DICOM Conformance Statement

DICOM Forwarder

Version 1.2

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1 Conformance Statement Overview

This document is structured as suggested in the DICOM Standard (PS 3.2: Conformance).

Table 1-1 Network Services Supported

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Verification		
Verification	Yes	Yes
Transfer Image Storage SOP Classes		
Secondary Capture Image Storage	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	Yes	Yes
Multi-frame True Color Secondary Capture Image Storage	Yes	Yes
Visible Light Endoscopic Image Storage	Yes	Yes
Visible Light Microscopic Image Storage	Yes	Yes
Visible Light Photographic Image Storage	Yes	Yes
Ophthalmic Photography 8 Bit Image Storage	Yes	Yes
Ophthalmic Tomography Image Storage	Yes	Yes
Transfer Video Image Storage SOP Classes		
Ophthalmic Photography 8 Bit Image Storage	Yes	Yes
Video Endoscopic Image Storage	Yes	Yes
Video Microscopic Image Storage	Yes	Yes
Video Photographic Image Storage	Yes	Yes
Transfer Other Storage SOP Classes		
Encapsulated PDF Storage	Yes	Yes
Raw Data Storage	Yes	Yes
Lensometry Measurements Storage	Yes	Yes
Autorefraction Measurements Storage	Yes	Yes
Keratometry Measurements Storage	Yes	Yes
Subjective Refraction Measurements Storage	Yes	Yes
Visual Acuity Measurements Storage	Yes	Yes
Ophthalmic Axial Measurements Storage	Yes	Yes
Intraocular Lens Calculations Storage	Yes	Yes
Ophthalmic Visual Field Static Perimetry Measurements Storage	Yes	Yes
Workflow Management		
Storage Commitment Push Model SOP Class	No	Yes
Modality Worklist Information Model - FIND	No	Yes
Query / Retrieve		
Patient Root Query/Retrieve Information Model – FIND	No	Yes
Study Root Query/Retrieve Information Model – FIND	No	Yes
Study Root Query/Retrieve Information Model – MOVE	No	Yes

The SOP Classes are categorized as follows:

Table 1-2 UID Values

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	Yes	Yes
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	Yes	Yes
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	Yes
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	Yes
Visible Light Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	Yes
Visible Light Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	Yes
Visible Light Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	Yes
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Yes	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Yes	Yes
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Yes	Yes
Ophthalmic Tomography Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.4	Yes	Yes
Keratometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.3	Yes	Yes
Ophthalmic Axial Measurements Storage	1.2.840.10008.5.1.4.1.1.78.7	Yes	Yes
Intraocular Lens Calculations Storage	1.2.840.10008.5.1.4.1.1.78.8	Yes	Yes
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	Yes
Lensometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.1	Yes	Yes
Autorefraction Measurements Storage	1.2.840.10008.5.1.4.1.1.78.2	Yes	Yes
Subjective Refraction Measurements Storage	1.2.840.10008.5.1.4.1.1.78.4	Yes	Yes
Visual Acuity Measurements Storage	1.2.840.10008.5.1.4.1.1.78.5	Yes	Yes
Ophthalmic Visual Field Static Perimetry Measurements Storage	1.2.840.10008.5.1.4.1.1.80.1	Yes	Yes

DICOM Forwarder does not support Media Interchange.

2 Table of Contents

3 Introduction

3.1 Revision History

Table 3-1 Revision History

Document Version	Date	Changes
I	2021-04-26	Creation of document for DICOM Forwarder v1.0
1.1	2021-10-18	Added QIDO—RS, WADO-RS, STOW-RS status codes, added the DF specific implementation class UID
1.2	2022-11-03	Extended list of attributes and supported status codes for QIDO—RS, WADO-RS, STOW-RS. Updated query, retrieve and storage activities.

3.2 Audience

This document is written for the people that need to understand how DICOM Forwarder will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader may understand how this product implements DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features.

3.3 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between DICOM Forwarder and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability. The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

- The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between the product and other DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.

3.4 Definitions and Terms

Informal definitions are provided for the following terms used in this Conformance Statement.

The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax

The information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class.

Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

Application Entity (AE)

An end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title

The externally known name of an Application Entity, used to identify a DICOM application to other DICOM applications on the network.

Application Context

The specification of the type of communication used between Application Entities.

Example: DICOM network protocol.

Association

A network communication channel set up between Application Entities.

Attribute

A unit of information in an object definition; a data element identified by a tag. The information may be a complex data structure (Sequence), itself composed of lower-level data elements.

Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD)

The specified set of Attributes that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The Attributes may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C).

Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Joint Photographic Experts Group (JPEG)

A set of standardized image compression techniques, available for use by DICOM applications.

Media Application Profile

The specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

Module

A set of Attributes within an Information Object Definition that are logically related to each other.

Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation

First phase of Association establishment that allows Application Entities to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context

The set of DICOM network services used over an Association, as negotiated between Application Entities; includes Abstract Syntaxes and Transfer Syntaxes.

Protocol Data Unit (PDU)

A packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Query Key

An input value for a query process. Query Keys denote the set of DICOM tags that are sent from the SCU to SCP and thus control the query result.

Security Profile

A set of mechanisms, such as encryption, user authentication, or digital signatures, used by an Application Entity to ensure confidentiality, integrity, and/or availability of exchanged DICOM data

Service Class Provider (SCP)

Role of an Application Entity that provides a DICOM network service; typically, a server that performs operations requested by another Application Entity (Service Class User).

Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

Service Class User (SCU)

Role of an Application Entity that uses a DICOM network service; typically, a client.

Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class

The specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification.

Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance

An information object; a specific occurrence of information exchanged in a SOP Class.

Examples: a specific x-ray image.

Tag

A 32-bit identifier for a data element, represented as a pair of four-digit hexadecimal numbers, the "group" and the "element". If the "group" number is odd, the tag is for a private (manufacturer-specific) data element.

Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax

The encoding used for exchange of DICOM information objects and messages.

Examples: JPEG compressed (images), little endian explicit value representation.

Unique Identifier (UID)

A globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier.

Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR)

The format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

3.5 Abbreviations

Table 3-2 Abbreviations used in this Document

Abbreviation	Definition
AE	Application Entity
AET	Application Entity Title

DF	DICOM Forwarder
DICOM	Digital Imaging and Communications in Medicine
EBE	Explicit Big Endian
ELE	Explicit Little Endian
EMR	Electronic Medical Record
EPDF	Encapsulated Portable Document Format
HDP	Health Data Platform
HL7	Health Level Seven
ILE	Implicit Little Endian
IOD	Information Object Definition
MWL	Modality Worklist
MPEG2	Motion Picture Expert Group 2; Abbreviation and synonym for video encoding and compression transfer syntax.
MPEG4	Motion Picture Expert Group 4; Abbreviation and synonym for video encoding and compression transfer syntax.
MPML	MPEG2 Main Profile @ Main Level (as defined in the MPEG-2 standard)
MP HL	MPEG2 Main Profile @ High Level (as defined in the MPEG-2 standard)
RLE	Run Length Encoding
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair, union of a specific DICOM service and related IOD.
TCP/IP	Transmission Control Protocol / Internet Protocol
UI	User Interface
UID	Unique Identifier
UPS	Unified Procedure Step
VL	Visible Light
XML	Extensible Markup Language

3.6 References

NEMA PS3 / ISO 12052, Digital Imaging and Communications in Medicine (DICOM) Standard, National Electrical Manufacturers Association, Rosslyn, VA, USA (available free at http://medical.nema.org/).

Integrating the Healthcare Enterprise (IHE) EYECARE Technical Framework, rev 3.7, 2010 (available free at http://www.ihe.net/Technical_Framework/index.cfm

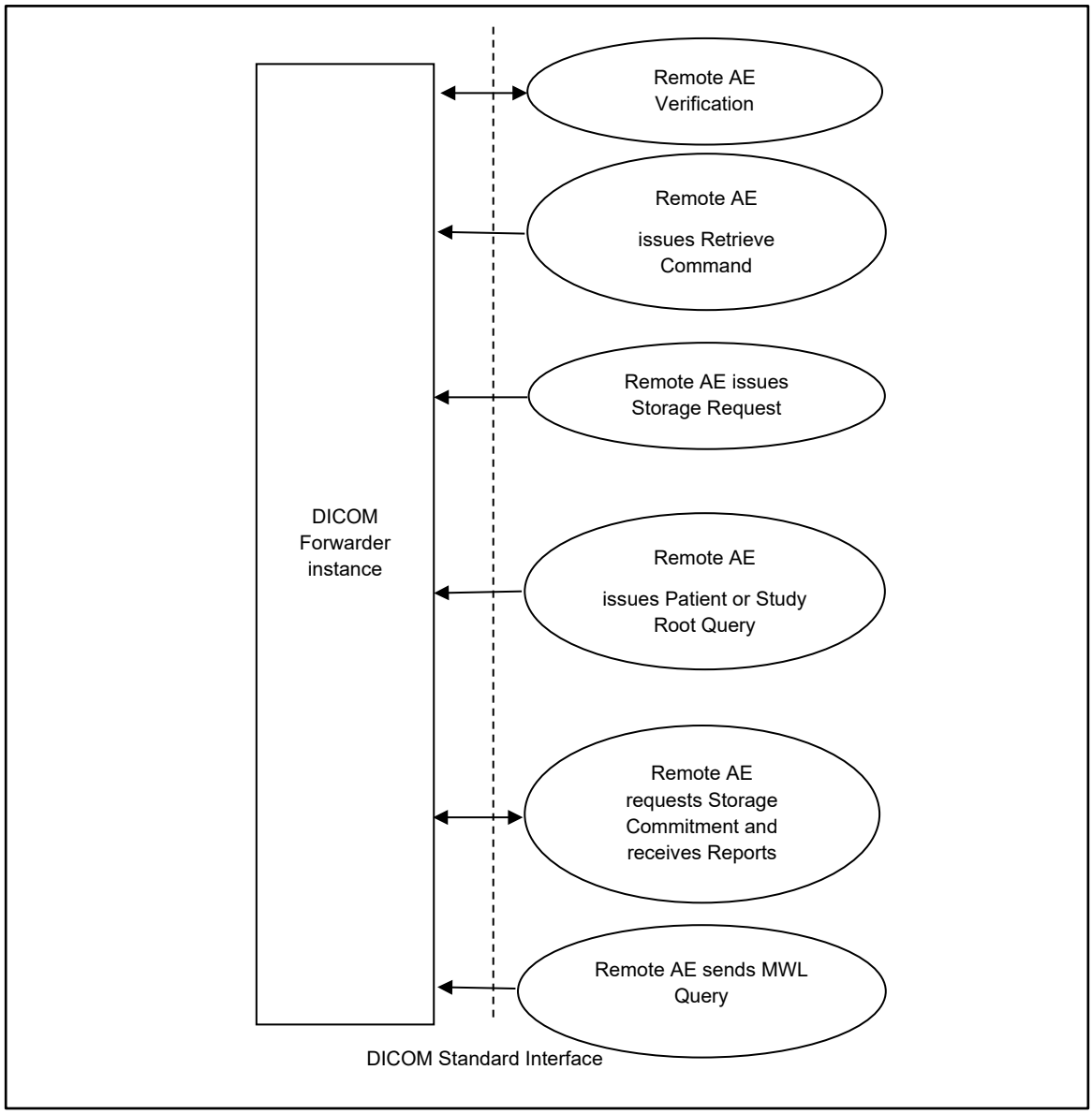
4 Networking

4.1 Implementation Model

The DICOM Forwarder “translates” DICOM DIMSE requests from a device to DICOMWeb and forwards the request to a DICOMWeb Server in the cloud.
As not all DICOM DIMSE functionalities are supported by DICOMWeb standard, some get translated seamlessly to FHIR requests instead and are forwarded to a FHIR server.

4.1.1 Application Data Flow

Figure 4-1 DICOM Forwarder - Functional Overview



4.1.2 Functional Definition of AEs

4.1.2.1 Functional Definition of DICOM Forwarder Application Entity

DICOM Forwarder is a software for transferring dicom data, e.g.: images, videos, and reports provided by computer-controlled diagnostic devices or other documentation systems.

The DICOM Forwarder AE initiates an association to a remote AE.

The DICOM Forwarder AE waits in the background for connections, and

- Answers Verification requests
- Processes Retrieve command and transfers data towards Remote AE.
- Processes and transforms Study and Patient Root Queries to HDP Cloud specific request.
- Processes Storage requests from remote AE and forwards them to HDP Cloud
- Processes and transfers Storage Commitment requests to HDP Cloud.
- Processes Storage Commitment requests, and therefore initiates an association and sends N-EVENT-REPORT-RQ.

4.1.3 Sequencing of Real-World Activities

To realize the real-world activities, the different entities work together. The sequence diagrams depict the intended workflow.

The only sequencing constraint that exists across DICOM Forwarder and the corresponding Application Entities, is the fact that a Composite SOP Instance must be received by DICOM Forwarder before Storage Commitment Push Model or Query-Retrieve Requests related to this SOP Instance can be successfully handled.

All Verification, Storage, Storage Commit, Modality Worklist Query and Retrieve DIMSE requests, as well as Study and Patient Root Query requests on Study, Series or Image level are converted to DICOMWeb requests by the DICOM Forwarder and are forwarded to a DICOMWeb Server hosted by HDP in the cloud.

However, as the DICOMWeb standard does not support Patient Root Queries on Patient level, such DIMSE requests are translated seamlessly by DICOM Forwarder to FHIR requests instead and are forwarded to a FHIR server also hosted by HDP in the cloud as shown in **Figure 4-5**.

4.1.3.1 DICOM Forwarder Activities

Figure 4-2 Verification

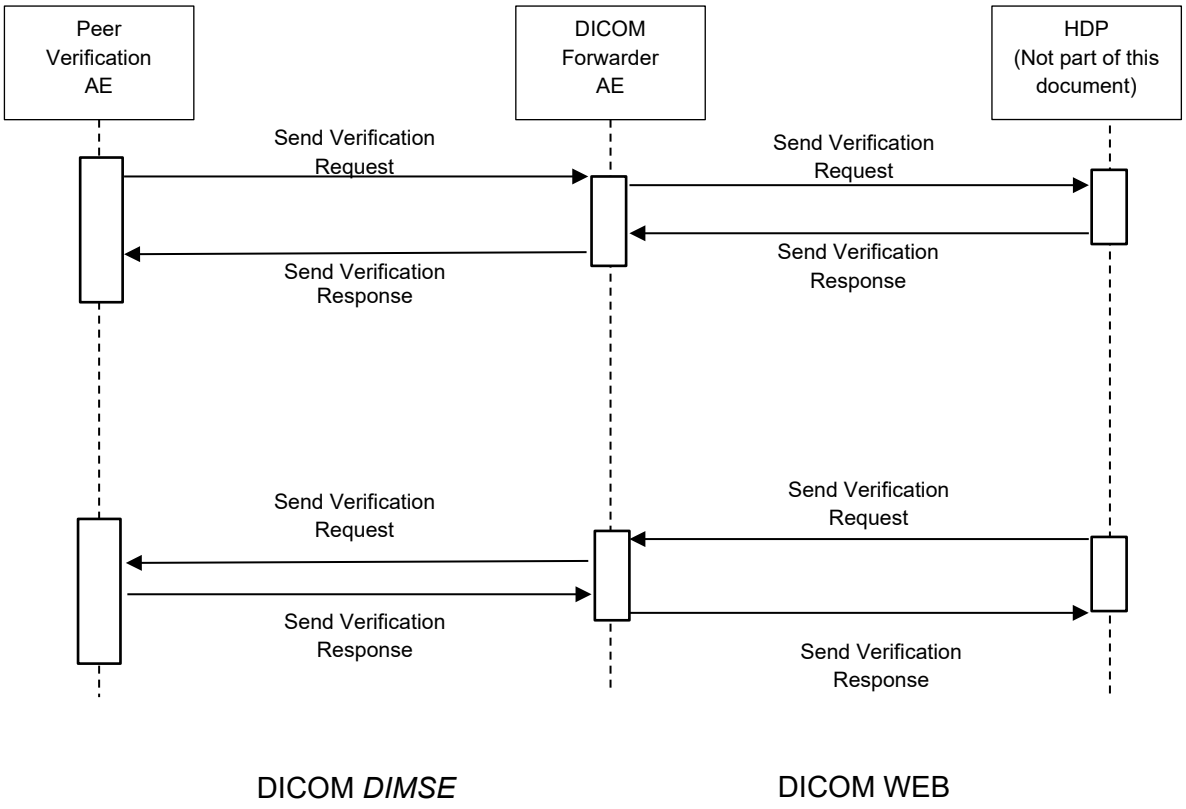
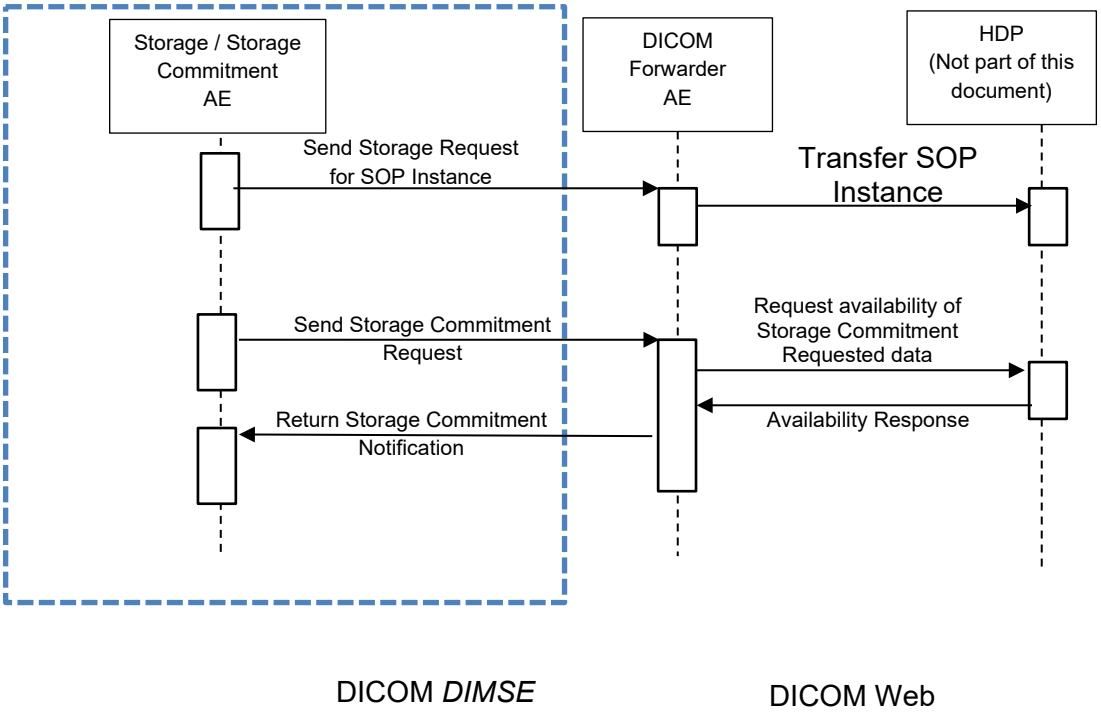
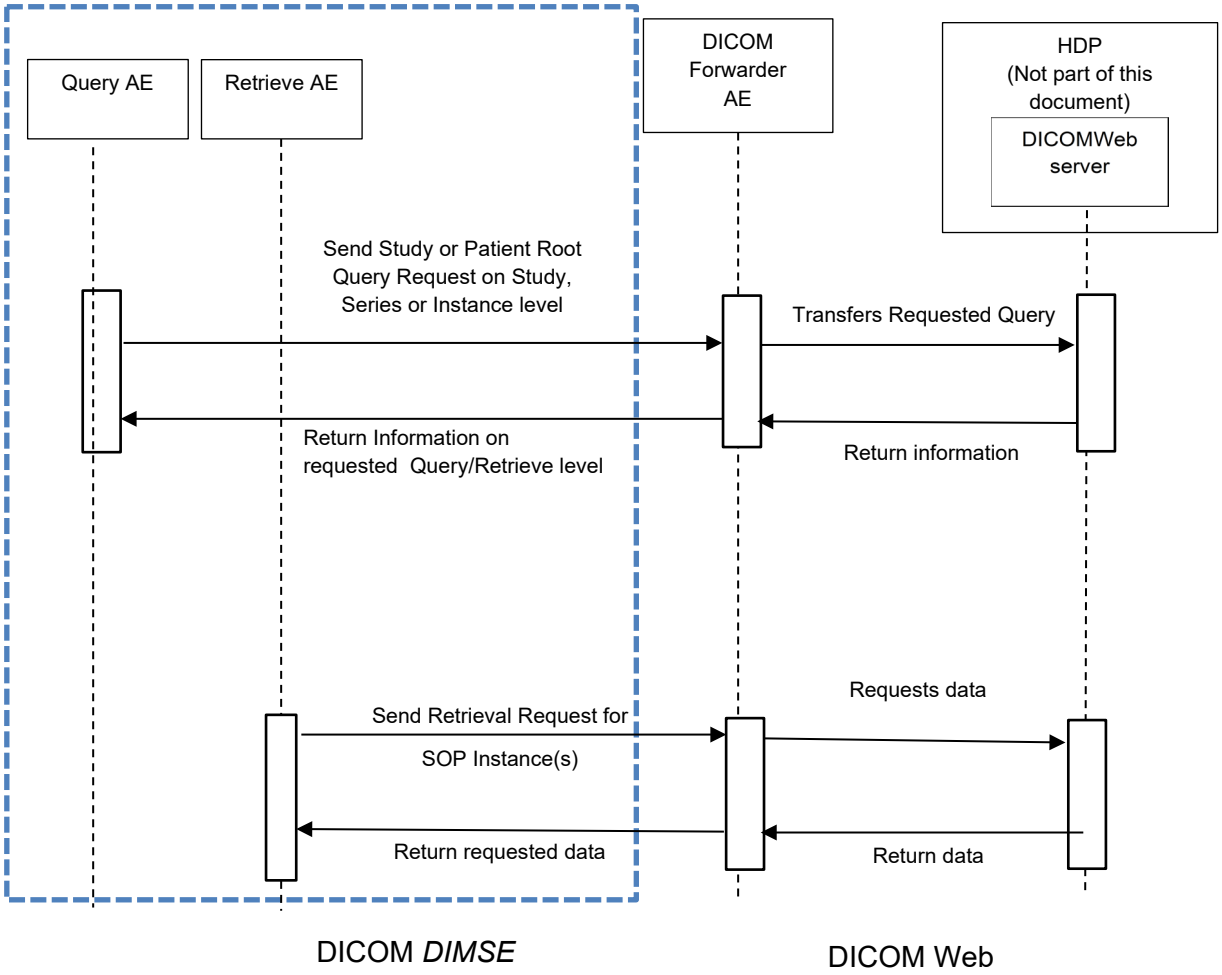


Figure 4-3 DICOM Forwarder Storage and Storage Commitment Provider



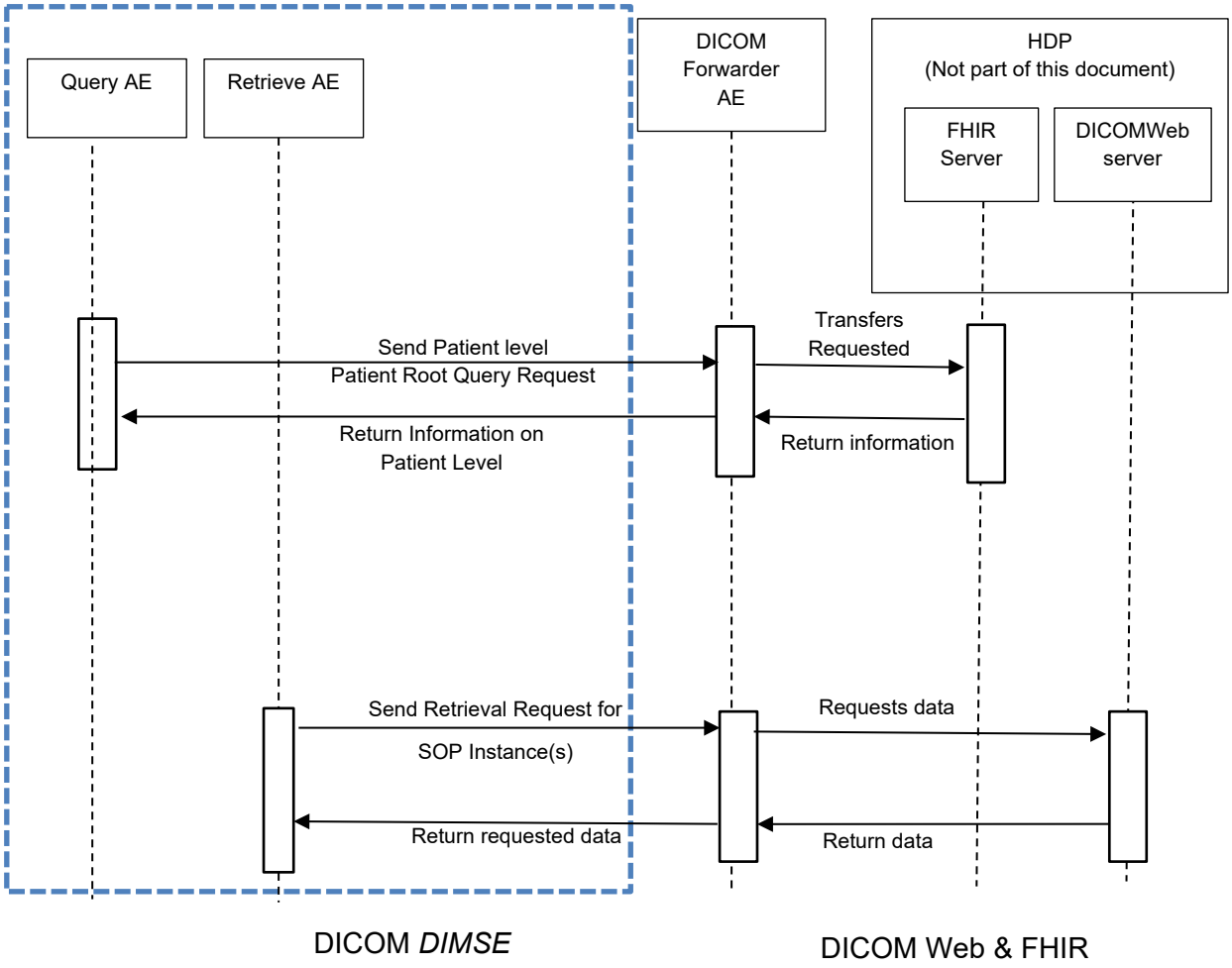
The blue mark indicates the device side of the communication.

Figure 4-4 DICOM Forwarder Study, Series and Instance level Query and Retrieve Provider



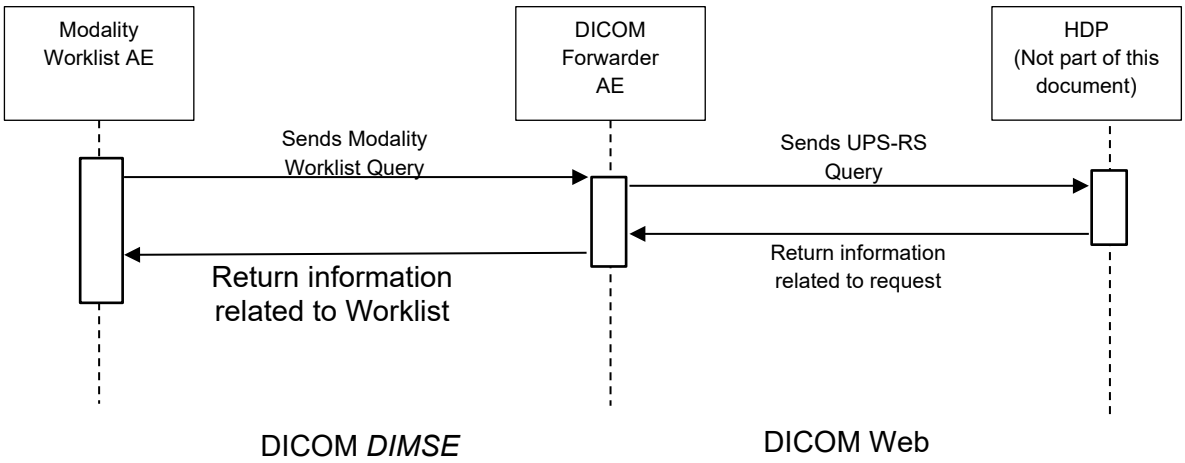
The blue mark indicates the device side of the communication.

Figure 4-5 DICOM Forwarder Patient level Patient Root Query and Retrieve Provider



The blue mark indicates the device side of the communication.

Figure 4-6 DICOM Forwarder Modality Worklist Provider



4.2 AE Specifications

4.2.1 DICOM Forwarder Application Entity Specification

4.2.1.1 SOP Classes

Table 4-1 SOP Classes for DICOM Forwarder AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	No	Yes
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	No	Yes
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	Yes	Yes
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	Yes
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	Yes
Visible Light Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	Yes
Visible Light Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	Yes
Visible Light Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	Yes
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Yes	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Yes	Yes
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Yes	Yes
Ophthalmic Tomography Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.4	Yes	Yes
Keratometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.3	Yes	Yes
Ophthalmic Axial Measurements Storage	1.2.840.10008.5.1.4.1.1.78.7	Yes	Yes
Intraocular Lens Calculations Storage	1.2.840.10008.5.1.4.1.1.78.8	Yes	Yes
Storage Commitment Push Model	1.2.840.10008.1.20.1	No	Yes
Lensometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.1	Yes	Yes
Autorefraction Measurements Storage	1.2.840.10008.5.1.4.1.1.78.2	Yes	Yes
Subjective Refraction Measurements Storage	1.2.840.10008.5.1.4.1.1.78.4	Yes	Yes
Visual Acuity Measurements Storage	1.2.840.10008.5.1.4.1.1.78.5	Yes	Yes
Ophthalmic Visual Field Static Perimetry Measurements Storage	1.2.840.10008.5.1.4.1.1.80.1	Yes	Yes
Patient Root Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	No	Yes
Study Root Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	No	Yes
Study Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	No	Yes

4.2.1.2 Associations Policies

4.2.1.2.1 General

The DICOM standard Application Context Name for DICOM 3.0 is always proposed:

Table 4-2 DICOM Application Context

Application Context Name	1.2.840.10008.3.1.1.1

4.2.1.2.2 Number of Associations

The DICOM Forwarder has one dedicated AE for both Storage and Storage Commitment requests. The maximum number of associations is shown below.

Table 4-3 Number of associations

Maximum number of simultaneous associations	100 per DICOM Forwarder

Table 4-4 Number of Associations as an Association Acceptor for DICOM Forwarder AE

Maximum number of simultaneous associations	100 per DICOM Forwarder

4.2.1.2.3 Asynchronous Nature

DICOM Forwarder Application Software does not support asynchronous communication (multiple outstanding transactions over a single Association).

4.2.1.2.4 Implementation Identifying Information

Table 4-5 Number of associations

Implementation Class UID	1.2.276.0.75.2.5.140
Implementation Version Name	"DCMFWD-" + current application version, e.g., DCMFWD-1.2.0

4.2.1.3 Association Initiation Policy

4.2.1.3.1 Activity – User Requests Verification (SCU)

4.2.1.3.1.1 Description and Sequencing of Activities

The DICOM Forwarder AE sends DICOM Verification requests when the user requests a test of availability of a DICOM connection through the Web UI.

4.2.1.3.1.2 Proposed Presentation Contexts

Table 4-6 Presentation Contexts proposed by the DICOM Forwarder AE

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Verification	1.2.840.10008.1.1	ILE	1.2.840.10008.1.2	BOTH	No

4.2.1.3.2 Activity – DICOM Forwarder Issues Storage Request (SCU)

4.2.1.3.2.1 Description and Sequencing of Activities

The DICOM Forwarder AE will transfer request to the HDP Cloud and transmit instances as reaction to a received C-MOVE request. An association is established when the user initiates a transmit request. The DICOM Forwarder AE will transfer the request to the HDP Cloud and establish an association automatically in response to a C-MOVE request.

4.2.1.3.2.2 Proposed Presentation Contexts

The DICOM Forwarder AE may request any of the Presentation Contexts listed in the following table for Storage. The DICOM Forwarder AE will only propose the transfer syntax, which was used when the object was initially accepted by the HDP Cloud.

Table 4-7 Presentation Context Table

Presentation Context Table				
Abstract Syntax	**Transfer Syntax**		**Role**	**Ext. Neg.**
Name/UID	**Name List**	**UID List**		
All SOP classes listed in section "Transfer Image Storage SOP Classes	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian RLE Lossless JPEG Baseline JPEG Lossless JPEG 2000 (Lossless Only) JPEG 2000	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.5 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91	BOTH	No
All SOP classes listed in section "Transfer Video Image Storage SOP Classes"	MPEG2 MPML MPEG2 MPHL MPEG-4 AVC/H.264 High Profile / Level 4.1 MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1 MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	1.2.840.10008.1.2.4.100 1.2.840.10008.1.2.4.101 1.2.840.10008.1.2.4.102 1.2.840.10008.1.2.4.103 1.2.840.10008.1.2.4.104 1.2.840.10008.1.2.4.105 1.2.840.10008.1.2.4.106	BOTH	No
All SOP classes listed in section "Transfer Other Storage SOP Classes"	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	BOTH	No

4.2.1.3.2.3 SOP Specific Conformance – Store Objects

The DICOM Forwarder AE provides limited standard conformance to the DICOM Storage Service Class as an SCU: Neither it is guaranteed that the DICOM Default Transfer Syntax (Implicit VR Little Endian) is always proposed in a presentation context. Nor is an “on-the-fly” transcoding to the DICOM Default Transfer Syntax supported for instances received and stored in lossless compression. A successful C-Store response status will not generate any actions.

Table 4-8 STORE command return code mappings

Service Status	Further Meaning	Error Code	Behavior
Other than SUCCESS		> 0000	For C-MOVE Requests they will be reported in the C-STORE-RESPOND under "Number Of Failed Suboperations" (0000,1022)

Limitation of C-MOVE with large DICOM files:

Due to the limited temporary storage available as a tmpfs volume for retrieved DICOM files, it is not guaranteed that large DICOM files (i.e. those with file size over 100 MB) can be transferred successfully to the destination AE.
tmpfs (short for Temporary File System) is a temporary file storage in volatile memory instead of a persistent storage device. In case this storage volume allocated for DICOM Forwarder docker container gets filled with large retrieved DICOM file(s), a Storage Request will not be initiated by DICOM Forwarder to the destination AE.

4.2.1.3.3 Activity - Remote AE Requests Storage Commitment (SCU)

4.2.1.3.3.1 N-EVENT-Report

4.2.1.3.3.1.1 Description and Sequencing of Activities

The DICOM Forwarder AE will respond to N-ACTION requests, and initiate an N-EVENT-REPORT, based on the DICOM data availability in HDP via initiating a C-FIND Query on the DICOM WEB level. When the requested DICOM data(s) could be retrieved out of the HDP, then the Storage sequence had been closed, therefor the Storage Commitment is completed.

4.2.1.3.3.1.2 Proposed Presentation Contexts

The DICOM Forwarder AE may request the following Presentation Contexts listed in the following table.

Table 4-9 Proposed Presentation Contexts for Activity "Remote AE Requests Storage Commitment"

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	ILE ELE EBE	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	No

4.2.1.3.3.1.3 SOP Specific Conformance – Storage Commitment

The DICOM Forwarder AE provides conformance to the DICOM Storage Commitment Service Class as an SCP.

The N-EVENT-REPORT contains the following Failure Reasons in the Failed SOP Sequence:

Table 4-10 Storage Commitment Failure Reasons

Service Status	Further Meaning	HDP Status Code	Failure Reason	Behavior
Failure	No such object instance	204	0112	The SOP instance is not available in HDP.
Failure	Processing failure	400	0110	Request is not processable/supported by HDP.
Failure	Refused: Not authorized	401	0124	Zeiss ID Authentication failed or invalid subscription key.
Failure	Forbidden	403	0110	Authorization error on HDP, eg: wrong tenant.
Failure	Refused: Not authorized	407	0124	Missing or invalid credentials are configured for http proxy server hence ZEISS ID token and/or HDP endpoints are not accessible.
Failure	Resource limitation	429	0213	Too many requests are sent to the HDP.
Failure	Internal server error	500	0110	The service is unavailable or busy.
Failure	Resource limitation	503	0213	The service is unavailable or busy.
Failure	Class instance conflict	200	0119	The SOP Class UID reported by HDP does not match with Referenced SOP Class UID included within N-ACTION request.
Failure	Duplicate SOP instances	200	0111	HDP reported multiple SOP Instances with the same SOP Instance UID.
Failure	Referenced SOP Class not supported		0122	The SOP Class is not supported by DICOM Forwarder.

4.2.1.4 Association Acceptance Policy

4.2.1.4.1 Activity – Remote AE Requests Verification (SCP)

4.2.1.4.1.1 Description and Sequencing of Activities

The DICOM Forwarder AE will respond to Verification requests from a Verification SCU. This way the requesting SCU can determine whether the respective DICOM Forwarder AEs are able to receive and handle incoming DICOM requests, including the end communication to/from HDP.

4.2.1.4.1.2 Accepted Presentation Contexts

Table 4-5 Acceptable Presentation Context for Activity "Remote AE Requests Verification"

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	ILE	1.2.840.10008.1.2	SCP	No

4.2.1.4.1.3 SOP Specific Conformance for Verification SOP Class as SCP

DICOM Forwarder provides standard conformance to the DICOM Verification Service Class as an SCP. One of the following status codes are returned:

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	Operation performed properly.
Failure	Failure	A700	Out of Resource

DICOM Forwarder AE will always accept a Presentation Context for the Verification SOP Class with the default DICOM transfer syntax.

The DICOM DIMSE Verification includes the health API check answer returned be HDP, therefor if the HDP is not available, or has an issue, the DICOM DIMSE Verification answer contains this issue with an A700 Failure.

4.2.1.4.2 Activity - Remote AE issues Storage Request (SCP)

4.2.1.4.2.1 Description and Sequencing of Activities

The DICOM Forwarder AE will store DICOM instances that are sent to it from a remote SCU. All storage objects received by the DICOM Forwarder in a DICOM DIMSE protocol, are being transformed to DICOM WEB and sent towards to the HDP.

4.2.1.4.2.2 Accepted Presentation Contexts

Table 4-6 Acceptable Presentation Context for Activity “Remote AE issues Storage Request”

Presentation Context Table				
Abstract Syntax	**Transfer Syntax**		**Role**	**Ext. Neg.**
Name / UID	**Name List**	**UID List**		
All SOP classes listed in section "Transfer Image Storage SOP Classes", “Transfer Video Image Storage SOP Classes” and “Transfer Other Storage SOP Classes”	The DICOM Forwarder will not limit any Transfer Syntax within the supported SOP Classes, and those will be transferred towards HDP		SCP	No

4.2.1.4.2.3 SOP Specific Conformance – Store Objects

The DICOM Forwarder AE conforms to the DICOM Storage Service Class as a Level 2 (Full) SCP. No elements are discarded. Certain Attribute will be coerced, see 8.1.4. All Type 1, Type 2 and Type 3 attributes will be retained. Private attributes will be stored and included when the object is sent out later to a remote AE.

In case an instance is rejected, one of the following status codes is returned by the DICOM Forwarder AE:

Table 4-13 Status code mappings

Service Status	Further Meaning	Status Code	HDP Status Code	Behavior
Error	Unable To Process	C000	204	Unexpected internal errors
Refused	Out Of Resources	A700	429	HDP rate limiting refuses connection.
Refused	Out Of Resources	A700	503	HDP Internal error, connection refused.
Error	Class instance conflict	A119	409	Class instance conflicts the ones HDP support
	Unable To Process	C000	415	The provided Content-Type is not supported
	Unable To Process	C000	406	The specified Accept header is not supported.
	Unable To Process	C000	400	Unexpected internal errors.
Error	Refused: Not authorized	0124	401	Zeiss ID Authentication failed or invalid subscription key.
Error	Refused: Not authorized	0124	407	Missing or invalid credentials are configured for http proxy server hence ZEISS ID token and/or HDP endpoints are not accessible.
Error	Unable To Process	0111	409 – Reason: 45070	SOP Instance UID already exists
Error	Unable To Process	0110	409 – Reason: 272	Processing failure
Error	Unable To Process	0110	409 – Reason: 43264	Processing failure
Error	Unable To Process	C000	409 – Reason: 43265	Unexpected internal errors
Error	Unable To Process	C000	409 – Reason: 45071	Unexpected internal errors
Success	Success	0000	200	Operation performed properly.

Limitation of C-STORE with large DICOM files:

Due to the limited temporary storage and potentially lower upload bandwith, all the files above 100MB are uploaded to the HDP after the C-STORE association is closed with a 0000 – Success message, even if the upload is not complete. If an error happens during the upload, the DICOM Forwarder tries to re-upload the file 3 times, after that it will be deleted without archiving it.

In order to prevent a possible data loss, the device shall utilize a Storage Commitment request before data deletion, to confirm if the data had been archived succesfully or not.

4.2.1.4.3 Activity – Remote AE issues Patient or Study Root Query (SCP)

4.2.1.4.3.1.1 Description and Sequencing of Activities

The DICOM Forwarder AE will respond to query requests that are sent to it by a remote SCU.

4.2.1.4.3.1.2 Accepted Presentation Contexts

Table 4-7 Acceptable Presentation Context

Presentation Context Table				
Abstract Syntax	**Transfer Syntax**		**Role**	**Ext. Neg.**
Name / UID	**Name List**	**UID List**		
Patient Root Q/R Information Model – FIND 1.2.840.10008.5.1.4.1.2.1.1	ILE	1.2.840.10008.1.2	SCP	YES
Study Root Q/R Information Model – FIND - 1.2.840.10008.5.1.4.1.2.2.1	ILE	1.2.840.10008.1.2	SCP	YES

C-Find Extended Negotiation is supported: For the field "Relational-queries", the value “1” is returned, meaning that those are supported by the DF AE.

4.2.1.4.3.1.3 SOP Specific Conformance – Find Objects

The DICOM Forwarder AE provides standard conformance to the DICOM Query/Retrieve Service Class as an SCP. The DICOM Forwarder AE supports both Hierarchical Queries and the Relational-queries extended SCP behavior. Matching for attributes with VR PN (Person Name) is always done case-insensitive. The following tables contain detailed information on matching and return keys.

Table 4-8 Matching Types

Abbreviation	Description
U	Universal Matching
S	Single Value Matching
*	Wildcard Matching
R	Range Matching
UNIQUE	Unique query key for the respective level

Table 4-16 Patient Root / Patient Level Attributes

Description	Tag	Matching Type
Patient's Name	(0010,0010)	U S *
Patient ID	(0010,0020)	U S
Patient's Birth Date	(0010,0030)	U S R
Issuer of Patient ID	(0010,0021)	U S
Patient Sex	(0010,0040)	U S
Ethnic Group	(0010,2160)	U
Patient Comments	(0010,4000)	U

Other Patient IDs	(0010,1000)	U
Other Patient IDs Sequence	(0010,1002)	U
›Patient ID	(0010,0020)	U
›Issuer of Patient ID	(0010,0021)	U

Table 4-17 Patient Root / Study Level Attributes

Description	Tag	Matching Type
Study Instance UID	(0020,000D)	U S, UNIQUE
Study ID	(0020,0010)	U
Accession Number	(0008,0050)	U S
Study Date	(0008,0020)	U S R
Referring Physician's Name	(0008,0090)	U S *
Modalities in Study (*1)	(0008,0061)	U S (only together with Patient ID)
Study Time	(0008,0030)	U
Study Description	(0008,1030)	U
Admitting Diagnoses Description	(0008,1080)	U
Instance Availability	(0008, 0056)	U

Remark (*1):
"Modalities in Study" is supported ONLY on STUDY LEVEL and ONLY in case "Patient ID" is also included in the C-FIND request dataset with a non-empty value, i.e. with Single Value Matching.

Table 4-18 Study Root / Study Level Attributes

Description	Tag	Matching Type
Patient's Name	(0010,0010)	U S *
Patient ID	(0010,0020)	U S
Patient's Birth Date	(0010,0030)	U S R
Issuer of Patient ID	(0010,0021)	U S
Patient Sex	(0010,0040)	U S
Ethnic Group	(0010,2160)	U
Patient Comments	(0010,4000)	U

Other Patient IDs	(0010,1000)	U
Patient's Birth Time	(0010, 0032)	U
Study Instance UID	(0020,000D)	U S, UNIQUE
Study ID	(0020,0010)	U
Accession Number	(0008,0050)	U S
Study Date	(0008,0020)	U S R
Referring Physician’s Name	(0008,0090)	U S *
Modalities in Study (*1)	(0008,0061)	U S (only together with Patient ID)
Study Time	(0008,0030)	U
Study Description	(0008,1030)	U
Admitting Diagnoses Description	(0008,1080)	U
Instance Availability	(0008, 0056)	U

Remark (*1):
"Modalities in Study" is supported ONLY on STUDY LEVEL and ONLY in case "Patient ID" is also included in the C-FIND request dataset with a non-empty value, i.e. with Single Value Matching.

Table 4-19 Series Level Attributes

Description	Tag	Matching Type
Modality	(0008,0060)	U S
Series Instance UID	(0020,000E)	U S, UNIQUE
Manufacturer's Model Name	(0008,1090)	U S
Performing Physicians’ Name	(0008,1050)	U
Series Description	(0008,103E)	U
Performed Procedure Step Start Date	(0040,0244)	U
Performed Procedure Step Start Time	(0040,0245)	U
Request Attributes Sequence	(0040,0275)	U
›Requested Procedure ID	(0040,1001)	U
›Scheduled Procedure Step ID	(0040,0009)	U
Series Number	(0020,0011)	U

Laterality	(0020,0060)	U
Series Date	(0008,0021)	U
Series Time	(0008,0031)	U

Table 4-20 Instance Level Attributes

Description	Tag	Matching Type
SOP Instance UID	(0008,0018)	U S, UNIQUE
Acquisition Date Time	(0008,002A)	U S R
SOP Class UID	(0008,0016)	U S
Instance Creation Date	(0008,0012)	U
Instance Creation Time	(0008,0013)	U
Instance Number	(0020,0013)	U
Referenced Instance Sequence	(0008,114A)	U
›Referenced SOP Instance UID	(0008,1155)	U
›Referenced SOP Class UID	(0008,1150)	U
Document Title	(0042,0010)	U
Image Laterality (*1)	(0020,0062)	U
Measurement Laterality	(0024,0113)	U
Rows	(0028,0010)	U
Columns	(0028,0011)	U
Bits Allocated	(0028,0100)	U
Number of Frames	(0028,0008)	U
Instance Availability	(0008,0056)	U
Image Type	(0008,0008)	U

Remark (*1):
In case the optional "Image Laterality" (0020,0062) attribute value is requested in a Patient or Study Root Query but no value was stored for the attribute, it's value is attempted to be set first based on "MeasurementLaterality" (0024,0113) – or if that is also empty - based on the Series level "Laterality" (0020,0060) attribute value if any of the latter attributes are included in the C-FIND request dataset.

The DICOM Forwarder AE shall return the following status codes in response of a C-FIND Request.

Table 4-21 Query command Status Codes

Service Status	Further Meaning	Status Code	HDP Status Code	Behavior
Success	Success	FF00	200	The search completed successfully. Response contains matching resource, matches are continuing.
Success	Success	FF01	200	The search completed successfully, but one or more optional query match keys received in the query request were ignored. Response contains matching resource, matches are continuing.
Success	Success	0000	200	The search completed successfully. All matching resources returned; matching is complete.
Success	No Content	0000	204	No Content
Error	Bad request	C000	400	HDP Core reported that the request was badly formatted. Possible DICOM Forwarder Issue.
Error	Refused: Not authorized	0124	401	Zeiss ID Authentication failed or invalid subscription key.
Error	Forbidden	C000	403	HDP Core reported authorization error.
Error	Refused: Not authorized	0124	407	Missing or invalid credentials are configured for http proxy server hence ZEISS ID token and/or HDP endpoints are not accessible.
Error	Resource limitation	A700	429	HDP Core reported too many requests
Error	Internal Server error	0110	500	HDP Core reported that an unexpected error occurred.
Refused	Out Of Resources	A700	503	HDP Internal error, connection refused.

Limitation of C-FIND Study and Patient Root Queries with large number of matches:

In order to avoid potential timeout issues for the established DICOM DIMSE assocations for C-FIND opertations, the maximum number of results is limited to 200 patients, studies, series or instances for queries performed at the corresponding levels.

This number is set by taking into account the maximum allowed size for an http response by the DICOMWeb server (in case of STUDY, SERIES or IMAGE level Study and Patient Root Queries) and by the FHIR server (in case of PATIENT level Patient Root Queries) hosted by HDP.

No errors are reported by DICOM Forwarder in case the number of matches exceeded this value, but only the first 200 results are returned.

4.2.1.4.4 Activity - Remote AE Requests Storage Commitment (SCP)

4.2.1.4.4.1 N-ACTION-RSP

4.2.1.4.4.1.1 Description and Sequencing of Activities

When DICOM Forwarder receives a storage commitment request, it checks whether the requested SOP instances are present in HDP and sends an N-EVENT-REPORT-RQ. DICOM Forwarder accepts a list of references to one or more DICOM SOP instances.

4.2.1.4.4.2 Accepted Presentation Contexts

Table 4-22 Acceptable Presentation Context for Activity "Remote AE Requests Storage Commitment"

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID 1.2.840.10008. ...**	**Name List**	**UID List 1.2.840.10008. ...**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	ILE	1.2.840.10008.1.2	SCP	No

4.2.1.4.4.3 SOP Specific Conformance – Storage Commitment

The DICOM Forwarder AE provides conformance to the DICOM Storage Commitment Service Class as an SCP. The number of referenced instances within one request is not limited. The N-EVENT-REPORT message is always sent in a separate association from the N-ACTION operation.

For Storage Commitment operations, the DICOM Forwarder AE will only accept association requests for known (configured in HDP) remote AEs.

One of the following Status codes is returned by the DICOM Forwarder AE in an N-ACTION response:

Table 4-23 Storage Commitment N-ACTION-RSP Status Codes

Service Status	Further Meaning	Status Code	HDP Status Code	Behavior
Failure	Processing failure	0110	400	Request is not processable/supported by HDP.
Success	Success	0000	200	Operation performed properly

4.2.1.4.5 Activity – Remote AE Issues Retrieve Command (SCP)

4.2.1.4.5.1 Description and Sequencing of Activities

The DICOM Forwarder AE will respond to C-MOVE requests that are sent to it by a remote SCU. The DICOM Forwarder AE will establish a new association with the remote AE specified in the move destination for the C-STORE sub operation. The DICOM Forwarder AE will always only propose the transfer syntax used when the object was initially sent to the HDP.

4.2.1.4.5.2 Accepted Presentation Contexts

Table 4-24 Acceptable Presentation Context for Activity "Remote AE Issues Retrieve Command"

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Study Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	ILE	1.2.840.10008.1.2	SCP	Yes

C-Move Extended Negotiation is supported: For the field "Relational-retrieve", the value "1" is returned, meaning that those are supported by the DF AE.

4.2.1.4.5.3 SOP Specific Conformance – Move Objects

The DICOM Forwarder AE will establish an association with the destination specified in the C-MOVE request. One or more of the Presentation Contexts listed in chapter 4.2.1.4.2 "Activity - Remote AE issues Storage Request (SCP)" may be negotiated in this association. The following tables contain detailed information on supported matching keys:

Table 4-25 Study Root / Study Level Attributes

Description	Tag	Matching Type
Study Instance UID	(0020,000D)	List of UID Matching

Table 4-26 Series Level Attributes

Description	Tag	Matching Type
Series Instance UID	(0020,000E)	List of UID Matching

Table 4-27 Instance Level Attributes

Description	Tag	Matching Type
SOP Instance UID	(0008,0018)	List of UID Matching

In case (default) hierarchical retrieve mode (i.e. when "Relational-retrieve" mode is not negotiated), a list of UIDs are only supported on the given Query/Retrieve Level while UIDs from all „above" levels must also be provided in Single Value matching mode:

- For STUDY level retrieve, a list of UIDs via Study Instance UID attribute.
- For SERIES level retrieve, a list of UIDs via Series Instance UID attribute and a single value via Study Instance UID attribute for the (single) corresponding Study.
- For IMAGE level retrieve, a list of UIDs via SOP Instance UID attribute and a single value via Series Instance UID and Study Instance UID attributes of the corresponding (single) Series and (single) Study.

In case "Relational-retrieve" mode is negotiated via Extended Negotiation, a list of UIDs are supported on the given Query/Retrieve Level:

- For STUDY level retrieve, a list of UIDs via Study Instance UID attribute.
- For SERIES level retrieve, a list of UIDs via Series Instance UID attribute.
- For IMAGE level retrieve, a list of UIDs via SOP Instance UID attribute.

The DICOM Forwarder AE shall return the following status codes in response of a C-MOVE Request:

Table 4-28 Retrieve command Status Codes

Service Status	Further Meaning	Status Code	HDP Status Code	Behavior
Success		0000	200	The operation is successful.
Failure	Unable to process	C000	400	HDP Core reported that the request was badly formatted.
Failure	Refused: Not authorized	0124	401	Authentication token is expired, or subscription key invalid.
Failure	No such object instance	0112	404	The specified DICOM resource could not be found.
Failure	Unable to process	C000	406	Communication rejected by HDP, a possible DICOM Forwarder issue.
Failure	Refused: Not authorized	0124	407	Missing or invalid credentials are configured for http proxy server hence ZEISS ID token and/or HDP endpoints are not accessible.
Failure	Resource limitation	A700	429	Too many requests are sent to the HDP.
Failure	Resource limitation	A702	503	The service is unavailable or busy.

4.2.1.4.6 Activity – Remote AE sends MWL Query (SCP)

4.2.1.4.6.1 Description and Sequencing of Activities

The DICOM Forwarder MWL AE will respond to DICOM C-FIND requests in response to a remote AE querying for a Modality Worklist.

4.2.1.4.6.2 Accepted Presentation Context

Table 4-29 Acceptable Presentation Context for Activity "Remote AE sends MWL Query"

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	ILE	1.2.840.10008.1.2	SCP	Yes

4.2.1.4.6.3 SOP Specific Conformance for Modality Worklist SOP Class as SCP

The DICOM Forwarder MWL AE provides standard conformance to the DICOM Basic Worklist Management Service Class.

Table 4-30 Matching Types

Abbreviation	Description
U	Universal Matching
S	Single Value Matching
*	Wildcard Matching
R	Range Matching

The following table contains detailed information on matching keys:

Table 4-31 Modality Worklist - Matching Keys

Description	Tag	Matching Type
Accession Number	(0008,0050)	U S
Requested Procedure ID	(0040,1001)	U S
Scheduled Procedure Step Sequence	(0040,0100)	
›Scheduled Station AE Title	(0040,0001)	U S
›Scheduled Procedure Step Start Date	(0040,0002)	U R
›Modality	(0008,0060)	U S
Patient's Name	(0010,0010)	U S *
Patient ID	(0010,0020)	U S

The following table contains the supported return keys:

Table 4-32 Modality Worklist - Return Keys

Description	Tag
Scheduled Procedure Step Sequence	(0040,0100)
>Scheduled Station AE Title	(0040,0001)
>Scheduled Procedure Step Start Date	(0040,0002)
>Scheduled Procedure Step Start Time	(0040,0003)
>Scheduled Performing Physician Name	(0040,0006)
>Scheduled Procedure Step Location	(0040,0011)
>Scheduled Procedure Step Status	(0040,0020)

>Scheduled Protocol Code Sequence	(0040,0008)
>> Code Meaning	(0008,0104)
>> Code Value	(0008,0100)
>> Coding Scheme Designator	(0008,0102)
>> Coding Scheme Version	(0008,0103)
>Modality	(0008,0060)
>Scheduled Procedure Step Description	(0040,0007)
>Scheduled Procedure Step ID	(0040,0009)
Requested Procedure ID	(0040,1001)
Requested Procedure Comments	(0040,1400)
Requested Procedure Description	(0032,1060)
Study Instance UID	(0020,000D)
Study Date (=Scheduled Procedure Step Start Date)	(0008,0020)
Study Time (=Scheduled Procedure Step Start Time)	(0008,0030)
Accession Number	(0008,0050)
Requested Procedure Code Sequence (=Scheduled Protocol Code Sequence)	(0032,1064)
> Code Meaning	(0008,0104)
> Code Value	(0008,0100)
> Coding Scheme Designator	(0008,0102)
> Coding Scheme Version	(0008,0103)
Referring Physician’s Name	(0008,0090)
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Issuer of Patient ID	(0010,0021)
Patient's Birth Date	(0010,0030)
Patient's Sex	(0010,0040)
Specific Character Set	(0008,0005)
Patient Comments	(0010,4000)

Regarding the DICOM DIMSE and DICOM Web protocol change, a mapping is used.

Table 4-33 MWL and UPS query match key mappings.

MWL query match key attribute name	MWL query match key attribute id	Search type	Mapped UPS-RS query match key attribute name	Mapped UPS query match key attribute id
Scheduled Procedure Step Sequence	(0040,0100)		-	
-	-		Scheduled Station Name Code Sequence (*2)	(0040,4025)
›Scheduled Station AE Title (*1)	(0040,0001)	U S	›Code Value	(0008,0100)
›Scheduled Procedure Step Start Date	(0040,0002)	U R	Scheduled Procedure Step Start Date Time	(0040,4005)
-	-		Scheduled Station Class Code Sequence (*3)	(0040,4026)
›Modality	(0008,0060)	U S	›Code Value	(0008,0100)
-	-		Referenced Request Sequence	(0040, A370)
Requested Procedure ID	(0040,1001)	U S	›Requested Procedure ID	(0040,1001)
Accession Number	(0008,0050)	U S	›Accession Number	(0008,0050)
Patient's Name	(0010,0010)	U S *	Patient's Name	(0010,0010)
Patient ID	(0010,0020)	U S	Patient ID	(0010,0020)
-	-	Predefined value "SCHEDULED"	Procedure Step State = SCHEDULED	(0074,1000)

Remark (*1):
Scheduled Station AE Title is mapped to Scheduled Station Name Code Sequence Code Value based on connected device configuration by taking configured *SNC* (Station Name Code) value of associated device.

Remark (*2):
For the Scheduled Station Name Code Sequence (0040,4025) of an UPS worklist item besides the Code Value (0008, 0100) attribute there are some other Type 1 – Mandatory fields that must be present within the stored worklist item e.g. Code scheme designator (0008, 0102) and Code meaning (0008, 0104). But as the Scheduled Station AE Title (0040,0001) MWL attribute value only gets mapped to the Code Value, these other mandatory fields are not present in the current MWL to UPS mapping table.

Remark (*3):
For the Scheduled Station Class Code Sequence (0040,4026) of an UPS worklist item besides the Code Value (0008, 0100) attribute there are some other Type 1 – Mandatory fields that must be present within the stored worklist item e.g. Code scheme designator (0008, 0102) and Code meaning (0008, 0104). But as the Modality (0008,0060) MWL attribute value only gets mapped to the Code Value, these other mandatory fields are not present in the current MWL to UPS mapping table.

The DICOM Forwarder AE shall return the following status codes in response of a C-FIND Request:

Table 4-34 MWL command return Status Codes

Service Status	Further Meaning	Status Code	HDP Status Code	Behavior
Success		0000	200	The operation is successful.
Success	No content	0000	204	The search completed successfully but returned no results.
Failure	Bad request	C000	400	HDP Core reported that the request was badly formatted.
Failure	Refused: Not authorized	0124	401	Authentication token is expired, or subscription key invalid.
Failure	Forbidden	0112	403	HDP Core reported authorization error.
Failure	Refused: Not authorized	0124	407	Missing or invalid credentials are configured for http proxy server hence ZEISS ID token and/or HDP endpoints are not accessible.
Failure	Resource limitation	A700	429	Too many requests are sent to the HDP.
Failure	Internal server error	0110	500	HDP Core reported that an unexpected error.
Failure	Resource limitation	A702	503	The service is unavailable or busy.

Limitation of C-FIND MWL Queries with large number of matches:
In order to avoid potential timeout issues for the established DICOM DIMSE assocations for MWL C-FIND opertations, the maximum number of results is limited to 200 workitems.
This number is set by taking into account the maximum allowed size for an http response by the DICOMWeb server hosted by HDP.
No errors are reported by DICOM Forwarder in case the number of matching workitems exceeded this value, but only the first 200 results are returned.

4.3 Network Interfaces

4.3.1 Physical/ Network Interface

The physical network interface is not visible for the instrument application. The instrument application uses the communication stack as offered by the Connectivity Module.

4.3.2 Additional Protocols

Both IP addresses and host names are supported and get resolved.
Else no additional protocols are supported.

4.3.3 IPv4 and IPv6 Support

DICOM Forwarder, on top of Connectivity Modul is released only for IPv4 communication.

4.4 Configuration

Connected device list is configurable on the Web Ui of Connectivity Module. Remote AE devices that are not set up and enabled are not allowed to communicate with DICOM Forwarder.

The built in DICOM configuration is:

- AET: CZMADF
- Port number: 11111

4.4.1 AE Title/Presentation Address Mapping

The mapping of the AE Title, TCP/IP addresses and ports is configurable and those are stored in the Web Ui of Connectivity Module. When a DICOM device is added to this mapping, the corresponding AE title will be allowed to communicate with the DICOM Forwarder AE. Modification or deletion of these devices are also handled in the Web Ui of Connectivity Module.

4.4.1.1 Local AE Titles

The IP is not configurable by the DICOM Forwarder, nor the HDP. The IP is administrated by the Connectivity Module. The DICOM Forwarder application uses only one AE for all transactions. The default AE title and port number are given in section 4.4.

4.4.1.2 Remote AE Titles/Presentation Address Mapping

The mapping of remote AE Titles to TCP/IP addresses and ports is configurable. DICOM Forwarder supports a proprietary auto configuration for corresponding external DICOM devices

5 Media Interchange

Media Interchange is not scope of this document since Media Interchange is not supported by DICOM Forwarder.

6 Support of Character Sets

Accepted Character Sets

Table 6-1 Supported Character Set

Supported Specific Character Set	
Character Set Description	**Defined Term**
US-ASCII	ISO 2022 IR 6
ISO-8859-1	ISO_IR 100
ISO-8859-2	ISO_IR 101
ISO-8859-3	ISO_IR 109
ISO-8859-4	ISO_IR 110
ISO-8859-5	ISO_IR 144
ISO-8859-6	ISO_IR 127
ISO-8859-7	ISO_IR 126
ISO-8859-8	ISO_IR 138
ISO-8859-9	ISO_IR 148
JIS_X0201	ISO_IR 13
TIS-620	ISO_IR 166
ISO-8859-1	ISO 2022 IR 100
ISO-8859-2	ISO 2022 IR 101
ISO-8859-3	ISO 2022 IR 109
ISO-8859-4	ISO 2022 IR 110
ISO-8859-5	ISO 2022 IR 144
ISO-8859-6	ISO 2022 IR 127
ISO-8859-7	ISO 2022 IR 126
ISO-8859-8	ISO 2022 IR 138
ISO-8859-9	ISO 2022 IR 148
JIS_X0201	ISO 2022 IR 13
TIS-620	ISO 2022 IR 166
JIS0208	ISO 2022 IR 87
JIS0212	ISO 2022 IR 159
cp949	ISO 2022 IR 149
UTF-8	ISO_IR 192
GB18030	GB18030

Returned Character Sets

N/A

7 Security

DICOM Forwarder accepts only associations from configured remote AE Titles.

Apart from that, the DICOM capabilities of the DICOM Forwarder does not support any specific security measures. Although the DICOM Forwarder is part of the Connectivity Module provided and HDP ecosystem, the application itself is restricted to run in a separate containerized environment.

Other network security procedures such as automated intrusion detection may be appropriate in some environments. Additional security features may be established by the local security policy and are beyond the scope of this conformance statement.

8 Annexes

8.1 IOD Contents

8.1.1 Created SOP Instance(s)

DICOM Forwarder does not create any DICOM data.

8.1.2 Usage of Attributes from Received IOD's

Not applicable.

8.1.3 Attribute Mapping

DICOM Forwarder translates DICOM DIMSE MWL Request to DICOM Web UPS-RS Request. The attribute mapping is applied on the **Table 4-32**.

8.1.4 Coerced/Modified Fields

DICOM Forwarder does not modify any DICOM data.

8.2 Data Dictionary of Private Attributes

DICOM Forwarder does not create any private attributes.

8.3 Coded Terminology and Templates

DICOM Forwarder does not use or create any codes.

8.4 Greyscale Image Consistency

Not applicable.

8.5 Standard Extended / Specialized/ Private SOP Classes

Not applicable

8.6 Private Transfer Syntaxes

No Private Transfer Syntax is supported.

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