GE Healthcare

Technical Publications

Direction DOC1183445
Revision 3.0

MammoWorkstation 4.7.0
V-Preview Extended Functionality
DICOM CONFORMANCE STATEMENT

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CONFORMANCE STATEMENT OVERVIEW

Table 0.1 provides an overview of the network services supported by MammoWorkstation.

Table 0.1 – NETWORK SERVICES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Breast Tomosynthesis Image Storage	Yes	Yes
Query/Retrieve		
Patient Root Query/Retrieve Information Model – FIND	Yes	No
Patient Root Query/Retrieve Information Model – MOVE	Yes	No
Study Root Query/Retrieve Information Model – FIND	Yes	No
Study Root Query/Retrieve Information Model – MOVE	Yes	No
Workflow Management		
Storage Commitment Push Model SOP Class	Yes	No

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1. INTRODUCTION

1.1 OVERVIEW

This DICOM Conformance Statement is divided into Sections as described below:

Section 1 Introduction, which describes the overall structure, intent, and references for this Conformance Statement

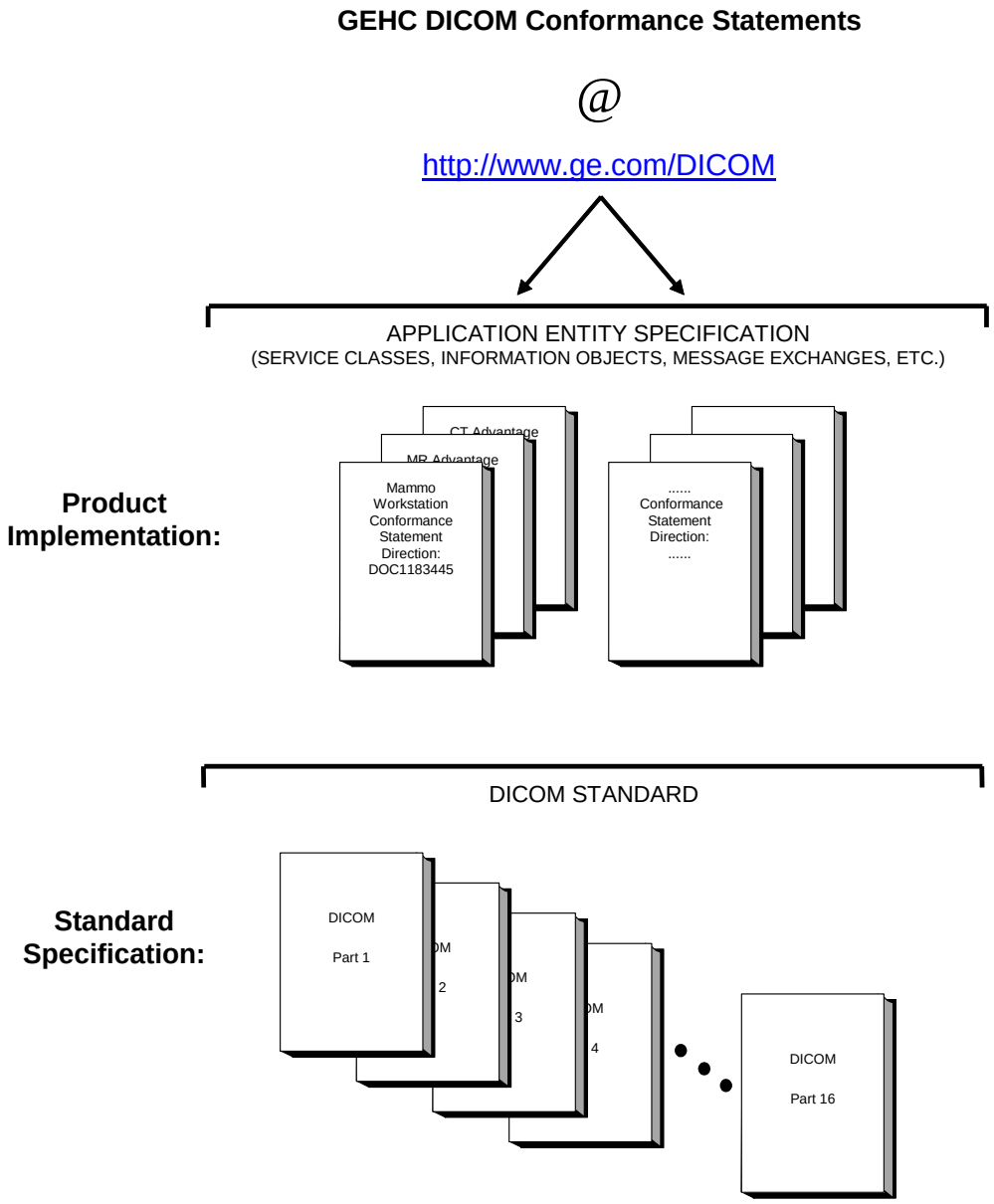
Section 2 Network Conformance Statement, which specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 3 Breast Tomosynthesis Image Information Object Implementation, which specifies the GEHC equipment compliance to DICOM requirements for the implementation of a Breast Tomosynthesis Image Information Object.

Section 4 Storage Commitment Push Model Implementation, which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Storage Commitment Push Model.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEHC DICOM Conformance Statements is shown in the Illustration below.



This document specifies the DICOM implementation. It is entitled:

MammoWorkstation 4.7.0
Conformance Statement for DICOM
Direction ***DOC1183445***

This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required to interoperate with the GEHC network interface.

The GEHC Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM Part 8 standard.

For more information regarding DICOM, copies of the Standard may be obtained on the Internet at http://medical.nema.org. Comments on the Standard may be addressed to:

DICOM Secretariat
NEMA
1300 N. 17th Street, Suite 1752
Rosslyn, VA 22209
USA
Phone: +1.703.841.3200

1.3 INTENDED AUDIENCE

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM Standard and with the terminology and concepts which are used in that Standard.

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document to provide an unambiguous specification for GEHC implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEHC medical data exchanged using DICOM. The GEHC Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEHC devices are capable of using different Information Object Definitions. For example, a GEHC CT Scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this DICOM Conformance Statement are the Module Definitions which define all data elements used by this GEHC implementation. If the user encounters unspecified private data elements while parsing a GEHC Data Set, the user is well advised to ignore those data elements (per the DICOM standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements which are sent by GEHC devices.

1.5 IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.
- **Validation** - Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications.

  Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEHC protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) described by these DICOM Conformance Statements**. The **user** should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

- **Interaction** - It is the sole responsibility of the **non–GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1.6 REFERENCES

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at http://medical.nema.org/

1.7 DEFINITIONS

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

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

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

Application Context – the specification of the type of communication used between *Application Entities*. Example: DICOM network protocol.

Association – a network communication channel set up between *Application Entities*.

Attribute – – a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010, 0020), Accession Number (0008, 0050), Photometric Interpretation (0028, 0004), Procedure Code Sequence (0008, 1032).

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

Joint Photographic Experts Group (JPEG) – a set of standardized image compression techniques, available for use by DICOM applications.

Media Application Profile – the specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

Module – a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

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

Presentation Context – the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

Protocol Data Unit (PDU) – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

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

Service Class Provider (SCP) – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

Service Class User (SCU) – role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance – an information object; a specific occurrence of information exchanged in a *SOP Class*. Examples: a specific x-ray image.

Tag – a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the "group" and the "element". If the "group" number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010, 0020) [Patient ID], (07FE, 0010) [Pixel Data], (0019, 0210) [private data element]

Transfer Syntax – the encoding used for exchange of DICOM information objects and messages. Examples: *JPEG* compressed (images), little endian explicit value representation.

Unique Identifier (UID) – a globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

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

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
AET	Application Entity Title
CR	Computed Radiography
CT	Computed Tomography
DBT	Digital Breast Tomosynthesis
DHCP	Dynamic Host Configuration Protocol
DICOM	Digital Imaging and Communications in Medicine
DNS	Domain Name System
DX	Digital X-ray
GSPS	Grayscale Softcopy Presentation State
HIS	Hospital Information System

HL7	Health Level 7 Standard
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Organization for Standards
JPEG	Joint Photographic Experts Group
LUT	Look-up Table
MG	Mammography (X-ray)
MTU	Maximum Transmission Unit (IP)
MWL	Modality Worklist
O	Optional (Key Attribute)
OSI	Open Systems Interconnection
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
R	Required (Key Attribute)
RIS	Radiology Information System
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
VR	Value Representation

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the **MammoWorkstation** compliance to DICOM requirements for **Networking** features.

Mammoworkstation implements the following networking features

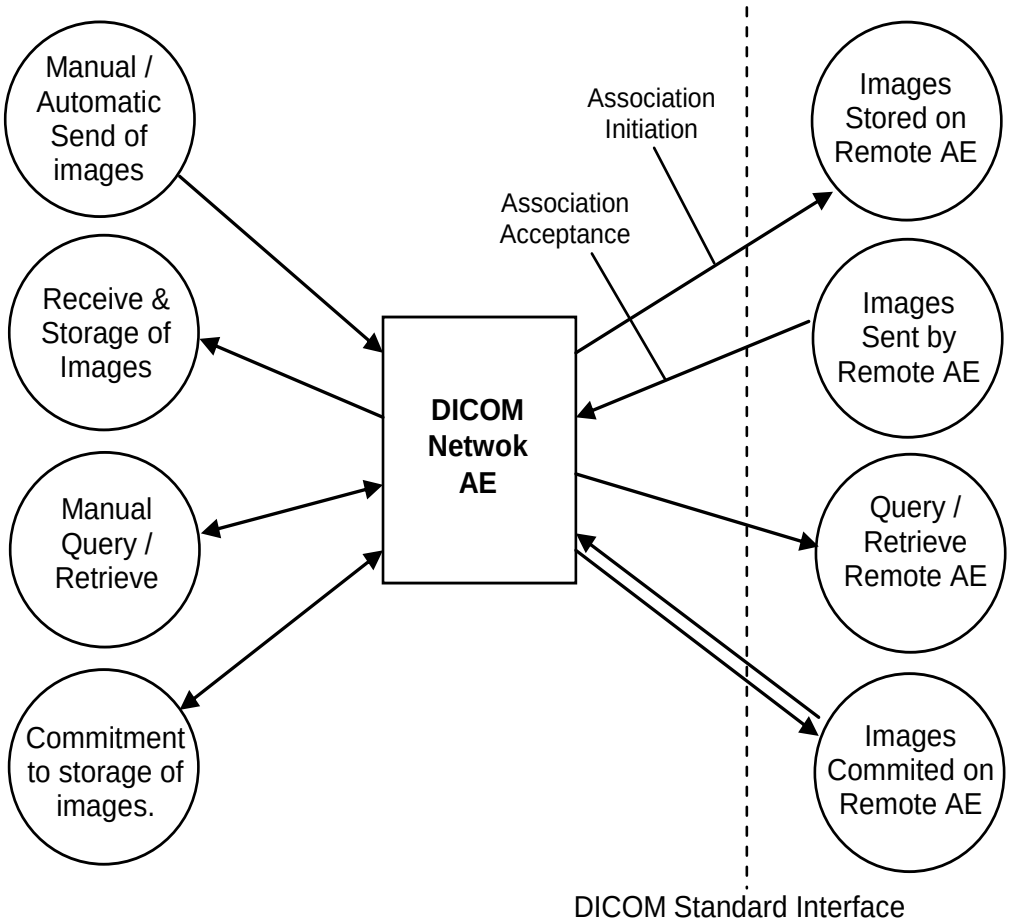
- Storage Service Class to facilitate manual / automatic transfer of images.
- Query / Retrieve Service Class to facilitate manual querying or retrieving of Patient, Study, Series, and Images.
- Storage Commitment Service Class to facilitate commitment to storage of information objects.

2.2 IMPLEMENTATION MODEL

2.2.1 Application Data Flow Diagram

The network application model for the MammoWorkstation is shown in the following Illustration :

ILLUSTRATION 2–1
MAMMOWORKSTATION NETWORK APPLICATION MODEL AND DATA FLOW DIAGRAM



2.2.2 Functional Definition of AE's

2.2.2.1 Network AE

The DICOM Network AE provides DICOM protocol communication for images. The DICOM Network AE is automatically brought up when the MammoWorkstation is powered on.

The DICOM Network AE provides the following Real World Activities:

- Manual Query/Retrieve of a remote DICOM archive to obtain a list of data **Patient/Study level** by selecting the remote DICOM AE. From the list, the user can select an entry and retrieve the SOP Classes supported by the MammoWorkstation from the remote DICOM AE.
- Manual and automatic send of images to remote DICOM Storage AE.
- Initiate storage commitment for documents created on the workstation (Storage Commitment N-ACTION).
- Flags documents in database on receiving storage commitment confirmation (N-EVENT-REPORT) from a remote AE.
- Receival and storage of images from any remote AE.

The DICOM Network AE initiates the following operations:

- Initiate a DICOM association to send DICOM SOP Classes (images) to a remote DICOM AE.
- Initiate a DICOM association to ask remote DICOM AE for transmit of SOP Classes (images) to MammoWorkstation.
- Initiate a DICOM association to ask remote DICOM AE storage commitemment (Storage Commitment N-ACTION) for specific images on MammoWorkstation.
- Initiate a DICOM association to ask remote DICOM AE for patient demographics.

The DICOM Network AE waits for association requests from Remote AE:

- Accepts DICOM associations from remote DICOM AE to store DICOM SOP Classes (images) on the MammoWorkstation.
- Accepts DICOM associations from remote DICOM AE transmitting storage commitment notification (Storage Commitment N-EVENT-REPORT).

2.2.3 Sequencing of Real-World Activities

In case of automatic send of documents (images) to a remote host:

1. Operator configures remote AE as a communication partner for auto-send of documents.
2. User imports case, and starts exam.
3. User clicks on close exam.
4. Configured document types are sent to remote hosts.

In case of storage commitment of specific documents:

1. Operator configures remote AE as a communication partner for auto push & storage commitment.
2. Images are sent to remote AE automatically by the system, either on generation.
3. When images are sent successfully, the NETWORK AE emits an N-ACTION request.
4. On reception of N-ACTION success response, Network AE is ready to receive at any time from Storage Commitment Provider the N-EVENT-REPORT-RQ notification on a new association.
5. On reception of N-EVENT-REPORT-RQ notification from Storage Commitment Provider, system flags the images in the database as committed.
6. When all images are flagged, Network AE sends a N-EVENT-REPORT-RSP to the Storage Commitment Provider.

2.3 AE -SPECIFICATIONS

2.3.1 Network AE Specification

The Network Application Entity provides Standard Conformance to the following DICOM SOP Classes as an **SCU** and/or as an **SCP.**

SOP Class Name	SOP Class UID	SCU	SCP
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3	Yes	Yes
Patient Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	No
Patient Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	No
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	No

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

Application Context Name	**1.2.840.10008.3.1.1.1**

The maximum length PDU receive size for the Network Application Entity is:

Maximum Length PDU	**64234 bytes** **(Not Configurable)**

2.3.1.1.2 Number of Associations

The NETWORK AE will initiate one or moreDICOM association at a time to perform a Query/Retrieve with a Remote Host AE.

The NETWORK AE will initiate only one DICOM association at a time to perform a DICOM store operation as a SCU to a Remote Host AE.

The NETWORK AE can accept a maximum of five DICOM associations at a time to perform a DICOM store operation as a SCP or respond to an echo.

The NETWORK AE will initiate only one DICOM association at a time to perform a DICOM storage commitment operation as a SCU to a Remote Host AE.

2.3.1.1.3 Asynchronous Nature

Asynchronous mode is supported while initiating Query/Retrieve operation with a remote host. Send & storage commitment operations are initiated synchronously on a single association with a remote host.

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM Implementation is:

MammoWorkstation Implementation UID	**1.2.276.0.69.25.1.1**
MammoWorkstation Implementation Version Name	**GE_MWS_470**

2.3.1.2 Association Initiation Policy

When the Network AE initiates an Association for any Real-World Activity, it will propose the Presentation Contexts for all Real-World Activities; i.e., there is only a single, comprehensive Presentation Context Negotiation proposed for the AE.

The Network AE proposes one or more Transfer Syntax in each Presentation Context.

2.3.1.2.1 Real-World Activity: Manual Query / Retrieve

2.3.1.2.1.1 Associated Real-World Activity

Manual Query / Retrieve of patient demographics:

1. The operator configures the remote AE as the Query / Retrieve communication partner.
2. The operator selects the remote AE from the list of communication partners, and queries for the list of patient (s) by clicking the Search button.
3. A list widget displays the results upon successful query.
4. The operator selects one or more Patients from the query list.
5. The selected list can be either prefetched by selecting prefetch option, or can be directly opened to fetch and start reviewing..

These operations will cause:

- The DICOM NETWORK AE to initiate a DICOM association.
- The DICOM NETWORK AE to emit a C-FIND request to get a list of patients regarding the criteria listed below, to get the appropriate studies, series or images for the selected list of patients.
- The DICOM NETWORK AE to emit a C-MOVE request to specify a selected list of Patients/Studies/Series/Images to be sent by the Remote AE to the MammoWorkstation.

2.3.1.2.1.2 Proposed Presentation Context Table

Presentation Context Table – Proposed by Network AE for Manual Query / Retrieve.					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

2.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for the Patient Root Query/Retrieve Information Model - FIND, Study Root Query/Retrieve Information Model – FIND.

A C-FIND CANCEL will be sent if the maximum number of Pending responses received during a C-FIND request is more than 2000.

Following are the status codes that are more specifically processed when receiving messages from a **Query** SCP equipment :

Service Status	Status Code	Further Meaning	Application Behavior When Receiving Status Code
Failure	A700	Refused: Out of resources	Association is closed. Appropriate message is displayed to the user.
	A900	Error: Identifier does not match SOP Class	Association is closed. Appropriate message is displayed to the user.
	C000-001	Error: Unable to process	Association is closed. Appropriate message is displayed to the user.
	C100	Error: More than one match found	Association is closed. Appropriate message is displayed to the user.
	C200	Unable to support requested template	Association is closed. Appropriate message is displayed to the user.
Cancel	FE00	Matching terminated due to cancel	Association is closed. Error message is displayed to the user.
Success	0000	Matching is complete - No final identifier is supplied	
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	
	FF01	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier	

2.3.1.2.1.2.2 SOP Specific DICOM Conformance Statement for the Patient Root Query/Retrieve Information Model - MOVE , Study Root Query/Retrieve Information Model – MOVE.

C-MOVE CANCEL is never sent to the Retrieve SCP.

Following are the status codes that are more specifically processed when receiving messages from a **Retrieve** SCP equipment:

Service Status	Status Code	Further Meaning	Application Behavior When Receiving Status Code
Failure	A701	Refused: Out of resources - Unable to calculate number of matches	Association is closed. Error message is displayed to the user.
	A702	Refused: Out of resources - Unable to perform sub-operations	Association is closed. Error message is displayed to the user.
	A801	Refused: Move Destination Unknown	Association is closed. Error message is displayed to the user.
	A900	Error: Identifier does not match SOP Class	Association is closed. Error message is displayed to the user.
	C001	Error: Unable to process	Association is closed. Error message is displayed to the user.
Cancel	FE00	Sub-operations terminated due to a Cancel indication	Association is closed. Error message is displayed to the user.
Warning	B000	Sub-operations Complete - One or more Failures.	Association is closed. Appropriate message is displayed to the user.
Success	0000	Sub-operations Complete - No Failure.	
Pending	FF00	Sub-operations are continuing -	

2.3.1.2.2 Real-World Activity: Manual/Automatic Transfer of Images

2.3.1.2.2.1 Associated Real-World Activity

Manual send of images:

1. Operator selects the database, and searches for the patient.
2. Operator selects the images from the search result, and clicks Send button to send the images.
3. Preferred remote AE can be selected in the Send GUI dialog before confirming send operation.

Automatic send of images:

1. Operator configures the remote AE for automatic send of images.
2. Operator imports the cases to the database.
3. On import, the configured type of images (generated or imported) are automatically sent to the configured remote AE.

This operation causes:

– The MammoWorkstation to retrieve the selected images from the database.

- The NETWORK AE to initiate a DICOM association, negotiate with the Remote AE an appropriate Abstract and Transfer Syntax.
- The emission of a C-STORE command to send the images, if the negotiation is successful.

The NETWORK AE initiates an association for each image. Every association is closed when the DICOM data has been sent (successfully or not) to the remote SCP. The NETWORK AE supports lossless and lossy JPEG 2000 compression. Compression can be configured in the MammoWorkstation and is invoked automatically for images while sending images to remote AE.

2.3.1.2.2.2 Proposed Presentation Context Table

Presentation Context Table – Proposed by Network AE for Manual / Automatic send of images.					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian JPEG 2000 Image Compression (Lossless Only) JPEG 2000 Image Compression	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91	SCU	None

2.3.1.2.2.2.1 SOP Specific DICOM Conformance Statement for All Storage SOP Classes

The Network AE includes optional data elements in the SOP Instances as described in Section 3.

Following are the status codes that are more specifically processed when receiving messages from a **Storage** SCP equipment:

Service Status	**Status Code**	**Further Meaning**	**Application Behavior When Receiving Status Code**
Failure	A700	Refused: Out of resources	Association is closed with Remote AE. Appropriate message is displayed to the user. Error is logged.
	A900	Error: Data Set does not match SOP Class	Association is closed with Remote AE. Appropriate message is displayed to the user. Error is logged.
	C000	Error: Cannot Understand	Association is closed with Remote AE. Appropriate message is displayed to the user. Error is logged.
	0110	Error: Processing failure	Association is closed with Remote AE. Appropriate message is displayed to the user. Error is logged.

Warning	B000	Coercion of Data Elements	Association is closed with Remote AE. A success message is displayed to the user. Warning is logged.
	B006	Elements Discarded	Association is closed with Remote AE. Appropriate message is displayed to the user. Warning is logged.
	B007	Data Set does not match SOP Class	Association is closed with Remote AE. Appropriate message is displayed to the user. Warning is logged.
Success	0000		A success message is displayed to the user.

2.3.1.2.3 Real-World Activity: Commitment to storage of images.

2.3.1.2.3.1 Associated Real-World Activity

Commitment to storage of images:

1. Operator configures remote AE as communication partner for auto push & storag commitment.
2. Images sent to remote AE automatically by the system on generation.

This operation causes:

- To send images to the remote AE.
- To initiate a DICOM association and negotiates abstract and transfer syntax, once the images are successfully sent.
- If the negotiation is successful, NETWORK AE emits a N-ACTION request.
- Waits for N-ACTION-RSP from Storage Commitment Provider.
- On reception of failure in N-ACTION-RSP, an error is logged.
- On reception of success, Network AE is ready to receive at any time from Storage Commitment Provider the N-EVENT-REPORT-RQ notification on a new association.
- On reception of N-EVENT-REPORT-RQ notification from Storage Commitment Provider, system flags the images in the database as committed.
- When all images are flagged, Network AE sends a N-EVENT-REPORT-RSP to the Storage Commitment Provider.

2.3.1.2.3.2 Proposed Presentation Context Table

Presentation Context Table – Proposed by Network AE for Storage Commitment.					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

2.3.1.2.3.2.1 SOP Specific DICOM Conformance Statement for the Storage Commitment Push Model SOP Class SCU

The NETWORK AE may request Storage Commitment for Instances of any of the Composite SOP Classes it supports as an SCU (see Section 3).

The Storage Commitment Information Object is described in Section 4.

Following are the status codes that are more specifically processed when receiving N-Action responses from a **Storage Commitment** SCP equipment:

Service Status	**Status Code**	**Further Meaning**	**Application Behavior When Receiving Status Code**
Failure	0119	Class-instance conflict	Association is closed with Remote AE. Error is logged.
	0210	Duplicate invocation	Association is closed with Remote AE. Error is logged.
	0115	Invalid argument value	Association is closed with Remote AE. Error is logged.
	0212	Mistyped argument	Association is closed with Remote AE. Error is logged.
	0113	No such event type	Association is closed with Remote AE. Error is logged.
	0114	No such argument	Association is closed with Remote AE. Error is logged.
	0118	No such SOP Class	Association is closed with Remote AE. Error is logged.
	0112	No such SOP Instance	Association is closed with Remote AE. Error is logged.
	0110	Processing failure	Association is closed with Remote AE. Error is logged.
	0213	Resource limitation	Association is closed with Remote AE. Error is logged.
	0211	Unrecognized operation	Association is closed with Remote AE. Error is logged.
Success	0000		

2.3.1.3 Association Acceptance Policy

2.3.1.3.1 Real-World Activity "Receive of Images"

2.3.1.3.1.1 Associated Real-World Activity

Receive of Images:

1. The NETWORK AE waits for an association.
2. The NETWORK AE accepts an association when it receives a valid association request from a DICOM Storage SCU.
3. When the association is accepeted, it will receive DICOM data transmitted on that association and store the supported SOP Classes in the database.

These operations will cause:

1. NETWORK AE to receive A-ASSOCIATE requests from remote Storage SCU.
2. Send A-ASSOCIATE acknowledgement message.
3. Receives C_STORE request from remote Storage SCU.
4. On successful storage of image objects, sends C-STORE response, and releases the association on receiving a A-RELEASE request.

By default, any Remote DICOM AE (Storage SCU) can send images to the NETWORK AE. No operator is required to receive an image. If images are received for the currently opened patient context, these images are opened automatically.

2.3.1.3.1.2 Accepted Presentation Context Table

Presentation Context Table - Accepted by AE NETWORK AE for Activity "Receive & Storage of Images"					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian JPEG 2000 Image Compression (Lossless Only) JPEG 2000 Image Compression JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]) JPEG Baseline (Process 1) JPEG Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None

Note: The Storage Commitment Provider initiating the association must use the role selection negotiation.

2.3.1.3.1.2.1 SOP Specific DICOM Conformance Statement for all Storage SOP Classes

The NETWORK AE provides Level 2 (FULL) Conformance, and stores all standard and private data elements of received SOP Instances.

The AE does not validate if the Attributes of the SOP Instance meet the requirements of the IOD with respect to Value Representation, presence of Type 1 and 2 elements, valid values, and consistency between image attributes and pixel data.

The AE provides Digital Signature Level 3 support, as it provides full fidelity storage of received SOP Instances.

Images sent in JPEG-2000, JPEG 2000 (Lossless Only), JPEG Baseline Lossy 8-Bit, JPEG Baseline Lossy 12-Bit,JPEG Lossless Hierarch., First-order prediction transfer syntax are decompressed by the NETWORK AE by default.

Following are the status codes the Application may send back to the SCU Equipment after performing the requested **Storage**:

Service Status	Status Code	Further Meaning	Status Code Explanation	Related Fields Sent Back to the SCU
Failure	A700	Refused: Out of resources	Indicated that there was not enough space or some other internal resource to store the image.	(0000,0902)
	A900	Error: Invalid Dataset	Indicates that an invalid SOP instance is received, and cannot be stored.	(0000,0902)
	0110	Processing Failure	Indicates that an internal system call has failed while processing the image.	(0000,0902)
Success	0000			None

Successfully received SOP Instances may be accessed via the user interface and by DICOM network query retrieve. SOP Instances are stored until manually deleted by the user.

2.3.1.3.1.3 Presentation Context Acceptance Criterion

The NETWORK AE evaluates each Presentation Context independently, and accepts any Presentation Context that matches an Abstract Syntax for any Real-World Activity.

2.3.1.3.1.4 Transfer Syntax Selection Policies

Within each Presentation Context, the NETWORK AE will select Transfer Syntaxes according to the following priority (highest priority first):

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

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks

MammoWorkstation provides DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8.

MammoWorkstation uses the MergeCOM-3 Advanced DICOM Tool Kit to communicate over the TCP/IP protocol stack on any physical interconnection media supporting the TCP/IP stack. The tool kit inherits the TCP/IP stack from the operating system upon which it executes.

2.4.2 Physical Media Support

The MammoWorkstation is indifferent to the physical medium over which TCP/IP executes; it inherits this from the operating system on which it exists.

2.4.3 Internet Protocol Version 6 (IPv6)

Internet Protocol Version 6 (IPv6) is not supported by the MammoWorkstation.

2.5 EXTENSIONS / SPECIALIZATIONS/ PRIVATIZATIONS

2.5.1 Standard Extended / Specialized / Private SOP Classes

None supported.

2.5.2 Private Transfer Syntaxes

None supported.

2.6 CONFIGURATION

2.6.1 AE Title/Presentation Address Mapping

Before communicating with a remote AE (WORKLIST AE, NETWORK AE, PRINT AE) the operator must register it by using the MammoWorkstation DICOM configuration. This task requires specifying the following information:

- Remote AE Title
- Remote IP Address
- Remote TCP/IP Port Number

This information is used to communicate over the TCP/IP protocol stack.

2.6.2 Configurable Parameters

The following fields are configurable for this AE (local):

- Local AE Title
- Local IP Address
- Local Listening Port Number

The following fields are configurable for every remote DICOM AE:

- Remote AE Title
- Remote IP Address
- Listening TCP/IP Port Number

Note: All configurations must be performed by a GE Field Engineer.

2.7 SUPPORT OF EXTENDED CHARACTER SETS

The MammoWorkstation uses the single single-byte extended character set ISO_IR 100 (Latin alphabet Number 1 supplementary set).

As a Storage SCP or Media Storage FSR, the product will accept SOP Instances with any value of Specific Character Set (0008,0005). However, it will display in the user interface only characters specified within ISO_IR 100 (Latin alphabet Number 1 supplementary set).

The product user interface will allow the user to enter characters from the console keyboard that are within ISO_IR 100 (Latin alphabet Number 1 supplementary set). If any such extended characters are included in SOP Instances or in query identifier matching fields, the product will appropriately specify the extended character set in Specific Character Set (0008,0005).

2.8 CODES AND CONTROLLED TERMINOLOGY

The product uses no coded terminology.

2.9 SECURITY PROFILES

The product does not conform to any defined DICOM Security Profiles.

It is assumed that the product is used within a secured environment. It is assumed that a secured environment includes at a minimum:

1. Firewall or router protections to ensure that only approved external hosts have network access to the product.
2. Firewall or router protections to ensure that the product only has network access to approved external hosts and services.
3. Any communications with external hosts and services outside the locally secured environment use appropriate secure network channels (such as a Virtual Private Network (VPN))

3. BREAST TOMOSYNTHESIS IMAGE INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

This section specifies the use of the DICOM Digital Mammography X-Ray Image IOD to represent the information included in MG Images produced and received by this implementation. Corresponding attributes are conveyed using the module construct.

3.2 MAMMOWORKSTATION MAPPING OF DICOM ENTITIES

The MammoWorkstation maps DICOM Information Entities to local Information Entities in the product's database and user interface.

TABLE 3-1
MAPPING OF DICOM ENTITIES TO MAMMOWORKSTATION ENTITIES

DICOM IE	MammoWorkstation Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image

3.3 IOD MODULE TABLE

The MG Image Information Object Definition comprises the modules of the following table.

TABLE 3-2
BREAST TOMOSYNTHESIS IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used	3.5.1.1
	Clinical Trial Subject	Not used	N/A
Study	General Study	Used	3.5.2.1
	Patient Study	Used	3.5.2.2
	Clinical Trial Study	Not used	N/A
Series	General Series	Used	3.5.3.1
	Clinical Trial Series	Not used	N/A
	Enhanced Mammography Series	Used	**Error! Reference source not found.**
Frame of Reference	Frame of Reference	Used	3.5.4.1
	Synchronization	Not used	N/A
Equipment	General Equipment	Used	3.5.5.1
	Enhanced General Equipment	Used	3.5.5.2

Image	Image Pixel	Used	**Error! Reference source not found.**
	Enhanced Contrast/Bolus	Not used	N/A
	Device	Not used	N/A
	Intervention	Not used	N/A
	Acquisition Context	Used	3.5.6.2
	Multi-frame Functional Groups	Used	3.5.6.3
	Multi-frame Dimension Module	Not used	N/A
	Image - Equipment Coordinate Relationship	Not used	N/A
	Specimen	Not used	N/A
	X-Ray 3D Image	Used	3.5.6.4
	Breast Tomosynthesis Contributing Sources	Used	3.5.6.5
	Breast Tomosynthesis Acquisition	Used	3.5.6.6
	X-Ray 3D Reconstruction	Used	3.5.6.7
	Breast View	Used	3.5.6.8
	SOP Common	Used	3.5.6.9
	Frame Extraction	Not used	N/A

3.4 BREAST TOMOSYNTHESIS IMAGE FUNCTIONAL GROUP MACROS

Table 3-3 specifies the use of the Functional Group macros used in the Multi-frame Functional Groups Module for the Breast Tomosynthesis Image IOD.

TABLE 3-3
BREAST TOMOSYNTHESIS IMAGE FUNCTIONAL GROUP MACROS

Functional Group Macro	Usage
Pixels Measure	Used as a Shared Functional Group
Frame Content	Used as a Per-frame Functional Group
Plane Position (Patient)	Used as a Per-frame Functional Group
Plane Orientation (Patient)	Used as a Shared Functional Group
Referenced Image	Not Used

Derivation Image	Used as a Shared Functional Group for Volume Preview
Frame Anatomy	Used as a Shared Functional Group
Identity Pixel Value Transformation	Used as a Shared Functional Group
Frame VOI LUT With LUT	Used as a Shared Functional Group
Real World Value Mapping	Not Used
Contrast/Bolus Usage	Not Used
X-Ray 3D Frame Type	Used as a Per-frame Functional Group

3.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM Part 3 (Information Object Definitions) for a description of each of the entities, modules, and attributes contained within the Breast Tomosynthesis Image Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported and expected. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from when generating the instance. It should be noted that they are the same ones as defined in the DICOM Standard Part 3 (Information Object Definitions). Also note that Attributes not present in tables are not supported.

3.5.1 Patient Entity Modules

3.5.1.1 Patient Module

This section specifies the Attributes of the Patient that describe and identify the Patient who is the subject of a diagnostic Study. This Module contains Attributes of the patient that are needed for diagnostic interpretation of the Image and are common for all studies performed on the patient.

TABLE 3-4
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Sent with value set in source image.
Patient ID	(0010,0020)	2	Sent with value set in source image.
Patient's Birth Date	(0010,0030)	2	Sent with value set in source image.
Patient's Sex	(0010,0040)	2	Sent with value set in source image.
Referenced Patient Sequence	(0008,1120)	3	Sent with value set in source image.
> Referenced SOP Class UID	(0008,1150)	1C	Sent with value set in source image.
> Referenced SOP Instance UID	(0008,1155)	1C	Sent with value set in source image if present.
Issuer of Patient ID	(0010,0021)	3	Not used
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	3	Not used
>Universal Entity ID	(0040,0032)	3	Not used
>Universal Entity ID Type	(0040,0033)	1C	Not used
>Identifier Type Code	(0040,0035)	3	Not used

Patient's Birth Time	(0010,0032)	3	Not used
Other Patient IDs	(0010,1000)	3	Not used
Other Patient IDs Sequence	(0010,1002)	3	Not used
>Patient ID	(0010,0020)	1	Not used
>Issuer of Patient ID	(0010,0021)	1	Not used
>Type of Patient ID	(0010,0022)	1	Not used
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)	1	Not used
>>Universal Entity ID	(0040,0032)	3	Not used
>>Universal Entity ID Type	(0040,0033)	1C	Not used
>>Identifier Type Code	(0040,0035)	3	Not used
Other Patient Names	(0010,1001)	3	Not used
Ethnic Group	(0010,2160)	3	Not used
Patient Comments	(0010,4000)	3	Not used
Patient Identity Removed	(0012,0062)	3	Used only in de-identified images with the value "YES"
De-identification Method	(0012,0063)	1C	Used only in de-identified images with the value "De-identification"

3.5.2 Study Entity Modules

3.5.2.1 General Study Module

This section specifies the Attributes which describe and identify the Study performed upon the Patient.

TABLE 3-5
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Sent with value set in the source image.
Study Date	(0008,0020)	2	The system set it to today's date when generating a new study, else set to value set in source image.
Study Time	(0008,0030)	2	The system set it to current time when generating a new study, else set to value set source image.
Referring Physician's Name	(0008,0090)	2	Sent with value set in the source image.
Study ID	(0020,0010)	2	Sent with value set in the source image.
Accession Number	(0008,0050)	2	Sent with value set in the source image.
Study Description	(0008,1030)	3	Sent with value set in the source image.
Referenced Study Sequence	(0008,1110)	3	Sent with value set in the source image.
> Referenced SOP Class UID	(0008,1150)	3	Sent with value set in the source image.
> Referenced SOP Instance UID	(0008,1155)	3	Sent with value set in the source image.
Procedure Code Sequence	(0008,1032)	3	Sent with value set in the source image.
>Code Value	(0008,0100)	1	Sent with value set in the source image.

>Coding Scheme Designator	(0008,0102)	1	Sent with value set in the source image.
>Code Meaning	(0008,0104)	1C	Sent with value set in the source image.

3.5.2.2 Patient Study Module

This section specifies the Attributes which provide information about the patient at the time the study was performed.

TABLE 3-6
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Sent with value set in the source image.

3.5.3 Series Entity Modules

3.5.3.1 General Series Module

This section specifies the Attributes which identify and describe general information about the Series within a Study.

TABLE 3-7
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Always set to "MG"
Series Instance UID	(0020,000E)	1	UID is generated by the system.
Series Number	(0020,0011)	2	Set to '1' as V-preview.
Laterality	(0020,0060)	2C	Not used
Series Date	(0008,0021)	3	The system sets it to today's date when generating a new series.
Series Time	(0008,0031)	3	The system sets it to current time when generating a new series.
Performing Physicians' Name	(0008,1050)	3	Sent with value set in the source image.
Protocol Name	(0018,1030)	3	Set to 3D_ROUTINE
Series Description	(0008,103E)	3	Set to "V-Preview"
Operators' Name	(0008,1070)	3	Sent with value set in the source image if present.
Body Part Examined	(0018,0015)	3	Set to BREAST
Request Attributes Sequence	(0040,0275)	3	Sent with value set in the source image if present.
>Requested Procedure ID	(0040,1001)	1C	Sent with value set in the source image if present.
>Scheduled Procedure Step ID	(0040,0009)	1C	Sent with value set in the source image if present.
>Scheduled Procedure Step Description	(0040,0007)	3	Sent with value set in the source image if present.
>Scheduled Protocol Code Sequence	(0040,0008)	1C	Sent with value set in the source image if present.
>>Code Value	(0008,0100)	1	Sent with value set in the source image if

			present or attribute is not sent otherwise
>>Coding Scheme Designator	(0008,0102)	1	Sent with value set in the source image if present or attribute is not sent otherwise
>>Code Meaning	(0008,0104)	1C	Sent with value set in the source image if present or attribute is not sent otherwise

3.5.3.2 Enhanced mammography Series Module

This Module contains IOD Attributes that describe a series performed on the patient for the context of a Breast Tomosynthesis device.

TABLE 3-8
ENHANCED MAMMOGRAPHY SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Described in General Series Module

3.5.4 Frame of reference Entity Modules

3.5.4.1 Frame of reference module

This section specifies the Attributes necessary to uniquely identify a frame of reference, which insures the spatial relationship of Images within a Series.

TABLE 3-9
FRAME OF REFERENCE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Sent with value set in the source image if present.
Position Reference Indicator	(0020,1040)	1	Sent with value set in the source image if present.

3.5.5 Equipment Entity Modules

3.5.5.1 General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced a Series of Images.

TABLE 3-10
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Set to "GE MEDICAL SYSTEMS"
Institution Name	(0008,0080)	3	Set to value read from workstation settings.
Institution Address	(0008,0081)	3	Set to value read from workstation settings.
Station Name	(0008,1010)	3	Set to value read from workstation settings.
Manufacturer's Model Name	(0008,1090)	3	Set to “VolumePreviewApp_[version](build number)”
Device Serial Number	(0018,1000)	3	Set to hardware serial number if available. Empty if otherwise.
Software Versions	(0018,1020)	3	Set to MammoWorkStation software version.

Pixel Padding Value	(0028,0120)	1C	Set to 0.

3.5.5.2 Enhanced General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced a Series of Composite Instances.

TABLE 3-11
ENHANCED GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	1	Described in General Equipment Module.
Manufacturer's Model Name	(0008,1090)	1	Described in General Equipment Module.
Device Serial Number	(0018,1000)	1	Described in General Equipment Module.
Software Versions	(0018,1020)	1	Described in General Equipment Module.

3.5.6 Image Entity Modules

3.5.6.1 Image Pixel Module

This section specifies the Attributes that describe the pixel data of the image.

TABLE 3-12
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Always set to 1
Photometric Interpretation	(0028,0004)	1	Set to "MONOCHROME2" (i.e. 0 is black)
Rows	(0028,0010)	1	Set to the number of rows.
Columns	(0028,0011)	1	Set to the number of columns.
Bits Allocated	(0028,0100)	1	Set to 16
Bits Stored	(0028,0101)	1	Set to 12
High Bit	(0028,0102)	1	Set to 11
Pixel Representation	(0028,0103)	1	Always set to 0000H (unsigned integer)
Pixel Data	(7FE0,0010)	1	Contains the V-preview image pixel data.

3.5.6.2 Acquisition Context Module

The table in this Section contains IOD Attributes that describe the acquisition context while acquiring the MG image.

TABLE 3-13
ACQUISITION CONTEXT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Acquisition Context Sequence	(0040,0555)	2	Zero length value is sent

3.5.6.3 Multi-frame Functional Groups Module

The table in this Section contains IOD Attributes that describe Multi-frame Functional Groups Module.

TABLE 3-14
MULTI-FRAME FUNCTIONAL GROUPS MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Shared Functional Groups Sequence	(5200,9229)	2	Sent with one item.
>Pixel Measures Sequence	(0028,9110)	1	Sent with one item.
>>Pixel Spacing	(0028,0030)	1C	Sent with value set to "0.1\0.1"
>>Slice Thickness	(0018,0050)	1C	Sent with value set to attribute Body Part Thickness (0018,11A0) in source image.
>Plane Orientation Sequence	(0020,9116)	1	Sent with one item.
>>Image Orientation (Patient)	(0020,0037)	1C	Sent with 6 values. Row value for the x, y, and z axes respectively, followed by the Column value for the x, y, and z axes respectively.
>Derivation Image Sequence	(0008,9124)	2	Sent with one or two items for V-Preview. Sent with zero items otherwise.
>Derivation Description	(0008,2111)	3	Set to “V-Preview([version])”
>>Derivation Code Sequence	(0008,9215)	1	Sent with one or two items
>>>Code Value	(0008,0100)	1	Sent with value set to "113078"
>>>Coding Scheme Designator	(0008,0102)	1	Sent with value set to "DCM"
>>>Code Meaning	(0008,0104)	1C	Sent with value set to "Maximum intensity projection"
>>Source Image Sequence	(0008,2112)	2	Sent with 9 items.
>>>Referenced SOP Class UID	(0008,1150)	1C	Set to MG SOP Class "1.2.840.10008.5.1.4.1.1.1.2.1"
>>>Referenced SOP Instance UID	(0008,1155)	1C	SOP Instance UID of Projection Image.
>>>Purpose of Reference Code Sequence	(0040,A170)	1	Sent with one or two items.
>>>>Code Value	(0008,0100)	1	Sent with value set to "121322"
>>>>Coding Scheme Designator	(0008,0102)	1	Sent with value set to "DCM"
>>>>Code Meaning	(0008,0104)	1C	Sent with value set to "Source image for image processing operation"
>Frame Anatomy Sequence	(0020,9071)	1	Sent with one item
>>Frame Laterality	(0020,9072)	1	Supported Values: R = right L = left B = both
>>Anatomic Region Sequence	(0008,2218)	1	Sent with one item.
>>>Code Value	(0008,0100)	1	Used Code: T-04000 for Breast

>>>Coding Scheme Designator	(0008,0102)	1	Always set to SRT
>>>Code Meaning	(0008,0104)	1C	Set to Breast
>Pixel Value Transformation Sequence	(0028,9145)	1	Sent with one item.
>>Rescale Intercept	(0028,1052)	1	Sent with value set to "0"
>>Rescale Slope	(0028,1053)	1	Sent with value set to "1"
>>Rescale Type	(0028,1054)	1	Sent with value set to "US"
>Frame VOI LUT Sequence	(0028,9132)	1	Sent with one item.
>>Window Center	(0028,1050)	1	Sent with three values.
>>Window Width	(0028,1051)	1	Sent with three values.
>>Window Center and Width Explanation	(0028,1055)	3	Set to "NORMAL\HARDER\SOFTER".
>>VOI LUT Function	(0028,1056)	3	Sent with value set to "SIGMOID"
Per-frame Functional Groups Sequence	(5200,9230)	1	Sent with as many items as there are frames
>Frame Content Sequence	(0020,9111)	1	Sent with one item
>>Frame Reference DateTime	(0018,9151)	1C	Sent with value set to date and time when half the exposures were made to acquire the image.
>>Frame Acquisition DateTime	(0018,9074)	1C	Sent with value set to the date and time the first exposure was made to acquire the image.
>>Frame Acquisition Duration	(0018,9220)	1C	Sent with value set to the time elapsed between first and last exposures made to acquire the image.
>Plane Position Sequence	(0020,9113)	1	Sent with one item
>>Image Position (Patient)	(0020,0032)	1C	Sent with value set to "x\y\z" where x, y and z are the coordinates of the upper left hand corner of the V-Preview in mm
>X-Ray 3D Frame Type Sequence	(0018,9504)	1	Sent with one item
>>Frame Type	(0008,9007)	1	Set to “DERIVED\PRIMARY\VOLUME\NONE”
>>Pixel Presentation	(0008,9205)	1	Set to "MONOCHROME"
>>Volumetric Properties	(0008,9206)	1	Set to “SAMPLED”
>>Volume Based Calculation Technique	(0008,9207)	1	Set to “MAX_IP”
>>Reconstruction Index	(0020,9536)	1C	Set to "1"

Instance Number	(0020,0013)	1	First image generated for the series: value is 1.
Content Date	(0008,0023)	1	Sent with value set to the date the image is created.
Content Time	(0008,0033)	1	Sent with value set to the time the image is created.
Number of Frames	(0028,0008)	1	Set to “1”

3.5.6.4 X-Ray 3D Image Module

The table in this Section contains IOD Attributes that describe an X-Ray 3D image by specializing Attributes of the General Image and Image Pixel Modules, and adding additional attributes.

TABLE 3-15
X-RAY 3D IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Set to “DERIVED\PRIMARY\VOLUME\NONE”
Pixel Presentation	(0008,9205)	1	Always set to "MONOCHROME"
Volumetric Properties	(0008,9206)	1	Set to “SAMPLED”
Volume Based Calculation Technique	(0008,9207)	1	Set to "MAX_IP"
Bits Allocated	(0028,0100)	1	Sent in Image Pixel Module.
Bits Stored	(0028,0101)	1	Sent in Image Pixel Module.
High Bit	(0028,0102)	1	Sent in Image Pixel Module.
Samples per Pixel	(0028,0002)	1	Sent in Image Pixel Module.
Photometric Interpretation	(0028,0004)	1	Sent in Image Pixel Module.
Content Qualification	(0018,9004)	1	Set to "PRODUCT".
Burned In Annotation	(0028,0301)	1	Set to "NO".
Lossy Image Compression	(0028,2110)	1	Set to "00"
Presentation LUT Shape	(2050,0020)	1	Set to "IDENTITY".

3.5.6.5 Breast Tomosynthesis Contributing Sources Module

The table in this Section contains IOD Attributes that describes the overall characteristics of one or more source images that were used to create a Breast Tomosynthesis Image SOP Class instance.

TABLE 3-16
BREAST TOMOSYNTHESIS CONTRIBUTING SOURCES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Contributing Sources Sequence	(0018,9506)	1	Sent with one item.
>Contributing SOP Instances Reference Sequence	(0020,9529)	1C	Sent with one item.
>>Study Instance UID	(0020,000D)	1	Sent with value set to attribute Study Instance UID (0020, 000D) in source images.

>>Referenced Series Sequence	(0008,1115)	1	Sent with one item.
>>>Series Instance UID	(0020,000E)	1	Sent with value set to attribute Series Instance UID (0020, 000E) in source image.
>>>Series Number	(0020,0011)	2	Sent with value set to attribute Series Number (0020, 0011) in source image.
>>>Referenced Instance Sequence	(0008,114A)	1	Sent with as many items as source images.
>>>>Referenced SOP Class UID	(0008,1150)	1	Sent with value set to attribute SOP Class UID (0008, 0016) of source image.
>>>>Referenced SOP Instance UID	(0008,1155)	1	Sent with value set to attribute SOP Instance UID (0008, 0018) of source image.
>>>>Instance Number	(0020,0013)	2	Sent with value set to attribute Instance Number (0020, 0013) of source image.
>Manufacturer	(0008,0070)	2	Sent with value set to attribute Manufacturer (0008, 0070) of source image.
>Manufacturer's Model Name	(0008,1090)	2	Sent with value set to attribute Manufacturer's Model Name (0008, 1090) in source image.
>Device Serial Number	(0018,1000)	1C	Sent with value set to attribute Device Serial Number (0018, 1000) in source image. This attribute is always present in source image.
>Software Versions	(0018,1020)	1C	Sent with value set to attribute Software versions (0018, 1020) in source image. This attribute is always present in source image.
>Acquisition DateTime	(0008,002A)	1C	Sent with value set to combination of attributes Acquisition Date (0008, 0022) and Acquisition Time (0008, 0032) in source image.
>Station Name	(0008,1010)	1C	Sent with value set to attribute Station Name (0008, 1010) in source image.
>Operators' Name	(0008,1070)	1C	Sent with value set to attribute Operator's name (0008, 1070) in source image.
>Protocol Name	(0018,1030)	1C	Sent with value set to attribute Protocol Name (0018, 1030) in source image.
>Acquisition Protocol Name	(0018,9423)	1C	Sent with value set to attribute Protocol Name (0018, 1030) in source image.
>Rows	(0028,0010)	1	Sent with value set to attribute Rows (0028, 0010) in source image.
>Columns	(0028,0011)	1	Sent with value set to attribute Columns (0028, 0011) in source image.
>Bits Stored	(0028,0101)	1	Sent with value set to attribute Bits Stored (0028, 0101) in source image.
>Lossy Image Compression	(0028,2110)	1C	Sent with value set to attribute Lossy Image Compression (0028, 2110) in source image.
>Detector Type	(0018,7004)	1	Sent with value set to attribute Detector Type (0018, 7004) in source image.
>Detector ID	(0018,700A)	1	Sent with value set to attribute Detector ID (0018, 700A) in source image.
>Date of Last Detector Calibration	(0018,700C)	1	Sent with value set to attribute Date of Last Detector Calibration (0018, 700C) in source image.

>Time of Last Detector Calibration	(0018,700E)	1	Sent with value set to attribute Time of Last Detector Calibration (0018, 700E) in source image.
>Detector Element Spacing	(0018,7022)	1	Sent with value set to attribute Detector Element Spacing (0018, 7022) in source image.

3.5.6.6 Breast Tomosynthesis Acquisition Module

The table in this Section contains IOD Attributes that describe the Breast Tomosynthesis acquisition module.

TABLE 3-17
BREAST TOMOSYNTHESIS ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
X-Ray 3D Acquisition Sequence	(0018,9507)	1	Sent with one item.
>Field of View Shape	(0018,1147)	1	Sent with value set to attribute Field of View Shape (0018, 1147) in source image.
>X-Ray Receptor Type	(0018,9420)	3	Set to "DIGITAL_DETECTOR"
>Source Image Sequence	(0008,2112)	1C	Sent with as many items as source images.
>>Referenced SOP Class UID	(0008,1150)	1	Sent with value set to attribute SOP Class UID (0008, 0016) in source image.
>>Referenced SOP Instance UID	(0008,1155)	1	Sent with value set to attribute SOP Class UID (0008, 0018) in source image.
>Field of View Dimension(s) in Float	(0018,9461)	1C	Sent with value set to attribute Field of View Dimensions (0018, 1149) in source image.
>Field of View Origin	(0018,7030)	1C	Sent with value set to attribute Field of View Origin (0018, 7030) in source image.
>Field of View Rotation	(0018,7032)	1C	Sent with value set to attribute (0018, 7032) in source image.
>Field of View Horizontal Flip	(0018,7034)	1C	Sent with value set to attribute Field of View Rotation (0018,7034) in source image
>Grid	(0018,1166)	1C	Sent with value set to attribute Grid (0018, 1166) in source image.
>KVP	(0018,0060)	1C	Sent with value set to the average of the source images attribute KVP (0018, 0060).
>X-Ray Tube Current in mA	(0018,9330)	1C	Sent with value set to the average of source images attribute X-Ray Tube Current (0018, 1151).
>Exposure Time in ms	(0018,9328)	1C	Sent with value set the converted total of the source images attribute Exposure Time (0018, 1150).
>Exposure in mAs	(0018,9332)	1C	Sent with value set the converted total of the source images attribute Exposure (0018, 1152).
>Start Acquisition DateTime	(0018,9516)	1C	Sent with value set to combination of source image attributes Acquisition Date (0008, 0022) and Acquisition Time (0008, 0032).
>Primary Positioner Scan Arc	(0018,9508)	1C	Sent with value set to the difference between attribute Positioner Primary Angle (0018, 1510) in the last and first acquired source images.

>Primary Positioner Scan Start Angle	(0018,9510)	1C	Sent with value set to the converted value from first source image attribute Positioner Primary Angle (0018, 1510).
>Primary Positioner Increment	(0018,9514)	1C	Sent with value set to converted absolute value from the difference between the values from the last and first source images Positioner Primary Angle (0018, 1510), divided by the number of source images.
>Distance Source to Detector	(0018,1110)	1	Sent with value (0018, 1110) in source image.
>Distance Source to Patient	(0018,1111)	1	Sent with value (0018, 1111) in source image.
>Estimated Radiographic Magnification Factor	(0018,1114)	1	Sent with value set to attribute Estimated Radiographic Magnification Factor (0018, 1114) in source image.
>Anode Target Material	(0018,1191)	1	Sent with value set to attribute Anode Target Material (0018, 1191) in source image.
>Body Part Thickness	(0018,11A0)	1	Sent with value set to attribute Body Part Thickness (0018, 11A0) in source image.
>Compression Force	(0018,11A2)	1	Sent with value set to attribute Compression Force (0018, 11A2) in source image.
>Exposure Control Mode	(0018,7060)	1	Sent with value set to attribute Exposure Control Mode (0018, 7060) in source image.
>Exposure Control Mode Description	(0018,7062)	1	Sent with value set to attribute exposure Control Mode Description (0018, 7062) in source image.
>Half Value Layer	(0040,0314)	1	Sent with value set to attribute Half Value Layer (0040, 0314) in source image.
>Focal Spot	(0018,1190)	1	Sent with value set to attribute Focal Spot (0018, 1190) in source image.
>Detector Temperature	(0018,7001)	1	Sent with value set to attribute Detector Temperature (0018, 7001) in source image.
>Filter Type	(0018,1160)	1	Sent with value set to attribute Filter Type (0018, 1160) in source image.
>Filter Material	(0018,7050)	1	Sent with value set to attribute Filter Material (0018, 7050) in source image.
>Organ Dose	(0040,0316)	3	Sent with value set to the private attribute Organ Dose (0045,10A4)
>Per Projection Acquisition Sequence	(0018,9538)	1	Sent with as many items as source images.
>>KVP	(0018,0060)	1C	Sent with value set to attribute KVP (0018, 0060) in source image.
>>X-Ray Tube Current in mA	(0018,9330)	1C	Sent with value set to conversion from attribute X-Ray Tube Current (0018, 1151) in source image.
>>Collimator Shape	(0018,1700)	1C	Sent with value set to attribute Collimator Shape (0018, 1700) in source image.
>>Collimator Left Vertical Edge	(0018,1702)	1C	Sent with value set to attribute Collimator Left Vertical Edge (0018, 1702) in source image.
>>Collimator Right Vertical Edge	(0018,1704)	1C	Sent with value set to attribute Collimator Right Vertical Edge (0018, 1704) in source image.
>>Collimator Upper Horizontal Edge	(0018,1706)	1C	Sent with value set to attribute Collimator Upper

			Horizontal Edge (0018, 1706) in source image.
>>Collimator Lower Horizontal Edge	(0018,1708)	1C	Sent with value set to attribute Collimator Lower Horizontal Edge (0018, 1708).
>>Positioner Primary Angle	(0018,1510)	1	Sent with value set to attribute Positioner Primary Angle (0018, 1510) in source image.
>>Exposure Time in ms	(0018,9328)	1	Sent with value set to the conversion from attribute Exposure Time (0018, 1150) in source image.
>>Exposure in mAs	(0018,9332)	1	Sent with value set to the convention from attribute Exposure (0018, 1152) in source image.
>>Relative X-ray Exposure	(0018,1405)	1	Sent with value set to attribute Relative X-ray Exposure (0018, 1405) in source image.
>>Organ Dose	(0040,0316)	3	Sent with value set to attribute Organ Dose (0040, 0316) in source image.
>>Entrance Dose in mGy	(0040,8302)	3	Sent with value set to attribute Entrance Dose in mGy (0040, 8302) in source image.

3.5.6.7 X-Ray 3D Reconstruction Module

The table in this Section contains IOD Attributes that describe the reconstructions used to create this SOP Instance.

TABLE 3-18
X-RAY 3D RECONSTRUCTION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
X-Ray 3D Reconstruction Sequence	(0018,9530)	1	Sent with one or more items
>Application Name	(0018,9524)	1	Set to “VolumePreviewApp”
>Application Version	(0018,9525)	1	Set to Mammoworkstation version & build number
>Application Manufacturer	(0018,9526)	1	Set to "GE MEDICAL SYSTEMS"
>Algorithm Type	(0018,9527)	1	Set to "FILTER_BACK_PROJ”
>Acquisition Index	(0020,9518)	1	Set to “1”

3.5.6.8 Breast View Module

The table in this Section contains IOD Attributes that describe the view of a Breast Tomosynthesis Image.

TABLE 3-19
BREAST VIEW MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
View Code Sequence	(0054,0220)	1	Sent with one item.
>Code Value	(0008,0100)	1	Sent with value copied from source image.
>Coding Scheme Designator	(0008,0102)	1	Sent with value copied from source image.
>Code Meaning	(0008,0104)	1	Sent with value copied from source image.
>View Modifier Code Sequence	(0054,0222)	2	Sent with zero or more items.

>>Code Value	(0008,0100)	1C	Sent with value copied from source image.
>>Coding Scheme Designator	(0008,0102)	1C	Sent with value copied from source image.
>>Code Meaning	(0008,0104)	1C	Sent with value copied from source image.
Breast Implant Present	(0028,1300)	1C	Sent with value copied from source image.

3.5.6.9 SOP Common Module

The table in this Section contains IOD attributes for SOP Common Module.

TABLE 3-20
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Set to "ISO_IR 100", i.e. all European characters
SOP Class UID	(0008,0016)	1	Set to the Breast Tomosynthesis SOP Class UID: "1.2.840.10008.5.1.4.1.1.13.1.3"
SOP Instance UID	(0008,0018)	1	UID is generated by the system.

4. STORAGE COMMITMENT PUSH MODEL IMPLEMENTATION

4.1 STORAGE COMMITMENT PUSH MODEL INFORMATION OBJECT DEFINITION

Please refer to DICOM Part 3 (Information Object Definitions) for a description of each of the attributes contained within the Storage Commitment Information Object.

The Storage Commitment Information Object is used both for N-ACTION Storage Commitment Requests by the SCU and N-EVENT-REPORT Storage Commitment Notifications by the SCP.

4.1.1 STORAGE COMMITMENT MODULE FOR N-ACTION

N-ACTION is sent by SCU when the documents are successfully sent to a remote host declared as Storage Commitment Provider on MammoWorkstation. Storage Commitment can be requested for the newly created documents on MammoWorkstation only.

The SCP role is not supported.

TABLE 4-1
STORAGE COMMITMENT MODULE FOR N-ACTION

Attribute Name	Tag	SCU Use	SCP Use
Transaction UID	(0008,1195)	Newly created per requested transaction	Not supported
Storage Media File-Set ID	(0088,0130)	Not used	Not supported
Storage Media File-Set UID	(0088,0140)	Not used	Not supported
Referenced SOP Sequence	(0008,1199)	Used to identify documents to commit	Not supported
>Referenced SOP Class UID	(0008,1150)	Used to identify documents to commit	Not supported
>Referenced SOP Instance UID	(0008,1155)	Used to identify documents to commit	Not supported
>Storage Media File-Set ID	(0088,0130)	Not used	Not supported
>Storage Media File-Set UID	(0088,0140)	Not used	Not supported

4.1.2 STORAGE COMMITMENT MODULE FOR N-EVENT-REPORT

When receiving N-EVENT-REPORT notification the system looks for the successfully committed documents and flags them in local database. Then the system looks for the documents for which commitment failed and records the failure status for them in local database; the failure reason is ignored.

The SCP role is not supported.

TABLE 4-2
STORAGE COMMITMENT MODULE FOR N-EVENT-REPORT

Attribute Name	Tag	SCU Use	SCP Use
Transaction UID	(0008,1195)	Supported but ignored	Not supported
Retrieve AE Title	(0008,0054)	Supported but ignored	Not supported
Storage Media File-Set ID	(0088,0130)	Not used	Not supported
Storage Media File-Set UID	(0088,0140)	Not used	Not supported

Referenced SOP Sequence	(0008,1199)	Used to identify successfully commited documents	Not supported
>Referenced SOP Class UID	(0008,1150)	Used to identify successfully commited documents	Not supported
>Referenced SOP Instance UID	(0008,1155)	Used to identify successfully commited documents	Not supported
>Retrieve AE Title	(0008,0054)	Supported but ignored	Not supported.
>Storage Media File-Set ID	(0088,0130)	Not used	Not supported
>Storage Media File-Set UID	(0088,0140)	Not used	Not supported
Failed SOP Sequence	(0008,1198)	Used when event type ID is 2 to identify the documents whose commitment has failed	Not supported
>Referenced SOP Class UID	(0008,1150)	Used when event type ID is 2 to identify the documents whose commitment has failed	Not supported
>Referenced SOP Instance UID	(0008,1155)	Used when event type ID is 2 to identify the documents whose commitment has failed	Not supported
>Failure Reason	(0008,1197)	See Section 4.1.2.1 for the list of processed values.	Not supported.

4.1.2.1 Processing of Failure Reason when received in a N-Event-Report

When receiving an N-Event-Report request with an Event Type ID equal to 2, meaning that Storage Commitment is complete, but failure exists, following is the set of value that this Storage Commitment SCU AE is able to process:

Failure Reason	Meaning	Application Behavior When Receiving Reason Code
0110H	Processing failure	Supported but ignored
0112H	No such object instance	Supported but ignored
0213H	Resource limitation	Supported but ignored
0122H	Referenced SOP Class not supported	Supported but ignored
0119H	Class / Instance conflict	Supported but ignored
0131H	Duplicate transaction UID	Supported but ignored
*	Other Failure Reason code values	Supported but ignored

4.1.2.2 Set of possible values that may be sent in Failure Reason in a N-Event-Report

When generating an N-Event-Report stating that failure exists in the completion of the Storage Commitment request, following is the list of Failure Reason (0008, 1197) code that this Storage Commitment SCP AE may generate:

Failure Reason	Meaning	Failure Reason Explanation
0110H	Processing failure	Not supported
0112H	No such object instance	Not supported
0213H	Resource limitation	Not supported

0122H	Referenced SOP Class not supported	Not supported
0119H	Class / Instance conflict	Not supported
0131H	Duplicate transaction UID	Not supported

5. REVISION HISTORY

Revision	Date	Author	Description
3	May 2014	Arun Kumar Raj Voruganti	Documented DICOM conformance of MWS V-Preview Extended Functionality.

To contact your local GE Healthcare representative, please go to:
http://www.gehealthcare.com/helpcenter.html

China Service Agent Address:
GE Medical Systems Trade & Development (Shanghai) Co., Ltd. (Area B, Warehouse No. 4,
#777 BingKe Road, Wai Gaoqiao Free Trade Zone, Shanghai, China, 200131)
Service Call Center: 800-810-8188
通用电气医疗系统贸易发展（上海）有限公司 (中国上海外高桥保税区冰克路777 号4 号仓库B 部位，邮编200131)
售后服务热线：800-810-8188

For the most recent China Service Agent information, please go to:
http://www.gehealthcare.com/cnzh/contact/address.html

Manufacturing site:
GE MEDICAL SYSTEMS SCS
283 RUE DE LA MINIERE
78530 BUC FRANCE

IMAGE DIAGNOST INTERNATIONAL
OSKAR-SCHLEMMER-STRASSE 11
80807 MUNICH GERMANY