SIEMENS

syngo® CAD Manager
VD10A

[redacted] **IKM**

DICOM Conformance Statement

Rev 1.0

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1 Introduction

1.1 Purpose

This document describes the DICOM Conformance of *syngo* CAD Manager product delivered by Siemens IKM CKS CAD. The *syngo* CAD Manager acts as SCP and SCU for DICOM Storage service and DICOM Verification service. This DICOM Conformance Statement is written according to DICOM Specifications 3.0.

1.2 Scope

This DICOM Conformance Statement refers to Siemens CAD – *syngo* CAD Manager VD10A software application.

Table 1 *syngo* CAD Manager scope

Software Name	Siemens CAD Product
syngo CAD Manager	*syngo* CAD Manager VD10A

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1.3 Abbreviations

Abbreviation	Description
ACR	American College of Radiology
AE	DICOM Application Entity
CAD	Computer Aided Detection
CDS	CAD DICOM Server
CXR	Chest X-Ray
DCS	DICOM Conformance Statement
DO	Derived Object
IOD	DICOM Information Object Definition

ISO	International Standard Organization
NEMA	National Electrical Manufacturers Association
PDU	DICOM Protocol Data Unit
PO GEN	Presentation Object Generator
RIS	Radiology Information System
RWA	Real-World Activity
SCP	DICOM Service Class Provider (DICOM server)
SCU	DICOM Service Class User (DICOM client)
SOP	DICOM Service-Object Pair
WSD	Workstation (DICOM Terminology)

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1.4 Definitions

Subject	Explanation
DICOM	Digital Imaging and Communications in Medicine.
DIMSE	DICOM Message Service Element.
DIMSE-C	DICOM Message Service Element with Composite information objects.

2 Implementation Model Verification

2.1 Verification

The Siemens *syngo* CAD Manager Service Tool application requests Verification to verify the ability of a foreign DICOM application on a remote node to respond to DICOM messages. Responding to Verification requests from remote nodes is handled by the Storage SCP application.

2.1.1 Application Data Flow Diagram

The *syngo* CAD Manager DICOM network implementation is a Windows Operating System application and acts as SCU for the C-ECHO DICOM network service.

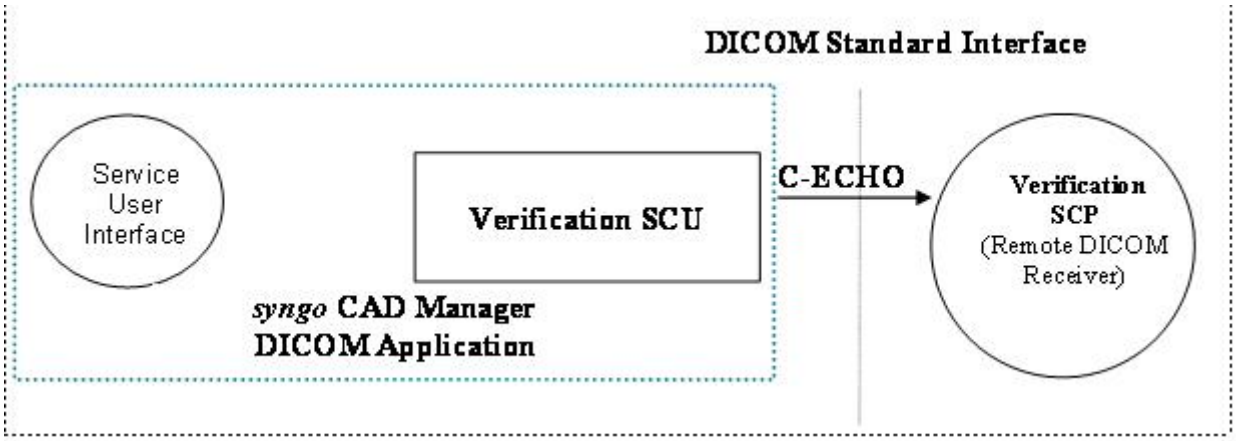

Figure 1 Application Data Flow Diagram - Verification SCU

2.1.2 Functional Definitions of Application Entities

The Siemens *syngo* CAD Manager Service Tool application opens an association when a "Test" of a remote application is requested during a configuration session. This can be done when entering new data for remote application configuration or to verify existing output node configuration data.

2.1.3 Sequencing of Real-World Activities

The output node configuration should be filled with AET, host name, and port number before performing a Verification service.

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3 Application Entity Specification Verification

3.1 Verification AE Specification

3.1.1 Association Establishment Policies.

3.1.1.1 General

The Siemens *syngo* CAD Manager Service Tool application attempts to open an association for verification request whenever the "Test" function is activated during network configuration of a remote DICOM application.

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3.1.1.2 Number of Associations

The Siemens *syngo* CAD Manager Service Tool application initiates one association at a time to request verification.

3.1.1.3 Asynchronous Nature

The Siemens *syngo* CAD Manager software does not support asynchronous communication. (multiple outstanding transactions over a single association).

3.1.1.4 Implementation Identifying Information

Table 2 Implementation details of CDS Verification SCU

Implementation Class UID	**1.3.12.2.1107.5.9.5.2.20090101**	
Implementation Version Name	SCM_VD10A	

3.1.1.5 Association Initiation Policy

The Siemens *syngo* CAD Manager DICOM Service Tool application attempts to initiate a new association for:

- DIMSE C-ECHO service operations.
- Associated Real-World Activity - Verification.
- Associated Real-World Activity – Request Verification “Test”.

The associated Real-World activity is a C-ECHO request initiated by Service and Configuration SW environment, whenever a "Test" is requested. If an association to a remote

Application Entity is successfully established, verification with the configured AET is requested via the open association. If the C-ECHO Response from the remote application contains a status other than "Success" this will be indicated in the service environment and the association is closed.

3.1.1.6 Proposed Presentation Contexts

The Siemens *syngo* CAD Manager DICOM application will propose Presentation Contexts as shown in the following table:

Table 3 Initiation presentation context - Verification

Presentation Context Table - Verification SCU					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID LIST**		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

3.1.1.7 SOP Specific Conformance – Verification SCU

The Application conforms to the definitions of the Verification SCU in accordance to the DICOM Standard.

3.1.1.8 Association Acceptance Policy

The Verification SCP is part of the Storage SCP – see Chapter 5.

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4 Implementation Model Storage

4.1 Storage

The *syngo* CAD Manager DICOM Application Entity originates associations for Storage of DICOM Composite Information Objects in Remote Application Entities and accepts association requests for Storage from Remote Application Entities.

4.1.1 Application Data Flow Diagram

The *syngo* CAD Manager DICOM network implementation acts as SCU and SCP for the C-STORE DICOM network service and as SCP for the C-ECHO DICOM network service. The product target Operating System is Windows XP or Windows 2008 Server.

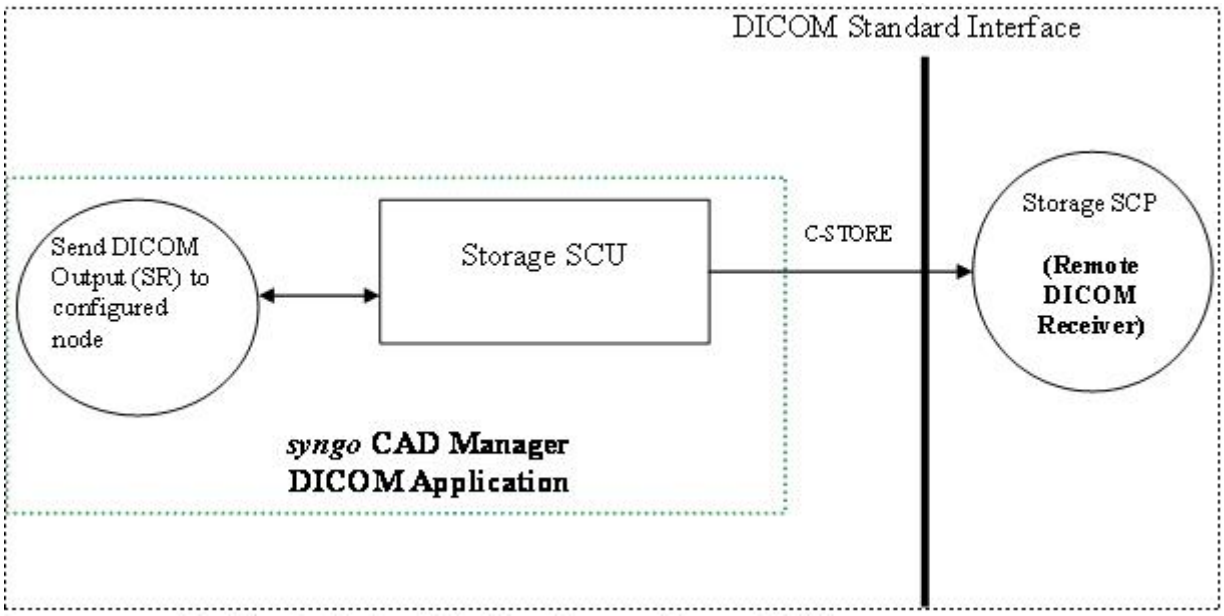

Figure 2 Application Data Flow Diagram - Storage SCU

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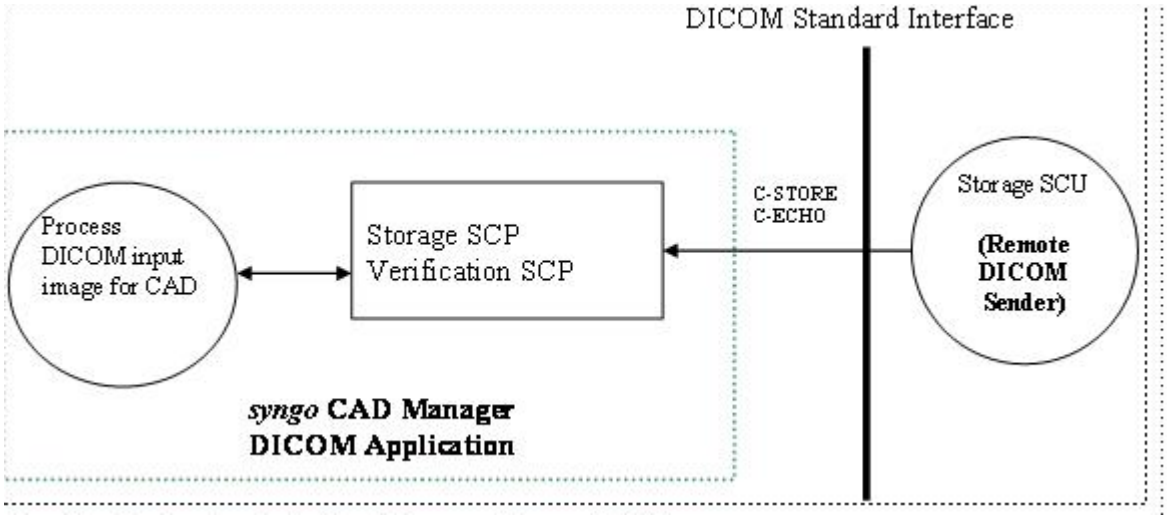

Figure 3 Application Data Flow Diagram - Storage SCP

4.1.2 Functional Definitions of Application Entities

The Storage SCU is initiated by the job control process that is responsible for CAD Processing. The transmission request consists of location of the output DICOM file and the destination information. An association is negotiated with the destination application entity and the image data is transferred using the C-STORE DIMSE-Service. Status of the transfer is reported to *syngo* CAD Manager status page.

The Storage SCP component of the *syngo* CAD Manager DICOM application operates as background server process. It starts when the machine is powered on and waits for Storage association requests. After accepting an association with a negotiated Presentation Context it starts to receive the Composite Image Objects and post a CAD Processing request to the job queue. The reception and CAD Processing status is reported to *syngo* CAD Manager status page.

Verification requests will also be processed and responded by the Storage SCP component.

4.1.3 Sequencing of Real-World Activities

Not Applicable.

4.1.4 Association Acceptance Policy

The Verification SCP is part of the Storage SCP – see Chapter 5.

4.2 Storage Commitment

The Storage Commitment service class defines an application-level class of service which facilitates the commitment to storage. It performs an additional task of commitment of composite objects apart from the network based storage of images as defined by the Storage Service class. The *syngo* CAD Manager DICOM implementation supports the Storage Commitment Push Model as SCU.

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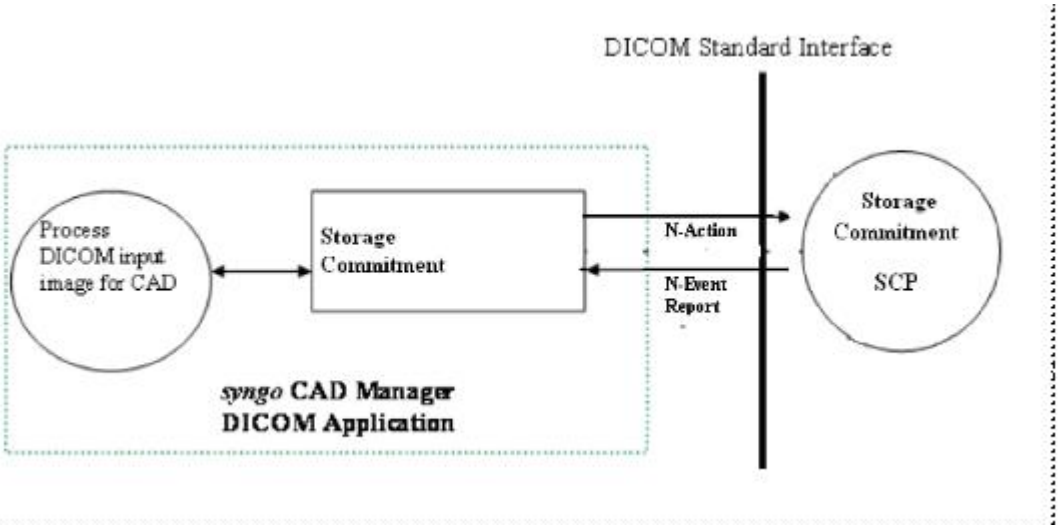

Figure 4 Application Data Flow Diagram - Storage Commitment

SOP Class Name	SOP Class ID
Storage Commitment Push Model	1.2.840.10008.1.20.1

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4.2.1 Functional Definitions of Application Entities

With each successfully completed send job, the *syngo* CAD Manager DICOM Application will close the association and expects responses on a different association that has to be established by the remote Storage Commitment SCP.

The commitment status derived from the related trigger response will be indicated in the related Status Flags of the related entity. It is possible to create triggers ("auto rules") from this event.

The Transaction UIDs of the pending commitment request are kept "open" for the send operation before a re-send is attempted. After 7 tries to re-send without a related response, the send request is aborted with error. In any case, commitment will only be requested for previously and successfully sent images.

4.2.2 Sequencing of Real-World Activities

The Storage Commitment trigger is automatically derived from the successful completion of a Send Job.

4.2.3 Association Acceptance Policy

The Verification SCP is part of the Storage SCP – see Chapter 5.

5 Application Entity Specification Storage

5.1 Storage AEs Specification

The *syngo* CAD Manager Storage service class user/service class provider applications use one AET when initiating/receiving associations to/from remote DICOM nodes. The same can be configured using Service UI configuration.

Siemens *syngo* CAD Manager DICOM product provides Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU:

Table 4 SOP Classes as Storage SCU

SOP Class Name	SOP Class UID	
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	
Derived Object for CT	1.2.840.10008.5.1.4.1.1.2.1	
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	
Digital mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	
Digital mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	

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Grayscale Softcopy Presentation State (GSPS)	1.2.840.10008.5.1.4.1.1.11.1	
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	
Private *syngo* CSA Non-Image Storage	1.3.12.2.1107.5.9.1	

Siemens *syngo* CAD Manager DICOM product provides Standard Conformance to the following DICOM V3.0 conform private SOP Classes as an SCP:

Table 5 SOP Classes as Storage SCP

SOP Class Name	**SOP Class UID**
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Digital Mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Verification SOP Class	1.2.840.10008.1.1

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5.1.1 Association Establishment Policies

5.1.1.1 General

The completion of CAD processing will activate the DICOM Storage Application to transmit the resultant DICOM output. An association request is sent to the destination AE and upon successful negotiation of a Presentation Context the transfer is started. If the transmission fails, it is reattempted multiple times for a span of 2 days. Please refer to

Table 1 for retransmission intervals. The default PDU size used will be 32 KB.

5.1.1.2 Number of Associations

The *syngo* CAD Manager SCU DICOM application initiates up to 10 associations at a time, one for each destination to which a transfer request is configured.

The *syngo* CAD Manager SCP DICOM application can accept multiple associations at a time. It accepts 4 associations concurrently. The SCP rejects any new association while all the 4 associations are being handled and it also sends the status code 0xC013 in the response message, which signifies a transient error.

5.1.1.3 Asynchronous Nature

The *syngo* CAD Manager DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

5.1.1.4 Implementation Identifying Information

Table 6 Implementation details of storage service

Implementation Class UID	**Refer to Table 2**	
Implementation Version Name	Refer to Table 2	

5.1.1.5 Association Initiation Policy

If a DICOM output transmission request gets active in the transmission list, the SCU DICOM application attempts to initiate a new association for:

DIMSE C-STORE

Service Operations

5.1.1.6 Associated Real-World Activity

Associated Real-World Activity – Send CAD Results to remote DICOM Storage.

The associated Real-World activity is a C-STORE request initiated by an internal daemon process triggered by the completion of Local CAD Processing. This results in sending of the

CAD results to a Remote DICOM Storage SCP. If the process successfully establishes an association to a remote Application Entity, it will transfer DICOM output generated as result of CAD Processing. If the C-STORE Response from the remote Application contains a status other than “Success” or “Warning”, the association is aborted.

5.1.1.7 Proposed Presentation Context – Send Images

The *syngo* CAD Manager SCU DICOM application will propose Presentation Contexts as shown in the following table:

Table 7 Initiation presentation context - Storage

Transfer Syntax			
Name List	**UID List**	**Role**	**Extended Negotiation**
IMPLICIT_LITTLE_ENDIAN	1.2.840.10008.1.2	SCU	None
EXPLICIT_LITTLE_ENDIAN	1.2.840.10008.1.2.1		
EXPLICIT_BIG_ENDIAN	1.2.840.10008.1.2.2		

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5.1.1.8 SOP Specific Conformance - General

If a C-STORE response indicates success, the CAD results and the associated DICOM inputs will be deleted. If a C-STORE response indicates failure, the failure will be logged, the association will be reattempted at a later time, and the CAD DICOM outputs will not be deleted. After a specified time period of successive failed attempts, no more attempts will be made, and the CAD results and associated DICOM inputs will be deleted. The retry duration is 48 hours and the retry interval is as specified in table below:

Table 8 Re-transmission interval of DICOM SCU

Number of times retransmission attempted	**Retransmission Interval**
1	4 min. after the first failure.
2	30 min. after the first failure.
3	4 hours after the first failure.
4	12 hours after the first failure.
5	24 hours after the first failure.

6	36 hours after the first failure.
7	48 hours after the first failure.
8	No more retransmissions.

NOTE	**Patient ID should be present in DICOM header in order for image to be accepted for processing.**

5.1.1.9 SOP Specific Conformance - CAD Digital Mammography SR

Table 9 describes the list of DICOM tags populated for CAD Digital Mammography SR. Various CAD specific tags are described in Table 2. The SR will conform to DICOM standards.

Table 9 DICOM Tags of CAD Mammography SR

Name	Tag	Type	Value Set
DICOM File Meta information			
Media Storage Instance UID	(0002,0003)		1.3.12.2.1107.5.9.1.<-->.<-->
Implementation Class UID	(0002,0012)		Refer to Table 2
Implementation Version Name	(0002,0013)		Refer to Table 2
Source Application Entity Title	(0002,0016)		Value configured as in Service UI. If nothing configured in Service UI then default: DICOM_LOCAL_SEND
SOP COMMON MODULE ATTRIBUTES			
Specific Character Set	(0008,0005)	1C	Copied from input images
Instance Creation Date	(0008,0012)	3	Date of SR Creation
Instance Creation Time	(0008,0013)	3	Time of SR Creation
SOP Class UID	(0008,0016)	1	Value set to: 1.2.840.10008.5.1.4.1.1.88.50

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SOP Instance UID	(0008,0018)	1	1.3.12.2.1107.5.9.1.<CAD Manager system serial number entered in the Service UI>.<Object Unique Identifier>
GENERAL STUDY MODULE ATTRIBUTES			
Study Date	(0008,0020)	2	Copied from the image analyzed
Study Time	(0008,0030)	2	Copied from the Image analyzed
Accession Number	(0008,0050)	2	Copied from the Image analyzed
Referring Physician's Name	(0008,0090)	2	Value set to: Empty
Study Instance UID	(0020,000D)	1	Copied from the Image analyzed
Study ID	(0020,0010)	2	Copied from the Image analyzed
SR DOCUMENT GENERAL MODULE ATTRIBUTES			
Content Date	(0008,0023)	1	SR Creation start date
Content Time	(0008,0033)	1	SR Creation start time
Instance Number	(0020,0013)	1	Copied from original image
Completion Flag	(0040,A491)	1	Value set to - COMPLETE
Performed Procedure Code Sequence	(0040,A372)	2	Value set to NULL
Verification Flag	(0040,A493)	1	Value set to - UNVERIFIED
SR DOCUMENT SERIES MODULE ATTRIBUTES			
Modality	(0008,0060)	1	Value set to SR
Manufacturer	(0008,0070)	2	Value set to SIEMENS

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Referenced Study Component Sequence	(0008,1111)	2	Value set to Empty
Software Version(s)	(0018,1020)	3	Possible values based on Version no.: **For VB20R SR:** Masses VD10A Clusters VD10A Masses and Clusters VD10A (Based on available licenses) **For VB21D SR:** *syngo* MammoCAD Note: Since the enhanced workflow is computed as a side effect of the masses algorithm, the software version for it is also Masses VD10A.
Series Instance UID	(0020,000E)	1	1.3.12.2.1107.5.5.1.<CAD Manager System serial number entered in the Service UI>.<Object Unique Identifier>
Series Number	(0020,0011)	1	Copied from the image analyzed
IMAGE REFERENCE MACRO ATTRIBUTES			
>Referenced SOP Class UID	(0008,1150)	1	Copied from SOP Class UID of the Image analyzed
>Referenced SOP Instance UID	(0008,1155)	1	Copied from SOP Instance UID of the Image analyzed
Referenced SOP Sequence	(0008,1199)	1	
PATIENT MODULE ATTRIBUTES			
Patient's Name	(0010,0010)	2	Copied from Image analyzed
Patient ID	(0010,0020)	2	Copied from Image analyzed
Patient's Birth Date	(0010,0030)	2	Copied from Image analyzed

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Patient's Sex	(0010,0040)	2	Copied from Image analyzed
SR DOCUMENT CONTENT			
Code Value	(0008,0100)	1C	Value set to 111036
Code Scheme Designator	(0008,0102)	1C	SNM3
Code Meaning	(0008,0104)	1C	Value set to: Mammography CAD Report
Value Type	(0040,a040)	1	Value set to - Container
Private Attributes			
SIEMENS IKM CKS MAMMOCAD OVI	(0031,xxxx)		CAD Overlay Images in XML

The CAD specific details are described in the tree format in Table 10:

Table 10 CAD specific attributes

Tag	Value Type	Relation with parent	Remarks
CAD Processing and Findings Summary	[CODE]	CONTAINS	Contains detection related details
Individual Impression/Recommendation (1..n)	[CONTAINER]	INFERRED FROM	One node for detection related details of each Image.
Rendering Intent	[CODE]	HAS CONCEPT MOD	Specifies whether the rendering device is required to be present or not.
ENHANCED WORKFLOW REPRESENTATION			
Single Image Findings (1..n) Nipple	[CODE]	CONTAINS	Nipple position information. Present only for VB21D SR if "Enhanced Workflow" license

			is available.
Rendering Intent[CODE]	[CODE]	HAS CONCEPT MOD	Specifies whether the rendering device is required to be present or not.
Algorithm Name	[TEXT]	HAS PROPERTIES	CAD Algorithm Name. e.g. "Masses"
Algorithm Version	[TEXT]	HAS PROPERTIES	CAD Algorithm Version. e.g. "VC21A"
Mammography CAD Geometry (Center)	[SCOORD]	HAS PROPERTIES	Center of the Nipple Position. Shape is described as POINT.
Image Reference	No value Type for the reference	SELECTED FROM	Image reference for this finding
Single Image Findings (1..n) **Breast Composition**	[CODE]	CONTAINS	Breast Density information. Present only for VB21D SR if “Enhanced Workflow” license is available.
Rendering Intent[CODE]	[CODE]	HAS CONCEPT MOD	Specifies whether the rendering device is required to be present or not.
Algorithm Name	[TEXT]	HAS PROPERTIES	CAD Algorithm Name. e.g. "Masses"
Algorithm Version	[TEXT]	HAS PROPERTIES	CAD Algorithm Version. e.g.

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			"VC21A"
Percentage Glandular Tissue	[NUM]	HAS PROPERTIES	Glandular Tissue for Breast in terms of percentage
Image Reference	No value Type for the reference	SELECTED FROM	Image reference for this finding
CLUSTER DETECTION REPRESENTATION			
Single Image Findings (1..n) Calcification Cluster	[CODE]	CONTAINS	Micro Calcification cluster information
Rendering Intent [CODE]	[CODE]	HAS CONCEPT MOD	Specifies whether the rendering device is required to be present or not.
Algorithm Name	[TEXT]	HAS PROPERTIES	CAD Algorithm Name. e.g. “Clusters“
Algorithm Version	[TEXT]	HAS PROPERTIES	CAD Algorithm Version. e.g. “VC21A“
Certainty of Finding	[NUM]	HAS PROPERTIES	Probability of the Certainty of Finding.Present in SR if “Enhanced Workflow” license is available on CAD Manager.
Number of calcifications	[NUM]	HAS PROPERTIES	No. of calcifications present in a micro calcification cluster. Present in SR if “Enhanced Workflow” license is Available on CAD Manager.

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Mammography CAD Geometry (Center)	[SCOORD]	HAS PROPERTIES	Center of the cluster findings. Shape is described as POINT.
Image Reference	No value Type for the reference	SELECTED FROM	Image reference for this finding
Mammography CAD Geometry (Outline)	[SCOORD]	HAS PROPERTIES	Coordinates of the Findings. Shape is described as POLYLINE.
Image Reference	No value Type for the reference	SELECTED FROM	Image reference for this finding.
MASS DETECTION REPRESENTATION			
Single Image Findings (1..n): Mass	[CODE]	CONTAINS	Mass information
Rendering Intent [CODE]	[CODE]	HAS CONCEPT MOD	Specifies requirement of the rendering device for presentation.
Algorithm Name	[TEXT]	HAS PROPERTIES	CAD Algorithm Name. e.g. “Masses“
Algorithm Version	[TEXT]	HAS PROPERTIES	CAD Algorithm Version e.g. “VC21A“
Certainty of Finding	[NUM]	HAS PROPERTIES	Probability of the Certainty of Finding. Present in SR if“Enhanced Workflow” license is available
Mammography CAD Geometry (Center)	[SCOORD]	HAS PROPERTIES	Center of the mass findings. Shape is described as POINT

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Image Reference	No value Type for the reference	SELECTED FROM	Image reference for the center of this finding.
Mammography CAD Geometry (Outline)	[SCOORD]	HAS PROPERTIES	Finding coordinates. Shape described as ELLIPSE.
Image Reference	No value Type for the reference	SELECTED FROM	Image reference for this finding.

5.1.1.10 SOP Specific Conformance - LungCAD DO

The Derived Object created by LungCAD algorithm has attributes described in Table 11. There can be other attributes that are directly copied from the original image.:

Table 11 DICOM Attributes of LUNGCAD DO, not modified from original image

Tag	Attribute Name	Type 1	Type 2	Type 3
(0002,0002)	Media Storage SOP Class UID	X		
(0008,0005)	Specific Character Set	X		
(0008,0016)	SOP Class UID	X		
(0008,0020)	Study Date		X	
(0008,0022)	Acquisition Date			X
(0008,0030)	Study Time		X	
(0008,0032)	Acquisition Time			X
(0008,0050)	Accession Number		X	
(0008,0060)	Modality	X		
(0008,0080)	Institution Name			X
(0008,0090)	Referring Physician's Name		X	

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(0008,1030)	Study Description			X
(0008,1060)	Name Phys(s) Read Study			X
(0010,0010)	Patient's Name		X	
(0010,0020)	Patient ID		X	
(0010,0030)	Patient's Birth Date		X	
(0010,0040)	Patient's Sex		X	
(0010,1020)	Patient's Size			X
(0010,1030)	Patient's Weight			X
(0010,21C0)	Pregnancy Status			X
(0018,5100)	Patient Position		X	
(0020,000D)	Study Instance UID	X		
(0020,0010)	Study ID		X	
(0020,0013)	Instance Number	X		
(0020,0020)	Patient Orientation		X	
(0028,0002)	Samples per Pixel	X		
(0028,0004)	Photometric Interpretation	X		
(0028,0010)	Rows	X		
(0028,0011)	Columns	X		
(0028,0030)	Pixel Spacing	X		
(0028,0100)	Bits Allocated	X		
(0028,0101)	Bits Stored	X		

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(0028,0102)	High Bit	X		
(0028,0103)	Pixel Representation	X		
(0028,1052)	Rescale Intercept	X		
(0028,1053)	Rescale Slope	X		
(0028,1054)	Rescale Type	X		
(0032,4000)	Study Comments			X

The DICOM attributes described in the table below are updated after copying from input the image:

Table 12 DICOM attributes of LungCAD DO modified from input images

Tag	Attribute Name	Type 1	Type 2	Type 3	Set Value
(0002,0001)	File Meta Info Version	X			0x0100
(0002,0003)	Media Storage SOP Inst UID	X			1.3.12.2.1107.5.9.3.<CAD Manager system serial number entered in the Service UI>.<Object Unique Identifier> Unique ID is created by PO GEN.
(0002,0010)	Transfer Syntax UID	X			Taken directly from original image if original image is an un-compressed image, else the value is set to EXPLICIT_LITTLE_ENDIAN
(0002,0012)	Implementation Class UID	X			Refer to Table 2
(0002,0013)	Implementation Version Name			X	Refer to Table 2

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(0002,0016)	Source App Entity Title			X	AET configured as in the Service UI. If nothing is configured in Service UI then default: DICOM_LOCAL_SEND
(0008,0008)	Image Type	X			Value 1: DERIVED VAlue 2: SECONDARY VAlue 3: AXIAL Value 4: LUNGCAD_<LUNGCAD Version No.>_DO Note: Values are in uppercase.
(0008,0018)	SOP Instance UID	X			A unique ID is created as follows: Lung CAD (UID: 1.3.12.2.1107.5.9.3.<CAD Manager System serial number entered in the Service UI>.<Object Unique Identifier>.
(0008,0021)	Series Date			X	<YYYYMMDD>
(0008,0031)	Series Time			X	<HHMMSS>
(0008,0070)	Manufacturer		X		Copied from Input Image

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(0008,103E)	Series Description			X	It is configured through Service User Interface.If no value is specified then the following default string will appear. CAD_Marks_<Series-DescOfOriginalImage>_<SeriesDateTime>The format for Series Date and Time is: <YYYYMMDDhhmmssfff> Where Y,M,D,h,m,s,f denotes Year, Month, Day, hour, minute, second, and millisecond respectively.
(0008,1090)	Manufacturer Model Name			X	Copied from Input Image
(0008,2111)	Derivation Description			X	LUNGCAD <Version Number>
(0020,0011)	Series Number		X		New number is created by adding 2000 to original series number
(0020,000E)	Series Instance UID	X			A unique ID is created as follows: 1.3.12.2.1107.5.9.3.<CAD Manager system serial number entered in the Service UI>.<Object Unique Identifier>.

The additional DICOM tags apart from the original DICOM image tags which are added to the output DICOM Derived Object (DO) image object are described in Table 13.

Table 13 LUNGCAD DO Attribute added to input image tags

Tag	**Attribute Name**	**Type 1**	**Type 2**	**Type 3**	**Set Value**
(0002,0000)	Group Length	X			

(0008,2112)	Source Image Sequence			X	The SOP instance UID(0008, 1155) and SOP class UID(0008,1150) of the original image is added to this sequence item.
Private Tag (0029,001x)	Private Creator			X	SIEMENS IKM CKS LUNGCAD BMK.
(0029,1x01)	Not Applicable			X	Bookmark XML generated by LungCAD algorithm will be the value .

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5.1.1.11 SOP Specific Conformance - CXRCAD DO

The Derived Object created by CXR algorithms has attributes described in Table 14. These attributes are directly copied from input images:

Table 14 DICOM Attributes of CXRCAD DO, not modified from original image

Tag	Attribute Name	Type 1	Type 2	Type 3
(0002,0002)	Media Storage SOP Class UID	X		
(0008,0005)	Specific Character Set	X		
(0008,0016)	SOP Class UID	X		
(0008,0020)	Study Date		X	
(0008,0022)	Acquisition Date			X
(0008,0030)	Study Time		X	

(0008,0032)	Acquisition Time			X
(0008,0050)	Accession Number		X	
(0008,0070)	Manufacturer		X	
(0008,0080)	Institution Name			X
(0008,0090)	Referring Physician's Name		X	
(0008,1030)	Study Description			X
(0008,1060)	Name Phys(s) Read Study			X
(0008,1090)	Manufacturer Model Name			X
(0010,0010)	Patient's Name		X	
(0010,0020)	Patient ID		X	
(0010,0030)	Patient's Birth Date		X	
(0010,0040)	Patient's Sex		X	
(0010,1020)	Patient's Size			X
(0010,1030)	Patient's Weight			X
(0010,21C0)	Pregnancy Status			X
(0018,0015)	Body Part Examined		X	
(0018,5100)	Patient Position		X	
(0020,000D)	Study Instance UID	X		
(0020,0010)	Study ID		X	
(0008,0020)	Study Date		X	
(0020,0013)	Instance Number	X		
(0020,0020)	Patient Orientation		X	

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(0028,0002)	Samples per Pixel	X		
(0028,0100)	Bits Allocated	X		
(0028,0101)	Bits Stored	X		
(0028,0102)	High Bit	X		
(0028,0103)	Pixel Representation	X		
(0028,1052)	Rescale Intercept	X		

The DICOM Attributes described in the table below are updated by copying from input images.

Table 15 DICOM attributes of CXRCAD DO modified from input images

Tag	Attribute Name	Type 1	Type 2	Type 3	Set Value
(0002,0001)	File Meta Info Version	X			0x0100
(0002,0003)	Media Storage SOP Inst UID	X			1.3.12.2.1107.5.9.2.<CAD Manager system serial number entered in the Service UI>.<Object Unique Identifier> Unique ID is created by PO GEN.
(0002,0010)	Transfer Syntax UID	X			Taken directly from original image if original image is an uncompressed image, else the value is set to EXPLICIT_LITTLE_ENDIAN
(0002,0012)	Implementation Class UID	X			Refer to Table 2
(0002,0013)	Implementation Version Name			X	Refer to Table 2

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(0002,0016)	Source App Entity Title			X	AET configured as in the Service UI. If nothing is configured in Service UI then default: DICOM_LOCAL_SEND
(0008,0008)	Image Type	X			Value 1: DERIVED Value 2: SECONDARY Value 3: NULL Value 4: CXRCAD_<CXRCAD Version Number>_DO Note: Values are in uppercase.
(0008,0018)	SOP Instance UID	X			A unique ID is created as follows: (UID: 1.3.12.2.1107.5.9.2.<CAD Manager System serial number entered in the Service UI>.<Object Unique Identifier>.
(0008,103E)	Series Description			X	It is configured through Service User Interface.If no value is specified then the following default string will appear. CAD_Marks_<Series-DescOfOriginalImage>_<SeriesDateTime>The format for Series Date and Time is: <YYYYMMDDhhmmssfff> Where Y,M,D,h,m,s,f denotes Year, Month, Day, hour, minute, second, and millisecond respectively.
(0008,2111)	Derivation Description			X	CXRCAD <Version Number>

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(0020,0011)	Series Number		X		New number created by adding 2000.
(0020,000E)	Series Instance UID	X			A unique ID is created as follows: (UID: 1.3.12.2.1107.5.9.2.<CAD Manager system serial number entered in the Service UI>.<Object Unique Identifier>.

The additional DICOM tags, apart from the original DICOM image tags which are added to the output DICOM Derived Object (DO) image object, are described in Table 15:

Table 16 CXR DO attributes added to input images

Tag	Attribute Name	Type 1	Type 2	Type 3	Set Value
(0008,0064)	Conversion Type	X			WSD
(0008,2112)	Source Image Sequence			X	The SOP instance UID(0008, 1155) and SOP class UID(0008,1150) of the original image is added to this sequence item.
Private Tag (0029,001x)	Private Creator				SIEMENS IKM CKS CXRCAD FINDINGS
(0029,1x01)	Not Applicable			X	XML input from Algorithm.

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5.1.1.12 SOP Specific Conformance - Grayscale Softcopy Presentation State (GSPS) Storage

Tables below describe the list of DICOM tags populated for GSPS outputs. The tags are common to all CAD Applications.

Table 17 GSPS for LungCAD and CXRCAD outputs

Modules	Attribute	Tag	Type	Value Set
PATIENT	Patient's Name	(0010,0010)	2	Copied from Input Image
	Patient ID	(0010,0020)	2	Copied from Input Image
	Patient's Birth Date	(0010,0030)	2	Copied from Input Image
	Patient's Sex	(0010,0040)	2	Copied from Input Image
STUDY	Study Instance UID	(0020,000D)	1	Copied from Input Image
	Study Date	(0008,0020)	2	Copied from Input Image
	Study Time	(0008,0030)	2	Copied from Input Image
	Referring Physician's Name	(0008,0090)	2	Copied from Input Image
	Study ID	(0020,0010)	2	Copied from Input Image
	Accession Number	(0008,0050)	2	Copied from Input Image
	Study Description	(0008,1030)	3	Copied from Input Image
GENERAL SERIES	Modality	(0008,0060)	1	PR
	Series Instance UID	(0020,000E)	1	<UIDRootOfAlgorithm>.serialnumber.<Unique ID>
	Series Number	(0020,0011)	2	Input Image Series Number + 3000

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	Series Description	(0008,103E)	3	It is configured through Service User Interface.If no value is specified then the following default string will appear. CAD_Marks_<Series-DescOfOriginalImage>_<SeriesDateTime>The format for Series Date and Time is: <YYYYMMDDhhmmssfff>Where Y,M,D,h,m,s,f denotes Year, Month, Day, hour, minute, second, and millisecond respectively.
	Patient Position	(0018,5100)	2C	Copied from Input Image
GENERAL EQUIPMENT	Manufacturer	(0008,0070)	2	SIEMENS
	Manufacturer's Model Name	(0008,1090)	3	<Algorithm Name> <VersionNumber>
SOP COMMON	SOP Class UID	(0008,0016)	1	1.2.840.10008.5.1.4.1.1.11.1
	SOP Instance UID	(0008,0018)	1	<UIDRootOfAlgorithm>.serialnumber.<Unique ID>
	Specific Character Set	(0008,0005)	1C	Copied from Input Image
	Instance Creation Date	(0008,0012)	3	Date of instance creation
	Instance Creation Time	(0008,0013)	3	Time of instance creation

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DICOM FILE META INFORMATION	Group Length	(0002,0000)	1	Generated by the Application
	File Meta Information Version	(0002,0001)	1	00 01
	Media Storage SOP Class UID	(0002,0002)	1	1.2.840.10008.5.1.4.1.1.11.1
	Transfer Syntax UID	(0002,0010)	1	1.2.840.10008.1.2.1
	Implementation Class UID	(0002,0012)	1	1.3.12.2.1107.5.9.5.2.<YYYYMMDD>
	Implementation Version Name	(0002,0013)	3	SCM_VD10A .
Module Specific to GSPS				
PRESENTATION STATE	Instance Number	(0020,0013)	1	Sequential number starting with 1
	Presentation Label	(0070,0080)	1	<Text identifying Algorithm Findings>
PRESENTATION STATE	Presentation Description	(0070,0081)	2	No Value
	Presentation Creation Date	(0070,0082)	1	YYYYMMDD
	Presentation Creation Time	(0070,0083)	1	HHMMSS.FFFFFF
	Presentation Creator's Name	(0070,0084)	2	<Text identifying the Algorithm that generated this PR>
	Referenced Series Sequence	(0008,1115)	1	Contains reference to the input series
	>Series Instance UID	(0020,000E)	1	SUID of input image

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	>Referenced Image Sequence	(0008,1140)	1	Reference of input image
	>>Referenced SOP Class UID	(0008,1150)	1	SOP class UID of input image
	>>Referenced SOP Instance UID	(0008,1155)	1	SOP instance UID of input image
OVERLAY PLANE	Overlay Rows	(6000,0010)	1	Total Rows of Input Image
	Overlay Columns	(6000,0011)	1	Total Columns of Input Image
	Overlay Type	(6000,0040)	1	G
	Overlay Subtype	(6000,0045)	3	AUTOMATED
	Overlay Origin	(6000,0050)	1	1/1
	Overlay Bits Allocated	(6000,0100)	1	1
	Overlay Bit Position	(6000,0102)	1	0
	Overlay Data	(6000,3000)	1C	Generated by the Application
OVERLAY/ CURVE ACTIVATION	Overlay Activation Layer	(6000,1001)	2C	LAYER_1
	Displayed Area Selection Sequence	(0070,005A)	1	Displayed area selection of input image
	>Referenced Image Sequence	(0008,1140)	1C	Reference to input image
	>>Referenced SOP Class UID	(0008,1150)	1C	SOP class UID of input image
	>>Referenced SOP Instance UID	(0008,1155)	1C	SOP instance UID of input image

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	>Displayed Area Top Left Hand Corner	(0070,0052)	1	1/1
	>Displayed Area Bottom Right Hand Corner	(0070,0053)	1	TotalRows/TotalColumnsEg: if input image contains 712 rows and 912 columns, value would be "712/912"
	>Presentation Size Mode	(0070,0100)	1	SCALE TO FIT
DISPLAYED AREA	>Presentation Pixel Spacing	(0070,0101)	1C	Copied from input image depending on modality:CT: Pixel Spacing (0028, 0030)CR: Imager Pixel Spacing (0018,1164)DX: Imager Pixel Spacing (0018,1164) **Note:** For CR, Imager Pixel Spacing is Type 3. If this tag is not present in any input image the value will be "0/0"
GRAPHIC ANNOTATION	Graphic Annotation Sequence	(0070,0001)	1	Graphics depicting CAD Marks generated by Algorithm
	>Referenced Image Sequence	(0008,1140)	1C	Reference to input image
	>>Referenced SOP Class UID	(0008,1150)	1C	SOP class UID of input image
	>>Referenced SOP Instance UID	(0008,1155)	1C	SOP instance UID of input image
	>Graphic Layer	(0070,0002)	1	LAYER_0

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	>Text Object Sequence	(0070,0008)	1C	Contains Finding Numbers, if generated by Algorithm.
GRAPHIC ANNOTATION	>>Bounding Box Annotation Units	(0070,0003)	1C	PIXEL
	>>Unformatted Text Value	(0070,0006)	1	Finding number if generated by Algorithm
	>>Bounding Box Top Left Hand Corner	(0070,0010)	1C	Generated by the Application
	>>Bounding Box Bottom Right Hand Corner	(0070,0011)	1C	Generated by the Application
	>>Bounding Box Text Horizontal Justification	(0070,0012)	1C	LEFT
	>Graphic Object Sequence	(0070,0009)	1C	Contains Graphics representing CAD marks as generated by algorithm
	>>Graphic Annotation Units	(0070,0005)	1	PIXEL
	>>Graphic Dimensions	(0070,0020)	1	2
	>>Number of Graphic Points	(0070,0021)	1	Generated by the Application
	>>Graphic Data	(0070,0022)	1	Generated by the Application
	>>Graphic Type	(0070,0023)	1	Supported Types: CIRCLE, POLYLINE
	>>Graphic Filled	(0070,0024)	1C	N

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GRAPHIC LAYER	Graphic Layer Sequence	(0070,0060)	1	Generated by the Application
	>Graphic Layer	(0070,0002)	1	LAYER_0
	>Graphic Layer Order	(0070,0062)	1	1
	>Graphic Layer Recommended Display Grayscale Value	(0070,0066)	3	65535
MODALITY LUT	Rescale Intercept	(0028,1052)	1C	Copied from input image, if available
	Rescale Slope	(0028,1053)	1C	Copied from input image, if available
	Rescale Type	(0028,1054)	1C	US
SOFTCOPY VOI LUT	Softcopy VOI LUT Sequence	(0028,3110)	1	Window values for referenced image
	>Window Center	(0028,1050)	1C	Copied from input image
	>Window Width	(0028,1051)	1C	Copied from input image
SOFTCOPY PRESENTATION LUT	Presentation LUT Shape	(2050,0020)	1C	IDENTITY

Table 18 GSPS Tags specific to CXR output

Attribute	**Tag**	**Value Set**
Private Creator	(0029,001x)	SIEMENS IKM CKS CXRCAD FINDINGS
XML internal to Algorithm	(0029,1x01)	XML input from Algorithm

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Table 19 GSPS Tags specific to LungCAD output

Attribute	Tag	Value Set
Private Creator	(0029,001x)	SIEMENS IKM CKS LUNGCAD BMK
XML internal to Algorithm	(0029,1x01)	XML input from Algorithm

5.1.1.13 Association Acceptance Policy

The *syngo* CAD Manager DICOM application accepts a new association for:

1. DIMSE C-ECHO.
2. DIMSE C-STORE.

   service operations. Any Information Objects transmitted on that association will be checked on conformance and accepted for CAD Processing.

5.1.1.14 Associated Real-World Activity - Receive

5.1.1.14.1 Associated Real-World Activity - Receiving images from a Remote Node

The daemon receiving process will accept an association and will receive any images transmitted on that association and will store the images on disk and initiate CAD Processing if the conformance is performed successfully.

5.1.1.14.2 Accepted Presentation Context - Receiving Images

The *syngo* CAD Manager DICOM application will accept Presentation Contexts as shown in the following table:

Table 20 Presentation Context for SCM SCP

Transfer Syntax			
Name List	**UID List**	**Role**	**Ext. Neg.**

IMPLICIT_LITTLE_ENDIAN	1.2.840.10008.1.2	SCP	None
EXPLICIT_LITTLE_ENDIAN	1.2.840.10008.1.2.1		
EXPLICIT_BIG_ENDIAN	1.2.840.10008.1.2.2		

5.1.1.15 SOP - Specific Conformance Statement - Common

Patient ID (type 2) is expected to contain a valid string. If it contains an empty string or NULL value the image will be rejected, however, the association will continue to receive other images.

The DICOM Receiver sends response to each message received as part of C_STORE request.

Table 21 lists the possible status code in response message and their meaning.

Table 21 Response Code of SCM SCP

Code	Meaning	Status
0x0000	Image accepted	Success
0xA900	Image not according to conformance of CDS SCP	Error
0xA700	Disk Full (transient rejection)	Error
0xC010	Attribute required for license check is missing	Error
0xC013	Max number concurrent association reached (transient rejection)	Error
0xC014	License validation failed	Error

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In case of error response, the association is terminated and no further message will be accepted from the SCU.

For algorithms that are configured to run with Port based licensing following attributes are used and should be available with valid values:

- (0008,0020) Manufacturer (Type 1)
- (0008,0060) Modality (Type 1)
- (0018,1000) Device Serial Number (Type 3)

5.1.1.16 SOP - Specific Conformance Statement - CAD Digital Mammography

All Type 1 attributes for the CAD Digital Mammography Image IOD are expected to be present with a valid value, and all relevant Type 2 attributes are expected to be present.

Also, for MammoCAD to process the image successfully, the following attributes should be present with the values indicated.

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Table 22 DICOM Attributes required for processing MammoCAD

DICOM Tag	Description	Expected Value
(0008,0060)	Modality	MG
(0008,0068)	Presentation Intent Type	The SOP Class UID should be 1.2.840.10008.5.1.4.1.1.1.2.1 .
(0008,0070)	Manufacturer	“SIEMENS” in mixed case.
(0008,1090)	Manufacturer's Model Name	“Mammomat Novation DR” or “Mammomat Inspiration” in mixed case.
(0018,1114)	Magnification Factor	If the tag is present, the value should be with a Lower limit of 0.9 and Upper of limit of 1.1(both inclusive).
(0018,0015)	Body Part Examined	If the tag is present, the value should be "BREAST”.

(0028,0030) (0018,1164) (0018,7022) (0018,7020)	Pixel Spacing Imager Pixel Spacing Detector Element Spacing Detector Element Physical Size	The specified tags are searched in order to find the pixel spacing value and the first found value should satisfy the following criteria. For: **Mammomat Novation DR:** The row and column spacing value should be in the range 0.069mm to 0.071mm inclusive. **Mammomat Inspiration:** The row and column spacing value should be in the range 0.084mm to 0.086mm inclusive.
(0018,5101)	View Position	The value should be either one of the given below: • MLO • CC • ML • LM
(0020,0062)	Image Literality	“L” or “R”
(0028,0010) (0028,0011)	Row Size Column Size	The row and column values should fall in the range as given below: Row size - [512 to 8192] both inclusiveColumn size - [512 to 8192] both inclusive
(0028,1300)	Implant present	If the tag is present, The value should be "NO".
(0028,1350)	Partial View	If the tag is present, The value should be "NO".
(0054,0220)	View Code Sequence	If View Code Sequence tag is not present, Image is valid Else, if View Code Sequence tag does not contain View Modifier Code Sequence tag, Image is Valid. Else, if View Modifier Code Sequence tag, Image does not contain Code Value tag, Image is Valid. Else Code value tag should not contain either "R-102D7" or "R-102D6" (Magnification or partial view)
(0054,0222)	View Modifier Code Sequence	
(0008,0100)	Code Value	
(0010,0040)	Patients Sex	If the tag is present, the value should not be "M"

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5.1.1.17 SOP - Specific Conformance Statement - LungCAD

All Type 1 attributes for the CT Image IOD are expected to be present with a valid value, and all Type 2 attributes are expected to be present. Also for LungCAD to process the image successfully, following attributes should be present with the values indicated.

Table 23 DICOM attributes required for processing LungCAD

DICOM Tag	Description	Expected Value
(0008,0008)	Image Type	Value 1: Should Not be 'DERIVED' Value 2: Should Not be 'SECONDARY'
(0008,0070)	Manufacturer	Not checked.
(0008,0068)	Presentation Intent Type	Not checked.
(0008,0060)	Modality	The value of this tag should be "CT"
(0008,1090)	Manufacturer's Model Name	Not checked.
(0018,0015) (0040,0318)	Body Part Examined Organ Exposed	Not checked.
(0018,1114)	Magnification Factor	Not checked.
(0018,1164)	Imager Pixel Spacing	Not checked.
(0028,0004)	Photometric Interpretation	Not checked.
(0028,0010) (0028,0011)	Size	Not checked.
(0054,0220)	View Code Sequence	Not checked.
(0054,0222)	View Modifier Code Sequence	Not checked.
(0008,0104)	Code Meaning	Not checked.
(0400,0010)	MAC Calculation Transfer Syntax UID	Not checked.

NOTE	**if configured, LungCAD can forward incoming DICOM images without modification to an output node.**

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5.1.1.18 SOP - Specific Conformance Statement - CXRCAD

All Type 1 attributes for the CXR Image IOD are expected to be present with a valid value, and all relevant Type 2 attributes are expected to be present. Also, for CXRCAD to process the image successfully, following attributes should be present with the vales indicated.

Table 24 DICOM attributes required for processing CXRCAD

DICOM Tag	Description	Expected Value
(0008,0008)	Image Type	Not checked
(0008,0070)	Manufacturer	Not checked
(0008,0060)	Modality	The value should be either one of the given below: • DX • CR
(0008,1090)	Manufacturer's Model Name	Not checked
(0018,0015) (0040,0318)	Body Part Examined Organ Exposed	Not checked
(0028,0030) (0018,1164) (0018,7022) (0018,7020)	Pixel Spacing Imager Pixel Spacing Detector Element Spacing Detector Element Physical Size	One of these DICOM tags should be present, otherwise, the image is rejected. When multiple of these tags are present then the first tag is used.
(0028,0004)	Photometric Interpretation	The value should be any one of the given below: • MONOCHROME1 • MONOCHROME2
(0028,0010) (0028,0011)	Number or rows Number of columns	The row and column value should fall in the range as given below: Row size: 800 to 6100 (both inclusive). Column size: 800 to 6100 (both inclusive).
(0054,0220)	View Code Sequence	Not checked

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(0054,0222)	View Modifier Code Sequence	Not checked
(0008,0104)	Code Meaning	Not checked

5.1.1.19 Optional Attributes

Not Applicable.

5.1.1.20 Specialized Information Object Definitions

Not Applicable.

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6 Configuration

6.1 DICOM Configuration

The *syngo* Service User Interface is used for DICOM Configuration.

6.1.1 Configuration parameters

The following fields are configured for the Local DICOM Storage SCP:
1. AE Title + Port number
2. IP Address
3. Subnet Mask
4. Default Gateway

The following fields are configured for each output device (Remote DICOM Storage SCP):
1. AE Title
2. Host name/ IP Address
3. Port Number
4. Storage Commitment AET + Port

The following fields are configured for each input device (Remote DICOM Storage SCU):

1. Host Name/IP Address
2. Network Speed

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