class Extended Elements. When a SOP Instance is selected for export from SEMPERDATA® SDA, its content is exported as it was initially, with Patient Demographics and Study Information modifications altered by a Semperdata user and transfer syntax changes configured for export to the destination.

The Patient Demographics and Study Information can be entered or altered manually or from HL7 messaging. The replacement behavior depends on which specific DICOM and HL7 services are supported. Also, this behavior is configurable. Values can be altered without changing the SOP Instance UID unless otherwise noted. Refer to the *ANNEXES* for the specific details of which Elements can have their values altered at the time of export.

The original value of any DICOM tag that Semperdata changes is stored in the Original Attributes Sequence as follows:

[4] The reason for this logic is that if a transfer syntax map is defined, there is specific intent is to use that map. If this was not the case, a disaster scenario can be: 100MB Cine Ultrasound is stored Lossy Compressed. The target does not accept and the SCU would fall back to ELE or ILE, sending a 2.4GB IOD. Multiply this by 10,000 ultrasounds and you can endanger an enterprise storage this way.

Table 3.2-10
ORIGINAL VALUE OF DICOM TAGS STORAGE

DICOM Tag Name	DICOM Tag	Value
Original Attributes Sequence	(0400,0561)	
>Source of Previous Values	(0400,0564)	SOURCE PACS
>Attribute Modification DateTime	(0400,0562)	Date/time when the modification occurred.
>Modifying System	(0400,0563)	LAITEK
>Reason for the Attribute Modification	(0400,0565)	CORRECT
>Modified Attributes Sequence	(0400,0550)	The original value

If a DICOM attribute is modified multiple times, it is stored multiple times in the Original Attributes Sequence, with different timestamps.

Semperdata® creates files called Service Logs that can be used to monitor their status and diagnose any problems that may arise. If any errors occur during DICOM communication, appropriate messages are always output to these Service Logs. In addition, error messages may be output as alerts to the User Interface in certain cases.

The table below describes the STORAGE-SCU AE response to C-STORE status codes for Storage SCP.

Table 3.2-11
STORAGE-SCU AE C-STORE RESPONSE STATUS HANDLING BEHAVIOR

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has successfully stored the exported SOP Instance. A message is sent to the QUERY-RETRIEVE-SCP AE indicating successful export. The QUERY-RETRIEVE-SCP AE sends the appropriate PENDING or SUCCESS status in the C-MOVE Response. Success indication message is output to the Service Logs. No message is posted to the User Interface.

Service Status	Further Meaning	Error Code	Behavior
Error	Cannot Process	C000 - CFFF	This is treated as a permanent Failure. A message is sent to the QUERY-RETRIEVE-SCP AE indicating an export failure, and the Association is released. The QUERY- RETRIEVE-SCP AE sends an appropriate status in the C-MOVE response. Error indication message is output to the Service Logs. No message is posted to the User Interface.

All Status Codes indicating an error or refusal are treated as a permanent failure. The STORAGE-SCU AE never automatically resends images when an error Status Code is returned in a C-STORE response.

For specific behavior regarding Status Code values returned in C-MOVE Responses, refer to the Services Supported as an SCP by the QUERY-RETRIEVE-SCP AE.

Table 3.2-11
STORAGE-SCU AE COMMUNICATION FAILURE BEHAVIOR

Exception	Behavior
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted using a DICOM A-ABORT, and a message is sent to the QUERY-RETRIEVE-SCP AE indicating an export failure. The QUERY-RETRIEVE-SCP AE sends an appropriate Status in the C-MOVE response. Error indication message is output to the Service Logs.
Association A-ABORTed by the SCP or the network layers indicate communication loss (e.g., low-level TCP/IP socket closure)	A retry attempts to establish another association and resumes the transfer. An error indication message is output to the Service Logs.

3.2.1.4 Association Acceptance Policy

The STORAGE-SCU AE does not accept Associations.

3.2.2 QUERY-RETRIEVE-SCP Application Entity Specification

3.2.2.1 SOP Classes

The QUERY-RETRIEVE-SCP AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 3.2-13
SOP CLASSES FOR QUERY-RETRIEVE-SCP AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	No	Yes
Patient Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	No	Yes
Patient Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	No	Yes
Study Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	No	Yes
Study Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	No	Yes
Modality Worklist Information Model – FIND	1.2.840.10008.1.20.1	No	Yes
Storage SOP Classes in table 3.2-1	See table 3.2-1	No	Yes

Note: Image data queries are default disabled and need to be enabled for a given caller.

3.2.2.2 Association Policies

3.2.2.2.1 General

The QUERY-RETRIEVE-SCP AE does not initiate Associations. It only accepts Association Requests from external DICOM AEs. The QUERY-RETRIEVE-SCP AE accepts Associations for Verification, C-FIND, and C-MOVE requests. In the case of a C-MOVE request, the QUERY-RETRIEVE-SCP AE issues a command to the STORAGE-SCU AE to initiate an Association with the Destination DICOM AE to send images as specified by the originator of the C-MOVE Request.

The DICOM standard Application Context Name for DICOM 3.0 is always accepted:

Table 3.2-14
DICOM APPLICATION CONTEXT FOR QUERY-RETRIEVE-SCP AE

Application Context Name	1.2.840.10008.3.1.1.1

3.2.2.2.2 Number of Associations

The QUERY-RETRIEVE-SCP AE can support multiple simultaneous Associations. Each time the QUERY-RETRIEVE-SCP AE receives an Association, a child process spawns to process the Verification, Query, or Retrieval request.

Table 3.2-15
NUMBER OF SIMULTANEOUS ASSOCIATIONS AS A SCP FOR QUERY-RETRIEVE-SCP AE

Maximum number of simultaneous Associations	**No set limit**

Note: Semperdata has no limitation on how many associations can establish as C-STORE SCU, but this is also limited by how many C-MOVE requests it receives. As a SCP (Query-Retrieve or STORE), Semperdata has an imposed limit of 100 (configurable) simultaneous associations from a given Host.

3.2.2.2.3 Asynchronous Nature

The QUERY-RETRIEVE-SCP AE does not support asynchronous communication (multiple outstanding transactions over a single Association). All Association requests must be completed and acknowledged before a new operation can be initiated.

Table 3.2-16
ASYNCHRONOUS NATURE AS A SCP FOR QUERY-RETRIEVE-SCP AE

Maximum number of outstanding asynchronous transactions	0

3.2.2.2.4 Implementation Identifying Information

The implementation information for the Application Entity is:

Table 3.2-17
DICOM IMPLEMENTATION CLASS AND VERSION FOR QUERY-RETRIEVE-SCP AE

Implementation Class UID	1.3.6.1.4.1.16592.1.3
Implementation Version Name	Semperdata_1.0

Note that this AE uses the same Implementation Class UID as the other network AEs. All SEMPERDATA® AEs use the same Implementation Version Name. The Version Name is updated with each new software product release that changes DICOM behavior.

3.2.2.3 Association Initiation Policy

The QUERY-RETRIEVE-SCP AE does not initiate Associations.

3.2.2.4 Association Acceptance Policy

3.2.2.4.1 Activity – Query Retrieval Request

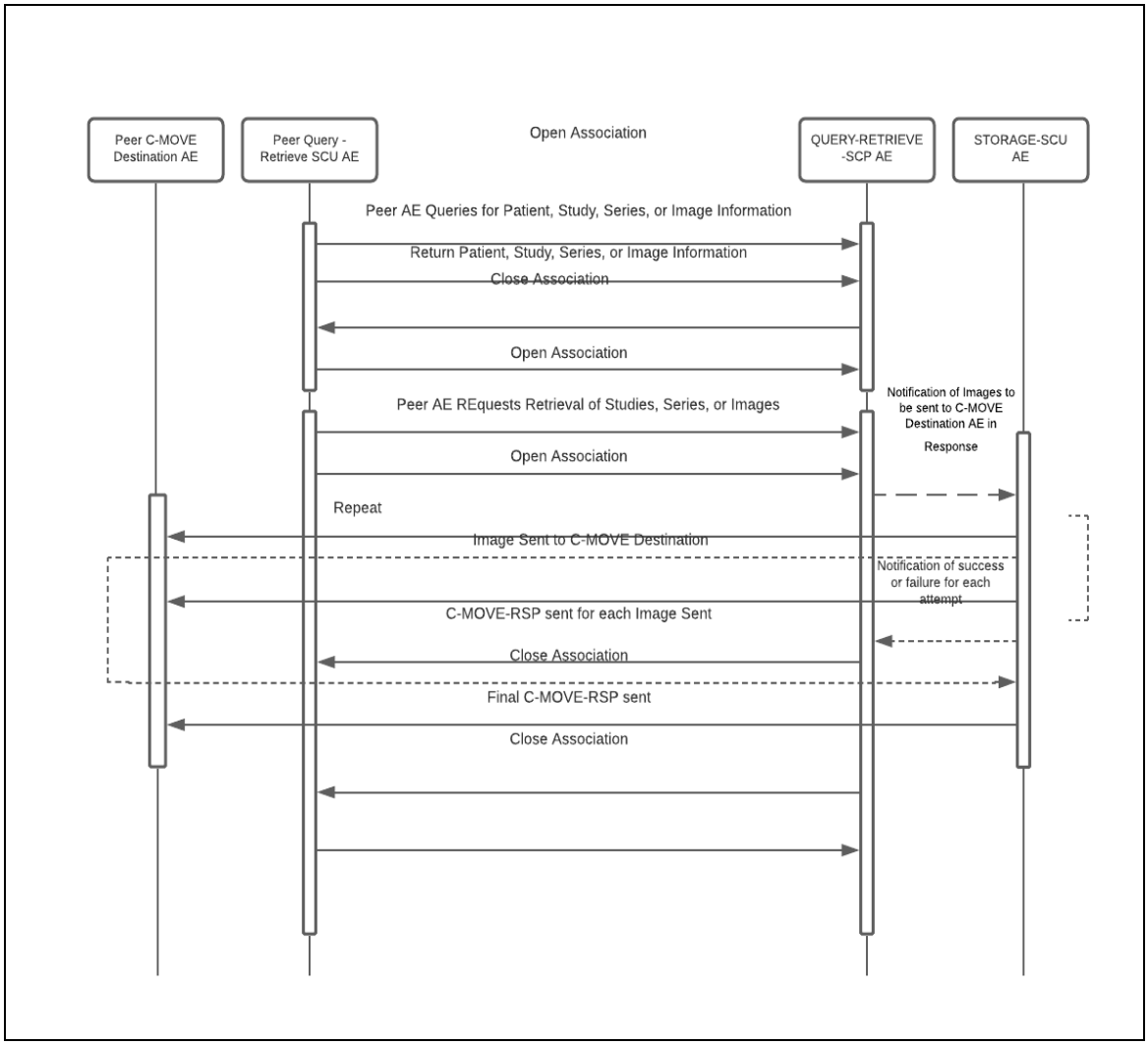
3.2.2.4.1.1 Description and Sequencing of Activity

The QUERY-RETRIEVE-SCP AE accepts Associations only if they have valid Presentation Contexts. If none of the requested Presentation Contexts are accepted, the Association Request itself is rejected. It can be configured to only accept Associations with certain hosts (using TCP/IP address) and/or Application Entity Titles.

If the QUERY-RETRIEVE-SCP AE receives a query (C-FIND) request, the response is sent over the same Association used to send the C-FIND-Request.

If the QUERY-RETRIEVE-SCP AE receives a retrieve request (C-MOVE), the responses are sent over the same Association used to send the C-MOVE-Request. The QUERY-RETRIEVE-SCP AE notifies the STORAGE-SCU to send the requested SOP Instances to the C-MOVE Destination. The STORAGE-SCU AE notifies the QUERY-RETRIEVE-SCP AE of the success or failure of each attempt to send a Composite SOP Instance to the peer C-MOVE Destination AE. The QUERY-RETRIEVE-SCP AE then sends a C-MOVE response indicating this status after each attempt. Once the STORAGE-SCU AE has finished attempting to transfer all the requested SOP Instances, the QUERY-RETRIEVE-SCP AE sends a final C-MOVE Response indicating the overall status of the attempted retrieval.

Figure 3.2-2
Sequencing of Activity – Handling Query and Retrieval Requests



The following sequencing constraints illustrated in *Figure 3.2-2* apply to the QUERY-RETRIEVE-SCP AE for handling queries (C-FIND-Requests):

1. Peer AE opens an Association with the QUERY-RETRIEVE-SCP AE
2. Peer AE sends a C-FIND-RQ Message
3. QUERY-RETRIEVE-SCP AE returns a C-FIND-RSP Message to the peer AE with matching information. A C-FIND-RSP is sent for each entity matching the identifier specified in the C-FIND-RQ. A final C-FIND-RSP is sent, indicating that the matching is complete.

4. Peer AE closes the Association. Note that the peer AE does not have to close the Association immediately. Further C-FIND or C-MOVE Requests can be sent over the Association before it is closed.

The following sequencing constraints illustrated in *Figure3.2-2* apply to the QUERY-RETRIEVE-SCP AE for handling retrievals (C-MOVE-Requests):

1. Peer AE opens an Association with the QUERY-RETRIEVE-SCP AE.
2. Peer AE sends a C-MOVE-RQ Message.
3. QUERY-RETRIEVE-SCP AE notifies the STORAGE-SCU AE to send the Composite SOP Instances to the peer C-MOVE Destination AE as indicated in the C-MOVE-RQ.
4. After attempting to send a SOP Instance, the STORAGE-SCU AE indicates to the QUERY-RETRIEVE-SCP AE whether the transfer succeeded or failed. The QUERY-RETRIEVE-SCP AE then returns a C-MOVE-RSP indicating this success or failure.
5. Once the STORAGE-SCU AE has completed all attempts to transfer the SOP Instances to the C-MOVE Destination AE, or the first failure occurred, the QUERY-RETRIEVE-SCP AE sends a final C-MOVE-RSP indicating the overall success or failure of the retrieval.
6. Peer AE closes the Association. Note that the peer AE does not have to close the Association immediately. Further C-FIND or C-MOVE Requests can be sent over the Association before it is closed.

The QUERY-RETRIEVE-SCP AE may reject Association attempts, as shown below. The Result, Source, and Reason/Diag columns represent the values returned in the corresponding fields of an ASSOCIATE-RJ PDU (see DICOM *PS 3.8*, Section *9.3.4*). The following abbreviations are used in the Source column:

- 1 – DICOM UL service-user
- 2 – DICOM UL service-provider (ASCE related function)
- 3 – DICOM UL service-provider (Presentation related function)

Table 3.2-18
ASSOCIATION REJECTION REASONS

Result	Source	Reason/Diag	Explanation
1 – rejected-permanent	a	3 – calling-AE- title-not-recognized	The Association request contained an unrecognized Calling AE Title. An Association request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason normally occurs when the Association acceptor has not been configured to recognize the AE Title of the Association initiator.

Result	Source	Reason/Diag	Explanation
1 – rejected-permanent	b	1 – no-reason-given	The Association request could not be parsed. An Association request with the same format will not succeed at a later time.

3.2.2.4.1.2 Accepted Presentation Contexts

QUERY-RETRIEVE-SCP AE accepts Presentation Contexts as shown in the following table:

Table 3.2-19
ACCEPTED PRESENTATION CONTEXT BY THE QUERY-RETRIEVE-SCP AE

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name**	**UID**		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Patient Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2		
Patient Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2		
Study Root QR Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2		
	1.2.840.10008.5.1.4.1.2.2.2	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

Presentation Context Table					
Study Root Q/R Information Model - MOVE		DICOM Implicit VR Little Endian	1.2.840.10008.1.2		

3.2.2.4.1.3 SOP Specific Conformance for Query SOP Classes

The QUERY-RETRIEVE-SCP AE supports hierarchical queries and not relational queries. There are no attributes always returned by default. Only those attributes requested in the query identifier are returned. Query responses always return values from the Semperdata® database. Exported SOP Instances are constantly updated with the latest values in the database before export. Thus, both the C-FIND Responses and the Composite SOP Instances exported to a destination AE contain the same changes to patient demographic information.

Patient Root Information Model

All required search keys on each of the four levels (Patient, Study, Series, and Image) are supported. However, the Patient ID (0010,0020) key must have at least a partial value if the Patient's Name (0010,0010) is not present in a Patient Level query.

Study Root Information Model

All the required search keys on each level (Study, Series, and Image) are supported. If no partial values are specified for Study attributes, then either the Patient ID (0010,0020) key or the Patient's Name (0010,0010) must have at least a partial value specified.

The tables should be read as follows:

- **Attribute Name**: Attributes supported for returned C-FIND Responses.
- **Tag**: Appropriate DICOM tag for this attribute.
- **VR**: Appropriate DICOM VR for this attribute.
- **Types of Matching**: The types of Matching supported by the C-FIND SCP:
  - An "S" indicates the identifier attribute can specify Single Value Matching,
  - An "R" indicates Range Matching,
  - A "*" denotes Wildcard Matching,
  - A "U" indicates Universal Matching,
  - "L" indicates that UID lists are supported for matching, and

- "NONE" indicates that no matching is supported but that values for this Element in the database can be returned.

All queries are case insensitive matching.

The supported query elements below are extensible with configuration.

Table 3.2-20
PATIENT ROOT C-FIND SCP SUPPORTED ELEMENTS

Level Name Attribute Name	Tag	VR	Types of Matching
Patient Level			
Patient's Name	(0010,0010)	PN	S,U,*
Patient ID	(0010,0020)	LO	S,U
Patient's Birth Date	(0010,0030)	DA	S,U
Patient's Birth Time	(0010,0032)	TM	NONE
Patient's Sex	(0010,0040)	CS	S,U
Other Patient IDs	(0010,1000)	LO	NONE
Other Patient Names	(0010,1001)	PN	NONE
Study Level			
Study ID	(0020,0010)	SH	S,U
Study Instance UID	(0020,000D)	UI	S,U
Study Date	(0008,0020)	DA	S,R,U
Study Time	(0008,0030)	TM	S,R,U
Accession Number	(0008,0050)	SH	S,U
Modalities in Study	0008,0061)	CS	S,U
Institution Name	(0008,0080)	LO	S,U
Referring Physician's Name	(0008,0090)	PN	S,U

Level Name Attribute Name	Tag	VR	Types of Matching
Study Description	(0008,1030)	LO	S,U
Number of Study related Images	(0020,1208)	IS	U
Series Level			
Modality	(0008,0060)	CS	S,U
Series Description	(0008,103E)	LO	S,U
Series Number	0020,0011)	IS	S,U
Series Instance UID	(0020,000E)	UI	S,U
Request Attribute Sequence	(0040,0275	SQ	
>Requested Procedure ID	(0040,1001)	SH	U
>Scheduled Procedure Step ID	(0040,0009)	SH	U
Performed Procedure Step Start Date	(0040,0244)	DA	U
Performed Procedure Step Start Time	(0040,0245)	TM	U
Body Part Examined	(0018,0015)	CS	S,U
Number of Series Related Instances	(0020,1209)	UI	NONE
Composite Instance Level			
Instance Number	(0020,0013)	IS	S,U
SOP Instance UID	(0020,0018)	UI	S,U
SOP Class UID	(0020,0016)	UI	S,U
Content Date	0008,0023)	DA	S,U
Image SOP Classes			
Samples per Pixel	(0028,0002)	US	U
Photometric Interpretation	(0028,0004)	CS	U
Number of Frames	(0028,0008)	IS	U

Level Name Attribute Name	Tag	VR	Types of Matching
Rows	(0028,0010)	US	U
Columns	(0028,0011)	US	U
Bits Allocated	(0028,0100)	US	U
High Bit	(0028,0102)	US	U
Pixel Representation	(0028,0103)	US	U
SR SOP Classes			
Referenced Request Sequence	(0040,A370)	SQ	
>Study Instance UID	(0020,000D)	UI	U
>Accession Number	(0008,0050)	SH	U
>Requested Procedure ID	(0040,1001)	SH	U
>Requested Procedure Code Sequence	(0032,1064	SQ	
>>Code Value	(0008,0100)	SH	S,U
>>Coding Scheme Designator	(0008,0102)	SH	S,U
>>Coding Scheme Version	(0008,0103)	SH	U
>>Code Meaning	(0008,0100)	LO	U
Content Template Sequence	(0040,A504)	SQ	
>Template Identifier	(0040,DB00)	CS	U
Key Object SOP Class			
Content Date	(0008,0023)	DA	U
Content Time	(0008,0033)	TM	U
Observation DateTime	(0040,A032)	DT	U
Referenced Request Sequence	(0040,A370)	SQ	
>Study Instance UID	(0020,000D)	UI	U

Level Name Attribute Name	Tag	VR	Types of Matching
>Accession Number	(0008,0050)	SH	U
>Requested Procedure ID	(0040,1001)	SH	U
>Requested Procedure Code Sequence	(0032,1064)	SQ	
>>Code Value	(0008,0100)	SH	U
>>Coding Scheme Designator	(0008,0102)	SH	U
>>Coding Scheme Version	(0008,0103)	SH	U
>>Code Meaning	(0008,0104)	LO	U
Concept Name Code Sequence	(0040,A043)	SQ	
>Code Value	(0008,0100)	SH	S,U

Table 3.2-21
STUDY ROOT C-FIND SCP SUPPORTED ELEMENTS

Level Name Attribute Name	Tag	VR	Types of Matching
Study Level			
Patient's Name	(0010,0010	PN	S,U,*
Patient ID	(0010,0020	LO	S,U
Patient's Birth Date	(0010,0030)	DA	S,U
Patient's Birth Time	(0010,0032)	TM	S,U
Patient's Sex	(0010,0040)	CS	S,U
Other Patient IDs	(0010,1000	LO	S,U
Other Patient Names	(0010,1001)	PN	S,U
Study Date	(0008,0020)	DA	R,U

Level Name Attribute Name	Tag	VR	Types of Matching
Study Time	(0008,0030)	TM	S,U
Accession Number	(0008,0050)	SH	S,U
Study ID	(0020,0010)	SH	S
Study Instance UID	(0020,000D	UI	S,U
Modalities in Study	(0008,0061)	CS	S,U
Institution Name	(0008,0080)	LO	S,U
Referring Physician's Name	(0008,0090)	PN	S,U
Study Description	(0008,1030)	LO	U
Number of Study Related Images	(0020,1208)	IS	S,U
Series Level			
Modality	(0008,0060)	CS	S,U
Series Description	(0008,103E)	LO	S,U
Series Number	0020,0011)	IS	S,U
Series Instance UID	(0020,000E)	UI	S,U
Request Attribute Sequence	(0040,0275	SQ	
>Requested Procedure ID	(0040,1001)	SH	U
>Scheduled Procedure Step ID	(0040,0009)	SH	U
Performed Procedure Step Start Date	(0040,0244)	DA	U
Performed Procedure Step Start Time	(0040,0245)	TM	U
Body Part Examined	(0018,0015)	CS	S,U
Number of Series Related Instances	(0020,1209)	UI	NONE
Composite Instance Level			
Instance Number	(0020,0013)	IS	S,U

Level Name Attribute Name	Tag	VR	Types of Matching
SOP Instance UID	(0020,0018)	UI	S,U
SOP Class UID	(0020,0016)	UI	S,U
Content Date	0008,0023)	DA	S,U
Image SOP Classes			
Samples per Pixel	(0028,0002)	US	U
Photometric Interpretation	(0028,0004)	CS	U
Number of Frames	(0028,0008)	IS	U
Rows	(0028,0010)	US	U
Columns	(0028,0011)	US	U
Bits Allocated	(0028,0100)	US	U
High Bit	(0028,0102)	US	U
Pixel Representation	(0028,0103)	US	U
SR SOP Classes			
Referenced Request Sequence	(0040,A370)	SQ	
>Study Instance UID	(0020,000D)	UI	U
>Accession Number	(0008,0050)	SH	U
>Requested Procedure ID	(0040,1001)	SH	U
>Requested Procedure Code Sequence	(0032,1064	SQ	
>>Code Value	(0008,0100)	SH	S,U
>>Coding Scheme Designator	(0008,0102)	SH	S,U
>>Coding Scheme Version	(0008,0103)	SH	U
>>Code Meaning	(0008,0100)	LO	U
Content Template Sequence	(0040,A504)	SQ	

Level Name Attribute Name	Tag	VR	Types of Matching
>Template Identifier	(0040,DB00)	CS	U
Key Object SOP Class			
Content Date	(0008,0023)	DA	U
Content Time	(0008,0033)	TM	U
Observation DateTime	(0040,A032)	DT	U
Referenced Request Sequence	(0040,A370)	SQ	
>Study Instance UID	(0020,000D)	UI	U
>Accession Number	(0008,0050)	SH	U
>Requested Procedure ID	(0040,1001)	SH	U
>Requested Procedure Code Sequence	(0032,1064)	SQ	
>>Code Value	(0008,0100)	SH	U
>>Coding Scheme Designator	(0008,0102)	SH	U
>>Coding Scheme Version	(0008,0103)	SH	U
>>Code Meaning	(0008,0104)	LO	U
Concept Name Code Sequence	(0040,A043)	SQ	
>Code Value	(0008,0100)	SH	S,U
>Coding Scheme Designator	(0008,0102)	SH	S,U
>Coding Scheme Version	(0008,0103)	SH	U
>Code Meaning	(0008,0104)	LO	U

Table 3.2-22
QUERY-RETRIEVE-SCP AE C-FIND RESPONSE STATUS RETURN BEHAVIOR

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	Matching is complete. No final identifier is supplied.
Failed	Unable to process	C001	No response is returned. An error message is an output to the Service Log.
Pending	Matches are continuing and current match is supplied.	FF00	Indicates that the search for further matches is continuing. This is returned when each successful match is returned and when further matches are forthcoming. This status code is returned if all Optional keys in the query identifier are actually supported.

3.2.2.4.2 Activity – Retrieve an Instance Move Request

3.2.2.4.2.1 Description and Sequencing of Activity

A remote system sends a request to move instances stored on Semperdata® to the destination AE of a remote system or to move instances from a remote system to the Semperdata® archive.

3.2.2.4.2.2 Accepted Presentation Contexts

Table 3.2-23
PRESENTATION CONTEXT TABLE FOR INSTANCE MOVE REQUEST

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Patient Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2		
Study Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2		

3.2.2.4.2.3 SOP Specific Conformance for Move SOP Classes

An initial C-MOVE Response is always sent after confirming that the C-MOVE request can be processed. After this, the QUERY-RETRIEVE-SCP AE returns a response to the C-MOVE SCU after the STORAGE-SCU AE has attempted to send each image. This response reports the number of remaining SOP Instances to transfer, and the number transferred having a successful, failed, or warning status.

If the Composite SOP Instances must be retrieved from the long-term archive before export, there may be quite a long delay between the first C-MOVE response and the next one after the attempt to export the first image. The maximum time for this delay depends on the archive but typically varies between 3 and 10 minutes.

The Priority attribute (0000,0700) of a C-MOVE command is not used to prioritize the request.

Table 3.2-24
QUERY-RETRIEVE-SCP AE C-MOVE RESPONSE STATUS RETURN BEHAVIOR

Exception	Behavior
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout). E.g., The QUERY-RETRIEVE-SCP AE is waiting for the next message PDU but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. Error message is output to the Service Log. If the STORAGE-SCU AE is still exporting Composite SOP Instances as a result of an earlier C-MOVE request received on this Association, it continues attempting to complete the entire C-MOVE request.
Association aborted by the SCU or the network layers indicate communication loss (e.g., low-level TCP/IP socket closure)	Error message is output to the Service Log. If the STORAGE-SCU AE is still exporting Composite SOP Instances as a result of an earlier C-MOVE request received on this Association, it continues attempting to complete the entire C-MOVE request.

3.2.3 STORAGE-SCP Application Entity Specification

3.2.3.1 SOP Classes

The STORAGE-SCP AE provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 3.2-25
SOP CLASSES FOR STORAGE-SCP AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	No	Yes
Storage Commitment Push Model	1.2.840.10008.1.20.1	No	Yes
All Composite Instance Storage SOP Classes, as included in Table 3.2-1		No	Yes

These are the default SOP Classes supported. It is possible to support additional or fewer SOP Classes by altering the configuration.

3.2.3.2 Association Policies

3.2.3.2.1 General

The STORAGE-SCP AE accepts Association Requests for Verification, Storage, and Storage Commitment Push Model. The AE proposes only the Storage Commitment Push Model.

The DICOM standard Application Context Name for DICOM 3.0 is always accepted and proposed:

Table 3.2-26
DICOM APPLICATION CONTEXT FOR STORAGE-SCP AE

Application Context Name	1.2.840.10008.3.1.1.1

3.2.3.2.2 Number of Associations

The STORAGE-SCP AE can support multiple simultaneous Associations requested by peer AEs. Each time the STORAGE-SCP AE receives an Association, a child processes the Storage request.

Table 3.2-27
NUMBER OF SIMULTANEOUS ASSOCIATIONS AS AN SCP FOR STORAGE-SCP AE

Maximum number of simultaneous Associations accepted	No set limit

3.2.3.2.3 Asynchronous Nature

The STORAGE-SCP AE does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 3.2-28
ASYNCHRONOUS NATURE AS A SCP FOR STORAGE-SCP AE

Maximum number of outstanding asynchronous transactions	0

3.2.3.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Table 3.2-29
DICOM IMPLEMENTATION CLASS AND VERSION FOR STORAGE-SCP AE

Implementation Class UID	1.3.6.1.4.1.16592.1.3
Implementation Version Name	Semperdata_1.0

Note: This AE uses the same Implementation Class UID as the other network AEs. All Semperdata® AEs use the same Implementation Version Name. The Version Name is updated with each new software product release that changes DICOM behavior.

3.2.3.3 Association Initiation Policy

3.2.3.3.1 SOP Specific Conformance for Verification SOP Class

Standard conformance is provided to the DICOM Verification Service Class as an SCU. The Verification Service as an SCU is supported as a diagnostic service tool for network communication.

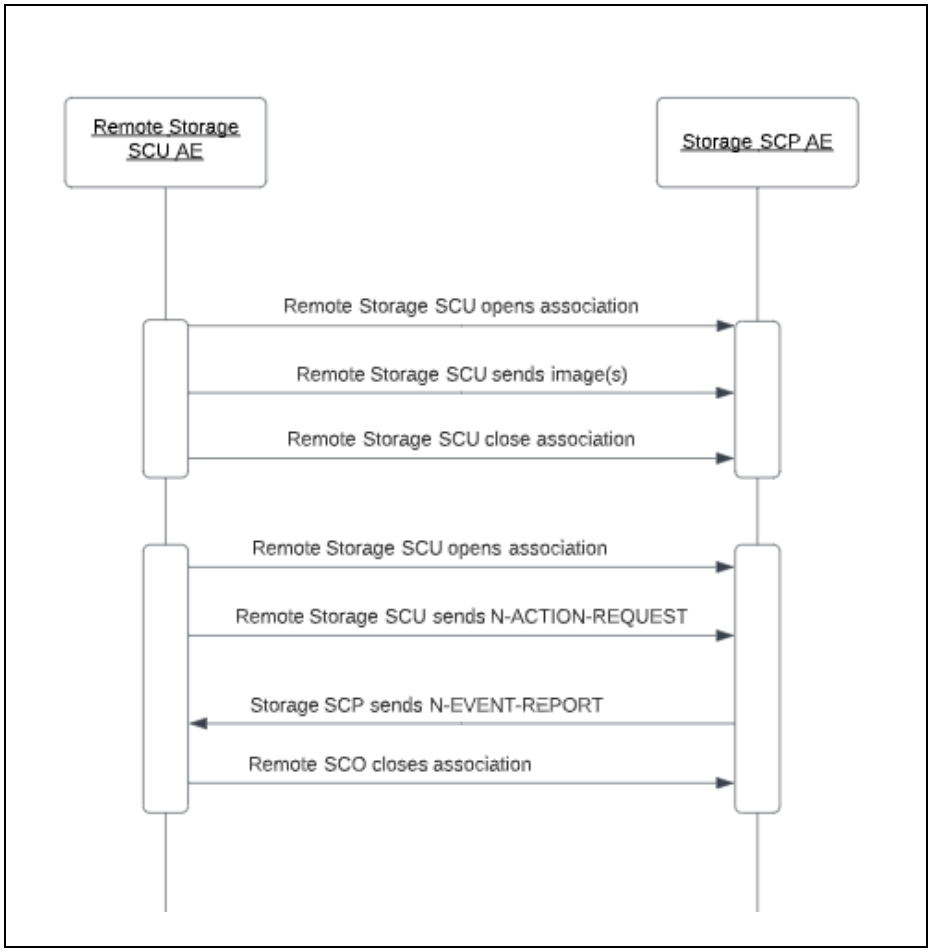
3.2.3.4 Association Acceptance Policy

3.2.3.4.1 Activity – Receive Instances and Storage Commitment Requests

3.2.3.4.1.1 Description and Sequencing of Activity

The STORAGE-SCP AE accepts Associations only if they have valid Presentation Contexts. If none of the requested Presentation Contexts are accepted, the Association Request is rejected. It can be configured to only accept Associations with certain hosts (using TCP/IP address) and/or Application Entity Titles. The remote SCU can request a Storage Commitment on the same association as shown below or on a separate association.

Figure 3.2-3
Sequencing of Activity – Storage Commitment



The STORAGE-SCP AE may reject Association attempts, as shown in the table below. The Result, Source, and Reason/Diag columns represent the values returned in the corresponding fields of an ASSOCIATE-RJ PDU (see DICOM *PS 3.8, Section 9.3.4*). The following abbreviations are used in the **Source** column:

- 1 – DICOM UL service-user
- 2 – DICOM UL service-provider (ASCE related function)
- 3 – DICOM UL service-provider (Presentation related function)

Table 3.2-30
ASSOCIATION REJECTION REASONS

Result	Source	Reason/Diag	Explanation
1 – rejected-permanent	a	3 – calling-AE- title-not- recognized	The Association request contained an unrecognized Calling AE Title. An Association request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason normally occurs when the Association acceptor has not been configured to recognize the AE Title of the Association initiator.
1 – rejected-permanent	b	1 – no-reason-given	The Association request could not be parsed. An Association request with the same format will not succeed at a later time.

3.2.3.4.1.2 Accepted Presentation Contexts

The default behavior of the STORAGE-SCP AE supports the Implicit VR Little Endian and Explicit VR Little Endian Transfer Syntaxes for all Associations.

When multiple Transfer Syntaxes are proposed, the SCP chose according to the following rules:

- The SCP accepts ELE over ILE.
- Lossless compression takes precedence over uncompressed (ELE or ILE).
- A lossy transfer syntax is never accepted in favor of a lossless syntax (lossless compressed or uncompressed).

Any of the Presentation Contexts shown in the following table are acceptable to the STORAGE-SCP AE for receiving images.

Table 3.2-31
ACCEPTED PRESENTATION CONTEXTS BY STORAGE-SCP AE

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name**	**UID**		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1		Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1		Big Endian Explicit	1.2.840.10008.1.2.2	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]): Default Transfer Syntax for Lossless JPEG Image Compression	1.2.840.10008.1.2.4.70	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1		JPEG Baseline (Process 1): Default Transfer Syntax for	1.2.840.10008.1.2.4.50	SCU	None

Presentation Context Table				
	Lossy JPEG 8 Bit Image Compression			
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	JPEG Extended (Process 2 & 4): Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)	1.2.840.10008.1.2.4.51	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	JPEG syntaxes (Retired)	1.2.840.10008.1.2.4.52 through 1.2.840.10008.1.2.4.66	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	JPEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	MPEG2 Main Profile / Main Level	1.2.840.10008.1.2.4.100	SCU	None
Any Composite Instance Storage SOP Class, as included in Table 4.2-1	RLE Lossless	1.2.840.10008.1.2.5	SCU	None

Note: For Semperdata® Router the list of accepted Presentation Context includes Transfer Syntaxes from TABLE 3.2-8 in section *Activity – Send Images.* The Router will accept proposed presentation contexts that include these transfer syntaxes but will not apply any transfer syntax transformations to them. All received datasets will be forwarded (via DICOM C-STORE SCU Send Instance) in the exact same representation.

3.2.3.4.1.3 SOP Specific Conformance for Verification SOP Class

The STORAGE-SCP AE provides standard conformance to the Verification SOP Class as an SCP.

3.2.3.4.1.4 SOP Specific Conformance for Storage SOP Classes

The associated Activity with the Storage service is the storage of medical image data received over the network on internal storage or designated virtual storage. The STORAGE-SCP AE returns a failure status if it cannot store the images in the internal storage or designated virtual storage.

The STORAGE-SCP AE does not have any dependencies on the number of Associations used to send images to it.

- Images belonging to more than one Study or Series can be sent over a single or multiple Associations.
- Images belonging to a single Study or Series can also be sent over different Associations.

There is no limit on the number of SOP Instances or the maximum amount of total SOP Instance data that can be transferred over a single Association.

The behavior for handling duplicate SOP Instances is configurable.

The default behavior is to assign a new SOP Instance UID to a received SOP Instance if it conflicts with an existing SOP Instance UID. An alternative configuration is possible that causes the original object with the conflicting SOP Instance UID to be replaced by the new SOP Instance. This behavior is most commonly enabled if a Storage SCU re-sends entire Studies or Series if a single failure occurs when sending a group of SOP Instances.

The STORAGE-SCP AE is configured to retain the original DICOM data in DICOM Part 10 compliant file format. The STORAGE-SCP AE is Level 2 (Full) conformant as a Storage SCP. In addition, all Private and SOP Class Extended Elements are maintained in the DICOM format files.

A subset of the file's Elements are in the database to support query and retrieval requests and also allow updating of Patient, Study, and Series information by user input or demographic and Study-related messages. Refer to the *ANNEXES* for the list of Elements that are checked and/or processed upon receiving a Composite SOP Instance.

The SCP can route composite instances to other destinations based on a configuration. Upon receiving an instance, the SCP saves the instance to a local cache, and applies a filter to determine the STORAGE SCP destinations. Filtering matches DICOM tags such as Modality, SOP Class UID, Study Date. For details, see Semperdata Router® - Product Guide.

For image display on the Administrative Web user interface, the system supports the following photometric interpretations:

- MONOCHROME1,
- MONOCHROME2,
- RGB,
- PALETTE COLOR,
- YBR FULL 422, and
- YBR FULL.

The display of information conveyed using the DICOM Curve Module is not supported. Graphic overlay data sent either embedded in the unused image pixel data bits or the separate Overlay Data Element is supported for display. Region of Interest overlays are not supported. Suppose an image's SOP Instance specifies an aspect ratio that is not one-to-one. In that case, the image data is automatically resized when displayed on the system monitor so that they are always displayed in a one-to-one aspect ratio.

Table 3.2-32
STORAGE-SCP AE C-STORE RESPONSE STATUS RETURN REASONS

Service Status	Further Meaning	Error Code	Reason
Success	Success	0000	The Composite SOP Instance was successfully received, verified, and stored in the system database.
Failed	Unable to process	C001	The instance as not received and stored.

Note: If a failure condition occurs when handling an Association, all images previously received successfully over the Association are maintained in the SEMPERDATA® database. No previously successfully received images are discarded. Even if an image is successfully received, but an error occurs transmitting the C-STORE Response, this final image is maintained rather than discarded. If the loss of an Association is detected, then the Association is closed.

The Behavior of STORAGE-SCP AE during communication failure is summarized in the following table:

Table 3.2-33
STORAGE-SCP AE STORAGE SERVICE COMMUNICATION FAILURE REASONS

Exception	Reason
Timeout for an expected DICOM	The Association is aborted by issuing a DICOM A-ABORT.
Message Request (DIMSE level timeout). E.g., The STORAGE-SCP AE is waiting for the next C-STORE Request on an open Association but the timer expires.	Error message is output to the Service Log. If some Composite SOP Instances have already been successfully received, they are maintained in the database. They are not automatically discarded because of a later failure.
Timeout for an expected DICOM PDU or TCP/IP packet (Low-level timeout). E.g., The STORAGE-SCP AE is waiting for the next C-STORE Data Set PDU but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. Error message is output to the Service Log. If a C-STORE Data Set has not been fully received, then the data already received is discarded. If some Composite SOP Instances have already been successfully received over the Association, then they are maintained in the database.
Association aborted by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	Error message is output to the Service Log. If some Composite SOP Instances have already been successfully received, then they are maintained in the database. They are not automatically discarded because of a later failure.

3.2.3.4.1.5 SOP Specific Conformance for Rejection in Key Object Selection SOP Class

When receiving a Rejection Note in Key Object Selection SOP Class from a remote AE configured with permission, Semperdata sets the rejection status. The Rejection Note is stored, and the instances listed in the rejection note are marked in the database as hidden from queries and prevented from retrieval.

The table below describes the behavior for each Rejection Note type.

Table 3.2-34
BEAHVIOUR OF EACH REJECTION NOTE TYPE

Rejection Note Document Title	Behavior type
Rejected for Patient Safety Reasons	Hidden
Incorrect Modality Worklist Entry	Hidden

Rejection Note Document Title	Behavior type
Rejected for Quality Reasons	Hidden
Data Retention Policy Expired	Hidden

Semperdata allows users to configure a special Application Entity Title so that instances that are rejected for Quality Reason can be queried and retrieved. If a new rejection note is received that rejects already rejected instances, then the second rejection note is ignored. However, if the second rejection note has other instances besides the original set, the new instances are also hidden. A rejection note that rejects a prior rejection note hides the prior rejection note.

3.2.4 QUERY-RETRIEVE-SCU Application Entity Specification

3.2.4.1 SOP Classes

Table 3.*2-8 ADDITIONAL TRANSFER SYNTAXES FOR SEMPERDATA® ROUTER SEND INSTANCES* specifies the SOP Classes the QUERY-RETRIEVE SCU AE supports.

3.2.4.1.1 SOP Specific Conformance for Query SOP Classes

The QUERY-RETRIEVE-SCU AE provides Standard Conformance to the following SOP Classes:

Table 3.2-35
SOP CLASSES FOR QUERY-RETRIEVE-SCP AE

SOP Class Name	SOP Class UID	SCU	SCP
Study Root Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Study Root Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No

3.2.4.2 Number of Associations

3.2.4.2.1 General

The QUERY-RETRIEVE-SCU AE initiates but never accepts associations.

3.2.4.2.2 Number of Associations

The AE sets no limit to the maximum number of simultaneous Associations.

Table 3.2-36
Number of Associations for STORAGE-SCU AE

Maximum number of simultaneous Associations	No set limit

3.2.4.2.3 Asynchronous Nature

The STORAGE-SCU AE does not support asynchronous communication (multiple outstanding transactions over a single Association). All Association requests must be completed and acknowledged before initiating a new operation.

Table 3.2-37
ASYNCHRONOUS NATURE AS A SCU FOR QUERY-RETRIEVE AE

Maximum number of outstanding asynchronous transactions	0

3.2.4.2.4 Implementation Identifying Information

Table 3.2-38
DICOM IMPLEMENTATION CLASS AND VERSION FOR QUERY-RETRIEVE-SCU AE

Implementation Class UID	1.3.6.1.4.1.16592.1.3
Implementation Version Name	Semperdata_1.0

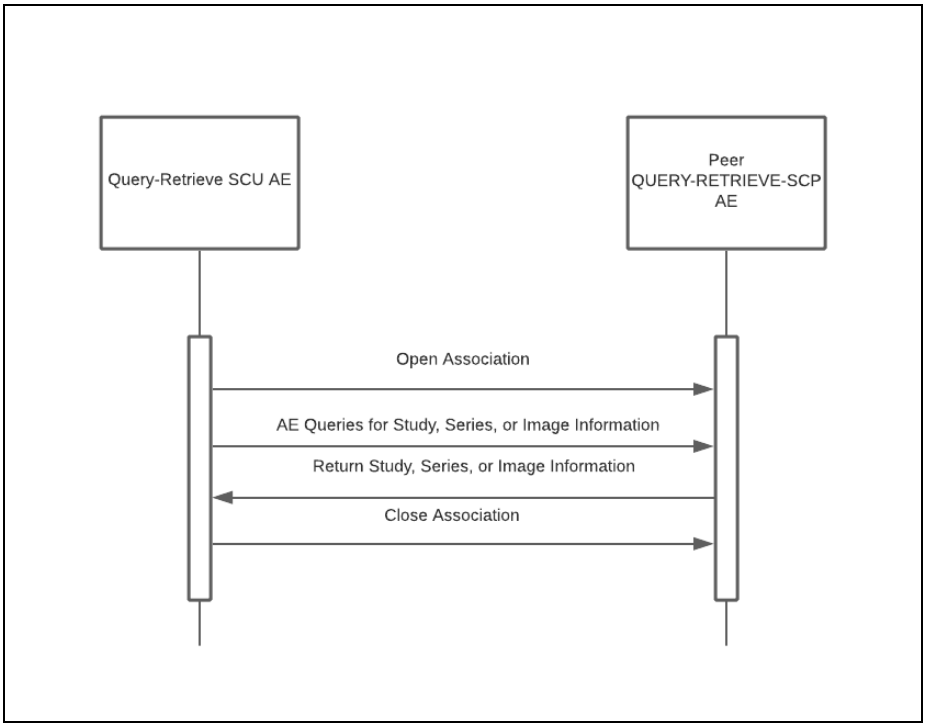
Note: This AE uses the same Implementation Class UID as the other network AEs. All Semperdata® AEs use the same Implementation Version Name. The Version Name is updated with each new software product release that changes DICOM behavior.

3.2.4.3 Association Initiation Policy

3.2.4.3.1 Activity – Query Remote AE

3.2.4.3.1.1 Description and Sequencing of Activities

Figure 3.2-4
Sequencing of Activity – Query for Inventory or Inventory Assessment



3.2.4.3.1.2 Proposed Presentation Contexts

Table 3.2-39
Proposed Presentation Contexts for QUERY-RETRIEVE-SCU to Query Remote AE

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name**	**UID**		
		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Presentation Context Table				
See Table 3.2-1 STANDARD STORAGE SOP CLASSES in section *AE Specifications*	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

3.2.4.3.1.3 Extended Negotiation

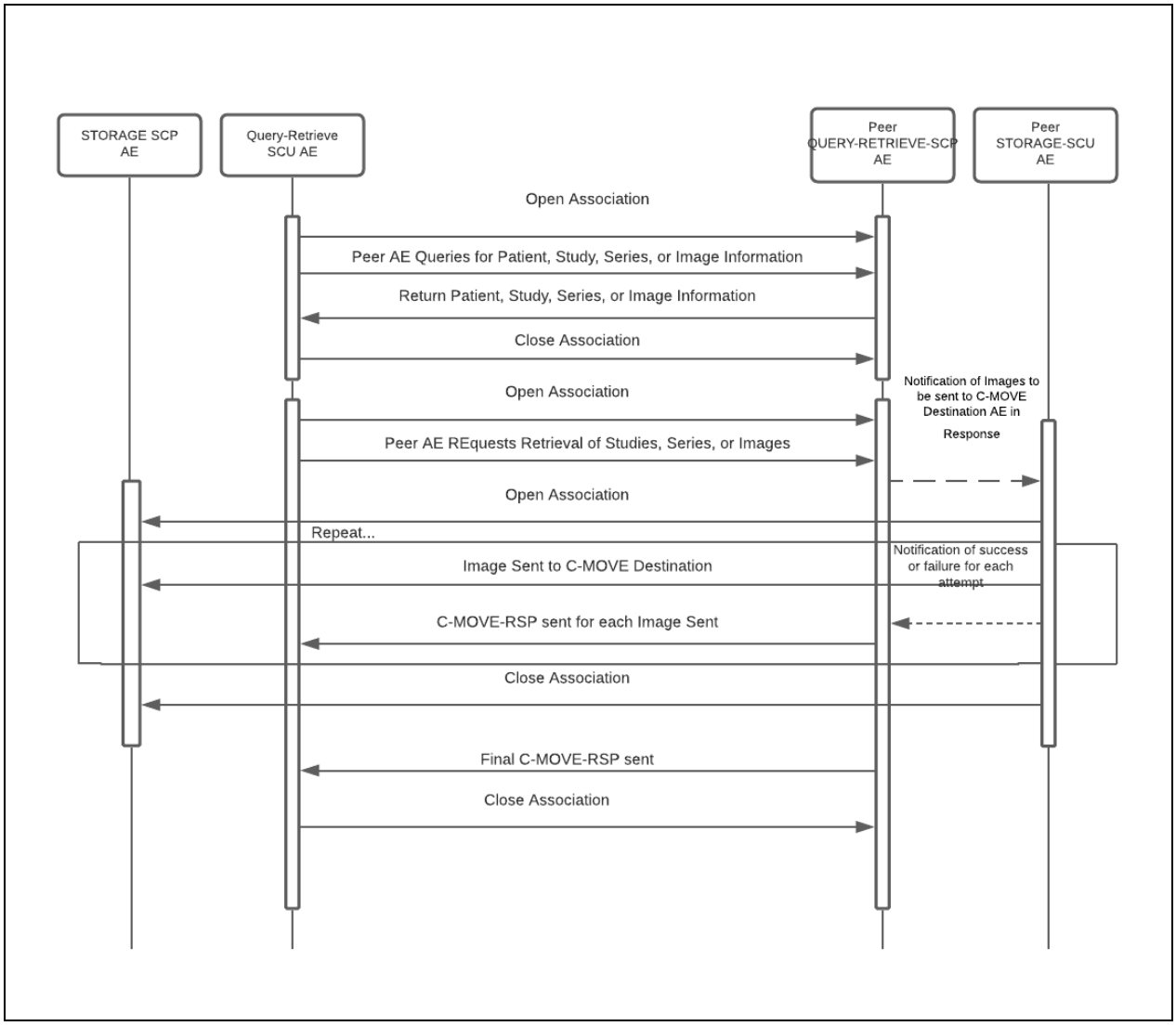
The SCU uses no extended negotiation or relational queries.

3.2.4.3.2 Activity – Move Instances

Migration inbound streams send move requests to a storage AE on a source PACS to move the instances of the queried studies in the local Semperdata® archive.

3.2.4.3.2.1 Description of Sequencing of Activities

Figure 3.2-5
Sequencing of Activity – Query-Retrieve



3.2.4.3.2.2 Proposed Presentation Contexts

Table 3.2-40
Proposed Presentation Contexts for QUERY-RETRIEVE-SCU to Query Remote AE

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name**	**UID**		
See Table 3.2-35	See Table 3.2-35	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

3.2.4.3.2.3 Extended Negotiation

No extended negotiation.

3.2.4.3.3 SOP Specific Performance

3.2.4.3.3.1 SOP Specific Conformance to C-FIND SOP Classes

Queries are initiated at the highest level of the information model (the STUDY level). The query is repeated at the next lower level (the SERIES) for each response received to find the instances available on the remote AE from where the images are retrieved.

No CANCEL requests are ever issued.

3.2.4.3.3.2 Presentation Context Selection Criteria

The Query-Retrieve SCU does not accept associations.

3.2.4.3.3.3 Transfer Syntax Selection Policies

The Query-Retrieve SCU prefers explicit Transfer Syntaxes. If offered a choice of Transfer Syntaxes in the accepted Presentation Contexts, it applies the following priority to the choice of Presentation Context to use for the C-STORE operation:

- First encountered explicit Transfer Syntax,

- Default Transfer Syntax.

3.2.4.3.3.4 SOP Specific Conformance to C-MOVE SOP Classes

No CANCEL requests are ever issued.

The retrieval is performed from the AE specified in the Retrieve AE attribute returned from the query performed by QUERY-RETRIEVE-SCU. The instances are retrieved to the current application's local database by specifying the destination as the AE Title of the STORE-SCP AE of the local application. This implies that the remote C-MOVE SCP must be preconfigured to determine the presentation address corresponding to the STORE-SCP AE. The STORE-SCP AE accepts storage requests addressed to it from anywhere, so no pre-configuration of the local application to accept from the remote AE is necessary (except in so far as it was necessary to configure QUERY-RETRIEVE -SCU).

3.2.5 WORKLIST-QUERY-SCU Application Entity Specification

3.2.5.1 SOP Classes

Table 3.2-41
SOP CLASSES FOR PREFETCH AE

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No

3.2.5.2 Association Polices

3.2.5.2.1 General

Table 3.2-42
DICOM APPLICATION CONTEXT FOR AE WORKLIST-QUERY SCU

Application Context Name	1.2.840.10008.3.1.1.1

3.2.5.2.2 Number of Associations There is one Worklist request per Association.

Table 3.2-43
NUMBER OF ASSOCIATIONS FOR WORKLIST QUERIES

Maximum number of simultaneous associations	1

3.2.5.2.3 Asynchronous Nature

There is no asynchronous communication (multiple outstanding transactions over a single Association).

Table 3.2-44
ASYNCHRONOUS NATURE AS A SCU FOR WORKLIST-QUERY-SCU AE

Maximum number of outstanding asynchronous transactions	0

3.2.5.2.4 Implementation Identifying Information

Table 3.2-45
DICOM IMPLEMENTATION CLASS AND VERSION FOR WORKLIST-QUERY-SCU AE

Implementation Class UID	1.3.6.1.4.1.16592.1.3
Implementation Version Name	Semperdata_1.0

Note: This AE uses the same Implementation Class UID as the other network AEs. All Semperdata® AEs use the same Implementation Version Name. The Version Name is updated with each new software product release that changes DICOM behavior.

3.2.5.3 Association Initiation Policy

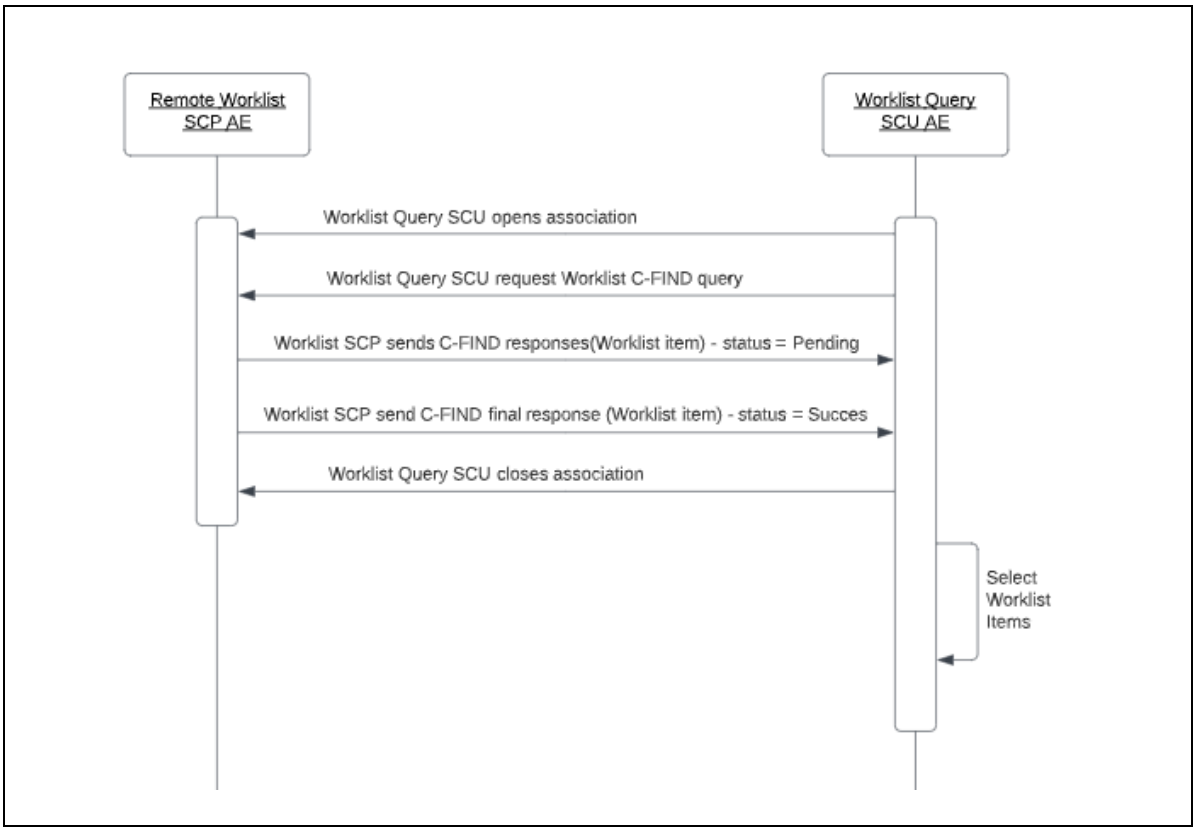
3.2.5.3.1 Activity – Worklist Update

3.2.5.3.1.1 Description and Sequencing of Activities

A scheduled pre-fetch process requests a Worklist Update at configurable periodic intervals.

Figure 3.2-6

Sequencing of Activity – Worklist Query SCU



3.2.5.3.1.2 Proposed Presentation Contexts

Table 3.2-46

PROPOSED PRESENTATION CONTEXTS FOR ACTIVITY WORKLIST UPDATE

Presentation Context Table			
Abstract Syntax	**Transfer Syntax**	**Role**	

Presentation Context Table					
Name	**UID**	**Name List**	**UID List**		**Ext. Neg.**
Modality Worklist Information Model - FIND	1.2.840.10008.5.1. 4.31	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

3.2.5.3.1.3 SOP Specific Conformance for Modality Worklist Query

Table 3.2-47
MODALITY WORKLIST COMMUNICATION FAILURE BEHAVIOR

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete	0000	The SCP has completed the matches. Worklist items are available for pre-fetch handling.
*	*	Any other status code.	No action.

Table 3.2-48
WORKLIST REQUEST IDENTIFIERS

Module Name	Attriubute Name	Tag	VR	Q	R
	Institution Name	(0008,0080)	LO		X
	Study Date	(0008,0020	DA	X	
Scheduled Procedure Step	Scheduled Procedure Step Sequence	(0040,0100)	SQ	X	
	Scheduled Procedure Step Start Date	(0040,0002)	DA	X	X
	Scheduled Procedure Step Start Time	(0040,0003)	TM		X
	Modality	(0008,0060)	CS		X

Module Name	Attriubute Name	Tag	VR	Q	R
	Scheduled Procedure Step Description	(0040,0007)	LO		X
Patient Identification	Patient Name	(0010,0010)	PN		X
	Patient ID	(0010,0020)	LO		X
	Patient's Birth Date	(0010,0030)	DA		X
	Patient Sex	(0010,0040)	CS		X
	Body Part examined	(0018,0015)	CS		X

Note: This list is extendable via configurations and Laitek can add additional DICOM tags.

The above table columns are:

- **Module Name**: The name of the associated module for supported worklist attributes.
- **Attribute Name**: Attributes supported to build an EXAMPLEINTEGRATED-MODALITY Worklist Request Identifier.
- **Tag**: DICOM tag for this attribute.
- **VR**: DICOM VR for this attribute.
- **R**: Return keys. An "x" indicates that this attribute is a Return Key with zero length for Universal Matching.
- **Q**: Interactive Query Key. An "x" " indicates that this attribute is configurable to be a matching key.
- **IOD**: An "x" indicates that this Worklist attribute is included into all Object Instances created during performance of the related Procedure Step.

3.2.6 WORKLIST-QUERY-SCP Application Entity Specification

3.2.6.1 SOP Classes

Table 3.2-49
SOP CLASSES FOR WORKLIST QUERY ROUTER APPLICATION ENTITY (SCP)

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	Yes

3.2.6.2 Association Policies

3.2.6.2.1 General

Table 3.2-50
DICOM APPLICATION CONTEXT FOR AE WORKLIST-QUERY SCP

Application Context Name	1.2.840.10008.3.1.1.1

3.2.6.2.2 Number of Associations

There can be multiple simultaneous associations request to the WORKLIST-QUERY SCP. The maximum number of simultaneous associations is configurable. The default value is 100 associations. Each received association will trigger at least one Modality Worklist Informational Modal – FIND request as a SCU. The maximum number of the requested associations is strictly related to the maximum number of associations accepted by the SCP (max 100).

Table 3.2-51
NUMBER OF ASSOCIATIONS FOR WORKLIST QUERIES

Maximum number of simultaneous associations received	100
Maximum number of simultaneous associations requested	100

3.2.6.2.3 Asynchronous Nature

There is no asynchronous communication (multiple outstanding transactions over a single Association).

Table 3.2-52
ASYNCHRONOUS NATURE AS A SCU FOR WORKLIST-QUERY-SCP AE

Maximum number of outstanding asynchronous transactions	0

3.2.6.2.4 Implementation Identifying Information

Table 3.2-53
DICOM IMPLEMENTATION CLASS AND VERSION FOR WORKLIST-QUERY-SCP AE

Implementation Class UID	1.3.6.1.4.1.16592.1.3
Implementation Version Name	Semperdata_1.0

Note: This AE uses the same Implementation Class UID as the other network AEs. All Semperdata® AEs use the same Implementation Version Name. The Version Name is updated with each new software product release that changes DICOM behavior.

3.2.6.3 Association Initialization Policy

3.2.6.3.1 Activity – Forward received MWL Query

3.2.6.3.1.1 Description and Sequencing of Activities

The Worklist Query SCP Application Entity, upon receiving a MWL Query from a Remote Worklist Query SCU forwards the request to a preconfigured Remote Modality Worklist SCP.

The sequencing diagram from "Activity - Receive MWL Query" reflects both activities: the receiving of the MWL Query and the forward of this Query to a Remote MWL SCP.

3.2.6.3.1.2 Proposed Presentation Contexts

Table 3.2-54
PROPOSED PRESENTATION CONTEXTS FROM WORKLIST-QUERY-SCP

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1. 4.31	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

3.2.6.3.1.3 SOP Specific Conformance for Modality Worklist Information Model – FIND SOP Class

The Worklist Query SCP Application entity forwards the received MWL Query to a Remote Worklist Query SCP. The Worklist Query SCP does not alter the MWL Query. All responses received from the Remote Worklist Query SCP are returned to the initial requester in conformance with the DICOM standard.

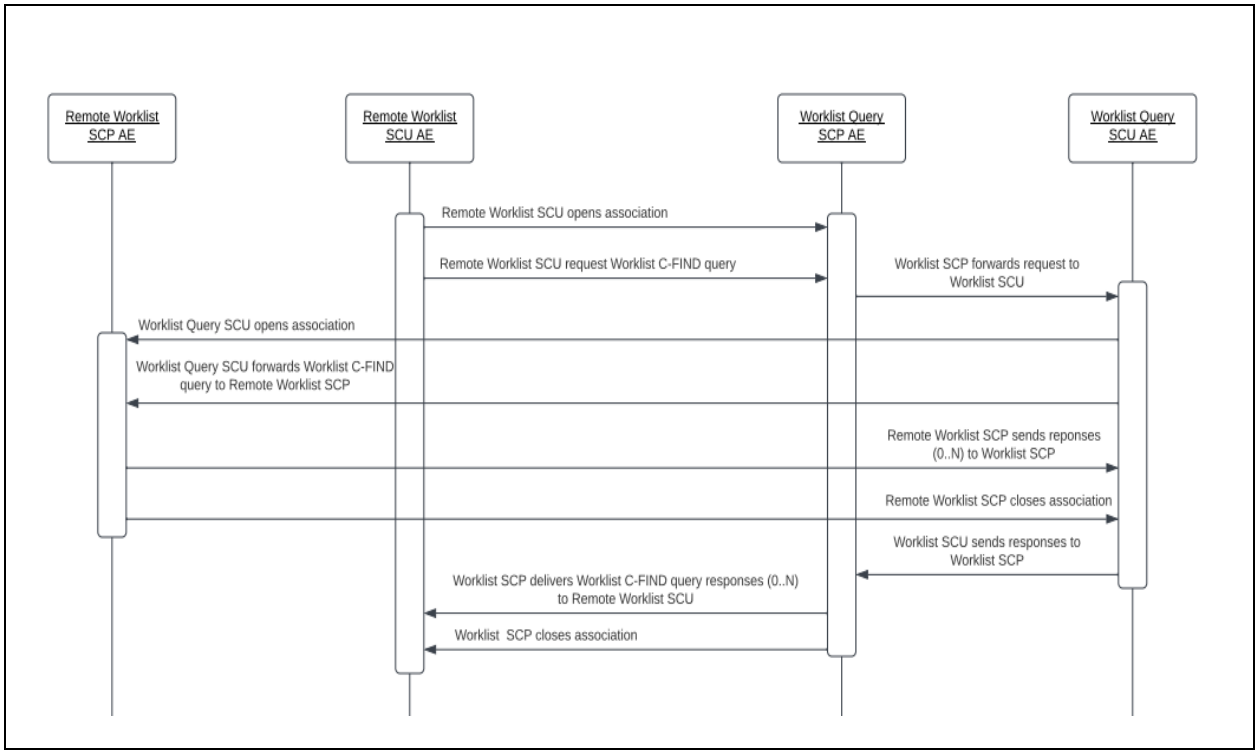
3.2.6.4 Association Acceptance Policy

3.2.6.4.1 Activity – Receive MWL Query

3.2.6.4.1.1 Description and Sequencing of Activities

The Worklist Query SCP Application Entity accepts associations only from Remote Query SCUs with configured permission. The query is forwarded to the Remote MWL SCP.

Figure 3.2-7
Sequencing of Activity – Worklist Query SCP



3.2.6.4.1.2 Accepted Presentation Contexts

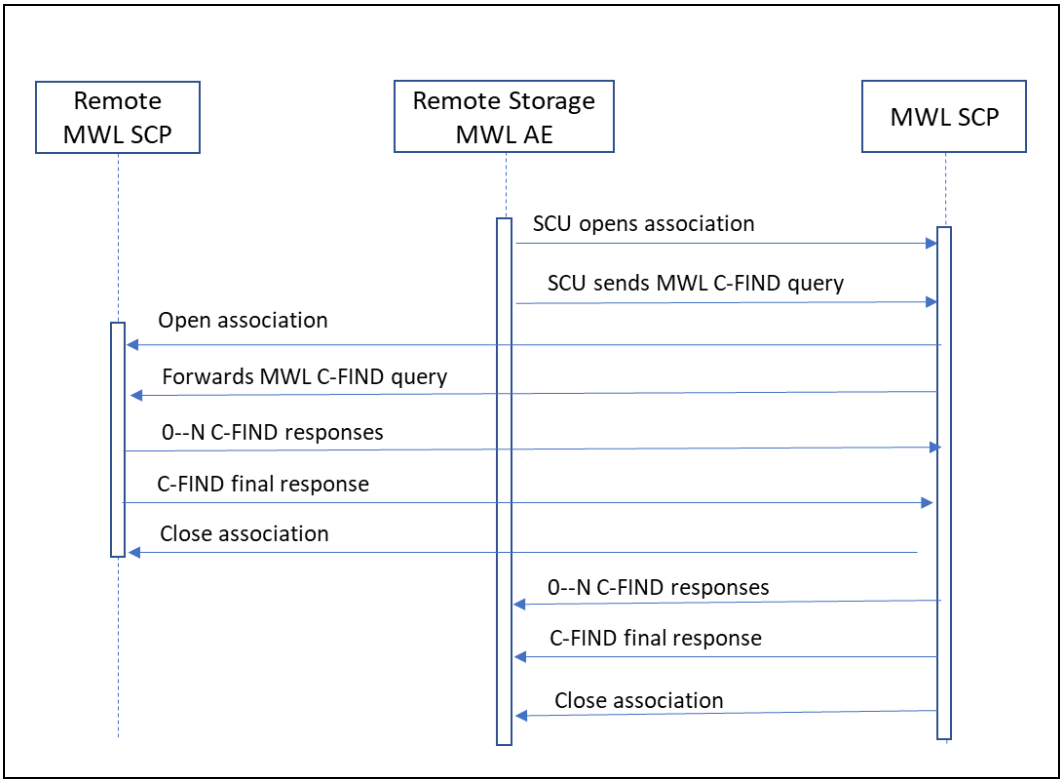
Table 3.2-55
ACCEPTED PRESENTATION CONTEXTS FROM WORKLIST-QUERY-SCP

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1. 4.31	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	None

3.2.6.4.1.3 SOP Specific Conformance for Modality Worklist Information Model – FIND SOP Class

The Worklist Query SCP Application entity accepts associations from any Remote Query SCU only if called with the above-specified presentation contexts, and the called Application Title from the received association request is configured in Router as a MWL SCP. In any other cases, the association is rejected. Once the association is accepted, the received MWL Query is forwarded to the configured Remote Worklist Query SCP. All received responses from the Remote Worklist Query SCP are sent back to the original remote requester.

Figure 3.2-8
Sequencing of Activity – SCU Requests MWL Query



3.3 NETWORK INTERFACES

3.3.1 Physical Network Interface

Semperdata® supports a single network interface. Any physical interface supported with TCP/IP on the Windows operating system can be used.

3.3.2 Additional Protocols

Semperdata® conforms to the System Management Profiles listed in *Table 3.3-1*. All requested transactions for the listed profiles and actors are supported. It does not support any optional transactions.

Table 3.3-1
SUPPORTED SYSTEM MANAGEMENT PROFILES

Profile Name	Actor	Protocols Used	Support
Network Address Management	DHCP Client	DHCP	Inherited from Windows Server OS
	DNS Client	DNS	Inherited from Windows Server OS

3.3.2.1 DHCP

When Windows Server OS is configured to use DHCP, it will obtain TCP/IP network configuration information from the DHCP server. The network parameters obtainable via DHCP are shown in *Table 3.3-2*. The **Default Value** column of the table shows the default used if the DHCP server does not provide a value, and static values are not configured in Windows Server OS. It is recommended to configured these in Windows when DHCP is not used.

Table 3.3-2
SUPPORTED DHCP PARAMETERS

DHCP Parameter	Default Value
IP Address	None
Hostname	Requested machine name
List of NTP servers	Empty list
List of DNS servers	Empty list
Routers	Empty list
Static routes	None
Domain name	None
Subnet mask	Derived from IP Address
Broadcast address	Derived from IP Address

DHCP Parameter	Default Value
Default router	None
Time offset	Site configurable (from Time zone)
MTU	Network Hardware Dependent
Auto-IP permission	No permission

The IP address assigned to the Semperdata server must be static. If Windows requests its IP address from DHCP, the IP address must be reserved. If the DHCP server refuses to renew a lease on the assigned IP address, all active DICOM Associations are aborted.

3.3.2.2 DNS

DNS can be used for address resolution. If DHCP is not in use or the DHCP server does not return any DNS server addresses, the identity of a DNS server can be configured via the Service/Installation Tool. Local mapping between hostname and IP address can be manually configured via the Service/Installation Tool if a DNS server is not in use.

3.3.2.3 NTP

Semperdata uses NetTime version 3.14 as a Network Time Synchronization Tool.

3.3.2.4 IPv4 and IPv6 Support

This product supports only IPv4.

3.4 CONFIGURATION

3.4.1 AE Title/Presentation Address Mapping

3.4.1.1 Local AE Titles

The mapping from AE Title to TCP/IP addresses and ports is configurable and set at the time of installation by the Installation Personnel or reconfigured by the archive administrator.

Table 3.4-1
DEFAULT APPLICATION ENTITY CHARACTERISTICS

Application Entity	Role	Default AE Title	Default TCP/IP Port
STORAGE-SCU	SCU	MIGR_STORESCU	None
STORAGE-SCP	SCP	MIGR_STORESCP	1977
QUERY-RETRIEVE-SCU	SCU	MIGR_QUERYSCU	None
QUERY-RETRIEVE-SCP	SCP	MIGR_QUERYSCP	1977
WORKLIST-QUERY-SCU	SCU	MIGR_QUERYSCU	None
WORKLIST-QUERY-SCP	SCP	No default. Need to be configured.	7701

The STORAGE-SCU and QUERY-RETRIEVE-SCP Application Entities can be configured to have the same AE Title. The STORAGE-SCP Application Entity must not have the same AE Title as the other two.

When configuring remote Application Entities, it is possible to encounter different AEs with the same AE Title. To overcome this problem of AE Titles that are not unique, the configuration supports AE Title aliases as a way to name an AE Title to a specific IP address, with its own AE Title, configurable association policies, and other AE specific behavior.

3.4.1.2 Remote AE Title/Presentation Address Mapping

The mapping of external AE Titles to TCP/IP addresses and ports is configurable. This mapping resolves the IP address and port of C-MOVE Destination Application Entities and must be correctly configured for the QUERY-RETRIEVE-SCP AE to function as a C-MOVE SCP correctly. The hostnames and IP addresses of the systems Semperdata communicates with must be static. As a security precaution, Semperdata uses DNS to verify that the hostname and IP address of another system has not changed since it was configured in Semperdata.

3.4.2 Parameters

Table 3.4-2
GENERAL CONFIGURATION PARAMETERS

Parameter	Configurable	Default Value
Local AE Title	Yes	AE_SAMPLE
Local port number	Yes	1234
Maximum PDU size the AE can receive	No	16 kbytes
Maximum PDU size the AE can send	No	16 kbytes inbound (SCP) 64 kbytes outbound (SCU)
Time-out waiting for response to TCP/IP connect()request. (Low-level timeout)	No	60 s
Time-out waiting for A-ASSOCIATE RQ PDU on open TCP/IP connection. (ARTIM timeout)	No	60 s
Time-out waiting for acceptance or rejection response to an Association Open Request. (Application Level timeout)	No	60s
Time-out waiting for acceptance of a TCP/IP message over the network. (Low-level timeout)	No	60 s
Time-out for waiting for data between TCP/IP packets. (Low-level timeout)	No	60 s
TCP/IP socket buffer size is set to 1,342,177 bytes in order to improve image data throughput performance.	No	1,342,177 bytes
Storage Commitment SCP timeout	yes	10 minutes

Table 3.4-3
STORAGE-SCU PARAMETERS

Parameter	Configurable	Default Value
Maximum PDU Size	No	16384
Maximum number of simultaneous Associations. (Can be configured to be a maximum total number or a maximum per external SCU AE)	No	No set limit
STORAGE-SCP AE time-out waiting on an open Association for the next Request message (C-STORE- RQ, Association Close Request. etc.) (DIMSE timeout)	No	No set limit
STORAGE-SCP AE maximum number of simultaneous Associations	No	Not set limit
Permanent archival of SOP Instances sent by a peer AE to the STORAGE-SCP AE in response to a retrieval request from QUERY-RETRIEVE AE.	No	FALSE (Such received SOP Instances are not archived.)
Permanent archival of SOP Instances sent unsolicited by a peer AE to the STORAGE-SCP AE. I.e. Not in response to a retrieval request from QUERY-RETRIEVE AE.	Yes	TRUE (Such received SOP Instances are archived.)

Table 3.4-4
QUERY-RETRIEVE-SCP PARAMETERS

Parameter	Configurable	Default Value
Maximum PDU Size	No	16384
Maximum number of simultaneous Associations (Can be configured to be a maximum total number or a maximum per external SCU AE)	No	No set limit
Maximum PDU size receiving	No	64 kbytes

Parameter	Configurable	Default Value
QUERY-RETRIEVE-SCP AE time-out waiting on an open Association for the next message (C-FIND-RQ, C- MOVE-RQ, Association Close Request. etc.) (DIMSE timeout)	No	No set limit
QUERY-RETRIEVE-SCP AE maximum number of simultaneous Associations	No	No set limit

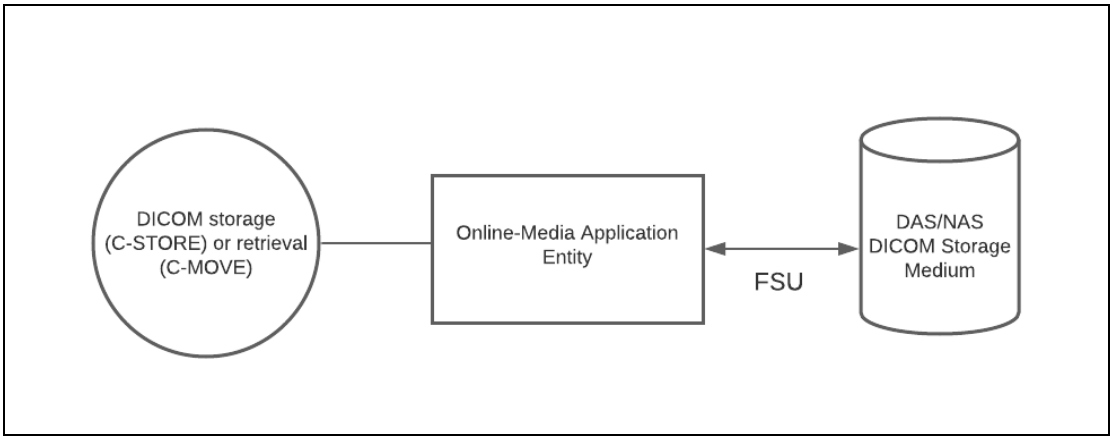
The AE titles must be uniquely defined. An AE title can be tied to a single host (IP). If the environment has multiple hosts with the same AE title, such AE title is defined utilizing an "alias AE",

4 MEDIA INTERCHANGE

4.1 IMPLEMENTATION MODEL

4.1.1 Application Data Flow Diagram

Figure 4.1-1
APPLICATION DATA FLOW DIAGRAM



4.1.2 Functional definitions of AE's

4.1.2.1 Functional Definition of Online-Media Application Entity

Semperdata® employs Media Storage for all DICOM Composite Objects. All composite IODs received by C-STORE operations are stored in DICOM Media File-sets on Direct-Attached Storage (DAS) or Network-Attached Storage (NAS) media. Likewise, all composite IODs retrieved from the archive by Query-Retrieve (C-MOVE) operations are retrieved from the DAS/NAS storage media. The Online Media Application Entity performs these media operations.

4.1.3 Sequencing of Real-World Activities

Required sequencing of real-world activities is defined in the individual specifications below.

4.1.4 File Meta Information for Implementation Class and Version

The implementation information written to the File Meta Header in each file is:

Table 4.1-1
DICOM IMPLEMENTATION CLASS AND VERSION FOR QUERY-RETRIEVE-SCP AE

File Meta Information Version	0x0001H
Implementation Class UID	1.3.6.1.4.1.16592.1.3.1
Implementation Version Name	Semperdata_1.0

Note: The media Implementation Class UID differs from the network AEs.

4.2 AE SPECIFICATIONS

The following section in the DICOM Conformance Statement is a set of Application Entity Specifications.

There shall be one such specification for each Application Entity type.

4.2.1 Online Media Application Entity – Specification

The SDA stores DICOM Part 10 Files in storage folders called Tomes. A Tome is a collection of files similar to the files stored on DVD disk media. Tomes can exist in three states:

Table 4.2-1
STATES OF TOMES IN SEMPERDATA

OPEN	Images may be added or removed. An OPEN Tome may be closed to prevent further changes to its content.
CLOSED	The Tome is closed to further modification. A CLOSED Tome may be re-OPENed by the archive application software or irreversibly moved to a SEALED state.
SEALED	The TOME is Read-only and cannot be re-opened. The sealed tome status allows copies of Tomes to be made to remote or offline media without concern that they become out-of-sync with the current stored data.

There are two storage formats for **Tomes**:

OPEN Tomes

Data in OPEN tomes is stored in the tome root directory until data reaches a certain configurable size. If a tome is at capacity and still in an open state, Semperdata places incoming images into the tome only if other images from the same study are in the tome. Note, however, that a study may still be split over multiple tomes.

For performance reasons, data is stored packed in uncompressed TAR archive files, one or more per study. Data received over a single association is stored in a single TAR file. The TAR files are named using the study instance UID followed by a suffix. A study sent over multiple associations is stored in multiple TAR files, with a version indicator appended to the UID: {Suid.v0.tar, Suid.v1.tar, etc.}

CLOSED and SEALED Tomes

Data stored in closed tomes is stored as DICOM Media File sets, comprising a DICOMDIR file in the tome root directory, plus Part 10 image files in a directory tree compliant with DICOM media requirements. That is, the file and directory names are less than 8 characters from {A-Z,0-9,_} and have no extensions. The entire CLOSED or SEALED tome is then images stored in an uncompressed ZIP-64 compatible.

CLOSED Media File sets have (0004,1212) File-set Consistency Flag in the DICOMDIR file set to a value of 0xFFFFH, indicating that the Media File set is not in a valid final form, as it is possible that the tome can be re-OPENed.

4.2.1.1 File Meta Information for the Online Media Application Entity

Table 4.2-2 contains the values of the File Meta Information that pertain to the Application Entity.

Table 4.2-2
FILE META INFORMATION FOR THE ONLINE MEDIA APPLICATION ENTITY
Source Application Entity Title

Source Application Entity Title	
Private Information Creator UID	

4.2.1.2 Real-World Activities

This section states the Roles and Media Storage Service Class Options supported by the Online Media Application Entity.

4.2.1.2.1 Real-World Activity Receive Images into SDA

When the Storage SCU receives an image, or when a change of image data causes a Private Change Object to be written to the Online Media, the image is written to an available OPEN tome.

Tomes are CLOSEDed according to a configurable algorithm that considers tome contents, size, and the amount of time the tome has been open.

4.2.1.2.2 Real-World Activity Send Images from SDA

When an image is retrieved for transmission by the Storage SCU, it is extracted from the Tome containing it, updated if necessary, from Semperdata database data, and transmitted.

4.2.1.2.3 Real-World Activity Update Images in SDA

When an Image, Series, Study, or Patient is updated by real-world activities such as operator commands or HL7 messages, a Private Change Object for every affected Study is written to an available OPEN Tome and recorded in the Semperdata database.

4.2.1.2.4 Real-World Activity Recover Images from SDA Storage

In the event that image data must be recovered and migrated from storage media without access to the SDA server or database, the entire content of storage SDA can be recovered using simple scripts and standard TAR and ZIP tools and sent to a new archive. Special tools may have to be constructed to apply changes in the Private Change Objects (defined in the Annex of this Conformance Statement) if the updates are to be applied and LAITEK's services are not available.

4.3 AUGMENTED AND PRIVATE APPLICATION PROFILES

4.3.1 Augmented Application Profiles

None.

4.3.2 Private Application Profiles

None.

4.4 MEDIA CONFIGURATION

Semperdata employs a pool of online (NAS/DAS) file storage for storage. This pool comprises a configurable number of Storage Segments. Each Storage Segment is a file system or mount point corresponding to a disk drive, mounted storage file system, or subdirectory. The Storage Segments to be used are configured using an administrative Web page. Examples of Storage Segment locations on a Microsoft Windows platform are: **E:**, **E:\seg1**, **\\nas1\sdadata** or **\\nas1\sdadata\seg2**.

Each Storage Segment is an instance of (Private) DAS/NAS storage media. The Private NAS/DAS media format is a generic mounted file system supporting multiple DICOM Media File sets per medium.

5 SUPPORT OF CHARACTER SETS

Table 5-1

SINGLE-BYTE CHARACTER SETS WITHOUT CODE EXTENSIONS

Character Set Description	Defined Term
Latin alphabet No. 1	ISO_IR 100
Latin alphabet No. 2	ISO_IR 101
Latin alphabet No. 3	ISO_IR 109

Table 5-2
SINGLE-BYTE CHARACTER SETS WITH CODE EXTENSIONS

Character Set Description	Defined Term
Default repertoire	ISO 2022 IR 6
Latin alphabet No. 1	ISO_IR 100
Latin alphabet No. 2	ISO_IR 101
Latin alphabet No. 3	ISO_IR 109
Latin alphabet No. 4	ISO_IR 110

6 SECURITY

6.1 SECURITY PROFILES

6.2 NONE SUPPORTED.ASSOCIATION LEVEL SECURITY

The QUERY-RETRIEVE-SCP AE and the STORAGE-SCP AE can both be configured to check the following DICOM values when determining whether to accept Association Open Requests:

- Calling AE Title
- Called AE Title

Each SCP AE is configurable to restrict acceptance of Association Requests to a configured list of Calling AE Titles. The list of Calling AE Titles for each SCP AE is independently configurable. The SCP AE accepts association requests only for the specified Called AE Title for the SCP.

Semperdata restricts association by the IP address of the requestor. The SCP AEs accept Association Requests only when the IP address of the Calling AE matches an IP address in the list. The SCP AEs can have different lists.

It is also possible to configure Semperdata to function in promiscuous mode. Semperdata accepts and stores data from any calling AE in this mode of operation. Whenever a new AE/IP combination is created, Semperdata saves the AE title/host information in its configuration file for future reference.

6.3 APPLICATION-LEVEL SECURITY

None supported.

7 ANNEXES

7.1 PRIVATE NAS/DAS MEDIA FORMAT SPECIFICATION

7.2 PRIVATE SOP CLASSES

Semperdata® uses a private SOP Class called Change Object to allow updating patient and other data in the studies in response to patient updates (via HL7 ADT, for example) while preserving the original state of the DICOM instances intact. The Change Object specifies the changes that update the DICOM Study Instances.

Of special note is that Instance UIDs can change, but as in all cases, the UIDs in the stored data are not changed. Instead, a change object is written into the original study, directing that, for example, the Study Instance UID is to be changed. The Semperdata® archive recognizes this duplication and directs queries for the "new" study UID to the objects stored with the "old" UIDs.

TABLE 7.2-1
PRIVATE SOP CLASSES

SOP Class	UID	SCU	SCP
Change Object Storage	1.3.6.1.4.1.16592.2.1977	Y	Y

TABLE 7.2-2
SOP COMMON MODULE ATTRIBUTES FOR CHANGE OBJECT SOP CLASS

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data. Enumerated Value: SIC = SOP Instance Change [Private Value]
Change Date	(1977,0082)	1	Date on which the change of attributes occurred. If the change originated from an HL7 message, the timestamp of the message is recorded here. If the change originated from an operator action, the

Attribute Name	Tag	Type	Attribute Description
			timestamp of the operator's command is recorded here.
Change Time	(1977,0083)	1	Time at which this change of attributes occurred.
Include Content Identification Macro Table 10-12 from PS.3-2009			
Referenced Series Sequence	(0080,1115)	1	Sequence of Items where each Item includes the Attributes of one Series to which the Change. One or more Items shall be present.
Series Instance UID	(0020,000E)	1	Unique identifier of a Series that is part of the Study defined by the Study Instance UID (0020,000D) in the enclosing dataset. Note: The Study Instance UID (0020,000D) is always that of the Change Object itself.
Referenced Image Sequence	(0008,1140)	1	The set of images and frames to which the Presentation applies. These shall be of the Study defined by Study Instance UID (0020,000D) and the Series defined by Series Instance UID (0020,000E). One or more Items shall be present. The referenced SOP Class shall be the same for all Images in any Item of this Referenced Series Sequence (0080,1115).
Include SOP Instance Reference Macro, Table 10-11 from PS.3-2009			
Original Attributes Sequence	(0400,0561)	1	Sequence of Items containing all attributes that were removed or replaced by other values in the main dataset. Exactly one Item may be present in this sequence.
Source of Previous Values	(0400,0564)	2	The source the provided the new values for the changed SOP instance. For example, this might be the Institution from which the original SOP Instances were received.
Attribute Modification DateTime	(0400,0562)	1	Date and time the attributes were removed and/or replaced.

Attribute Name	Tag	Type	Attribute Description
			The value of this attribute shall be identical to the date and time contained in the Attributes (1977,0082) Change Date and (1977,0083) Change Time
Modifying System	(0400,0563)	1	LAITEK INC. SEMPERDATA
Reason for the Attribute Modification	(0400,0565)	1	Reason for the attribute modification. Defined terms are: COERCE = Replace values of attributes such as Patient Name, ID, Accession Number, for example, during import of media from an external institution, or reconciliation against a master patient index. CORRECT = Replace incorrect values, such as Patient Name or ID, for example, when an incorrect worklist item was chosen or the operator input an error.
Modified Attributes Sequence	(0400,0550)	1	Sequence containing a single item that contains all the Attributes, with their previous values, that were modified or removed from the main data set.
Any Attribute from the original data set that was modified or removed; may include Sequence Attributes and their Items. The values of each attribute, including Sequence Items contained therein, shall exactly match the values in the original referenced instances.			
Replacement Attributes Sequence	(1977,0551)	1	Sequence containing a single item that contains all the Attributes, with their previous values, that were modified or removed from the main data set.
Any Attribute that is to be inserted in the data set in place of modified attributes; may include Sequence Attributes and their Items. If an attribute is present in the Replaced Attributes Sequence and not in the Replacement Attributes Sequence, then that attribute is deleted in the changed IOD.			

7.3 PRIVATE TRANSFER SYNTAXES

None

7.4 PRIVATE ATTRIBUTES

TABLE 7.4-1
LAITEK PRIVATE ATTRIBUTES

For internal use only, Semperdata® creates private attributes but never exports them.

TABLE 7.4-2
INTERPETED VENDOR PRIVATE ATTRIBUTES

Tag	VR	Vendor	Description
(0021,1000)	SH	Philips	Biplane image sets Image Type to BIPLANE
(0043,1082)	LO	GE	System configuration. Modified for version compatibility.
(0043,1097)	LO	GE	Imaging filter parameters. Modified for version compatibility.
(0071,1001)	LO	GE	Annotation type interpreted to create DICOM GSPS objects.
(0071,1022)	US	GE	Annotation font size interpreted to create DICOM GSPS objects
(4105,1001)	LO	GE RadWorks	Annotation type interpreted to create DICOM GSPS objects.
(0073,2000)	LO	iSite	Annotation type interpreted to create GSPS objects.
(0073,1004)	SQ	iSite	List of key images to create DICOM Key Object Note
(0073,1005)	ST	iSite	Expected value is "Y". SDA reports when the value is unexpected.
(0073,1006)	ST	iSite	Expected value is "0". SDA reports when the value is unexpected.
(07a1,100A)	OB	CareStream	Private pixel data. SDA decompresses to standard DICOM
(7FD1,0010)	UL	GE	Proprietary compression
(7FD1,00A0)	UL	GE	Proprietary compression
(7FD1,1010)	UL	GE	Proprietary compression
(7FD1,A010)	UL	GE	Proprietary compression

TABLE 7.4-3
VENDOR PRIVATE ATTRIBUTES EXCISED

Tag	VR	Vendor	Description
(0009,1010)	SQ	GE	Icon image sequence deleted
(0009,1110)	SQ	GE	Icon image sequence
(0089,1010)	SQ	Siemens	Icon image sequence deleted
(0089,1110)	SQ	Siemens	Icon image sequence

8 GLOSSARY

Term	Definition	Standard/Other
Rejection Note	A Key Object Selection document that identifies images to be rejected or hidden to poor quality, patient safety, or retention expiration.	IHE DICOM
Digital Imaging and Communications in Medicine (DICOM) Standard	DICOM® — Digital Imaging and Communications in Medicine — is the international standard for medical images and related information.	DICOM Standard
Semperdata® Atrium - Product Guide	Guide to install, configure, and service Semperdata® Atrium.	Laitek
Semperdata® Study Importer - Product Guide	Guide to install, configure, and service Semperdata® Study Importer.	Laitek
Semperdata® Router - Product Guide	Guide to install, configure, and service Semperdata® Router-Product Guide	Laitek

9 REFERENCES

Document Reference	Title	Description
SDA-4.10.0-PG-03	Semperdata Router® - Product Guide	Product guide containing high-level information to assist you when using the Semperdata® Router product.

Document Reference:	SDA-4.10-DO-13
Revision Date:	11-AUG-2023
Revision:	1