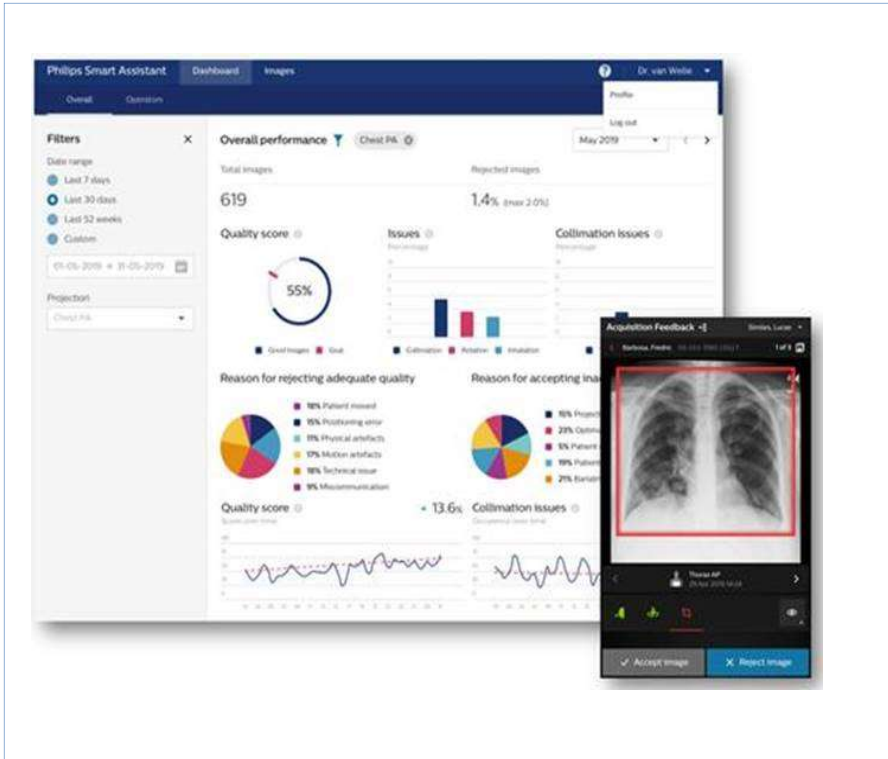


DICOM Conformance Statement

Philips Radiology Smart Assistant 1.0



Issued by:

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1. DICOM Conformance Statement Overview

Philips AI based “Radiology Smart Assistant” is an easy to install vendor agnostic solution that helps radiology departments and imaging service providers to improve operational excellence (efficiency) within their installed base through better clinical excellence for PA chest images by providing instant user feedback about image quality level at the point of acquisition.

The following are the features supported from DICOM conformance point of view:

- Verification of application level communication.
- Storage of images to a DICOM node (only store without commitment).
- Query and Retrieve of instances from an external DICOM system (Q/R)

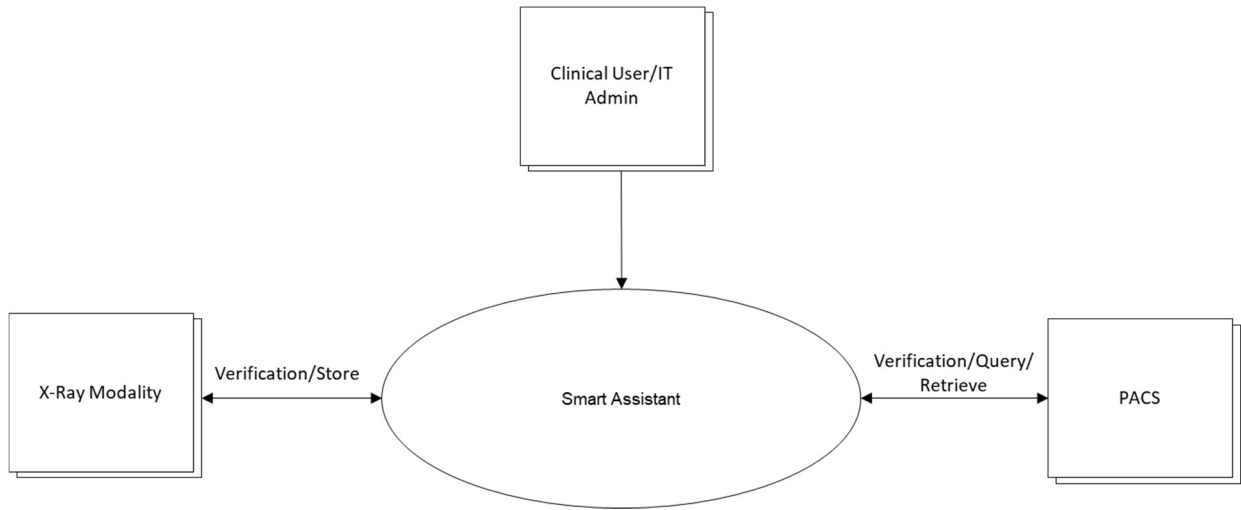


Figure 1 - Smart Assistant in a DICOM network

A table of Supported Networking DICOM Services, (SOP) Classes is provided with roles (User/Provider) and can be found on the table below. The services are specified as a SCU, SCP based on the Smart Assistant DICOM context.

Table 1: Network Services

SOP Class		User of Service (SCU)	Provider of Service (SCP)	Display
Name	UID			
Other				
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes	N/A
Print Management				
Not Applicable				
Query/Retrieve				
Study Root QR Information Model - FIND SOP Class	1.2.840.10008.5.1.4.1.2.2.1	Yes	No	N/A
Study Root QR Information Model - MOVE SOP Class	1.2.840.10008.5.1.4.1.2.2.2	Yes	No	N/A
Transfer				
Computed Radiography Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.1	No	Yes	N/A
Digital X-Ray Image Storage - For Pres. SOP	1.2.840.10008.5.1.4.1.1.1.1	No	Yes	N/A
Secondary Capture Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.7	No	Yes	N/A
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	No	Yes	N/A

SOP Class		User of Service (SCU)	Provider of Service (SCP)	Display
Name	UID			

Workflow Management

Not Applicable

Note : X-Ray Radiofluoroscopic Image Storage SOP class is not supported for Query / Retrieve

Table 2: Media Services

Media Storage Application Profile	File-set Creator (FSC)	File-set Updater (FSU)	File-set Reader (FSR)
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Not Applicable

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3. Introduction

The Smart Assistant supports the following workflows from the system usage point of view. The details are provided in the table below.

Passive (Store as SCP)	In this case Smart Assistant listens to images exported from the modality and provides an instant feedback to the Radiographer on the image quality. Here Smart Assistant acts as one of the store (only DICOM store without storage commitment) destinations to modality.
Retrospective (Query / Retrieve as SCU)	It is about looking back into the quality of images acquired in the past. In this case images acquired in last 6 months or 1 years are pulled from PACS and analyzed. The analysis results are available in a dashboard. Here DICOM query/retrieve from PACS is used.

3.1. Revision History

The revision history provides dates and differences of the different releases.

Table 3: Revision History

Document Version	Date of Issue	Description of change
01	15-June-2021	First release for Philips Radiology Smart Assistant 1.0

3.2. Audience

This Conformance Statement is intended for:

- (Potential) customers
- System integrators of medical equipment
- Marketing staff interested in system functionality
- Software designers implementing DICOM interfaces

It is assumed that the reader is familiar with the DICOM standard.

3.3. Remarks

The DICOM Conformance Statement is contained in chapter 4 through 8 and follows the contents and structuring requirements of DICOM PS 3.2.

This DICOM Conformance Statement by itself does not guarantee successful interoperability of Philips equipment with non-Philips equipment. The user (or user's agent) should be aware of the following issues:

- **Interoperability**
Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into an IT environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of Philips equipment with non-Philips equipment. It is the user's responsibility to analyze thoroughly the application requirements and to specify a solution that integrates Philips equipment with non-Philips equipment.
- **Validation**
Philips equipment has been carefully tested to ensure that the actual implementation of the DICOM interface corresponds with this Conformance Statement. Where Philips equipment is linked to non-Philips equipment, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user's agent) to specify the appropriate test suite and to carry out the additional validation tests.
- **New versions of the DICOM Standard**

The DICOM Standard will evolve in future to meet the user's growing requirements and to incorporate new features and technologies. Philips is actively involved in this evolution and plans to adapt its equipment to future versions of the DICOM Standard. In order to do so, Philips reserves the right to make changes to its products or to discontinue its delivery. The user should ensure that any non-Philips provider linking to Philips equipment also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into Philips equipment may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

3.4. Definitions, Terms and Abbreviations

Table 4: Definitions, Terms and Abbreviations

Abbreviation/Term	Explanation
AE	Application Entity
AP	Application Profile
CR	Computed Radiography
CT	Computed Tomography
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
DIMSE-C	DIMSE-Composite
DIMSE-N	DIMSE-Normalized
DX	Digital X-Ray
FSC	File-set Creator
FSR	File-set Reader
FSU	File-set Updater
GUI	Graphic User Interface
ILE	DICOM Implicit VR Little Endian
IOD	Information Object Definition
PDU	Protocol Data Unit
RF	X-Ray Radiofluoroscopic
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
XA	X-Ray Angiographic

3.5. References

[DICOM] Digital Imaging and Communications in Medicine, Parts 1 - 22 (NEMA PS 3.1- PS 3.22),
 National Electrical Manufacturers Association
 1300 North 17th Street
 Suite 900
 Arlington, Virginia 22209
 Internet: <https://www.dicomstandard.org/current>

Note that at any point in time the official standard consists of the most recent yearly edition of the base standard (currently 2021) plus all the supplements and correction items that have been approved as Final Text.

4. Networking

This section contains the networking related services (vs. the media related ones).

4.1. Implementation model

The implementation model consists of three sections:

- The application data flow diagram, specifying the relationship between the Application Entities and the "external world" or Real-World Activities,
- A functional description of each Application Entity, and
- The sequencing constraints among them.

4.1.1. Application Data Flow

The Smart Assistant system consists of one single application entity, the Smart Assistant Application Entity (Smart Assistant AE). The figure below shows the networking application data flow as a functional overview of the Smart Assistant AE.

It incorporates the following functionality:

- The Smart Assistant AE can verify application level communication by using the verification service as SCU and SCP.
- The Smart Assistant AE can receive images by using the storage service as SCP. But it does not support storage commitment
- The Smart Assistant AE can query and retrieve images from a remote DICOM node.

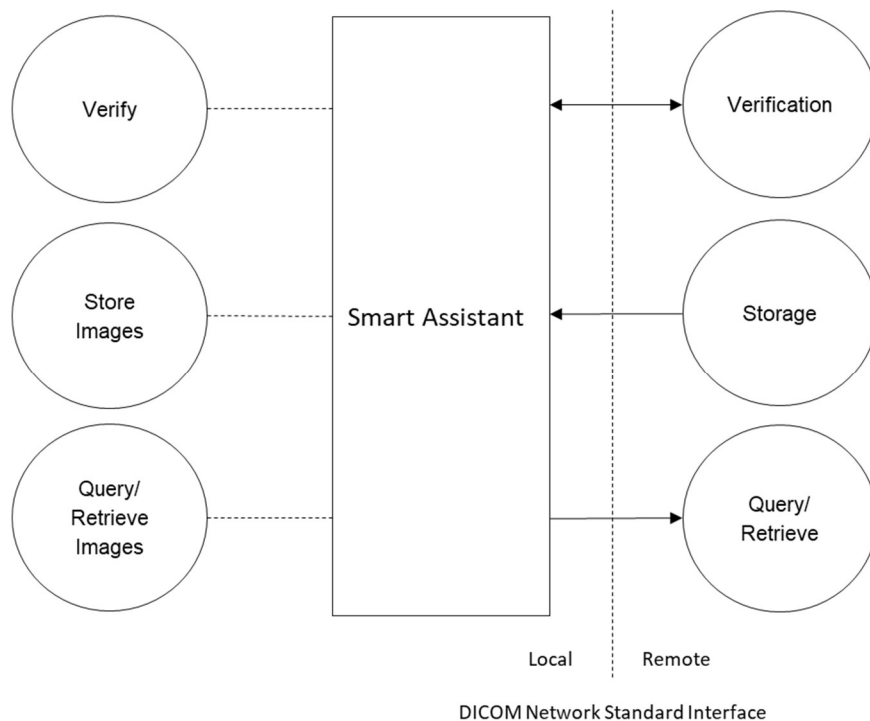


Figure 2 - Application Data Flow

4.1.2. Functional Definition of AE's

This section contains a functional definition for each individual local Application Entity.

4.1.2.1. Functional Definition of Smart Assistant AE

The Smart Assistant AE is the one and only application entity within Smart Assistant. It includes the following service classes.

Verification Service Class

The Smart Assistant provides the verification service as SCU and SCP.

In the SCP mode, a remote SCU sends an association request with the Smart Assistant AE for verification SOP class. After accepting the association, the Smart Assistant AE receives and responds to the verification request and releases the association when requested.

In the SCU mode Smart Assistant sends starts an association with remote AE and sends verification request on successful association. Once the response for verification request is received, Smart Assistant releases the association.

Storage Service Class

The Smart Assistant AE provides the storage service as SCP. After an exam is completed, the modality pushes images to Smart Assistant AE. The transaction starts with modality initiating an association with Smart Assistant. The Smart Assistant accepts association and waits for the images. It accepts the images pushed by modality and stores in a local database.

Query/Retrieve Service Class

The Smart Assistant AE provides the query/retrieve as SCU.

It queries the remote node and requests to move images to a remote node (the move destination is the store node in Smart Assistant)

4.1.3. Sequencing of Real World Activities

This section describes the interaction with Smart Assistant and external entities in passive and retrospective workflows.

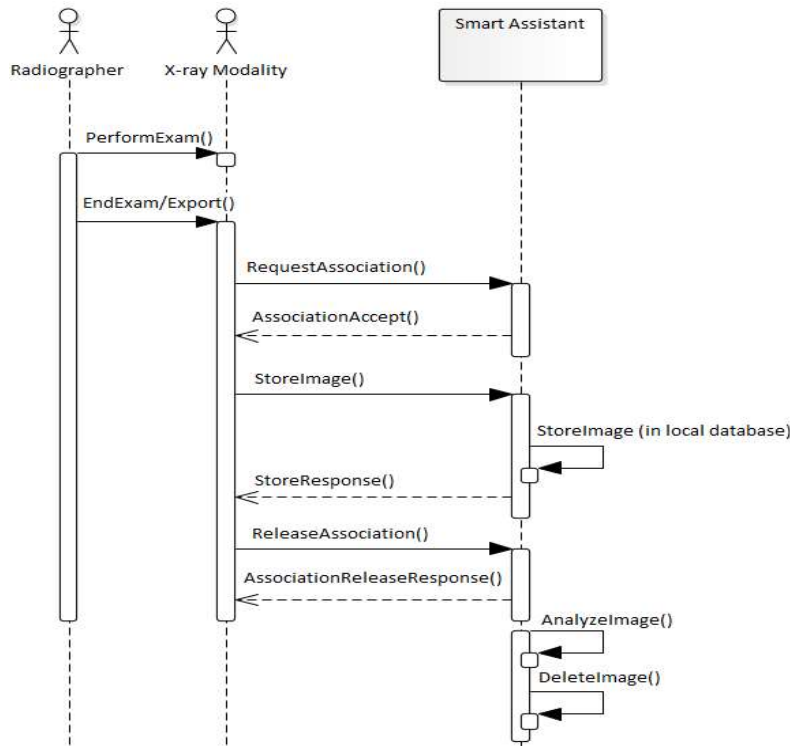


Figure 3 - Passive Workflow (STORE SCP)

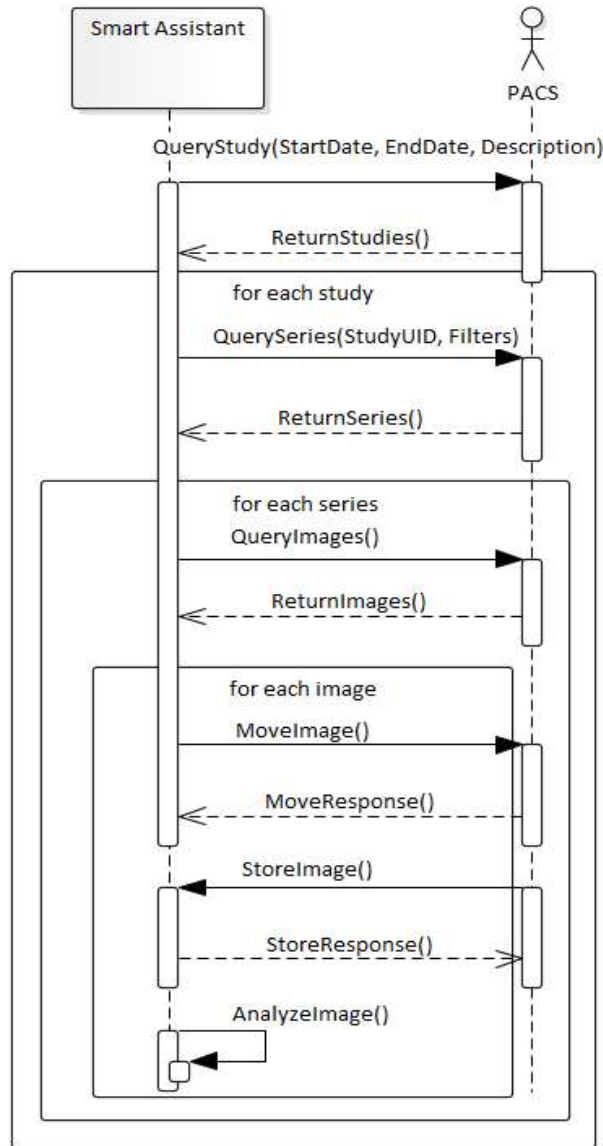


Figure 4 - Retrospective Workflow (Query / Retrieve SCU)

4.2. AE Specifications

This section in the DICOM Conformance Statement is a set of Application Entity specifications. There are as many of these subsections as there are different AE's in the implementation.

The Smart Assistant system consists of the following AEs:

- Smart Assistant AE
- Query/Retrieve AE

4.2.1. Smart Assistant AE

4.2.1.1. SOP Classes

This application entity provides Standard Conformance for the following SOP classes.

Table 5 - SOP Classes for Smart Assistant

SOP Class		User of Service (SCU)	Provider of Service (SCP)
Name	UID		
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes
Computed Radiography Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.1	No	Yes
Digital X-Ray Image Storage - For Pres. SOP	1.2.840.10008.5.1.4.1.1.1.1	No	Yes
Secondary Capture Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.7	No	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	No	Yes

Note: SOP specific behavior is documented later in the conformance statement in the applicable SOP specific conformance section.

4.2.1.2. Association Policies

Each AE specification contains a description of the general association establishment and acceptance policies of the AE.

4.2.1.2.1. General

The DICOM standard application context is specified below.

Table 6 - DICOM Application Context

Description	Value
Application Context Name	1.2.840.10008.3.1.1.1

4.2.1.2.2. Number of Associations

The number of simultaneous associations that an Application Entity may support as an Initiator or Acceptor is specified here.

Table 7 - Number of associations as an Association Initiator

Description	Value
Maximum number of simultaneous associations	Configurable / limited by system resources

Table 8 - Number of associations as an Association Acceptor

Description	Value
Maximum number of simultaneous associations	Configurable / limited by system resources (Default value 50)

4.2.1.2.3. Asynchronous Nature

Not applicable

4.2.1.2.4. Implementation Identifying Information

The value supplied for Implementation Class UID and version name are documented here.

Table 9 - DICOM Implementation Class and Version for Smart Assistant

Implementation Class UID	1.3.46.670589.54.2.20.6
Implementation Version Name	20.6.0.0

4.2.1.2.5. Communication Failure Handling

The behavior of the AE during communication failure is summarized in the next table.

Exception Behavior	Behavior
ARTIM Timeout	The association setup fails; the reason is logged and reported to the user.

4.2.1.3. Association Initiation Policy

The Application Entity will respond to a received Association rejection as shown in the table below.

Table 10 - Association Rejection response

Result	Source	Reason/Diagnosis	Behavior
1 - rejected-permanent	1 - DICOM UL service-user	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - application-context-name-not supported	Error message is shown to user and the error is logged.
		3 - calling-AE-title-not-recognized	Error message is shown to user and the error is logged.
		7 - called-AE-title-not-recognized	Error message is shown to user and the error is logged.
	2 - DICOM UL service-provider (ACSE related function)	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - protocol-version-not-supported	Error message is shown to user and the error is logged.
		3 - DICOM UL service-provider (Presentation related function)	1 - temporary-congestion
2 - local-limit-exceeded	Error message is shown to user and the error is logged.		
2 - rejected-transient	1 - DICOM UL service-user	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - application-context-name-not-supported	Error message is shown to user and the error is logged.
		3 - calling-AE-title-not-recognized	Error message is shown to user and the error is logged.
		7 - called-AE-title-not-recognized	Error message is shown to user and the error is logged.
	2 - DICOM UL service-provider (ACSE related function)	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - protocol-version-not-supported	Error message is shown to user and the error is logged.
	3 - DICOM UL service-provider (Presentation related function)	1 - temporary-congestion	Error message is shown to user and the error is logged.
		2 - local-limit-exceeded	Error message is shown to user and the error is logged.

The behavior of the AE on receiving an Association abort is summarized in the next table.

Table 11 - Association Abort Handling

Source	Reason/Diagnosis	Behavior
0 - DICOM UL service-user (initiated abort)	0 - reason-not-specified	Error message is shown to user and the error is logged.
2 - DICOM UL service-provider (initiated abort)	0 - reason-not-specified	Error message is shown to user and the error is logged.
	1 - unrecognized-PDU	Error message is shown to user and the error is logged.
	2 - unexpected-PDU	Error message is shown to user and the error is logged.
	4 - unrecognized-PDU-parameter	Error message is shown to user and the error is logged.
	5 - unexpected-PDU-parameter	Error message is shown to user and the error is logged.
	6 - invalid-PDU-parameter-value	Error message is shown to user and the error is logged.

4.2.1.3.1. (Real-World) Activity – Verification as SCU

4.2.1.3.1.1. Description and Sequencing of Activities

The Smart Assistant implements the Verification SOP class to verify application level communication.

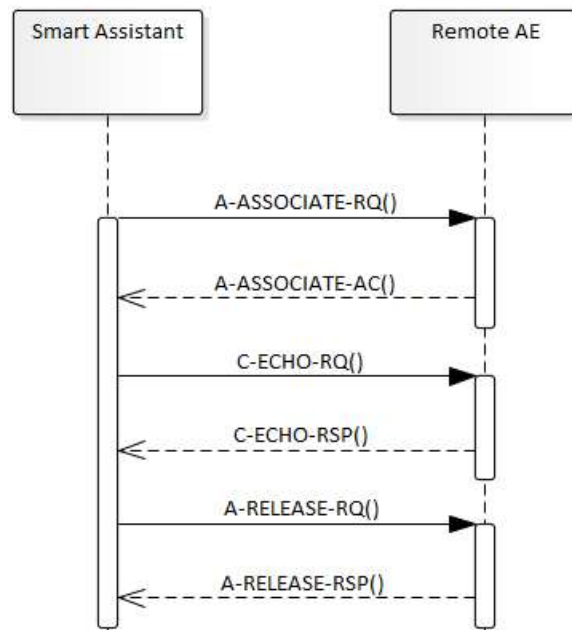


Figure 5 - Data Flow - Verification SCU

4.2.1.3.1.2. Proposed Presentation Contexts

The presentation contexts are defined in the next table.

Table 12 - Proposed Presentation Contexts for (Real-World) Activity – Verification as SCU

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
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	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

4.2.1.3.1.3. SOP Specific Conformance for Verification SOP Class

The Smart Assistant provides standard conformance to the DICOM Verification service class.

4.2.1.3.1.3.1. Dataset Specific Conformance for Verification C-ECHO SCU

C-ECHO does not have a dataset, hence no dataset specific conformance.

Table 13 - Status Response

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Confirmation	Successful communication is established
Failure	XXX	Rejection	unsuccessful handshake

4.2.1.4. Association Acceptance Policy

The Application Entity may reject Association attempts as shown in the table below.

Table 14 - Association Reject Reasons

Result	Source	Reason/Diagnosis	Behavior
1 - rejected permanent	1 - DICOM UL service-user	1 - no-reason-given	Association is not established due to any problem other than that specified for Smart Assistant in the rows below. (Example: Problem while decoding the DICOM stream).
		2 - application-context-name-not-supported	An application context name other than 1.2.840.10008.3.1.1.1 is requested by the SCU during association.
		3 - calling-AE-title-not-recognized	The configuration does not contain a repository having the Calling AE Title as per the association request; There is a problem in configuration (related to composing the configuration from the SCU and the SCP configuration).
		7 - called-AE-title-not-recognized	The called AE Title in the association request does not match the AE Title as per the configuration.
	2 - DICOM UL service provider (ACSE related function)	1 - no-reason-given	Not used.
		2 - protocol-version-not-supported	Not used.
		3 - DICOM UL service provider (Presentation related function)	1 - temporary-congestion
2 - local-limit-exceeded	Not used.		
2 - rejected-transient	1 - DICOM UL service-user	1 - no-reason-given	Not used.
		2 - application-context-name-not-supported	Not used.
		3 - calling-AE-title-not-recognized	Not used.
		7 - called-AE-title-not-recognized	Not used.

Result	Source	Reason/Diagnosis	Behavior
	2 - DICOM UL service provider (ACSE related function)	1 - no-reason-given	Maximum number of associations is exceeded and an association request is received.
		2 - protocol-version-not-supported	Not used.
	3 - DICOM UL service provider (Presentation related function)	1 - temporary-congestion	Not used.
		2 - local-limit-exceeded	Not used.

The behavior of the AE for sending an Association abort is summarized in next table.

Table 15 - Association Abort Policies

Source	Reason/Diagnosis	Behavior	Sent when
0 - DICOM UL service-user (initiated abort)	0 - reason-not-specified	When received, the Smart Assistant terminates the connection with the following log: Association ABORTED by peer (0: ABORT_SOURCE_dul_user, 0: ABORT_REASON_not_specified).	Association times out due to inactivity; Any other problem than ones specified for Smart Assistant in the rows below. (Examples: Problem while decoding the DICOM stream, Invalid request, Echo/Store SCP was unable to send the Response to SCU, Error writing to SCU stream).
2 - DICOM UL service-provider (initiated abort)	0 - reason-not-specified	When received, The Smart Assistant terminates the connection with the following log: Association ABORTED by peer 2: ABORT_SOURCE_dul_provider, 0: ABORT_REASON_not_specified	Import fails.
	1 - unrecognized-PDU	When received, the Smart Assistant terminates the connection with the following log: Association ABORTED by peer (2: ABORT_SOURCE_dul_provider, 1: ABORT_REASON_unrecognized_pdu).	An unrecognized PDU type is received.
	2 - unexpected-PDU	When received, the Smart Assistant terminates the connection with the following log: Association ABORTED by peer (2: ABORT_SOURCE_dul_provider, 2: ABORT_REASON_unexpected_pdu).	The received PDU type is not expected in the current state of connections.
	4 - unrecognized-PDU parameter	When received, the Smart Assistant terminates the connection with the following log: Association ABORTED by peer (2: ABORT_SOURCE_dul_provider, 4: ABORT_REASON_unrecognized_pdu_parameter).	An unrecognized Associate PDU item is received.
	5 - unexpected-PDU parameter	When received, the Smart Assistant terminates the connection with the following log: Association ABORTED by peer (2: ABORT_SOURCE_dul_provider, 5: ABORT_REASON_unexpected_pdu_parameter).	One of the Associate PDU items is received more than once; One of the Associate PDU items is received unexpectedly.

Source	Reason/Diagnosis	Behavior	Sent when
	6 - invalid-PDU-parameter value	When received, the Smart Assistant terminates the connection with the following log: Association ABORTED by peer (2: ABORT_SOURCE_dul_provider, 6: ABORT_REASON _invalid_pdu_parameter).	One of the Associate PDU items is received more than once; One of the Associate PDU items is not received; Empty Called AE Title String (space-only) is received; Empty Calling AE Title String (space-only) is received; Unknown abstract syntax is received; The length or the format of the received PDU item is invalid.

Notes:

1. Associate PDU items that are recognized:

- 0x10 APPLICATION CONTEXT
- 0x20 PRESENTATION CONTEXT (RQ)
- 0x21 PRESENTATION CONTEXT (AC)
- 0x30 ABSTRACT SYNTAX
- 0x40 TRANSFER SYNTAX
- 0x50 USER INFO
- 0x51 MAXIMUM LENGTH
- 0x52 IMPLEMENTATION CLASS UID
- 0x54 SCP/SCU ROLE SELECTION

0x55 IMPLEMENTATION VERSION NAME

2. Associate PDU items for Unexpected-PDU parameter received more than once:

- 0x10 APPLICATION CONTEXT (SCU, SCP)
- 0x30 ABSTRACT SYNTAX (SCU, SCP)
- 0x40 TRANSFER SYNTAX (SCU)

Received unexpectedly:

- 0x20 PRESENTATION CONTEXT (RQ) (SCU)

3. Associate PDU items for Invalid-PDU parameter value:

Received more than once (SCU, SCP):

- 0x50 USER INFO
- 0x51 MAXIMUM LENGTH
- 0x52 IMPLEMENTATION CLASS UID
- 0x55 IMPLEMENTATION VERSION NAME

Received illegally:

- 0x21 PRESENTATION CONTEXT (AC) (SCP)

PDU items not received:

- 0x10 APPLICATION CONTEXT (SCU, SCP)
- 0x20 PRESENTATION CONTEXT (RQ) (SCP)
- 0x21 PRESENTATION CONTEXT (AC) (SCU)
- 0x50 USER INFO (SCU, SCP)
- 0x30 ABSTRACT SYNTAX (SCU)
- 0x40 TRANSFER SYNTAX (SCU)
- 0x51 MAXIMUM LENGTH (SCU, SCP)
- 0x52 IMPLEMENTATION CLASS UID (SCU)

4. PDU types that are recognized:

- 0x01 A-ASSOCIATE-RQ
- 0x02 A-ASSOCIATE-AC
- 0x03 A-ASSOCIATE-RJ
- 0x04 P-DATA-TF
- 0x05 A-RELEASE-RQ
- 0x06 A-RELEASE-RP
- 0x07 A-ABORT

5. Expected PDU's for following states:

STATE_IDLE:

- 0x01 A-ASSOCIATE-RQ
- 0x02 A-ASSOCIATE-AC
- 0x03 A-ASSOCIATE-RJ
- 0x05 A-RELEASE-RQ
- 0x06 A-RELEASE-RP

- STATE_ASSOCIATED:
 - 0x01 A-ASSOCIATE-RQ
 - 0x02 A-ASSOCIATE-AC
 - 0x03 A-ASSOCIATE-RJ
 - 0x06 A-RELEASE-RP
- STATE_ASSOCIATING (SCU):
 - 0x01 A-ASSOCIATE-RQ
 - 0x04 P-DATA-TF
 - 0x05 A-RELEASE-RQ
 - 0x06 A-RELEASE-RP
- STATE_RELEASING:
 - 0x01 A-ASSOCIATE-RQ
 - 0x02 A-ASSOCIATE-AC
 - 0x03 A-ASSOCIATE-RJ
- STATE_WAIT_FOR_ASSOCIATE (SCP):
 - 0x02 A-ASSOCIATE-AC
 - 0x03 A-ASSOCIATE-RJ
 - 0x04 P-DATA-TF
 - 0x05 A-RELEASE-RQ
 - 0x06 A-RELEASE-RP
 - 0x07 A-ABORT
- STATE_WAIT_FOR_FINISH:
 - 0x01 A-ASSOCIATE-RQ
 - 0x02 A-ASSOCIATE-AC
 - 0x03 A-ASSOCIATE-RJ
 - 0x04 P-DATA-TF
 - 0x05 A-RELEASE-RQ
 - 0x06 A-RELEASE-RP
- STATE_WAIT_FOR_DISCONNECT:
 - 0x01 A-ASSOCIATE-RQ
 - 0x02 A-ASSOCIATE-AC
 - 0x03 A-ASSOCIATE-RJ
- STATE_TIMED_OUT:
 - 0x01 A-ASSOCIATE-RQ
 - 0x02 A-ASSOCIATE-AC
 - 0x03 A-ASSOCIATE-RJ
 - 0x04 P-DATA-TF
 - 0x05 A-RELEASE-RQ
 - 0x06 A-RELEASE-RP
 - 0x07 A-ABORT

Table 16 - Status Response

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Verification is complete	The Smart Assistant has successfully received the verification request
Failure	XXX	Rejection	unsuccessful handshake

4.2.1.4.1. (Real-World) Activity – Verification as SCP

4.2.1.4.1.1. Description and Sequencing of Activities

The Smart Assistant accepts associations from configured systems that wish to verify application level communication using the C-ECHO command.

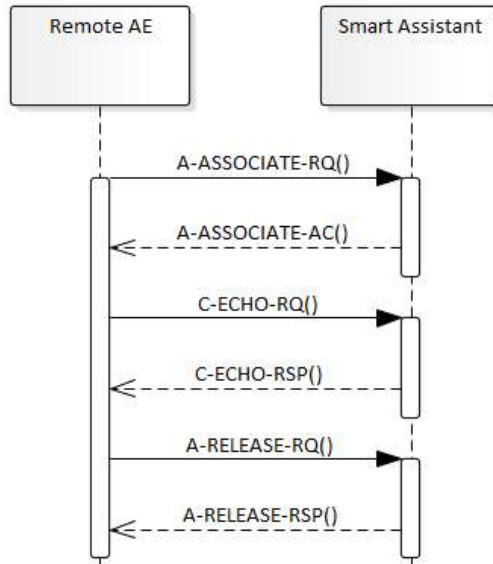


Figure 6 - Data Flow – Verification as SCP

4.2.1.4.1.2. Accepted Presentation Contexts

The presentation contexts are defined in the next table.

Table 17 - Acceptable Presentation Contexts for (Real-World) Activity – Verification as SCP

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
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
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

The Smart Assistant accepts all contexts in the intersection of the proposed and acceptable Presentation Contexts. This means that multiple proposed presentation contexts with the same SOP class, but different transfer syntaxes are accepted by Smart Assistant as far as those transfer syntaxes are part of the acceptable transfer syntaxes.

4.2.1.4.1.3. SOP Specific Conformance for Verification SOP Class

This section includes the SOP specific behavior for the verification SOP Class, i.e. error codes, error and exception handling, time-outs, etc. This behavior is summarized in the tables below. The standard as well as the manufacturer specific status codes and their corresponding behavior are specified.

Table 18 - Status Response

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Verification is complete	The Smart Assistant has successfully received the verification request
Failure	XXX	Rejection	unsuccessful handshake

Table 19 - DICOM Command Communication Failure Behavior

Exception	Behavior
Timeout	The Association is aborted using AP-ABORT and command marked as failed. The reason is logged and reported to the user.
Association aborted	The command is marked as failed. The reason is logged and reported to the user.

4.2.1.4.1.3.1. Dataset Specific Conformance for Verification SOP Class C-ECHO-SCP

Not Applicable

4.2.1.4.2. (Real-World) Activity – Image Import

4.2.1.4.2.1. Description and Sequencing of Activities

The Smart Assistant accepts associations from configured systems that wish to store images in the Smart Assistant using the C-STORE command.

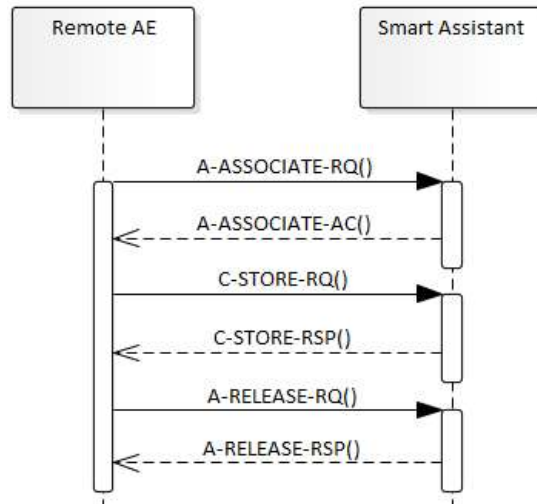


Figure 7 - Data Flow - Store Image – Storage as SCP

4.2.1.4.2.2. Accepted Presentation Contexts

The presentation contexts are defined in the next table.

Table 20 - Acceptable Presentation Contexts for (Real-World) Activity – Image Import

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Computed Radiography Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Digital X-Ray Image Storage - For Pres. SOP	1.2.840.10008.5.1.4.1.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
X-Ray Radiofluoroscopic Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.12.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

Note 1: The Smart Assistant accepts all contexts in the intersection of the proposed and acceptable Presentation Contexts. This means that multiple proposed presentation contexts with the same SOP class, but different transfer syntaxes are accepted by the Smart Assistant as far as those transfer syntaxes are part of the acceptable transfer syntaxes. There is no check for duplicate contexts, and these are therefore accepted, considering every import as new object.

Note 2: The SUT does not check the validity of the modality value as it is always connected with diagnostic xray modality.

4.2.1.4.2.3. SOP Specific Conformance for Storage SOP Classes

This section and sub-section include the manufacturer SOP and Dataset specific information as well the status codes and corresponding behavior.

The Smart Assistant will only accept associations from configured systems. The Smart Assistant may provide level 2 (Full) conformances, depending on the implemented database.

Remarks:

- Value Representation 'UN' (Unknown) is supported, and will be used for any attributes not known to Smart Assistant and Received per implicit transfer (ILE).

4.2.1.4.2.3.1. Dataset Specific Conformance for C-STORE-RSP

Detail regarding the Dataset Specific response behavior will be reported in this section. This includes the dataset specific behavior, i.e. error codes, error and exception handling, time-outs, etc.

Table 21 - Status Response

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Successful command	Successful completion of the store request.
Failure	xxxx	All failures	Store is failed /Error logged

4.2.2. Query/Retrieve AE

4.2.2.1. SOP Classes

This application entity provides Standard Conformance for the following SOP classes.

Table 22 - SOP Classes for Smart Assistant

SOP Class		User of Service (SCU)	Provider of Service (SCP)
Name	UID		
Study Root QR Information Model - FIND SOP Class	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Study Root QR Information Model - MOVE SOP Class	1.2.840.10008.5.1.4.1.2.2.2	Yes	No

Note: SOP specific behavior is documented later in the conformance statement in the applicable SOP specific conformance section.

4.2.2.2. Association Policies

Each AE specification contains a description of the general association establishment and acceptance policies of the AE.

4.2.2.2.1. General

The DICOM standard application context is specified below.

Table 23 - DICOM Application Context

Description	Value
Application Context Name	1.2.840.10008.3.1.1.1

4.2.2.2.2. Number of Associations

The number of simultaneous associations that an Application Entity may support as an Initiator or Acceptor is specified here.

Table 24 - Number of associations as an Association Initiator

Description	Value
Maximum number of simultaneous associations	1

4.2.2.2.3. Asynchronous Nature

Not applicable.

4.2.2.2.4. Implementation Identifying Information

The value supplied for Implementation Class UID and version name are documented here.

Table 25 - DICOM Implementation Class and Version for QR AE

Implementation Class UID	1.3.46.670589.30.1.0.3
Implementation Version Name	PRSA_1.0.3

4.2.2.2.5. Communication Failure Handling

The behavior of the AE during communication failure is summarized in the next table.

Exception Behavior	Behavior
ARTIM Timeout	The association setup fails; the reason is logged and reported to the user.

4.2.2.3. Association Initiation Policy

The Application Entity will respond to a received Association rejection as shown in the table below.

Table 26 - Association Rejection response

Result	Source	Reason/Diagnosis	Behavior
1 - rejected-permanent	1 - DICOM UL service-user	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - application-context-name-not supported	Error message is shown to user and the error is logged.
		3 - calling-AE-title-not-recognized	Error message is shown to user and the error is logged.
		7 - called-AE-title-not-recognized	Error message is shown to user and the error is logged.
	2 - DICOM UL service-provider (ACSE related function)	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - protocol-version-not-supported	Error message is shown to user and the error is logged.
		3 - DICOM UL service-provider (Presentation related function)	1 - temporary-congestion
2 - local-limit-exceeded	Error message is shown to user and the error is logged.		
2 - rejected-transient	1 - DICOM UL service-user	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - application-context-name-not-supported	Error message is shown to user and the error is logged.

Result	Source	Reason/Diagnosis	Behavior
		3 - calling-AE-title-not-recognized	Error message is shown to user and the error is logged.
		7 - called-AE-title-not-recognized	Error message is shown to user and the error is logged.
	2 - DICOM UL service-provider (ACSE related function)	1 - no-reason-given	Error message is shown to user and the error is logged.
		2 - protocol-version-not-supported	Error message is shown to user and the error is logged.
	3 - DICOM UL service-provider (Presentation related function)	1 - temporary-congestion	Error message is shown to user and the error is logged.
		2 - local-limit-exceeded	Error message is shown to user and the error is logged.

The behavior of the AE on receiving an Association abort is summarized in the next table.

Table 27 - Association Abort Handling

Source	Reason/Diagnosis	Behavior
0 - DICOM UL service-user (initiated abort)	0 - reason-not-specified	Error message is shown to user and the error is logged.
2 - DICOM UL service-provider (initiated abort)	0 - reason-not-specified	Error message is shown to user and the error is logged.
	1 - unrecognized-PDU	Error message is shown to user and the error is logged.
	2 - unexpected-PDU	Error message is shown to user and the error is logged.
	4 - unrecognized-PDU-parameter	Error message is shown to user and the error is logged.
	5 - unexpected-PDU-parameter	Error message is shown to user and the error is logged.
	6 - invalid-PDU-parameter-value	Error message is shown to user and the error is logged.

4.2.2.3.1. (Real-World) Activity - Find as SCU

4.2.2.3.1.1. Description and Sequencing of Activities

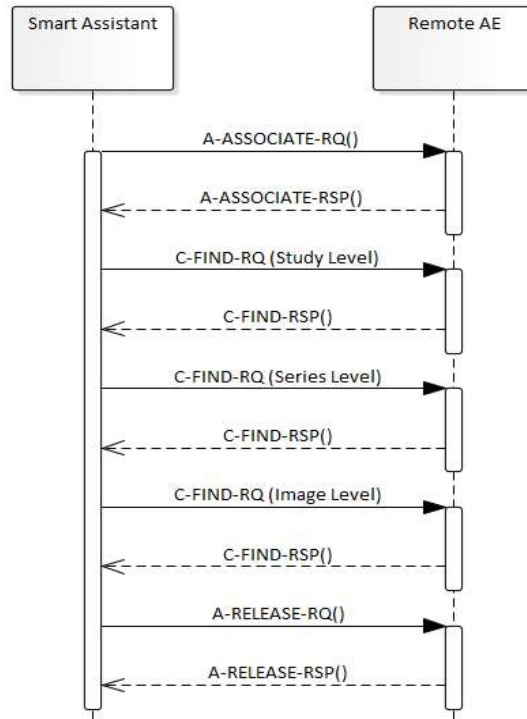


Figure 8 Data Flow – FIND as SCU

4.2.2.3.1.2. Proposed Presentation Contexts

Table 28 - Proposed Presentation Contexts for (Real-World) Activity

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Study Root QR Information Model - FIND SOP Class	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

4.2.2.3.1.3. SOP Specific Conformance for SOP Classes

4.2.2.3.1.3.1. SOP Specific Conformance for Study Root QR Information Model - FIND SOP Class

4.2.2.3.1.3.1.1. Dataset Specific Conformance for Study Root QR Information Model - FIND SOP Class C-FIND-SCU

Table 29 C-FIND-RQ Dataset Specification.

Study Root QR Information Model - FIND SOP Class				
Attribute Name	Tag	VR	Type of Matching	Comment
Query/Retrieve Level	0008,0052	CS	Single Value	Study, Series, Image
Study Level Keys For The Study Root Query/Retrieve Information Model				
Study Date	0008,0020	DA	Range	
Study Description	0008,1030	LO	Universal	
Series Level Attributes For The Study Root Query/Retrieve Information Model				
Modality	0008,0060	CS	Single Value, Universal	
Series Description	0008,103E	LO	Universal	
Body Part Examined	0018,0015	CS	Single Value, Universal	
Protocol Name	0018,1030	LO	Universal	
View Position	0018,5101	CS	Universal	
Image Level Attributes For The Study Root Query/Retrieve Information Model				
View Position	0018,5101	CS	Universal	
AcquisitionDeviceProcessingDescription	0018,1400	LO	Universal	
AnatomicRegionSequence	0008,2218	SQ	Universal	
>CodeValue	0008,0100	SH	Universal	
>CodeMeaning	0008,0104	LO	Universal	
ViewCodeSequence	0054,0220	SQ	Universal	
>CodeValue	0008,0100	SH	Universal	
>CodeMeaning	0008,0104	LO	Universal	

Series level query is done upon successful study level query and then image level is queried.

This part of the section includes the dataset specific behavior, i.e. error codes, error and exception handling, time-outs, etc.

Table 30: Status Response

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Matching is complete – No final identifier is supplied	Query results are displayed on UI with number of images found (Acquisition dashboard)
Failure	xxxx	All failures	Query is failed /Error logged

4.2.2.3.2. (Real-World) Activity - Move as SCU

4.2.2.3.2.1. Description and Sequencing of Activities

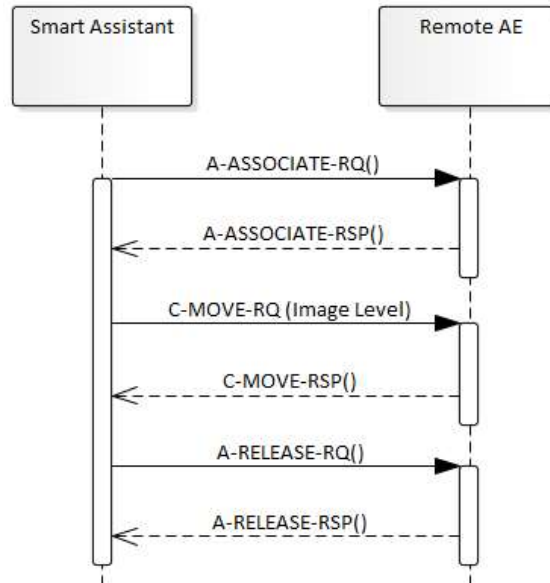


Figure 9: Data Flow Diagram – MOVE as SCU

4.2.2.3.2.2. Proposed Presentation Contexts

Table 31 Proposed Presentation Contexts for (Real-World) Activity

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Study Root QR Information Model - MOVE SOP Class	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

4.2.2.3.2.3. SOP Specific Conformance for SOP Classes

4.2.2.3.2.3.1. SOP Specific Conformance for Study Root QR Information Model - MOVE SOP Class

4.2.2.3.2.3.1.1. Dataset Specific Conformance for Study Root QR Information Model - MOVE SOP Class C-MOVE-SCU

Table 32 C-MOVE-RQ Dataset Specification.

Study Root QR Information Model - MOVE SOP Class			
Attribute Name	Tag	VR	Comment
Query/Retrieve Level	0008,0052	CS	Image

This part of the section includes the dataset specific behavior, i.e. error codes, error and exception handling, time-outs, etc.

Table 33: Status Response

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Sub-operations complete – No failures	Retrieve results are displayed on UI with number of images found
Failure	xxxx	All failures	Retrieve is failed /Error logged

4.2.2.4. Association Acceptance Policy

Not Applicable

4.3. Network Interfaces

4.3.1. Physical Network Interfaces

The System provides only DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8 of the standard.

TCP/IP is the only protocol stack supported.

Supported physical medium include:

IEEE 802.3-1995, 10BASE-T

IEEE 802.3-1995, 100BASE-TX (Fast Ethernet)

IEEE 802.3, 1000BASE-X (Fiber Optic Gigabit Ethernet).

The TCP/IP Stack as supported by the underlying Operating System.

The API is the WinSock 2 interface as supported by the underlying Operating System.

4.3.2. Additional Protocols

No additional protocols are used.

4.4. Configuration

Any implementation's DICOM conformance may be dependent upon configuration, which takes place at the time of installation. Issues concerning configuration are addressed in this section.

4.4.1. AE Title/Presentation Address Mapping

An important installation issue is the translation from AE title to presentation address. How this is to be performed is described here.

4.4.1.1. Local AE Titles

The local AE title mapping and configuration are specified as:

Table 34: AE Title configuration table

Application Entity	Default AE Title	Default TCP/IP Port
Smart Assistant AE	PRSA_STORE_SCP	104

4.4.1.2. Remote AE Title/Presentation Address Mapping

All remote applications to be selected as destination (SCP) are configurable for the following items:

- The Application Entity Title of the remote application.
- The Presentation Address of where the remote application should accept association requests.

4.4.2. Parameters

The specification of important operational parameters, their default value, and range (if configurable) are specified here.

Table 35: Configuration Parameters Table

Parameter	Configurable	Default Value
General Parameters		
Time-out waiting for acceptance or rejection Response to an Association Open Request (Application Level timeout)	Yes	30 [s]
General DIMSE level time-out values (Verification, Storage)	No	-
Time-out for response to TCP/IP connect request. (Low-level timeout)	No	-
Time-out waiting for acceptance of a TCP/IP message over the network (Low-level timeout)	No	-
Any changes to default TCP/IP settings, such as configurable stack parameters.	No	-
Automatic export to a configurable destination	Yes	-
AE Specific Parameters		
Size constraint in maximum object size	No	-
Maximum PDU size the AE can receive	Yes	65535
Maximum PDU size the AE can send	Yes	65535
AE specific DIMSE level time-out values	No	-
GUI user readable string for remote AE titles	No	-

5. Media Interchange

Not Applicable

6. Support of Character Sets

Any support for character sets in Network and Media services is described here.

Table 36: Supported DICOM Character Sets

Character Set Description	Defined Term	ESC Sequence	ISO Registration Number	Code Element	Character Set
GB18030	GB18030	-	-	-	-
Latin alphabet No. 1	ISO_IR 100	-	ISO-IR 100	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Latin alphabet No. 2	ISO_IR 101	-	ISO-IR 101	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646

7. Security

7.1. Security Profiles

Smart Assistant 1.0 allows the use of either a conventional (non-secure) DICOM communication or a secure DICOM communication based on the Transport Layer Security (TLS) protocol. If configured Smart Assistant 1.0 supports the following security measures:

- Secure authentication of a node
- Integrity and confidentiality of transmitted data

7.1.1. Security use Profiles

Not applicable.

7.1.2. Security Transport Connection Profiles

Smart Assistant 1.0 conforms to the TLS protocol v1.2 of Secure Transport Connection Profile.

Smart Assistant 1.0 initiates TLS Connections and accepts TLS Connections. TLS ports are configurable.

Secure communication is a "mode of operation" of Smart Assistant 1.0 supported by the implementation of the DICOM TLS 1.2 Secure Transport Connection Profile. This functionality will be used by the nodes that can authenticate each other before they exchange DICOM information. For secure communication the TLS protocol v1.2 is used which provides message authentication, integrity, and confidentiality. Confidentiality is optional and can be controlled by the encryption settings.

Smart Assistant 1.0 shall communicate using the following Cipher Suites:

- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
- TLS_DHE_RSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA
- TLS_RSA_WITH_AES_128_GCM_SHA256
- TLS_RSA_WITH_AES_256_CBC_SHA256
- TLS_RSA_WITH_AES_128_CBC_SHA256
- TLS_RSA_WITH_AES_256_CBC_SHA
- TLS_RSA_WITH_AES_128_CBC_SHA

The following TLS Certification checks will be done (TLS Handshake). The machine (either server or client) that will send its certificate will:

Choose the certificate according to Common Name (CN) value in the Subject-field. This name is case-sensitive. All present certificates should have unique CN names.

The server verifies that

- The client certificate is a X.509 certificate which is valid.
- The Client Authentication (CA) of the client certificate is in the list of trusted certificates.
- The client certificate is not expired (present time is between "Valid From" and "Valid To" fields of the X.509 certificate)
- The client certificate has the correct purpose (at least the Client Authentication purpose), If the purpose is specified.

The client verifies that

- The server certificate is a X.509 certificate which valid.
- The Client Authentication (CA) of the client certificate is in the list of trusted certificates.
- The server certificate is not expired (present time is between "Valid From" and "Valid To" fields of the X.509 certificate)
- The server certificate has the correct purpose (at least Server Authentication purpose), If the purpose is specified.

No verification is done on:

- Revocation of certificates
- Limiting the connection to a limited set of IP-addresses

Node authentication with encryption is only possible when both nodes have:

- An access to their own private keys
- An access to a copy of the certificate of the other node containing its public key

Figure below presents the message flow of TLS handshake supported by Smart Assistant 1.0

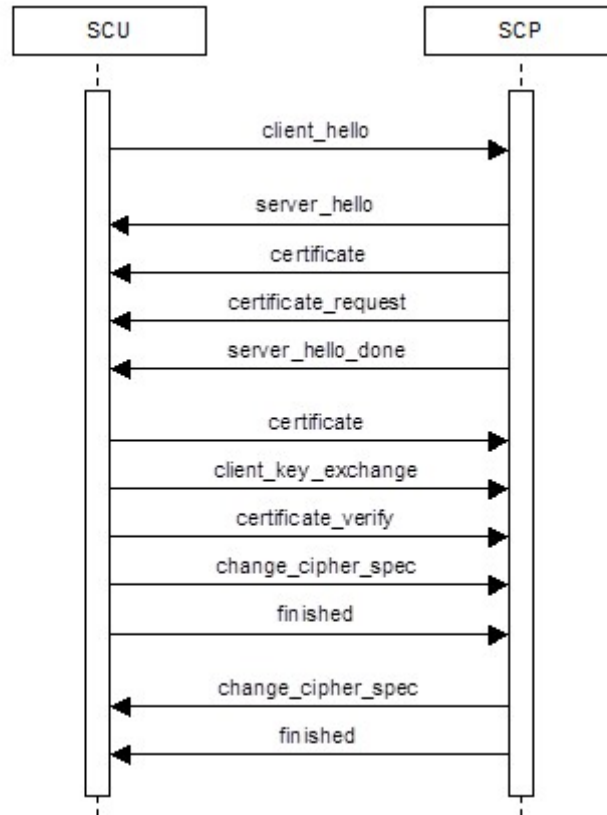


Figure 10: Secure DICOM Flow Diagram

7.1.3. Digital Signature Profiles

Not applicable.

7.1.4. Media Storage Security Profiles

Not applicable.

7.1.5. Attribute Confidentiality Profiles

Not applicable.

7.1.6. Network Address Management Profiles

Not applicable

7.1.7. Time Synchronization Profiles

Not supported.

7.1.8. Application Configuration Management Profiles

Not applicable.

7.1.9. Audit Trail Profiles

Not supported.

7.2. Association Level Security

Not applicable.

7.3. Application Level Security

Not applicable.

8. Annexes of application

8.1. IOD Contents

8.1.1. Created SOP Instance

Not applicable.

8.1.1.1. List of created SOP Classes

Not applicable.

8.1.2. Usage of Attributes from Received IOD

Not applicable.

8.1.3. Attribute Mapping

Not applicable.

8.1.4. Coerced/Modified fields

Not applicable.

8.2. Data Dictionary of Private Attributes

Not applicable.

8.3. Coded Terminology and Templates

Not applicable.

8.3.1. Context Groups

Not applicable.

8.3.2. Template Specifications

Not applicable.

8.3.3. Private code definitions

Not applicable.

8.4. Grayscale Image consistency

Not applicable.

8.5. Standard Extended/Specialized/Private SOPs

Not applicable.

8.6. Private Transfer Syntaxes

Not applicable.

