DICOM Conformance Statement
Planmeca Romexis 6.1

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1 Introduction

This is a conformance statement for the Planmeca Romexis dental imaging program, which supports DICOM Storage, Storage Commitment, Print, Modality Worklist, Query/Retrieve (Q/R) and Modality Performed Procedure Step Worklist services as a Service Class User (SCU). In addition to SCU, Planmeca Romexis supports DICOM Storage and Q/R services as a Service Class Provider (SCP).

Romexis acquires images from Planmeca's digital panoramic, digital intraoral x-rays and Planmeca's 3D CBVT equipment. Film images can be scanned using the TWAIN standard. Images from any other digital dental x-ray can be imported into Romexis in TIFF or JPEG format or as DICOM files, with or without DICOMDIR.

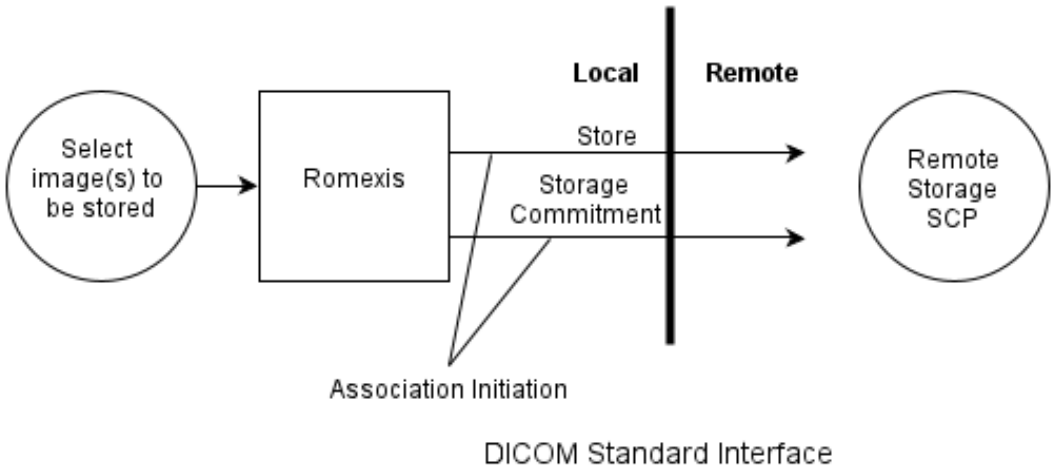
2 Implementation model

Planmeca Romexis implements a DICOM Storage SCU, DICOM Storage Commitment SCU, DICOM Basic Print SCU, DICOM Modality Worklist SCU, DICOM Q/R SCU, Verification SCU and MPPS Worklist SCU. Romexis can send images to a DICOM Storage Service Class Provider (SCP) and to a DICOM Basic Print SCP. Romexis can send DICOM queries and move requests to a DICOM Q/R SCP. Romexis can test the connection to remote DICOM SCPs. Romexis can send session related status messages to MPPS provider service as SCU.

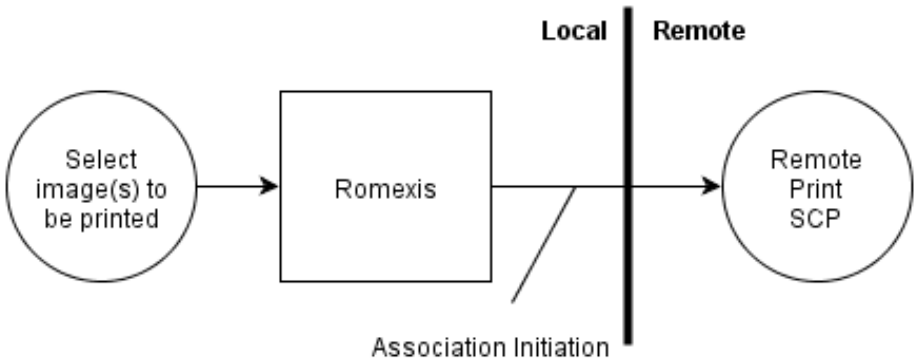
Planmeca Romexis implements a DICOM Storage SCP and DICOM Q/R SCP. DICOM Storage SCP can receive and store various 2D and 3D DICOM objects. DICOM Q/R SCP can be queried for images.

2.1 Application data flow diagram

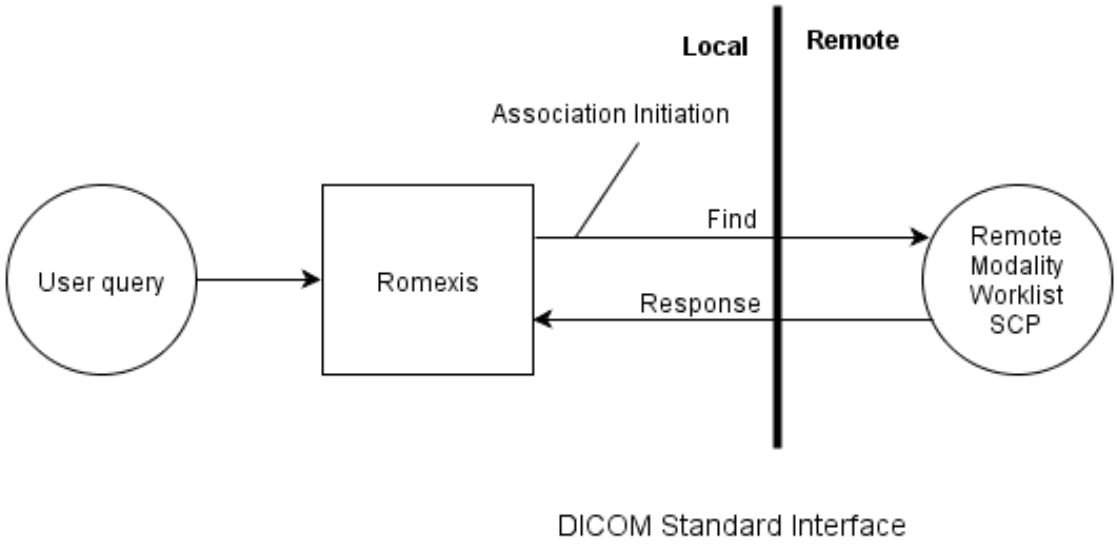
2.1.1 Storage



2.1.2 Print

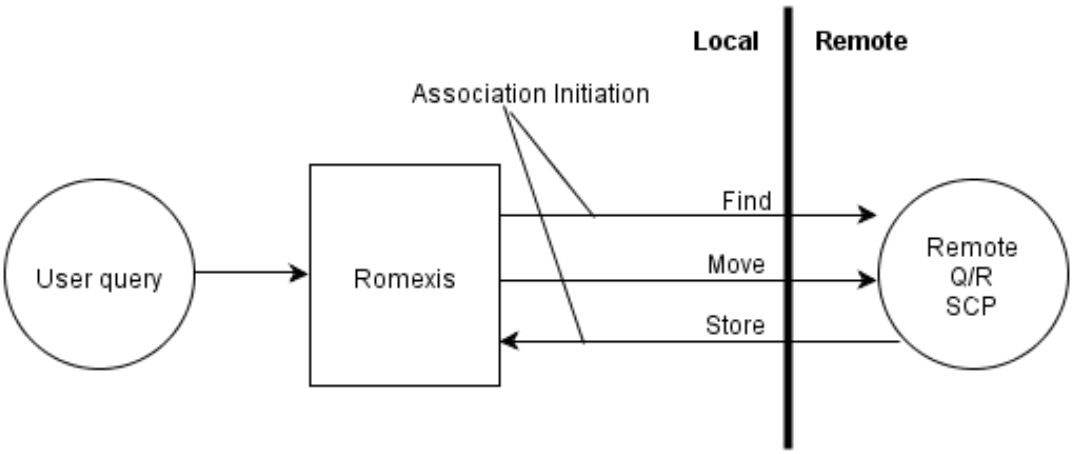


2.1.3 Worklist



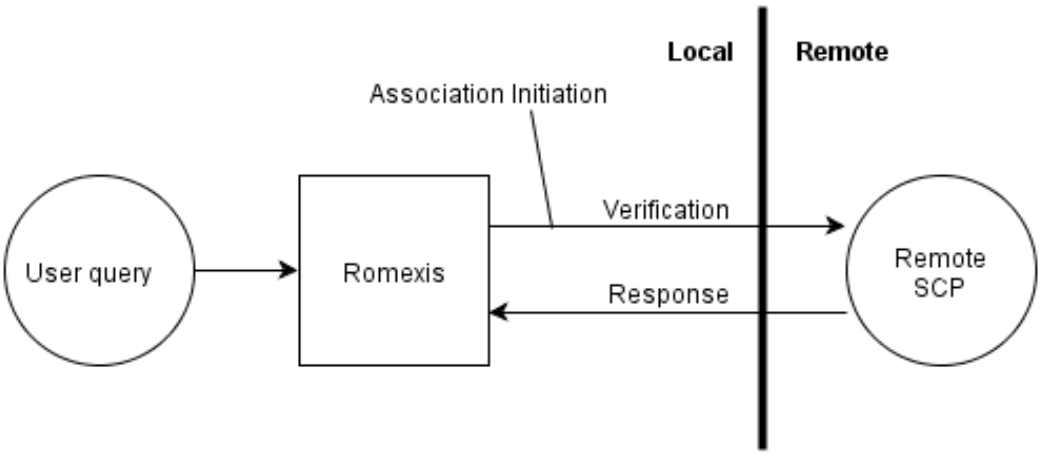
DICOM Standard Interface

2.1.4 Retrieve



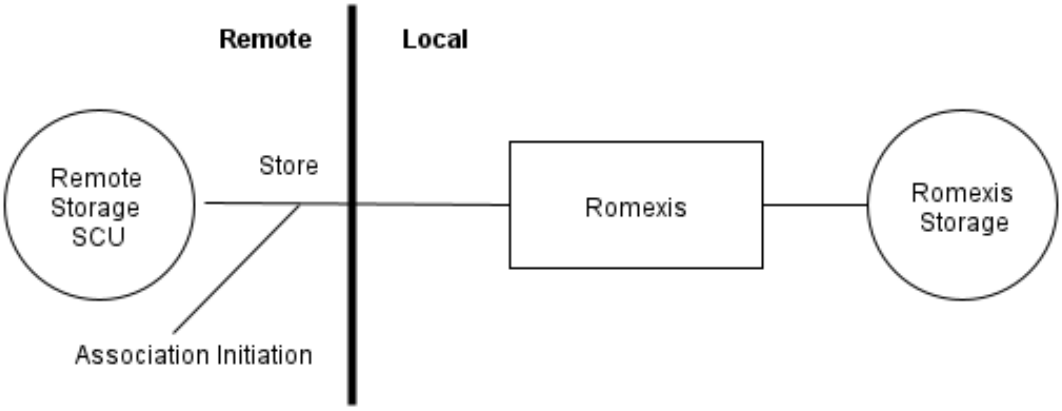
DICOM Standard Interface

2.1.5 Verification

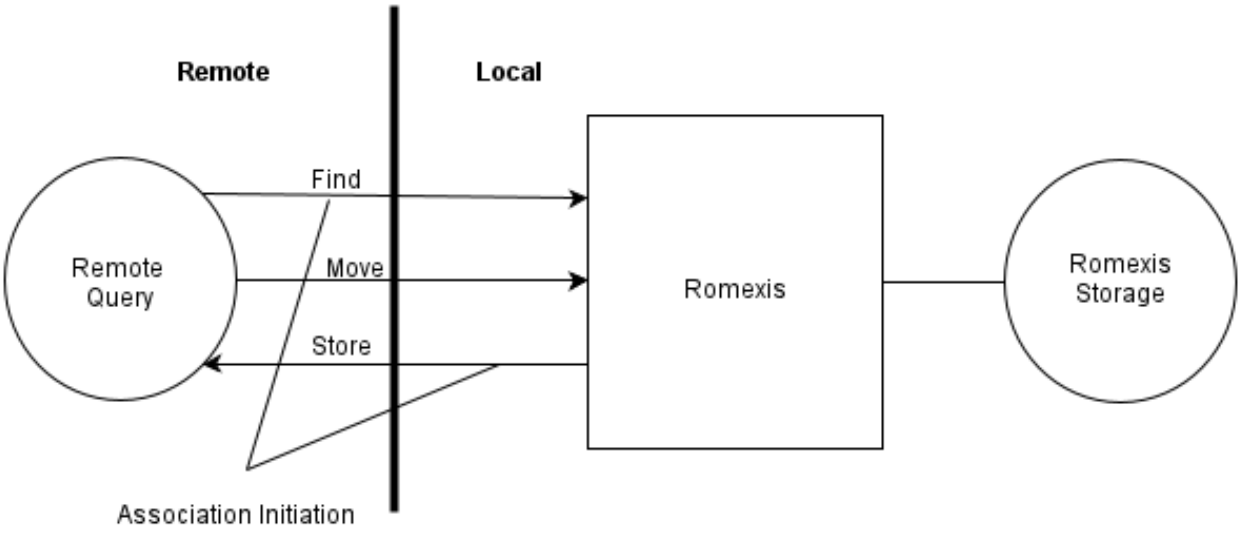


DICOM Standard Interface

2.1.6 Storage SCP



2.1.7 Query Retrieve SCP



2.2 Functional definition of Application Entities

All communications and image transfer with remote application is accomplished utilizing the DICOM protocol over a network using the TCP/IP protocol stack. TLS connections can optionally be used.

2.2.1 Verification

The verification SCU is available to operators for test and validation purposes of remote AEs. Romexis opens an association and sends C-ECHO request to verify specified DICOM SCP node. Upon receiving the response from SCP or in case of failure it closes the connection.

Romexis implements a Verification SCP for the remote AEs to verify the Romexis SCP node.

2.2.2 Storage

Romexis establishes an association with a remote AE selected by the user just prior to sending a Store request to that AE. If Storage Commitment is configured to be used in Romexis, Romexis opens another association and sends a Storage Commitment request to the AE. Alternatively, Romexis can be configured to use single association for both Store and Storage Commitment requests.

Romexis supports sending X-Ray Radiation Dose Structured Reports for CT, Intraoral, Panoramic and Cephalometric images. Storage Commitment is not used for RDSR.

Romexis can act as a Storage SCP when a remote application sends it a DICOM storage request. AE Title for Romexis Storage SCP is ROMEXIS_SCP and must be used when sending a storage request to Romexis. Romexis Storage SCP does not support Storage Commitment.

2.2.3 Print

Romexis establishes an association with a remote AE selected by the user just prior to sending a Print request to that AE.

2.2.4 Worklist

Romexis establishes an association with a remote AE selected by the user for Modality Worklist services. When an association is requested with a SCP, Romexis responds with a list of SOP Class UIDs that it will accept. If a Find request is sent then it will wait for find responses.

2.2.5 Retrieve

Romexis establishes an association with a remote AE selected by the user for Q/R services. When an association is requested with a SCP, Romexis responds with a list of SOP Class UIDs that it will accept. If a Find request is sent then it will wait for Find responses. If a Move request is sent, it will wait for a Move response.

Romexis can act as a Q/R SCP service and accepts Find, Move and Get requests from remote applications. Configuration follows same rules as Storage SCP.

2.2.6 MPPS

The Romexis DICOM Modality Performed Procedure Step (MPPS) SCU service is used together with DICOM Modality Worklist SCU service. If Romexis MPPS service is configured, it will send study ID, status of study, dates, patient name in starting the exposure, and dates and complete list of images including X-ray parameters to the server after closing exposure task.

3 Application Entity specifications

Romexis Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as a SCU:

SOP Class Name	SOP Class UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
CT Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.2
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Encapsulated STL Storage	1.2.840.10008.5.1.4.1.1.104.3

X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67
Basic Grayscale Print Management (META) Basic Film Session Basic Film Box Basic Grayscale Image Box Printer	1.2.840.10008.5.1.1.9 1.2.840.10008.5.1.1.1 1.2.840.10008.5.1.1.2 1.2.840.10008.5.1.1.4 1.2.840.10008.5.1.1.16
Print Job	1.2.840.10008.5.1.1.14
Modality Worklist Find	1.2.840.10008.5.1.4.31
Patient Root Query/Retrieve Information Model - Find	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - Move	1.2.840.10008.5.1.4.1.2.1.2
Verification	1.2.840.10008.1.1
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3

Romexis Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as a SCP:

SOP Class Name	SOP Class UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
CT Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.2
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Encapsulated STL Storage	1.2.840.10008.5.1.4.1.1.104.3
Verification	1.2.840.10008.1.1
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Patient Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.1.3
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Study Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.2.3

3.1 Association establishment policies

3.1.1 General

The maximum PDU size is 65,536 bytes

3.1.1.1 Storage

Romexis will initiate an association as a SCU of Storage Services when a local operator requests to send images over the network to a remote Storage SCP. If RDSR is enabled, a separate association will be initiated for the RDSR storage as a SCU.

3.1.1.2 Storage SCP

Storage SCP can handle multiple simultaneous incoming storage requests in parallel coming from remote Storage SCUs.

3.1.1.3 Print

Romexis will initiate an association as a SCU of Print Services when a local operator requests to print images over the network to a remote DICOM Basic Print Provider.

3.1.1.4 Worklist

Romexis will initiate an association as a Modality Worklist SCU requesting modality and patient data.

3.1.1.5 Retrieve

Romexis will initiate an association as a Query/Retrieve SCU requesting data for images and the images themselves. Romexis will wait for an association as a Store SCP.

3.1.1.6 Query/Retrieve SCP

Query/Retrieve SCP can handle multiple simultaneous incoming Find, Move and Get requests in parallel coming from remote AEs.

3.1.1.7 Verification

Romexis will initiate an association as a SCU when local operator requests a verification of remote SCP node.

3.1.1.8 MPPS

Romexis will initiate an association as a MPPS when the local operator requests to capture a set of images.

3.1.2 Number of associations

Romexis only opens one association at a time.

3.1.3 Asynchronous nature

Romexis does not support asynchronous communication.

3.1.4 Implementation identifying information

The Implementation Class Unique Identifier (UID) for the Romexis Application Entity is:

2.16.840.1.113669.632.10.99.2

The Implementation Version Name for the Romexis Application Entity is:

ROMEXIS 001

3.2 Association initiation by real-world activity

Romexis initiates a new association for the appropriate DICOM SCP node for verification of the specified DICOM SCP node. The association is closed when a response from SCP is received or in case of failure.

Romexis initiates a new association for the appropriate Storage Service Class that corresponds to the image(s) requested to be transferred. The association is closed when all images have been sent to the remote DICOM network node.

Romexis initiates a new association for Print Service Class. The association is closed when all images have been printed and all print jobs have completed.

Romexis initiates an association for the appropriate Q/R Services Class that corresponds to the set of images requested to be transferred. The association is closed when all queries or moves have been sent to the remote DICOM network node.

Romexis initiates an association for the appropriate Modality Worklist Service Class that corresponds to the set of data requested to be transferred. The association is closed when all queries have been sent to the remote DICOM network node.

Romexis is able to abort the association when a time out or an error occurs.

Romexis initiates an association for MPPS for a patient opened via Worklist at the moment of starting the exposure or Intracam or TWAIN capture task. The association is closed when all images are captured and the session related data sent to the server.

3.2.1 Real-world activity for Verification operation

Romexis AE provides standard conformance to the DICOM Verification Service Class as SCU.

3.2.1.1 Proposed presentation contexts for C-ECHO

The presentation contexts that are proposed by Romexis AE for the C-ECHO operation are specified in the following table.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

3.2.2 Real-world activity for Send Image operations

Romexis initiates associations for the transfer of images to a DICOM Image Storage Server. Romexis listens for storage requests coming from a remote SCU and stores the incoming images.

3.2.2.1 Associated real-world activity for Send Image operations

Once the Store Image association has been established, an image Store message is sent by Romexis.

Proposed presentation contexts for Send Image operations

The presentation contexts that are proposed by Romexis for the Send Image operation are specified in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian JPEGProcess14SV1	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCU	None
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian JPEGProcess14SV1	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCU	None
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian JPEGProcess14SV1	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCU	None
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian JPEGProcess14SV1	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCU	None
Digital Intra-oral	1.2.840.10008.5.1.4.1.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

X-Ray Image Storage - For Processing		Explicit VR Little Endian Explicit VR Big Endian JPEGProcess14SV1	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70		
CT Image Storage- For Presentation	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian JPEGProcess14SV1	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCU	None
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2 .1	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian JPEGProcess14SV1	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCU	None
Encapsulated STL Storage	1.2.840.10008.5.1.4.1.1.104.3	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None
Storage Commitment Push	1.2.840.10008.1.20.1	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

All these SOP classes conform to the standard Storage Services as specified in the DICOM Standard.

NOTE: It is possible to force a different SOP Class and Modality for an image type.

3.2.2.2 SOP Specific Conformance

Romexis sends the following attributes in C_STORE_RQ. All the mandatory attributes are sent.

(0x0008,0x0005) SpecificCharacterSet

(0x0008,0x0016) SOPClassUID

(0x0008,0x0018) SOPInstanceUID

(0x0008,0x0020) StudyDate

(0x0008,0x0023) ContentDate

(0x0008,0x002A) AcquisitionDateTime

(0x0008,0x0030) StudyTime

(0x0008,0x0033) ContentTime

(0x0008,0x0050) AccessionNumber

(0x0008,0x0060) Modality

(0x0008,0x0070) Manufacturer

(0x0008,0x0090) ReferringPhysicianName

(0x0008,0x1030) StudyDescription

(0x0008,0x1090) ManufacturerModelName

Not for Encapsulated STL:

(0x0008,0x0008)	ImageType
(0x0008,0x0012)	InstanceCreationDate
(0x0008,0x0013)	InstanceCreationTime
(0x0008,0x0021)	SeriesDate
(0x0008,0x0022)	AcquisitionDate
(0x0008,0x0031)	SeriesTime
(0x0008,0x0032)	AcquisitionTime
(0x0008,0x0068)	PresentationIntentType
(0x0008,0x0080)	InstitutionName
(0x0008,0x1040)	InstitutionalDepartmentName
(0x0008,0x1010)	StationName
(0x0008,0x1070)	Operators'Name

for DigitalIntraoralXRayImageStorageForPresentation,DigitalIntraoralXRayImageStorageForProcessing only:

(0x0008,0x2218)	AnatomicRegionSequence
(0x0008,0x0100)	CodeValue
(0x0008,0x0102)	CodingSchemeDesignator
(0x0008,0x2228)	PrimaryAnatomicStructureSequence
(0x0008,0x0100)	CodeValue
(0x0008,0x0102)	CodingSchemeDesignator

Encapsulated STL only:

(0x0008,0x1110)	Referenced Study Sequence

Enhanced CT only:

(0x0008,0x9205)	PixelPresentation
(0x0008,0x9206)	VolumetricProperties
(0x0008,0x9207)	VolumeBasedCalculationTechnique

(0x0010,0x0010)	PatientName

(0x0010,0x0020)	PatientID
(0x0010,0x0030)	PatientBirthDate
(0x0010,0x0040)	PatientSex
(0x0010,0x1000)	OtherPatientID
(0x0010,0x1010)	Patient's Age
(0x0010,0x2180)	Occupation
(0x0010,0x4000)	Patient Comments
(0x0018,0x0015)	BodyPartExamined

CT, IO, Pan, Ceph only:

(0x0018,0x5100)	PatientPosition
(0x0018,0x0060)	KVP

CT only:

(0x0018,0x0050)	SliceThickness
(0x0018,0x1000)	DeviceSerialNumber
(0x0018,0x1020)	SoftwareVersion

Not for Encapsulated STL:

(0x0018,0x1004)	PlateID
(0x0018,0x1150)	ExposureTime
(0x0018,0x1151)	XrayTubeCurrent
(0x0018,0x115e)	ImageAreaDoseProduct

Not for CT:

(0x0018,0x1164)	ImagerPixelSpacing
(0x0018,0x700A)	DetectorID

Enhanced CT only:

(0x0018,0x9004)	ContentQualification

(0x0018,0x9073)	AcquisitionDuration
(0x0020,0x000D)	Study Instance UID
(0x0020,0x000e)	SeriesInstanceUID
(0x0020,0x0010)	StudyID
(0x0020,0x0011)	SeriesNumber

CT only:

(0x0020,0x0012)	AcquisitionNumber
(0x0020,0x0013)	InstanceNumber

CT only:

(0x0020,0x0032)	ImagePositionPatient
(0x0020,0x0037)	ImageOrientationPatient

CT and Encapsulated STL only:

(0x0020,0x0052)	FrameOfReferenceUID
(0x0020,0x1040)	PositionReferenceIndicator

Not for CT:

(0x0020,0x0020)	PatientOrientation

Not for Encapsulated STL:

(0x0020,0x4000)	ImageComments

Enhanced CT only:

(0x0020,0x9221)	DimensionOrganizationSequence
(0x0020,0x9222)	DimensionIndexSequence

Not for Encapsulated STL:

(0x0028,0x0002)	SamplesPerPixel
(0x0028,0x0004)	PhotometricInterpretation
(0x0028,0x0006)	PlanarConfiguration

Enhanced CT only:

(0x0028,0x0008)	NumberOfFrames

Not for Encapsulated STL:

(0x0028,0x0010)	Rows
(0x0028,0x0011)	Columns

CT only:

(0x0028,0x0030)	PixelSpacing

Not for Encapsulated STL:

(0x0028,0x0100)	BitsAllocated
(0x0028,0x0101)	BitsStored
(0x0028,0x0102)	HighBit
(0x0028,0x0103)	PixelRepresentation
(0x0028,0x0106)	SmallestImagePixelValue
(0x0028,0x0107)	LargestImagePixelValue

Encapsulated STL only:

(0x0028,0x0301)	Burned In Annotation

Not for CT or Encapsulated STL:

(0x0028,0x1040)	PixelIntensityRelationship
(0x0028,0x1041)	PixelIntensityRelationshipSign

Not for Encapsulated STL:

(0x0028,0x1052)	RescaleIntercept
(0x0028,0x1053)	RescaleSlope

Not for CT or Encapsulated STL:

(0x0028,0x1054)	RescaleType

Not for Encapsulated STL:

(0x0028,0x2110) LossyImageCompression

Not for CT or Encapsulated STL:

(0x0040, 0x1002) ReasonForRequestedProcedure

Encapsulated STL only:

(0x0040,0x08EA) Measurement Units Code Sequence

(0x0040,0xA043) Concept Name Code Sequence

(0x0042,0x0010) Document Title

(0x0042,0x0011) Encapsulated Document

(0x0042,0x0012) MIME Type of Encapsulated Document

for DigitalXRayImageStorageForPresentation,DigitalXRayImageStorageForProcessing only:

(0x0060,0x3002) HistogramNumberOfBins

(0x0060,0x3004) HistogramFirstBinValue

(0x0060,0x3006) HistogramLastBinValue

(0x0060,0x3008) HistogramBinWidth

(0x0060,0x3020) HistogramData

(0x0060,0x3000) HistogramSequence

Encapsulated STL only:

(0x0070,0x0081) Content Description

Enhanced CT only:

(0x5200,0x9229) SharedFunctionalGroupsSequence

(0x0028,0x9110) PixelMeasuresSequence

(0x0018,0x0050) SliceThickness

(0x0028,0x0030) PixelSpacing

(0x5200,0x9230) PerFrameFunctionalGroupsSequence

(0x0020,0x9113) PlanePositionSequence

(0x0020,0x0032) ImagePositionPatient

CT only:

(0x7FE0,0x0010) PixelData

Not for CT or Encapsulated STL:

(0x7FE0,0x0010) PixelData

NOTE: RequestedProcedureDescription (received from Worklist) is copied to StudyDescription, 0x0008,0x1030, (if not received from Worklist) when creating image headers e.g. for Storage.

3.2.3 Real-world activity for Print Image operations

Romexis initiates associations for the printing of images to a Basic Print SCP. Romexis pre-formats the images before printing.

3.2.3.1 Associated real-world activity for Print Image operations

Once the Print Image association has been established, Romexis sends a Basic Film Session, N_CREATE message to the Basic Print SCP. This is followed by a Basic Film Box N_CREATE message. Romexis then sends a Basic Grayscale Image Box, N_SET message. Finally, an N_ACTION message is sent to instruct the Basic Print SCP to print either at the Basic Film Session or Basic Film Box level.

3.2.3.2 Proposed presentation contexts for Print Image operations

The presentation contexts that are proposed by Romexis AE for the Print Image operation are specified in the following table.

All these SOP classes conform to the standard Print Services as specified in the DICOM standard.

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Basic Grayscale Print Management (META)	1.2.840.10008.5.1.1.9	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None
Print Job	1.2.840.10008.5.1.1.14	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

3.2.3.3 SOP Specific Conformance

Attribute values for SOP classes proposed by Romexis are specified in the following table.

SOP Class Name	Command	Attribute Name	Valid Range	Default Value
Basic Film Session	N_CREATE	Number of Copies	1-10	1
		Print Priority	HIGH, MEDIUM, LOW	HIGH
		Medium Type	PAPER, CLEAR FILM, BLUE FILM	None
		Film Destination	N/A	None
		Film Session Label	N/A	None
Basic Film Session	N_ACTION	Referenced Print Job Sequence		None
Basic Film Box	N_CREATE	Image Display Format	STANDARD\1,1 STANDARD\1,2 STANDARD\2,2 STANDARD\2,3 STANDARD\3,3 STANDARD\3,4 STANDARD\3,5 STANDARD\4,4 STANDARD\4,5 STANDARD\4,6	Mandatory, no default
		Film Orientation	PORTRAIT, LANDSCAPE	PORTRAIT
		Film Size ID	8INX10IN, 10INX14IN, 14INX14IN, 24CMX24CM, 10INX12IN, 11INX14IN, 14INX17IN,24CMX30CM	None
		Magnification Type	REPLICATE, BILINEAR, CUBIC	None
		Configuration Information	This information is printer specific	None
		Smoothing Type	N/A	None
		Border Density	BLACK, WHITE	BLACK
		Empty Image Density	BLACK, WHITE	BLACK

SOP Class Name	Command	Attribute Name	Valid Range	Default Value
Basic Film Box	N_ACTION	Referenced Print		None

		Job Sequence		
Basic Grayscale Image Box	N_SET	Image Position	1-24	Mandatory, no default
		Samples Per Pixel	1/3	None
		Photometric Interpretation	MONOCHROME1, MONOCHROME2	MONO-CHROME2
		Rows	any integer	None
		Columns	any integer	None
		Pixel Aspect Ratio	1/1	1/1
		Pixel Representation	0 (unsigned), 1 (signed)	0
		Requested Image Size	N/A	None
Printer	N_GET / N_EVENT_REPORT	Printer Status	*	None
		Printer Status Info	*	None
		Printer Name	*	None
		Manufacturer	*	None
		Manufacturer Model Name	*	None
		Software Version	*	None

* Romexis will display any information returned for Printer messages

3.2.4 Real-world activity for Find operations for Modality Worklist services

Romexis opens an association and performs C-FINDs. The association is closed after an error or when the initiator requests that it be closed.

3.2.4.1 Associated real-world activity for Find operations

Once the association has been established, Romexis will send a Find message to the Modality Worklist SCP and wait for respond.

3.2.4.2 Presentation context table for Find operations for Basic Modality

Worklist Management. Acceptable Find execution presentation contexts for Romexis are:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Modality Worklist Find	1.2.840.10008.5.1.4.31	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

3.2.4.3 SOP Specific Conformance

The following attributes can be used as search criteria in C_FIND_RQ:

0008,0060 Modality

0040,0001 Scheduled Station AE Title

0040,0002 Scheduled Procedure Step Start Date (date range can be used)

0010,0010 Patient's name

0010,0020 Patient ID

0010,0030 Patient's Birth Date

0008,0050 Accession Number

0032,1032 Requesting Physician

Romexis reads the following attributes from a C_FIND_RSP message:

(0020,000D) Study Instance UID

(0008,0050) Accession Number

(0010,0010) Patient's name

(0010,0020) Patient ID

(0010,0030) Patient's Birth Date

(0010,0040) Patient's Sex

(0008,0060) Modality

(0032,1032) Requesting Physician

(0008,1030) Study Description

(0040,1001) Requested Procedure ID

(0032,1060) Requested Procedure Description

(0008,0090) Referring Physician

(0008,1050) Performing Physician

(0040,0100) Scheduled Procedure Step Sequence

(0040,0002) Scheduled Procedure Step Start Date

(0040,0003) Scheduled Procedure Step Start Time

(0040,0006) Scheduled Performing Physician Name

(0040,0009) Scheduled Procedure Step ID

(0040,0007) Scheduled Procedure Step Description

3.2.5 Real-world activity for Find and Move Execution operations for Q/R services

Romexis opens an association and performs C-FINDs or C-MOVEs.

3.2.5.1 Associated real-world activity for Find and Move Execution operations

Once the association has been established, Romexis sends a Find Q/R Service message. After response has been received, Romexis sends a request for a Move Service message and waits for incoming Storage association.

3.2.5.2 Presentation context table for Find and Move Execution operations

Acceptable Find and Move presentation contexts for Romexis Q/R services are:

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Patient Root Query/Retrieve Information Model – Find	1.2.840.10008.5.1.4.1.2.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None
Patient Root Query/Retrieve Information Model-Move	1.2.840.10008.5.1.4.1.2.1.2	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

3.2.5.3 SOP Specific Conformance

The following attributes can be used as search criteria in C_FIND_RQ:

0010,0010 Patient's name

0010,0020 Patient ID

Romexis executes a hierarchial search for each matching patient to find studies, series and composite instances.

Romexis reads the following attributes from C_FIND_RSP messages:

Patient level:

(0010,0010) Patient's name

(0010,0020) Patient ID

(0010,0030) Patient's Birth Date

(0020,1200) Number of Patient Related Studies

Study level:

(0008,0020) Study Date

(0008,0030) Study Time

(0008,0050) Accession Number

(0008,0061) Modalities in Study

(0008,1030) Study Description

(0020,000D) Study Instance UID

(0020,0010) Study ID

(0020,1206) Number of Study Related Series

(0020,1208) Number of Study Related Instances

Series level:

(0008,0060) Modality

(0020,000E) Series Instance UID

Composite Object Instance level:

(0008,0018) SOP Instance UID

3.2.6 Real-world activity for Query/Retrieve SCP

Romexis SCP supports following presentation contexts.

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Patient Root Query/Retrieve Information Model – Find	1.2.840.10008.5.1.4.1.2.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Patient Root Query/Retrieve Information Model-Move	1.2.840.10008.5.1.4.1.2.1.2	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Patient Root	1.2.840.10008.5.1.4.1.2.1.3	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

Query/Retrieve Information Model - GET		Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2		
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.2.3	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None

3.2.6.1 SOP Specific Conformance

Following attributes can be used as search criteria for C_FIND_QR. Find requests are divided into 4 levels in Romexis (PATIENT, STUDY, SERIES and INSTANCE). Any matching properties mostly follow the standards? recommendation.

Patient Level (Patient Root) search attributes

Patient's Name	0010,0010	required
Patient ID	0010,0020	unique
Patient's Birth Date	0010,0030	optional
Patient's Sex	0010,0040	optional

Patient Level (Patient Root) extra response attributes

Patient Comments	0010,4000	optional
Other Patient IDs Sequence	0010,1002	optional

Study Level (Patient Root) search attributes

Study Date	0008,0020	required
Study Time	0008,0030	required
Accession Number	0008,0050	required
Study ID	0020,0010	required
Study Instance UID	0020,000D	unique

Study Level (Patient Root) extra response attributes

Modalities in Study	0008,0061	optional

SOP Classes in Study	0008,0062	optional
Referring Physician's Name	0008,0090	optional
Study Description	0008,1030	optional
Number of Study Related Instances	0020,1208	optional

Series Level (Patient Root) search attributes

Series Instance UID	0020,000E	required

Series Level (Patient Root) extra response attributes

Modality	0008,0060	optional
Series Number	0020,0011	optional

Composite Object Instance Level (Patient and Study Root)

Instance Number	0020,0013	required
SOP Instance UID	0008,0018	unique
SOP Class UID	0008,0016	optional

Study Level (Study Root) search attributes

Study Date	0008,0020	required
Study Time	0008,0030	required
Accession Number	0008,0050	required
Patient's Name	0010,0010	required
Patient ID	0010,0020	required
Study ID	0020,0010	required
Study Instance UID	0020,000D	required
Patient's Birth Date	0010,0030	optional
Patient's Sex	0010,0040	optional

Study Level (Study Root) extra response attributes

Modalities in Study	0008,0061	optional
SOP Classes in Study	0008,0062	optional
Referring Physician's Name	0008,0090	optional

Study Description	0008,1030	optional
Other Patient IDs Sequence	0010,1002	optional
Patient's Age	0010,1010	optional
Occupation	0010,2180	optional
Number of Study Related Instances	0020,1208	optional
Series Level (Study Root) search attributes		
Series Instance UID	0020,000E	required
Series Level (Study Root) extra response attributes		
Modality	0008,0060	optional
Series Number	0020,0011	optional

3.2.7 Real-world activity for MPPS

Once the MPPS association is established, Romexis invokes either an N-CREATE or N-SET request to the server. When the starting the x-ray capture, intracam or TWAIN capture task, Romexis sends an N-CREATE request to the server. When the status of the MPPS instance is to be updated, Romexis will initiate the MPPS N-SET service request to update the status of the MPPS instance. The COMPLETE status will be finally delivered with the MPPS N-SET request after all associated images are captured.

3.2.7.1 Presentation context table for real-world activity acquire images

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

3.2.7.2 SOP Specific Conformance

The following attributes are either required, provided or supported.

Scheduled Step Attribute Sequence	0040,0270	required
Study Instance UID	0020,000D	required
Accession Number	0008,0050	provided
Requested Procedure ID	0040,1001	provided
Patient’s Name	0010,0010	provided

Patient ID	0010,0020	provided
Patient's Birth Date	0010,0030	provided
Patient's Sex	0010,0040	provided
Performed Procedure Step ID	0040,0253	required
Performed Station AE Title	0040,0241	required
Performed Station Name	0040,0242	supported
Performed Procedure Step Start Date	0040,0244	required
Performed Procedure Step Start Time	0040,0245	required
Performed Procedure Step Start Status	0040,0252	required
Performed Procedure Step End Date	0040,0250	supported
Performed Procedure Step End Time	0040,0251	supported
Modality	0008,0060	required
Study ID	0020,0010	supported
Performed Series Sequence	0040,0340	supported
Performing Physician's Name	0008,1050	supported
Protocol Name	0018,1030	required
Series Instance UID	0020,000E	required
Total Number of Exposures	0040,0301	supported
Image Area Dose Product	0018,115E	supported
KVP	0018,0060	supported
X-Ray Tube Current in µA	0018,8151	supported
Exposure Time (msec)	0018,1150	supported

3.3 Association acceptance policy

3.3.1 Real-world activity for Verification operation

Romexis sends a C-ECHO RSP to the requesting SCU to provide its state of being able to receive DICOM requests.

3.3.1.1 Presentation context table for Verification operation

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCP	None

3.3.2 Real-world activity for Send Image operation

A remote SCU requests to store images into Romexis using the C-STORE command.

3.3.2.1 Presentation context table for Send Image operation

The presentation contexts that are proposed by Romexis for the Storage operation are specified in the following table:

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Explicit VR Little Endian Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
CT Image Storage- For Presentation	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None

Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2 .1	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None
Encapsulated STL Storage	1.2.840.10008.5.1.4.1.1.104.3	Explicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	None

4 Communication Profiles

4.1 Supported communication stacks

Romexis provides DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8 of the DICOM Standard.

4.2 TCP/IP stack

Romexis communicates over the TCP/IP stack on any physical interconnection media supporting the TCP/IP stack. Romexis inherits the TCP/IP stack from the Windows NT environment.

4.2.1 Physical media support

Romexis is indifferent to the physical medium over which TCP/IP executes on Windows NT. It runs over the TCP/IP protocol stack on any physical interconnection media supporting the TCP/IP stack.

5 Extensions/Specializations/Privatizations

Not supported

6 AE title / presentation address mapping

Presentation address mapping is configured in Romexis / DICOM Settings. Please see Romexis Installation Manual for details.

7 Support of extended character sets

Not supported.

8 Security Profiles

Romexis supports standard TLS 1.2 connections where Romexis distributes the public key on negotiation. In addition to the standard TLS 1.2 connection two-way authentication is also supported where Romexis has a list of accepted keys which are accepted by Romexis in addition to the Romexis?s own public key.

8.1 Authentication Mechanisms

Romexis is authenticated by the Romexis's own public key in all cases. If two-way authentication is enabled, connecting entity should have its public certificate added for Romexis to accept the connection.

8.2 TLS Parameters

Supported cipher suites for DICOM traffic are:
TLS_DHE_RSA_WITH_AES_128_GCM_SHA256,
TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256,
TLS_DHE_RSA_WITH_AES_256_GCM_SHA384,
TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384,
TLS_RSA_WITH_AES_128_CBC_SHA and SSL_RSA_WITH_3DES_EDE_CBC_SHA using IANA naming. Romexis only supports TLS 1.2 version and versions smaller than 1.2 are disabled/rejected.

TLS is not currently supported in Print SCU, MPPS SCU and Storage Commitment SCU in two association mode.

9 Version history

9.1 Version 3.0 changes

- Added support for the Requesting Physician (0032,1032) tag in Worklist.
- RequestedProcedureDescription (received from Worklist) is copied to StudyDescription tag, 0x0008,0x1030, (if not received from Worklist) when creating image headers e.g. for Storage.

9.2 Version 4.0 changes

- Updated for version 4.0

9.3 Version 5.0 changes

- Updated for version 5.0

9.4 Version 5.3 changes

- Added support for the RDSR SOP Class regarding CT images.
- Added support for the Storage and Verification SCP SOP Classes.

9.5 Version 5.3.5 changes

- Ch 3 Application Entity specification table updated
- Ch 3.2.2.2 SOP Specific Conformance updated

9.6 Version 6.0 changes

- Added support for Encapsulated STL Storage SOP Class and related tags to C_STORE SOP Specific conformance.
- Added support for RDSR SOP Class regarding Intraoral, Panoramic and Cephalometric images.

9.7 Version 6.1 changes

- Added support for Q/R SCP
- Added support for Security profiles

10 Further information

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