S517-E133C

DICOM Conformance Statement
for AI-Station
（Ver. 1.0.0 or later）

SHIMADZU

Revision History

Rev.	Date	Contents
-	2022/03	Newly created
A	2022/05	Add description of Query/Retrieve. Fix descriptions of Conformance for Secondary Capture Image Storage SOP Class. Add Extended Secondary Capture Object.
B	2023/04	Fix descriptions of 3.2.1.2.1 General Series IOD Module.
C	2024/08	Fix the application entity specification. Fix the client operation of Query/Retrieve SOP

Table of contents

1 Introduction

1.1 Purpose of this document

This document declares the conformance of AI-Station to the DICOM standard. This document only covers the DICOM functionality of components that consist of application entities. This DICOM standard compliance condition applies to the DICOM SCU function and deals with the send/receive structure and method of sending/receiving image information to DICOM 3.0 compatible devices.

1.2 Related document

ACR-NEMA Digital Imaging and Communications in Medicine, DICOM 3.0

1.3 ABBREVIATIONS

DICOM：	Digital Imaging and Communications in Medicine
NEMA：	National Electrical Manufacturing Association
AE：	Application Entity
SCP：	Service Class Provider
SCU：	Service Class User
TCP/IP：	Transmission Control Protocol/Internet Protocol
IPv4：	Internet Protocol version 4
IPv6：	Internet Protocol version 6
UID：	Unique Identifier

2 Implementation Model

AI-station has the following functions via Ethernet connected to an external DICOM server.

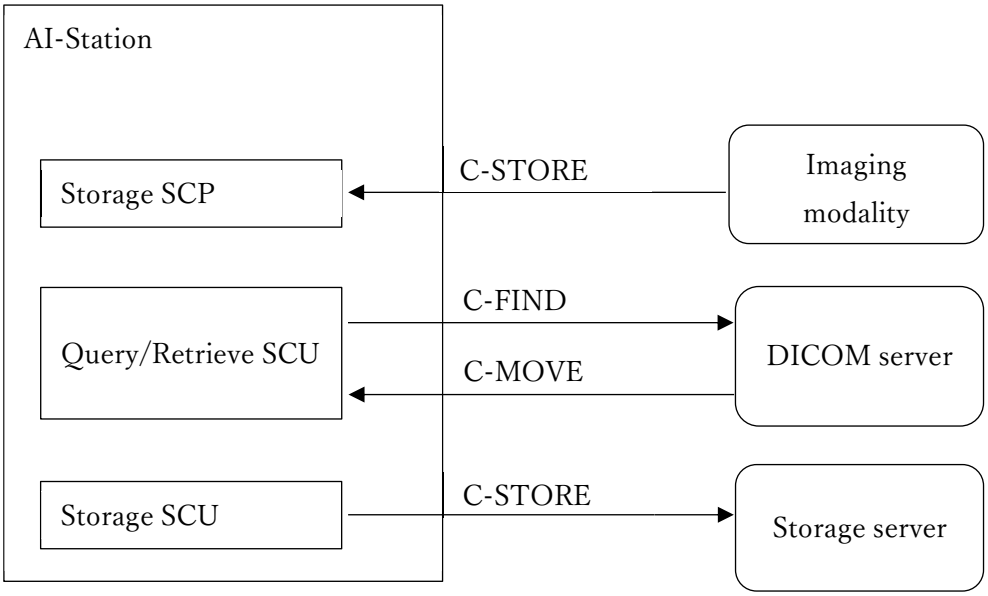
- Receive images from the imaging modality.
- Query/Retrieve from DICOM server.
- Transfer secondary capture images using storage service class.

2.1 Application Data Flow

When AI-Station is started, it starts the storage SCP service, which serves as an image server in the background. It waits for an association from the imaging modality to receive images, and the association will be terminated when the images are received, or an error occurs.

AI-Station starts up the association for Query/Retrieve SCU service to the Query/Retrieve SCP (DICOM server) by user operation.

AI-Station performs image processing using the images received from the imaging modality or retrieved from DICOM server and records the results in the secondary capture image format. The processed image will be sent to the destination storage server by user operation.



DICOM Interface

2.2 AE's Functional Description

The AE is assumed to use the TCP/IP protocol stack and the DICOM transport protocol to create an SCU instance and accept it with SCP in order to send and receive information to a server on the network.

2.3 Sequencing of Real-World Activity

Not applicable.

2.4 Application Entity Specification

AI-Station's application entities provide standard compliance requirements as SCU and SCP for the following SOP Classes.

2.4.1 SOP Class as an SCP

SOP Class Name	SOP Class UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1

2.4.2 SOP Class as an SCU

SOP Class Name	SOP Class UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Study Root Query/Retrieve Information Model-FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model-MOVE	1.2.840.10008.5.1.4.1.2.2.2

3 Application Entity Specification

3.1 Method of establishing an association

3.1.1 Summary

The AI-Station can be configured with IP address, port number, AE title, and other information to negotiate with application entities.

3.1.2 Number of associations

AI-Station accepts only one association.

3.1.3 asynchronous

AI-Station does not support asynchronous process.

3.1.4 Implementation Identifying Information

Implementation class UID of AI-Station is [1.2.392.200036.9110.1.0.2021701].

Implementation version name is [AI-I***]. (“***” is version number)

3.1.5 Association Relationships through Real World Activities

An association is established by an establishment request to the Storage SCP or the Query/Retrieve SCP.

3.1.6 Presentation Contexts

AI-Station proposes only the following presentation contexts.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
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

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

3.2 Client Operation

3.2.1 Client Operation of Image Storage SOP

3.2.1.1 Related Real-world Operation

The Image storage service is started when the image transmission is executed by user operation. It establishes an association by sending the A-ASSOCIATE-RQ PDU and receiving the A-ASSOCIATE-AC PDU to the DICOM AE that supports SCP of the storage service class that has connection settings.

After sending the C-STORE-RQ message and the secondary capture image IOD Module by P-DATA-TF, if it receives the C-STORE-RSP message, it releases the association by sending the A-RELEASE-RQ PDU and receiving the A-RELEASE-RSP PDU and terminates the image storage service.

3.2.1.2 Conformance for Secondary Capture Image Storage SOP Class

The IOD module used in the Secondary capture image storage AE complies with the SCU of the standard DICOM storage SOP class of the secondary capture image IOD.

The following is a list of information modules that compose the secondary capture image IOD.

IE	Module	Usage
Patient	Patient	M
Study	General Study	M
	Patient Study	U
Series	General Series	M
Equipment	General Equipment	U
	SC Equipment	M
Image	General Image	M
	Image Pixel	M
	Overlay Plane	U
	Modality LUT	U
	VOI LUT	U
	SOP Common	M

3.2.1.2.1 Patient IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,1120)	Referenced Patient Sequence	SQ	3	（Not used）
(0010,0010)	Patient's Name	PN	2	Inherit from imaging modality
(0010,0020)	Patient ID	LO	2	Inherit from imaging modality
(0010,0030)	Patient's Birth Date	DA	2	Inherit from imaging modality
(0010,0032)	Patient's Birth Time	TM	3	（Not used）
(0010,0040)	Patient's Sex	CS	2	Inherit from imaging modality
(0010,1000)	Other Patient IDs	LO	3	（Not used）
(0010,1001)	Other Patient Names	PN	3	（Not used）
(0010,2160)	Ethnic Group	SH	3	（Not used）
(0010,4000)	Patient Comments	LT	3	Inherit from imaging modality

*"Inherit from imaging modality" means that the image information of the imaging modality used for processing is inherited and registered without any processing.

3.2.1.2.2 General Study IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,0020)	Study Date	DA	2	Inherit from imaging modality
(0008,0030)	Study Time	TM	2	Inherit from imaging modality
(0008,0050)	Accession Number	SH	2	Inherit from imaging modality
(0008,0090)	Referring Physician's Name	PN	2	Inherit from imaging modality
(0008,1030)	Study Description	LO	3	（Not used）
(0008,1060)	Name of Physician(s) Reading Study	PN	3	（Not used）
(0008,1110)	Referenced Study Sequence	SQ	3	（Not used）
(0020,000D)	Study Instance UID	UI	1	Inherit from imaging modality
(0020,0010)	Study ID	SH	2	Inherit from imaging modality

3.2.1.2.3 Patient Study IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,1080)	Admitting Diagnoses Description	LO	3	（Not used）
(0010,1010)	Patient's Age	AS	3	（Not used）
(0010,1020)	Patient's Size	DS	3	（Not used）
(0010,1030)	Patient's Weight	DS	3	（Not used）
(0010,2180)	Occupation	SH	3	（Not used）
(0010,21B0)	Additional Patient History	LT	3	（Not used）

3.2.1.2.4 General Series IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,0021)	Series Date	DA	3	（Not used）
(0008,0031)	Series Time	TM	3	（Not used）
(0008,0060)	Modality	CS	1	“SC”
(0008,103E)	Series Description	LO	3	（Not used）
(0008,1050)	Performing Physician’s Name	PN	3	（Not used）
(0008,1070)	Operators’ Name	PN	3	（Not used）
(0008,1111)	Referenced Performed Procedure Step Sequence	SQ	3	（Not used）
(0018,0015)	Body Part Examined	CS	3	（Not used）
(0018,1030)	Protocol Name	LO	3	（Not used）
(0018,5100)	Patient Position	CS	2C	（Not applicable）
(0020,000E)	Series Instance UID	UI	1	Depends on system configuration setting. Inherit from imaging modality or “1.2.392.200036.9110.～”
(0020,0011)	Series Number	IS	2	This value is created by incrementing the series number of the imaging modality. Default value to be incremented is set to 0.
(0028,0108)	Smallest Pixel Value in Series	US	3	（Not used）
(0020,0109)	Largest Pixel Value in Series	US	3	（Not used）

3.2.1.2.5 General Equipment IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,0070)	Manufacturer	LO	2	“Shimadzu Corp.”
(0008,0080)	Institution Name	LO	3	(Not used)
(0008,0081)	Institution Address	SH	3	(Not used)
(0008,1010)	Station Name	SH	3	(Not used)
(0008,1040)	Institutional Department Name	LO	3	(Not used)
(0008,1090)	Manufacturer’s Model Name	LO	3	“AI-Station”
(0018,1000)	Device Serial Number	LO	3	AI-Station’s S/N
(0018,1020)	Software Version(s)	LO	3	AI Station’s version
(0018,1050)	Spatial Resolution	DS	3	（Not used）
(0018,1200)	Date of Last Calibration	DA	3	（Not used）
(0018,1201)	Time of Last Calibration	TM	3	（Not used）
(0028,0120)	Pixel Padding Value	US	3	（Not used）

3.2.1.2.6 SC Equipment IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,0060)	Modality	CS	3	“SC”
(0008,0064)	Conversion Type	CS	1	“WSD”
(0018,1010)	Secondary Capture Device ID	LO	3	（Not used）
(0018,1016)	Secondary Capture Device Manufacturer	LO	3	（Not used）
(0018,1018)	Secondary Capture Device Manufacturer’s Model Name	LO	3	（Not used）
(0018,1019)	Secondary Capture Device Software Versions	LO	3	（Not used）
(0018,1022)	Video Image Format Acquired	SH	3	（Not used）
(0018,1023)	Digital Image Format Acquired	LO	3	（Not used）

3.2.1.2.7 General Image IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,0008)	Image Type	CS	3	“DERIVED¥SECONDARY”
(0008,0022)	Acquisition Date	DA	3	（Not used）
(0008,0023)	Content Date	DA	2C	Date when the image was generated by AI-Station
(0008,0032)	Acquisition Time	TM	3	（Not used）
(0008,0033)	Content Time	TM	3	Time when the image was generated by AI-Station
(0008,1140)	Referenced Image Sequence	SQ	3	Register the information of imaging modality. >(0008,1150) SOP class UID >(0008,1155) SOP Instance UID
(0028,2110)	Lossy Image Compression	CS	3	（Not used）
(0008,2111)	Derivation Description	ST	3	（Not used）
(0008,2112)	Source Image Sequence	SQ	3	（Not used）
(0020,0012)	Acquisition Number	IS	3	（Not used）
(0020,0013)	Instance Number	IS	2	This value is created by incrementing the instance number of the imaging modality. Default value to be incremented is set to “0”.
(0020,0020)	Patient Orientation	IS	2C	Inherit from imaging modality
(0020,1002)	Images in Acquisition	IS	3	（Not used）
(0020,4000)	Image Comments	LT	3	Depends on image processing method. Set the user-defined comments about the image by user operation,

3.2.1.2.8 Image Pixel IOD Module

Tag	Attribute Name	VR	Type	Description
(0028,0002)	Samples per Pixel	US	1	Depends on image processing method. “1” or “3”.
(0028,0004)	Photometric Interpretation	CS	1	Depends on image processing method. ”MONOCHROME2” or “RGB”
(0028,0006)	Planar Configuration	US	1C	Depends on image processing method. “0” or not applicable
(0028,0010)	Rows	US	1	Depends on image processing method. Inherit from imaging modality or set fixed value “1500”
(0028,0011)	Columns	US	1	Depends on image processing method. Inherit from imaging modality or set fixed value “1200”
(0028,0034)	Pixel Aspect Ratio	IS	1C	“1¥1”
(0028,0100)	Bits Allocated	US	1	Depends on image processing method. “16” or “8”.
(0028,0101)	Bits Stored	US	1	Depends on image processing method. “12” or “8”.
(0028,0102)	High Bit	US	1	Depends on image processing method. “11” or “7”.
(0028,0103)	Pixel Representation	US	1	“0”
(0028,0106)	Smallest Image Pixel Value	US	3	（Not used）
(0028,0107)	Largest Image Pixel Value	US	3	（Not used）
(7FE0,0010)	Pixel Data	OB	1	Image data

3.2.1.2.9 SC Image IOD module

Tag	Attribute Name	VR	Type	Description
(0018,1012)	Date of Secondary Capture	DA	3	（Not used）
(0018,1014)	Time of Secondary Capture	TM	3	（Not used）

3.2.1.2.10 SOP Common IOD Module

Tag	Attribute Name	VR	Type	Description
(0008,0005)	Specific Character Set	CS	1C	Inherit from imaging modality
(0008,0012)	Instance Creation Date	DA	3	（Not used）
(0008,0013)	Instance Creation Time	TM	3	（Not used）
(0008,0014)	Instance Creator UID	UI	3	（Not used）
(0008,0016)	SOP Class UID	UI	1	“1.2.840.10008.5.1.4.1.1.7”
(0008,0018)	SOP Instance UID	UI	1	“1.2.392.200036.9110.～”

3.2.1.2.11 Presentation State Identification Module

Tag	Attribute Name	VR	Type	Description
(0070,0084)	Content Creator’s Name	PN	2	Depends on image processing method. Set the user-defined name by user operation,

3.2.2 Client Operation of Query/Retrieve SOP

3.2.2.1 Related Real-world Operation

AI-Station will issue a FIND request when a user of AI-Station wishes to view patient and study information from a remote DICOM SCP (Query).

AI-Station will issue a MOVE request when a user of AI-Station wishes to move instances or images from a remote DICOM SCP back to AI-Station (Retrieve).

3.2.2.2 Conformance for Query/Retrieve Information Model – FIND

AI-Station uses hierarchical queries with study root level. AI-Station can also use relational queries by changing the settings. The following table shows specific keys using for queries.

Attribute Name	Tag	Type
STUDY LEVEL		
Study Date	(0008,0020)	R
Patient's Name	(0010,0010)	R
Patient ID	(0010,0020)	R
Patient's Birth Date	(0010,0030)	R
Patient Sex	(0010,0040)	R
SERIES LEVEL		
Modality	(0008,0060)	R

3.2.2.3 Conformance for Query/Retrieve Information Model – MOVE

The following table shows specific keys using for Move operation.

Attribute Name	Tag	Type
STUDY LEVEL		
Study Instance UID	(0020,000D)	U
SERIES LEVEL		
Series Instance UID	(0020,000E)	U
IMAGE LEVEL		
SOP Class UID	(0008,0016)	O
SOP Instance UID	(0008,0018)	U

3.3 Server operation

This service becomes standby mode after AI-Station is started.

3.3.1 Server Operation of Verification SOP

It establishes an association by sending an A-ASSOCIATE-RQ PDU and receiving an A-ASSOCIATE-AC PDU for the DICOM AE that supports SCP that has connection settings. Here, if it is judged that acceptance is impossible, the A-ASSOCIATE-RJ PDU is sent, and the association is released.

After receiving a C-ECHO-RQ message by the P-DATA TF, it sends a C-ECHO-RSP message. After that, it receives the A-RELEASE-RQ PDU and sends the A-RELEASE-RSP PDU to release the association and continue the waiting state.

The service of verification SOP permits the association regardless of the AE title of the sender.

3.3.2 Server Operation of Storage SOP

It establishes an association by receiving the A-ASSOCIATE-RQ PDU and sending the A-ASSOCIATE-AC PDU to the DICOM AE that supports the SCU of the storage service class that is set up the connection.

After receiving the C-STORE-RQ message and the image storage IOD Module by the P-DATA TF, it sends the C-STORE-RSP message. After that, the association is opened by receiving the A-RELEASE-RQ PDU and sending the A-RELEASE-RSP PDU.

4 Communication Profiles

4.1 Supported Protocol Stack

AI-Station provides DICOM V3.0 TCP/IP Network Protocol Stacks

4.2 TCP/IP Stack

AI-Station inherits TCP/IP stack from execution environment OS.

4.3 Physical Device Support

AI-Station inherits Physical Device Support from runtime environment OS.

4.4 IPv4 and IPv6 support

AI-Station supports IPv4 connection.

5 Extension/Specialization/Private SOP Classes

5.1 Extended Secondary Capture Object

AI-Station is making the following extensions to Secondary Capture SOP class:

Tag	Attribute Name	VR	Type	Remarks
(6B07,0010)	Private Creator	LO	-	Present in Vertebral Body Measurement Report images
(6B07,1001)	Result Data	LT	-	Present in Vertebral Body Measurement Report images
(6B07,1002)	Image Data	OW	-	Present in Vertebral Body Measurement Report images

6 Configuration

AI-Station can change following parameters.

6.1 DICOM Receiving（Storage SCP）

Item	Description
Port number	Set AI-Station's port number.
AE title	Set AI-Station's AE title
Allowed AE title	Set the AE title of the sender to be allowed to receive.

6.2 DICOM Transmission（Storage SCU）

Item	Description
IP address	Set destination server's IP address.
Port number	Set destination server's port number.
Source AE title	Set AI-Station's AE title.
Destination AE title	Set destination's AE title

6.3 Secondary Capture Image

Item	Description
Series number	The series number of the secondary capture image is created by incrementing the series number of the imaging modality. Set the value to be incremented.
Instance number	The instance number of the secondary capture image is created by incrementing the instance number of the imaging modality. Set the value to be incremented.