R2 ImageChecker®
R2 Quantra™

R2 Cenova™ 1.2

DICOM Conformance Statement

MAN-001104 Rev 001

HOLOGIC™

Mammography

R2 Cenova™ 1.2

DICOM Conformance Statement

PN MAN-01104 Rev 001

HOLOGIC™

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MergeCOM-3 Advanced Integrator's Tool Kit is a product of Merge Healthcare.

1. Overview

The R2 Cenova server uses proprietary software applications developed by Hologic to assist radiologists in the analysis of digital mammography images. The two principal options available with the R2 Cenova server are:

- ImageChecker® CAD (computer-aided detection) software used to identify and mark regions of interest on routine screening and diagnostic mammograms.
- Quantra™ software used to calculate volumetric breast density.

The R2 Cenova software applications implement the necessary DICOM services for interoperability between this product, other Hologic products, and products from other vendors. It also provides information necessary to configure other vendors' products to communicate with this product via DICOM.

The following table provides an overview of the network services supported by the R2 Cenova software.

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Digital Mammography X-Ray Image Storage – For Processing	No	Yes
Mammography CAD SR	Yes	No
Secondary Capture Image Storage	Yes	No
RT Structure Set Storage	Yes	No

2. Contents

3. Introduction

Hologic, Inc. develops and markets a full line of mammography products including the R2 Cenova digital mammography server. In general, R2 Cenova accepts digital mammography images as a Service Class Provider (SCP) of the Storage Service Class, performs Computer-Aided Detection (CAD) and volumetric assessment of breast tissue on the images, and exports CAD results as a Service Class User (SCU) of the Storage Service Class. The system also serves as an SCP of the Verification Service Class.

3.1. Revision History

The information in this document applies to R2 Cenova software version 1.2.

3.2. Audience

This document is intended to aid in connecting the R2 Cenova server to other components that make use of the DICOM standard for interconnecting networked imaging devices. The reader of this document should be familiar with the DICOM standard and PACS components that utilize the standard.

3.3. Remarks

A DICOM conformance statement – the structure and content of which are specified by the DICOM standard – is intended to aid in determining the suitability of interconnecting digital imaging devices. References to specific functionality in a conformance statement are not sufficient to guarantee interoperability between components. The following should be considered when evaluating interoperability:

- The DICOM conformance statement for the R2 Cenova server provides a starting point for ascertaining whether the product can communicate with other systems.
- The only way to know whether the R2 Cenova server can interoperate with other systems is to perform connectivity testing.
- This document represents a best effort to document the functionality of commercial versions of the R2 Cenova server and is not a functional specification of any Hologic component or product. Hologic reserves the right to make changes at any time to the functionality of the DICOM components described herein, and is committed to following the evolution of the DICOM standard.

3.4. Definitions, Terms and Abbreviations

This document uses the following acronyms.

AE	Application Entity
CAD	Computer Aided Detection
DICOM	Digital Imaging and Communications in Medicine
GE RWS	GE Medical Systems Review Workstation
IOD	Information Object Definition
PDU	Protocol Data Unit
RT	Radiotherapy
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
SR	Structured Report
UID	Unique Identifier
VA	Volumetric Assessment
VR	Value Representation

3.5. References

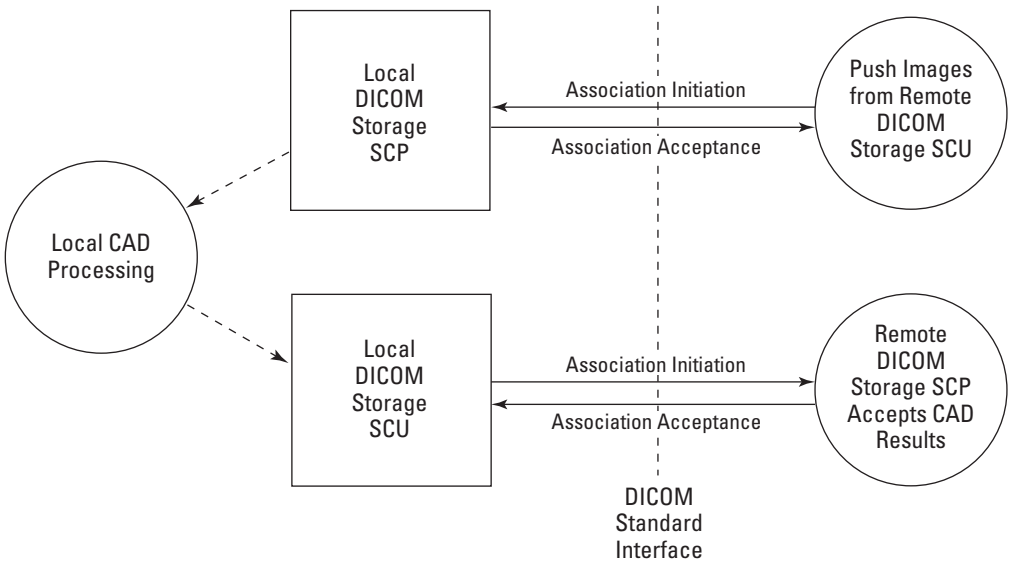
National Electrical Manufacturers Association DICOM Standard, PS 3.

4. Networking

4.1. Implementation Model

4.1.1. Application Data Flow

The following diagram depicts the Application Entities (AE) and their relationships to Real-World Activities.



Application Data Flow

The Local Processing is initiated at system startup. The Local DICOM Storage SCU and local DICOM storage SCP are executed at system startup and exist in one executable program using two AE titles.

A Remote DICOM Storage SCU initiates a push of images to the Local DICOM Storage SCP. Each image accepted is passed to Local CAD Processing. Upon completion of CAD processing, the CAD results pass to the Local DICOM Storage SCU, which pushes the CAD results to a Remote DICOM Storage SCP.

Images that are accepted by the Local DICOM Storage SCP are stored temporarily, until processing is completed and the CAD results are exported successfully.

4.1.2. Functional Definition of AE's

The Local DICOM Storage SCP AE supports the following functions:

- Accepts DICOM association requests
- Accepts DICOM storage requests
- Validates images for CAD processing, checks for disk space, and stores images to disk files

The Local DICOM Storage SCU AE supports the following functions:

- Negotiates and establishes DICOM association with remote destination
- Stores DICOM Composite SOP Instance to remote destination

4.1.3. Sequencing of Real-World Activities

4.1.3.1. Local CAD Processing

When Local CAD Processing is triggered by digital images pushed from a remote application:

- The Local DICOM Storage SCP AE responds to DICOM association initiation, and selects a matching Presentation Context (Abstract Syntax and Transfer Syntax).
- The Local DICOM Storage SCP AE accepts an association and waits for a C-STORE request.
- Upon receiving a C-STORE request, the Local DICOM Storage SCP validates the attributes in the message, performs a license check, stores the image object to disk, and queues the image for processing.
- The Local DICOM Storage SCP sends a C-STORE response.
- Upon completion of CAD processing, the CAD results are formatted into a DICOM Structured Report (Mammography CAD SR) or equivalent.
- The Local DICOM Storage SCU is executed, which initiates an association to a remote application.
- The Local DICOM Storage SCU sends a C-STORE request containing the structured report or equivalent object and waits for a C-STORE response.
- The Local DICOM Storage SCU closes the association and exits.

The CAD results that are exported as a DICOM structured report contain references to the corresponding DICOM digital mammography For Processing images. Image pixel data are not stored in the DICOM structured report. This DICOM structured report is stored under the same DICOM Study as the images. The corresponding DICOM digital mammography For Presentation images are expected to be distributed from the originating digital mammography acquisition system to all desired destinations. It is the responsibility of a softcopy display to match correctly the digital mammography For Presentation images to the corresponding CAD results in the DICOM structured report.

4.2. AE Specifications

4.2.1. Local DICOM Storage SCP

4.2.1.1. SOP Classes

This Application Entity provides Standard Conformance to the following DICOM SOP Classes as an SCP:

SOP Class Name	SOP Class UID
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Verification SOP Class	1.2.840.10008.1.1

4.2.1.2. Association Policies

The Local DICOM Storage SCP accepts associations, but does not initiate associations.

4.2.1.2.1. General

The maximum PDU size accepted is 64234. If during association negotiation the maximum sized PDU of the system negotiating with the application is larger than this value, the PDU size will be limited to this value. This value is defined in the mergecom.pro file provided with the MergeCOM-3 Advanced Integrator's Tool Kit.

The DICOM standard Application context is accepted:

DICOM Application Context for Local DICOM Storage SCP	
Application Context Name	1.2.840.10008.3.1.1.1

4.2.1.2.2. Number of Associations

The Local DICOM Storage SCP accepts up to six simultaneous associations.

4.2.1.2.3. Asynchronous Nature

Asynchronous mode is not supported. All operations are performed synchronously.

4.2.1.2.4. Implementation Identifying Information

The Implementation Class UID is '2.16.840.1.1.2.840.113986, and the Implementation Version Name is 'MergeCOM3_370'. These values are defined in the mergecom.pro file provided with the MergeCOM-3 Advanced Integrator's Tool Kit.

4.2.1.3. Association Initiation Policy

The Local DICOM Storage SCP does not initiate associations.

4.2.1.4. Association Acceptance Policy

The Local DICOM Storage SCP accepts an association when it receives a valid association request, with at least one matching presentation context. If the number of simultaneous associations has reached the maximum, an association request remains pending (i.e., no response is returned) until an opened association is closed or the remote SCU aborts the association.

4.2.1.4.1. Push Images from Remote DICOM Storage SCU

4.2.1.4.1.1. Description and Sequencing of Activities

The Real-World Activity (i.e., Local CAD Processing) is associated with a C-STORE SCP operation (i.e., Local DICOM Storage SCP Application Entity), and is triggered by a Push images from Remote DICOM Storage SCU. This results in the storage and CAD processing of the received images on the R2 Cenova server. The C-STORE SCP operation will respond with a failure status if it is unable to store the images.

4.2.1.4.1.2. Accepted Presentation Contexts

The Local DICOM Storage SCP accepts the Presentation Contexts shown in the following table:

Abstract Syntax Name	UID	Transfer Syntax Name	UID	Role	Extended Negotiation
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Verification	1.2.840.10008.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

When presented with multiple transfer syntaxes within one requested Presentation Context, the Local DICOM Storage SCP accepts Explicit VR Little Endian over Implicit VR Little Endian.

4.2.1.4.1.3. SOP Specific Conformance

The Local DICOM Storage SCP provides Level 2 (Full) conformance to all of the accepted Storage SOP Classes. It does not provide Digital Signature support. No coercion of Attributes is performed. Image instances with a value other than '00' for Lossy Image Compression (0028,2110) are rejected. Images that are stored successfully may not be accessed by remote systems.

All Type 1 attributes for the Digital Mammography X-Ray Image IOD are expected to be present with a valid value (not zero length), and all Type 2 attributes are expected to be present. If not, the image instance may be rejected. See section '**Created SOP Instance(s)**' for detail regarding attributes required for CAD processing.

The following table lists the possible values for the Status (0000,0900) attribute of the C-STORE response:

Service Status	Further Meaning	Status Code	Reason
Success	Success	0000	Image header is valid, and image successfully queued for processing.
Refused	Out of resources	A700	Not enough disk space to store the image. Error Comment (0000,0902) contains 'Out of resources'.
Error	Data set does not match SOP Class.	A900	Offending Element (0000,0901) is the Attribute Tag that is missing or has an invalid value.
Error	License attribute missing	C010	Offending Element (0000,0901) is the missing Attribute Tag that is required for license check.
Error	License validation failed	C011	Offending Element (0000,0901), if present, is the Attribute Tag that failed the license check.
Error	Required attribute missing	C012	Offending Element (0000,0901) is the missing Attribute Tag that is required for CAD processing.
Error	Attribute value out of range	C013	Offending Element (0000,0901) is the Attribute Tag for which the value is out of range (includes zero-length value) for CAD processing.
Error	Image will not be processed	C014	Reason internal to CAD device.

4.2.2. Local DICOM Storage SCU

4.2.2.1. SOP Classes

This Application Entity provides Standard Conformance to the following DICOM SOP Class as an SCU:

SOP Class Name	SOP Class UID
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7

This Application Entity also produces a non-Standard version of the following DICOM SOP Class as an SCU. This SOP Class is used to store CAD results only to the GE RWS, and is maintained for legacy purposes. Instances of this SOP Class should not be archived. This non-Standard usage was created before the Mammography CAD SR SOP Class was approved into the DICOM Standard, and should be considered obsolete.

SOP Class Name	SOP Class UID
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3

4.2.2.2. Association Policies

The Local DICOM Storage SCU initiates associations, but does not accept associations.

4.2.2.2.1. General

The maximum PDU size offered is 64234. This value is defined in the mergecom.pro file provided with the MergeCOM-3 Advanced Integrator's Tool Kit. The DICOM standard Application context is proposed:

DICOM Application Context for Local DICOM Storage SCU	
Application Context Name	1.2.840.10008.3.1.1.1

4.2.2.2.2. Number of Associations

Up to two Local DICOM Storage SCU instances may be executed simultaneously.

4.2.2.2.3. Asynchronous Nature

Asynchronous mode is not supported. All operations are performed synchronously.

4.2.2.2.4. Implementation Identifying Information

The Implementation Class UID is '2.16.840.1.1.2.840.113986', and the Implementation Version Name is 'MergeCOM3_370'. These values are defined in the mergecom.pro file provided with the MergeCOM-3 Advanced Integrator's Tool Kit.

4.2.2.3. Association Initiation Policy

4.2.2.3.1. Local CAD Processing

4.2.2.3.1.1. Description and Sequencing of Activities

The Real-World Activity (i.e., Remote DICOM Storage SCP accepts CAD Results) is associated with a C-STORE SCU operation (i.e., Local DICOM Storage SCU Application Entity) and is triggered by the completion of Local CAD Processing. This Local CAD Processing results in the sending of CAD results to a Remote DICOM Storage SCP.

4.2.2.3.1.2. Proposed Presentation Contexts

The following Presentation Contexts will be proposed with each association request:

Abstract Syntax Name	UID	Transfer Syntax Name	UID	Role	Extended Negotiation
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

4.2.2.3.1.3. SOP Specific Conformance

The behavior of the Local DICOM Storage SCU when encountering status codes in a C-STORE response is summarized in the table below:

Service Status	Further Meaning	Status Code	Reason
Success	Success	0000	The Remote Store SCP successfully stored the SOP Instance. The CAD results and associated images shall be permitted to be deleted.
Warning	Coercion of data elements, Data set does not match SOP Class, Elements discarded	B000, B007, B006	Treated as Success. The CAD results and associated images shall be permitted to be deleted.
Failure	Any	Any	Failure is logged. The association will be reattempted at a later time, and the CAD results and associated images shall not be deleted. After a specified time period of successive failed attempts, no more attempts will be made, and the CAD results and associated images shall be permitted to be deleted. The retry interval and retry duration are configurable per destination.

The behavior of the Local DICOM Storage SCU during communication failure is summarized in the table below.

Exception	Behavior
Timeout	Local DICOM Storage SCU aborts the association. Failure is logged. The association will be reattempted at a later time, according to the retry strategy.
Association rejected or aborted by SCP	Failure is logged. The association will be reattempted at a later time, according to the retry strategy.

4.2.2.3.1.4. CAD Results Composite Objects

Instance UIDs are globally unique for all SOP Instances generated by the Local DICOM Storage SCU. The UID root is '1.2.840.113986'.

4.2.2.3.1.4.1. Mammography CAD Structured Report

The four Mammography CAD SR results that may be produced are listed in the following table.

This Mammography CAD SR Result…	Provides…
5.x CAD	Backwards compatibility with previous releases of R2 ImageChecker 5.x products.
9.2 CAD	The latest R2 ImageChecker CAD algorithm enhancements.
9.2 VA	Quantra volumetric assessment of breast tissue.
9.2 CAD + VA	R2 ImageChecker CAD results and Quantra volumetric assessment of breast tissue.

The Local DICOM Storage SCU provides standard conformance to the Mammography CAD SR SOP Class. See section **8.1.1**, '**Created SOP Instance(s)**' for Mammography CAD SR content detail.

4.2.2.3.1.4.2. Secondary Capture Image

Two types of Secondary Capture Image may be produced:

- **CAD SC** – A single SOP instance contains nondiagnostic representations of up to four images for a case in a 2 × 2 layout, with the R2 CAD marks burned into the image pixel data.
- **VA SC** – A single SOP instance contains an image of a table with text values of Quantra volumetric assessment results.

The local DICOM Storage SCU provides standard conformance to the Secondary Capture Image Storage SOP Class. See section **8.1.1**, '**Created SOP Instance(s)**', for Secondary Capture Image content details.

4.2.2.3.1.4.3. RT Structure Set

The use of the RT Structure Set Storage SOP Class is proprietary between Hologic and GE Medical Systems. The Modality (0008,0060) attribute value is 'MG', to avoid confusion with valid RT Structure Set instances, and the proprietary instances should never be archived.

4.2.2.4. Association Acceptance Policy

The Local DICOM Storage SCU does not accept associations.

4.3. Network Interfaces

4.3.1. Physical Network Interface

The TCP/IP stack is inherited from the Windows XP Professional (Service Pack 2) operating system. For connectivity Hologic systems normally use 10/100/1000 Base-T Ethernet with RJ45 connector. DICOM is indifferent to the physical medium over which TCP/IP executes.

4.3.2. Additional Protocols

None

4.4. Configuration

A Web-based Configuration Tool is used for DICOM configuration.

4.4.1. AE Title/Presentation Address Mapping

The default Listen Port for the Local DICOM Storage SCP is 7100. The AE Titles for the SCUs and SCPs are provided to the application from a database internal to the application.

4.4.2. Configurable Parameters

The following fields are configurable for the Local DICOM Storage SCP:

- AE Title
- Port Number

The following field is configurable for the Local DICOM Storage SCU:

- AE Title

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

- AE Title
- Hostname/IP Address
- Maximum case timeout (in seconds)

The following fields are configurable for each output device (Remote DICOM Storage SCP):

- AE Title
- Hostname/IP Address
- TCP/IP Port Number
- Retry Interval (in minutes)
- Retry Duration (in hours)
- Service List and Transfer Syntax List (i.e., presentation context) to be requested by the Local DICOM Storage SCU for this device are determined automatically from the Output Format assigned during input-to-output mapping.

5. Support of Character Sets

Latin alphabet no. 1 (ISO_IR 100) is supported from Local Processing. The Character Set received in the input images is copied to the CAD output results.

6. Security Profiles

The R2 Cenova server does not support any specific DICOM security measures. It is assumed that the R2 systems are used within a secured environment. It is assumed that a secured environment includes at a minimum:

- Firewall or router protections to ensure that only approved external hosts have network access to the R2 systems.
- Firewall or router protections to ensure that the R2 systems only have network access to approved external hosts and services.
- Any communication with external hosts and services outside the locally secured environment use appropriate secure network channels such as a Virtual Private Network (VPN).
- Other network security procedures such as automated intrusion detection may be appropriate in some environments. Additional security features may be established by the local security policy and are beyond the scope of this conformance statement.

7. Security

7.1. Security Profiles

Not applicable.

7.2. Association Level Security

Not applicable.

7.3. Application Level Security

Not applicable.

8. Annexes

8.1. IOD Contents

8.1.1. Created SOP Instance(s)

The attributes contained in created Mammography CAD SR Instances are listed in the following tables.

Table 1: IOD of Created Mammography CAD SR Instances

IE	Module	Reference	Presence of Module
Patient	Patient	Table 3	ALWAYS
Study	General Study	Table 4	ALWAYS
	Patient Study	Table 5	ANAP
Series	SR Document Series	Table 8	ALWAYS
Equipment	General Equipment	Table 6	ALWAYS
Document	SR Document General	Table 9	ALWAYS
	SR Document Content	Table 10	ALWAYS
	SOP Common	Table 7	ALWAYS

The attributes contained in created Secondary Capture Image Instances are listed in the following tables.

Table 2: IOD of Created Secondary Capture Image Instances

IE	Module	Reference	Presence of Module
Patient	Patient	Table 3	ALWAYS
Study	General Study	Table 4	ALWAYS
	Patient Study	Table 5	ANAP
Series	General Series	Table 16	ALWAYS
Equipment	General Equipment	Table 6	ALWAYS
	SC Equipment	Table 17	ALWAYS
Image	General Image	Table 18	ALWAYS
	Image Pixel	Table 19	ALWAYS
	VOI LUT	Table 20	ALWAYS
	SOP Common	Table 7	ALWAYS

8.1.1.1. Common Modules

Table 3: Patient Module of Created SOP Instances

Attribute Name	Tag	Value	Presence of Value	Source
Patient's Name	(0010, 0010)	Copied from source image header*	ALWAYS	AUTO
Patient ID	(0010, 0020)	Copied from source image header	ALWAYS	AUTO
Patient's Birth Date	(0010, 0030)	Copied from source image header	VNAP	AUTO
Patient's Sex	(0010, 0040)	Copied from source image header	VNAP	AUTO
All other Patient Attributes		Copied from source image header, if present	ANAP	AUTO

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Table 4: General Study Module of Created SOP Instances

Attribute Name	Tag	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	Copied from source image header	ALWAYS	AUTO
Study Date	(0008,0020)	Copied from source image header	ALWAYS	AUTO
Study Time	(0008,0030)	Copied from source image header	VNAP	AUTO
Referring Physician's Name	(0008,0090)	Copied from source image header	VNAP	AUTO
Study ID	(0020,0010)	Copied from source image header	VNAP	AUTO
Accession Number	(0008,0050)	Copied from source image header	VNAP	AUTO
Study Description	(0008,1030)	Copied from source image header, if present	ANAP	AUTO
Physician(s) of Record	(0008,1048)	Copied from source image header, if present	ANAP	AUTO
Name of Physician(s) Reading Study	(0008,1060)	Copied from source image header, if present	ANAP	AUTO

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Table 5: Patient Study Module of Created SOP Instances

Attribute Name	Tag	Value	Presence of Value	Source
Admitting Diagnoses Description	(0008,1080)	Copied from source image header, if present	ANAP	AUTO
Patient's Age	(0010,1010)	Copied from source image header, if present	ANAP	AUTO
Patient's Size	(0010,1020)	Copied from source image header, if present	ANAP	AUTO
Patient's Weight	(0010,1030)	Copied from source image header, if present	ANAP	AUTO
Occupation	(0010,2180)	Copied from source image header, if present	ANAP	AUTO
Additional Patient's History	(0010,21B0)	Copied from source image header, if present	ANAP	AUTO

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⚠ ***Note:** The 'source image' refers to the first image received by the R2 Cenova Server for a given Study.*

Table 6: General Equipment Module of Created SOP Instances

Attribute Name	Tag	Value	Presence of Value	Source
Manufacturer	(0008,0070)	'HOLOGIC, Inc.' or 'R2 Technology, Inc.'	ALWAYS	CONFIG
Institution Name	(0008,0080)	Copied from source image header, if present*	ANAP	AUTO
Institution Address	(0008,0081)	Copied from source image header, if present	ANAP	AUTO
Station Name	(0008,1010)	Computer Name	ALWAYS	AUTO
Manufacturer's Model Name	(0008,1090)	'Digital CAD Server'	ALWAYS	AUTO
Device Serial Number	(0018,1000)	System Serial Number	ALWAYS	AUTO
Software Versions	(0018,1020)	System Software Version	ALWAYS	AUTO

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Table 7: SOP Common Module of Created SOP Instances

Attribute Name	Tag	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	'1.2.840.10008.5.1.4.1.1.88.50' or '1.2.840.10008.5.1.4.1.1.7'	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	Generated automatically by the system	ALWAYS	AUTO
Specific Character Set	(0008,0005)	Copied from source image header, if present	ANAP	AUTO

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⚠ **Note:* The 'source image' refers to the first image received by the R2 Cenova Server for a given Study.*

8.1.1.2. Mammography CAD SR Modules

Table 8: SR Document Series Module of Created Mammography CAD SR Instances

Attribute Name	Tag	Value	Presence of Value	Source
Modality	(0008,0060)	'SR'	ALWAYS	AUTO
Series Instance UID	(0020,000E)	Generated automatically by the system	ALWAYS	AUTO
Series Number	(0020,0011)	Generated automatically by the system	ALWAYS	AUTO
Referenced Performed Procedure Step Sequence	(0008,1111)	Zero length	VNAP	AUTO

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Table 9: SR Document General Module of Created Mammography CAD SR Instances

Attribute Name	Tag	Value	Presence of Value	Source
Instance Number	(0020,0013)	'1'	ALWAYS	AUTO
Completion Flag	(0040,A491)	'COMPLETE'	ALWAYS	AUTO
Verification Flag	(0040,A493)	'UNVERIFIED'	ALWAYS	AUTO
Content Date	(0008,0023)	The date of document generation	ALWAYS	AUTO
Content Time	(0008,0033)	The time of document generation	ALWAYS	AUTO
Performed Procedure Code Sequence	(0040,A372)	Zero length	VNAP	AUTO
Current Requested Procedure Evidence Sequence	(0040,A375)	A sequence contains one or more items that identify each image processed	ALWAYS	AUTO
>Study Instance UID	(0020,000D)	Copied from source image header*	ALWAYS	AUTO
>Referenced Series Sequence	(0008,1115)	Sequence contains one Item for each Series included in the Study	ALWAYS	AUTO
>>Series Instance UID	(0020,000E)	Copied from source image header	ALWAYS	AUTO
>>Referenced SOP Sequence	(0008,1199)	One sequence item per image within a Series	ALWAYS	AUTO
>>>Referenced SOP Class UID	(0008,1150)	Copied from source image header	ALWAYS	AUTO
>>>Referenced SOP Instance UID	(0008,1155)	Copied from source image header	ALWAYS	AUTO

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⚠ **Note:* The 'source image' refers to the first image received by the R2 Cenova Server for a given Study.*

Table 10: SR Document Content Module of Created Mammography CAD SR SOP Instances

Attribute Name	Tag	Value	Presence of Value	Source
Value Type	(0040,A040)	'CONTAINER'	ALWAYS	AUTO
Concept Name Code Sequence	(0040,A043)	One sequence identifies the Root Content Item	ALWAYS	AUTO
>Code Value	(0008,0100)	'111036'	ALWAYS	AUTO
>Coding Scheme Designator	(0008,0102)	'DCM'	ALWAYS	AUTO
>Code Meaning	(0008,0104)	'Mammography CAD Report'	ALWAYS	AUTO
Continuity of Content	(0040,A050)	'SEPARATE'	ALWAYS	AUTO
Content Template Sequence	(0040,A504)	One sequence item identifies the root template	ALWAYS	AUTO
>Mapping Resource	(0008,0105)	'DCMR'	ALWAYS	AUTO
>Template Identifier	(0040,DB00)	'4000'	ALWAYS	AUTO
Content Sequence	(0040,A730)	Sequence contains multiple Items according to TID 4000	ALWAYS	AUTO
> …(Item 1)		Include Item for TID 1204 'Language of Content Item and Descendants'. See Table 11	ALWAYS	AUTO
> …(Item 2)		Include Item for 'Image Library' container. See Table 12	ALWAYS	AUTO
> …(Item 3)		Include Item for TID 4001 'Mammography CAD Overall Impression / Recommendation'. See Table 13	ALWAYS	AUTO
> …(Item 4)		Include Item for 'Summary of Detections' code. See Table 14	ALWAYS	AUTO
> …(Item 5)		Include Item for 'Summary of Analyses' code. See Table 15	ALWAYS	AUTO

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Table 11: Language of Content Item and Descendants (TID 4000, TID 1204)

NL	Rel with Parent	VT	Concept Name	Value
	HAS CONCEPT MOD	CODE	(121049, DCM, 'Language of Content Item and Descendants')	(en, RFC3066, 'English')
>	HAS CONCEPT MOD	CODE	(121046, DCM, 'Country of Language')	(US, ISO3166_1, 'UNITED STATES')

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Table 12: Image Library Container (TID 4000)

NL	Rel with Parent	VT	Concept Name	Value
	CONTAINS	CONTAINER	(111028, DCM, 'Image Library')	Continuity of Content = 'SEPARATE'
>	CONTAINS	INCLUDE	DTID (4020) CAD Image Library Entry	A sequence Item is included for each image in the Study. See Table 12-1

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Table 12-1: CAD Image Library Entry (TID 4020)

NL	Rel with Parent	VT	Concept Name	Value
		IMAGE		Referenced SOP Sequence containing the SOP Class UID and SOP Instance UID copied from the source image header
>	HAS ACQ CONTEXT	CODE	(111027, DCM, 'Image Laterality')	(T-04030, SNM3, 'Left breast') or (T-04020, SNM3, 'Right breast')
>	HAS ACQ CONTEXT	CODE	(111031, DCM, 'Image View')	(R-10224, SNM3, 'medio-lateral'), (R-10226, SNM3, 'medio-lateral oblique'), (R-10228, SNM3, 'latero-medial'), (R-10230, SNM3, 'latero-medial oblique'), (R-10242, SNM3, 'cranio-caudal'), (R-10244, SNM3, 'caudo-cranial (from below)'), (R-102D0, SNM3, 'superolateral to inferomedial oblique'), (R-102CF, SNM3, 'exaggerated cranio-caudal'), (R-1024A, SRT, 'cranio-caudal exaggerated laterally'), or (R-1024B, SRT, 'cranio-caudal exaggerated medially')
>>	HAS CONCEPT MOD	CODE	(111032, DCM, 'Image View Modifier')	One or more of (R-102D1, SNM3, 'Axillary Tail'), (R-102D3, SNM3, 'Rolled Lateral'), (R-102D4, SNM3, 'Rolled Medial'), (R-102CA, SRT, 'Rolled Inferior'), (R-102C9, SRT, 'Rolled Superior'), (R-102D5, SNM3, 'Implant Displaced'), or (R-102C2, SNM3, 'Tangential') if (0054, 0222) is not empty in the source image
>	HAS ACQ CONTEXT	TEXT	(111044, DCM, 'Patient Orientation Row')	Copied from source image header (0020, 0020) attribute value 1
>	HAS ACQ CONTEXT	TEXT	(111043, DCM, 'Patient Orientation Column')	Copied from source image header (0020, 0020) attribute value 2
>	HAS ACQ CONTEXT	DATE	(111060, DCM, 'Study Date')	Copied from source image header (0008, 0020) attribute value
>	HAS ACQ CONTEXT	TIME	(111061, DCM, 'Study Time')	Copied from source image header (0008, 0030) if value is not empty
>	HAS ACQ CONTEXT	DATE	(111018, DCM, 'Content Date')	Copied from source image header (0008, 0023) if value is not empty
>	HAS ACQ CONTEXT	TIME	(111019, DCM, 'Content Time')	Copied from source image header (0008, 0033) if value is not empty
>	HAS ACQ CONTEXT	NUM	(111026, DCM, 'Horizontal Pixel Spacing')	Converted from source image header (0018, 1164) attribute value 1. UNITS = (um, UCUM, 'micrometer')
>	HAS ACQ CONTEXT	NUM	(111066, DCM, 'Vertical Pixel Spacing')	Converted from source image header (0018, 1164) attribute value 2. UNITS = (um, UCUM, 'micrometer')

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Table 13: Mammography CAD Overall Impression / Recommendation (TID 4000, TID 4001)

NL	Rel with Parent	VT	Concept Name	Value
	CONTAINS	CODE	(111017, DCM, 'CAD Processing and Findings Summary'	(111241, DCM, 'All algorithms succeeded; without findings'), (111242, DCM, 'All algorithms succeeded; with findings'), (111243, DCM, 'Not all algorithms succeeded; without findings'), (111244, DCM, 'Not all algorithms succeeded; with findings'), or (111245, DCM, 'No algorithms succeeded; without findings')
>	HAS PROPERTIES	INCLUDE	DTID (4002) Mammography CAD Impression/Recommendation Body	See Table 13-1. Shall be present if 'Quantra' option is licensed and enabled. N/A for 5.x CAD SR.
>	INFERRED FROM	INCLUDE	DTID (4003) Mammography CAD Individual Impression/Recommendation	See Table 13-2. Repeat for each individual impression / recommendation included in the report. Not present if there are no single image findings or composite features to report.

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Table 13-1: Mammography CAD Overall Impression/Recommendation Body (TID 4002, TID 4019)

NL	Rel with Parent	VT	Concept Name	Value
		TEXT	(111033, DCM, 'Impression Description')	'Volumetric assessment impression'
		TEXT	(111001, DCM, 'Algorithm Name')	'VA'
		TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
		TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
		NUM	(R2cn015, 99R2TECH, 'Volume of fibroglandular tissue')	A calculated value. UNITS = (cm3, UCUM, 'Cubic centimeter')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04020, SNM3, 'Right breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')
		NUM	(112193, DCM, 'Volume of breast')	A calculated value. UNITS = (cm3, UCUM, 'Cubic centimeter')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04020, SNM3, 'Right breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')
		NUM	(R2cn016, 'Percentage of fibroglandular tissue')	A calculated value. UNITS = (%, UCUM, 'Percent')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04020, SNM3, 'Right breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')
		NUM	(R2cn014, 99R2TECH, 'Volumetric assessment confidence')	'0', '1', or '2'. UNITS = ({0:2}, UCUM, 'range: 0:2')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04020, SNM3, 'Right breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')
		NUM	(R2cn015, 99R2TECH, 'Volume of fibroglandular tissue')	A calculated value. UNITS = (cm3, UCUM, 'Cubic centimeter')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04030, SNM3, 'Left breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')
		NUM	(112193, DCM, 'Volume of breast')	A calculated value. UNITS = (cm3, UCUM, 'Cubic centimeter')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04030, SNM3, 'Left breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')
		NUM	(R2cn016, 99R2TECH, 'Percentage of fibroglandular tissue'	A calculated value. UNITS = (%, UCUM, 'Percent')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04030, SNM3, 'Left breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')
		NUM	(R2cn014, 99R2TECH, 'Volumetric assessment confidence')	'0', '1', or '2'. UNITS = ({0:2}, UCUM, 'range: 0:2')
>	HAS CONCEPT MOD	CODE	(G-C171, SRT, 'Laterality')	(T-04030, SNM3, 'Left breast')
>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(112187, DCM, 'Unspecified method of calculation')

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Table 13-2: Mammography CAD Individual Impression/Recommendation (TID 4003)

NL	Rel with Parent	VT	Concept Name	Value
		CONTAINER	(111034, DCM, 'Individual Impression/Recommendation')	Continuity of Content = 'SEPARATE'
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111150, DCM, 'Presentation Required: Rendering device is expected to present')
>	CONTAINS	INCLUDE	DTID (4004) Mammography CAD Composite Feature	See Table 13-3. Repeat for each 'Mass with calcifications' composite feature if 'Malc Mark' option is licensed and enabled. N/A for 5.x CAD SR.
>	CONTAINS	INCLUDE	DTID (4006) Mammography CAD Single Image Finding	See Tables 13-4-1 to 13-4-6. Repeat for each single image finding.

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Table 13-3: Mammography CAD Composite Feature (TID 4004)

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111015, DCM, 'Composite Feature')	(111459, DCM, 'Mass with calcifications')
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111150, DCM, 'Presentation Required: Rendering device is expected to present'), or (111151, DCM, 'Presentation Optional: Rendering device may present')
>	HAS PROPERTIES	INCLUDE	DTID (4005) Mammography CAD Composite Feature Body	See Table 13-3-1.
>	INFERRED FROM	INCLUDE	DTID (4006) Mammography CAD Single Image Finding	See Table 13-4-3. One Single Image Finding for the density included in the 'Mass with calcifications' composite feature.
>	INFERRED FROM	INCLUDE	DTID (4006) Mammography CAD Single Image Finding	See Table 13-4-4. One Single Image Finding for each calcification cluster included in the 'Mass with calcifications' composite feature.

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Table 13-3-1: Mammography CAD Composite Feature Body (TID 4005, TID 4019)

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111016, DCM, 'Composite Type')	(111154, DCM, 'Target content items are related spatially')
		CODE	(111057, DCM, 'Scope of Feature')	(111157, DCM, 'Feature detected on only one of the images')
		TEXT	(111001, DCM, 'Algorithm Name')	'Malc'
		TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
		TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
		NUM	(111011, DCM, 'Certainty of Feature')	A calculated value. UNITS = (%, UCUM, 'Percent')

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Table 13-4-1: Mammography CAD Breast Geometry Single Image Finding (TID 4006, TID 4019, TID 4008)

Shall be present if 'Breast Geometry' option is licensed and enabled. N/A for 5.x CAD SR

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111059, DCM, 'Single Image Finding')	(111100, DCM, 'Breast geometry')
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111151, DCM, 'Presentation Optional: Rendering device may present')
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'Breast Geometry'
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	HAS PROPERTIES	SCOORD	(111007, DCM, 'Breast Outline Including Pectoral Muscle Tissue')	The coordinates that define the breast outline. GRAPHIC TYPE = 'POLYLINE'
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	SCOORD	(111045, DCM, 'Pectoral Muscle Outline')	The coordinates that define the pectoral muscle outline. GRAPHIC TYPE = 'POLYLINE'
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.

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Table 13-4-2: Mammography CAD Nipple Single Image Finding (TID 4006, TID 4019, TID 4021)

Shall be present if 'Breast Geometry' option is licensed and enabled. N/A for 5.x CAD SR

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111059, DCM, 'Single Image Finding')	(T-04100, SNM3, 'Nipple')
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111151, DCM, 'Presentation Optional: Rendering device may present')
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'Breast Geometry'
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	HAS PROPERTIES	SCOORD	(111010, DCM, 'Center')	The coordinate of the nipple center. GRAPHIC TYPE = 'POINT'
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.

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Table 13-4-3: Mammography Breast Density Single Image Finding (TID 4006, TID 4019, TID 4021, TID 4011, TID 1400)

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111059, DCM, 'Single Image Finding')	(F-01796, SRT, 'Mammography breast density')
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111150, DCM, 'Presentation Required: Rendering device is expected to present'), or (111151, DCM, 'Presentation Optional: Rendering device may present')
>>	HAS PROPERTIES	NUM	(111071, DCM, 'CAD Operating Point')	'1' or '2' if the value of 'Rendering Intent' is (111151, DCM, 'Presentation Optional'). UNITS = ({1:2}, UCUM, 'range: 1:2'). N/A for 5.x CAD SR.
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'R2_MAMMO_DENSITY' for 5.x CAD SR, or 'Mass' otherwise.
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	HAS PROPERTIES	NUM	(111012, DCM, 'Certainty of Finding')	A calculated value. UNITS = (%, UCUM, 'Percent'). Shall be present if 'Lesion Certainty' option is licensed and enabled. N/A for 5.x CAD SR.
>	HAS PROPERTIES	SCOORD	(111010, DCM, 'Center')	The coordinate of the center of the density finding. GRAPHIC TYPE = 'POINT'
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	SCOORD	(111041, DCM, 'Outline')	The coordinates that define the outline of the density finding. GRAPHIC TYPE = 'POLYLINE'. Shall be present if 'PeerView Digital' option is licensed and enabled.
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	NUM	(G-A185, SNM3, 'Long Axis')	A calculated value. UNITS = (cm, UCUM, 'centimeter'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>	HAS PROPERTIES	NUM	(121242, DCM, 'Distance from nipple')	A calculated value. UNITS = (cm, UCUM, 'centimeter'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>	HAS PROPERTIES	NUM	(121244, DCM, 'Distance from chest wall')	A calculated value. UNITS = (cm, UCUM, 'centimeter'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>	HAS PROPERTIES	NUM	(R2cn010, 99R2TECH, 'Density')	A calculated value. UNITS = (%, UCUM, 'Percent'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(R-10260, SRT, 'Estimated')
>	HAS PROPERTIES	NUM	(R2cn011, 99R2TECH, 'Degree of spiculation')	A calculated value. UNITS = (%, UCUM, 'Percent'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(R-10260, SRT, 'Estimated')

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Table 13-4-4: Mammography CAD Calcification Cluster Single Image Finding (TID 4006, TID 4019, TID 4021, TID 4010, TID 1400)

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111059, DCM, 'Single Image Finding')	(F-01775, SRT, 'Calcification Cluster')
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111150, DCM, 'Presentation Required: Rendering device is expected to present'), or (111151, DCM, 'Presentation Optional: Rendering device may present')
>>	HAS PROPERTIES	NUM	(111071, DCM, 'CAD Operating Point')	'1' or '2' if the value of 'Rendering Intent' is (111151, DCM, 'Presentation Optional'). UNITS = ({1:2}, UCUM, 'range: 1:2'). N/A for 5.x CAD SR.
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'R2_MAMMO_CALC' for 5.x CAD SR; otherwise 'Calc'.
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	HAS PROPERTIES	NUM	(111012, DCM, 'Certainty of Finding')	A calculated value. UNITS = (%, UCUM, 'Percent'). Shall be present if 'Lesion Certainty' option is licensed and enabled. N/A for 5.x CAD SR
>	HAS PROPERTIES	SCOORD	(111010, DCM, ' Center')	The coordinate of the center of the calcification cluster finding. GRAPHIC TYPE ='POINT'
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the' Image Library' based on its node position.
>	HAS PROPERTIES	SCOORD	(111041, DCM, 'Outline')	The coordinates that define the outline of the calcification cluster finding. GRAPHIC TYPE = 'POLYLINE'. Shall be present if 'PeerView Digital' option is licensed and enabled. N/A for 5.x CAD SR
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	NUM	(111038, DCM, 'Number of calcifications')	The number of individual calcifications found in the cluster. UNITS = (1, UCUM, 'no units'). Shall be present if 'PeerView Digital' option is licensed and enabled.
>	HAS PROPERTIES	NUM	(G-A185, SNM3, 'Long Axis')	A calculated value. UNITS = (cm, UCUM, 'centimeter'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>	HAS PROPERTIES	NUM	(121242, DCM, 'Distance from nipple')	A calculated value. UNITS = (cm, UCUM, 'centimeter'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>	HAS PROPERTIES	NUM	(121244, DCM, 'Distance from chest wall')	A calculated value. UNITS = (cm, UCUM, 'centimeter'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>	HAS PROPERTIES	NUM	(R2cn012, 99R2TECH, 'Contrast')	A calculated value. UNITS = (%, UCUM, 'Percent'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.
>>	HAS CONCEPT MOD	CODE	(121401, DCM, 'Derivation')	(R-10260, SRT, 'Estimated')
>	INFERRED FROM	INCLUDE	DTID (4006) Mammography CAD Single Image Finding	See Table 13-4-5. There should be one of these for each individual calcification found in the cluster if 'PeerView Digital' option is licensed and enabled.

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Table 13-4-5: Mammography CAD Individual Calcification Single Image Finding (TID 4006, TID 4019, TID 4021, TID 4009, TID 1400)

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111059, DCM, 'Single Image Finding')	(F-01776, SRT, 'Individual Calcification') Shall be present if 'PeerView Digital' option is licensed and enabled.
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111151, DCM, 'Presentation Optional: Rendering device may present')
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'R2_MAMMO_CALC' for 5.x CAD SR, or 'Calc' otherwise.
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	HAS PROPERTIES	SCOORD	(111010, DCM, 'Center')	The coordinate of the center of the individual calcification finding. GRAPHIC TYPE = 'POINT'
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	SCOORD	(111041, DCM, 'Outline')	The coordinates that define the outline of the individual calcification finding. GRAPHIC TYPE = 'POLYLINE' or 'POINT'.
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	NUM	(G-A185, SNM3, 'Long Axis')	A calculated value. UNITS = (cm, UCUM, 'centimeter'). Shall be present if 'LesionMetrics' option is licensed and enabled. N/A for 5.x CAD SR.

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Table 13-4-6: Mammography CAD Selected Region Single Image Finding (TID 4006, TID 4019, TID 4021, TID 4013)

Shall be present if 'Breast Geometry' and 'Breast Sizing' options are licensed and enabled. N/A for 5.x CAD SR

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111059, DCM, 'Single Image Finding')	(111099, DCM, 'Selected region')
>	HAS CONCEPT MOD	CODE	(111056, DCM, 'Rendering Intent')	(111152, DCM, 'Not for Presentation: Rendering device expected not to present')
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'Breast Geometry'
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	HAS PROPERTIES	SCOORD	(111010, DCM, 'Center')	The coordinate of the center of the breast bounding box. GRAPHIC TYPE = 'POINT'
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	SCOORD	(111041, DCM, 'Outline')	The coordinates that define the outline of the breast bounding box. GRAPHIC TYPE = 'POLYLINE'.
>>	R-SELECTED FROM	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position.
>	HAS PROPERTIES	TEXT	(111058, DCM, 'Selected Region Description')	'Breast Bounding Box'

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Table 14: Summary of Detections (TID 4000, TID 4015)

NL	Rel with Parent	VT	Concept Name	Value
	CONTAINS	CODE	(111064, DCM, 'Summary of Detections'	(111222, DCM, 'Succeeded'), (111223, DCM, 'Partially Succeeded'), (111224, DCM, 'Failed'), or (111225, DCM, 'Not Attempted')
>	INFERRED FROM	CONTAINER	(111063, DCM, 'Successful Detections')	Continuity of Content = 'SEPARATE'
>>	CONTAINS	INCLUDE	DTID (4017) CAD Detection Performed	See Table 14-1. Repeat for each type of successful algorithm detection.
>	INFERRED FROM	CONTAINER	(111025, DCM, 'Failed Detections')	Continuity of Content = 'SEPARATE'
>>	CONTAINS	INCLUDE	DTID (4017) CAD Detection Performed	See Table 14-1. Repeat for each type of failed algorithm detection.

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Table 14-1: CAD Detection Performed (TID 4017, TID 4019)

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111022, DCM, 'Detection Performed')	(F-01796, SRT, 'Mammography breast density'), (F-01775, SRT, 'Calcification Cluster'), or (111100, DCM, 'Breast geometry')
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'R2_MAMMO_DENSITY'or 'R2_MAMMO_CALC' for 5.x CAD SR. 'Mass', or 'Calc', or 'Breast Geometry'
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	R-HAS PROPERTIES	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position. Repeat for every image the algorithm has performed on.
>		INCLUDE	DTID (4023) CAD Operating Points	See Table 14-2. N/A for 5.x CAD SR.

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Table 14-2: CAD Operating Points (TID 4023)

NL	Rel with Parent	VT	Concept Name	Value
	HAS PROPERTIES	NUM	(111072, DCM, 'Maximum CAD Operating Point')	'2'. UNITS = ([arb {U}, UCUM, 'arbitrary unit')
	HAS PROPERTIES	NUM	(111092, DCM, 'Recommended CAD Operating Point')	'0', '1', or '2'. UNITS = ({0:2}, UCUM, 'range: 0:2')
	HAS PROPERTIES	CONTAINER	(111093, DCM, 'CAD Operating Point Table')	Continuity of Content = 'SEPARATE'
>	CONTAINS	CODE	(122698, DCM, 'X-Concept')	(111012, DCM, 'Certainty of Finding')
>	CONTAINS	CODE	(122699, DCM, 'Y-Concept')	(R2cn013, 99R2TECH, 'Estimated sensitivity')
>	CONTAINS	NUM	(111071, DCM, 'CAD Operating Point')	'0'. UNITS = ({0:2}, UCUM, 'range: 0:2')
>>	HAS PROPERTIES	NUM	(111012, DCM, 'Certainty of Finding')	A baseline value. UNITS = (%, UCUM, 'Percent')
>>	HAS PROPERTIES	NUM	(R2cn013, 99R2TECH, 'Estimated sensitivity')	A baseline value. UNITS = (%, UCUM, 'Percent')
>	CONTAINS	NUM	(111071, DCM, 'CAD Operating Point')	'1'. UNITS = ({0:2}, UCUM, 'range: 0:2')
>>	HAS PROPERTIES	NUM	(111012, DCM, 'Certainty of Finding')	A baseline value. UNITS = (%, UCUM, 'Percent')
>>	HAS PROPERTIES	NUM	(R2cn013, 99R2TECH, 'Estimated sensitivity')	A baseline value. UNITS = (%, UCUM, 'Percent')
>	CONTAINS	NUM	(111071, DCM, 'CAD Operating Point')	'2'. UNITS = ({0:2}, UCUM, 'range: 0:2')
>>	HAS PROPERTIES	NUM	(111012, DCM, 'Certainty of Finding')	A baseline value. UNITS = (%, UCUM, 'Percent')
>>	HAS PROPERTIES	NUM	(R2cn013, 99R2TECH, 'Estimated sensitivity')	A baseline value. UNITS = (%, UCUM, 'Percent')

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Table 15: Summary of Analyses (TID 4000, TID 4016)

NL	Rel with Parent	VT	Concept Name	Value
	CONTAINS	CODE	(111065, DCM, 'Summary of Analyses')	(111225, DCM, 'Not Attempted') for 5.x CAD SR. Otherwise, if 'Malc Mark' or 'Quantra' option is licensed and enabled, (111222, DCM, 'Succeeded'), (111223, DCM, 'Partially Succeeded'), (111224, DCM, 'Failed'), or (111225, DCM, 'Not Attempted')
>	INFERRED FROM	CONTAINER	(111062, DCM, 'Successful Analyses')	Continuity of Content = 'SEPARATE'
>>	CONTAINS	INCLUDE	DTID (4018) CAD Analysis Performed	See Table 15-1. Repeat for each type of successful analysis algorithm.
>	INFERRED FROM	CONTAINER	(111024, DCM, 'Failed Analyses')	Continuity of Content = 'SEPARATE'
>>	CONTAINS	INCLUDE	DTID (4018) CAD Analysis Performed	See Table 15-1. Repeat for each type of failed analysis algorithm.

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Table 15-1: CAD Analysis Performed (TID 4018, TID 4019)

NL	Rel with Parent	VT	Concept Name	Value
		CODE	(111004, DCM, 'Analysis Performed')	(P5-B3402, SRT, 'Spatial collocation analysis') or (P5-B3414, SRT, 'Breast composition analysis')
>	HAS PROPERTIES	TEXT	(111001, DCM, 'Algorithm Name')	'Malc' or 'VA'
>	HAS PROPERTIES	TEXT	(111003, DCM, 'Algorithm Version')	Algorithm version
>	HAS PROPERTIES	TEXT	(111002, DCM, 'Algorithm Parameters')	Algorithm parameters
>	R-HAS PROPERTIES	IMAGE		Reference to an IMAGE content item in the 'Image Library' based on its node position. Repeat for every image the algorithm has processed.

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8.1.1.3. Secondary Capture Image Modules

Table 16: General Series Module of Created Secondary Capture Image Instances

Attribute Name	Tag	Value	Presence of Value	Source
Series Instance UID	(0020,000E)	Generated automatically by the system	ALWAYS	AUTO
Series Number	(0020,0011)	1	ALWAYS	AUTO
Laterality	(0020,0060)	Zero length	VNAP	AUTO
Series Description	(0008,103E)	'R2 VA SC' or 'R2 CAD SC'	ALWAYS	AUTO
Body Part Examined	(0018,0015)	BREAST	ALWAYS	AUTO

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Table 17: SC Equipment Module of Created Secondary Capture Image Instances

Attribute Name	Tag	Value	Presence of Value	Source
Conversion Type	(0008,0064)	SYN	ALWAYS	AUTO
Modality	(0008,0060)	MG	ALWAYS	AUTO

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Table 18: General Image Module of Created Secondary Capture Image Instances

Attribute Name	Tag	Value	Presence of Value	Source
Instance Number	(0020,0013)	1	ALWAYS	AUTO
Patient Orientation	(0020,0020)	Zero length	VNAP	AUTO
Content Date	(0008,0023)	The date of document generation	ALWAYS	AUTO
Content Time	(0008,0033)	The time of document generation	ALWAYS	AUTO
Image Type	(0008,0008)	DERIVED\SECONDARY	ALWAYS	AUTO
Burned In Annotation	(0028,0301)	YES	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	'00' for VA SC output '01' for CAD SC output	ALWAYS	AUTO
Presentation LUT Shape	(2050,0020)	IDENTITY	ALWAYS	AUTO

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Table 19: Image Pixel Module of Created Secondary Capture Image Instances

Attribute Name	Tag	Value	Presence of Value	Source
Samples per Pixel	(0028,0002)	1	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	MONOCHROME2	ALWAYS	AUTO
Rows	(0028,0010)	Generated by the system	ALWAYS	AUTO
Columns	(0028,0011)	Generated by the system	ALWAYS	AUTO
Bits Allocated	(0028,0100)	8	ALWAYS	AUTO
Bits Stored	(0028,0101)	8	ALWAYS	AUTO
High Bit	(0028,0102)	7	ALWAYS	AUTO
Pixel Representation	(0028,0103)	0	ALWAYS	AUTO
Pixel Data	(7FE0,0010)	Generated by the system	ALWAYS	AUTO

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Table 20: VOI LUT Module of Created Secondary Capture Image Instances

Attribute Name	Tag	Value	Presence of Value	Source
Window Center	(0028,1050)	128	ALWAYS	AUTO
Window Width	(0028,1051)	256	ALWAYS	AUTO

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8.1.2. Usage of Attributes from Received IODs

The following general Type 2 and Type 3 attributes are required to be present with a valid value (not zero length), in order for an image instance to be accepted for CAD processing:

- (0008,0020) Study Date
- (0008,0070) Manufacturer
- (0008,1090) Manufacturer's Model Name

One of the following Type 3 attributes is required to be present with a valid value (not zero length), in order for an image instance to be accepted for processing:

- (0018,1000) Device Serial Number
- (0018,1008) Gantry ID
- (0018,700A) Detector ID

It is preferred that the following Type 2 and Type 3 attributes be present with a valid value (not zero length), though an image instance will be accepted for CAD processing without them:

- (0008,0023) Content Date
- (0008,0030) Study Time
- (0008,0033) Content Time
- (0010,0010) Patient's Name
- (0010,0020) Patient ID
- (0018,7004) Detector Type: Digital Mammography specific

Image instances with a value less than 0.9 or greater than 1.1 for Estimated Radiographic Magnification Factor (0018,1114) are accepted but ignored for CAD processing.

Image instances that contain any of the following values in View Modifier Code Sequence (0054,0222) are accepted but ignored for CAD processing:

Code Value (0008,0100)	Code Meaning (0008,0104)
R-102D2	Cleavage
R-102D6	Magnification
R-102D7	Spot Compression

8.1.3. Attribute Mapping

Patient and Study level attributes are copied from the received image SOP Instances to the corresponding CAD results SOP Instances. See the tables in section **8.1.1**, '**Created SOP Instance(s)**' for details and additional information that is copied from the source images to the corresponding CAD results.

8.1.4. Coerced/Modified Attributes

None

8.2. Data Dictionary of Private Attributes

Not Applicable

8.3. Coded Terminology and Templates

See section '**8.1.1**', '**Created SOP Instance(s)**' for usage of DICOM TID 4000 and its related templates and context groups in created Mammography CAD SR SOP Instances.

8.3.1. Context Groups

Created Mammography CAD SR SOP Instances use the context groups that are associated with DICOM TID 4000 and related templates.

8.3.2. Template Specifications

Created Mammography CAD SR SOP Instances use DICOM TID 4000 and related templates.

8.3.3. Private Code Definitions

Coding Scheme Designator	Code Value	Code Meaning	Definition
99R2TECH	R2cn010	Mass density	The average brightness of a lesion relative to its immediate background normalized on a scale of 0 to 100.
99R2TECH	R2cn011	Degree of spiculation	A measurement proportional to the number of pixels that lie on lines pointing to a common origin inside the potential lesion, reported on a normalized scale of 0–100 containing the entire spectrum of biopsy-proven malignant masses.
99R2TECH	R2cn012	Calcification contrast	The average difference in brightness between the individual calcifications and their immediate background normalized on a scale of 0 to 100.
99R2TECH	R2cn013	Estimated sensitivity	Estimated ImageChecker algorithm sensitivity.
99R2TECH	R2cn014	Volumetric assessment confidence	A measure of confidence in the results produced by the Quantra algorithm.
99R2TECH	R2cn015	Volume of fibroglandular tissue	Volume of breast fibroglandular tissue as measured by Quantra.
99R2TECH	R2cn016	Percentage of fibroglandular tissue	Volumetric percentage of breast fibroglandular tissue (the fibroglandular tissue volume divided by the total breast volume as measured by Quantra).

8.4. Grayscale Image Consistency

Not Applicable

8.5. Standard Extended/Specialized/Private SOP Classes

None

8.6. Private Transfer Syntaxes

None

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