



Carestream
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CS Imaging 8

DICOM Conformance Statement Networking Interchange

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Conformance Statement Overview

CS Imaging is an imaging software which also implements a subset of the DICOM standard to achieve the exchange of patient information and image data with remote systems.

The set of DICOM functionalities available thru CS Imaging enables to:

- Query a RIS system for patient scheduling information prior new image acquisition.
- Send newly acquired or saved images to a PACS or remote system.
- Query and retrieve a PACS system for already archived images.
- Store locally images sent by a remote system.

Network Services:

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Verification		
Verification	Yes	Yes
Transfer		
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 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 (1)	Yes (1)
Secondary Capture Image Storage	Yes	Yes
X-Ray 3D Craniofacial Image Storage	Yes (2)	Yes (2)
Raw Data Storage	Yes (3)	Yes (3)
VL Endoscopic Image Storage	Yes	Yes
VL Photographic Image Storage	Yes	Yes
X-Ray Radiation Dose SR Storage	Yes	No
Query/Retrieve		
Patient Root Q/R Information Model - FIND	Yes (4)	No
Patient Root Q/R Information Model - MOVE	Yes (4)	No
Study Root Q/R Information Model - FIND	Yes (4)	No
Study Root Q/R Information Model - MOVE	Yes (4)	No
Workflow Management		
Modality Worklist Information Model - FIND	Yes	No

Note (1): CT Image Storage SOP Class is the default data format for 3D volume datasets supported by the associated 3D imaging application. Therefore, one single 3D volume dataset is maintained internally as a set of single CT slice files. To ease the data management of the associated 3D imaging application, each 3D volume dataset is maintained within a specific sub-directory of the patient data folder by CS Imaging.

Note (2): X-Ray 3D Craniofacial Storage SOP Class is the default data format for all extracted slices or localizers of the associated 3D imaging application. Nevertheless, in the current implementation of CS Imaging, CSDS can be configured to automatically generate a Secondary Capture Image Storage SOP Class object for each frame of such extracted data, which includes drawings and graphics, directly embedded into the pixels (burnt). While storage as an SCU (push) can be easily done through CS Imaging for both types of data, retrieval (but especially reimport) of such data within CS Imaging database, even if theoretically feasible, is practically not realistic, by the nature of the associated 3D imaging application current design.

Note (3): Raw Data Storage SOP Class is the default data format for Mesh and screenshots of intraoral scanners.

Note (4): CS Imaging provides conformance only to the Baseline C-FIND SCU and C-MOVE SCU Behavior defined by the DICOM Standard (i.e. only to the Hierarchical Search mechanism: Relational queries are not supported).

UID Values:

UID Name	UID Value	Category
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Storage
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Storage
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Storage
Digital Intra-Oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Storage
Digital Intra-Oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Storage
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Storage
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Storage
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	Storage
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Storage
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Storage
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Storage
X-Ray Radiation Dose SR Storage	1.2.840.10008.5.1.4.1.1.88.67	Storage
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Query/Retrieve
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Query/Retrieve
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Query/Retrieve
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Query/Retrieve
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Worklist
Verification	1.2.840.10008.1.1	Verification

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1 INTRODUCTION

This document provides the DICOM Conformance Statement of the CS Imaging software.

CS Imaging is an imaging application which implements a subset of the DICOM standard to achieve the exchange of patient information and image data with the remote systems.

This DICOM implementation enables the system to communicate with any DICOM compliant systems (RIS, PACS, workstations, etc.). This allows the exchange of patient information, images and ensures proper integration into the workflow of the medical institution and the patient management environment.

As aforementioned, CS Imaging is firstly an imaging software, the DICOM functionalities are extensions based on the existing user interface. So, the query, store and retrieve operations keep using similar GUI elements as the imaging software. One difference from normal DICOM applications is that, CS Imaging has a dedicated server acting as a DICOM gateway (or communicator) which hugely simplifies the configuration of DICOM Application Entities.

The server, named CS DICOM Server (abbreviated as CSDS), is only installed on the server station as a Windows Service running in the background. It consists of a web server providing RESTful APIs for the clients to initiate query, store and retrieve operations, and a Storage SCP receiving images from PACS and other entities. The existence of CS DICOM Server provides the ability to transfer image data in an asynchronous manner: this is particularly useful for large dataset, like 3D volume, transfers.

CS Imaging implementation of the DICOM standard is based partly on the underlying DICOM compliant DCMTK library provided by the OFFIS company (for all the "communication" side of the implementation), and partly on Carestream Dental libraries (for the image creation processes).

1.1 Revision History

Revision	Date	Author	Description
1.0	2018-11-30	Xavier CARAYOL, Chunting GU	Initial draft for Rosslyn Gate 2
1.1	2019-06-27	Pengxian Li, Xavier CARAYOL	Revised for Rosslyn Gate 3
1.2	2020-04-09	Pengxian Li	OS constraint is removed
1.3	2020-07-21	Pengxian Li	Activate DICOM server is not supported
1.4	2020-11-24	Pengxian Li	Integrate with DCMTK library version 3.6.4
1.5	2021-03-25	Pengxian Li	Support modality worklist SCU
1.6	2021-08-20	Robin Nie	TLS 1.2 is supported as SCU
1.7	2021-12-29	Robin Nie	Revise SOP Specific conformance for Q&R SOP class and Modality Worklist SOP class

1.2 Audience

It is assumed that the reader of this document is familiar with the DICOM standard and with the terminology and concepts used in the standard.

1.3 Applicable Software Version

This document is related to the version 8.0.3.0 and above of CS Imaging, unless otherwise explicitly stated.

This CS Imaging version is associated with the DCMTK library version 3.6.4 as described in this document.

1.4 Carestream Dental Root UID

The Carestream Dental root UID is: **1.2.250.1.90** (provided by the French ISO member body AFNOR).

1.5 Definitions, Terms and Abbreviations

The following definitions are used in this conformance statement:

Composite Instance	Any type of DICOM SOP Instances (either images or other data types).
CS Imaging	The imaging application which CS Imaging is built on. Also known as CSI.
3D Module	The imaging application designed and developed by Carestream Dental providing 3D display and processing functionality (also called CSI 3D Module).
CS DICOM Server	A DICOM gateway (or communicator) for CS Imaging to provide the capabilities of asynchronous transfers and centralized configurations. Also known as CSDS.

The following symbols and abbreviations are used in this conformance statement:

ACR	American College of Radiology
ACSE	Association Control Service Element
AE	Application Entity
ANSI	American National Standards Institute
AP	Application Profile
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
CEN TC251	Comité Européen de Normalisation - Technical Committee 251 - Medical Informatics
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
DIMSE-C	DICOM Message Service Element-Composite
DIMSE-N	DICOM Message Service Element-Normalized
FSC	File-set Creator
FSR	File-set Reader
FSU	File-set Updater
HISPP	Healthcare Informatics Standards Planning Panel
HL7	Health Level 7
IE	Information Entity
IEEE	Institute of Electrical and Electronics Engineers
IOD	Information Object Definition
ISO	International Standards Organization
ISP	International Standardized Profile
JIRA	Japanese Industry Radiology Apparatus
CS3D	Carestream Dental 3D Review Application
CSDS	Carestream Dental DICOM Server
CSI	Carestream Dental Imaging Software

MSDS	Healthcare Message Standard Developers Sub-Committee
MPPS	Modality Performed Procedure Step
MWL	Modality Worklist
NEMA	National Electrical Manufacturers Association
OSI	Open Systems Interconnection
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
Q&R	Query and Retrieve
RIS	Radiology Information System
RWA	Real-World Activity
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier

1.6 References

[1]. ACR/NEMA Standards Publications, PS3 DICOM Standard:

<https://www.dicomstandard.org/>

Current Edition:

<https://www.dicomstandard.org/current/>

Current standard status may be checked also at:

<http://www.dclunie.com/dicom-status/status.html>

[2]. OFFIS DCMTK library DICOM Conformance Statements and User's Manuals.

2 NETWORKING

2.1 Implementation Model

2.1.1 Application Data Flow Diagram

The DICOM network services implemented by CS Imaging can be conceptually modeled as the following separate Application Entities:

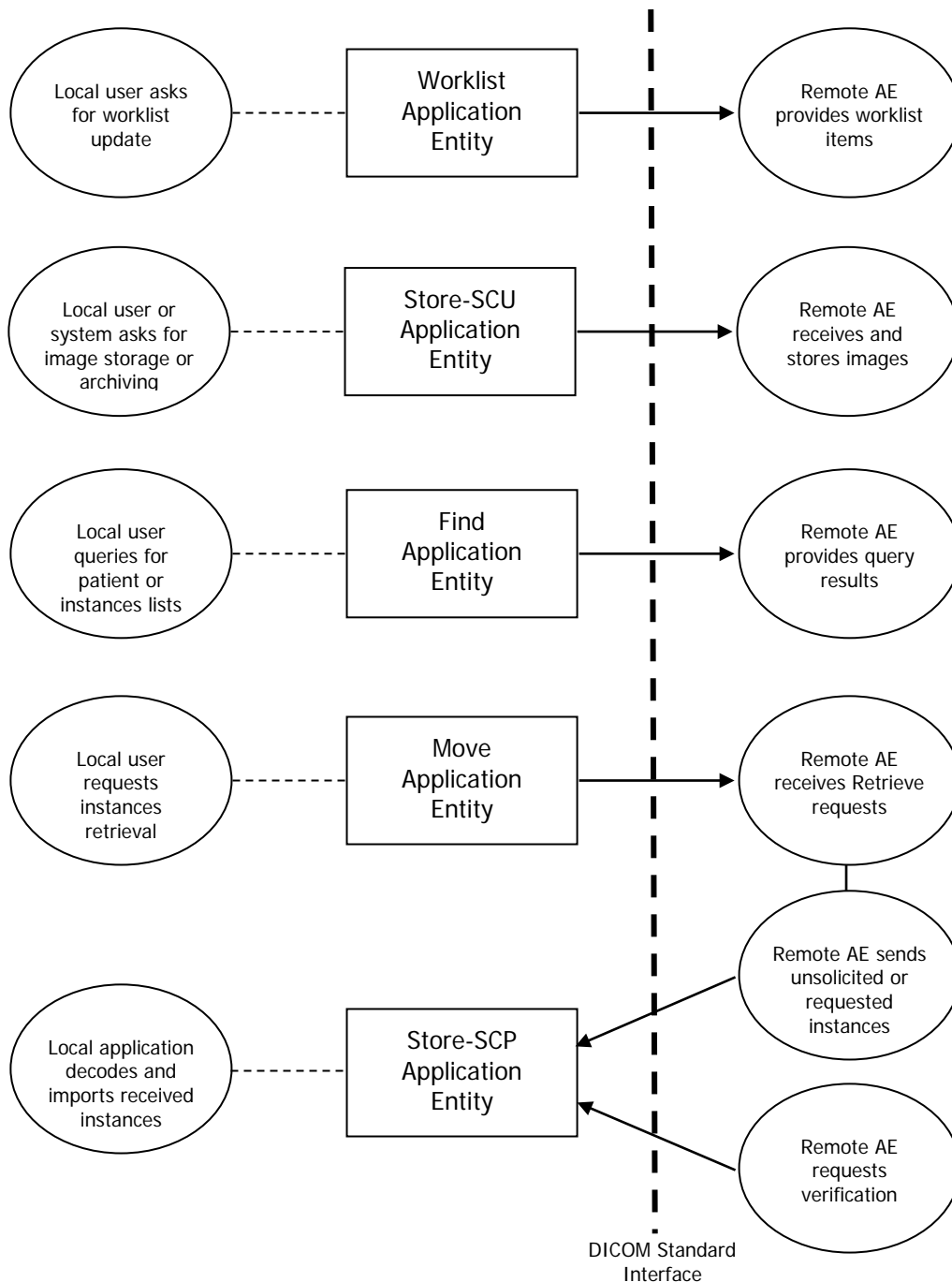


Figure 1: Application Data Flow Diagram - Networking

- 1) The Worklist Application Entity receives Worklist information items from a remote AE. When the user requests a Worklist Item list update, the Worklist Application Entity queries

- the remote AE for Worklist Items matching the user requirements (user configurable) and returns the set of items found by the remote AE.
- 2) The Store-SCU Application Entity sends images to a remote AE. This is performed either upon user request for a specific selected image set.
 - 3) The Find Application Entity receives patient or composite instance lists from a remote AE. When the user requests a patient list update, the Find Application Entity queries the remote AE for patients matching the user requirements (user configurable) and returns the set of entries found by the remote AE. When the user requests composite instance list update for a given patient entry (selected in the patient list previously returned), the Find Application Entity queries the remote AE for all composite instances belonging to the selected patient entry matching the user requirements (user configurable) and returns the set of composite instances found by the remote AE.
 - 4) The Move Application Entity requests composite instances to be retrieved locally from a remote AE. When the user requests a composite instance list retrieval or transfer, the Move Application Entity sends to the remote AE the composite instance list identification parameters (either a Study Instance UID or a Series Instance UID or a SOP Instance UID) and returns the final status of the request. Processing control of the underlying associated Composite Instance Storage requests performed by the remote AE to the final destination storage AE is outside the scope of this Move Application Entity.
 - 5) The Store-SCP Application Entity receives images (either unsolicited or requested by the user) from a remote AE. When a new incoming composite instance is received, it is placed in a temporary storage location before being decoded and imported into the internal database. A new patient entry is created in the internal database if the composite instance does not belong to an already existing patient. Currently, the patient matching is performed on Patient ID only. The Store-SCP Application Entity can also process verification requests from a remote AE.

Note: The selection of the information model (either Patient Root or Study Root) for the Find or the Move Application Entities is configurable when defining the associated remote Find-SCP AE into CS Imaging. The configurations are centralized together with CS DICOM Server.

Note: The "flat" model implemented by CS Imaging either for the Patient Root or the Study Root Information Models hides the regular levels of the related DICOM Q&R Find information models.

Note: The Move Application Entity does not provide the user with the ability to retrieve all composite instances belonging to a given patient at a time: Move requests are only possible starting down at the Study level in the DICOM information models.

Note: The Store-SCU Application Entity is implemented as a part of CS DICOM Server, providing thus asynchronous transfer mechanism. The Store-SCP Application Entity is implemented as another part of CS DICOM Server.

2.1.2 Functional Definitions of AE's

2.1.2.1 Functional Definition of Worklist Application Entity

When the user asks for a Worklist update, a Worklist request is sent to a remote system (generally a RIS system). For this purpose, the Worklist AE establishes an Association to the remote AE and transfers the request that includes the user selected matching criteria. After receiving the Worklist Items corresponding to the request, a specific patient list is constructed and presented to the user for selection. This list is then cleared with the next Worklist update.

2.1.2.2 Functional Definition of Store-SCU Application Entity

When the user or the system automatically asks for image storage, a store request is posted to the CS DICOM Server, which acts as the Store-SCU AE. This component then conveys that request to the remote system (generally a PACS system) asynchronously. For this purpose, the Store-SCU AE establishes an Association to the remote AE and negotiates a proper Presentation Context (i.e. transfer syntaxes per SOP Classes). If successful, an image transfer is started. The remote AE can be chosen from a preferred server set. The CS DICOM Server maintains all the transfer request status in a local database which can be queried by the clients through web service interface.

2.1.2.3 Functional Definition of Find Application Entity

When the user asks for a patient list update, a query request is sent to a remote system (generally a PACS system). For this purpose, the Find Application Entity establishes an Association to the remote AE and transfers the request that includes the user selected matching criteria. After receiving the patient list corresponding to the request, a specific list is constructed and presented to the user. For each patient entry found in the returned list, the user can ask for a related composite instance list update. The query will start from getting all studies belonging to the patient. Then, recursively and transparently for the user, a set of query sub-requests is sent to the remote AE to get all series and instances. The recursive query stops at the series level if the modality is CT (a CT series normally means a 3D volume which should be represented to the user as a single object in CS Imaging). For this purpose, the Find Application Entity establishes a new Association to the remote AE for each query request. After receiving all the associated composite instances corresponding to those requests, a specific "flat" list is constructed and presented to the user. This "flat" 2 steps design of the CS Imaging Q&R implementation is done to simplify for the user composite instance retrieval from a PACS system.

2.1.2.4 Functional Definition of Move Application Entity

When the user asks for composite instance retrieval, one or more move requests are sent to a remote system (generally a PACS system). For this purpose, for each request, the Move Application Entity establishes a separate Association to the remote AE and transfers the associated request that includes the related composite instance identifying parameters, i.e. the Unique Keys used to identify an entity at the information model level of the request. The number of move requests sent to the remote AE depends on the information model level where the requests occur. The Move Application Entity is designed to allow retrieval of all composite instances or a user defined set of composite instances belonging to a single Study or a single Series at a time. Such operation is not allowed at the Patient level.

2.1.2.5 Functional Definition of Store-SCP Application Entity

The Store-SCP Application Entity is used to receive either requested (because of a user composite instance retrieval request) or unsolicited composite instances from a remote AE. For this purpose, the Store-SCP Application Entity accepts associations from the remote AE and stores any incoming composite instances in a temporary location then imports them into the internal database of CS Imaging. The Store-SCP Application Entity can also accept Associations from a remote AE for verification purposes.

2.2 AE Specifications

2.2.1 Worklist AE Specifications

2.2.1.1 SOP Classes

The Worklist AE provides Standard Conformance to the following SOP Classes:

Table 1: SOP Classes for Worklist AE

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

2.2.1.2 Association Policies

2.2.1.2.1 General

The Worklist AE always proposes the DICOM standard application context name for DICOM 3.0.

Table 2: DICOM Application Context for Worklist AE

Application Context Name	1.2.840.10008.3.1.1.1
---------------------------------	-----------------------

2.2.1.2.2 Number of Associations

The Worklist AE initiates one Association at a time for each configured Worklist server. Nevertheless, multiple Worklist servers can be configured into CS Imaging.

Table 3: Number of Associations as an Association Initiator for Worklist AE

Maximum number of simultaneous associations	1
--	---

2.2.1.2.3 Asynchronous Nature

The Worklist AE does not support negotiation of multiple outstanding transactions over a single Association, i.e. asynchronous communication.

Table 4: Asynchronous Nature as an Association Initiator for Worklist AE

Maximum number of outstanding asynchronous transactions	1
--	---

2.2.1.2.4 Implementation Identifying Information

The implementation information for the Worklist AE is provided by the underlying OFFISDCMTK library implementation: At the date of this document, for the DCMTK version described in section 1.3, this information is:

Table 5: DICOM Implementation Class and Version for Worklist AE

Implementation Class UID	1.2.276.0.7230010.3.0.3.6.2
Implementation Version Name	OFFIS_DCMTK_364

2.2.1.3 Association Initiation Policy

2.2.1.3.1 Activity - Update Worklist

2.2.1.3.1.1 Description and Sequencing of Activities

Request for Worklist update is initiated by user interaction. The user can perform a query with search criteria. The search criteria are available for Patient Name, Patient ID, Accession Number, Scheduled Procedure Step Start Date, Modality and Scheduled Station AE Title.

Upon initiation of the user request the Worklist AE builds an identifier for the C-FIND request, which includes the search criteria, if any, initiates an Association to the remote AE, and waits for Worklist responses. After retrieval of all the responses, the Worklist AE constructs an internal dataset of the matching Worklist items and passes it back to CSI. then, CSI displays the resulting Worklist Items on the GUI.

The Worklist AE initiates this Association, in order to issue the C-FIND request, according to the Modality Worklist Information Model - FIND.

A possible sequence of interactions between the Worklist AE and a RIS system (i.e. a system supporting the Modality Worklist SOP Class as an SCP) is illustrated in the following diagram:

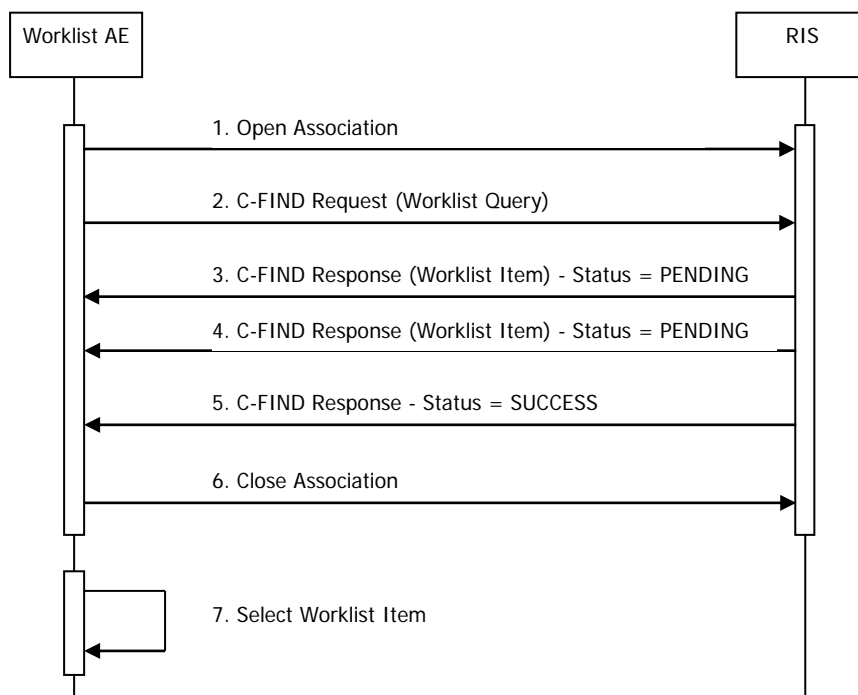


Figure 2: Sequencing of Activity - Update Worklist

- 1) The Worklist AE opens an Association with the RIS system.
- 2) The Worklist AE sends a C-FIND request to the RIS containing the Worklist Query attributes and search criteria.
- 3) The RIS returns a C-FIND response containing the requested attributes of the first matching Worklist Item.
- 4) The RIS returns another C-FIND response containing the requested attributes of the second matching Worklist Item.
- 5) The RIS returns another C-FIND response with a status Success, indicating that no further matching Worklist Item exists (we assume that only 2 items match in this diagram).
- 6) The Worklist AE closes the Association with the RIS.
- 7) The user selects a Worklist Item from the list and prepares to acquire related images.

Note: If a patient has multiple modality worklist on RIS, only the latest one will be displays on GUI.

2.2.1.3.1.2 Proposed Presentation Contexts

The Worklist AE proposes Presentation Contexts as shown in the following table:

Table 6: Proposed Presentation Contexts for Activity Update Worklist

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	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		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.2.1.3.1.3 SOP Specific Conformance for Modality Worklist SOP Class

The behavior of the Worklist AE, when encountering status codes in a Modality Worklist C-FIND response, is summarized in the table below. If the Worklist AE receives any other SCP response status than Success or Pending, the Association is closed, and the Worklist Items already correctly returned are presented to the user.

Table 7: Modality Worklist C-FIND Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete	0000	The SCP has successfully returned all matching information. Worklist Items are available for further processing.
Pending	Matches are continuing	FF0*	The Worklist Item contained in the identifier is collected for further processing
*	*	*	The Association is aborted using A-ABORT and the Worklist is marked as globally failed. All already retrieved items are returned to the user.

The behavior of the Worklist AE during communication failure is summarized in the table below:

Table 8: Modality Worklist Communication Failure Behavior

Exception	Behavior
Timeout	The Association is aborted, and the Worklist is marked as globally failed. No Worklist Item is returned to the user.
Association aborted by the SCP or network layers	The Worklist is marked as globally failed. No Worklist Item is returned to the user.

CANCEL request is issued by the Find AE when receiving maximum number (200) of results.

The Table below provides a description of the Worklist AE Worklist Request Identifier and specifies the attributes that are copied into the images.

Unexpected attributes returned in a C-FIND response are ignored, while requested attributes not supported by the SCP are set to have no value. Non-matching responses returned by the SCP due to unsupported optional matching keys are ignored. No attempt is made to filter out possible duplicate entries.

Note: this table is based on the underlying OFFISDCMTK library implementation specifications.

Table 9: Worklist Request Identifier

Module Name	Tag	Q	M	D	IOD
-------------	-----	---	---	---	-----

Attribute Name					
Scheduled Procedure Step Sequence	(0040,0100)				
> Scheduled Station AE Title	(0040,0001)	Y	SV		
> Scheduled Procedure Step Start Date	(0040,0002)	Y	SV		
> Scheduled Procedure Step Start Time	(0040,0003)				
> Modality	(0008,0060)	Y	ANY	Y	
> Scheduled Performing Physician's Name	(0040,0006)				
> Scheduled Procedure Step Description	(0040,0007)				
> Scheduled Station Name	(0040,0010)				
> Scheduled Procedure Step Location	(0040,0011)				
> Pre Medication	(0040,0012)				
> Scheduled Procedure Step ID	(0040,0009)				
> Requested Contrast Agent	(0032,1070)				
Requested Procedure ID (see note below)	(0040,1001)				Y
Requested Procedure Description (see note below)	(0032,1060)				Y
Study Instance UID	(0020,000D)				Y
Requested Procedure Priority	(0040,1003)				
Patient Transport Arrangements	(0040,1004)				
Study Status ID	(0032,000A)				
Accession Number	(0008,0050)	Y	ANY		Y
Requesting Physician	(0032,1032)				
Referring Physician's Name	(0008,0090)				Y
Admission ID	(0038,0010)				
Current Patient Location	(0038,0300)				
Patient Name	(0010,0010)	Y	WILDCARD	Y	Y
Patient ID	(0010,0020)	Y	ANY	Y	Y
Patient's Birth Date	(0010,0030)			Y	Y
Patient's Sex	(0010,0040)			Y	Y
Patient's Weight	(0010,1030)				
Patient State	(0038,0500)				
Medical Alerts	(0010,2000)				
Contrast Allergies	(0010,2110)				
Special Needs	(0038,0050)				

Note: The attribute Requested Procedure ID (0040,1001) if present, will be used as Study ID (0020,0010) attribute for all images acquired during the underlying exam. The attribute Requested Procedure Description (0032,1060) if present, will be used as Study Description (0008,1030) attribute for all images acquired during the underlying exam.

The table above should be read as follows:

Q: A "Y" indicates that the Worklist AE will supply this attribute as matching key, if entered by the user in the user interface.

Note: If the user provides no value, the attribute will not be part of the search criteria.

M: "SV" indicates that the Worklist AE may supply the attribute value for Single Value

Matching. "WILDCARD" indicates that the Worklist AE may supply the attribute value for Wildcard Matching. "ANY" indicates that the Worklist AE may supply the attribute for Single Value, Wildcard or Multiple Value matching, based on the user inputs (thru the GUI).

Note: If the user provides no value, the attribute will not be part of the matching keys.

D: A "Y" indicates that CS Imaging presents the attribute in the Procedure Step list for user selection.

IOD: A "Y" indicates that the attribute is included into all the acquired images (DICOM files) during acquisition.

Note: The Worklist AE will supply all the attributes described above as Return Key with zero length for Universal Matching if not used as Matching Keys.

2.2.1.3.1.4 SOP Specific Conformance for Verification SOP Class

The Worklist AE provides Standard Conformance for the Verification SOP Class as an SCU.

Note: The Worklist AE initiates a Verification request prior to any Update Worklist operation. In case of failure, a dialog error box is presented to the user. Verification and Update Worklist operations are performed over different Associations.

2.2.1.4 Association Acceptance Policy

The Worklist AE does not accept Associations.

2.2.2 Store-SCU AE Specifications

2.2.2.1 SOP Classes

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

Table 10: SOP Classes for Store-SCU AE

SOP Class Name	SOP Class UID	SCU
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes
Digital Intra-Oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Yes
Digital Intra-Oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes
X-Ray Radiation Dose SR Storage	1.2.840.10008.5.1.4.1.1.88.67	Yes
Verification	1.2.840.10008.1.1	Yes

2.2.2.2 Association Policies

2.2.2.2.1 General

The Store-SCU AE always proposes the DICOM standard application context name for DICOM 3.0.

Table 11: DICOM Application Context for Store-SCU AE

Application Context Name	1.2.840.10008.3.1.1.1
---------------------------------	-----------------------

2.2.2.2.2 Number of Associations

The Store-SCU AE initiates one Association at a time for each configured storage server. Nevertheless, multiple storage servers can be configured into CS Imaging.

Table 12: Number of Associations as an Association Initiator for Store-SCU AE

Maximum number of simultaneous associations	1
--	---

2.2.2.2.3 Asynchronous Nature

The Store-SCU AE does not support negotiation of multiple outstanding transactions over a single Association, i.e. asynchronous communication.

Table 13: Asynchronous Nature as an Association Initiator for Store-SCU AE

Maximum number of outstanding asynchronous transactions	1
--	---

2.2.2.2.4 Implementation Identifying Information

The implementation information for the Store-SCU AE is provided by the underlying OFFISDCMTK library implementation: At the date of this document, for the DCMTK version described in section 1.3, this information is:

Table 14: DICOM Implementation Class and Version for Store-SCU AE

Implementation Class UID	1.2.276.0.7230010.3.0.3.6.2
Implementation Version Name	OFFIS_DCMTK_364

2.2.2.3 Association Initiation Policy

2.2.2.3.1 Activity - Transfer Image

2.2.2.3.1.1 Description and Sequencing of Activities

Request for image transfer is initiated either manually by user interaction, or automatically (configurable) each time an image or a 3D volume dataset is created (i.e. acquired or saved within CS Imaging).

In the manual mode, the user can select one or more images, or one single 3D volume dataset or 3D volume extracted images from the current patient image list and request them to be sent to multiple destinations (configurable and re-selectable).

For each selected destination, a set of requests for transfer is then passed to the Store-SCU AE (i.e. the CS DICOM Server component), one for each image or 3D volume dataset, for later processing when available.

Note: Since, at the date of this document, CS Imaging creates CT Image SOP Class images for 3D volume slices, the request for transfer of such a dataset volume corresponds in fact to a request for transfer of several separate images representing the volume.

When ready to process a request for transfer, the Store-SCU AE may perform a verification operation, first, based on the user configuration of that server within the application, by initiating an Association to the remote AE for Verification. If successful, the Store-SCU AE initiates then another Association to the remote AE and transfers the image or the 3D volume dataset belonging to the initial user or system transfer request. When the transfer request is related to the transfer of a 3D volume dataset (i.e. a set of separate CT slices), then the transfer is performed over the same Association. After the transfer is completed, successfully or not, the Store-SCU AE records accordingly the transfer status into a local database, so that the user can manage it later in the associated Transaction Log Dialog Window, from where the user may retrieve detailed status about the error in case of failure.

This process is repeated for each destination specified in the initial transfer requests.

Note: The user cannot suspend, resume or cancel any ongoing transfer request thru the Transaction Log Dialog Window. The user can only view the final transfer status and retry it on failure if necessary. Detailed description of this functionality is nevertheless outside the scope of this document.

A possible sequence of interactions between the Store-SCU AE and multiple Image Servers (i.e. a system supporting the Storage SOP Class as an SCP) is illustrated in the following diagram:

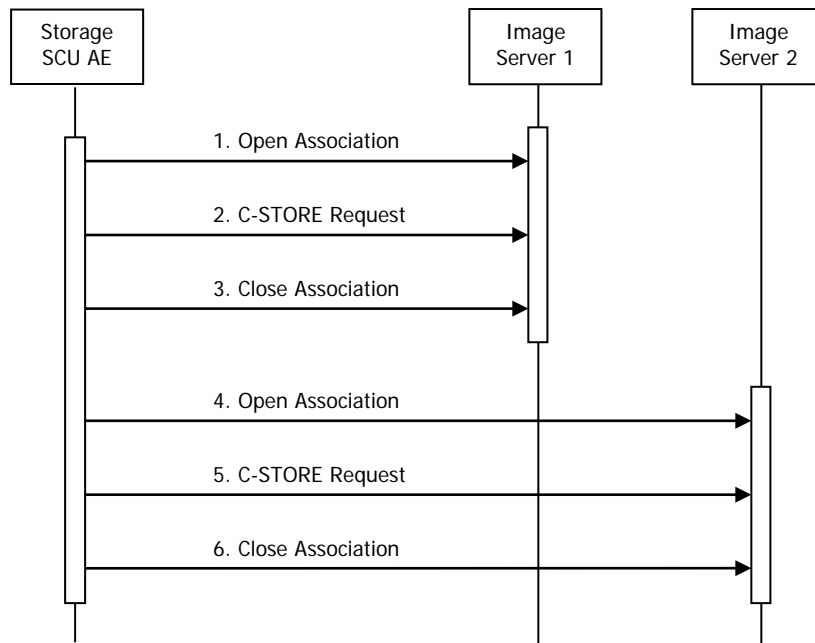


Figure 3: Sequencing of Activity - Transfer Image

- 1) The Store-SCU AE opens an Association with the first configured or selected Image Server system.
- 2) A created image or 3D volume dataset is transmitted to the Image Server using a C-STORE request and the Image Server replies with a C-STORE response.
- 3) The Store-SCU AE closes the Association with the Image Server.
- 4) Then the Store-SCU AE opens another Association with the second configured or selected Image Server system.
- 5) The same created image or 3D volume dataset is transmitted to the Image Server using a C-STORE request and the Image Server replies with a C-STORE response.
- 6) The Store-SCU AE closes the Association with the Image Server.

2.2.2.3.1.2 Proposed Presentation Contexts

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

Table 15: Proposed Presentation Contexts for Activity Transfer Image

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Refer to table above for Storage SOP Classes	Refer to table above for Storage SOP Classes	(As specified in the file to store)	(As specified in the file to store)	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Verification	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		

2.2.2.3.1.3 SOP Specific Conformance for all Image Storage SOP Classes

The behavior of the Store-SCU AE, when encountering status codes in a C-STORE response, is summarized in the table below.

Table 16: Storage C-STORE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The SCP has successfully stored the SOP Instance.
*	*	*	The Association is aborted using A-ABORT and the transfer status to the faulty destination is updated accordingly for the user.

The behavior of the Store-SCU AE during communication failure is summarized in the table below:

Table 17: Storage Communication Failure Behavior

Exception	Behavior
Timeout	The Association is aborted, and the transfer status is updated.
Association aborted by the SCP or network layers	The transfer status is updated.

Failed image storage can be restarted manually any time by user interaction.

2.2.2.3.1.4 SOP Specific Conformance for Verification SOP Class

The Store-SCU AE provides Standard Conformance for the Verification SOP Class as an SCU.

Note: Depending on the configuration made by the user for the remote AE Verification may be performed before each Image Storage operation. Verification and Image Storage operations are nonetheless performed over different Associations.

2.2.2.4 Association Acceptance Policy

The Store-SCU AE does not accept Associations.

2.2.3 Find AE Specifications

2.2.3.1 SOP Classes

The Find AE provides Standard Conformance to the following SOP Classes:

Table 18: SOP Classes for Find AE

SOP Class Name	SOP Class UID	SCU	SCP
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	No
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Verification	1.2.840.10008.1.1	Yes	No

The Find AE provides conformance only to the Hierarchical Search method of the C-FIND SCU Baseline Behavior as defined in the DICOM Standard.

2.2.3.2 Association Policies

2.2.3.2.1 General

The Find AE Always proposes the DICOM standard application context name for DICOM 3.0.

Table 19: DICOM Application Context for Find AE

Application Context Name	1.2.840.10008.3.1.1.1
---------------------------------	-----------------------

2.2.3.2.2 Number of Associations

The Find AE initiates one Association at a time for each configured Q&R server. Nevertheless, multiple Q&R servers can be configured into CS Imaging.

Table 20: Number of Associations as an Association Initiator for Find AE

Maximum number of simultaneous associations	1
--	---

2.2.3.2.3 Asynchronous Nature

The Find AE does not support negotiation of multiple outstanding transactions over a single Association, i.e. asynchronous communication.

Table 21: Asynchronous Nature as an Association Initiator for Find AE

Maximum number of outstanding asynchronous transactions	1
--	---

2.2.3.2.4 Implementation Identifying Information

The implementation information for the Find AE is provided by the underlying OFFISDCMTK library implementation. At the date of this document, for the DCMTK version described in section 1.3, this information is:

Table 22: DICOM Implementation Class and Version for Find AE

Implementation Class UID	1.2.276.0.7230010.3.0.3.6.2
Implementation Version Name	OFFIS_DCMTK_364

2.2.3.3 Association Initiation Policy

2.2.3.3.1 Activity - Query Composite Instances

2.2.3.3.1.1 Description and Sequencing of Activities

Query activities of CS Imaging are split into two steps. The first step is to collect a list of patients from the query results based on the user entered matching keys. The most commonly used matching key is Patient Name, but several other keys could also be provided as advanced search criteria's (Patient ID, Study ID, Study Date, Accession Number, etc.).

Note: The detailed underlying query requests might be different depending on whether the remote AE is Patient Root Information Model or Study Root Information Model. But the general strategy is similar.

Upon initiation of the user request, for a query of the patients, the Find AE builds an identifier for the C-FIND request, which includes the search criteria's, if any, then initiates an Association to the remote AE, and waits for Query responses. After retrieval of all the responses, the Find AE constructs an internal dataset of the matching entries returned, eliminates the duplicate patients (only for Study Root Information Model), and passes it back to CS Imaging. CS Imaging, then, displays the resulting data to the user in a patient list window, which will be cleared the next time the user requires such update.

The second-step query will be triggered when the user selects such a patient from the list. At that point, all the instances belong to this patient are supposed to be queried, and no criteria is needed. The Find AE performs a recursive set of queries to the remote AE for all composite instances belonging to all series belonging to all study belonging to the selected patient. The query will stop at series level if the modality of the series is CT, because a CT series normally represents one single 3D volume entity by itself and querying for all underlying individual composite instances will be obviously useless.

For each of those sub-queries, the Find AE establishes a new Association to the remote AE and transfers the request that includes the specific matching criteria for a given level of the information model.

After retrieval of all the responses, the Find AE constructs an internal dataset of the composite instances returned and passes it back to CS Imaging. CS Imaging, then, displays the resulting data to the user in a second window called Image Gallery, which will be cleared the next time another patient is selected from the patient list.

The Find AE initiates the required Associations, to issue the C-FIND requests, according to the Information Model setup while configuring the related Q&R remote AE server, i.e. either the Patient Root Q&R Information Model - FIND or the Study Root Q&R Information Model - FIND.

A possible sequence of interactions between the Find AE and a PACS system (i.e. a system supporting the Query/Retrieve SOP Class as an SCP) is illustrated in the following diagram, for the DICOM Q&R Patient Root Information Model:

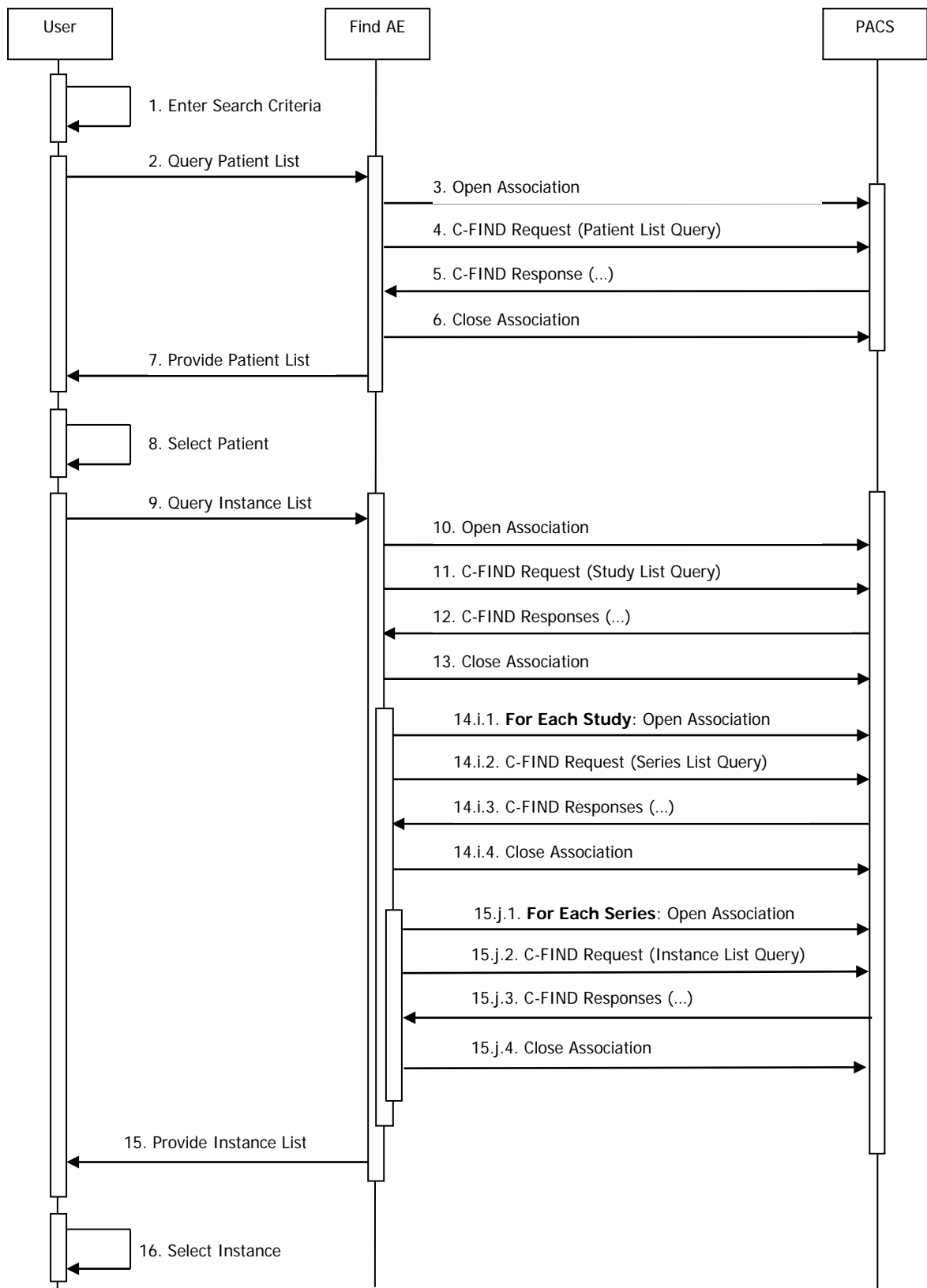


Figure 4: Sequencing of Activity - Query Composite Instances

- 1) The user enters search criteria for all levels of the Information Model.
- 2) The user requests the Find AE to return matching patient list.
- 3) The Find AE opens an Association with the PACS system.

- 4) The Find AE sends a C-FIND request to the PACS containing the patient query attributes and search criteria.
- 5) The PACS returns C-FIND responses containing the requested attributes of all matching patient entries.
- 6) The Find AE closes the Association with the PACS.
- 7) The Find AE provides the user with the patient list returned.
- 8) The user selects a specific patient.
- 9) The user requests the Find AE to return matching instance list for the selected patient.
- 10) The Find AE opens an Association with the PACS system.
- 11) The Find AE sends a C-FIND request to the PACS containing the series query attributes and search criteria.
- 12) The PACS returns C-FIND responses containing the requested attributes of all matching study entries of the given patient.
- 13) The Find AE closes the Association with the PACS.
- 14) The Find AE performs the same type of operations to retrieve all the series belonging to each study returned by the PACS system.
- 15) The Find AE performs again the same type of operations for retrieve finally all the composite instances belonging to each series returned by the PACS system.
- 16) The Find AE provides the user with the all the instance lists returned.
- 17) The user can then select a specific set of instances for further actions.

Note: The purpose and specific actions the user can perform on the selected instance(s) is outside the scope of the Find AE. Refer to section 2.2.3 for more information.

2.2.3.3.1.2 Proposed Presentation Contexts

The Find AE proposes Presentation Contexts as shown in the following table:

Table 23: Proposed Presentation Contexts for Activity Query Composite Instances

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	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		
Study Root Query/Retrieve Information Model - FIND	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		
Verification	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		

The Find AE does not perform any extended negotiation: As stated above, the Find AE provides conformance only to the Hierarchical Search method of the C-FIND SCU Baseline Behavior as defined in the DICOM Standard.

2.2.3.3.1.3 SOP Specific Conformance for Q&R SOP Class

The behavior of the Find AE, when encountering status codes in a Q&R C-FIND response is, summarized in the table below. If the Find AE receives any other SCP response status than Success or Pending, the Association is closed, and the data entries already correctly returned are presented to the user. CANCEL request is issued by the Find AE when receiving maximum number (200) of results.

Table 24: Q&R C-FIND Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete	0000	The SCP has successfully returned all matching information. Data entries are available for further processing.
Pending	Matches are continuing	FF0*	The data entry contained in the identifier is collected for further processing
*	*	*	The Association is aborted using A-ABORT and the Query is marked as globally failed. All already retrieved entries are returned to the user.

The behavior of the Find AE during communication failure is summarized in the table below:

Table 25: Q&R Communication Failure Behavior

Exception	Behavior
Timeout	The Association is aborted, and the Query is marked as globally failed. No data entry is returned to the user.
Association aborted by the SCP or network layers	The Query is marked as globally failed. No data entry is returned to the user.

The tables below provide a description of the Find AE query identifiers and support for Optional Keys.

Unexpected attributes returned in a C-FIND response are ignored, while requested optional attributes not supported by the SCP are set to have no value. Non-matching responses returned by the SCP due to unsupported optional keys are ignored.

Note: this table is based on the underlying OFFISDCMTK library implementation specifications.

Table 26: Patient Root Q&R Information Model Request Identifier

Q&R Level Attribute Name	Tag	Type	Q	M	D
PATIENT					
Patient's Name	(0010,0010)	O	Y	WILDCARD	Y
Patient ID	(0010,0020)	U	Y	WILDCARD	Y
Patient's Birth Date	(0010,0030)	O			Y
Patient's Sex	(0010,0040)	O			Y
STUDY					
Study Date	(0008,0020)	O	Y	SV-RG	Y
Study Time	(0008,0030)	O			
Accession Number	(0008,0050)	O	Y	WILDCARD	Y
Study ID	(0020,0010)	O			
Study Instance UID	(0020,000D)	U			
Referring Physician's Name	(0008,0090)	O			

Study Description	(0008,1030)	O			
Name of Physicians Reading the Study	(0008,1060)	O			
Modalities in Study	(0008, 0061)	O	Y	SV	Y
SERIES					
Modality	(0008,0060)	R	Y	SV	Y
Series Number	(0020,0011)	O			
Series Instance UID	(0020,000E)	U			
Series Date	(0008, 0021)	O			Y
Series Time	(0008, 0031)	O			Y
Number of Series Related Instances	(0020, 1209)	O			Y
Series Description	(0008,103E)	O			Y
INSTANCE					
Instance Number	(0020,0013)	O			
SOP Instance UID	(0008,0018)	U			
SOP Class UID	(0008, 0016)	R			Y

Table 27: Study Root Q&R Information Model Request Identifier

Q&R Level Attribute Name	Tag	Type	Q	M	D
STUDY					
Study Date	(0008,0020)	O	Y	SV-RG	Y
Study Time	(0008,0030)	O			
Accession Number	(0008,0050)	O	Y	WILDCARD	Y
Patient's Name	(0010,0010)	O	Y	WILDCARD	Y
Patient ID	(0010,0020)	R	Y	WILDCARD	Y
Study ID	(0020,0010)	O			
Study Instance UID	(0020,000D)	U			
Referring Physician's Name	(0008,0090)	O			
Study Description	(0008,1030)	O			
Name of Physicians Reading the Study	(0008,1060)	O			
Patient's Birth Date	(0010,0030)	O			
Patient's Sex	(0010,0040)	O			
Modalities in Study	(0008, 0061)	O		SV	Y
SERIES					
Modality	(0008,0060)	R	Y	SV	Y
Series Number	(0020,0011)	O			
Series Instance UID	(0020,000E)	U			
Series Date	(0008, 0021)	O			Y
Series Time	(0008, 0031)	O			Y
Number of Series Related Instances	(0020, 1209)	O			Y
Series Description	(0008,103E)	O			Y
INSTANCE					
Instance Number	(0020,0013)	O			

SOP Instance UID	(0008,0018)	U			
SOP Class UID	(0008, 0016)	O			Y

The table columns above should be read as follows:

Q: A "Y" in this column indicates that the Find AE will supply this attribute as matching key, if entered by the user in the dialog user interface.

Note: For the Patient's Name, not only the Last Name, but all components are used.

M: "SV-RG" in this column indicates that the Find AE may supply the attribute value for either Single Value or Range Matching. "WILDCARD" indicates that the Worklist AE may supply the attribute value for Wildcard Matching. "ANY" indicates that the Find AE may supply the attribute for Single Value, Wildcard or Multiple Value matching, based on the user inputs (thru the GUI).

D: A "Y" in this column indicates that CS Imaging will display the attribute in the different lists for user selection.

Note: The Find AE will supply all the attributes described above as Return Key with zero length for Universal Matching if not used as Matching Keys.

Note: The wildcard () will be automatically added to the prefix and suffix of the user entered Matching Keys if they don't have it already. This applies to Patient ID, Patient Name and Accession Number.*

2.2.3.3.1.4 SOP Specific Conformance for Verification SOP Class

The Find AE provides Standard Conformance for the Verification SOP Class as an SCU.

Note: The Find AE initiates a Verification request prior to any main Query operations initiated by the user. In case of failure, a dialog error box is presented to the user. Verification and Query operations are performed over different Associations.

2.2.3.4 Association Acceptance Policy

The Find AE does not accept Associations.

2.2.4 Move AE Specifications

2.2.4.1 SOP Classes

The Move AE provides Standard Conformance to the following SOP Classes:

Table 28: SOP Classes for Move AE

SOP Class Name	SOP Class UID	SCU	SCP
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	No
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No

The Move AE provides conformance only to the Hierarchical Search method of the C-MOVE SCU Baseline Behavior as defined in the DICOM Standard.

2.2.4.2 Association Policies

2.2.4.2.1 General

The Move AE Always proposes the DICOM standard application context name for DICOM 3.0.

Table 29: DICOM Application Context for Move AE

Application Context Name	1.2.840.10008.3.1.1.1
---------------------------------	-----------------------

2.2.4.2.2 Number of Associations

The Move AE initiates one Association at a time for each configured Q&R server. Nevertheless, multiple Q&R servers can be configured into CS Imaging.

Table 30: Number of Associations as an Association Initiator for Move AE

Maximum number of simultaneous associations	1
--	---

2.2.4.2.3 Asynchronous Nature

The Move AE does not support negotiation of multiple outstanding transactions over a single Association, i.e. asynchronous communication.

Table 31: Asynchronous Nature as an Association Initiator for Move AE

Maximum number of outstanding asynchronous transactions	1
--	---

2.2.4.2.4 Implementation Identifying Information

The implementation information for the Move AE is provided by the underlying OFFISDCMTK library implementation. At the date of this document, for the DCMTK version described in section 1.3, this information is:

Table 32: DICOM Implementation Class and Version for Move AE

Implementation Class UID	1.2.276.0.7230010.3.0.3.6.2
Implementation Version Name	OFFIS_DCMTK_364

2.2.4.3 Association Initiation Policy

2.2.4.3.1 Activity - Retrieve Composite Instances

2.2.4.3.1.1 Description and Sequencing of Activities

Request for composite instance retrieval is initiated by user interaction.

As described for the Find AE, the Move AE allows the user to retrieve instances or series (CT only) belonging to a selected patient. E.g., CT modality 3D volume is a series represented to the user as a single item in the list. If the user retrieves it, all the instances belonging to this series will be retrieved.

Upon initiation of the user request, the Move AE builds an identifier for the C-MOVE request, which includes the level of retrieval, the matching entity values and the destination AE title, initiates an Association to the remote AE, and waits for the final Move response (i.e. the final status of all C-STORE sub-operations returned by the remote AE).

Note: The destination AE title provided to the PACS system (i.e. the Q&R SCP system) refers to the Store-SCP as described in section 2.2.4. It is "extracted" from the Store-SCP AE configuration parameters.

The Move AE initiates the required Associations, to issue the C-MOVE requests, according to the Information Model setup while configuring the related Q&R remote AE server, i.e. either the Patient Root Q&R Information Model - MOVE or the Study Root Q&R Information Model - MOVE.

A possible sequence of interactions between the Move AE and a PACS system (i.e. a system supporting the Query/Retrieve SOP Class as an SCP) is illustrated in the following diagram:

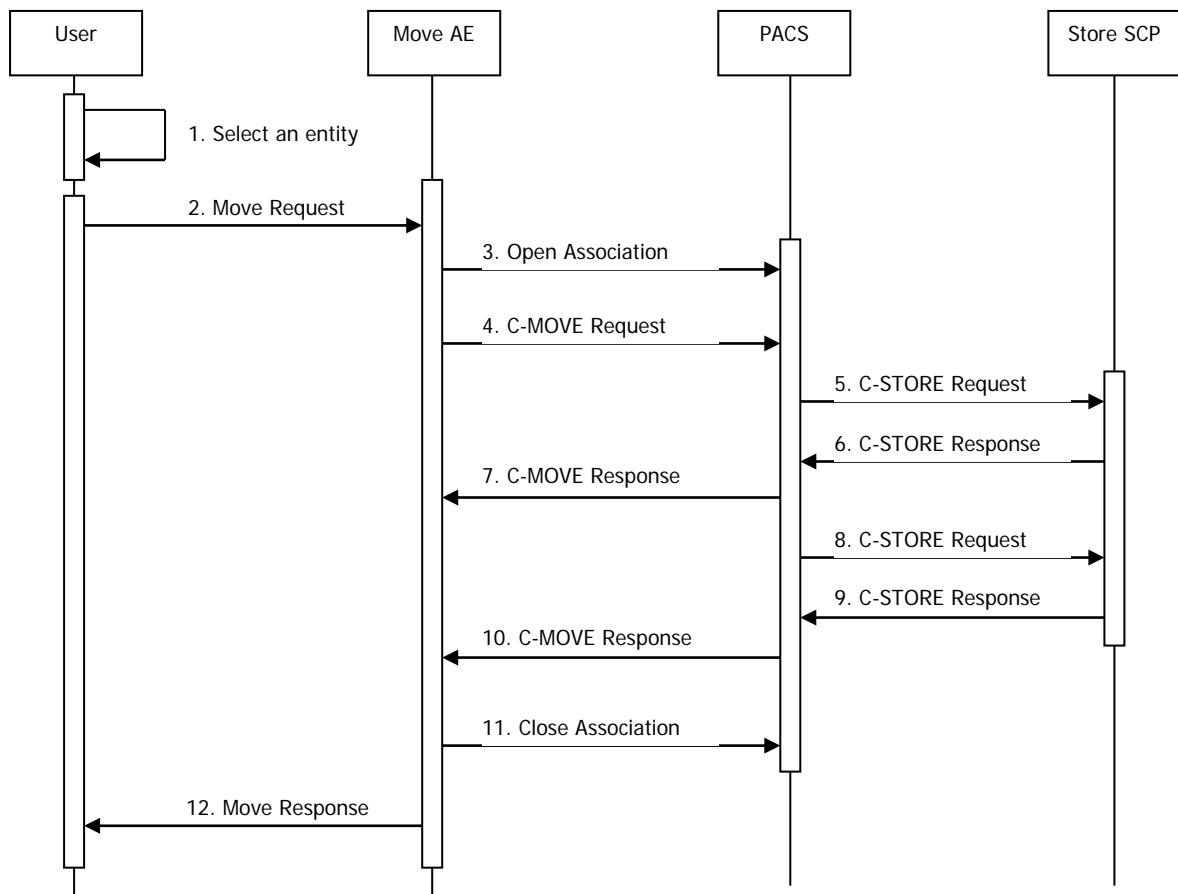


Figure 5: Sequencing of Activity - Retrieve Composite Instances

- 1) The user selects an entity to move to a specific destination storage server.
- 2) The user requests the Move AE to move the selected entity.
- 3) The Move AE opens an Association with the PACS system.
- 4) The Move AE sends a C-MOVE request to the PACS containing the associated Move identifier.

- 5) The PACS system initiates a C-STORE sub-operation to the destination Store SCP for the first matching entry found in its database.
- 6) The Store SCP returns the status of the C-STORE sub-operation to the PACS system.
- 7) The PACS system sends to the Move AE a C-MOVE response with a status of Pending.
- 8) The PACS system initiates a second C-STORE sub-operation to the destination Store SCP for the last matching entry found in its database.
- 9) The Store SCP returns the status of the C-STORE sub-operation to the PACS system.
- 10) The PACS system sends to the Move AE a C-MOVE response with a status of Success.
- 11) The Move AE closes the Association with the PACS.
- 12) The Move AE returns to the user the final status of the Move request.

2.2.4.3.1.2 Proposed Presentation Contexts

The Move AE proposes Presentation Contexts as shown in the following table:

Table 33: Proposed Presentation Contexts for Activity Retrieve Composite Instances

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	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		
Study Root Query/Retrieve Information Model - MOVE	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		

The Move AE does not perform any extended negotiation: As stated above, the Move AE provides conformance only to the Hierarchical Search method of the C-MOVE SCU Baseline Behavior as defined in the DICOM Standard.

2.2.4.3.1.3 SOP Specific Conformance for Q&R SOP Class

The behavior of the Move AE, when encountering status codes in a Q&R C-MOVE response is, summarized in the table below. If the Move AE receives any other SCP response status than Success or Pending, the Association is closed and no other information than a globally failed status is returned to the user (e.g. the list of already successfully moved entities for is not provided to the user).

Table 34: Q&R C-MOVE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Moving is complete	0000	The SCP has successfully moved all required entities.
Pending	Moving are continuing	FF00	Entities are still moved by the SCP.
*	*	*	The Association is aborted using A-ABORT and the Move request is marked as globally failed. List of already moved instances is not provided to the user.

The behavior of the Move AE during communication failure is summarized in the table below:

Table 35: Q&R Communication Failure Behavior

Exception	Behavior
Timeout	The Association is aborted, and the Move request is marked as globally failed. List of already moved instances is not provided to the user.
Association aborted by the SCP or network layers	The Move request is marked as globally failed. List of already moved instances is not provided to the user.

No CANCEL requests are ever issued by the Move AE.

The Move AE may supply Unique Key values for the following levels:

Table 36: Supported Q&R of the Move AE

Q&R Levels
STUDY
SERIES
INSTANCE

To prevent unexpected and unpredictable results, the Move AE does not support retrieval of composite instances at the PATIENT level.

The Move AE never provides a list of matching UID whatever the Q&R level being used: only Single Value Matching is issued per requests, i.e. the Move AE orders the move of only one entity per request. Therefore, the Move AE will issue separate requests for retrieving a list of individual user's selected composite instances.

2.2.4.4 Association Acceptance Policy

The Move AE does not accept Associations.

2.2.5 Store-SCP AE Specifications

2.2.5.1 SOP Classes

The Store-SCP AE provides Standard Conformance to the following SOP Classes:

Table 37: SOP Classes for Store-SCP AE

SOP Class Name	SOP Class UID	SCP
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes
Digital Intra-Oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Yes
Digital Intra-Oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes
X-Ray Radiation Dose SR Storage	1.2.840.10008.5.1.4.1.1.88.67	No
Verification	1.2.840.10008.1.1	Yes

2.2.5.2 Association Policies

2.2.5.2.1 General

The Store-SCP AE will never initiate Associations; it only accepts Association requests from remote AE. The Store-SCP will accept Associations for Verification and Storage requests.

The Store-SCP AE always accepts the DICOM standard application context name for DICOM 3.0.

Table 38: DICOM Application Context for Store-SCP AE

Application Context Name	1.2.840.10008.3.1.1.1
---------------------------------	-----------------------

2.2.5.2.2 Number of Associations

The Store-SCP AE currently can support one to ten associations at a time.

Table 39: Number of Associations as an Association Acceptor for Store-SCP AE

Maximum number of simultaneous associations	10(Configurable)
--	------------------

2.2.5.2.3 Asynchronous Nature

The Store-SCP AE does not support negotiation of multiple outstanding transactions over a single Association, i.e. asynchronous communication. All Associations requests shall be completed and acknowledged before a new operation is initiated.

Table 40: Asynchronous Nature as an Association Acceptor for Store-SCP AE

Maximum number of outstanding asynchronous transactions	1
--	---

2.2.5.2.4 Implementation Identifying Information

The implementation information for the Store-SCP AE is provided by the underlying OFFISDCMTK library implementation. At the date of this document, for the DCMTK version described in section 1.3, this information is:

Table 41: DICOM Implementation Class and Version for Store-SCP AE

Implementation Class UID	1.2.276.0.7230010.3.0.3.6.2
Implementation Version Name	OFFIS_DCMTK_364

2.2.5.2.5 Maximum PDU Size

The Store-SCP AE supports a default PDU size of 16K bytes. The value is configurable from 8 KB to 64 KB.

Table 42: Maximum PDU Size for Store-SCP AE

Maximum PDU Size	16K bytes (Configurable)
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2.2.5.3 Association Initiation Policy

The Store-SCP does not initiate Associations.

2.2.5.4 Association Acceptance Policy

2.2.5.4.1 Activity - Receive Composite Instances

2.2.5.4.1.1 Description and Sequencing of Activities

The Store-SCP listens for incoming Association requests from remote AE.

When an Association is opened by a remote AE for composite instance transfer, the Store-SCP AE creates a new file in a configurable directory for storing temporarily the received composite instance using the composite instance UID as file name. If the same composite instance is received twice before being processed by CS Imaging, the file is overwritten.

NOTE: CS Imaging doesn't check the calling AE title against the configuration for the Store SCP AE.

When an Association is terminated, CS Imaging is ready to process the instance(s) received by the Store-SCP AE. If a received file can be properly decoded, it is then imported into the CS Imaging internal database. Patient matching is performed on the Patient ID attribute extracted from the composite instance. If no patient already exists into the CS Imaging internal database, a new one is created.

Note: When a 3D volume dataset created originally by Carestream Dental equipment is received (in a single association), a subdirectory is created (based on the Series Instance UID information) for storing the dataset, to ensure and ease that dataset management by the associated 3D imaging application.

While importing a valid composite instance file to its final patient data directory, CS Imaging renames the file using a unique file name if necessary. This allows composite instance duplication into the internal database.

Note: This assertion is not true for 3D volume dataset slice files. In that case, each slice file is named according to the associated Instance Number information and replaces therefore any existing file within the final patient data subdirectory with the same file name. This is done to prevent unexpected duplication of slices for a given 3D volume dataset, and to enable overriding of any damaged data files.

When an Association is opened by a remote AE for verification, the Store-SCP AE processes on its own the request.

2.2.5.4.1.2 Accepted Presentation Contexts

The Store-SCP AE accepts Presentation Contexts as shown in the following table:

Table 43: Acceptable Presentation Contexts for Activity Receive Images

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Refer to table above for Storage SOP Classes	Refer to table above for Storage SOP Classes	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		
		JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50		
		JPEG Extended (Process 2 & 4)	1.2.840.10008.1.2.4.51		
		JPEG Lossless, Non-Hierarchical First-Order Prediction (Process 14)	1.2.840.10008.1.2.4.70		
		JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90		
		JPEG 2000 Image Compression (Lossless or Lossy)	1.2.840.10008.1.2.4.91		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Due to the underlying OFFIS DCMTK library used in the DICOM implementation of CS Imaging, the Store-SCP AE may accept more Transfer Syntaxes for the SOP Classes listed in the table above, or even other Presentation Contexts for other Storage SOP Classes: nevertheless, it is not guaranteed that neither CS DICOM Server nor CS Imaging will be able to handle properly such SOP Classes or Transfer Syntaxes.

2.2.5.4.1.2.1 Extended Negotiation

No extended negotiation is performed, though Store-SCP AE:

- Is a Level 2 Storage SCP (Full - does not discard any data element)
- Does not coerce any received data elements

2.2.5.4.1.3 SOP Specific Conformance for Storage SOP Classes

The Store-SCP AE provides Standard Conformance for the Storage SOP Classes listed in the table above as an SCP.

The Store-SCP AE retains the original DICOM data related to a received composite instance in a DICOM Part 10 compliant file format. In additions, all Private and SOP Class Extended Elements are maintained in the DICOM format files.

2.2.5.4.1.4 SOP Specific Conformance for Verification SOP Class

The Store-SCP AE provides Standard Conformance for the Verification SOP Class as an SCP.

2.3 Network Interfaces

2.3.1 Physical Network Interface

CS Imaging inherits the TCP/IP stack from the Microsoft Windows Operating System upon which it executes.

2.3.2 Additional Protocols

DHCP protocol can be used to obtain TCP/IP network configuration information.

DNS protocol or NetBT (NetBIOS over TCP/IP for small network segment) can be used for name resolution (remote system identification by name): If available, name resolution allows using Hostname instead of TCP/IP addresses while configuring remote systems (see section 2.4)

2.4 Configuration

CS Imaging provides the ability to configure "server connections". A server connection is an entity identified by a user configurable name, corresponding to the association of the following local and remote parameters:

- 1) Local parameters:
 - Calling AE Title
- 2) Remote parameters:
 - Called AE Title
 - IP Address or Hostname
 - Port Number

For each server connection, the supported DICOM services may be specified.

2.4.1 AE Title/Presentation Address Mapping

2.4.1.1 Local AE Titles

All local AE Titles (Calling AE Titles) are user configurable per server connection.

Table 44: AE Titles Configuration Table

Application Entity	Default AE Title	Default TCP/IP Port
Worklist	CSDS	Not Applicable (SCU only)
Store-SCU	CSDS	Not Applicable (SCU only)
Find	CSDS	Not Applicable (SCU only)
Move	CSDS	Not Applicable (SCU only)
Store-SCP	CSDS	104

2.4.1.2 Remote AE Title/Presentation Address Mapping

The Remote AE Titles (Called AE Titles), hostnames (or IP Addresses) and Port Numbers are user configurable per server connection.

For each CS Imaging AE, multiple remote AE SCP can be defined. The user depending on SCP availability can then choose defaults.

2.4.2 Parameters

CS Imaging inherits most of the parameters from the underlying OFFISDCMTK library implementation. Therefore, those parameters are fixed and not configurable.

3 MEDIA INTERCHANGE

At the date of this document, CS Imaging does not support media interchange.

4 SUPPORT OF CHARACTER SETS

All the CS Imaging AE support the following character sets:

Table 45: Supported Character Sets

ISO Code	Description
ISO_IR 6	Default character set
ISO_IR 192	ISO 10646 (UTF-8) Unicode in UTF-8
ISO-IR 100	ISO 8859-1:1998 - 8-bit single byte coded graphic character sets - Part 1: Latin alphabet No. 1
ISO-IR 101	ISO 8859-2:1999 - 8-bit single byte coded graphic character sets - Part 2: Latin alphabet No. 2
ISO-IR 109	ISO 8859-3:1999 - 8-bit single byte coded graphic character sets - Part 3: Latin alphabet No. 3
ISO-IR 110	ISO 8859-4:1998 - 8-bit single byte coded graphic character sets - Part 4: Latin alphabet No. 4
ISO-IR 144	ISO 8859-5:1999 - 8-bit single byte coded graphic character sets - Part 5: Latin/Cyrillic alphabet
ISO-IR 127	ISO 8859-6:1999 - 8-bit single byte coded graphic character sets - Part 6: Latin/Arabic alphabet
ISO-IR 126	ISO 8859-7:2003 - 8-bit single byte coded graphic character sets - Part 7: Latin/Greek alphabet
ISO-IR 138	ISO 8859-8:1999 - 8-bit single byte coded graphic character sets - Part 8: Latin/Hebrew alphabet
ISO-IR 148	ISO 8859-9:1999 - 8-bit single byte coded graphic character sets - Part 9: Latin alphabet
ISO-IR 166	ISO 8859-11:2001 - 8-bit single byte coded graphic character sets - Part 11: Latin/Thai alphabet

5 SECURITY

5.1 Security Profiles

CS Imaging optionally supports the TLS 1.2 for SCU only.

CS Imaging provides a configuration parameter for each Remote AE for which it initiates connections. This configuration parameter indicates whether the Remote AE is designated as handling TLS connections or non-TLS connections.

CS Imaging must be configured with the appropriate private key, certificate. These parameters are used for TLS connections with all applicable Remote Application Entities.

A private key is managed as a file in the file system. A private key may optionally be encoded with a password in which case it must be configured for use by CS Imaging. The password is managed in the same manner as other configuration parameters: it is stored within a configuration file in the file system.

CS Imaging provides a configuration parameter for verifying peer certificates. CS Imaging reads certificates from the configured trusted certificate and the OS provided certificate stores.

When an integrity check fails, the transport connection is closed, an authentication failure message is logged to the CS Imaging log file.

5.2 Application Level Security

It is assumed that CS Imaging is used in an already secured environment. Therefore, CS Imaging relies on both the underlying Microsoft Windows Operating System security scheme and the Site security policy setup by the user.