Lifetrack

PACS: DICOM Conformance Statement

Version 1.0

Mar 3, 2016

The information contained in this document is accurate as of the date of publication. It may however become outdated quickly, because it deals with technical specifications and similar matters. For the latest information and version of Lifetrack's Platform Requirements, please visit https://lifetrackmed.com/en/platform-requirements

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1. Introduction

1.1. Overview and Audience

Lifetrack™ PACS is a PACS software product that provides medical imaging departments of all types (Hospitals, Imaging Centers, and Clinics) with the capability to archive patient imaging studies and generate reports on said studies.

The scope of this DICOM Conformance Statement is to facilitate integration between Lifetrack and other DICOM products. It is assumed that the reader of this document is familiar with the DICOM Standard and with the terminology and concepts that are used in that Standard.

1.2. Network services

Table 1.1 NETWORK SERVICES

Networking SOP Classes	User (SCU)	Provider (SCP)
Transfer		
US Image Storage	Yes	Yes
US Multi-frame Storage	Yes	Yes
Computed Radiography Image Storage	Yes	Yes
Digital X-Ray Image Storage - For Presentation	Yes	Yes
Digital X-Ray Image Storage - For Processing	Yes	Yes
Digital Mammography X-Ray Image Storage - For Presentation	Yes	Yes
Digital Mammography X-Ray Image Storage - For Processing	Yes	Yes
Digital Intra-oral X-Ray Image Storage - For Presentation	Yes	Yes
Digital Intra-oral X-Ray Image Storage - For Processing	Yes	Yes
CT Image Storage	Yes	Yes
MR Image Storage	Yes	Yes
Enhanced MR Image Storage	Yes	Yes
Secondary Capture Image Storage	Yes	Yes
X-Ray Angiographic Image Storage	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	Yes	Yes
Nuclear Medicine Image Storage	Yes	Yes
VL Endoscopic Image Storage	Yes	Yes
VL Microscopic Image Storage	Yes	Yes
VL Slide-Coordinates Microscopic Image Storage	Yes	Yes
VL Photographic Image Storage	Yes	Yes
Positron Emission Tomography Image Storage	Yes	Yes
RT Image Storage	Yes	Yes
Raw Data Storage	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	Yes	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	Yes	Yes

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Multi-frame Color Secondary Capture Image Storage	Yes	Yes
Grayscale Softcopy Presentation State Storage	Yes	Yes
Hardcopy Grayscale Image Storage SOP Class	Yes	Yes
Hardcopy Color Image Storage SOP Class	Yes	Yes
Basic Text SR	Yes	Yes
Enhanced SR	Yes	Yes
Comprehensive SR	Yes	Yes
Key Object Selection Document	Yes	Yes
Storage Commitment Push Model	No	Yes
Workflow Management		
Modality Worklist - FIND	No	Yes
Modality Performed Procedure Step	Yes	Yes
Instance Availability Notification	Yes	No
Basic Study Content Notification	Yes	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
Patient/Study Only Q/R - FIND	No	Yes
Patient/Study Only Q/R - MOVE	No	Yes
Connectivity Verification		
Verification	Yes	Yes

2. Abbreviations

AE	DICOM Application Entity
AET	Application Entity Title
CT	Computed Tomography
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
DX	Digital X-Ray
GSDF	Gray-scale Standard Display Function
HIS/RIS	Hospital Information System / Radiology Information System
IHE	Integrating the Healthcare Enterprise
IHE-TF	Integrating the Healthcare Enterprise Technical Framework
IAN	Instance Availability Notification
IOD	Information Object Definition
ISO	International Standard Organization
PACS	Picture Archiving Communication System
PDU	DICOM Protocol Data Unit
LUT	Look-up Table
MPPS	Modality Performed Procedure Step

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MR	Magnetic Resonance Image
MWL	Modality Worklist
Q/R	Query Retrieve
SCP	Service Class Provider
SCU	Service Class User
SCN	Study Content Notification
SOP	DICOM Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
TLS	Transport Layer Security
UID	Unique Identifier
US	Ultrasound
VR	Value Representation

3. References

[DICOM]	ACR-NEMA Digital Imaging and Communications in Medicine (DICOM) V3.0.2008
[IHE-TF]	IHE Radiology Technical Framework Revision 9 - Final Text, June 2008

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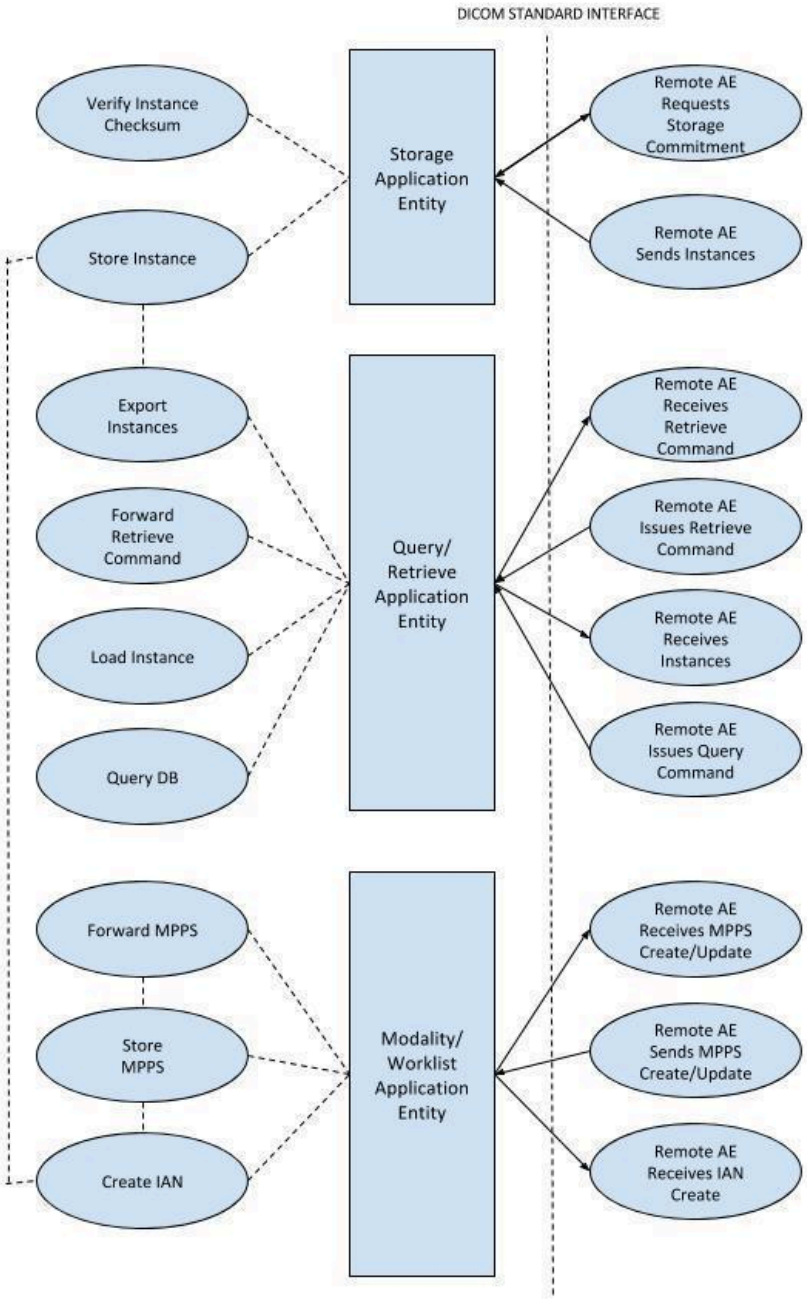
4. Networking

4.1. Implementation Model

4.1.1. Application Data Flow

Figure 1. Application Data Flow Diagram



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4.1.2. Application Entities (AEs)

Lifetrack PACS is logically divided into DICOM Application Entities:

- Storage Application Entity
- Query/Retrieve Application Entity
- Modality Worklist Application Entity

4.1.3. Functional Definition of AEs

a. Storage Application Entity

The Storage Application Entity waits for another application to connect at the presentation address configured for its Application Entity Title. The STORAGE-SCP AE will accept Associations with Presentation Contexts for SOP Classes of the Verification, Storage, and Storage Commitment Service Classes.

Lifetrack PACS stores a received image in its entirety in its internal data store and extracts information about the images and stores this information within its internal database.

b. Query/Retrieve Application Entity

The Query/Retrieve Application Entity waits for another application to connect at the presentation address configured for its Application Entity Title. When another application connects, the Storage AE expects it to be a DICOM application.

The Query/Retrieve AE will accept Associations with Presentation Contexts for SOP Classes of the Verification and Query/Retrieve Service Classes.

Once received a Retrieve (Move) request, Query/Retrieve AE will initiate a new association and send the requested instances to the Move Destination AE.

c. Modality Worklist Application Entity

The Modality Worklist Application Entity waits for another application to connect at the presentation address configured for its Application Entity Title. When another application connects, the Modality Worklist AE expects it to be a DICOM application.

The Modality Worklist AE will accept Associations with Presentation Contexts for SOP Classes of the Verification and Modality Worklist Service Classes.

When a Modality Worklist Find request is received, Modality Worklist AE will query the local database for a list of Scheduled Procedure Steps matching the query and will return a pending C-Find response for each match.

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4.2. AE Specifications

4.2.1. Storage Application Entity Specification

Storage Application Entity provides Standard Conformance to the following SOP Classes:

Table 1.2. SOP Classes for Storage AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	No	Yes
Hardcopy Gray Scale Image Storage SOP Class	1.2.840.10008.5.1.1.29	No	Yes
Hardcopy Color Image Storage SOP Class	1.2.840.10008.5.1.1.30	No	Yes
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	No	Yes
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	No	Yes
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	No	Yes
Digital Mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	No	Yes
Digital Mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	No	Yes
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	No	Yes
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	No	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	No	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	No	Yes
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	No	Yes
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	No	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	No	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	No	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	No	Yes
Multi-frame Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	No	Yes
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	No	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	No	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	No	Yes

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Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	No	Yes
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	No	Yes
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	No	Yes
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	No	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	No	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	No	Yes
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	No	Yes
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	No	Yes
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	No	Yes
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	No	Yes
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	No	Yes
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	No	Yes

Association Policy

The Storage AE can both accept and propose Association Requests. The Storage AE will accept Association Requests for the Verification, Storage, and Storage Commitment Push Model Services. It will propose Associations only for the Storage Commitment Push Model Service.

The DICOM standard application context name for DICOM 3.0 is always accepted and proposed:

Table 1.3 DICOM application context name for Storage Server AE

Application Context Name	1.2.840.10008.3.1.1.1

Association Initiation Policy

Activity - Send Storage Commitment Notification over new Association

Description and Sequencing of Activities

An Association Request is sent to the peer AE that sent the Storage Commitment Push Model request and upon successful negotiation of the required Presentation Context the outstanding N-EVENT-REPORT is sent.

Proposed Presentation Contexts

Storage Server will propose Presentation Contexts as shown in the following table:

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Table 1.7 Proposed Presentation Contexts by the Storage Server AE

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Storage Commitment Push Model	1.2.840.10008.1.20.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

Association Acceptance Policy

Activity - Receive Images and Storage Commitment Requests

Description and Sequencing of Activities

A remote peer DICOM Application Entity, acting as an Storage SCU, establishes an association with Storage Server that accepts these Associations for the purpose of receiving supported SOP Class Instances and Storage Commitment requests.

In the default configuration any Calling and Called AET will be accepted. But the Called AET does not correspond to the actual Storage AET, only a Presentation Context for the Verification SOP Class will be accepted and the SCU can only verify the DICOM Association, but cannot invoke any other related DICOM service.

The Storage AE may reject Association attempts as shown in the table below.

Table 1.8 Association Rejection Reasons

Result	Source	Reason	Description
2 – rejected transient	provider	2 - local-limit exceeded	The (configurable) maximum number of simultaneous associations has been reached. An association request with the same parameters may succeed at a later time.
1 – rejected permanent	user	2 – application context name not	The Association request contained an unsupported Application Con text Name. An association request with the same parameters will NOT succeed at a later time.

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		supported	
1 – rejected permanent	user	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.

Accepted Presentation Contexts

Table 1.9 Accepted Presentation Contexts for Storage AE

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	Transfer Syntaxes for Non- Image Storage Services		SCP	None
Hardcopy Grayscale Image Storage SOP Class	1.2.840.10008.5.1.1.29	Transfer Syntaxes for Image Storage Services		SCP	None
Hardcopy Color Image Storage SOP Class	1.2.840.10008.5.1.1.30	Transfer Syntaxes for Image Storage Services		SCP	None
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Transfer Syntaxes for Image Storage Services		SCP	None
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Transfer Syntaxes for Image Storage Services		SCP	None
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Transfer Syntaxes for Image		SCP	None
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Transfer Syntaxes for Image Storage Services		SCP	None
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Transfer Syntaxes for Image Storage Services		SCP	None

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Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Transfer Syntaxes for Image Storage Services	SCP	None
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Transfer Syntaxes for Image Storage Services	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Transfer Syntaxes for Image Storage Services	SCP	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Transfer Syntaxes for Image Storage Services	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Transfer Syntaxes for Image Storage Services	SCP	None
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Transfer Syntaxes for Image Storage Services	SCP	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Transfer Syntaxes for Image Storage Services	SCP	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Transfer Syntaxes for Image Storage Services	SCP	None
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Transfer Syntaxes for Image Storage Services	SCP	None
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Transfer Syntaxes for Image	SCP	None
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Transfer Syntaxes for Image Storage Services	SCP	None
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Transfer Syntaxes for Non-Image Storage Services	SCP	None
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Transfer Syntaxes for Image Storage Services	SCP	None
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Transfer Syntaxes for Image Storage Services	SCP	None
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Transfer Syntaxes for Image Storage Services	SCP	None
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Transfer Syntaxes for Image Storage Services	SCP	None
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Transfer Syntaxes for Image Storage Services	SCP	None

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RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Transfer Syntaxes for Image Storage Services	SCP	None
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1. 1.11.1	Transfer Syntaxes for Non- Image Storage Services	SCP	None
Basic Text SR	1.2.840.10008.5.1.4.1. 1.88.11	Transfer Syntaxes for Non- Image Storage Services	SCP	None
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Transfer Syntaxes for Non- Image Storage Services	SCP	None
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Transfer Syntaxes for Non- Image Storage Services	SCP	None
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Transfer Syntaxes for Non- Image Storage Services	SCP	None

Table 1.10 Accepted Transfer Syntaxes for Non-Image Storage Services

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

Table 1.11 Accepted Transfer Syntaxes for Image Storage Services

Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
JPEG Baseline	1.2.840.10008.1.2.4.50
JPEG Extended	1.2.840.10008.1.2.4.51
JPEG Lossless, Non-Hierarchical	1.2.840.10008.1.2.4.57
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	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

If the Called AET is not corresponding to the actual Storage AET, it only will be accepted the Presentation Context for the Verification SOP Class.

SOP Specific Conformance

Specific Conformance for Verification SOP Class

Storage Server provides standard conformance to the DICOM Verification Service Class as a

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SCP. The status code for the C-ECHO is described in the following table:

Table 1.12 C-Echo Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The C-ECHO request is accepted

Specific Conformance for Storage SOP Classes

The associated Activity with the Storage service is the storage of medical DICOM data received over the network on a designated storage repository. The Storage AE will return a failure status if it is unable to store the received instance(s).

The Storage 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 either the number of SOP Instances or the maximum amount of total SOP Instance data that can be transferred over a single Association.

The Storage AE is configured to retain the original DICOM data in DICOM Part 10 compliant file format. The Storage 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. In addition to saving all Elements in files, a subset of the Elements are stored in the Query/Retrieve Server database to support query and retrieval requests and also allow updating of Patient, Study, and Series in-formation by user input, or demographic and Study related messages.

If the received instance is a duplicate of a previously received instance, the old file and database information will not be overwritten with the new one.

Storage AE C-STORE Response

Table 1.13 Server C-STORE Response Status

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The Composite SOP Instance was successfully received, verified, and stored in the system repository.
Error	Processing Failure	0110	This status is returned due to internal errors such as a processing failure response from the internal database or a file system operation. The appropriate Status will be sent in the C-STORE Response. Error indication message is output to the Service Log.
Warning	Coercion of Data	B000	This status is returned if one or more Attribute values were coerced/ modified on reception. Image

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	Elements		transmission is considered successful. The appropriate SUCCESS Status will be sent in the C-STORE Response. Warning indication message is output to the Service Log.
Warning	Data Set does not match SOP class	B007	This status is returned if the C-STORE Request specifies Attributes that are not specific as part of the Storage SOP class. Image transmission is considered successful. The appropriate SUCCESS Status will be sent in the C-STORE Response. Warning indication message is output to the Service Log.

Storage AE Storage Service Communication Failure Reasons

Table 1.14 Storage Service Communication Failure Reasons

Exception	Reason
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). I.e. The STORAGE-SCP AE is waiting for the next C-STORE Request on an open Association but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. 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 be-cause of a later failure.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout). I.e. The STOR-AGE-SCP AE is waiting for the next C-STORE DataSet 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.

Specific Conformance for Storage Commitment SOP Class

The associated Activity with the Storage Commitment Push Model service is the communication by the Storage Server AE to peer AEs that it has committed to permanently store Composite SOP Instances that have been sent to it. It thus allows peer AEs to determine whether the Query/Retrieve Server has taken responsibility for the archiving of specific SOP Instances so that they can be flushed from the peer AE system.

The Storage AE takes the list of Composite SOP Instance UIDs specified in a Storage Commitment Push Model N-ACTION Request and checks if they are present in the query/retrieve Server repository. As long as the Composite SOP Instance UIDs are present in

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the database, the Storage AE will consider those Composite SOP Instance UIDs to be successfully archived. The Storage AE does not require the Composite SOP Instances to actually be successfully written to archive media in order to commit to responsibility for maintaining these SOP Instances.

Once the Storage AE has checked for the existence of the specified Composite SOP Instances, it will then attempt to send the Notification request (N-EVENT-REPORT-RQ). The Storage Server AE will request a new Association with the peer AE that made the original N-ACTION Request.

The Storage AE will not cache Storage Commitment Push Model N-ACTION Requests that specify Composite SOP Instances that have not yet been transferred to the Query/Retrieve Server. If a peer AE sends a Storage Commitment Push Model N-ACTION Request before the specified Composite SOP Instances are later sent over the same Association, the Storage Server AE will not commit to responsibility for such SOP Instances.

The Storage AE does not support the optional Storage Media File-Set ID & UID attributes in the N-ACTION.

The Storage AE will support Storage Commitment Push Model requests for SOP Instances of any of the Storage SOP Classes that are also supported by the Storage Server AE:

Table 1.15 Supported Referenced SOP Classes In Storage Commitment Push Model N-ACTION Requests

Supported Referenced SOP Classes
Hardcopy Grayscale Image Storage SOP Class
Hardcopy Color Image Storage SOP Class
Computed Radiography Image Storage
Digital X-Ray Image Storage - For Presentation
Digital X-Ray Image Storage - For Processing
Digital Mammography X-Ray Image Storage - For Presentation
Digital Mammography X-Ray Image Storage - For Processing
Digital Intra-oral X-Ray Image Storage - For Presentation
Digital Intra-oral X-Ray Image Storage - For Processing
CT Image Storage
Ultrasound Multi-frame Image Storage
MR Image Storage
Enhanced MR Image Storage
Ultrasound Image Storage
Secondary Capture Image Storage
X-Ray Angiographic Image Storage
X-Ray Radiofluoroscopic Image Storage
Nuclear Medicine Image Storage
VL Endoscopic Image Storage

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VL Microscopic Image Storage
VL Slide-Coordinates Microscopic Image Storage
VL Photographic Image Storage
Positron Emission Tomography Image Storage
RT Image Storage
Grayscale Softcopy Presentation State Storage SOP Class
Basic Text SR
Comprehensive SR
Key Object Selection Document

The Storage AE will return the following Status Code values in N-ACTION Responses:

Table 1.16 Storage N-ACTIN Response Status

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has successfully received the Storage Commitment Push Model N-ACTION Request and can process the commitment request for the indicated SOP Instances.
Error	Processing Failure	0110	Indicates that the Storage Commitment Push Model N-ACTION Request cannot be parsed or fully processed due to a database or system failure.
Error	Missing Attribute	0120	Indicates that the Storage Commitment Push Model N-ACTION Request cannot be processed because a required attribute is missing from the N-ACTION Request Data Set.
Error	Missing Attribute Value	0121	Indicates that the Storage Commitment Push Model N-ACTION Request cannot be processed because a Type 1 attribute in the N-ACTION Request Data Set does not specify a value.

The Storage AE will exhibit the following Behavior according to the Status Code value re-turned in an N-EVENT-REPORT Response from a destination Storage Commitment Push Model SCU:

Table 1.17 Storage N-EVENT Report Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCU has successfully received the Storage Commitment Push Model N-EVENT-REPORT Request. Success indication message is output to the Service Logs.

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Warning	Attribute List Error	0107	Transmission of Storage Commitment Push Model N-EVENTREPORT Request is considered successful. Warning indication message is output to the Service Logs.
*	*	Any Other Code	This is treated as a permanent Failure. Error indication message is output to the Service Logs.

The next table reports the Storage Server behavior in case of communication failure:

Table 1.18 Storage AE Storage Commitment Push Model Communication Failure Behavior

Exception	Behavior
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). I.e. The STORAGE-SCP AE is waiting for the next N-ACTION Request on an open Association but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. If some Composite SOP Instances have been successfully received over the same Association via the Storage Service then they are maintained in the database. They are not automatically discarded because of a later Storage Commitment messaging failure. Any previously received Storage Commitment Push Model NACTION Requests will still be fully processed. Error indication message is output to the Service Logs. No message is posted to the User Interface.
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted by issuing a DICOM A- ABORT. If some Composite SOP Instances have been successfully received over the same Association via the Storage Service then they are maintained in the database. They are not automatically discarded because of a later Storage Commitment messaging failure. Any previously received Storage Commitment Push Model NACTION Requests will still be fully processed. Error indication message is output to the Service Logs. No message is posted to the User Interface.
Association A-ABORTed by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure).	The TCP/IP socket is closed. If some Composite SOP Instances have been successfully received over the same Association via the Storage Service then they are maintained in the database. They are not automatically discarded because of a later Storage Commitment messaging failure. Any previously received Storage Commitment Push Model NACTION Requests will still be fully processed. Error indication message is output to the Service Logs. No message is posted to the User Interface.

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4.2.2. Query/Retrieve Application Entity Specification

SOP Classes

Query/Retrieve Application Entity provides Standard Conformance to the following SOP Classes:

Table 1.19 SOP Classes for Query/Retrieve AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	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
Patient/Study Only Q/R Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1	No	Yes
Patient/Study Only Q/R Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2	No	Yes
Hardcopy Grayscale Image Storage SOP Class	1.2.840.10008.5.1.1.29	Yes	No
Hardcopy Color Image Storage SOP Class	1.2.840.10008.5.1.1.30	Yes	No
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes	No
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes	No
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	No
Digital Mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes	No
Digital Mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	No
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Yes	No
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	No
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	No
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	No
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes	No
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	No
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	No

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Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	No
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Yes	No
Multi-frame Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	No
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes	No
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes	No
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	No
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	No
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	No
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	No
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Yes	No
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	No
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	No
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	No
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	Yes	No
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Yes	No
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Yes	No
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Yes	No
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes	No

Association Establishment Policy

General

The Query/Retrieve AE can both accept and propose Association Requests. The Query/Retrieve AE will accept Association Requests for the Verification and Query/Retrieve Services. It will propose Associations for Verification and Storage Services.

The DICOM standard application context name for DICOM 3.0 is always accepted and proposed:

Table 1.20 DICOM application context name for Query/Retrieve Server AE

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Application Context Name	1.2.840.10008.3.1.1.1

Number of Associations

Query/Retrieve can support multiple simultaneous Associations requested by peer AEs. Default is 10. This value can be configured through the attribute "MaxClients" in the Application Server configuration file (i.e. jboss-service.xml for JBoss application seerver).

Table 1.21 Number of Associations accepted for Query/Retrieve Server AE

Maximum number of simultaneous Associations	10 (Configurable)

Asynchronous Nature

Query/Retrieve Server does not support asynchronous communication. Multiple outstanding transactions are not supported. It allows up to one invoked and one performed operation on an Association (it is synchronous). Asynchronous mode of operation is not supported.

Table 1.22 Asynchronous Nature as SCP for Query/Retrieve Server AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)

Implementation Identifying Information

The implementation information for this Application Entity is:

Table 1.23 DICOM Implementation Class and Version for Query/Retrieve AE

Implementation Class UID	1.2.40.0.13.1.1
Implementation Version Name	dcm4che-1.1

Association Initiation Policy

Activity - Send Images Requested by an External Peer AE

Description and Sequencing of Activities

The Query/Retrieve AE will initiate a new Association when a valid C-MOVE Request has been performed by an external Peer. The Query/Retrieve AE will send the Association Re-quest to the specific C-MOVE destination, and upon successful negotiation of the required Presentation Con-text the image transfer is started. In all cases an attempt will be made to transmit all the indicated images in a single Association but this may not always be possible. The Association will be released when all the images have been sent.

If an error occurs during transmission over an open Association then the image transfer is

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halted. The Query/ Retrieve Server AE will not attempt to independently retry the image export.

Proposed Presentation Contexts

Query/Retrieve Server will propose Presentation Contexts as shown in the following table:

Table 1.24 Proposed Presentation Contexts by the Query/Retrieve Server AE

Abstract Syntax		Transfer Syntax	Role	Ext. Neg.
Name	UID	Name List		
Hardcopy Grayscale Image Storage SOP Class	1.2.840.10008.5.1.1.29	Transfer Syntaxes for Image Storage Services	SCU	None
Hardcopy Color Image Storage SOP Class	1.2.840.10008.5.1.1.30	Transfer Syntaxes for Image Storage Services	SCU	None
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Transfer Syntaxes for Image Storage Services	SCU	None
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Transfer Syntaxes for Image Storage Services	SCU	None
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Transfer Syntaxes for Image Storage Services	SCU	None
Digital Mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Transfer Syntaxes for Image Storage Services	SCU	None
Digital Mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Transfer Syntaxes for Image Storage Services	SCU	None
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Transfer Syntaxes for Image Storage Services	SCU	None
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Transfer Syntaxes for Image Storage Services	SCU	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Transfer Syntaxes for Image Storage Services	SCU	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Transfer Syntaxes for Image Storage Services	SCU	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Transfer Syntaxes for Image Storage Services	SCU	None
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Transfer Syntaxes for Image Storage Services	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Transfer Syntaxes for Image Storage Services	SCU	None

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Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Transfer Syntaxes for Image Storage Services	SCU	None
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Transfer Syntaxes for Image Storage Services	SCU	None
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Transfer Syntaxes for Image Storage Services	SCU	None
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Transfer Syntaxes for Image Storage Services	SCU	None
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Transfer Syntaxes for Image Storage Services	SCU	None
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Transfer Syntaxes for Image Storage Services	SCU	None
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Transfer Syntaxes for Image Storage Services	SCU	None
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Transfer Syntaxes for Image Storage Services	SCU	None
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Transfer Syntaxes for Image Storage Services	SCU	None
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Transfer Syntaxes for Image Storage Services	SCU	None
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	Transfer Syntaxes for Non- Image Storage Services	SCU	None
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Transfer Syntaxes for Non- Image Storage Services	SCU	None
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Transfer Syntaxes for Non- Image Storage Services	SCU	None
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Transfer Syntaxes for Non- Image Storage	SCU	None

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		Services		
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Transfer Syntaxes for Non- Image Storage Services	SCU	None

Table 1.25 Proposed Transfer Syntaxes for Non-Image Storage Services

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

Table 1.26 Proposed Transfer Syntaxes for Image Storage Services

Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
JPEG Baseline	1.2.840.10008.1.2.4.50
JPEG Extended	1.2.840.10008.1.2.4.51
JPEG Lossless, Non-Hierarchical	1.2.840.10008.1.2.4.57
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	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

SOP Specific Conformance

Specific Conformance for Image, SR, KIN and SPS SOP Classes

When a SOP Instance is selected for export from Query/Retrieve Server, its contents will be exported as it was originally received unless some of the Patient demographic and Study information Elements were altered.

The Patient demographic and Study information can be entered or altered by several means: manually (through the web interface), 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.

The Query/Retrieve AE will exhibit the following behavior according to the Status Code value returned in a C-STORE Response from a destination C-STORE SCP:

Table 1.27 Query/Retrieve AE C-STORE Response Status Handling Behavior

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Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The remote Storage SCP has successfully stored the exported SOPInstance. The appropriate PENDING or SUCCESS Status will be sent in the C-MOVE Response. Success indication message is output to the Service Log.
Refused	Out of Resources	A700-A7FF	This is treated as a permanent Failure. The appropriate Status will be sent in the C-MOVE Response. Error indication message is output to the Service Log.
Error	Cannot Understand	C000-CFFF	This is treated as a permanent Failure. The appropriate Status will be sent in the C-MOVE Response. Error indication message is output to the Service Log.
Warning	Coercion of Data Elements	B000	Image transmission is considered successful. The appropriate PENDING or SUCCESS Status will be sent in the C-MOVE Response. Success indication message is output to the Service Log.
Warning	Data Set does not match SOP class	B007	Image transmission is considered successful. The appropriate PENDING or SUCCESS Status will be sent in the C-MOVE Response. Success indication message is output to the Service Log.
Warning	Elements Discarded	B006	Image transmission is considered successful. The appropriate PENDING or SUCCESS Status will be sent in the C-MOVE Response. Success indication message is output to the Service Log.
Warning	Attribute List Error	0107	Image transmission is considered successful. The appropriate PENDING or SUCCESS Status will be sent in the C-MOVE Response. Success indication message is output to the Service Log.
Warning	Attribute Value Out of Range	0116	Image transmission is considered successful. The appropriate PENDING or SUCCESS Status will be sent in the C-MOVE Response. Success indication message is output to the Service Log.
*	*	Any other statuscode	This is treated as a permanent Failure. The appropriate Status will be sent in the C-MOVE Response. Error indication message is output to the Service Log.

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Table 1.28 Query/Retrieve AE Communication Failure Behavior

Exception	Behavior
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout).	The Association is aborted by issuing a DICOM A-ABORT. The appropriate Status will be sent in the CMOVE Response. Error indication message is output to the Service Logs
Timeout expiry for an expected DICOM PDU or TCP/IP packet (Low-level timeout).	The Association is aborted by issuing a DICOM A-ABORT. The appropriate Status will be sent in the CMOVE Response. Error indication message is output to the Service Logs
Association A-ABORTed by the SCU or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure).	The TCP/IP Socket is closed. Error indication message is output to the Service Logs.

Association Acceptance Policy

Activity - Handling Query and Retrieval Requests

Description and Sequencing of Activities

The Query/Retrieve AE accepts Associations only if they have valid Presentation Contexts. If none of the requested Presentation Contexts are accepted then the Association Request itself is rejected. It can be con-figured to only accept Associations from certain Application Entities.

If Query/Retrieve AE receives a query (C-FIND) request then the response(s) will be sent over the same Association used to send the C-FIND-Request.

If Query/Retrieve AE receives a retrieval (C-MOVE) request then the responses will be sent over the same Association used to send the C-MOVE-Request.

The Query/Retrieve AE will send the requested SOP Instances to the C-MOVE Destination over a newly created Association and report in the C-MOVE-Response any success or failure status of each attempt to send a CompositeSOP Instance.

When an association has been established the Sequencing of Real-World Activities is as described in Section 1.3.1.3, “Sequencing of Real-World Activities”.

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The Query/Retrieve 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.

Table 1.29 Association Rejection Reasons

Result	Source	Reason	Description
2 – rejected transient	provider	2 - local-limit exceeded	The (configurable) maximum number of simultaneous associations has been reached. An association request with the same parameters may succeed at a later time.
1 – rejected permanent	user	2 - application context name not supported	The Association request contained an unsupported Application Con-text Name. An association request with the same parameters will NOT succeed at a later time.
1 – rejected permanent	user	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.

Accepted Presentation Contexts

Table 1.30 Accepted Presentation Contexts for Query/Retrieve AE

Abstract Syntax Name	Transfer Syntax UID	Role Name List	Ext. UID List		Neg.
Verification SOP Class	1.2.840.10008.1.1	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	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.21.2.840.10008.1.2.1	SCP	Relational queries
Patient Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.21.2.840.10008.1.2.1	SCP	Relational retrieve
Study Root Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	Relational queries

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Study Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	Relational retrieve
Patient/Study Only Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	Relational queries
Patient/Study Only Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	Relational retrieve

If the Called AET is not corresponding to the actual Storage AET, it only will be accepted the Presentation Context for the Verification SOP Class.

SOP Specific Conformance

Specific Conformance for Verification SOP Class

Storage Server provides standard conformance to the DICOM Verification Service Class as a SCP. The status code for the C-ECHO is described in the following table:

Table 1.31 C-Echo Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The C-ECHO request is accepted

Specific Conformance for Query SOP Classes

The Query/Retrieve AE supports hierarchical and relational queries. There are no attributes always re-turned by default. Only those attributes requested in the query identifier are returned.

Query responses always return values from the Query/Retrieve database. Exported SOP Instances are always updated with the latest values kept in the database prior to export. Thus, a change in Patient demographic information will be contained in both the C-FIND Responses and any Composite SOP Instances exported to a C-MOVE Destination AE.

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 of the three levels

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(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.

Patient/Study Only Information Model: All the required search keys on the Patient and Study levels are supported. The Patient ID (0010,0020) key must be at least partially stated if the Patient's Name (0010,0010) is not present in a Patient Level query.

Table 1.32 Patient Root C-FIND SCP Supported Elements

Attribute Name	Tag	VR	Types of Matching
SOP Common			
Specific Character Set	0008,0005	CS	NONE
Patient Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	S,*,U
Issuer of Patient ID	0010,0021	LO	NONE
Patient's Birth Date	0010,0030	DA	S,U,R
Patient's Sex	0010,0040	CS	S,*,U
Study Level			
Study Instance UID	0020,000D	UI	S,L
Study ID	0020,0010	SH	S,*,U
Study Date	0008,0020	DA	S,U,R
Study Time	0008,0030	TM	S,U,R
Accession Number	0008,0050	SH	S,*,U
Referring Physician's Name	0008,0090	PN	S,*,U
Modalities In Study	0008,0061	CS	S,*,U
Series Level			
Series Instance UID	0020,000E	UI	S,L
Series Number	0020,0011	IS	S,*,U
Modality	0008,0060	CS	S,*,U
Performed Procedure Step Start Date	0040,0244	DA	S,U,R
Performed Procedure Step Start Time	0040,0245	TM	S,U,R
Image Level			
SOP Instance UID	0008,0018	UI	S,L
SOP Class UID	0008,0016	UI	S,L
Instance Number	0020,0013	IS	S,*,U
Completion Flag	0040,0A91	CS	S,*,U
Verification Flag	0040,0A93	CS	S,*,U

Table 1.33. Study Root C-FIND SCP Supported Elements

Attribute Name	Tag	VR	Types of Matching
SOP Common			
Specific Character Set	0008,0005	CS	NONE

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Study Level			
Patient's Name	0010,0010	PN	S,*,U
Patient ID	0010,0020	LO	S,*,U
Issuer of Patient ID	0010,0021	LO	NONE
Patient's Birth Date	0010,0030	DA	S,U,R
Patient's Sex	0010,0040	CS	S,U
Study Instance UID	0020,000D	UI	S,L
Study ID	0020,0010	SH	S,*,U
Study Date	0008,0020	DA	S,U,R
Study Time	0008,0030	TM	S,U,R
Accession Number	0008,0050	SH	S,*,U
Referring Physician's Name	0008,0090	PN	S,*,U
Modalities In Study	0008,0061	CS	S,*,U
Series Level			
Series Instance UID	0020,000E	UI	S,L
Series Number	0020,0011	IS	S,*,U
Modality	0008,0060	CS	S,*,U
Performed Procedure Step Start Date	0040,0244	DA	S,U,R
Performed Procedure Step Start Time	0040,0245	TM	S,U,R
Image Level			
SOP Instance UID	0008,0018	UI	S,L
SOP Class UID	0008,0016	UI	S,L
Instance Number	0020,0013	IS	S,*,U
Completion Flag	0040,0A91	CS	S,*,U
Verification Flag	0040,0A93	CS	S,*,U

Types of Matching

The types of Matching supported by the C-FIND SCP. An "S" indicates the identifier attribute uses Single Value Matching, an "R" indicates Range Matching, an "*" indicates wildcard matching, a 'U' indicates Universal Matching, and an 'L' indicates that UID lists are supported for matching. "NONE" indicates that no matching is supported, but that values for this Element are requested to be returned (i.e. universal matching).

Table 1.34 Query/Retrieve C-FIND Response Status

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	Matching is complete. No final identifier is supplied
Error	Processing Failure	0110	This status is returned due to internal errors such as a processing failure response on an query of the internal database. The appropriate Status will be sent in the C-FIND Response. Error indication message is output to the Service Log.

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Cancel	Matching terminated due to Cancel Request	FE00	The C-FIND SCU sent a Cancel Request. This has been acknowledged and the search for matches has been halted. Cancel indication message is 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. Pending indication message is output to the Service Log.

Specific Conformance for Query SOP Classes

Exported SOP Instances are always updated with the latest values kept in the database prior to export.

Table 1.35 Query/Retrieve Server C-MOVE Response Status

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	Matching is complete. No final identifier is supplied
Error	Processing Failure	0110	This status is returned due to internal errors such as a processing failure response on an query of the internal database. The appropriate Status will be sent in the C-MOVE Response. Error indication message is output to the Service Log.
Error	Unable to perform sub operations	A702	C-STORE sub-operations cannot be performed due to failure of an Association Request or a C-STORE Request. Error indication message is output to the Service Log.
Error	Move Destination unknown	A801	The Destination Application Entity named in the C-MOVE Request is unknown to Query/Retrieve SCP AE. Error indication message is output to the Service Log.
Error	Identifier does not match SOP Class	A900	The C-MOVE identifier contains invalid Elements or values, or is missing mandatory Elements or values for the specified SOP Class or retrieval level. Error indication message is output to the Service Log.
Error	Unable to process	Cxxx	The Move Destination AET is missing in the C-MOVE Request. Error indication message is output to the Service Log.

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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. Pending indication message is output to the ServiceLog.

Table 1.36 Query/Retrieve Service Communication Failure Behavior

Exception	Behavior
Timeout expiry for an expected DICOM Message Request (DIMSE level timeout). I.e. the Query/Retrieve Server SCP AE is waiting for the next C-FIND or C-MOVE Request on an open Association but the timer expires.	The Association is aborted by issuing a DICOM A-ABORT. Error message is output to the Service Log.
Timeout expiry for an expected DICOM PDU or TCP/ IP packet (Low-level timeout). I.e. The Query/Retrieve Server 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.
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.

4.2.3. Modality Worklist Application Entity Specification

SOP Classes

Modality Worklist Application Entity provides Standard Conformance to the following SOP Classes:

Table 1.37 SOP Classes for Modality Worklist AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	No	Yes
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	No	Yes

SOP Classes for Modality Worklist AE

Association Establishment Policy

General

Modality Worklist AE can both accept and propose Association Requests. The Query/Retrieve AE will accept Association Requests for the Verification and Query/Retrieve Services. It will propose Associations for Verification and Storage Services.

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The DICOM standard application context name for DICOM 3.0 is always accepted and proposed:

Table 1.38 DICOM application context name for Modality Worklist AE

Application Context Name	1.2.840.10008.3.1.1.1

Number of Associations

Modality Worklist can support multiple simultaneous Associations requested by peer AEs. Default is 10. This value can be configured through the attribute "MaxClients" in the Application Server configuration file (i.e. jboss-service.xml for JBoss application server).

Table 1.39 Number of Associations accepted for Modality Worklist AE

Maximum number of simultaneous Associations	10 (Configurable)

Asynchronous Nature

Modality Worklist does not support asynchronous communication. Multiple outstanding transactions are not supported. It allows up to one invoked and one performed operation on an Association (it is synchronous). Asynchronous mode of operation is not supported.

Table 1.40 Asynchronous Nature as SCP for Modality Worklist AE

Maximum number of outstanding asynchronous transactions	1 (Not Configurable)

Implementation Identifying Information

The implementation information for this Application Entity is:

Table 1.41 DICOM Implementation Class and Version for Modality Worklist AE

Implementation Class UID	1.2.40.0.13.1.1
Implementation Version Name	dcm4che-1.1

Association Initiation Policy

The Modality Worklist Server AE does not initiate Associations.

Association Acceptance Policy

Activity - External Peer AE requests MWL query

Description and Sequencing of Activities

The Modality Worklist Server AE accepts Associations only if they have valid Presentation

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Contexts. If none of the requested Presentation Contexts are accepted then the Association Request itself is rejected. It can be configured to only accept Associations from certain Application Entities.

When Modality Worklist SCUs query the Modality Worklist Server AE the queries run against the MWL items in the local database.

The Modality Worklist Server 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

Association Rejection Reasons

Table 1.42 Association Rejection Reasons

Result	Source	Reason	Description
2 – rejected transient	provider	2 - local-limit exceeded	The (configurable) maximum number of simultaneous associations has been reached. An association request with the same parameters may succeed at a later time.
1 – rejected permanent	user	2 - application context name not supported	The Association request contained an unsupported Application Context Name. An association request with the same parameters will NOT succeed at a later time.
1 – rejected permanent	user	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.

Accepted Presentation Contexts

Table 1.43 Accepted Presentation Contexts for Query/Retrieve AE

Abstract Syntax Name	Transfer Syntax UID	Role Name List	Ext. UID List		Neg.
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Modality Worklist Information	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

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Model – FIND		Explicit VR Little Endian	1.2.840.10008.1.2.1		

If the Called AET is not corresponding to the actual Modality Worklist AET, only the Presentation Con-text for the Verification SOP Class will be accepted.

SOP Specific Conformance

Specific Conformance for Verification SOP Class

Storage Server provides standard conformance to the DICOM Verification Service Class as a SCP. The status code for the C-ECHO is described in the following table:

Table 1.44 C-Echo Response Status Handling Behavior

Service Status	Further Meaning	Error code	Behavior
Success	Success	0000	The C-ECHO request is accepted

Specific Conformance for Modality Worklist SOP Class

Return attributes depend on the information provided by the connected HIS/RIS. 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 Modality Worklist database.

Table 1.45 Modality Worklist C-FIND SCP Supported Elements

Attribute Name	Tag	VR	Types of Matching
Specific Character Set	0008,0005	CS	NONE
Scheduled station AE title	0040,0001	AE	S
Scheduled Procedure Step Start Date	0040,0002	DA	S,R
Scheduled Procedure Step Start Time	0040,0003	TM	S,R
Scheduled Performing Physician's Name	0040,0006	PN	S,*
Modality	0008,0060	CS	S
Accession Number	0008,0050	SH	S
Patient's Name	0010,0010	PN	S,*
Patient's ID	0010,0020	LO	S
All others			NONE

Types of Matching

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The types of Matching supported by the C-FIND SCP. An "S" indicates the identifier attribute uses Single Value Matching, an "R" indicates Range Matching, an "*" indicates wildcard matching, a "U" indicates Universal Matching. "NONE" indicates that no matching is supported, but that values for this Element are requested to be returned.

Modality Worklist AE C-STORE Response

Table 1.46 Modality Worklist C-STORE Response Status

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete	0000	Success indication message is output to the Service Log.
Error	Processing Failure	0110	This is treated as a permanent Failure. The appropriate Status will be sent in the C-FIND Response. Error indication message is output to the Service Log.
Canceled	Matching terminated due to cancel request	FE00	This status is returned if a Cancel Request is received from the SCU during the processing of a Modality Worklist request. A cancel indication message is output to the Service Log.
Pending	Matching is continuing	FF00	This status is returned with each matching response. A pending indication message is output to the Service Log.

Modality AE Storage Service Communication Failure Reasons

Table 1.47 Modality Server Service Communication Failure Behavior

Exception	Behavior
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.

4.3. Physical Network Interfaces

4.3.1. Supported Communication Stacks

DICOM Upper Layer over TCP/IP is supported.

TCP/IP Stack

Lifetrack inherits their TCP/IP stack from the installed Java Runtime Environment.

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4.3.2. Physical Network Interface

Lifetrack is indifferent to the physical medium over which TCP/IP executes; it inherits this from the Java Runtime Environment.

4.3.3. Configuration

AE Title/Presentation Address Mapping

Local AE Titles

The local AE Titles and TCP ports are configurable through web interface.

Table 1.48 AE Title Configuration Table

Application Entity	Default AE Title	Default TCP/IP Port
Storage Server	STORE_SCP	2350
Query/Retrieve Server	QR_SCP	2350
Modality Work- list Server	MWL_SCP	2350

Remote AE Title

Remote AE Titles, TCP/IP Addresses and ports can be configured through web interface. In the default configuration, Association Requests with any Calling AET will be accepted.

4.3.4. Parameters

The following table shows the configuration parameters relevant to DICOM communication.

Table 1.49 Configuration Parameter Table

Parameter	Configurable (Yes/No)	Default Value
General Parameters		
Listening Port	Yes	104
Maximum number of simultaneous Associations	Yes	10
Time-out waiting for A-ASSOCIATE RQ on open TCP/IP connection (ARTIM timeout)	Yes	5s
Time-out waiting on an open association for the next message (DIMSE timeout)	Yes	10 minutes
Time-out waiting for acceptance or rejection Response to an Association Open Request. (Application Level timeout)	No	10 minutes
Time-out waiting on an open association for the next message after sending A-RELEASE RSP or A-ABORT RQ (Closing timeout)	Yes	16s

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Maximum PDU size the AE can receive	Yes	16352
Maximum PDU size the AE can send	No	65535
Pack Command and Data PDVs in one PDU	Yes	false
Support for the Basic TLS Secure Transport Connection Profile	Yes	Off
Accepted TLS Ciphers	Yes	-

5. Support of Extended Character Sets

Lifetrack supports UTF-8 as an extended character set.

6. Media Interchange

Lifetrack does not support Media Storage.

7. Security

7.1. Security Profiles

Lifetrack supports secure DICOM communication in conformance with the Basic TLS Secure Transport Connection Profile.

7.2. Association Level Security

Lifetrack can be configured to accept Association Requests from only a limited list of Calling AE Titles.

In the default configuration, Association requests with any Calling AET and any Called AET will be accepted. However, if the Called AET is not correspondent to any of the actual Storage Server AETs, only acceptance of the Presentation Context for Verification SOP Class will be returned in the Association Acceptance Response (A-ASSOCIATE AC).

7.3. Application Level Security

Lifetrack requires user authentication in order to access to the user interface functionalities.

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DICOM Conformance Statement

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Revision and Review Table

Rev	Date	By	Notes
1.0	3/3/2016	CC	Initial release

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