Domako 1.3

DICOM Conformance Statement 1.0

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1 Introduction

1.1 Purpose

A DICOM Conformance Statement is intended to describe which components, optional components or extensions of the DICOM standard are supported by a particular implementation. The Conformance Statement of one implementation can be compared with the Conformance Statement from another implementation to determine which capabilities are commonly supported.

DICOM does not, by itself, guarantee interoperability. Furthermore, the identification of common capabilities by comparing DICOM Conformance Statements is also not sufficient to guarantee connectivity between two devices.

A DICOM Conformance Statement cannot replace validation and cross-vendor testing with other devices. Validation and cross-vendor testing are still required to ensure that both devices are performing as intended.

The reader should be aware of a number of important issues:

- Even when comparing this Conformance Statement with the Conformance Statement of another device indicates that connectivity is possible, the system integrator is responsible for carrying out test procedures to ensure that the required connectivity is actually met.

- Neither the DICOM Standard nor this Conformance Statement can ensure interoperability when integrating devices from different vendors. It is the system integrator’s responsibility to ensure that the application requirements of all devices within the complete system are met.

- The DICOM standard undergoes continual review and improvement in order to meet changing requirements. Corrections, extensions and additional services are added from time to time. Medigration reserves the right to make changes to the product described in this conformance statement in order to cover changes in the DICOM standard. Readers should be aware that connected devices should also follow changes in the DICOM standard in order to retain connectivity.

The intended audience for this Conformance Statement is hospital technical staff, system integrators and software engineers. The reader is assumed to have good understanding of the DICOM standard.

1.2 Scope

This conformance statement describes the DICOM capabilities of the medigration Domako dosemanagement software. Domako is specifically designed to be integrated into a DICOM network environment containing Modalities, PACS and Workstations from different vendors. It supports those DICOM services needed to receive dose reports, images and other objects to extract dose information. Note that domako will not archive these objects, so it has to be ensured that they are safely stored and archived by a PACS system. Domako maintains a local database where these objects are cached and will support DICOM services to query this local cache. Objects will be deleted automatically from the local cache if they have been imported to the dose management database.

Domako is capable of accepting any kind of DICOM composite object (DCO) through its DICOM interface, such as structured reports, images, overlays, lookup-tables, waveforms, presentation states or radiotherapy plans which can be stored using the Storage Service Class. It will ignore every object that cannot be interpreted according to radiation dose data.

This Conformance Statement describes the DICOM Conformance of the network interface.

1.3 Definitions, Acronyms and Abbreviations

1.3.1 Definitions

Definition	*Description*
System Integrator	A person or organization responsible for integrating devices into a new or existing system. The System Integrator takes responsibility for ensuring that the system works as a whole.

Table 1: Definitions

Other definitions can be found within the different parts of the DICOM standard [1].

1.3.2 Acronyms and Abbreviations

Acronym/Abbreviation	*Description*
AE	**A**pplication **E**ntity
DCO	**D**ICOM **C**omposite **O**bject. A DICOM object such as an image, overlay, lookup-table, waveform, presentation state or radiotherapy plan which can be stored using the Storage Service Class.
SR	**S**tructured **R**eport
SW	**S**oft**w**are

Table 2: Acronyms and Abbreviations

Other acronyms and abbreviations used within this document are defined within the different parts of the DICOM standard [1].

1.4 References

[1] DICOM, PS3 – 2016b, National Electrical Manufacturers Association, 1300 N. 17th Street Rosslyn, Virginia 22209, USA.

2 Implementation Mode

Domako is a software for extracting, storing and evaluating radiation dose data that may be provided by different DICOM datasources. It will be read from DICOM Composite Objects such as Structured Reports and Images.

Domako is capable of accepting any kind of DICOM composite object (DCO) through its DICOM interface, such as structured reports, images, overlays, lookup-tables, waveforms, presentation states or radiotherapy plans which can be stored using the Storage Service Class. It will ignore every object that cannot be interpreted according to radiation dose data.

Domako maintains a local database where these objects are cached and will support DICOM services to query this local cache. Objects will be deleted automatically from the local cache if they have been imported to the dose management database.

2.1 Application Data Flow Diagram

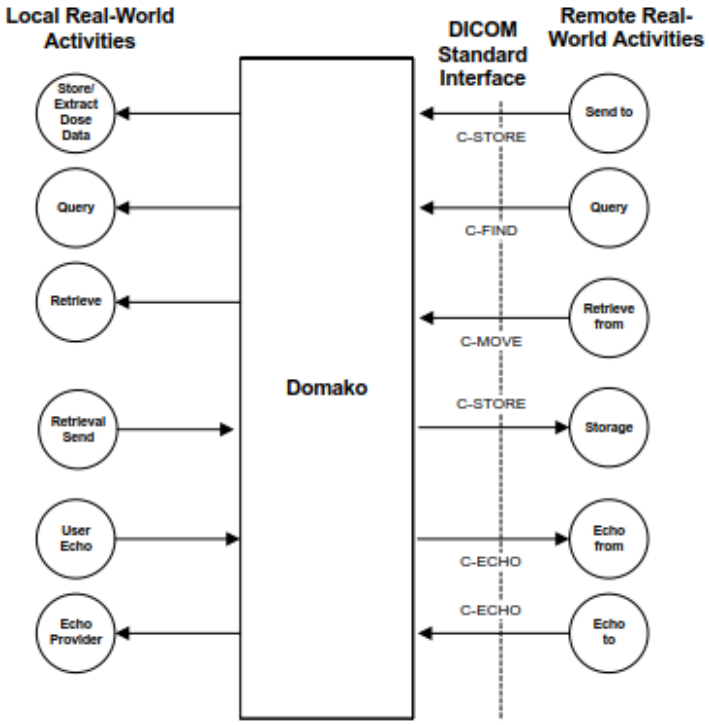

Figure 1: Domako Implementation Model

Figure 1 illustrates the relationships between the Domako Application Entity (AE) and its associated Real-World Activities. The **Remote Real-World Activities** are shown on the right and the **Local Real-World Activities** are shown on the left.

Send to is an activity performed by a remote device to send DCOs to Domako to be cached and interpreted by the **Store/Extract Dose Data** local activity.

Query and **Retrieve** are activities performed by Domako to answer queries of a remote device and to receive orders for sending DCOs. The processing of Query/Retrieve requests is managed by the **Query** and the **Retrieve from** activity of the remote device.

DCOs can be sent as the result of a retrieve request by the **Retrieval Send** local activity. They are stored by the **Storage** activity on the remote device.

User Echo is an activity performed by the Domako to verify the ability of a remote device to respond to DICOM messages. Echo messages will be sent upon operation request. They are responded by the **Echo from** activity on the remote device.

Echo to is an activity performed by a remote device to verify the ability of Domako to respond to DICOM messages. The local activity **Echo Provider** will respond to a received echo message.

2.2 Functional Definition of Application Entities

The Domako software acts as a single Application Entity (AE) providing a general storage service for structured reports, medical images and other related objects. The AE is able to receive images for storage and to respond to query and retrieve requests.

Domako acts as an SCU of the following DICOM Service Classes:

- Verification
- Storage

Domako acts as an SCP of the following DICOM Service Classes:

- Verification
- Storage
- Query/Retrieve

2.3 Sequencing of Real-World Activities

No sequencing of Real-World activities is relevant except that DCOs must be available before they can be retrieved. DCOs are made available by reception via the DICOM Storage Service Class. DCOs will no longer be available any time after they have been processed and radiation dose data has been extracted.

3 Domako Application Entity Specification

Domako provides standard conformance to the Verification Service Class by supporting the SOP Class and roles listed in Table 3.

SOP Class Name	*UID*	*Role*
Verification	1.2.840.10008.1.1	SCU/SCP

Table 3: Supported DICOM Verification SOP Classes and Roles

Domako provides standard conformance to the Storage Service class by supporting the SOP Classes and roles listed in Table 4.

Additional SOP classes may be accepted but will not be parsed for radiation dose data.

SOP Class Name	*UID*	*Role*
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCU/SCP
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	SCU/SCP
Digital Mammography X-Ray Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	SCU/SCP
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCU/SCP
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	SCU/SCP
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCU/SCP
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	SCU/SCP
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCU/SCP
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1	SCU/SCP
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3	SCU/SCP
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	SCU/SCP
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	SCU/SCP
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	SCU/SCP
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	SCU/SCP

Table 4: Supported DICOM Storage SOP Classes and Roles

Domako provides standard conformance to the Query/Retrieve Service class by supporting the SOP Classes and roles listed in Table 5.

SOP Class Name	*UID*	*Role*
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	SCP
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	SCP

Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCP
Patient/Study Only Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	SCP
Patient/Study Only Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	SCP

Table 5: Supported DICOM Query/Retrieve SOP Classes and Roles

3.1 Association Establishment Policies

3.1.1 General

All relevant DICOM communication parameters (AE Titles, hostnames or IP addresses, port numbers, etc.) are configurable. See section 5 for more information on configurable parameters. A maximum PDU size of 16KB will be offered when establishing associations. Any maximum PDU size will be accepted although PDU sizes larger than 64k will never be sent.

3.1.2 Number of Associations

The number of concurrent associations which can be accepted is configurable. See section 5 for more information on configurable parameters.

No fixed limit exists on the number of associations which can be initiated other than the resource limits imposed by the underlying operating system.

3.1.3 Implementation Identifying Information

Information	*Value*
Implementation Class UID:	1.2.276.0.7230010.3.0.3.5.4
Implementation Version Name:	medigration

Table 6: Implementation Identifying Information

3.2 Association Initiation Policy

Domako will initiate associations in the following situations:

- As the result of a retrieve request (C-MOVE) in order to perform the sub-operations necessary to send the requested images to a remote device.

3.2.1 Operator Initiated Communication Verification

3.2.1.1 Associated Real-World Activity (User Echo)

A support operator is able to initiate a test to verify communication. The associated local real-world activity is **User Echo** and the remote real-world activity is **Echo from**. The communication verification test is considered successful if an association can be established, a presentation context for the Verification SOP Class can be negotiated, a response is received from a C-ECHO request and the association is released.

3.2.1.2 Proposed Presentation Contexts

A single presentation context will be proposed for *operator-initiated communication verification* as shown in Table 7.

Abstract Syntax		*Transfer Syntax*		*Role*	*Extended Negotiation*
Name	*UID*	*Name*	*UID*		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 7: Proposed presentation context for verification

3.2.1.3 SOP Specific Conformance

Standard conformance is provided for the Verification SOP Class.

3.2.1.4 Association Termination

The association will be released upon receipt of the C-ECHO-RSP message.

3.2.2 Retrieve-Initiated Image Send

3.2.2.1 Associated Real-World Activity (Retrieval Send)

A new association will be established in response to a retrieve request (C-MOVE) received by the **Retrieve** Real-World Activity. The local real-world activity is **Retrieval Send** and the remote real-world activity is **Storage**. All images referenced by a single C-MOVE request will be sent over a single association.

3.2.2.2 Proposed Presentation Contexts

One or more presentation contexts will be proposed for retrieve initiated image send as outlined in Table 8. However, only those Storage SOP Classes of images to actually be sent will be proposed (e.g. if only CT images are to be sent then only the CT Image Storage SOP Class will be proposed as an abstract syntax). Each abstract syntax will be proposed within at least 2 presentation contexts using different transfer syntax subsets. The presentation context proposal policy attempts to propose abstract syntax / transfer syntax combinations such that the original transfer syntax of received images can be maintained when sending images. This behavior is intended to eliminate transfer syntax conversion wherever possible and is particularly beneficial in the context of digitally signed images.

The presentation context proposal policy can be modified by configuration options so that only the default transfer syntax (Implicit VR Little Endian) is proposed during association negotiation with specific application entities.

Abstract Syntax		*Transfer Syntax*		*Role*	*Extended Negotiation*
Name	*UID*	*Name*	*UID*		
Any of the Storage SOP Class names listed in Table 4.	Any of the Storage SOP Class UIDs listed in Table 4.	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2.	SCU	None
		Medigration Explicit VR Little Endian	1.2.276.0.33.1	SCU	None
		Medigration Implicit VR Little Endian	1.2.276.0.33.2	SCU	None
		Medigration Explicit VR Big Endian	1.2.276.0.33.3	SCU	None
		Medigration Pyra Explicit	1.2.276.0.33.4	SCU	None

		VR Little Endian			
		Medigration Pyra Implicit VR Little Endian	1.2.276.0.33.5	SCU	None
		Medigration Pyra Explicit VR Big Endian	1.2.276.0.33.6	SCU	None

Table 8: Proposed presentation contexts for retrieve initiated image send

3.2.2.3 SOP Specific Conformance

The behavior when receiving C-STORE response status codes is shown in Table 9.

Status Code	*Meaning*	*Behavior when receiving status code*
	Any other status code not included in this table	An error message is recorded in a log file. The Number of Failed Sub-Operations Count will be incremented (returned in C-MOVE responses).
A7xx	Refused – Out of Resources	
A9xx	Error – Data Set does not match SOP Class	A message is recorded in a log file. The Number of Warning Sub-Operations Count will be incremented (returned in C-MOVE responses).
Cxxx	Error – Cannot Understand	
B000	Warning – Coercion of Data Elements	A message is recorded in a log file. The Number of Successful Sub-Operations Count will be incremented (returned in C-MOVE responses).
B007	Warning – Data Set does not match SOP Class	
B006	Warning – Elements Discarded	
0000	Success	

Table 9: Behavior when receiving C-STORE response status codes (retrieve initiated)

Extended negotiation is not supported for the **Retrieval Send** Real-World Activity. All optional attributes included in Storage SOP Instances will be sent as originally received. Storage SOP Instances are stored without modification when received and are not modified when sent. No additional attributes are added. The Domako application entity is bit-preserving and maintains the integrity of any embedded digital signatures when sending provided the original transfer syntax is supported by the remote Application Entity.

3.2.2.4 Association Termination

The association will be released upon receipt of the C-STORE-RSP message for the last sent image or upon receipt of refused or unknown status code.
If the peer AE aborts the association prematurely, all unsent SOP Instances are considered failed.

3.3 Association Acceptance Policy

Domako will accept associations for the following situations:

- To respond to communication verification requests from remote devices.
- To receive DCOs to extract radiation dose data from remote devices.
- To process query and retrieve requests from remote devices.

Associations can be accepted at any time while the Domako application entity is active. The Domako application entity may not be active if stopped or restarted by an operator.

Associations will be terminated (A-ABORT) if they are idle for more than 20 minutes.

3.3.1 Respond to Communication Verification Requests

3.3.1.1 Associated Real-World Activity

An association will be accepted from a remote Application Entity in order to respond to communication verification requests. The local real-world activity is **Echo Provider** and the remote real-world activity is **Echo to**.

3.3.1.2 Acceptable Presentation Contexts

Any of the presentation contexts shown in Table 10 can be accepted.

Abstract Syntax		*Transfer Syntax*		*Role*	*Extended Negotiation*
Name	*UID*	*Name*	*UID*		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Table 10: Acceptable presentation context for verification

3.3.1.3 SOP Specific Conformance

Standard conformance is provided for the Verification SOP Class.

3.3.1.4 Presentation Context Acceptance Criteria

A presentation context for the Verification SOP Class will always be accepted provided the transfer syntax selection policy is met. Presentation contexts for other supported activities may also be accepted on the same association.

3.3.1.5 Transfer Syntax Selection Policies

Only the default DICOM Transfer Syntax (Implicit VR Little Endian) will be accepted.

3.3.2 Receive DCOs for Storage

3.3.2.1 Associated Real-World Activity

An association will be accepted from a remote Application Entity in order to receive DCOs for storage and radiation dose data extraction. The local real-world activity is **Store/Extract Dose Data** and the remote real world activity is **Send to**.

Received DCOs are stored on local disk, radiation dose and summary information will be extracted where applicable and stored in a database.

The extraction of radiation dose and summary information is tolerant of encoding errors wherever possible. Invalid attribute values will be retained in the image files but may be ignored or truncated when inserted into the database.

After dose data has been extracted the accompanying DCOs will be stored in a temporal database where they can be queried as long as the are kept. The contents of the temporal database are searched when performing the **Query** real-world activity (see section 3.3.3). Invalid attribute values may appear to be returned missing or truncated when performing a C-FIND operation. However, the complete DCO will always be sent when retrieved (including any invalid attribute values).

3.3.2.2 Acceptable Presentation Contexts

Any of the presentation contexts shown in Table 11 can be accepted.

Abstract Syntax		*Transfer Syntax*		*Role*	*Extended Negotiation*
Name	*UID*	*Name*	*UID*		
Any of the Storage SOP Class names listed in Table 4.	Any of the Storage SOP Class UIDs listed in Table 4.	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		JPEG Lossless, Non-Hierachical, First-Order Pred. (Process 14)	1.2.840.10008.1.2.4.70	SCP	None

Table 11: Acceptable presentation contexts for storage

3.3.2.3 SOP Specific Conformance

Conformance to the SOP Classes of the Storage Service Class is at Level 2 (Full). Moreover, all received attributes (Type 1, Type 2, Type 3 and Private) are stored without modification. No attributes are discarded. Received DCOs are written to local disk using the DICOM File Format as specified in PS 3.10. The storage architecture is bit-preserving and images are written to the Data Set portion of the File Format exactly as received over the network interface. The identity of the transfer syntax used to receive the image is recorded in the File Format meta header along with the Source Application Entity Title.

No specific policies are required concerning the attribute Lossy Image Compression (0028,2110).

No automatic coercion of attribute values will be performed.

If a success or warning status is returned in a C-STORE response the image has been stored to local disk and registered in the central database. If an image is received containing a SOP Instance UID which is already stored in the database then a success status is returned and the image will be updated.

Stored DCOs in the temporal database can be accessed via the **Query/Retrieve** Real-World Activity. The duration of storage is temporal. DCOs are at least stored

until they have been processed and radiation dose data has been extracted.

The meaning of status codes which can be returned in a C-STORE response are listed in Table 12. More detailed error information may be provided in the related fields Offending Element (0000, 0901) and Error Comment (0000,0902).

Status Code	*Meaning*	*Detail*
A700	Refused – Out of Resources	Insufficient disk space is available or insufficient permissions exist to store the image. The image cannot be stored. An error message is recorded in a log file.
A900	Error – Data Set does not match SOP Class	A serious incompatibility between the dataset and the supposed SOP Class was detected. The image cannot be stored. An error message is recorded in a log file.
C000	Error – Cannot Understand	A serious error occurred while parsing the image or an error occurred while updating the database. The image cannot be stored. An error message is recorded in a log file.
0000	Success	The image has been successfully stored or an image with the same SOP Instance UID already exists. A message is recorded in a log file.

Table 12: C-STORE response status codes

3.3.2.4 Presentation Context Acceptance Criteria

Presentation contexts for any of the supported Storage SOP Classes will always be accepted provided the transfer syntax selection policy is met. Presentation contexts for other supported activities may also be accepted on the same association.

3.3.2.5 Transfer Syntax Selection Policies

Preference is by default given to receiving images encoded using an explicit transfer syntax. However, configuration options can be used to limit acceptance to only the default DICOM Transfer Syntax (Implicit VR Little Endian) when accepting associations from specific application entities (see section 5 for configuration options).

When multiple Transfer Syntaxes are presented, a selection is made using following priority:

1. Explicit VR Little Endian
2. Explicit VR Big Endian
3. Implicit VR Little Endian

3.3.2.6 Data Elements that Contribute to Dose Database

When processing a structured report DCO, Domako will follow the

- TID 10001 Projection X-Ray Radion Dose
- TID 10011 CT Radiation Dose

templates.

The following dose related concepts will be extracted and stored to the dose database:

DCM 111031 Image View
DCM 111526 Date Time Started
DCM 111631 Average Glandular Dose
DCM 111632 Anode Target Material
DCM 112227 Frame of Reference UID
DCM 113705 Scope of Accumulation
DCM 113721 Irradiation Event Type
DCM 113731 Total Number of Radiographic Frames
DCM 113732 Fluoro Mode
DCM 113733 KVP
DCM 113734 X-Ray Tube Current
DCM 113736 Exposure
DCM 113742 Irradiation Duration
DCM 113750 Distance Source to Detector
DCM 113757 X-Ray Filter Material
DCM 113764 Acquisition Plane
DCM 113767 Average Tube Current
DCM 113768 Number of Pulses
DCM 113769 Irradiation Event UID
DCM 113771 X-Ray Filters
DCM 113772 X-Ray Filter Type
DCM 113791 Pulse Rate
DCM 113793 Pulse Width
DCM 113809 Start of X-Ray Irradiation
DCM 113820 Acquisition Type
DCM 113822 CT Acquisition Parameters
DCM 113824 Exposure Time

DCM 113825 Scanning Length
DCM 113826 Nominal Single Collimation Width
DCM 113827 Nominal Total Collimation Width
DCM 113828 Pitch Factor
DCM 113829 CT Dose
DCM 113830 Mean CTDIvol
DCM 113831 CT X-Ray Source Parameters
DCM 113833 Maximum X-Ray Tube Current
DCM 113835 CTDIw Phantom Type
DCM 113838 DLP
DCM 113839 Effective Dose
DCM 113842 X-Ray Modulation Type
DCM 113855 Total Acquisition Time
DCM 113870 Person Name
DCM 113900 Dose Check Alert Details
DCM 113903 DLP Alert Value
DCM 113907 Reason for Proceeding
DCM 113930 Size Specific Dose Estimate
DCM 121014 Device Observer Manufacturer
DCM 121015 Device Observer Model Name
DCM 121016 Device Observer Serial Number
DCM 121106 Comment
DCM 122130 Dose Area Product
DCM 123014 Target Region
DCM 125203 Acquisition Protocol
SRT G-C171 Laterality

When processing a structured report or an image DCO, the following data elements will be extracted and stored to the dose database:

0002,0016 Source Application Entity Title
0008,0018 SOP Instance UID
0008,0020 Study Date
0008,0021 Series Date
0008,0022 Acquisition Date
0008,0030 Study Time
0008,0031 Series Time
0008,0032 Acquisition Time
0008,0050 Accession Number
0008,0060 Modality
0008,0070 Manufacturer
0008,0080 Institution Name
0008,1010 Station Name
0008,1030 Study Description
0008,103e Series Description
0008,1040 Institutional Department Name
0008,1050 Performing Physicians' Name

0008,1070 Operators' Name
0008,1090 Manufacturer Model Name
0008,3010 Irradiation Event UID
0010,0010 Patient Name
0010,0020 Patient ID
0010,0030 Patient Birth Date
0010,0040 Patient Sex
0010,1020 Patient Size
0010,1030 Patient Weight
0010,21c0 Pregnancy Status
0018,0015 Body Part Examined
0018,0060 KVP
0018,1000 Device Serial Number
0018,1030 Protocol Name
0018,1110 Distance Source to Detector
0018,1150 Exposure Time
0018,1152 Exposure
0018,1153 Exposure in uAs
0018,115e Image Area Dose Product
0018,9302 Acquisition Type
0020,000e Series Instance UID
0020,000d Study Instance UID
0020,0011 Series Number
0020,0060 Laterality
0020,4000 Image Comments
0032,1060 Requested Procedure Description
0040,0007 Scheduled Procedure Step Description
0040,0254 Performed Procedure Step Description
0040,0302 Entrance Dose
0040,0316 Organ Dose
0040,0318 Organ Exposed

3.3.3 Query the local Database and Retrieve DCOs

3.3.3.1 Associated Real-World Activity

An association will be accepted from a remote Application Entity in order to query the database and initiate retrieval of images. The local real-world activity is **Query/Retrieve** and the remote real world activity is **Query/Retrieve Archive**.

Received images are stored on local disk as part of the local real-world activity **Storage** (see section 3.3.2). As part of the **Storage** real-world activity, summary information extracted from the image and inserted in a central database. The extraction of summary information is tolerant of encoding errors wherever possible. Invalid attribute values will be retained in the image files but may be ignored or truncated when inserted into the central database.

In order to perform the **Query/Retrieve Archive** real-world activity described in this section, the contents of the central database is searched. Invalid attribute values may appear to be returned missing or truncated when performing a C-FIND operation. However, the complete image will always be sent when retrieved (including any invalid attribute values).

3.3.3.2 Acceptable Presentation Contexts

Any of the presentation contexts shown in Table 13 can be accepted.

Abstract Syntax		*Transfer Syntax*		*Role*	*Extended Negotiation*
Name	*UID*	*Name*	*UID*		
Any of the Query/Retrieve SOP Class names listed in Table 5.	Any of the Query/Retrieve SOP Class UIDs listed in Table 5.	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Medigration Explicit VR Little Endian	1.2.276.0.33.1	SCU	None
		Medigration Implicit VR Little Endian	1.2.276.0.33.2	SCU	None
		Medigration Explicit VR Big Endian	1.2.276.0.33.3	SCU	None
		Medigration Pyra Explicit VR Little Endian	1.2.276.0.33.4	SCU	None
		Medigration Pyra Implicit VR Little Endian	1.2.276.0.33.5	SCU	None
		Medigration Pyra Explicit VR Big Endian	1.2.276.0.33.6	SCU	None

Table 13: Acceptable presentation contexts for Query/Retrieve

3.3.3.3 SOP Specific Conformance for Query (C-FIND) SOP Classes

Standard conformance is provided for the C-FIND SOP Classes and Information Models listed in Table 5.

Priority processing is not supported. Relational queries are not supported.

The attributes values returned by a C-FIND response may differ from the values stored in the images because the attribute value in the received image was invalid and could not be recorded in the database or because the attribute value was too long and was truncated prior to insertion in the database.

Fractional second components of time values are not stored in the database. Fractional seconds are truncated in C-FIND requests and responses. Fractional second components in Study Time or Image Time query keys will be ignored and a C-FIND response will not contain fractional seconds.

The query keys supported are listed in Table 14, Table 15, Table 16 and Table 17. The tables also indicate if the attribute is supported as a matching key. In the case of Query SOP Classes of the Study Root Information Model, the Patient Level Query Keys are also supported at the study level.

Attribute Name	*Tag*	*Matching*
Patient's Name	(0010,0010)	✓
Patient ID	(0010,0020)	✓
Patient's Birth Date	(0010,0030)	✓
Patient's Sex	(0010,0040)	✓
Number of Patient Related Studies	(0020,1200)	×
Number of Patient Related Series	(0020,1202)	×
Number of Patient Related Instances	(0020,1204)	×

Table 14: Supported Patient Level Query Keys

Attribute Name	*Tag*	*Matching*
Study Date	(0008,0020)	✓
Study Time	(0008,0030)	✓
Accession Number	(0008,0050)	✓
Study ID	(0020,0010)	✓
Study Instance UID	(0020,000D)	✓
Referring Physician's Name	(0008,0090)	✓
Modalities in Study	(0008,0061)	✓
Study Description	(0008,1030)	✓
Name of Physician(s) Reading Study	(0008,1060)	✓
Number of Study Related Series	(0020,1206)	×
Number of Study Related Instances	(0020,1208)	×

Table 15: Supported Study Level Query Keys

Attribute Name	*Tag*	*Matching*
Modality	(0008,0060)	✓
Series Number	(0020,0011)	✓
Series Instance UID	(0020,000E)	✓
Body Part Examined	(0018,0015)	✓
Series Description	(0008,103E)	✓
Request Attribute Sequence	(0040,0275)	✓
> Requested Procedure ID	(0040,1001)	✓
> Scheduled Procedure Step ID	(0040,0009)	✓
Performed Procedure Step Start Date	(0040,0244)	✓
Performed Procedure Step Start Time	(0040,0245)	✓
Number of Series Related Images	(0020,1209)	×

Table 16: Supported Series Level Query Keys

Attribute Name	*Tag*	*Matching*
General Image Level Query Keys		
Image Number	(0020,0013)	✓
SOP Class UID	(0008,0016)	✓
SOP Instance UID	(0008,0018)	✓
Content Date	(0008,0023)	✓
Content Time	(0008,0033)	✓
Number of Frames	(0028,0008)	✓
Bits Allocated	(0028,0100)	✓
Rows	(0028,0010)	✓
Columns	(0028,0011)	✓
Observation Date Time	(0040,A032)	×
Image Level Query Keys for Presentation State		
Presentation Label	(0070,0080)	×
Presentation Description	(0070,0081)	×
Presentation Creation Date	(0070,0082)	×
Presentation Creation Time	(0070,0083)	×
Presentation Creator's Name	(0070,0084)	×
Referenced Series Sequence	(0008,1115)	×
> Series Instance UID	(0020,000E)	×
> Referenced Image Sequence	(0008,1140)	×
>> Referenced SOP Class UID	(0008,1150)	×
>> Referenced SOP Instance UID	(0008,1155)	×
Image Level Query Keys for Structured Report and Key Image Notes		
Completion Flag	(0040,A491)	✓
Verification Flag	(0040,A493)	✓
Verifying Observer Sequence	(0040,A073)	✓
> Verifying Organization	(0040,A027)	×
> Verification DateTime	(0040,A030)	✓
> Verifying Observer Name	(0040,A075)	✓

> Verifying Observer Identification Code Sequence	(0040,A088)	×
>> Code Value	(0008,0100)	×
>> Coding Scheme Designator	(0008,0102)	×
>> Coding Scheme Version	(0008,0103)	×
>> Code Meaning	(0008,0104)	×
Referenced Request Sequence	(0040,A370)	×
> Study Instance UID	(0020,000D)	×
> Accession Number	(0008,0050)	×
> Requested Procedure ID	(0040,1000)	×
> Requested Procedure Code Sequence	(0032,1064)	×
>> Code Value	(0008,0100)	×
>> Coding Scheme Designator	(0008,0102)	×
>> Coding Scheme Version	(0008,0103)	×
>> Code Meaning	(0008,0104)	×
>> Concept Name Code Sequence	(0040,A043)	✓
> Code Value	(0008,0100)	✓
> Coding Scheme Designator	(0008,0102)	✓
> Coding Scheme Version	(0008,0103)	×
> Code Meaning	(0008,0104)	×

Table 17: Supported Image Level Query Keys

Related date and time query keys (e.g. Study Date and Study Time or Image Date and Image Time) are treated independently during matching. If both the date and time parts are included in a query request then results will only be returned for entries on the matching day and at the matching time. For example, specifying the date range 19990101-19990102 together with the time range 0900-1700 could match 1999.01.01 12:00 but would not match 1999.01.01 18:00 nor 1999.01.02 08:00.

The C-FIND response identifier will contain, in addition to the requested key attributes and the current query/retrieve level, the supplementary attributes listed in Table 18.

Attribute Name	*Tag*	*Conditions*
Specific Character Set	(0008,0005)	A value of “ISO_IR 100 is returned.
Retrieve AE Title	(0008,0054)	The Domako application entity title is returned.
Storage Media File-Set ID	(0008,0130)	Returned if one or more SOP Instances associated with the C-FIND response are only available offline (e.g. on a media not present on online or nearline storage). Contains the identity of the first offline media which must be made available in order to
Storage Media File-Set UID	(0008,0140)	

		satisfy a retrieve request on the unique key corresponding to the contents of the C-FIND response. The Storage Media File-Set ID corresponds to the label of an archive media.
Instance Availability	(0008,0056)	A value of ONLINE, NEARLINE, OFFLINE is returned.

Table 18: Supplementary Response Identifier Keys

The meaning of status codes which can be returned in a C-FIND response are listed in Table 19. More detailed error information may be provided in the related fields Offending Element (0000,0901) and Error Comment (0000,0902).

Status Code	*Meaning*	*Detail*
A900	Failed – Identifier does not match SOP Class	A serious incompatibility between the identifier and the supposed SOP Class was detected. The query cannot be processed. An error message is recorded in a log file.
C000	Failed – Unable to process	A serious error occurred while parsing the query identifiers or an error occurred while searching the database. The query cannot be processed. An error message is recorded in a log file.
FE00	Cancel	Matching terminated due to Cancel request.
0000	Success	Matching is complete.
FF00	Pending	Matches are continuing – Current Match is supplied and Optional Keys were supported in the same manner as Required Keys.
FF01	Pending - Warning	Matches are continuing – Warning that one or more Optional Keys were not supported for existence and/or matching for this identifier.

Table 19: C-FIND response status codes

3.3.3.4 SOP Specific Conformance for Retrieve (C-MOVE) SOP Classes

Standard conformance is provided for the C-MOVE SOP Classes and Information Models listed in Table 5.
Requests to retrieve DCOs which are currently only accessible on offline media (e.g. on an inaccessible media) will cause a media load request to be posted to the operator to make the media available (i.e. to insert the required media). The processing of the C-MOVE request will proceed without waiting for the required media to become available and sub-operations for unavailable images will fail. The C-MOVE request should be repeated at a later time. An SCU can determine the availability of images prior to a C-MOVE by evaluating the Instance Availability (0008,0056) attribute in a C-FIND response.

Priority processing is not supported. Relational queries are not supported.

The behavior of retrieve sub-operations is described in section 3.2.2 and the supported Storage SOP Classes listed in Table 2. All Storage SOP Classes which can be received can also be retrieved.

The meaning of status codes which can be returned in a C-MOVE response are listed in Table 20. More detailed error information may be provided in the related fields Offending Element (0000, 0901) and Error Comment (0000,0902).

Status Code	*Meaning*	*Detail*
A702	Refused – Out of Resources	Unable to perform sub-operations. None of the images could be sent. The move destination rejected the association, supports none of the required SOP Classes or failed all of the C-STORE sub-operations. An error message is recorded in a log file.
A801	Refused – Move Destination unknown	The application entity title specified in the C-MOVE request is not known to the system configuration. An error message is recorded in a log file.
A900	Failed – Identifier does not match SOP Class	A serious incompatibility between the retrieve identifiers and the supposed SOP Class was detected. The retrieve request cannot be processed. An error message is recorded in a log file.
C000	Failed – Unable to process	A serious error occurred while parsing the retrieve identifiers or an error occurred while searching the

		database. The retrieve request cannot be processed. An error message is recorded in a log file.
C101	Failed – SOP Instances Offline	All of the requested images are offline. None of the images could be sent. The operator will be requested to make the required offline media available. The C-MOVE operation should be repeated at a later time. An error message is recorded in a log file.
FE00	Cancel	Sub-operations terminated due to cancel indication.
B000	Warning	Sub-operations complete – One or more failures. One or more images could not be successfully sent. Some of the requested images may be offline, the move destination does not support one or more of the required SOP Classes or the move destination may have failed one or more C-STORE sub-operations. If some of the images are offline the operator will be requested to make the required to make the required offline media available. The C-MOVE operation should be repeated at a later time. An error message is recorded in a log file.
0000	Success	Sub-operations complete – No Failures. All requested images were successfully sent.
FF00	Pending	Sub-operations are continuing. A response with a pending status will be returned after each sub-operation has been performed.

Table 20: C-MOVE response status codes

3.3.3.5 Presentation Context Acceptance Criteria

Presentation contexts for any of the supported Query/Retrieve SOP Classes will always be accepted provided the transfer syntax selection policy is met. Presentation contexts for other supported activities may also be accepted on the same association.

3.3.3.6 Transfer Syntax Selection Policies

Preference is by default given to receiving query/retrieve identifiers encoded using an explicit transfer syntax. However, configuration options can be used to limit acceptance to only the default DICOM Transfer Syntax (Implicit VR Little Endian) when accepting associations from specific application entities (see section 5 for configuration options).

When multiple Transfer Syntaxes are presented, a selection is made using following priority:

1. Explicit VR Little Endian
2. Explicit VR Big Endian
3. Implicit VR Little Endian

4 Communication Profiles

4.1 Supported Communication Stacks

TCP/IP Network Communication is supported as defined in PS 3.8.

4.1.1 TCP/IP Stack

The TCP/IP stack is inherited from the underlying operating system.

4.1.1.1 Physical Network Media Support

No dependency exists on the physical network medium over which TCP/IP executes. The supported physical network media are inherited from the underlying operating system.

5 Configuration

The following DICOM-related network parameters are configurable by an operator:

- The title of the Domako Application Entity. Associations may or may not be accepted if the Called AE Title is not equal to the configured AE Title (this is configurable).
- The Port Number to use when listening for associations (default 104).
- The AE Titles, IP Address and Port Number for all peer application entities. These parameters must be configured before associations can be initiated or accepted. Association attempts from unknown AE Title and IP Address pairs will not be accepted.
- Support by peer application entities for the Verification SOP Class. If supported, a connectivity test can be performed upon user request.
- The preferred transfer syntax for each peer application entity. The transfer syntax selection policies can be configured such that only the Implicit VR Little Endian Transfer Syntax will be accepted for individual application entities.

The following DICOM-related network parameters are configurable by a field service engineer for the Storage, **Query/Retrieve**, **Retrieval Send** and **Echo Provider** local activities:

- The number of concurrent associations which can be accepted (default 20). This limit is bound only by the availability of underlying operating system resources.
- General association inactivity timeout (default 1800 seconds).
- Timeout waiting for a DIMSE request (default 1200 seconds).
- Timeout waiting for a DIMSE response (default 300 seconds).
- Maximum size of a received PDU (default 16KB).

The **User Send** and **User Echo** local activities use timeout and maximum PDU size parameters with defaults as defined above but are not configurable by a field service engineer.

6 Support of Extended Character Sets

The following extended character sets are supported:

ISO-IR 100 Latin Alphabet Supplementary Set No. 1 (ISO 8859-1)

Note: The DICOM default character set (ISO-IR 6) is a subset of ISO-IR 100.

History

Date	*Version*	*Author*	*Description*
Domako 1.3			
2021-12-17	1.0	Raufer	Release.
2021-12-06	0.1	Raufer	Document edited.
Domako 1.2			
2021-03-31	1.0	Raufer	Release.
2021-03-31	0.1	Raufer	Document edited.
Domako 1.1			
2018-10-19	1.0	Steinlein	Release.
2018-10-11	0.1	Steinlein	Document edited.
Domako 1.0			
2018-05-16	2.0	Steinlein	Release with incorporated changes from review.
2018-05-15	1.1	Steinlein	Document edited.
2017-12-04	1.0	Steinlein	Release with incorporated changes from review.
2017-12-01	0.1	Steinlein	Document created.