

# DICOM Conformance Statement

## DICOM Store Release 1.2



**Issued by:**

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# 1. DICOM Conformance Statement Overview

Table 1: Web Services

Web Services	User Agent	Origin Server
Retrieve Transaction (WADO-RS)	No	Yes
Store Transaction (STOW-RS)	No	Yes
Search Transaction (QIDO-RS)	No	Yes

Table 2: Network Services

SOP Class		User of Service (SCU)	Provider of Service (SCP)
Name	UID		
<b>Query Retrieve</b>			
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
<b>Transfer</b>			
Digital X-Ray Image Storage - For Pres. SOP	1.2.840.10008.5.1.4.1.1.1.1	No	Yes
Digital Mammography X-Ray Image Storage - Pres. SOP	1.2.840.10008.5.1.4.1.1.1.2	No	Yes
CT Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.2	No	Yes
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	No	Yes
Ultrasound Multi-frame Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.3.1	No	Yes
MR Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.4	No	Yes
Ultrasound Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.6.1	No	Yes
Secondary Capture Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.7	No	Yes
Multi-frame Grayscale Byte SC Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.7.2	No	Yes
Multi-frame Grayscale Word SC Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.7.3	No	Yes
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	No	Yes
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	No	Yes
X-Ray Angiographic Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.12.1	No	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	No	Yes
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	No	Yes
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	No	Yes
Keratometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.3	No	Yes
Ophthalmic Axial Measurements Storage	1.2.840.10008.5.1.4.1.1.78.7	No	Yes
Intraocular Lens Calculations Storage	1.2.840.10008.5.1.4.1.1.78.8	No	Yes
Basic Text SR SOP Class	1.2.840.10008.5.1.4.1.1.88.11	No	Yes
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	No	Yes
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	No	Yes
Positron Emission Tomography Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.128	No	Yes

SOP Class		User of Service (SCU)	Provider of Service (SCP)
Name	UID		
RT Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.481.1	No	Yes
RT Dose Storage SOP Class	1.2.840.10008.5.1.4.1.1.481.2	No	Yes
RT Structure Set Storage SOP Class	1.2.840.10008.5.1.4.1.1.481.3	No	Yes
RT Beams Treatment Record Storage SOP Class	1.2.840.10008.5.1.4.1.1.481.4	No	Yes
RT Plan Storage SOP Class	1.2.840.10008.5.1.4.1.1.481.5	No	Yes
RT Brachy Treatment Record Storage SOP Class	1.2.840.10008.5.1.4.1.1.481.6	No	Yes
RT Treatment Summary Record Storage SOP Class	1.2.840.10008.5.1.4.1.1.481.7	No	Yes
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8	No	Yes

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### 3. Introduction

HSDP DICOM Store Release 1 service provides cloud-based storage for Digital Imaging and Communications in Medicine (DICOM) Data as part of the HSDP Store theme. It enables standards-based interoperability between enabled apps and devices with third-party systems via DICOMweb standard interfaces.

DICOM Store is integrated with the HSDP’s Identity and Access Management (IAM), Clinical Data Repository (CDR) and Audit Services to enable seamless secure and compliant clinical workflows.

The DICOM Store service supports the following RESTful web services specified in the DICOM PS3.18 - Web Services standard (commonly referred as DICOMweb). It supports Studies Service and Resources (previously referred as the WADO-RS, STOW-RS, and QIDO-RS services).

The DICOM Store service supports the following native (TCP/IP based) connectivity services specified in the DICOM PS3.7 - C-STORE Service SCP standard (commonly referred as DICOM Message Service Element (DIMSE)). The C-STORE service is used by a DIMSE Service User to store a composite SOP Instance on a peer DIMSE Service User.

The Import service supports Query and Retrieve from external DICOM systems at Study and Series hierarchy level as defined in DICOM PS3.7 - C-FIND SCU and DICOM PS3.7 - C-MOVE SCU respectively. These transactions can be achieved using RESTful web APIs provided by Import service.

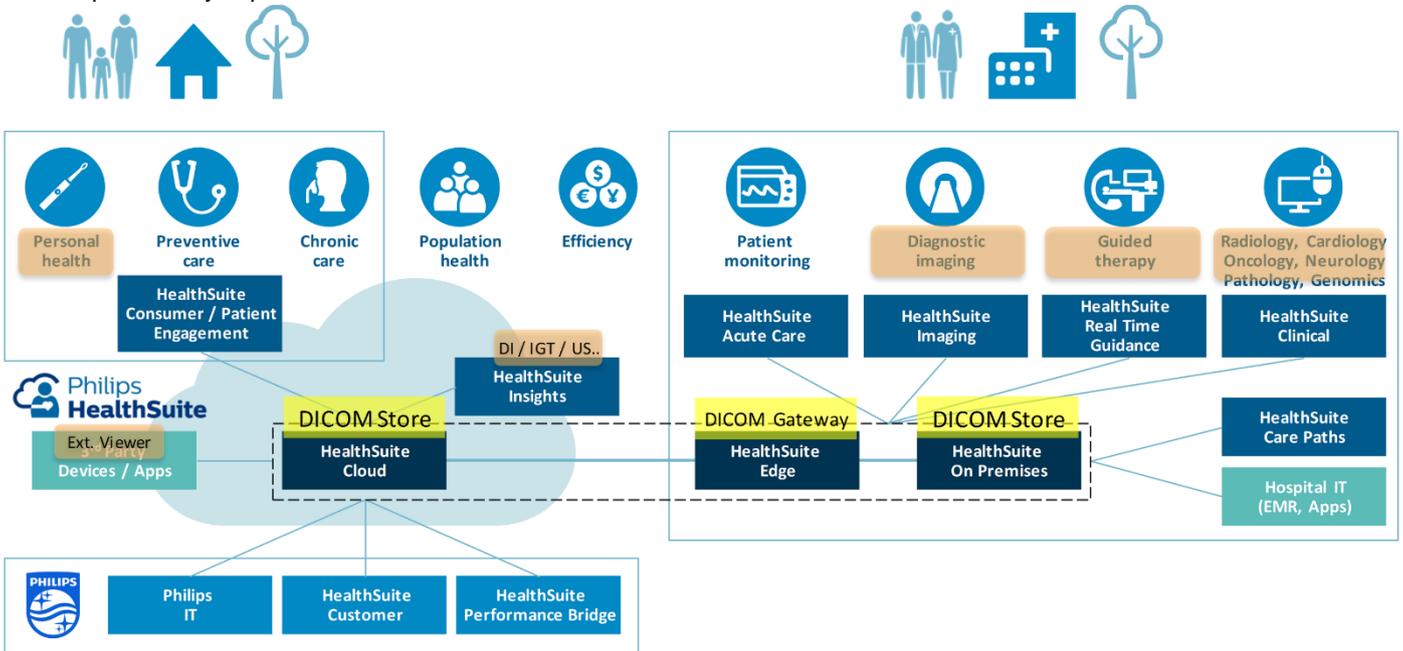


Figure 1 Dicomstore Release 1.2 Workflow

### 3.1 Revision History

Table 3: Revision History

Document Version	Date of Issue	Status	Description
00	16-Apr-2020	Approved	Final version

## 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 7 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 assure 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
ANSI	American National Standard Institute
DICOM	Digital Imaging and Communications in Medicine
EBE	DICOM Explicit VR Big Endian
ELE	DICOM Explicit VR Little Endian
HIS	Hospital Information System

Abbreviation/Term	Explanation
ILE	DICOM Implicit VR Little Endian
IOD	Information Object Definition
NEMA	National Electrical Manufacturers Association
NM	Nuclear Medicine
PDU	Protocol Data Unit
RF	X-Ray Radiofluoroscopic
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

## 3.5 References

[DICOM] Digital Imaging and Communications in Medicine, Parts 1 - 22 (NEMA PS 3.1- PS 3.22),  
National Electrical Manufacturers Association (NEMA) Publication Sales 1300 N. 17th Street, Suite 900 Rosslyn, Virginia.  
22209, United States of America  
Internet: <https://www.dicomstandard.org/>

## 4. Networking

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

### 4.1 Implementation model

### 4.2 Application Data flow

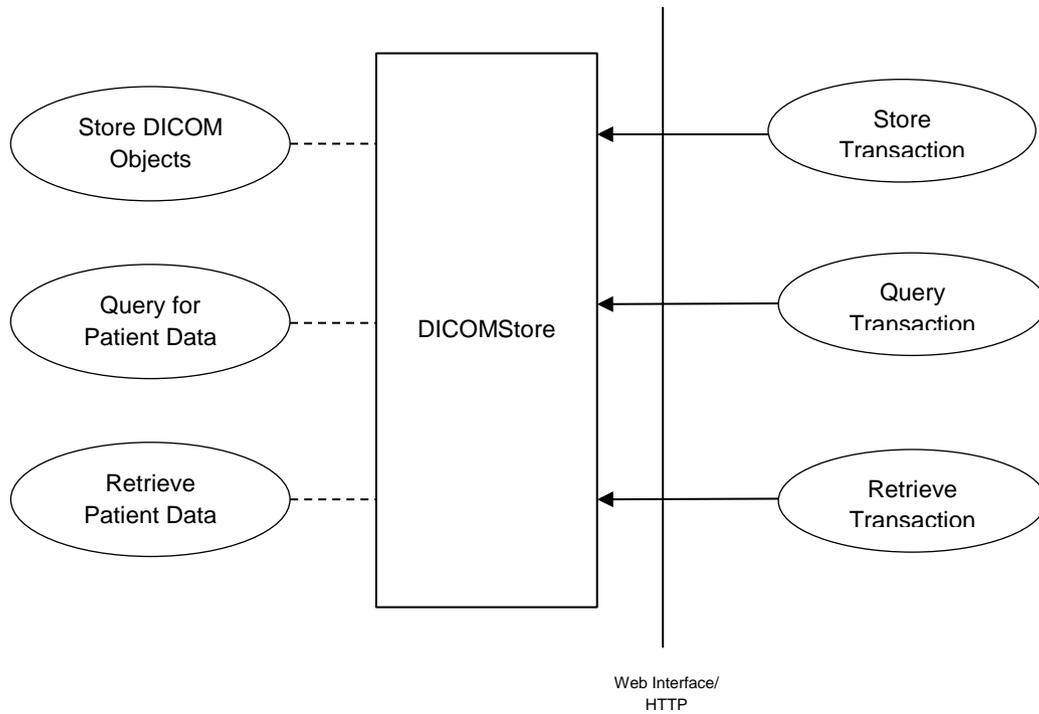


Figure 2 Data Flow Diagram 1

Dicomstore 1.2 enables standards-based interoperability between enabled apps and devices with third-party systems via DICOMweb standard services for

- STORE - Store DICOM objects (STOW-RS)
- QUERY - Search for DICOM objects (QIDO-RS)
- RETRIEVE - Retrieve DICOM objects (WADO-RS)
- Study Root Query/Retrieve as SCU
- Image Import

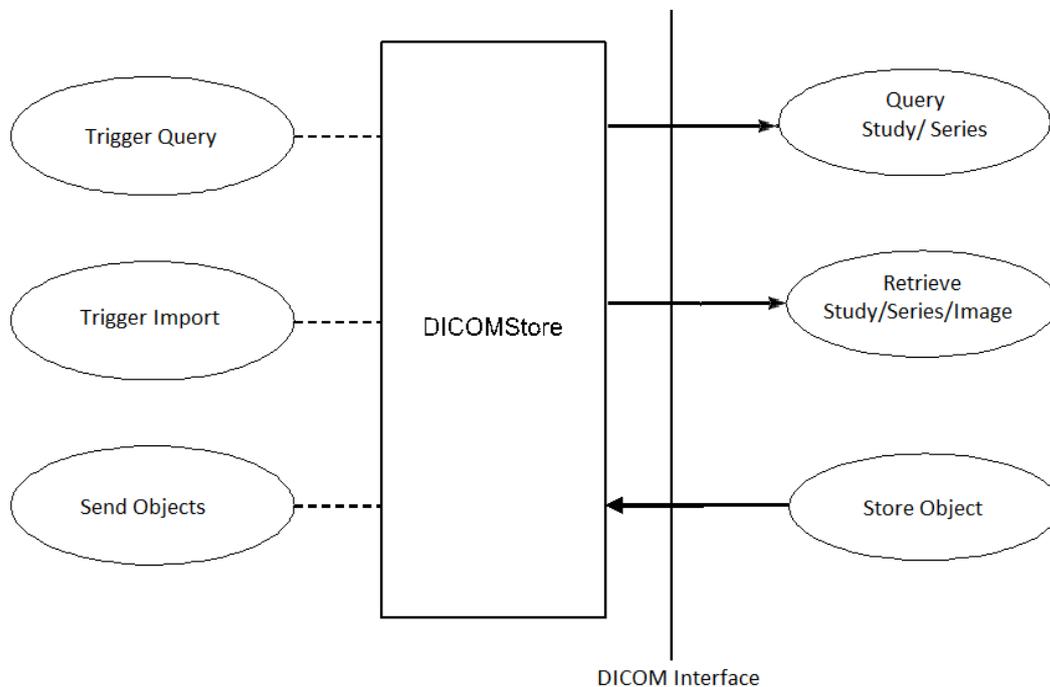


Figure 3 Data Flow Diagram 2

#### 4.2.1 Functional Definition of AE

#### 4.2.2 Functional Definition of DICOMStore Web AE

The Dicomstore AE implements the following DICOMweb Services

- Retrieve Transaction (WADO-RS)
- Store Transaction (STOW-RS)
- Search Transaction (QIDO-RS)

#### 4.2.3 Functional Definition of Dicomstore AE

Dicomstore AE implements the following network transaction to achieve the Import workflow.

- Study Root Query/Retrieve as SCU
- Image Import

#### 4.2.4 Sequencing of Real World Activities

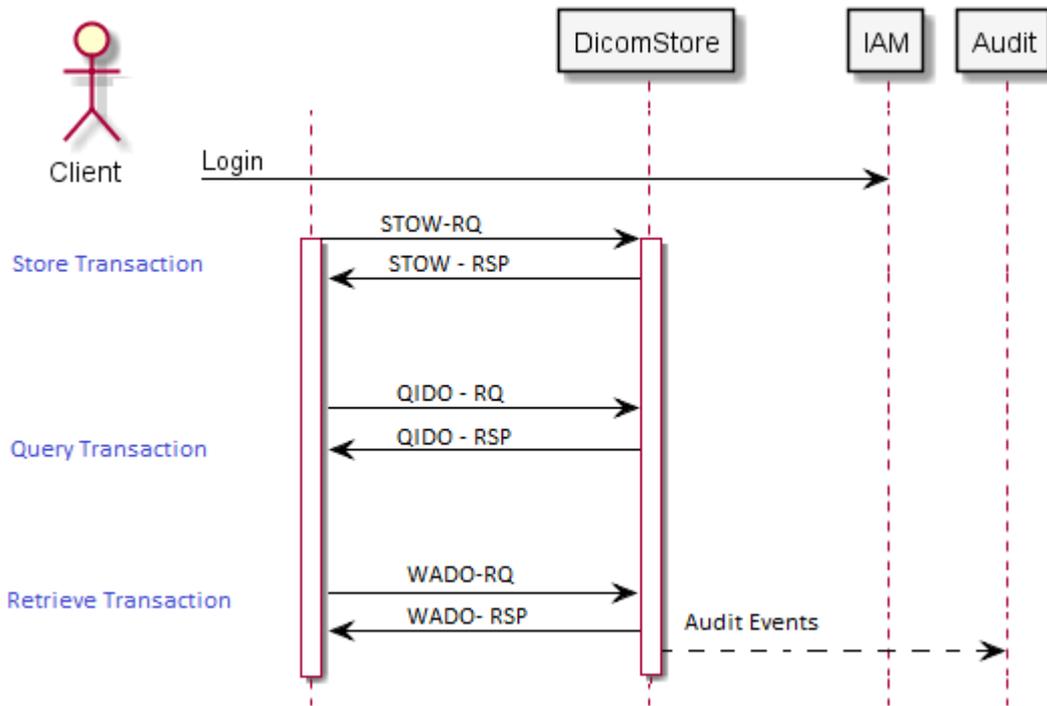


Figure 4 Sequencing of Real world activities

## 4.3 AE Specifications

The following table describes the common status code for all the transactions.

Table 5: Status Code Behaviour

Status	Code Status	Condition
Success	200 (Success)	Requested operation was processed without error.
Failure	401 (Unauthorized)	The OAuth access token used is not recognized.
	404 (Not found)	The target resource was not found
	406 (Not acceptable)	The Target Resource does not have a representation that would be acceptable to the user agent

### 4.3.1 HSDP Dicomstore Web AE

Detail of this specific Dicomstore is specified in this section.

The following services are described here

- DICOMweb Retrieve Transaction
- DICOMweb Store Transaction
- DICOMweb Query Transaction

### 4.3.1.1 Retrieve Transaction (WADO-RS) as Origin Server

#### 4.3.1.1.1 Supported Retrieve Transactions

The following Retrieve transaction types are supported:

- Retrieve metadata
- Retrieve pixel data
- Retrieve as Dicom Part 10
- Retrieve bulk data
- Retrieve at Study, Series or Instance levels
- Retrieve Frame

**Table 6: General Parameters**

Options	Restrictions
Data Types Supported (Accept Type)	Application/dicom Application/dicom+json
Transfer Syntaxes Supported (transfer-syntax Accept parameter)	See Table 14 & 15
SOP restrictions	See Table 13.
Query parameter 'limit' and 'offset'	none

#### 4.3.1.1.2 Status Code Behavior

**Table 7: Status Code Behaviour**

Service Status	HTTP Status Code	Condition
Failure	404 (Not Found)	The Target Resource does not exist
	400 (Bad Request)	The origin server cannot process the request because of errors in the request headers or parameters.

### 4.3.1.2 Search Transaction (QIDO-RS) as Origin Server

#### 4.3.1.2.1 Supported Search Transactions

The following Search transaction types are supported:

- Search for all Studies
- Search for all Series
- Search for all Series belonging to a Study
- Search for all Instances belonging to a particular Series and Study

**Table 8: General Parameters**

Options	Restrictions
Data Types Supported (Accept Type)	Application/dicom+json

#### 4.3.1.2.2 Supported Search keys

The following table lists the matching and return keys are supported at the Study level.

**Table 9: Supported Matching and Return keys for Study Level**

Attributes Name	Tag	Matching	Return	Type of Matching	Comments
Study Date	(0008,0020)	X	X	Single value, Range	
Study Time	(0008,0030)	-	X	-	
Accession Number	(0008,0050)	X	X	Single value	
Patient Name	(0010,0010)	X	X	Wildcard	
Patient ID	(0010,0020)	X	X	Single value	
Study ID	(0020,0010)	X	X	Single value	
Study Instance UID	(0020,000D)	X	X	Single value	
Modalities in Study	(0008,0061)	X	X	Single value	
Patient's Birth Date	(0010,0030)	-	X	-	
Patient's Sex	(0010,0040)	-	X	-	
Number of Study Related Series	(0020,1206)	-	X	-	
Number of Study Related Instances	(0020,1208)	-	X	-	

The following table lists the matching and return keys shall be supported at the Series level.

**Table 10: Supported Matching and Return keys for Series Level**

Attributes Name	Tag	Matching	Return	Type of Matching	Comments
Modality	(0008,0060)	X	X	Single value	
Series Number	(0020,0011)	X	X	Single value	
Series Instance UID	(0020,000E)	X	X	Single value	
Number of Series Related Instances	(0020,1209)	-	X	-	
Series Description	(0008,103E)	-	X	-	
Request Attribute Sequence		-	X	-	
Requested Procedure ID	(0040,1001)	X	X	Single value	

The following table lists the matching and return keys shall be supported at the Instance level.

**Table 11: Supported Matching and Return keys for Instance Level**

Attributes Name	Tag	Matching	Return	Type of Matching	Comments
SOP Class UID	(0008,0016)	X	X	Single value	
SOP Instance UID	(0008,0018)	X	X	Single value	
Instance Number	(0020,0013)	X	X	Single value	

### 4.3.1.2.3 Status Code Behavior

Table 12: Status Code Behaviour

Service Status	HTTP Status Code	Condition
Success	204 (No Content)	The search completed successfully, but there were zero results.
Failure	500 (Internal Server error)	The server cannot process the request because of an internal error.

### 4.3.1.3 Store Transaction (STOW-RS) as Origin Server

#### 4.3.1.3.1 Supported Store Transactions

The following Study transaction are supported:

- Store Part 10 Objects

Table 13: General Parameters

Options	Restrictions
Data Types Supported (Content Type)	application/dicom
Accept Type Supported	application/dicom+json

#### 4.3.1.3.2 Supported DICOM Objects for Store Transaction

Table 14: Supported SOP class

SOP Class Name	SOP class UID
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
Radiation Therapy Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
Keratometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.3
Ophthalmic Axial Measurements Storage	1.2.840.10008.5.1.4.1.1.78.7
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4

SOP Class Name	SOP class UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Digital X-Ray – For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital Mammography X-Ray – For Presentation	1.2.840.10008.5.1.4.1.1.1.2
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11
X-Ray Radiation Dose SR Storage	1.2.840.10008.5.1.4.1.1.88.67
Intraocular Lens Calculations Storage	1.2.840.10008.5.1.4.1.1.78.8

Table 15: Supported Transfer Syntaxes

Transfer Syntax Name	Transfer Syntax UID
Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99
JPEG Extended (Process 2 & 4): Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)	1.2.840.10008.1.2.4.51
JPEG Extended (Process 3 & 5) (Retired)	1.2.840.10008.1.2.4.52
JPEG Spectral Selection, Non-Hierarchical (Process 6 & 8) (Retired)	1.2.840.10008.1.2.4.53
JPEG Spectral Selection, Non-Hierarchical (Process 7 & 9) (Retired)	1.2.840.10008.1.2.4.54
JPEG Full Progression, Non-Hierarchical (Process 10 & 12) (Retired)	1.2.840.10008.1.2.4.55
JPEG Full Progression, Non-Hierarchical (Process 11 & 13) (Retired)	1.2.840.10008.1.2.4.56
JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57
JPEG Lossless, Non-Hierarchical (Process 15) (Retired)	1.2.840.10008.1.2.4.58
JPEG Extended, Hierarchical (Process 16 & 18) (Retired)	1.2.840.10008.1.2.4.59
JPEG Extended, Hierarchical (Process 17 & 19) (Retired)	1.2.840.10008.1.2.4.60
JPEG Spectral Selection, Hierarchical (Process 20 & 22) (Retired)	1.2.840.10008.1.2.4.61
JPEG Spectral Selection, Hierarchical (Process 21 & 23) (Retired)	1.2.840.10008.1.2.4.62
JPEG Full Progression, Hierarchical (Process 24 & 26) (Retired)	1.2.840.10008.1.2.4.63
JPEG Full Progression, Hierarchical (Process 25 & 27) (Retired)	1.2.840.10008.1.2.4.64
JPEG Lossless, Hierarchical (Process 28) (Retired)	1.2.840.10008.1.2.4.65
JPEG Lossless, Hierarchical (Process 29) (Retired)	1.2.840.10008.1.2.4.66
JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70
JPEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80
JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81
JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90
JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91
JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)	1.2.840.10008.1.2.4.92
JPEG 2000 Part 2 Multi-component Image Compression	1.2.840.10008.1.2.4.93
JPIP Referenced	1.2.840.10008.1.2.4.94

Transfer Syntax Name	Transfer Syntax UID
JPIP Referenced Deflate	1.2.840.10008.1.2.4.95
MPEG2 Main Profile / Main Level	1.2.840.10008.1.2.4.100
MPEG2 Main Profile / High Level	1.2.840.10008.1.2.4.101
MPEG-4 AVC/H.264 High Profile / Level 4.1	1.2.840.10008.1.2.4.102
MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1	1.2.840.10008.1.2.4.103
MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	1.2.840.10008.1.2.4.104
MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video	1.2.840.10008.1.2.4.105
MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	1.2.840.10008.1.2.4.106
HEVC/H.265 Main Profile / Level 5.1	1.2.840.10008.1.2.4.107
HEVC/H.265 Main 10 Profile / Level 5.1	1.2.840.10008.1.2.4.108

Note that conversion between transfer syntaxes is only supported for the transfer syntaxes mentioned in table 16.

**Table 16: Transfer Syntaxes supported for conversion**

Transfer Syntax Name	Transfer Syntax UID
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 (Retired)	1.2.840.10008.1.2.2
JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	1.2.840.10008.1.2.4.50
RLE Lossless	1.2.840.10008.1.2.5

#### 4.3.1.3.3 Status Code Behavior

**Table 17: Status Code Behaviour**

Service Status	HTTP Status Code	Condition
Failure	409 (Conflict)	Study Instance UID mismatch

## 4.3.2 HSDP Dicomstore AE

### 4.3.2.1 Association Policies

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

#### 4.3.2.1.1 General

The DICOM standard application context is specified below.

**Table 18: DICOM Application Context**

Description	Value
Application Context Name	1.2.840.10008.3.1.1.1

#### 4.3.2.1.2 Number of Associations

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

**Table 19: Number of associations as an Association Initiator for this AE**

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

**Table 20: Number of associations as an Association Acceptor for this AE**

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

#### 4.3.2.1.3 Asynchronous Nature

The Dicomstore supports asynchronous operations for storage commitment as SCU and will perform asynchronous window negotiation.

**Table 21: Asynchronous nature as an Association Initiator for this AE**

Description	Value
Maximum number of outstanding asynchronous transactions	1

#### 4.3.2.1.4 Implementation Identifying Information

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

#### 4.3.2.1.5 Communication Failure Handling

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

**Table 22: Communication Failure Behavior**

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

#### 4.3.2.2 Association Initiation Policy

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

**Table 23: Association Rejection response**

Result	Source	Reason/Diagnosis	Behavior
1 - rejected-permanent	1 - DICOM UL service-user	1 - no-reason-given	Association is not established. The following error is logged. Association rejected by peer 1: REJECT_RESULT_permanent, 1: REJECT_SOURCE_dul_user, 1: REJECT_REASON_no_reason_given

Result	Source	Reason/Diagnosis	Behavior
		2 - application-context-name-not-supported	Association is not established. The following error is logged. Association rejected by peer 1: REJECT_RESULT_permanent, 1: REJECT_SOURCE_dul_user, 2: REJECT_REASON_application_context_not_support
		3 - calling-AE-title-not-recognized	Association is not established. The following error is logged. Association rejected by peer 1: REJECT_RESULT_permanent, 1: REJECT_SOURCE_dul_user, 3: REJECT_REASON_calling_aetitle_not_recognized
		7 - called-AE-title-not-recognized	Association is not established. The following error is logged. Association rejected by peer 1: REJECT_RESULT_permanent, 1: REJECT_SOURCE_dul_user, 7: REJECT_REASON_called_aetitle_not_recognized
	2 - DICOM UL service-provide (ACSE related function)	1 - no-reason-given	Association is not established. The following error is logged. Error: UserRecoverable: impl.dicom.access.PEER: Associationrejected by peer 1: REJECT_RESULT_permanent, 2: REJECT_SOURCE_dul_provider (acse), 1: REJECT_REASON_no_reason_given
		2 - protocol-version-not-supported	Association is not established. The following error is logged. Association rejected by peer 1: REJECT_RESULT_permanent, 2: REJECT_SOURCE_dul_provider (acse), 2: REJECT_REASON_application_context_not_support
	3 - DICOM UL service-provider (Presentation related function)	1 - temporary-congestion	Association is not established. The following error is logged. Association rejected by peer 1: REJECT_RESULT_permanent, 3: REJECT_SOURCE_dul_provider (presentation), 1: REJECT_REASON_no_reason_given)
		2 - local-limit-exceeded	Association is not established. The following error is logged. Association rejected by peer 1: REJECT_RESULT_permanent, 3: REJECT_SOURCE_dul_provider (presentation), 2: REJECT_REASON_application_context_not_support
2 - rejected-transient	1 - DICOM UL service-user	1 - no-reason-given	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 1: REJECT_SOURCE_dul_user, 1: REJECT_REASON_no_reason_given
		2 - application-context-name-not-supported	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 1: REJECT_SOURCE_dul_user, 2: REJECT_REASON_application_context_not_support

Result	Source	Reason/Diagnosis	Behavior
		3 - calling-AE-title-not-recognized	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 1: REJECT_SOURCE_dul_user, 3: REJECT_REASON_calling_aetitle_not_recognized
		7 - called-AE-title-not-recognized	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 1: REJECT_SOURCE_dul_user, 7: REJECT_REASON_called_aetitle_not_recognized
	2 - DICOM UL service-provider (ACSE related function)	1 - no-reason-given	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 2: REJECT_SOURCE_dul_provider (acse), 1: REJECT_REASON_no_reason_given
		2 - protocol-version-not-supported	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 2: REJECT_SOURCE_dul_provider (acse), 2: REJECT_REASON_application_context_not_support
	3 - DICOM UL service-provider (Presentation related function)	1 - temporary-congestion	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 3: REJECT_SOURCE_dul_provider (presentation), 1: REJECT_REASON_no_reason_given
		2 - local-limit-exceeded	Association is not established. The following error is logged. Association rejected by peer 2: REJECT_RESULT_transient, 3: REJECT_SOURCE_dul_provider (presentation), 2: REJECT_REASON_application_context_not_support

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

**Table 24: Association Abort Handling**

Source	Reason/Diagnosis	Behavior when received	Sent when
0 - DICOM UL service-user (initiated abort)	0- reason-not-specified	When received, the DICOMStore terminates the connection with the following log: Association ABORTED by peer 0: ABORT_SOURCE_dul_user, 0: ABORT_REASON_not_specified	<ul style="list-style-type: none"> <li>N-EVENT-REPORT for printing received with status FAILURE.</li> <li>Abort is issued to an executing job that utilizes this network connection (ExportNetwork/ArchiveNetwork/DICOMCopy/DICOMMove)</li> <li>Any other problem than ones specified for HSDP Clinical Platform (CPF) SCU in the rows below. (Examples: Problem while decoding the DICOM stream, SCU was unable to send the Response to SCP, Error writing to SCU stream).</li> </ul>

Source	Reason/Diagnosis	Behavior when received	Sent when
2 - DICOM UL service-provider (initiated abort)	0 - reason-not-specified	When received, the HSDP Clinical Platform (CPF) terminates the connection with the following log: Association ABORTED by peer 2: ABORT_SOURCE_dul_provider, 0: ABORT_REASON_not_specified	<ul style="list-style-type: none"> <li>• There are problems in SCU/SCP role negotiation.</li> <li>• Any other problem than ones specified for HSDP Clinical Platform (CPF) SCU in the rows below. (Example: Problem while decoding the DICOM stream).</li> </ul>
	1 - unrecognized-PDU	When received, the HSDP Clinical Platform (CPF) 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 <sup>4</sup> .
	2 - unexpected-PDU	When received, The DICOMStore 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 connection <sup>5</sup> .
	4 - unrecognized-PDU-parameter	When received, The DICOMStore 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 <sup>1</sup> .
	5 - unexpected-PDU-parameter	When received, The DICOMStore terminates the connection with the following log: Association ABORTED by peer 2: ABORT_SOURCE_dul_provider, 5: ABORT_REASON_unexpected_pdu_parameter.	<ul style="list-style-type: none"> <li>• One of the Associate PDU items is received more than once<sup>2</sup>.</li> <li>• One of the Associate PDU items is received unexpectedly<sup>2</sup>.</li> </ul>
	6 - invalid-PDU-parameter-value	When received, The DICOMStore terminates the connection with the following log: Association ABORTED by peer 2: ABORT_SOURCE_dul_provider, 6: ABORT_REASON_invalid_pdu_parameter.	<ul style="list-style-type: none"> <li>• One of the Associate PDU items is received more than once<sup>3</sup>.</li> <li>• One of the Associate PDU items is not received<sup>3</sup>.</li> <li>• There is mismatch in the application context names between the SCU and the SCP.</li> <li>• Illegal Asynchronous Operations Window invoke value is received.</li> <li>• Illegal Asynchronous Operations Window perform value is received.</li> <li>• Unknown presentation context id is received.</li> <li>• Unknown abstract syntax is received.</li> <li>• The length or the format of a received PDU item is invalid.</li> </ul>

**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 25: DICOM Command Communication Failure Behavior**

Exception	Behavior
Reply Time-out	The association is aborted using A-ABORT and command marked as failed. The reason is logged and reported to the user.

#### 4.3.2.2.1 (Real-World) Activity – FIND as SCU

##### 4.3.2.2.1.1 Description and Sequencing of Activities

HSDP Clinical Platform (CPF) sends associations to systems to query the remote database using the C-FIND command.

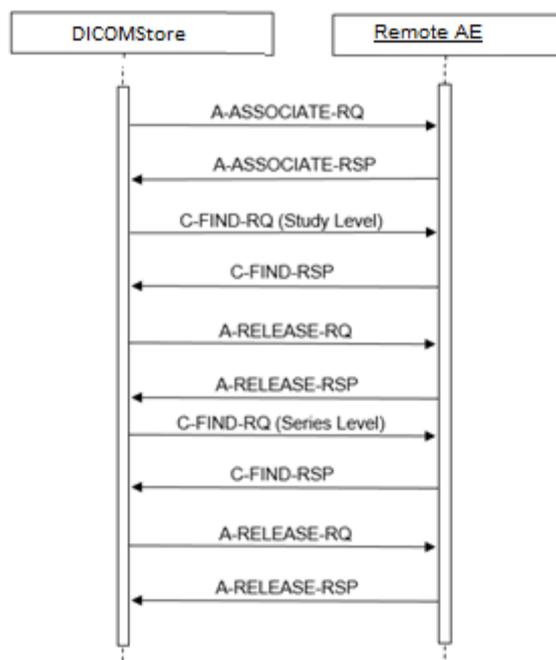


Figure 7: Data Flow Diagram – FIND as SCU

4.3.2.2.1.2 Proposed Presentation Contexts

The presentation contexts are defined in the next table.

Table 26: Proposed Presentation Contexts for (Real-World) Activity – FIND As SCU

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
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		

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

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

Dicomstore supports the following Query keys. Image Level is not supported.

**Table 27: Supported Query Keys for Study Root Information Model**

Study Root QR Information Model - FIND SOP Class				
Attribute Name	Tag	VR	Type of Matching	Comment
<b>Study level keys</b>				
Query/Retrieve Level	0008,0052	CS	NA	
Study Date	0008,0020	DA	Universal	
Study Time	0008,0030	TM	Universal	
Accession Number	0008,0050	SH	Universal	
Modalities in Study	0008,0061	CS	Universal	
Referring Physician Name	0008,0090	PN	Universal	
Patient's Name	0010,0010	PN	Universal	
Patient ID	0010,0020	LO	Universal	
Study Instance UID	0020,000D	UI	UNIQUE	
Study ID	0020,0010	SH	Universal	
<b>Series level keys</b>				
Modality	0008,0060	CS	Universal	
Series Instance UID	0020,000E	UI	UNIQUE	
Series Number	0020,0011	IS	Universal	
Scheduled Procedure Step ID	0040,0009	SH	Universal	
Performed Procedure Step Start Date	0040,0244	DA	Universal	
Performed Procedure Step Start Time	0040,0245	TM	Universal	
Request Attributes Sequence	0040,0275	SQ	Universal	

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

**Table 28: Status Response**

Service Status	Error Code	Further Meaning	Behavior*
Success	0000	Matching is complete – No final identifier is supplied	Status is logged
Failure	A700	Refused – Out of resources	Status is logged
	C000	Failed – Unable to process	Status is logged
Pending	FF00	Matches are continuing – Current match is supplied and any optional keys were supported in the same manner as required keys	Status is logged
	FF01	Matches are continuing – Warning that one or more optional keys were not supported for existence and/or matching for this identifier	Status is logged

#### 4.3.2.2.2 (Real-World) Activity – MOVE as SCU

##### 4.3.2.2.2.1 Description and Sequencing of Activities

Dicomstore accepts associations from systems that wish to retrieve images using the C-MOVE command.

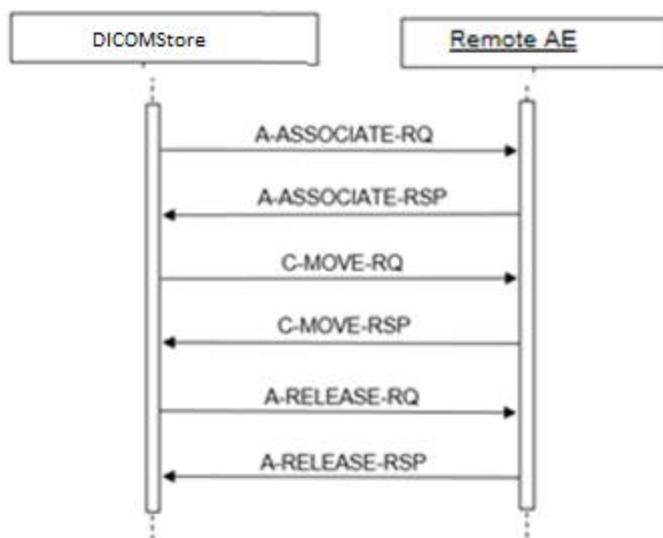


Figure 8: Data Flow Diagram – MOVE as SCU

#### 4.3.2.2.2 Proposed Presentation Contexts

The presentation contexts are defined in the next table.

Table 29: Proposed Presentation Contexts for (Real-World) Activity – MOVE As SCU

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

Table 30: Status Response

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Sub-operations complete – No failures	Status is logged
Failure	A701	Refused – Out of resources - Unable to calculate number of matches	Status is logged
	C000	Failed – Unable to process	Status is logged
Warning	B000	Sub-operations complete – One or more failures	Status is logged
Cancel	FE00	Sub-operations terminated due to Cancel indication	Status is logged
Pending	FF00	Sub-operations are continuing	Status is logged

### 4.3.2.3 (Real-World) Activity – Image Import

#### 4.3.2.3.1 Description and Sequencing of Activities

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

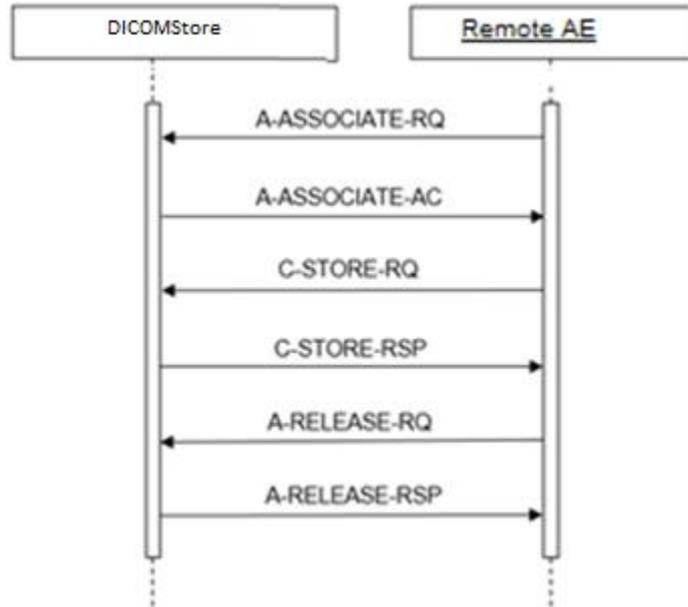


Figure 14: Data Flow Diagram – Store Image – Storage as SCP.

#### 4.3.2.3.2 Accepted Presentation Contexts

The presentation contexts are defined in the next table.

**Table 31: Acceptable Presentation Contexts for (Real-World) Activity – Image Import**

In Table 31 where no transfer syntax is listed all transfer syntax listed in table 15 are supported.

The Dicomstore 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 Dicomstore 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.

#### 4.3.2.3.3 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 their corresponding behavior.

The Dicomstore will only accept associations from configured systems. The Dicomstore 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 Dicomstore and received per implicit transfer (ILE).

#### 4.3.2.3.3.1 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 32: Status Response**

Service Status	Error Code	Further Meaning	Behavior
Success	0000	Successful command	Successful completion of the store request.
Failure	A700	Refused: out of resources	Not enough resources available to do a store.
	C000	Error: cannot understand	Any other exception generated during the store.

## 4.4 Network Interfaces

### 4.4.1.1 Physical Network Interfaces

Dicom store support the physical medium as provided by the HSDP Hosting infrastructure

### 4.4.1.2 Additional Protocols

#### 4.4.1.2.1 Basic TLS Secure Transport Connection Profile

HSDP infrastructure on the cloud manages this for all hosted services

#### 4.4.1.2.2 Basic Time Synchronization Profile

Time Synchronization is managed by HSDP Hosting infrastructure

#### 4.4.1.2.3 Basic Application Level Confidentiality Profile

Not supported

**4.4.1.2.4 IPv4 and IPv6 Support**

IPv4 and IPv6 Support managed by HSDP Hosting infrastructure

**4.4.1.3 Configuration**

Not Applicable.

## 5. Media Interchange

Not Supported

## 6. Support of Character Sets

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

**Table 33: Supported DICOM Character Sets**

Character Set Description	Defined Term	ESC Sequence	ISO Registration Number	Code Element	Character Set
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
Latin alphabet No. 3	ISO_IR 109	-	ISO-IR 109	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Latin alphabet No. 4	ISO_IR 110	-	ISO-IR 110	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Cyrillic	ISO_IR 144	-	ISO-IR 144	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Arabic	ISO_IR 127	-	ISO-IR 127	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Greek	ISO_IR 126	-	ISO-IR 126	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Hebrew	ISO_IR 138	-	ISO-IR 138	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Latin alphabet No. 5	ISO_IR 148	-	ISO-IR 148	G1	Supplementary set of ISO 8859
		-	ISO-IR 6	G0	ISO 646
Japanese	ISO_IR 13	-	ISO-IR 13	G1	JIS X 0201: Katakana
		-	ISO-IR 14	G0	JIS X 0201: Romaji
Thai	ISO_IR 166	-	ISO-IR 166	G1	TIS 620-2533 (1990)
		-	ISO-IR 6	G0	ISO 646
Korean	ISO 2022 IR 149	ESC 02/04 02/09 04/03	ISO-IR 149	G1	KS X 1001: Hangul and Hanja
Japanese	ISO 2022 IR 159	ESC 02/04 02/08 04/04	ISO-IR 159	G0	JIS X 0212: Supplementary Kanji set
Japanese	ISO 2022 IR 87	ESC 02/04 04/02	ISO-IR 87	G0	JIS X 0208: Kanji

## 7. Security

### 7.1 Security Profiles

#### 7.1.1 Security use Profiles

The DICOM Store APIs and underlying platform service components support:

- DICOM Store APIs requests are only allowed from secure HTTPS channels. HTTP requests from clients are rejected.

#### 7.1.2 Security Transport Connection Profiles

The DICOM Store APIs are protected using the OAuth2 access mechanism, and OAuth2 access tokens are required for invoking any DICOM Store API. Dicom Store uses IAM as provided on HSDP Cloud Foundry to authenticate & authorize the users accessing the Dicom Services.

The DICOM Store APIs are only allowed over secure HTTPS channels.

Data access security is achieved by using S3 Credentials service as provided by HSDP Cloud Foundry.

#### 7.1.3 Digital Signature Profiles

Not supported by Dicom Store.

#### 7.1.4 Media Storage Security Profiles

Not supported by Dicom Store

#### 7.1.5 Attribute Confidentiality Profiles

Not supported by Dicom Store, Dicom Store stores and retrieves the Dicom content as is.

#### 7.1.6 Network Address Management Profiles

Network Address is managed by the Cloud Foundry or IaaS on which Dicom Store is hosted.

#### 7.1.7 Time Synchronization Profiles

Time Synchronization is managed by HSDP Hosting infrastructure

#### 7.1.8 Application Configuration Management Profiles

Dicom Configuration API's are provided to configure Dicom Services. POST and GET methods are allowed to update and retrieve the Configuration resources.

#### 7.1.9 Audit Trail Profiles

The following Audit events are generated:

Audit Event	Trigger	Comments
Patient Record	When Patient data is accessed	-
DICOM Instance Accessed	When DICOM objects are accessed i.e. WADO	-
Query	When DICOM data is queried on the Dicomstore i.e. QIDO	-
Data Import	When data is imported to the Dicomstore	-
Delete	When DICOM data is deleted on Dicomstore	-
Security Alert	When there is an attempt for unauthorized access	-

## 7.2 Association Level Security

Not supported.

## 7.3 Application Level Security

### 7.3.1 Authorization

The DICOM Store integrates Authorize – IAM capabilities to provide Organization-Based Access Control (OBAC), in which access to the DICOM Study is protected by a set of access control permissions that allow access based on the role of the logged-in user. Further, the user is also required to have access to the necessary resources such as Patient, Imaging Study in the Clinical Data Repository.

### 7.3.2 Authentication

The Dicom Store APIs are protected using the OAuth2 access mechanism, and OAuth2 access tokens are required for invoking any Dicom Store API. The authentication flow is as given below:

- The application must first authenticate using the supported grant types through the IAM's OAuth2 API.
- The application must extract the access token from the OAuth2 token response and invoke the Dicom Store API with the access token in the Authorization header as "Authorization: Bearer <access token>"
- The supplied access token is validated for each Dicom Store API using IAM's Introspect API.
- If the access token is expired, the API call is rejected with HTTP Status code 401 Unauthorized. The application may choose to refresh the token through the OAuth2 flow and resubmit the request.