DICOM Conformance Statement

for Image Management Family of Products:

vnaPlus and *imageGateway*

Doc#: 20120120.1

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1. Overview

The Leafsprout Image Management Family of Products (IM) encompasses the following two product lines:

1) ***vnaPlus*** (the VNA) for archiving of imaging exams. The VNA accepts imaging studies from DICOM-compliant sources and persists them in its permanent storage for future discovery and retrieval by client systems. The VNA also processes and archives HL7 imaging orders, reports, and patient demographics updates for all exams under its management. From the functional perspective, *vnaPlus* fulfills the roles of the IHE Image Manager and IHE Image Archive.

2) ***imageGateway*** (the Gateway) for distribution of imaging exams. The Gateway interfaces with existing RIS/PACS or VNA systems in order to allow its connected enterprises to participate in sharing of diagnostic imaging information via a cross-enterprise health information exchange. The Gateway is offered in the following flavors:

   a. **Exam Publisher (imageGateway/Publisher)** – accepts imaging studies and reports from the associated RIS/PACS/VNA and publishes them to the XDS Infrastructure. While publishing studies or reports, the relevant local vocabularies (e.g., procedure codes, body parts) are translated by *imageGateway* to their regional/global equivalents.
   b. **Exam Prefetcher (imageGateway/Prefetcher)** – intercepts local imaging orders and locates relevant priors which it subsequently automatically imports into the associated local PACS. In the process of importing, *imageGateway* optionally creates an HL7 order for each foreign exam to be brought in. It subsequently imports the exam (comprising imaging studies and reports) into the local PACS. While bringing in foreign exams, imageGateway localizes each exam to the environment of the destination PACS.

Note: Not all product flavors and features are offered in all geographies. Contact Leafsprout for more details.

Contents

2. Networking

The networking-related view of the Leafsprout Image Management Family of Products (*vnaPlus* or *imageGateway*) is presented in the sections below.

2.1 Implementation Model

Image Management Family of Products, or IM, is implemented as a set of logical archives/gateways, each exposing multiple DICOM services, and each embodying a separate DICOM Application Entity. These Application Entities (logical archives/gateways) can independently initiate and accept associations to/from remote DICOM application entities in their local environments. This allows for a single instance of *vnaPlus* or *imageGateway* to be used for multiple independent organizations.

2.1.1. Application Data Flow

The following diagrams outline the activities involved in various data flows supported by the Leafsprout Image Management Family of Products.

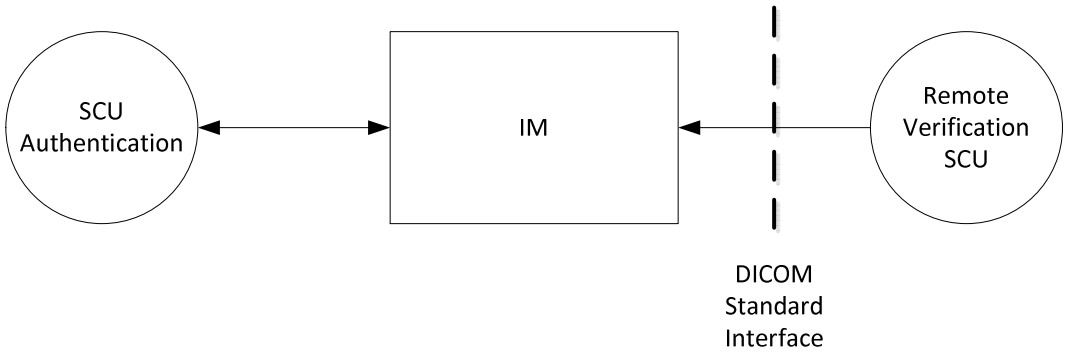

Figure 1-1 Accept Verification of Communication

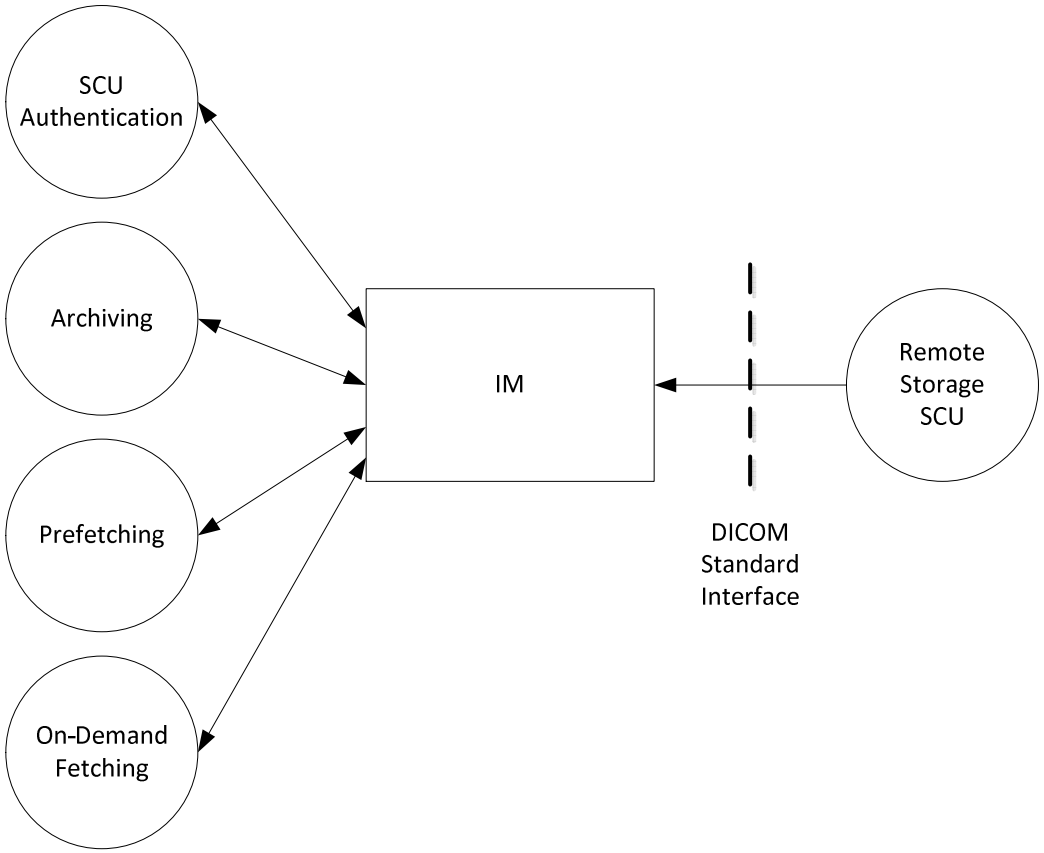

Figure 1-2 Receive Instances

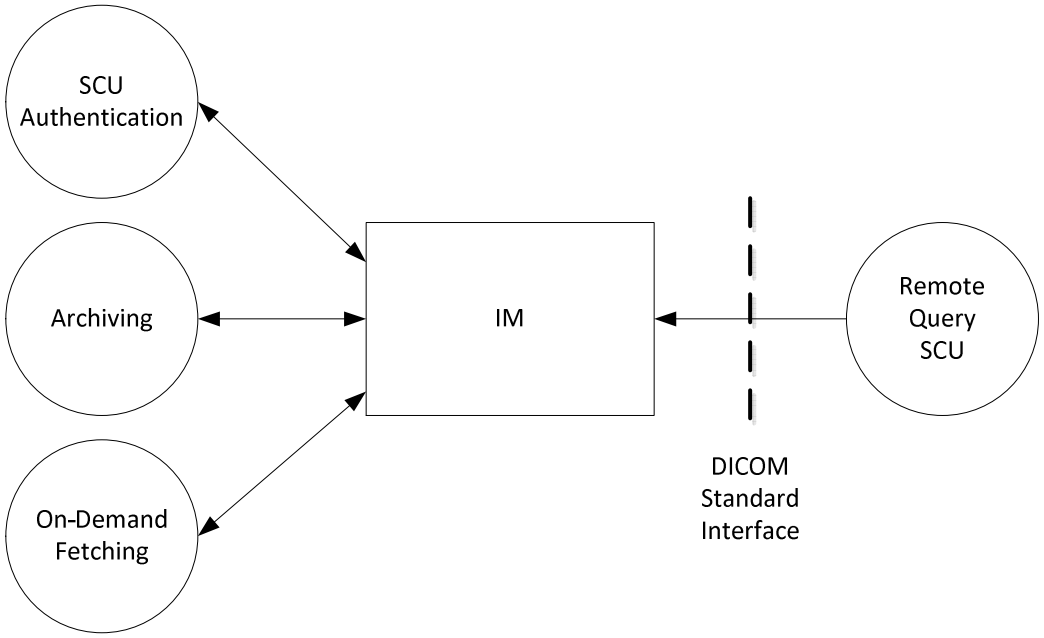

Figure 1-3 Receive Queries

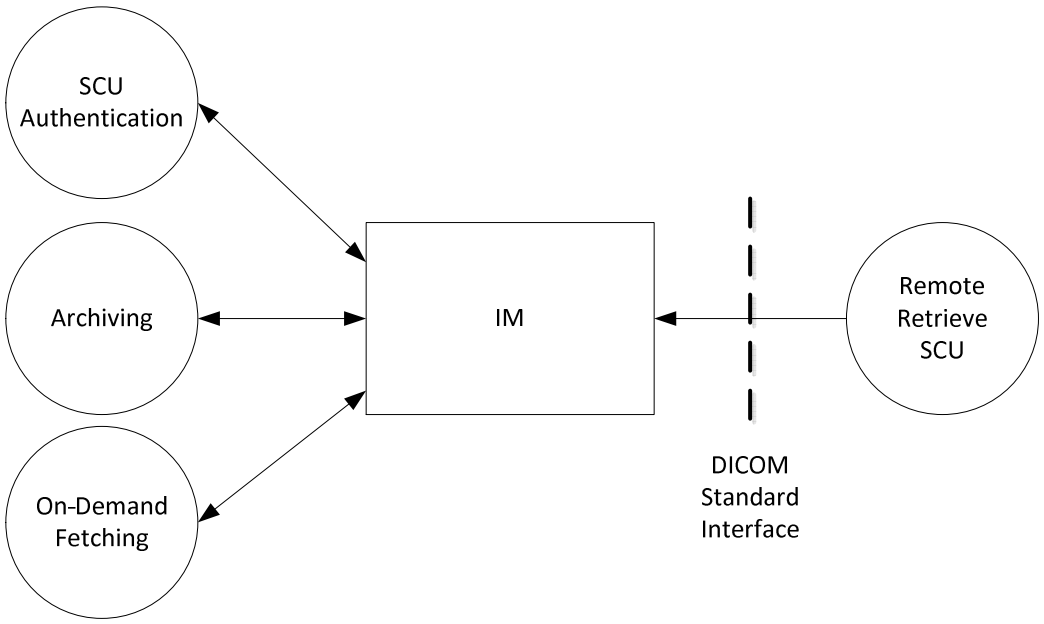

Figure 1-4 Receive Retrieve Requests

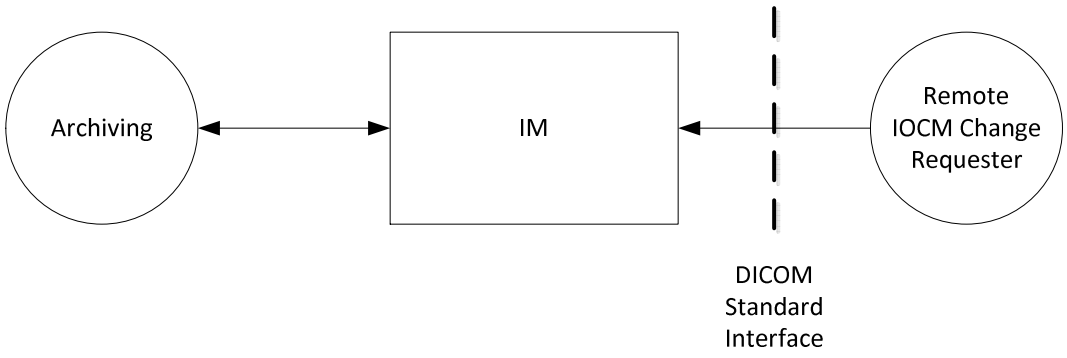

Figure 1-5 Receive IOCM Rejection Notes

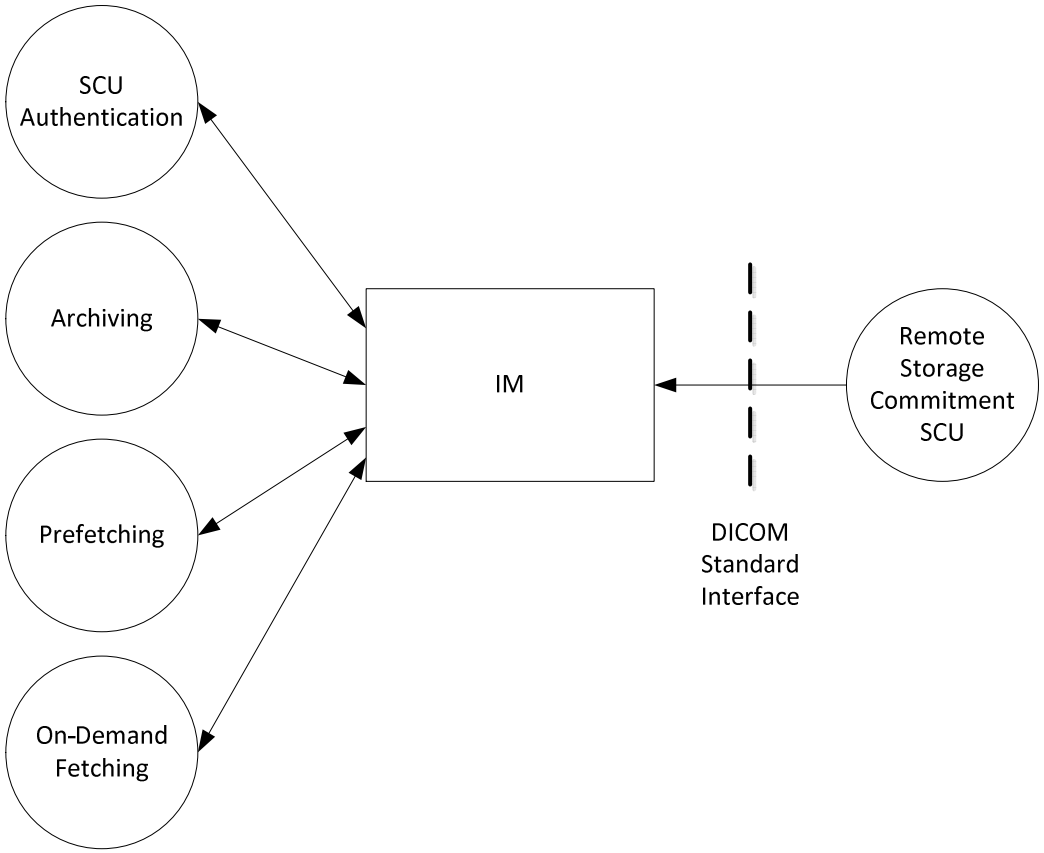

Figure 1-6 Accept Storage Commitment

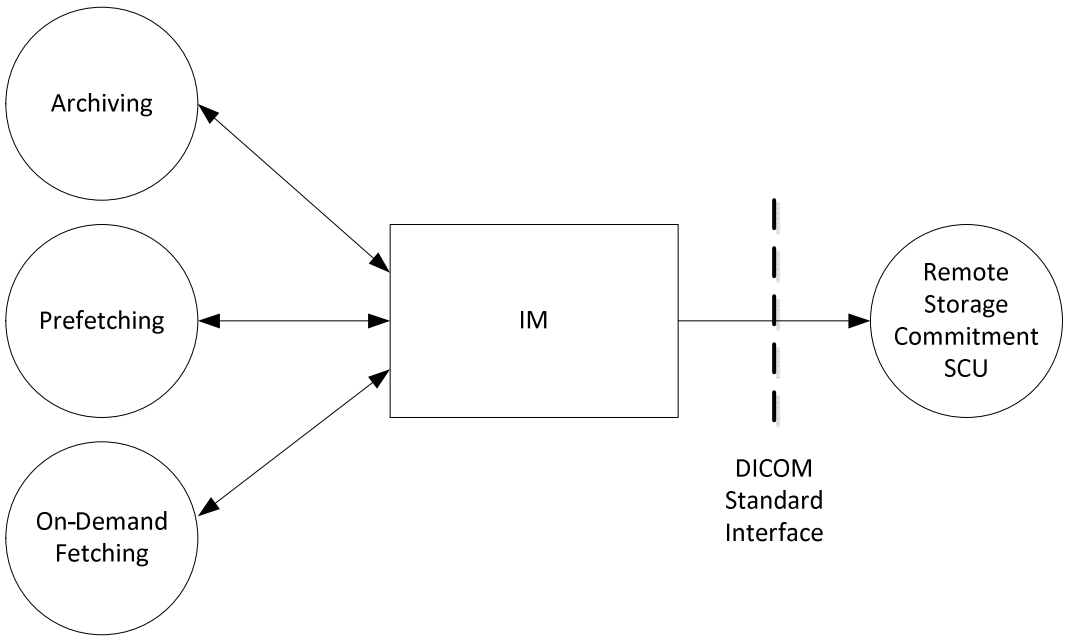

Figure 1-7 Confirm Storage Commitment

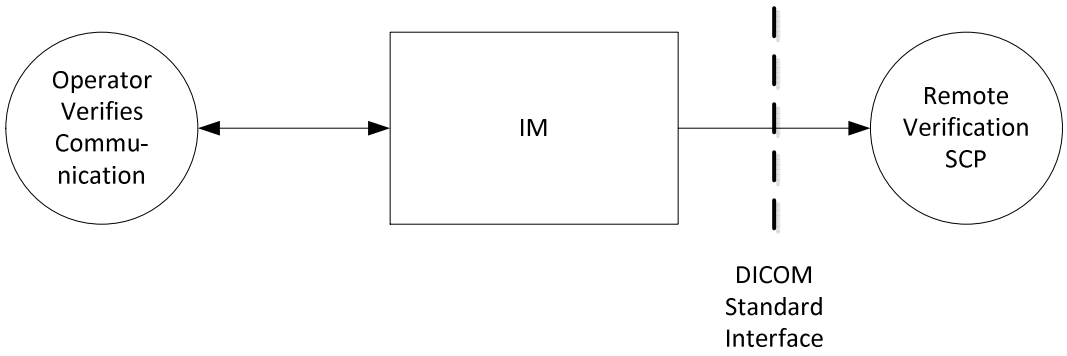

Figure 1-8 Request Verification of Communication

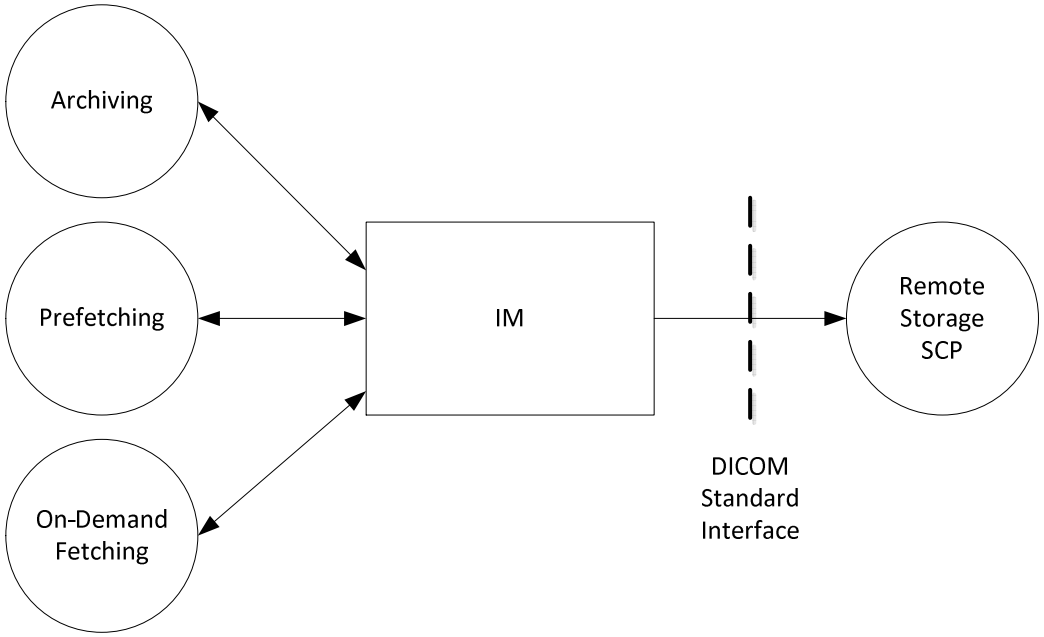

Figure 1-9 Send Instances

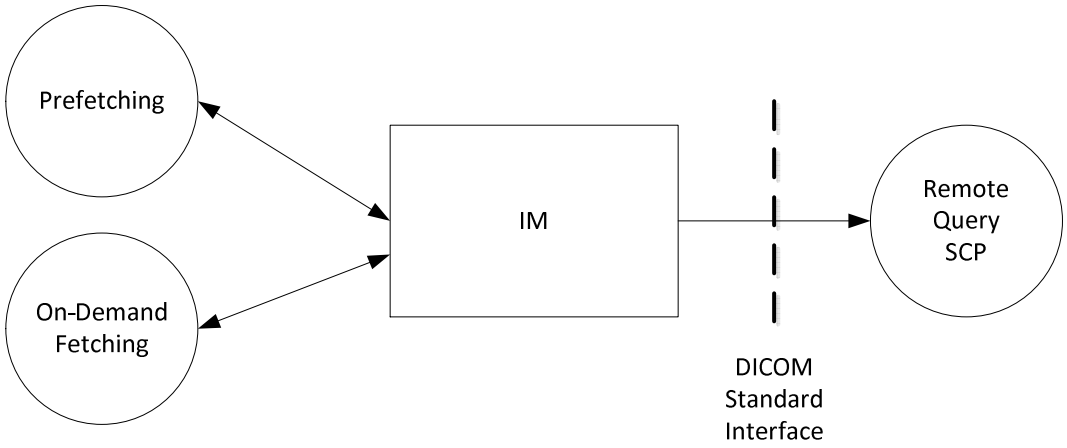

Figure 1-10 Send Queries

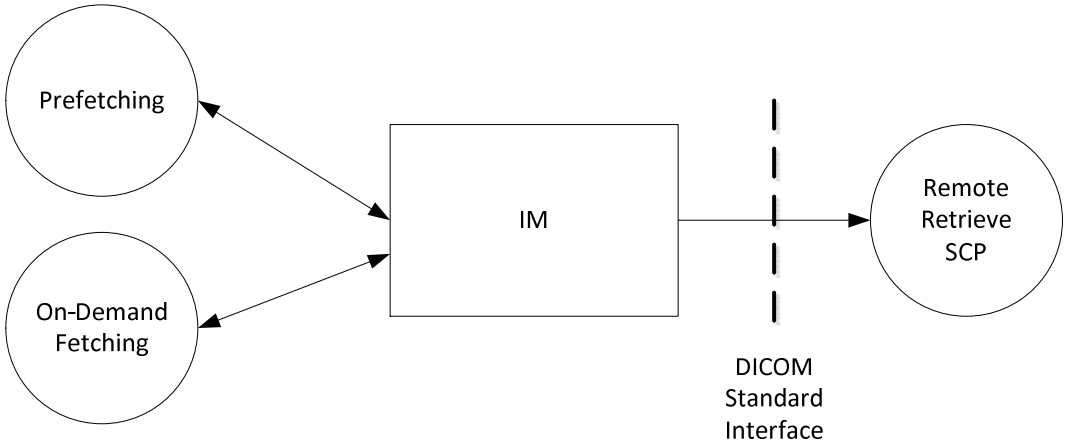

Figure 1-11 Send Retrieve Requests

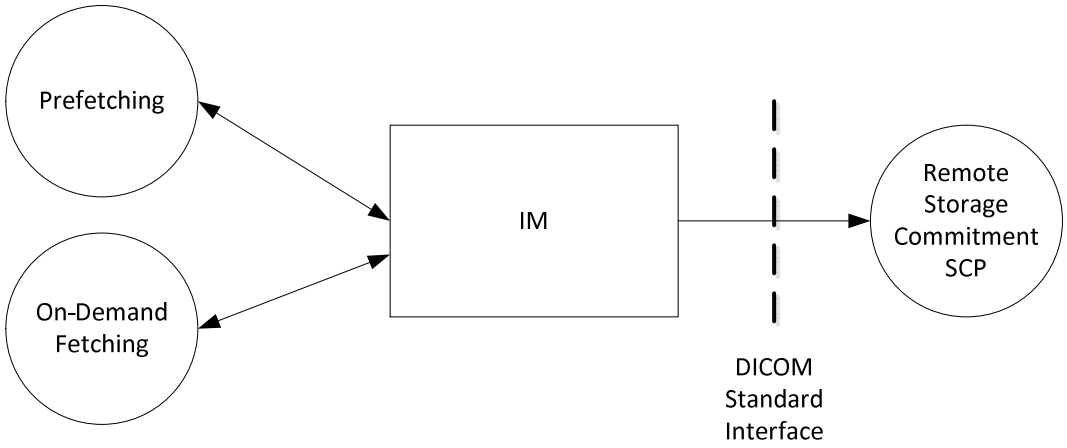

Figure 1-12 Request Storage Commitment

2.1.2. Functional Definition of Application Entities

IM can be configured into multiple partitions or logical gateways. Each gateway presents itself to the outside world as an Application Entity with its own AE Title. The partitions are separated physically and logically so, for example, if DICOM instances are sent to two AE gateways they will be stored twice – once per AE.

2.1.3. Sequencing of Real World Activities

The four high-level real-world activities performed by the Leafsprout Image Management Family of Products have been outlined below. The particular data flows (see Section 2.1.1) involved have been listed for each activity.

Archiving:

IM supports the archival of imaging exams into its storage, and exposing these exams to remote Application Entities whenever requested. In this mode, all interactions that IM engages in with external Application Entities are resolved against the IM's storage and its index (database). For each logical AE, there are three distinct storage areas that are independently accessible to remote clients: (1) local exam storage, (2) foreign exam storage, and (3) temp exam storage. Remote clients can send, query and retrieve studies to/from each of these storage areas.

The following DICOM activities are involved in the process of Archiving by IM:

- Receive Instances -> Accept Storage Commitment -> Confirm Storage Commitment
- Receive Queries
- Receive Retrieve Requests -> Send Instances
- Receive IOCM Rejection Notes

The DICOM Web flavors of Receive Instances, Receive Queries, and Receive Retrieve Requests are also supported by IM via the use of the STOW-RS, QIDO-RS and WADO protocols. For details see 2.3.2.

Publishing:

IM supports publishing of imaging studies to the XDS-I infrastructure. The received DICOM instances are recorded in a DICOM Key Object Selections document which is published to a preconfigured XDS Document Repository using communication protocols outside DICOM. The instances can either be permanently archived by the AE in its storage units or automatically purged after a preconfigured period of time.

The following Application Data Flows (see Section 2.1.1) are involved in the process of Publishing by IM. The flows in parenthesis denote non-DICOM workflows:

- Receive Instances -> (Register Instances in XDS)
- Accept Storage Commitment -> (Register Instances in XDS)

The registration in XDS can be performed, based on configuration, either after the instances have been received or after they have been successfully committed. There are other triggers that influence the timing of the registration but they are outside the realm of DICOM (e.g., publishing upon an HL7 event).

Pre-fetching:

IM supports automated pre-fetching of foreign prior studies into a preconfigured Application Entity to facilitate the availability of a more complete imaging history for a given patient. The pre-fetching is triggered via an action outside the realm of DICOM, namely via a HL7 Order message associated with a scheduled local exam. The discovery of relevant prior exams can involve different protocols and approaches (e.g., XDS query with Modality and Body Part relevancy rules) the details of which are outside the scope of this document.

While bringing foreign prior studies into the destination Application Entity (e.g., PACS system), IM coerces a configurable set of DICOM attributes so the imported studies are localized to the destination environment. Before pre-fetching a study, IM can check for the availability of that study in the destination Application Entity by utilizing the Study Root Find SOP Class.

The following Application Data Flows (see Section 2.1.1) are involved in the process of Pre-fetching by IM:

- Send Queries -> Send Retrieve Requests -> Receive Instances -> Accept Storage Commitment -> Confirm Storage Commitment -> Send Instances -> Request Storage Commitment

When IM is not integrated with a Master Patient Index (PIX/PDQ system), the activity Send Queries may be performed more than once, not only to discover whether a given exam is already present in the destination Application Entity but also to discover the demographics of the patient. The use of the Storage Commitment functionality is optional and can be enabled/disabled in the configuration.

On-Demand Fetching:

IM supports on-demand discovery and fetching of foreign prior studies into a preconfigured destination Application Entity. The on-demand aspect is attained via a Query SCP that is exposed by IM. The SCP discovers the priors using protocols and approaches that are outside the scope of this Conformance Statement, e.g., XDS query. The query results returned to the remote Query SCU are cached by IM for a preconfigured amount of time so the remote AE can issue a subsequent Move request against any of the returned studies.

IM can determine which studies already reside at the destination Application Entity by utilizing the Study Root Find SOP Class. Those locally-present studies can be automatically filtered out from the C-Find responses.

When IM receives a Retrieve/Move request from a Remote Retrieve SCU, it checks its cache to determine the previously discovered location of the study (which remote AE) and subsequently transfers the study from the relevant Storage SCP to the destination specified in the C-Move request.

While bringing foreign prior studies into the destination Application Entity, IM coerces a configurable set of DICOM attributes so the imported studies are localized to the destination environment.

The following DICOM activities are involved in the process of On-Demand Fetching (the activities in parenthesis denote non-DICOM workflows):

- Receive Queries -> (Perform XDS Query) -> Send Queries
- Receive Retrieve Requests -> Send Retrieve Requests -> Receive Instances -> Accept Storage Commitment -> Confirm Storage Commitment -> Send Instances -> Request Storage Commitment

The use of the Storage Commitment functionality while On-Demand Fetching is optional and can be enabled/disabled in the configuration.

2.2 AE Specifications

The following sections specify the implemented application entities.

2.2.1. Application Entity IM

The following section specifies the Image Management Family of Products Application Entity (IM).

2.2.1.1. SOP Classes

The following non-storage SOP Classes are supported:

Table 2: Standard Non-Storage SOP Classes

SOP Class UID	*SOP Class Name*	*SCU*	*SCP*
1.2.840.10008.1.1	Verification	Yes	Yes
1.2.840.10008.5.1.4.1.2.2.1	Study Root Query/Retrieve Model - FIND	Yes	Yes
1.2.840.10008.5.1.4.1.2.2.2	Study Root Query/Retrieve Model - MOVE	Yes	Yes
1.2.840.10008.5.1.4.1.2.1.1	Patient Root Query/Retrieve Model – FIND (*)	Yes	Yes
1.2.840.10008.5.1.4.1.2.1.2	Patient Root Query/Retrieve Model – MOVE (*)	Yes	Yes
1.2.840.10008.1.20.1	Storage Commit Push Model	Yes	Yes

(*) Patient Root Models are enabled only for the product configurations implementing the real-world activity “Archiving” (*vnaPlus*).

The following storage SOP Classes are supported:

Table 3: Standard Storage SOP Classes

SOP Class UID	*SOP Class Name*	*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 XRay Image Storage Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.1.1	Digital XRay Image Storage Processing	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography XRay Image Storage Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography XRay Image Storage Processing	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.3	Digital Intraoral XRay Image Storage Presentation	Yes	Yes
1.2.840.10008.5.1.4.1.1.1.3.1	Digital Intraoral XRay Image Storage 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
1.2.840.10008.5.1.4.1.1.3	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
1.2.840.10008.5.1.4.1.1.5	Nuclear Medicine Image Storage (Retired)	Yes	Yes

1.2.840.10008.5.1.4.1.1.6	Ultrasound Image Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.6.2	Enhanced US Volume Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image 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	Yes	Yes
1.2.840.10008.5.1.4.1.1.9	Standalone Curve Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.1.1	ECG 12 Lead 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
1.2.840.10008.5.1.4.1.1.9.4.2	General Audio Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.10	Standalone Modality LUT Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.5.1	Arterial Pulse Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.9.6.1	Respiratory Waveform Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.11	Standalone VOI LUT Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.1	Grayscale Softcopy Presentation State Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.2	Color Softcopy Presentation State Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.3	Pseudo-Color Softcopy Presentation State Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.4	Blending Softcopy Presentation State Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.11.5	XA/XRF Grayscale Softcopy Presentation State Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.12.1	XRay 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	XRay Radiofluoroscopic Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.12.2.1	Enhanced XRF Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.13.1.1	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
1.2.840.10008.5.1.4.1.1.12.3	XRay Angiographic BiPlane Image Storage (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.20	Nuclear Medicine Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.66	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
1.2.840.10008.5.1.4.1.1.66.5	Surface Segmentation Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.67	Real World Value Mapping Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.77.1	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
1.2.840.10008.5.1.4.1.1.78.1	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
1.2.840.10008.5.1.4.1.1.78.6	Spectacle Prescription Report Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.79.1	Macular Grid Thickness and Volume Report	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.1	Text SR Storage – Trial (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.2	Audio SR Storage – Trial (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.3	Detail SR Storage – Trial (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.4	Comprehensive SR Storage – Trial (Retired)	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.11	Basic Text Structured Report	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.22	Enhanced Structured Report	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.33	Comprehensive Structured Report	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.40	Procedure Log	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.50	Mammography CAD Structured Report	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 Structured Report	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR	Yes	Yes
1.2.840.10008.5.1.4.1.1.88.69	Colon CAD SR	Yes	Yes
1.2.840.10008.5.1.4.1.1.104.1	Encapsulated PDF Storage	Yes	Yes
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
1.2.840.10008.5.1.4.1.1.130	Enhanced PET Image Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.131	Basic Structured Display Storage	Yes	Yes
1.2.840.10008.5.1.4.1.1.129	Standalone PET Curve 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

By changing the configuration, additional or fewer SOP Classes may be supported.

2.2.1.2. Association Policies

2.2.1.2.1. General

The Application Context Name supported by this AE is conformant with DICOM 3.0 and has the value of 1.2.840.10008.3.1.1.1.

2.2.1.2.2. Number of Associations

The IM AE supports multiple associations both as an SCU and SCP.

As an SCU, IM attempts to reuse a single association with a remote Application Entity for multiple operations. When there are no operations that are queued up, the association is closed.

As an SCP, IM supports a configurable maximum number of simultaneous associations. The default value is 200 and it can be increased or decreased by the Administrator.

2.2.1.2.3. Asynchronous Nature

The IM AE does not support asynchronous communication (multiple outstanding transactions over a single association).

2.2.1.2.4. Implementation Identifying Information

Implementation Class UID:	1.3.6.1.4.1.42982.1.1.1
Implementation Version Name:	<product_version>, e.g., 2.8.0

2.2.1.3. Association Initiation Policy

The set of Association Initiation Policies described below has been presented in the context of SCP-related activities first, followed by the SCU-related activities.

2.2.1.3.1. Activity – Accept Verification of Communication

Description of Sequencing Activities

A remote Application Entity verifies its ability to communicate with IM by sending a verification request.

Proposed Presentation Contexts

Table 4: Proposed Presentation Contexts for Request Storage Commitment

Abstract Syntax		**Transfer Syntax**	**Role**	**Extended Negotiation**
Name	**UID**			
Verification	1.2.840.10008.1.1	Explicit VR Little Endian Implicit VR Little Endian	SCP	None

SOP Specific Conformance

Standard conformance is provided.

2.2.1.3.2. Activity – Receive Instances

Description of Sequencing Activities

A remote Application Entity sends Composite SOP Instances to the IM AE for archiving (Archiving workflow) or forwarding (Pre-fetching and On-Demand Fetching workflows).

Accepted Presentation Contexts

Table 5: Accepted Presentation Contexts for Receive Instances

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**			
Supported SOP Classes	See Table 2	See Table 6	SCP	None

Table 6: Accepted Transfer Syntaxes for Receive Instances

Name	UID
1.2.840.10008.1.2	Implicit VR Little Endian
1.2.840.10008.1.2.1	Explicit VR Little Endian
1.2.840.10008.1.2.2	Explicit VR Big Endian
1.2.840.10008.1.2.1.99	Deflated Explicit VR Little Endian
1.2.840.10008.1.2.4.50	JPEG Baseline (Process 1)
1.2.840.10008.1.2.4.51	JPEG Extended (Process 2 & 4)
1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)
1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])
1.2.840.10008.1.2.4.80	JPEG-LS Lossless Image Compression
1.2.840.10008.1.2.4.81	JPEG-LS Lossy (Near-Lossless) Image Compression
1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)
1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression
1.2.840.10008.1.2.4.100	MPEG2 Main Profile/Main Level
1.2.840.10008.1.2.4.101	MPEG2 Main Profile/High Level
1.2.840.10008.1.2.4.102	MPEG-4 AVC/H.264 High Profile/Level 4.1
1.2.840.10008.1.2.4.103	MPEG-4 AVC/H.264 BD-compatible High Profile/Level 4.1
1.2.840.10008.1.2.4.104	MPEG-4 AVC/H.264 High Profile/Level 4.2 (excluding stereoscopic 3D)
1.2.840.10008.1.2.4.105	MPEG-4 AVC/H.264 High Profile/Level 4.2 (stereoscopic 3D)
1.2.840.10008.1.2.5	RLE Lossless

SOP Specific Conformance

The IM AE is a Level 2 conformant Storage SCP. All Type 1, Type 2 and Type 3 attributes are retained. In addition, private attributes are retained as well and are included when the instance is sent out again.

When an instance is received that has a SOP Instance that is already present in IM the transfer will complete successfully. The existing instance in IM will be overwritten with the new one.

Table 7: Return Statuses for Receive Instances

Service Status	Further Meaning	Error Code	Reason
Success	Success	0x0000	The Composite SOP Instance was successfully received, verified and processed.
Error	Processing Failure	0xC100	The Composite SOP Instance could not be processed due to an application error.

2.2.1.3.3. Activity – Receive Queries

Description of Sequencing Activities

A remote Application Entity queries IM for the contents of its storage (Archiving workflow) or for the contents of the XDS Infrastructure (On-Demand Fetching workflow). By directing the query to a specific Called AE Title exposed by IM, the remote SCU can decide how a given query should be resolved (against IM's storage or XDS).

Accepted Presentation Contexts

Table 8: Accepted Presentation Contexts for Receive Queries

Abstract Syntax		**Transfer Syntax**	**Role**	**Extended Negotiation**
Name	**UID**			
Patient Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Explicit VR Little Endian Implicit VR Little Endian	SCP	None
Study Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Explicit VR Little Endian Implicit VR Little Endian	SCP	None

Note: Clients are encouraged to use the IHE-recommended Study Root Model. Support for the Patient Root Model may be obsoleted in future releases.

SOP Specific Conformance

Standard conformance is provided with the restrictions outlined below. The following Query levels are supported:

- PATIENT, STUDY, SERIES, INSTANCE – for queries against IM's storage
- STUDY – for queries against the XDS Infrastructure

Query Matching and Return Keys

The following attributes are supported by the SCP as **both matching and return keys**:

PATINET LEVEL:

- Patient ID (0010,0020)
- Patient Name (0010,0010)
- Patient Gender (0010,0040)
- Patient Birth Date (0010,0030)

STUDY LEVEL:

- Study Instance UID (0020,000D)
- Study Date (0008,0020)
- Study Time (0008,0030)
- Accession Number (0008,0050)
- Modalities In Study (0008,0061)

- Study ID (0020,0010)
- Referring Physician (0008,0090)

SERIES LEVEL:

- Series Instance UID (0020,000E)
- Modality (0008,0060)
- Series Number (0020,0011)
- Requested Procedure ID (0040,1001)
- Scheduled Procedure Step ID (0040,0009)
- Performed Procedure Step Start Date (0040,0244)
- Performed Procedure Step Start Time (0040,0245)

INSTANCE LEVEL:

- SOP Instance UID (0008,0018)
- Instance Number (0020,0013)
- SOP Class UID (0008,0016)

The following attributes are supported by the SCP as **return keys only**:

PATINET LEVEL:

- Issuer of Patient ID (0010,0021)
- Issuer of Patient ID Qualifier Sequence (0010,0024)
- Patient Birth Time (0010,0032)
- Patient Address (0010,1040)
- Patient Size (0010,1020)
- Patient Weight (0010,1030)
- Ethnic Group (0010,2160)
- Additional Patient History (0010,21B0)
- Patient Comments (0010,4000)

STUDY LEVEL:

- Study Description (0008,1030)
- Issuer of Accession Number Sequence (0008,0051)
- Performing Physician's Name (0008,1050)
- Number of Study Related Series (0020,1206)
- Number of Study Related Instances (0020,1208)

SERIES LEVEL:

- Series Date (0008,0021)
- Series Time (0008,0031)
- Body Part Examined (0008,0015)
- Series Description (0008,103E)
- Performed Procedure Step ID (0040,0253)
- Number of Series Related Instances (0020,1209)

INSTANCE LEVEL:

- Instance Creation Date (0008,0012)
- Instance Creation Time (0008,0013)
- Time Zone Offset from UTC (0008,0201)
- Rows (0028,0010)
- Columns (0028,0011)
- Bits Allocated (0028,0100)
- Number of Frames (0028,0008)

Table 9: Return Statuses for Receive Queries

Service Status	Further Meaning	Error Code	Reason
Success	Success	0x0000	Matching is complete.
Pending	Matches are continuing and all Optional Keys were supported.	0xFF00	Indicates that the search for further matches is continuing. This status code is returned when all Optional Keys in the query identifier were supported.
	Matches are continuing and some Optional Keys were not supported.	0xFF01	Indicates that the search for further matches is continuing. This status code is returned when some Optional Keys in the query identifier were not supported.
Cancel	Matching terminated due to Cancel request.	0xFE00	The C-FIND SCU sent a Cancel request. As a result, the search for matches has been halted.
Failure	Processing Failure	0xC100	The query could not be processed due to an application error.

2.2.1.3.4. Activity – Receive Retrieve Requests

Description of Sequencing Activities

A remote Application Entity wants to retrieve instances residing in the IM storage (Archiving workflow) or in the XDS-I network (On-Demand Fetching workflow). By directing the Move request to a specific Called AE Title exposed by IM, the remote SCU can decide how the Move should be resolved (against the IM storage or against the XDS Infrastructure).

Accepted Presentation Contexts

Table 10: Accepted Presentation Contexts for Receive Retrieve Requests

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**			
Patient Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Explicit VR Little Endian Implicit VR Little Endian	SCP	None
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Explicit VR Little Endian Implicit VR Little Endian	SCP	None

Note: Clients are encouraged to use the IHE-recommended Study Root Model. Support for the Patient Root Model may be obsoleted in future releases.

SOP Specific Conformance

Standard conformance is provided with the restrictions outlined below. The following Move levels are supported:

- PATIENT, STUDY, SERIES, INSTANCE – for Move requests against IM's storage
- STUDY – for Move requests against the XDS Infrastructure

Table 11: Return Statuses for Receive Retrieve Requests

Service Status	Further Meaning	Error Code	Reason
Success	Success	0x0000	Sub-operations complete. No failures.
Pending	Sub-operations are continuing	0xFF00	A response with this status code is sent every time a Composite SOP Instance has been successfully sent to the C-MOVE Destination AE.
Warning	Sub-operations Complete – One or more Failures	0xB000	Operations complete but not all Composite SOP Instances have been successfully sent to the C-MOVE Destination AE.
Cancel	Sub-operations terminated due to Cancel request	0xFE00	The C-MOVE SCU sent a Cancel request. As a result, the export of the Composite SOP Instances to the C-MOVE Destination AE has been halted.
Failure	Processing Failure	0xC100	The move could not be processed due to an application error.

2.2.1.3.5. Activity – Receive IOCM Rejection Notes

Description of Sequencing Activities

A remote Imaging Object Change Management (IOCM) Change Requester intends to reject one or more instances that were previously archived by the IM (Archiving workflow). By sending an IOCM-compliant rejection note to the IM, the Change Requester indicates whether instances referenced in the note should be deleted (purged from the IM storage) or only hidden (not visible to the ordinary clients but still kept in the IM storage for future discovery by administrative or QA clients via a separate IOCM-specific Q/R SCP AETITLE).

Accepted Presentation Contexts

Table 12: Accepted Presentation Contexts for Receive IOCM Rejection Notes

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**			
Key Object Selection Document (IOCM Rejection Note)	1.2.840.10008.5.1.4.1.1.88.59	See Table 13	SCP	None

Table 13: Accepted Transfer Syntaxes for Receive IOCM Rejection Notes

Name	UID
1.2.840.10008.1.2	Implicit VR Little Endian
1.2.840.10008.1.2.1	Explicit VR Little Endian
1.2.840.10008.1.2.2	Explicit VR Big Endian

SOP Specific Conformance

The following IOCM Rejection Note types (codes) are supported by the IM. The action that the IM undertakes for each type of the note is outlined in the column Action/Behavior.

Table 14: Supported IOCM Rejection Notes

Rejection Note	Action / Behavior
DCM-113001: Rejected for Quality Reasons	Hide Instances
DCM-113037: Rejected for Patient Safety Reasons	Hide Instances
DCM-113038: Incorrect Modality Worklist Entry	Hide Instances
DCM-113039: Data Retention Policy Expired	Delete Instances

Table 15: Return Statuses for Receive IOCM Rejection Notes

Service Status	Further Meaning	Error Code	Reason
Success	Success	0x0000	The Composite SOP Instance was successfully received, verified and processed.
Error	Processing Failure	0xC100	The Composite SOP Instance could not be processed due to an application error.

2.2.1.3.6. Activity – Accept Storage Commitment Requests

Description of Sequencing Activities

After sending Composite SOP Instances to IM, a remote Application Entity wants to confirm the proper storage of these instances in IM. In order to do so, the remote Application Entity sends a Storage Commitment request (N-ACTION) to IM. This can happen in the context of Archiving workflow, Pre-fetching workflow, and On-Demand Fetching workflow.

Depending on the configuration, IM may not provide long term archiving and there is no guarantee that the committed instances will remain in the system for a longer period of time.

Accepted Presentation Contexts

Table 16: Accepted Presentation Contexts for Accept Storage Commitment Requests

Abstract Syntax		**Transfer Syntax**	**Role**	**Extended Negotiation**
Name	**UID**			
Storage Commitment Push Model	1.2.840.10008.5.1.20.1	Explicit VR Little Endian Implicit VR Little Endian	SCP	None

SOP Specific Conformance

Standard conformance is provided.

IM will commit instances only when it has successfully verified that the instances are present in the storage and can be read. The rules governing how long these instances will be kept in storage are independent of Storage Commitment and are governed by the configuration.

Table 17: Return Statuses for Accept Storage Commitment Requests

Service Status	**Further Meaning**	**Error Code**	**Reason**
Success	Success	0x0000	The requested Storage Commitment has been successfully received and scheduled.
Failure	Processing Failure	0x0001	An internal error occurred during processing of the Storage Commitment Request (N-ACTION).

2.2.1.3.7. Activity – Confirm Storage Commitment

Description of Sequencing Activities

IM will issue Confirm Storage Commitment (N-EVENT-REPORT) notification message after it receives a Storage Commitment Request and has confirmed that all instances were committed. This can take place in the context of Archiving workflow, Pre-fetching workflow, and On-Demand Fetching workflow.

Proposed Presentation Contexts

Table 18: Proposed Presentation Contexts for Confirm Storage Commitment Requests

Abstract Syntax		**Transfer Syntax**	**Role**	**Extended Negotiation**
Name	**UID**			
Storage Commitment Push Model	1.2.840.10008.5.1.20.1	Explicit VR Little Endian Implicit VR Little Endian	SCP	None

SOP Specific Conformance

Standard conformance is provided.

By default, IM will attempt to send the N-EVENT-REPORT notification on the same association that was used to receive the N-ACTION request. If the N-ACTION association has been closed by the SCU, IM will open a new association with the SCU (DICOM role reversal) and send the N-EVENT-REPORT notification containing the results of the commitment on this newly opened association.

Table 19: Return Status Handling Behavior

Service Status	**Further Meaning**	**Error Code**	**Behavior**
Success	Success	0x0000	Operation is considered complete.
Failure	Processing Failure	*	Operation is considered failed. The commitment is marked as failed.

2.2.1.3.8. Activity – Request Verification of Communication

Description of Sequencing Activities

A remote Application Entity sends a verification request to IM in order to confirm its ability to communicate with the IM Application Entity.

Proposed Presentation Contexts

Table 20: Proposed Presentation Contexts for Request Storage Commitment

Abstract Syntax		**Transfer Syntax**	**Role**	**Extended Negotiation**
Name	**UID**			
Verification	1.2.840.10008.1.1	Explicit VR Little Endian Implicit VR Little Endian	SCU	None

SOP Specific Conformance

Standard conformance is provided.

2.2.1.3.9. Activity – Send Instances

Description of Sequencing Activities

The following events can trigger IM to send instances to a remote Application Entity:

- IM accepts a C-MOVE request of a study residing in its storage from a remote Application Entity (Archiving workflow).
- IM accepts a C-MOVE request for a study residing in the XDS-I Network (On-Demand Fetching workflow).
- The operator requests a transmission of a specific study.
- The Prefetcher's logic determines a given study must be sent to a remote Application Entity as a relevant prior (Prefetching workflow).

Proposed Presentation Contexts

Table 21: Proposed Presentation Contexts for Send Instances

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**			
Standard Storage SOP Classes	See Table 3	See Table 6	SCU	None

SOP Specific Conformance

The IM AE is a Level 2 conformant Storage SCU. All Type 1, Type 2 and Type 3 attributes are sent. In addition, private attributes are sent as well.

Send operations are retried unless they are sub-operations in a C-MOVE request. In that case the error is propagated back to the requestor of the C-MOVE. The number of retries and the pause between retries are configurable. If IM fails to complete the transfer within the maximum number of retries, the transfer is marked as failed.

Table 22: Return Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Instance is stored	0x0000	Operation is considered complete.
Warning		0xBxxx	Warning is logged. Operation is considered complete.
Failure	All failures	*	The failure is logged and the operation is retried.

2.2.1.3.10. Activity – Send Queries

Description of Sequencing Activities

The following events can trigger IM to send a query to a remote Application Entity:

- IM needs to discover which studies are already present in the remote Application Entity to make prefetching-related decisions.
- IM needs to discover the demographics of a patient associated with a given study.

Both activities take place in the context of Pre-fetching and On-Demand Fetching workflows.

Proposed Presentation Contexts

Table 23: Proposed Presentation Contexts for Send Queries

Abstract Syntax		**Transfer Syntax**	**Role**	**Extended Negotiation**
Name	**UID**			
Study Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Explicit VR Little Endian Implicit VR Little Endian	SCU	None

SOP Specific Conformance

Standard conformance is provided.

When executed in the context of the automated Pre-fetcher, query operations are retried, similar to the Send Instances operations.

Table 24: Return Status Handling Behavior

Service Status	**Further Meaning**	**Error Code**	**Behavior**
Success	Matching is complete.	0x0000	Operation is considered complete and successful.
Pending	Matches are continuing and all Optional Keys were supported.	0xFF00	Operation is considered in progress. Partial results are being processed.
	Matches are continuing and some Optional Keys were not supported.	0xFF01	Operation is considered in progress. Partial results are being processed.
Failure	All failures	*	Operation is considered complete and failed.

2.2.1.3.11. Activity – Send Retrieve Requests

Description of Sequencing Activities

The following events can trigger IM to send a query to a remote Application Entity:

- IM identifies a relevant prior study that needs to be transferred from a remote Application Entity into its storage so it can be routed to the preconfigured destination (Pre-fetching workflow).
- IM accepts a C-MOVE request of a study residing in the XDS-I Network (On-Demand Fetching workflow).

Proposed Presentation Contexts

Table 25: Proposed Presentation Contexts for Send Retrieve Requests

Abstract Syntax		**Transfer Syntax**	**Role**	**Extended Negotiation**
Name	**UID**			
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Explicit VR Little Endian Implicit VR Little Endian	SCU	None

SOP Specific Conformance

Standard conformance is provided.

When executed in the context of the automated Pre-fetcher, retrieve operations are retried, similar to the Send Instances operations.

Table 26: Return Status Handling Behavior

Service Status	**Further Meaning**	**Error Code**	**Behavior**
Success	Sub-operations complete – No Failures	0x0000	Operation is considered complete and successful.
Pending	Sub-operations are continuing.	0xFF00	Operation is considered in progress. Results are returned to the requesting system (if any).
Failure	All failures	*	Operation is considered complete and failed.

2.2.1.3.12. Activity – Request Storage Commitment

Description of Sequencing Activities

The following events can trigger IM to request a Storage Commitment from a remote Application Entity:

- IM accepts a C-MOVE request for a study residing in the XDS-I Network (On-Demand Fetching workflow).
- The operator requests the transmission of a specific study.
- The Pre-fetcher's logic determines a given study must be sent to a remote Application Entity as a relevant prior (Pre-fetching workflow).

Proposed Presentation Contexts

Table 27: Proposed Presentation Contexts for Request Storage Commitment

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**			
Storage Commitment Push Model	1.2.840.10008.5.1.20.1	Explicit VR Little Endian Implicit VR Little Endian	SCU	None

SOP Specific Conformance

Standard conformance is provided.

If a Storage Commitment is enabled for a remote destination, IM will, after sending the instances to the remote destination, issue a Storage Commitment request (N-ACTION). All Storage SOP Classes supported by the IM can be the subject of a Storage Commitment.

The time period of the validity of the Transaction UID that is generated for the Storage Commitment is configurable.

Table 28: Return Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0x0000	The request for Storage Commitment is considered successfully sent. IM will wait for a configurable amount of time to receive the N-EVENT-REPORT.
Failure	All failures	*	Request is considered failed. The associated Send Instances operation will be retried.

2.3 Network Interfaces

2.3.1 Physical Network Interface

The application is indifferent to the physical medium and hardware over which network communication takes place. The medium is abstracted by the underlying operation system.

2.3.2 Additional Protocols

The Leafsprout Image Management Family of Products exposes several HTTP-based services implementing various DICOM Web protocols that allow remote clients to store, query and retrieve DICOM instances. The set of implemented server-side interfaces has been outlined below.

2.3.2.1 General

All HTTP-based services negotiate the response content encoding based on appropriate parameters in the request.

Response Media Type Selection

Each service defines a list of supported response media types (described in each service-specific section below). The service determines the response media type based on the following evaluation sequence:

- The “accept” (for RS-* services) or “contentType” (for WADO-URI) query string parameter
- The “Accept” HTTP header

Response Character Set Selection

Each service determines the response character set for textual content based on the following evaluation sequence:

- The “charset” media type parameter in the selected response media type
- The “charset” query string parameter
- The “Accept-Charset” HTTP header
- Default “utf-8”

The character set names can be specified using IANA Preferred MIME Name (such as “utf-8”) or their equivalent DICOM Defined Terms for Specific CharacterSet (0008,0005) (such as “ISO_IR 192”). The supported character sets are as outlined in the table below.

Table 29: HTTP Character Sets

Character Set Encoding Name using IANA terminology	**Description**
ISO-8859-1	Latin-1 Latin alphabet
ISO-8859-2	Latin-2 Eastern European
ISO-8859-3	Latin alphabet #3
ISO-8859-4	Latin alphabet #4
ISO-8859-5	Cyrillic
ISO-8859-6	Arabic
ISO-8859-7	Greek
ISO-8859-8	Hebrew
ISO-8859-9	Latin alphabet #5
TIS-620	Thai
ISO-2022-JP	Japanese 7-bit encoding
ISO-2022-KR	Korean 7-bit encoding
ISO-2022-CN	Chinese 7-bit encoding
GB18030	Chinese
GBK	Chinese
UTF-8	Unicode UTF-8
UTF-16	Unicode UTF-16, Little Endian
Character Set Encoding Name using DICOM-defined terms	**Description**
ISO_IR 100	Latin-1 Latin alphabet
ISO_IR 101	Latin-2 Eastern European
ISO_IR 109	Latin alphabet #3
ISO_IR 110	Latin alphabet #4
ISO_IR 144	Cyrillic
ISO_IR 127	Arabic
ISO_IR 126	Greek
ISO_IR 138	Hebrew
ISO_IR 148	Latin alphabet #5
ISO_IR 166	Thai
GB18030	Chinese
GBK	Chinese
ISO_IR 192	Unicode UTF-8

2.3.2.2 STOW-RS

IM supports the RESTful DICOM Store Over the Web (STOW-RS) protocol for accepting DICOM instances to be archived in the storage. The details of the supported functionality have been outlined below. Items marked with an asterisk (*) are available in the newest releases of the software only (2.8.1 or higher).

STOW-RS Action Types (using POST):

- StoreInstances
    - /studies[/{studyInstanceUid}]

STOW-RS Request Content Types:

- multipart application/dicom
- multipart application/dicom+xml (x XML data parts + y bulk data parts) *
- multipart application/dicom+json (1 JSON array of metadata + x bulk data parts) *

STOW-RS Response Content Types:

- application/dicom (Leafsprout extension)
- application/dicom+xml
- application/dicom+json (single object) *

STOW-RS Response Status Codes:

- 200 – OK, indicating that the STOW-RS Service successfully stored all the instances, with no response content
- 202 – Accepted, with additional information regarding which instances have been stored and which instances have failed to be stored included in the XML response message body.
- 400 – Bad Request
- 401 – Unauthorized
- 403 – Forbidden
- 409 – Conflict
- 415 – Unsupported Media Type

2.3.2.3 QIDO-RS

IM supports the RESTful DICOM Query Based on ID for DICOM Objects (QIDO-RS) protocol for querying objects managed by IM (studies, series and instances). The details of the supported functionality have been outlined below.

QIDO-RS Action Types (using GET):

- SearchForStudies
  - /studies[?query]
- SearchForSeries
  - /studies/{studyInstanceUid}/series[?query]
  - /series[?query]
- SearchForInstances
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/instances[?query]
  - /studies/{studyInstanceUid}/instances[?query]
  - /instances[?query]

QIDO-RS Response Content Types:

- multipart application/dicom (Leafsprout extension)
- multipart application/dicom+xml
- multipart application/dicom+json (JSON array) *

QIDO-RS Response Status Codes:

- 200 – OK
- 400 – Bad Request
- 401 – Unauthorized
- 409 – Conflict

2.3.2.4 WADO-RS

IM supports the RESTful Web Access to DICOM Objects (WADO-RS) protocol for retrieving SOP Instances residing in its storage. The details of the supported functionality have been outlined below.

WADO-RS Action Types (using GET):

- RetrieveStudy
  - /studies/{studyInstanceUid}
- RetrieveSeries
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}
- RetrieveInstance
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/instances/{sopInstanceUid}
- RetrieveFrames
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/instances/{sopInstanceUid}/frames/{frameList}*
- RetrieveBulkdata
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/instances/{sopInstanceUid}/bulk*
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/instances/{sopInstanceUid}/frames/{frameList}/bulk*
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/instances/{sopInstanceUid}/tags/{bulkDataTag}/bulk*
- RetrieveMetadata
  - /studies/{studyInstanceUid}/metadata
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/metadata
  - /studies/{studyInstanceUid}/series/{seriesInstanceUid}/instances/{sopInstanceUid}/metadata

WADO-RS Response Content Types:

- Instances Response
  - multipart bulk data media types*
  - multipart application/dicom
- Bulkdata Response*
  - multipart bulk data media types*
- Rendered Response*
  - rendered media types (image/jpeg, image/png, image/gif)*
  - multipart rendered media types (image/jpeg, image/png, image/gif)*
- Metadata Response
  - multipart application/dicom (Leafsprout extension)
  - multipart application/dicom+xml
  - multipart application/dicom+json (JSON array) *

WADO-RS Response Status Codes:

- 200 – OK
- 206 – Partial Content. Accept type, Transfer Syntax or decompression method supported for some but not all requested content
- 400 – Bad Request

- 404 – Not Found
- 406 – Not Acceptable
- 410 – Gone. Specified resource was deleted

2.3.2.5 WADO-URI

IM supports WADO-URI (using GET) retrieval of Composite SOP Instances residing in its storage. The supported mime types are as follows:

WADO-URI Response Content Types:

- For image objects:
  - rendered media types (image/jpeg, image/png, image/gif)
  - application/dicom
- For non-image objects:
  - application/dicom

The specific set of supported WADO parameters is listed in Table 24. All other parameters are ignored.

Table 30: WADO-URI Parameters

Name	Description
requestType	Must be set to WADO
studyUID	The Study Instance UID of the requested object.
seriesUID	The Series Instance UID of the requested object.
objectUID	The SOP Instance UID of the requested object.
contentType	The mime type for the requested object (see above for the supported mime types)
rows	The maximum number of target rows for the requested image. (1)
columns	The maximum number of target columns for the requested image. (1)
frameNumber	The frame number to be returned. (1)
region	The region of the requested image to return. (1)
windowCenter	The window center (luminosity) of the requested image. (1)
windowWidth	The window width (contrast) of the requested image. (1)
imageQuality	The quality of the requested image. Only valid for image/jpeg mine type. (1)

Parameters marked with (1) are ignored when the requested contentType is application/dicom.

2.3.2.6 WADO-WS

IM supports SOAP-based Web Access to DICOM Objects (WADO-WS) protocol for retrieving SOP Instances residing in its storage. The implementation is based on the IHE RAD-69 transaction. The details of the supported functionality have been outlined below.

WADO-WS Action Types (using POST):

- RetrieveImagingDocumentSet

2.3.3 IPv4 and IPv6 Support

This product supports IPv4 and IPv6.

2.4 Configuration

The configuration of the IM DICOM Services is stored in its database. A web-based client is provided to administer the configuration.

2.3.1 AE Title/Presentation Address Mapping

The AE Title and Presentation Address-related information can be found in the sections below.

2.3.1.1 Local AE Titles

Each logical gateway (IM supports many logical gateways) can be assigned its own set of AE Titles. A logical gateway is also referred to as an Organization-level gateway. The default naming convention for Application Entities exposed by IM is as follows:

<Organization_Identifier>_<AE_type>, e.g., EGH_QLOCAL (for Query/Retrieve SCP for local exams at EGH).

The TCP/TLS ports are shared between all logical gateways; their values are as follows:

Storage SCP: 104/4104 (unsecure/secure)

Query/Retrieve SCP: 107/4107 (unsecure/secure)

2.3.1.2 AE Title/Presentation Address Mapping

All remote systems that communicate with IM have to be defined in the configuration. For these DICOM Systems the following information needs to be provided:

1. DICOM AE Title
2. Host name or IP address
3. Port number (secure or unsecure)
4. Supported Services (Storage, Query/Retrieve, Storage Commitment, etc.)
5. Digital certificate (optional) that IM can verify before accepting a request

2.3.2 Parameters

The following general parameters are configurable for IM (default values are included):

1. Storage SCP ports, 104/4104 (unsecure/secure)
2. Query Retrieve SCP ports, 107/4170 (unsecure/secure)
3. Max Number of associations, 200
4. Max number of study level records returned in queries, 1000
5. Storage SCP Association Idle Timeout (DIMSE Timeout), 1800s.
6. Query/Retrieve SCP Association Idle Timeout (DIMSE Timeout), 1800s.
7. Storage SCP ARTIM Timeout (waiting for A-ASSOCIATE RQ on open TCP/IP connection) , 30s
8. Query/Retrieve SCP ARTIM Timeout (waiting for A-ASSOCIATE RQ on open TCP/IP connection) , 30s
9. Storage SCP Max PDU Size, 128KB
10. Query/Retrieve SCP Max PDU Size, 128KB
11. Storage SCU Association Establish Timeout, 20s
12. Query/Retrieve SCU Association Establish Timeout, 20s
13. Storage SCU Association Close Timeout, 5s
14. Query/Retrieve SCU Association Close Timeout, 5s
15. Storage SCU Message Response (DIMSE) Timeout , 600s
16. Query/Retrieve SCU Message Response (DIMSE) Timeout, 60s
17. Storage SCU Max PDU Size, 128KB
18. Query/Retrieve SCU Max PDU Size, 128KB

3. Media Interchange

IM does not support Media Interchange.

4. Supported Character Sets

IM supports the character sets listed in the table below.

Table 31: Supported Character Sets

DICOM Character Set Name	Description
ISO_IR 6	US-ASCII (DICOM Default)
ISO_IR 100	ISO-8859-1 - Latin alphabet No. 1
ISO_IR 101	ISO-8859-2 - Latin alphabet No. 2
ISO_IR 109	ISO-8859-3 - Latin alphabet No. 3
ISO_IR 110	ISO-8859-4 - Latin alphabet No. 4
ISO_IR 144	ISO-8859-5 - Cyrillic
ISO_IR 127	ISO-8859-6 - Arabic
ISO_IR 126	ISO-8859-7 - Greek
ISO_IR 138	ISO-8859-8 - Hebrew
ISO_IR 148	ISO-8859-8 - Latin alphabet No. 5
ISO_IR 166	TIS-620 - Thai
ISO_IR 13	Japanese Single-Byte (no kanji)
ISO 2022 IR 13\ISO 2022 IR 87\ISO 2022 IR 159	Japanese (all)
ISO 2022 IR 6\ISO 2022 IR 87\ISO 2022 IR 159	Japanese (no half-width katakana)
ISO 2022 IR 6\\ISO 2022 IR 149	Korean
EUC_KR	EUC Korean
GB18030	GB18030 Chinese
ISO_IR 192	UTF-8 Unicode

Handling of external datasets received by this Application Entity:

When a dataset with a missing Specific Character Set Element (0008, 0005) is received by IM, an administrator-configured character set (from the list above) is used to interpret this dataset. The relevant DICOM Character Set Name is then embedded into the Element (0008, 0005) to avoid any future ambiguity.

Handling of datasets generated by this Application Entity:

When a dataset is created by IM (e.g., a C-FIND Response, KOS object) the Specific Character Set Element (0008, 0005) used for this dataset will be “ISO_IR 192” (UTF-8) by default. A different character set encoding (from the supported list above) can be used instead.

5. Security

IM is expected to be used within a controlled security environment.

5.1 Security Profiles

1. The Basic TLS Secure Transport Connection Profile is supported. This implies that IM is capable of:
    - Encrypting all communications with external Application Entities.
    - Authenticating each connecting client based on the digital certificate passed by the client.
2. Non-Downgrading BCP195 TLS Secure Transport Connection Profile is supported. The default security parameters for a communication channel comply with BCP195 and employ the following ciphers which are negotiated in the order specified below:

    - TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
    - TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
    - TLS_DHE_RSA_WITH_AES_256_GCM_SHA384
    - TLS_DHE_RSA_WITH_AES_128_GCM_SHA256

    Other similar strength ciphers may be enabled, if required.
3. The Audit Trail Message Transmission Profile is supported. Audit messages can be formatted according to the DICOM Supplement 95 format or the original RFC 3881 format. The Syslog protocol (RFC 5424) is used to transport the messages. The following low-level transports can be utilized: Syslog over TLS (RFC 5425), Syslog over UDP (RFC 5426), or Syslog over TCP (RFC 3195).
4. Encapsulation of a DICOM File in an AES-encrypted file (Leafsprout extension). AES key length is 256 bit, RFC2898 used for key derivation, SHA512 used for signing.
5. The Digital Signatures Security Profile is currently not supported.

All cryptographic keys are managed using a Secure Certificate Store provided by the OS runtime.

5.2 Association Level Security

In addition to client certificates described above, IM can be configured to accept associations only from a limited set of configured calling AE Titles. This can be independently configured for each logical gateway and for each service type (Storage and Query/Retrieve SCP).

5.3 Application Level Security

All configuration and administration activities can be performed using a secure web client. The use of this client is secured via an explicit log-in page that authenticates the user against a preconfigured user store (typically an Active Directory). There is no need for application-level administrators to have routine access to the underlying physical or virtual machine running the application.

6. Annexes

None.