



GE Healthcare

**Technical
Publications**

DIRECTION DOC0660253

Revision 1

Discovery NM/CT 670
Conformance Statement for DICOM V3.0



GE Healthcare

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LIST OF REVISIONS

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CONFORMANCE STATEMENT OVERVIEW

The Discovery NM/CT 670 system is a combination of an NM camera and a BrightSpeed Elite 16 slices CT scanner. It works in three different modes

1. NM standalone - Generates NM images.
2. NM/CT hybrid - A single NM scan (Tomo, Gated Tomo only) partnered with the related Hybrid CT protocol with one or more CT acquisition(s), NM and CT series will be included in the same study.
3. CT standalone exams scheduled via CT UI. Generates CT images only.

The Discovery NM/CT 670 DICOM implementation allows the user to send Nuclear Medicine image data, which may be partnered with CT image data acquired through the front-end acquisition system, and Secondary Capture Objects, created as reports of several Quality Control (QC) operations on the NM camera, to another DICOM station. Note that CT images and secondary capture are sent by the CT scanner independently. (Reference A - See “Overview” on page 1-1 of the BrightSpeed Elite 16 slices CT Scanner Conformance Statement).

The Discovery NM/CT 670 DICOM implementation supports storage commitment for the already transferred data. This guarantees the user that the acquired Nuclear Medicine image data and CT image data is safely archived for future use.

The Discovery NM/CT 670 DICOM implementation also supports receiving Worklist information from a remote AE.

The Discovery NM/CT 670 DICOM implementation also provides a verification mechanism by which a remote application entity (AE) can verify application-level communication with the NM DICOM Server AE and CT DICOM server. Also provided is a mechanism by which a Discovery NM/CT 670 DICOM user can verify application-level communication with a remote DICOM AE.

Table 0.1 provides an overview of the network services supported by Discovery NM/CT 670 DICOM.

Table 0-1. NETWORK SERVICES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Secondary Capture Image Storage	Yes	No
Nuclear Medicine Image Storage	Yes	No
Workflow Management		
Storage Commitment Push Model SOP Class	Yes	No
Modality Worklist Information Model – FIND SOP Class	Yes	No

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SECTION 1: INTRODUCTION

1.1 OVERVIEW

The Discovery NM/CT 670 system is a combination of an NM camera and a BrightSpeed Elite 16 slices CT scanner. It works in three different modes (Reference A- See “Overview” on page 1-1 of the BrightSpeed Elite 16 slices CT Scanner Conformance Statement).

1. NM standalone – Scheduled via the NM user interface. Generates NM images.
2. NM/CT hybrid – A single NM scan (Tomo, Gated Tomo only) partnered with the related Hybrid CT protocol with one or more CT acquisition(s), NM and CT series will be included in the same study.
3. CT standalone exams scheduled via CT UI. Generates CT images only.

DICOM Conformance related to the NM camera is described in this document.

BrightSpeed Elite 16 slices CT scanner Conformance statement is described in a separate document (Reference A- See “Overview” on page 1-1 of the BrightSpeed Elite 16 slices CT Scanner Conformance Statement).

DICOM behavior of the NM/CT hybrid scanning is described in this document.

This DICOM Conformance Statement is divided into Sections, Appendices and referenced documents, 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 GE Healthcare equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 3 - Nuclear Medicine Information Object Implementation, which specifies the GE Healthcare equipment compliance to DICOM requirements for the implementation of a Nuclear Medicine Information Object.

Section 4 - Modality Worklist Information Model, which specifies the information model used for the implementation of the Modality Worklist Information Model.

Section 5- Discovery NM/CT 670 Storage Commitment PUSH Model Implementation, which is used both for N-ACTION Storage Commitment requests by the SCU and N-EVENT REPORT Storage Commitment notifications by the SCP.

Section 6 - Discovery NM/CT 670 Modality Performed Procedure Step SOP Class Definition enabled for CT standalone exams only, allows a Modality Performed Procedure Step Message to be communicated to the Hospital/Radiology information system. The PPS feature provides the DICOM Modality Performed Procedure Step service as a service class user (SCU).

Section 7 - Secondary Capture Information Object Implementation, which specifies the GE Healthcare equipment compliance to DICOM requirements for the implementation of a Secondary Capture Information Model.

Appendix A - Discovery NM/CT 670 Private Data Dictionary

Reference A - DOC0636565 Discovery* and BrightSpeed* Dicom Conformance Statement

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEHC DICOM Conformance Statements is shown in the [Illustration 1-1](#).

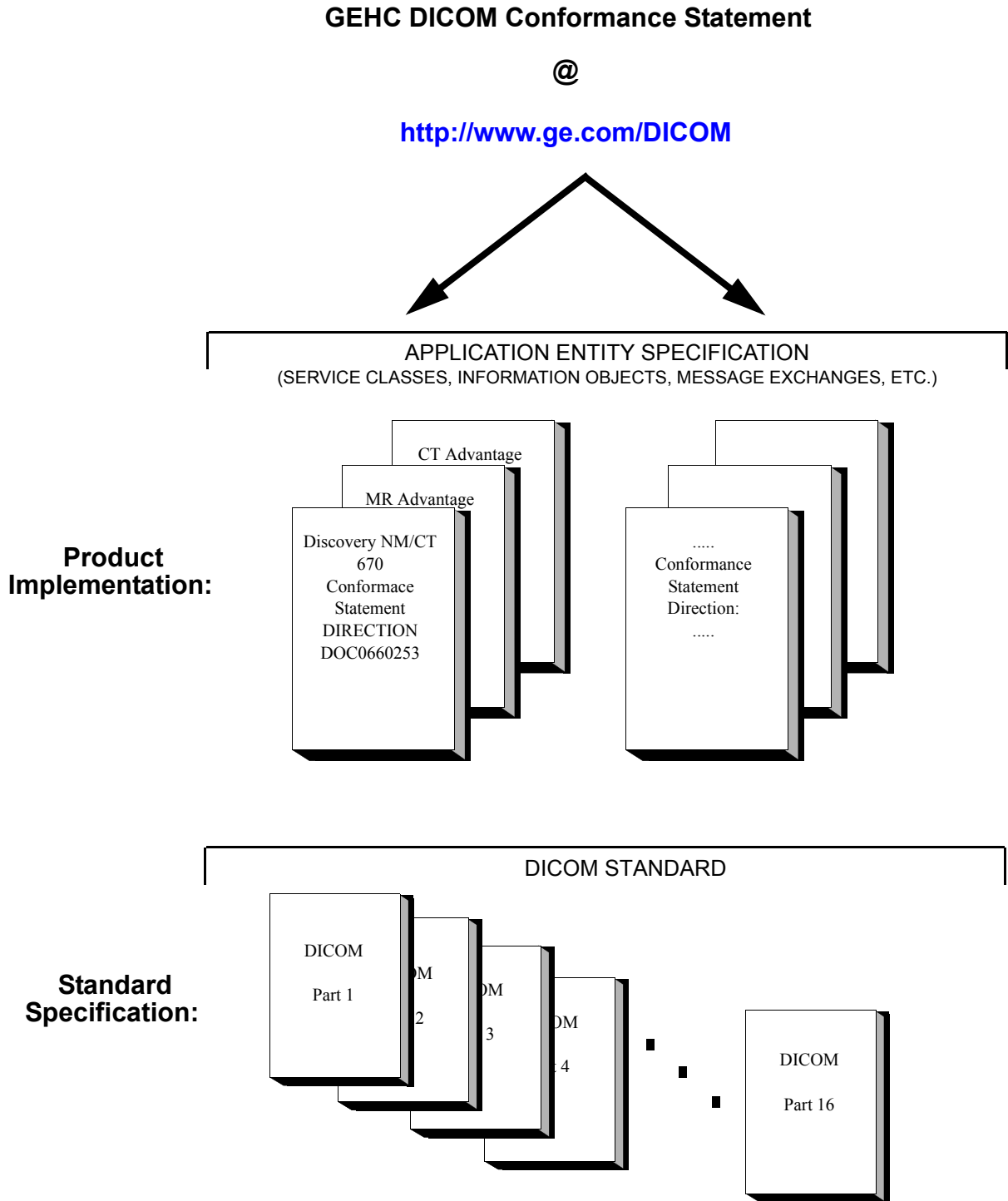


Illustration 1-1. Documentation Structure

This document specifies the DICOM implementation. It is entitled:

It documents the DICOM v3.0 Conformance Statement and Technical Specification required to interoperate with the GE Healthcare network interface. Introductory information, which is applicable to all GE Healthcare Conformance Statements, is described in the document:

Discovery NM/CT 670
Conformance Statement for DICOM
DIRECTION DOC0660253.

This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required, interoperating 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:

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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. Failures 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

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
AET	Application Entity Title
CT	Computerized Tomography
DHCP	Dynamic Host Configuration Protocol
DICOM	Digital Imaging and Communications in Medicine
DNS	Domain Name System
HIS	Hospital Information System
HL7	Health Level 7 Standard
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
ISO	International Organization for Standards
JPEG	Joint Photographic Experts Group
LUT	Look-up Table
MPEG	Moving Picture Experts Group
MWL	Modality Worklist
NM	Nuclear Medicine

NTP	Network Time Protocol
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
SPS	Scheduled Procedure Step
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
UL	Upper Layer
VR	Value Representation

SECTION 2: NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant Networking features on this GE Healthcare product.

The Discovery NM/CT 670 system is a combination of an NM system and a BrightSpeed Elite 16 Slices (Reference A- See “Overview” on page 1-1 of the BrightSpeed Elite 16 Slices CT scanner). It works in three different modes:

1. NM standalone;
2. Hybrid NM-CT exams and
3. CT standalone exam. (See “Important remarks” on page 1-4.).

This section details the roles and DICOM Service Classes supported by the Discovery NM/CT 670.

The Discovery NM/CT 670 DICOM implementation allows the user to acquire, store and send Nuclear Medicine image data and CT image data and Secondary Capture Objects, created as reports of several Quality Control (QC) operations, to another DICOM station. In this situation Discovery NM/CT 670 provides the DICOM C-STORE service as a service class user (SCU).

The Discovery NM/CT 670 DICOM implementation supports Storage Commitment for the already transferred data. This guarantees the user that the acquired Nuclear Medicine image data and CT image data are safely archived for future use. In this situation Discovery NM/CT 670 provides the DICOM Storage Commitment Service as Service Class User (SCU).

The Discovery NM/CT 670 DICOM implementation supports receiving Worklist information from a remote AE. When a query is performed, the remote AE Worklist items matching the query request are received. For NM standalone exams and hybrid exams, the Discovery NM/CT 670 DICOM implementation supports receiving more than one Scheduled Procedure Step per study instance, enabling the acquisition of their matching number of protocols for this study. Similarly, Discovery NM/CT 670 supports scheduling locally more than one protocol to be performed for a study. Note that each Scheduled Procedure Step is performed independently. For CT standalone exams the Discovery NM/CT 670 DICOM implementation supports scheduling a single Scheduled Procedure Step per study instance (via Worklist or by local scheduling) enabling the acquisition of a single protocol per study.

For standalone CT, the Discovery NM/CT 670 DICOM implementation creates and updates Modality Performed Procedure Step (MPPS) instances managed by a remote AE in association with image acquisition. Completion or discontinuation of the MPPS is performed as the result of an operator action. For NM standalone and NM/CT hybrid exams, the MPPS is not supported.

The Discovery NM/CT 670 DICOM uses two different AE titles, one for the NM and one for the CT. A verification mechanism is provided, by which a remote application entity (AE) can verify application-level communication with the NM DICOM Server and CT DICOM server. Also provided is a mechanism by which a Discovery NM/CT 670 user can verify application-level communication with a remote DICOM AE. In these situations, Discovery NM/CT 670 provides the DICOM C-ECHO service as both a SCP and SCU, respectively, from NM and CT.

2.2 IMPLEMENTATION MODEL

Two different Application Entities (AE) logically provide all DICOM functionality on the Discovery NM/CT 670 product: the NM DICOM Server AE for NM and the CT DICOM Server Application Entity (AE) for CT. The two DICOM servers Application Entities are commanded to perform DICOM services through the use of the Discovery NM/CT 670 user interface. The DICOM Server AEs also listen on a pre-defined port for incoming connections from remote DICOM AEs.

For CT DICOM Server Application Entity Implementation model, refer to BrightSpeed* Dicom Conformance Statement (Reference A- See "Overview" on page 1-1.).

2.2.1 Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in [Illustration 2-1](#), below.

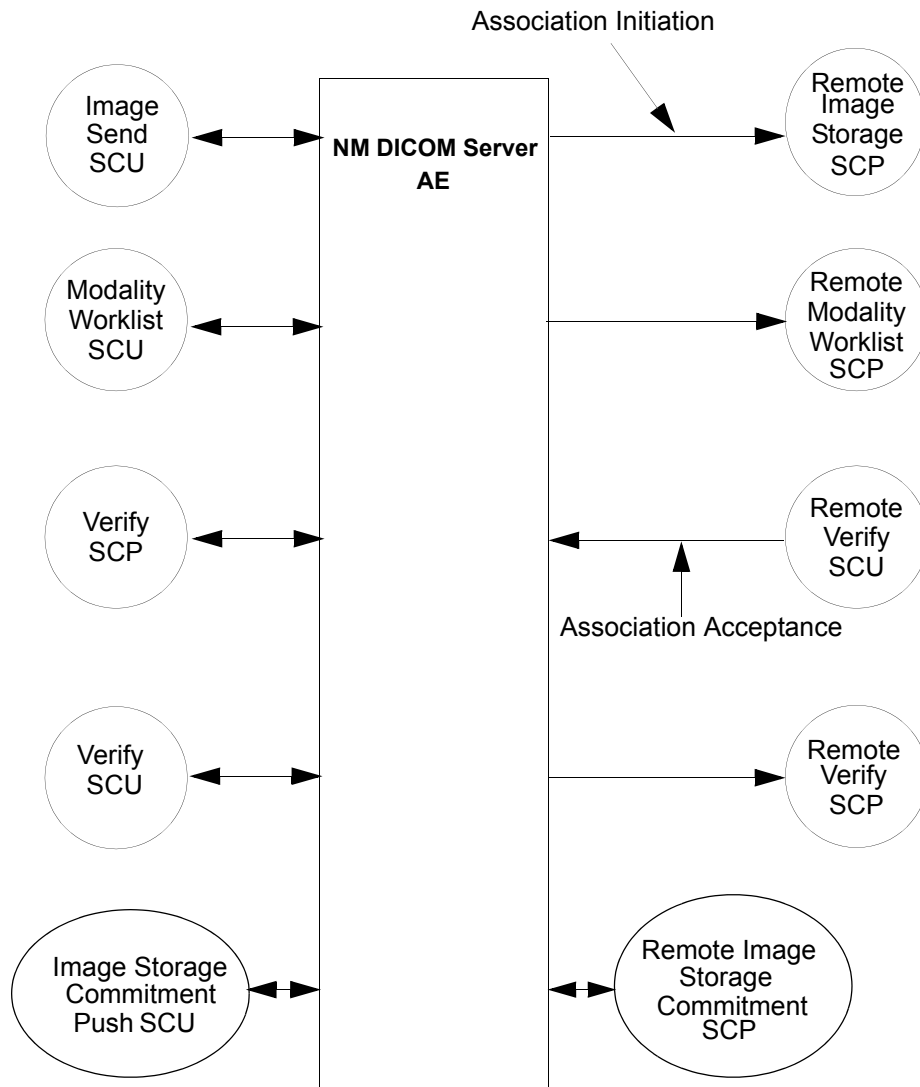


Illustration 2-1. Basic and Specific Application Models

2.2.2 Functional Definitions of Application Entities

The NM DICOM Server AE initiates the following functions:

- *Store*: Initiates a DICOM association in order to send images to a remote AE. If the remote AE accepts a presentation context applicable to the image(s) being sent, the NM DICOM Server AE will send the images via the C-STORE service.
- *Storage commitment*: Initiates a DICOM association in order to request a storage commitment from a remote AE. If the remote AE supports storage commitment the NM DICOM Server AE will request a storage commitment for the image(s) previously sent successfully via the N-ACTION-RQ.
- *Verify*: Initiates a DICOM association in order to send a verification message to a remote AE via a C-ECHO-RQ message.
- *Modality Work List (MWL)*: Initiates a DICOM association in order to query the work list from a remote AE. If the remote AE accepts a presentation context applicable to the modality work list request being sent, the NM DICOM Server AE will receive appropriate MWL responses via the C-FIND service.

The NM DICOM Server AE responds to the following functions:

- *Verify*: Responds to incoming C-ECHO-RQ messages by returning a C-ECHO-RSP message with a status of "success."
- *Storage Commitment Response*: Responds to incoming N-EVENT_REPORT messages arriving from Remote AE with the status of storage commitment for images previously requested by NM DICOM Server AE.

2.2.3 Sequencing of Real-World Activities

The NM DICOM Server AE queries the remote station for the modality Worklist; performs acquisition according to local schedules, or by Worklist procedures; stores images; and then requests Storage Commitment for previously stored images.

2.3 AE SPECIFICATIONS

Note

For CT DICOM Server AE SPECIFICATIONS, refer to BRIGHTSPEED Conformance Statement (See Reference A- See "Overview" on page 1-1)

2.3.1 NM DICOM Server AE Specification

This Application Entity provides Standard Conformance to the following DICOM v3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7

SOP Class Name	SOP Class UID
Verification - SOP Class	1.2.840.10008.1.1
Modality Worklist Information Model - Find	1.2.840.10008.5.1.4.31

This Application Entity provides Standard Conformance to the following DICOM v3.0 SOP Classes as an SCP:

SOP Class Name	SOP Class UID
Verification - SOP Class	1.2.840.10008.1.1

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 negotiation is included in all association establishment requests. The maximum length PDU for an association initiated by the NM DICOM Server AE is:

Maximum Length PDU	64234 bytes

The SOP Class Extended Negotiation is not supported.

The maximum number of Presentation Context Items that will be proposed is 5. Note that the same Abstract Syntax may be offered multiple times with different Transfer Syntaxes.

The user information items sent by this product are:

- PDU Maximum length (PDU maximum length is 64234, and is not configurable)
- Implementation UID

2.3.1.1.2 Number of Associations

The NM DICOM Server AE (SCU) will initiate a single DICOM association to perform a multiple image store for all images selected in the Data Management to a remote AE. Multiple Send operations can be performed both in manual send and in auto-send. The Storage Commitment Request (SCU) initiates a new single association for all the images that were successfully stored on the remote AE. The Maximum Number of associations that the NM DICOM Server AE (SCU) can open in parallel is 5.

The NM DICOM Server AE (SCP) can have multiple DICOM associations open simultaneously to service verifications. The Maximum Number of associations that the NM DICOM Server AE (SCP) can accept in parallel is 5.

2.3.1.1.3 Asynchronous Nature

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

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM v3.0 Implementation is:

Discovery NM/CT 670 Implementation UID	1.2.840.113619.6.280
---	-----------------------------

2.3.1.2 Association Initiation Policy

The NM DICOM Server AE initiates a new association

- Due to an image send operation being initiated from the Discovery NM/CT 670 user interface, or by auto send option.
- Due to a storage commitment request operation being initiated from the Discovery NM/CT 670 user interface upon successful image transfer or by auto send option
- Due to a Verify operation initiated to determine whether the remote DICOM station is operational.
- Due to modality worklist request being initiated from the Discovery NM/CT 670 user interface

2.3.1.2.1 Real-World Activity: Image Send

Note

For hybrid scanning selecting CT image(s) to be transferred and selecting the send destination is done from the CT scanner; sending NM images (manually or automatically) is performed via the NM camera Operator Console screen. For Real World activity of CT Image Send (Push) please refer to BRIGHTSPEED Conformance Statement (see Reference A- See "Overview" on page 1-1).

2.3.1.2.1.1 Associated Real-World Activity

There are two ways to send NM data: manual and automatic. In the manual way, in order to send NM data, the operator must both select image(s) to be transferred from the Data Management and select a destination by pressing the destination button. Once these selections have been made, the operator pushes the Transfer Destination button to initiate an image send operation. In the automatic way, when NM acquisition has been completed (in a NM-only context as well as in the hybrid context) the data is automatically sent to the destination(s) which are predefined within system configuration; the NM DICOM Server AE will then initiate an association with the remote AE in order to send the selected image(s) – one image per association – and will accept and interpret responses received from the remote AE.

The UI will indicate the status of the dataset being transferred. The status can be one of PENDING, SUCCESS, or FAILURE. The associated error messages due to a failed status can be found in system log.

2.3.1.2.1.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the NM DICOM Server AE after real-world activity "Image Send" has been initiated:

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
Secondary Image Capture Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

2.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for all Storage SOP Classes

This implementation can perform multiple C-STORE operations over a single association.

Upon receiving a C-STORE confirmation containing a Successful status, this implementation will perform the next C-STORE operation. The association will be maintained if possible.

Upon receiving a C-STORE confirmation containing a Refused status, this implementation will terminate the association.

Upon receiving a C-STORE confirmation containing any status that is not Success or Refused, this implementation will consider the current request to be a failure but will continue to attempt to send the remaining images in the request on the same association.

Each C-STORE operation supports an "Association Timer". This timer starts when the association request is sent and stops when the association is established. The time-out is 60 seconds. It is non-configurable.

Each C-STORE operation also supports an "Operation Inactivity Timer". This time-out starts once the first C-STORE request has been issued (on association) or received and is reset each time a C-STORE response has been received or when subsequent C-STORES are sent. This time-out is 5 minutes. It is non-configurable.

If any of the timers mentioned above expires, the connection is closed and the operation in progress is considered failed.

When DICOM Server AE initiates an association to issue a C-STORE, the image will be transmitted by the NM DICOM Server AE with the same elements as was created locally.

Transfer log shows one of these statuses for store request: JOB_SUCCEEDED, JOB_FAILED, JOB_IN_PROGRESS. The specific error codes can be observed in the log.

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

Service Status	Status Codes	Further Meaning	Application Behavior When receiving Status Codes
Refused	A7xx	Out of resources.	The message "Transfer Failed" is displayed in Transfer Log.

Service Status	Status Codes	Further Meaning	Application Behavior When receiving Status Codes
Error	Cxxx	Cannot Understand	The message "Transfer Failed" is displayed in Transfer Log.
	A900	Data Set does not match SOP Class	The message "Transfer Failed" is displayed in Transfer Log.
Warning	B000	Coercion of Data Elements	The message "Warning!! Instance does not match SOP Class or Coercion of data elements" posted to the Log.
	B007	Data Set does not match SOP Class	The message "Warning!! Instance does not match SOP Class or Coercion of data elements" posted to the Log.
	B006	Elements Discarded	The message "Warning!! Instance does not match SOP Class or Coercion of data elements" posted to the Log.
Success	0000		The message "Transfer Completed" posted to the Log.

2.3.1.2.2 Real -world Activity: Storage Commitment Push Model

Note

For Real World activity of CT Storage Commitment please refer to BrightSpeed Conformance Statement (see Reference A- See "Overview" on page 1-1).

2.3.1.2.2.1 Associated Real-World Activity

The operator must both select image(s) to be transferred from the Data Transfer panel, and select a destination from the list of previously defined destinations. Once these selections have been made, the operator pushes the "Destination" button to initiate an image send operation.

If the destination is configured as storage commitment capable or the destination is configured to use other storage commitment capable devices, the NM DICOM Server initiates the following operations:

- Negotiates and establishes association with remote Storage Commitment Provider
- Sends the selected images to the remote DICOM AE.
- Closes the association.
- If all the images are transferred without failures the following steps will be executed. If there are any failures the job will be marked as failed and the Storage Commitment request will not be sent.
- Establishes a new association for sending the commitment request.
- Receives the response on same association or on a different association.
- Updates the archive flag information for successful instances.

The Transfer Log shows the status of the storage commitment request progress. The status can be either JOB_SUCCEEDED, JOB_FAILED, or JOB_IN_PROGRESS.

2.3.1.2.2.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the NM DICOM Server AE after real-world activity “Storage Commitment Request” has been initiated:

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

2.3.1.2.2.3 SOP Specific DICOM Conformance Statement for Storage Commitment SOP Class

The selected image(s) are sent to the remote station using DICOM C-STORE operations. If there are any failures in the image transfers the Storage commitment request will not be sent. If all the images are successfully transferred then the commitment request will be sent on a different association with the list of SOP instances. Number of SOP instances in individual request equals the number of images selected to be sent simultaneously.

The NM DICOM Server AE uses DICOM network storage services to transfer SOP Instances which are to be committed. It does not support the optional Storage Media File-Set ID and UID Attributes in the Storage Commitment N-ACTION for transfer of SOP Instances by media for Storage Commitment.

The NM DICOM Server AE may request Storage Commitment for Secondary Capture Image Storage and Nuclear Medicine Image Storage.

The Storage Commitment Information Object is described in [Table 2-1 on page 2-9](#).

If the N-ACTION request fails, the image(s) storage commitment will be considered as failed; otherwise following sequence of actions will take place:

The SCU waits for N_ACTION_RSP from the provider on the same association. If it does not receive N_ACTION_RSP for a predefined, non-configurable timeout (10 minutes) it will close the association. The image(s) storage commitment will be considered as failed.

A new Transaction UID will be created for each retry by the user. The old Transaction UID is not applicable for these requests.

If a Storage Commitment N-EVENT-REPORT is received on the Association initiated by this Application Entity, it will be processed as described for Association initiated by the Storage Commitment SCP. See Real-World Activity: Receive N-EVENT-REPORT from Storage Commitment SCP.:

Table 2-1. Storage Commitment Module for N-ACTION

Attribute Name	Tag	SCU User
Transaction UID	(0008,1195)	Generated for each retry

Table 2-1. Storage Commitment Module for N-ACTION (Continued)

Attribute Name	Tag	SCU User
Storage Media File-Set ID	(0088,0130)	Not supported
Storage Media File-Set UID	(0088,0140)	Not supported
Referenced SOP Sequence	(0008,1199)	
>Referenced SOP Class UID	(0008,1150)	
>Referenced SOP Instance UID	(0008,1155)	
>Storage Media File-Set ID	(0088,0130)	Not supported
>Storage Media File-Set UID	(0088,0140)	Not supported

The behavior of NM DICOM Server AE when encountering status codes in a N-ACTION response is summarized in the Table below:

Table 2-2. Storage Commitment N-ACTION Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Success	Success	0000	The request for storage comment is considered successfully sent. A timer is started which will expire if no N-EVENT-REPORT for the Transaction UID is received within a configurable timeout period.
*	*	Any other status code.	The Association is closed. Storage commit considered failed.

The behavior of Storage AE during communication failure is summarized in the Table below:

Table 2-3. Storage Commitment Communication Failure Behavior

Exception	Behavior
Timeout	The Association is closed. Storage commit considered failed.
Association aborted by the SCP or network layers	The Association is closed. Storage commit considered failed.

2.3.1.2.3 Real-world Activity: Verify

2.3.1.2.3.1 Associated real-World Activity

Note

For CT Real Time Activity: Verify refer to BrightSpeed Conformance Statement (see Overview on page 1-1).

Service personnel invoke the DICOM Station Configuration Utility from the Discovery NM/CT 670 user interface. The NM DICOM Server AE will initiate an association with the remote DICOM AE in order to verify communication at the application level. The success or failure of the verification process is displayed to the user.

2.3.1.2.3.2 Proposed Presentation Context Table

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

2.3.1.2.3.2.1 SOP Specific DICOM Conformance Statement for Verification SOP Class

The NM DICOM Server AE provides standard conformance to the DICOM Verification Service Class.

All the operations used by this SOP class support an Association Timer. This timer is started when the association request is sent, and is stopped when the respective response is received. The default time-out value is 15 seconds and is not configurable.

2.3.1.2.4 Real-World Activity: Modality Worklist

Note

For NM standalone exams and NM/CT hybrid exams the Worklist query is performed via the NM camera Operator Console screen.
 Worklist for CT standalone scanning is performed via CT scanner Operator Console.
 For Real World activity: Worklist Query for CT standalone, please refer to BRIGHTSPEED Conformance Statement (see Reference A- See "Overview" on page 1-1).

2.3.1.2.4.1 Associated Real-World Activity

The user requests Discovery NM/CT 670 to query the remote AE for a worklist, by pushing the Refresh button in the To Do list.

2.3.1.2.4.2 Proposed Presentation Context Table

The following table shows the proposed presentation contexts for the NM DICOM Server AE after real-world activity “Modality Work List” has been initiated:

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist C - FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

2.3.1.2.4.2.1 SOP Specific DICOM Conformance Statement for all Query SOP Classes

Discovery NM/CT 670 provides standard conformance to the DICOM V3.0 Modality Worklist Service Class as an SCU for the following SOP Classes:

- Modality Worklist C-FIND, UID = 1.2.840.10008.5.1.4.31

If Modality Worklist query failed, the user receives a notification message.

All the operations used by this SOP class support an Association Timer. This timer is started when the association request is sent, and is stopped when the respective response is received. The default time-out value is 60 seconds, and is not configurable.

All the operations used by this SOP class support a Session Timer. This timer is started when the association is established, and stopped when association is ended. The time-out value is 180 seconds and it is not configurable.

If any of the two timers mentioned above expires, the connection is closed and the operation in progress is considered failed.

If the remote AE does not support the proposed Presentation Context, an appropriate error is logged and the operator is notified.

Each C-FIND response received from the remote AE is parsed to verify the length/type of the items in the response.

Operator cannot cancel the Worklist query i.e. C-FIND Cancel is not supported.

If NM DICOM Server AE receives a success response with no matching response, a pop-up will show saying that the Worklist query has failed.

When the C-FIND response received from the Worklist SCP does not include one of the tags defined as type 1 (e.g. Patient name, Patient ID, Study Instance UID) the NM DICOM Server AE will show a pop-up message listing which tags are missing, the Worklist item will be rejected.

Upon detecting any other error in the response data, the response is discarded and the next response (if any) is considered.

2.3.1.2.5 Transfer Syntax Selection Policies

The transfer syntax selection policy is as follows:

- Only the following transfer syntaxes are proposed: Implicit VR Little Endian (1.2.840.10008.1.2), Explicit VR Little Endian (1.2.840.10008.1.2.1)
- Among all proposed transfer syntaxes, the Explicit Little Endian transfer syntax is chosen first if all proposed Transfer Syntaxes are accepted by Remote AE.

2.3.1.3 Association Acceptance Policy

The NM DICOM Server AE places no limitation on whom may connect to it. The maximum number of associations accepted in parallel is limited to 5.

Any remote AE can open an association to the NM DICOM Server AE for the purpose of application level communication verification.

2.3.1.3.1 Real-World Activity: Verify SCP

2.3.1.3.1.1 Associated Real-World Activity

The NM DICOM Server AE is always listening for associations. No operator action is required to respond to a Verification request.

The real-world activity associated with the Verification request is to send a C-ECHO-RSP message with a status of “success” to the requesting AE.

2.3.1.3.1.2 Accepted Presentation Context Table

Presentation Context Table - Accepted					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

2.3.1.3.1.2.1 SOP Specific DICOM Conformance Statement for Verification SOP Class

The NM DICOM Server AE provides standard conformance to the DICOM verification service class.

2.3.1.3.2 Real-World Activity: Receive N-EVENT-REPORT from Storage Commitment SCP

2.3.1.3.2.1 Associated Real-World Activity

As part of the storage commitment implementation, Remote AE (SCP) initiates an association to this implementation and sends an N-EVENT-REPORT. The attribute of the N-EVENT-REPORT message includes an indication on all images for which a commitment has succeeded and those for which it has failed.

The receipt of an N-EVENT-REPORT on an association that NM DICOM Server AE has initiated is not supported. The Remote AE (SCP) must initiate a new association in order to send the new N-EVENT-REPORT.

2.3.1.3.2.2 Accepted Presentation Context Table

The following table shows the presentation contexts accepted by the NM DICOM Server AE for real-world activity "Storage Commitment Response":

Presentation Context Table - Accepted					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.3.1.3.2.2.1 Handling N_EVENT_REPORT Details

Once the N_EVENT_REPORT response is received, the following actions will be taken depending on the status of response. The following table lists the attributes supported for the N_EVENT_REPORT from the SCP. "*" indicates that a value is returned.

Table 2-4. Storage Commitment Module For N-EVENT-REPORT

Attribute Name	Tag	SCU User	Success Case	Failure Case
Transaction UID	(0008,1195)	Value received from SCP	*	*
Retrieve AE Title	(0008,0054)	Not used		
Storage Media File-Set ID	(0088,0130)	Not used		
Storage Media File-Set UID	(0088,0140)	Not used		
Referenced SOP Sequence	(0008,1199)	Value received from SCP	*	

Table 2-4. Storage Commitment Module For N-EVENT-REPORT (Continued)

Attribute Name	Tag	SCU User	Success Case	Failure Case
>Referenced SOP Class UID	(0008,1150)	Value received from SCP	*	
>Referenced SOP Instance UID	(0008,1155)	Value received from SCP	*	
>Retrieve AE Title	(0008,0054)	Not used		
>Storage Media File-Set ID	(0088,0130)	Not used		
>Storage Media File-Set UID	(0088,0140)	Not used		
Failed SOP Sequence	(0008,1198)	Value received from SCP		*
>Referenced SOP Class UID	(0008,1150)	Value received from SCP		*
>Referenced SOP Instance UID	(0008,1155)	Value received from SCP		*
>Failure Reason	(0008,1197)	Value received from SCP		*

If in the N-EVENRT_REPORT only part of the SOP instance UIDs requested are committed, the whole storage commit request will be considered as unarchived. The failed SOP instance UIDs will be logged in /home/ctuser/Nuevo/logFiles/ nwscp.log

If a Storage Commitment N-EVENT-REPORT is received on the Association initiated by this Application Entity, it will be processed as described for Association initiated by the Storage Commitment SCP

Commit response to SUCCESS status - The Archived icon in the Data management browser for all the successful instances will be updated.

Commit response with FAILURE status - Storage commit failed status will be reflected by the fact that images/series/studies will be marked as Transferred or and not Archived in the Data Management panel. However the user can manually retry to send the images again. This will go through the whole sequence of operations once again. There is no UI to request storage commit again.

Refer to [Table 5-2 on page 5-2](#) for supported Failure Status values from N-Event-Report Request

2.3.1.3.3 Presentation Context Acceptance Criterion

The SCP does not have a default acceptance policy if more than one acceptable transfer syntaxes are proposed by the SCU. It is the responsibility of the SCU to make a selection from more than one transfer syntaxes accepted.

2.3.1.3.4 Transfer Syntax Selection Policies

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

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

2.4 COMMUNICATION PROFILES

2.4.1 Support Communication Stacks (PS 3.8, PS 3.9)

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

2.4.2 OSI Stack

The OSI Communication Stack is not supported by this implementation.

2.4.3 TCP/IP Stack

The TCP/IP Communication Stack is inherited from the Windows operating system.

2.4.3.1 API

Not applicable to this product.

2.4.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

2.4.4 Point-to-Point Stack

The Point-to-Point Communication Stack is not supported by this implementation.

2.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

2.5.1 Standard Extended/Specialized/Private SOPs

2.5.1.1 Standard Extended SOP Classes

Discovery NM/CT 670 NM Images are Standard Extended NM Image Storage SOP Class (see [Section 7: : SC Information Object Implementation on page 7-1](#) for a complete description).

Discovery NM/CT 670 Secondary Capture Images are Standard Extended Secondary Capture Image Storage SOP Class (see [Section 7.2: SC IOD Implementation on page 7-1](#) for a complete description).

2.5.1.2 Private SOP Class

No Private SOP Classes are generated by the NM camera.

2.5.1.3 Private Transfer Syntaxes

Discovery NM/CT 670 does not implement any private transfer syntaxes.

2.6 CONFIGURATION

The Discovery NM/CT 670 system is configured by GE Healthcare Field Service Engineers. The DICOM configuration items below are configurable or re-configurable by a Field Service Engineer but are not accessible through the Discovery NM/CT 670 user interface.

2.6.1 AE Title/Presentation Address Mapping

Discovery NM/CT 670 allows for the configuration of the mapping of remote AE titles to IP addresses and ports. The IP address of a remote AE may be in a different subnet (using routing). A router is configurable to ensure communication from one sub-net to another. This configuration is performed by GE Healthcare Field Service Engineers.

2.6.2 Configuration Parameters

The following parameters are configurable for the NM DICOM Server AE:

- Local AE Title – default value is as the NM machine name
- Local IP address
- Local DICOM Port Number – default value is 104

Note that PDU length and any time-outs are not configurable for Discovery NM/CT 670. The configuration of IP routers and subnet mask is available on a OS level.

The following parameters are configurable for the Remote DICOM AE:

- Remote AE Title
- Remote IP address
- Remote DICOM Port Number – default value is 104
- Remote AE functionality flags:
 - m Send destination
 - m Auto-send destination
 - m Auto-Processing destination (shall be used for Xeleris Workstations only)
 - m Modality Worklist Provider
 - m Storage commit server

2.7 SUPPORT OF EXTENDED CHARACTER SETS

Discovery NM/CT 670 will support only the ISO_IR 100 (ISO 8859-1:1987 Latin alphabet N 1. supplementary set) as extended character sets.

2.8 CODES AND CONTROLLED TERMINOLOGY

2.8.1 Fixed Coded Terminology

The product uses the fixed (non-configurable, non-extensible) coded terminology in Image SOP Instance attributes:

- (0040,0555) - Acquisition Context Module (See [Section 3.5.6.5](#))
- (0054, 0300) - Radionuclide Code Sequence (See [Section 3.5.8.4](#) NM Isotope Module)

The Discovery NM/CT 670 DICOM implementation is capable of supporting arbitrary coding schemes for Procedure and Protocol Codes. The contents of Requested Procedure Code Sequence (0032,1064) and Scheduled Protocol Code Sequence (0040,0008) supplied in Worklist Items will be mapped to Image IOD attributes as described in DICOM Standard. During installation, a service technician will establish a mapping between the site-specific codes and the Protocol Names used internally to identify acquisition protocols. A remote AE station configured to act as Worklist provider is configured to map according to one of three tags:

- (0032,1060) - Requested Procedure Code Sequence
- (0040,0008) - Scheduled Protocol Code Sequence
- (0040,0007) - Scheduled Procedure Step Description

2.8.2 Mapped Coded Terminology

The product uses no mapped coded terminology

2.8.3 Configurable Coded Terminology

The product uses no configurable 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))

By default, the system is configured to work with firewall.

SECTION 3: NUCLEAR MEDICINE (NM) INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

This section specifies the use of the DICOM NM Image IOD to represent the information included in NM images produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

- [Section 3.2: NM IOD Implementation on page 3-1](#)
- [Section 3.3: NM Entity-Relationship Mode on page 3-1](#)
- [Section 3.4: IOD Module Table on page 3-5](#)
- [Section 3.5: Information Module Definitions on page 3-6](#)

3.2 NM IOD IMPLEMENTATION

The Discovery NM/CT 670 implementation of DICOM uses the Nuclear Medicine multi-frame image format when creating image objects. In order to preserve full fidelity when transferring data to a Xeleris/eNTEGRA station, some specialized database information is encoded as private DICOM attributes. All of the standard and private attributes used are defined in the module tables. The Discovery NM/CT 670 private data dictionary is included in [Appendix A](#).

3.3 NM ENTITY-RELATIONSHIP MODE

The Entity-Relationship diagram for the NM Image inter-operability schema is shown in [Illustration 3-1](#). The Entity-Relationship diagram for the hybrid NM/CT images interoperability schema is show in [Illustration 3-2](#). In [Illustration 3-1](#) and [Illustration 3-2](#) the following diagrammatic convention is established to represent the information organization:

- Each entity is represented by a rectangular box.
- Each relationship is represented by a diamond shaped box.
- The fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. For example, the relationship between Series and Image can have up to n NM Images per Series, but the NM Image can only belong to 1 Series.

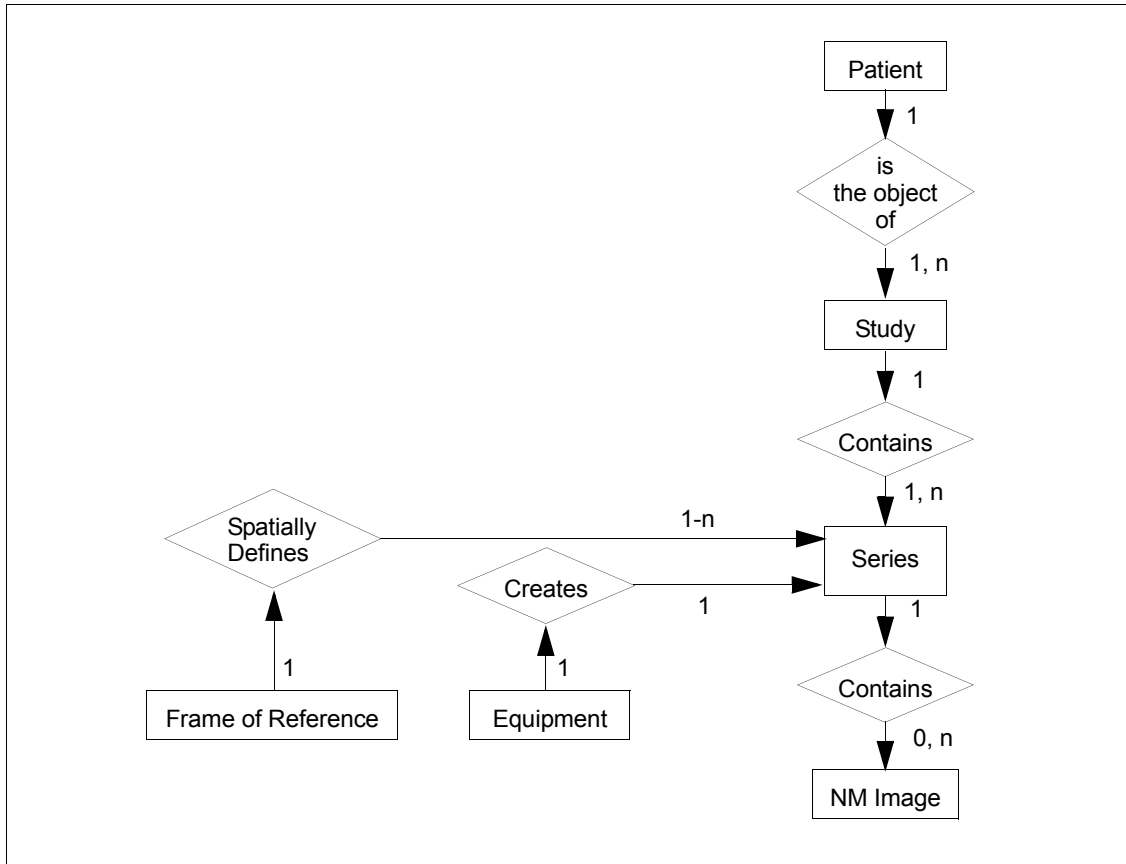
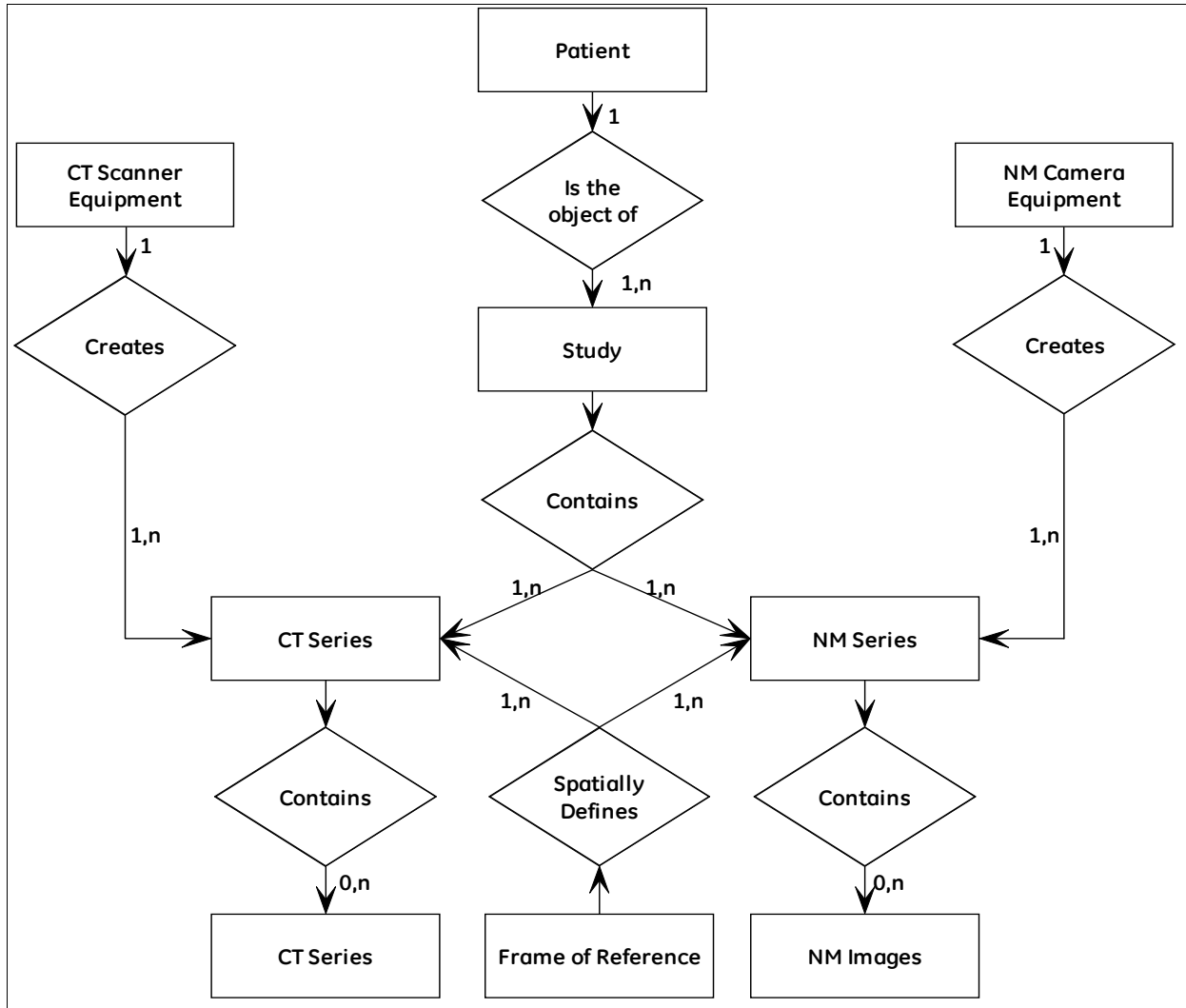


Illustration 3-1. NM Image Entity Relationship Diagram



For a detailed explanation of the Frame of Reference and linkage with CT and NM series refer to [Section 3.5.4.1: Frame of Reference Modules on page 3-12](#).

Illustration 3-2. Hybrid NM/CT Images Entity Relationship Diagram

3.3.1 Entity Descriptions

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the NM Information Object

3.3.1.1 Patient Entity Description

The Patient Entity defines the characteristics of a patient who is the subject of one or more medical studies which produce medical images.

3.3.1.2 Study Entity Description

The Study Entity defines the characteristics of a medical study performed on a patient. A study is a collection of one or more series of medical images which are logically related for the purpose of diagnosing a patient. Each study is associated with exactly one patient.

3.3.1.3 Series Entity Description

The Series Entity defines the attributes which are used to group images into distinct logical sets. Each series is associated with exactly one study.

3.3.1.4 Equipment Entity Description

The Equipment Entity describes the particular imaging device which produced the series of images. An imaging device may produce one or more series within a study. The Equipment Entity does not describe the data acquisition or image creation Attributes used to generate images within a series.

3.3.1.5 Frame of Reference Entity Description

The Frame of Reference Entity identifies the coordinate system which conveys spatial and/or temporal information of images in a series.

3.3.1.6 NM Image Entity Description

The NM Image Entity defines the attributes which describe the pixel data of a NM image. The pixel data is generated as a direct result of patient scanning (an ORIGINAL image). An image is defined by its image plane, pixel data characteristics, gray scale and/or color mapping characteristics and modality specific characteristics (acquisition parameters and image creation information).

3.3.2 Discovery NM/CT 670 Mapping of DICOM Entities

Table 3-5. Mapping of DICOM Entities to Discovery NM/CT 670 Entities

DICOM	Discovery NM/CT 670 Entity
Patient	Patient
Study	Study
Series	Series
Image	Dataset

3.4 IOD MODULE TABLE

Within an entity of the DICOM v3.0 NM IOD, attributes are grouped into related sets of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related to each other. A module grouping does not infer any encoding of information into datasets.

[Table 3-6](#) identifies the defined modules within the entities which comprise the DICOM v3.0 NM IOD. Modules are identified by Module Name.

Please refer to the DICOM v3.0 Standard Part 3 for a complete definition of the entities, modules, and attributes. Modules which are not listed here are not used.

Table 3-6. NM Image IOD Modules

Entity Name	Module	Reference
Patient	Patient	Section 3.5.1.1
Study	General Study	Section 3.5.2.1
	Patient Study	Section 3.5.2.2
Series	General Series	Section 3.5.3.1
	Discovery NM/CT 670 Private Series	Section 3.5.3.2
	NM/PET Patient orientation	Section 3.5.3.3
Frame of Reference	Frame of Reference	Section 3.5.4.1
Equipment	General Equipment	Section 3.5.5.1
Image	General Image	Section 3.5.6.1
	Discovery NM/CT 670 Private Image	Section 3.5.6.2
	Image Pixel	Section 3.5.8.1
	NM Image Pixel	Section 3.5.8.1
	Multi-frame	Section 3.5.6.4
	NM Multi-frame	Section 3.5.8.2
	NM Image	Section 3.5.8.3
	NM Isotope	Section 3.5.8.4
	NM Detector	Section 3.5.8.5

Table 3-6. NM Image IOD Modules (Continued)

Entity Name	Module	Reference
	NM TOMO Acquisition	Section 3.5.8.6
	Discovery NM/CT 670 Private TOMO Acquisition	Section 3.5.8.7
	NM Multi-gated Acquisition	Section 3.5.8.8
	NM Phase	Section 3.5.8.11
	Discovery NM/CT 670 Private Multi-Gated	Section 3.5.8.9
	Discovery NM/CT 670 Private GSPECT Acquisition	Section 3.5.8.10
	SOP Common	Section 3.5.7.1

3.5 INFORMATION MODULE DEFINITIONS

Please refer to the DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the Standard entities and modules contained within the NM Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. 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. It should be noted that they are the same as those defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

Discovery NM/CT 670 Private attributes are defined in private modules, each of which follow the related Standard module. Private data element tags are assigned following the rules given in Part 5 of the DICOM v3.0 Standard, and are identified using the (gggg,xxnn) format, where xx represents a reserved block of element numbers within the group gggg.

Note

Note that any element not listed in table(s) means that it is not supported (not stored in the created images).

3.5.1 Common 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. The fields in the Patient Module which can be copied from user input or the worklist will be updated to reflect the possible sources.

Table 3-7. Patient Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Patient Name*
Patient ID	(0010,0020)	2	Patient ID*
Patient's Birth Date	(0010,0030)	2	Patient Date Of Birth*
Patient's Sex	(0010,0040)	2	Patient Sex*

*Copied from the work list if the study source was actually copied from a worklist query result (if available).

3.5.2 Common Study Entity Modules

The following Study IE Modules are common to all Composite Image IODs which reference the Study IE. These Modules contain Attributes of the patient and study that are needed for diagnostic interpretation of the image.

3.5.2.1 General Study Modules

This section specifies the Attributes which describe and identify the study performed upon the patient..

Table 3-8. General Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Unique identifier to be used to identify the Study. * Generated by the system for Locally Scheduled protocols.
Study Date	(0008,0020)	2	Creation date of study entity. Study date is taken from the SPS Start date of the first SPS in the study – Tag (0040, 0002).
Study Time	(0008,0030)	2	Creation time of study entity. Study time is taken from the SPS Start time of the first SPS in the study – Tag (0040, 0003).
Referring Physician's Name	(0008,0090)	2	Name of the patient's referring physician.
Study ID	(0020,0010)	2	Study Name (Processing Tag field).*
Accession Number	(0008,0050)	2	A RIS generated number that identifies the order for the Study.* Can be modified in user interface.

Table 3-8. General Study Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Study Description	(0008,1030)	3	Institution-generated description or classification of the Study (component) performed.
Name of Physician(s) Reading Study	(0008,1060)	3	Names of the physician(s) reading the Study. Set in To Do list

*Copied from the work list if the study source was actually copied from a worklist query result.

3.5.2.2 Patient Study Modules

This section defines Attributes that provide information about the Patient at the time the Study was performed..

Table 3-9. Patient Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Patient Age field.*
Patient's Size	(0010,1020)	3	Patient Height field.*
Patient's Weight	(0010,1030)	3	Patient Weight field.*
Admitting Diagnoses Description	(0008,1080)	3	Description of the admitting diagnosis (diagnoses)

*Copied from the work list if the study source was actually copied from a worklist query result (if available).

3.5.3 Common Series Entity Modules

The following Series IE Modules are common to all Composite Image IODs which reference the Series IE.

3.5.3.1 General Series Modules

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

Table 3-10. General Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Internally set to "NM".
Series Instance UID	(0020,000E)	1	Internally generated.
Series Number	(0020,0011)	2	Internally generated.
Laterality	(0020,0060)	2C	Body Part Laterality, if present.
Series Date	(0008,0021)	3	Date of Series Creation.
Series Time	(0008,0031)	3	Time of Series Creation.
Performing Physicians' Name	(0008,1050)	3	Name of the physician(s) administering the Series. Used for MWL query only, not stored in the image.
Protocol Name	(0018,1030)	3	User-defined description of the protocol identification performed for the Series creation.
Series Description	(0008,103E)	3	User provided description of the Series.
Operators' Name	(0008,1070)	3	Operator's Name
Body Part Examined	(0018,0015)	3	Body Part field.
Patient Position	(0018,5100)	2C	Patient Position The Defined Terms are: HFP = Head First-Prone HFS = Head First-Supine HFDR = Head First-Decubitus Right HFDL = Head First-Decubitus Left FFDR = Feet First-Decubitus Right FFDL = Feet First-Decubitus Left FFP = Feet First-Prone FFS = Feet First-Supine

Table 3-10. General Series Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Request Attributes Sequence	(0040,0275)	3	The sequence has exactly 1 item. Relevant only for items deriving from MWL.
>Accession Number	(0008,0050)	3	An identifier of the Imaging Service Request for this Requested Procedure.* May be set in User Interface.
>Study Instance UID	(0020,000D)	3	The unique identifier for the Study provided for this Requested Procedure.*
>Requested Procedure Description	(0032,1060)	3	Institution-generated administrative description or classification of Requested Procedure.*
>Scheduled Procedure Step ID	(0040,0009)	1C	Identifier that identifies the Scheduled Procedure Step.*
>Scheduled Procedure Step Description	(0040,0007)	3	Institution-generated description or classification of the Scheduled Procedure Step to be performed.*
>Scheduled Protocol Code Sequence	(0040,0008)	3	Sequence describing the Scheduled Protocol following a specific coding scheme.* Number of items as read from Worklist
> Requested Procedure ID	(0040,1001)	1C	Identifier that identifies the Requested Procedure in the Imaging Service Request.*
>Referenced Study Sequence	(0008,1110)	3	Uniquely identifies the Study SOP Instances associated with this SOP Instance. One item may be included.*
>Requested Procedure Code Sequence	(0032,1064)	3	Not stored in the image.

*Copied from the work list if the study source was actually copied from a worklist query result (if available).

3.5.3.2 Discovery NM/CT 670 Private Series Module

This Module contains private Attributes that convey information not contained in the related DICOM Standard v3.0 General Series Module.

Table 3-11. Discovery NM/CT 670 Private Series Module Attributes

Attribute Name	Tag	VR	Private Creator ID	Attribute Description
Matched protocol	(0009, xx43)	LO	"QUASAR_INTERNAL_USE"	For Worklist items. The originally matched protocol vs. protocol name which is the protocol actually acquired
Series Data Sequence	(0033,xx70)	SQ	"GEMS_XELPRV_01"	Sequence of item contains information about acquisition parameters. May contain from 1 to n Items. Each Items describes specific parameters set.

Table 3-11. Discovery NM/CT 670 Private Series Module Attributes (Continued)

Attribute Name	Tag	VR	Private Creator ID	Attribute Description
>Object Type	(0033,xx08)	CS	"GEMS_XELPRV_01"	
>Modified Flag	(0033,xx10)	SL	"GEMS_XELPRV_01"	
>Name	(0033,xx11)	LO	"GEMS_XELPRV_01"	
>Series Data UID	(0033,xx16)	LO	"GEMS_XELPRV_01"	
>Date	(0033,xx17)	SH	"GEMS_XELPRV_01"	
>Time	(0033,xx18)	SH	"GEMS_XELPRV_01"	
>Series Data Flags	(0033,xx19)	UL	"GEMS_XELPRV_01"	
>ProtocolName	(0033,xx1A)	LO	"GEMS_XELPRV_01"	
>Relevant data UID	(0033,xx1B)	LO	"GEMS_XELPRV_01"	
>Int Data	(0033,xx1D)	UL	"GEMS_XELPRV_01"	
>Double Data	(0033,xx1E)	FD	"GEMS_XELPRV_01"	
>StringData	(0033,xx1F)	OB	"GEMS_XELPRV_01"	
>IntDataFormat	(0033,xx21)	OB	"GEMS_XELPRV_01"	
>DoubleDataFormat	(0033,xx22)	OB	"GEMS_XELPRV_01"	
>StringDataFormat	(0033,xx23)	OB	"GEMS_XELPRV_01"	
>SDO Description	(0033,xx24)	LT	"GEMS_XELPRV_01"	
>Seriesdata Private SOPClassUID	(0033,xx71)	UI	"GEMS_XELPRV_01"	
>Seriesdata InstanceUID	(0033,xx72)	UI	"GEMS_XELPRV_01"	

3.5.3.3 NM/PET Patient Orientation Module

This section specifies the Attributes which identify and describe NM/PET Patient Orientation of the Series within a Study.

Table 3-12. NM/PET Patient Orientation Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient Orientation Code Sequence	(0054,0410)	2	Zero length
> 'Code Sequence Macro' Baseline			
> Patient Orientation Modifier Code Sequence	(0054,0412)	2C	Zero length
> 'Code Sequence Macro'			
Patient Gantry Relationship Code Sequence	(0054,0414)	2	Zero length
> 'Code Sequence Macro'			

3.5.4 Common Frame of Reference Entity Modules

The following Frame of Reference IE Module is common to all Composite Image IODs which reference the Frame of Reference IE.

3.5.4.1 Frame of Reference Modules

This section specifies the Attributes necessary to insure the spatial relationship of Images within a Series or across multiple Series. According to DICOM standard, images that are spatially related (hence share the same coordinate system) share the same Frame Of Reference UID value.

A hybrid CT/NM scan is composed of a single NM scan partnered with one or more CT scans. The two modalities share the same imaging space and the body imaged by the two modalities is represented, in most of the cases, by spatially aligned images. There are situations for which optimal NM imaging and optimal CT imaging impose changing the table height during the hybrid scan. In this case, the imaging space of both modalities remains the same, but the NM and CT images of the body are no longer spatially aligned. In order to prevent accidental fusion of such images, the same Frame Of Reference UID value shared by two series of different modalities will show that the images are spatially related and that the imaged body was scanned spatially aligned between the two images.

With this approach the handling of Frame Of Reference UID is done as follows:

1. In all combinations, images acquired with the same landmark and same table height will have the same Frame of Reference UID value. The generated images are "inherently" aligned.
2. Discovery NM/CT 670 uses a private tag named "Acq Parent UID". In CT images, it is (0031,xx01) Private Creator "GEHC_HYBRID_01". In NM images, it is (0011, xx31) Private Creator "GEMS_GENIE_1". All the images (NM projections and CT slices obtained by on-the-fly reconstruction or retrospective reconstruction) resulting from scans defined as part of a single hybrid procedure and using the same landmark shall have the same Acq Parent UID value. Hence, when the operator sets a new CT landmark, overriding the landmark set on NM persistence or during a previous CT scan belonging to the same hybrid procedure, a new value is assigned to the Acq Parent UID attribute. The Acq Parent UID

attribute allows Xeleris workstation, or other Image Displayer implementations, to check that CT and NM series were acquired as part of the same hybrid procedure and are using the same landmark.

3. When NM is acquired first, and the CT series is acquired at a different table height than used by NM, but with same landmark, then the CT series will get a different Frame Of Reference UID value than that used by NM, but the same Acq Parent UID value as NM. This shows that the imaged body is no longer aligned between the two modalities, although they have been acquired by a single hybrid scan (using the same imaging space). In this case, image registration must be applied in order to register the two modalities. The information stored by each modality in Table Height (0018,1130) can be used in this registration process.
4. When CT is acquired first, and the NM series is acquired at a different table height than used by CT, but with same landmark, the NM series will get the same Frame Of Reference UID value than that used by CT, the same Acq Parent UID value as CT and the image position of the NM will be modified to compensate for the table height differences existing between the two modalities. Therefore, in this case, the imaged body is aligned between the two modalities and the same Frame Of Reference UID value shows it.
5. CT images acquired with a different landmark than the NM scan or than previous CT series of the same hybrid scan, will get a Frame of Reference UID value different of the NM scan or of the previous CT series, showing that the images are not spatially related. The Acq Parent UID value of these images will be also changed, as indicated above at 2. In this way, Xeleris (and potentially other image displayers) will be informed that these images are not spatially aligned and image registration must be applied in order to achieve it.

Note that for CT standalone exams, the same Frame of Reference UID (0020,0052) value does not imply imaged body alignment, but just image space alignment. This attribute must be used in conjunction with the Table Height (0018,1130) to determine if two imaged bodies are spatially aligned. See Discovery* and BrightSpeed* DICOM Conformance Statement. (See Reference A- See "Overview" on page 1-1).

The Frame of Reference Module Attributes appear for TOMO and GATED TOMO scan types. They are not available for STATIC, WHOLE BODY, GATED and DYNAMIC scans.

Table 3-13. Frame of Reference Module Attributes

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Uniquely identifies the frame of reference for a Series. See explanation above
Position Reference Indicator	(0020,1040)	2	Position Reference Indicator, if available.

3.5.5 Common Equipment Entity Modules

The following Equipment IE Module is common to all Composite Image IODs which reference the Equipment IE.

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. For Series created on the Discovery NM/CT 670 system, the values are generally copied from the original data

Table 3-14. General Equipment Module Attributes

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	GE MEDICAL SYSTEMS
Institution Name	(0008,0080)	3	Taken from Discovery NM/CT 670's configuration
Institution Address	(0008,0081)	3	Taken from Discovery NM/CT 670's configuration.
Institutional Department Name	(0008,1040)	3	Taken from Discovery NM/CT 670's configuration
Manufacturer's Model Name	(0008,1090)	3	Tandem_Discovery_670
Device Serial Number	(0018,1000)	3	Taken from Discovery NM/CT 670's configuration
Software Versions	(0018,1020)	3	Software Versions . e.g., "1.003.009.0\HARDWARE_VERSION_1"

3.5.6 Common Image Entity Modules

The following Image IE Modules are common to all Composite Image IODs which reference the Image IE.

3.5.6.1 General Image Module

This section specifies the Attributes which identify and describe an image within a particular series.

Table 3-15. General Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient Orientation	(0020,0020)	2C	Zero length
Content Date	(0008,0023)	2C	Image Date
Content Time	(0008,0033)	2C	Image Time
Image Type	(0008,0008)	3	Section 3.5.8.3: NM Image Module on page 3-21
Acquisition Date	(0008,0022)	3	The starting date for acquiring the data that resulted in this image

Table 3-15. General Image Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Acquisition Time	(0008,0032)	3	The starting time for acquiring the data that resulted in this image
Image Comments	(0020,4000)	3	User-defined comments about the image

3.5.6.2 Discovery NM/CT 670 Private Image Module

This section specifies the Attributes which identify and describe an image within a particular series. This Module contains *private* Attributes that convey information not contained in the related DICOM Standard v3.0 Module.

Table 3-16. Discovery NM/CT 670 Private Image Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Camera Shape	(0009, xx08)	3	"QUASAR_INTERNAL_USE"	Camera Shape: H mode, L mode
Origin	(0009, xx12)	3	"QUASAR_INTERNAL_USE"	The origin of the image."isWorklist" if scheduled in MWL. "regular" if locally scheduled.
Sequence Type	(0009, xx13)	3	"QUASAR_INTERNAL_USE"	Acquired Sequence Type
Sequence Name	(0009, xx14)	3	"QUASAR_INTERNAL_USE"	Acquired Sequence Name
Image Type	(0009, xx1B)	3	"QUASAR_INTERNAL_USE"	Image type string as passed in the scan request
Stop Reason	(0009, xx1D)	3	"QUASAR_INTERNAL_USE"	Defines condition that image was installed to db
Auto Application	(0009, xx1E)	3	"QUASAR_INTERLA_USE"	Auto application to be invoked on Xeleris
Patient Unique Key	(0009, xx39)	3	"QUASAR_INTERNAL_USE"	Patient unique key
Protocol Scheduled Date	(0009, xx40)	3	"QUASAR_INTERNAL_USE"	Protocol Scheduled Date
Protocol Scheduled Time	(0009, xx41)	3	"QUASAR_INTERNAL_USE"	Protocol Scheduled Time
Acquisition flag	(0009, xx42)	3	"QUASAR_INTERNAL_USE"	Used for indicating if the study is acquired
Private SPS ID	(0009, xx44)	3	"QUASAR_INTERNAL_USE"	Keeps the SPS ID for protocols that were appended to the original MWL protocol.

Table 3-16. Discovery NM/CT 670 Private Image Module Attributes (Continued)

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Pre-Medication	(0009,xx45)	3	"QUASAR_INTERNAL_USE"	Keeps the Pre-Medication as appears in the ToDo list
Collimator SQ	(0037,xx10)	3	"QUASAR_INTERNAL_USE"	Contains information of collimators parameters. Contains 1 item.
> Hole Diameter	(0037,xx1B)	3	"QUASAR_INTERNAL_USE"	collimator hole diameter
>Hole Length	(0037,xx30)	3	"QUASAR_INTERNAL_USE"	collimator hole length
>Collimator Thickness	(0037,xx40)	3	"QUASAR_INTERNAL_USE"	collimator thickness
>Septal Thickness	(0037,xx50)	3	"QUASAR_INTERNAL_USE"	collimator septal thickness
>Intrinsic Resolution	(0037,xx60)	3	"QUASAR_INTERNAL_USE"	collimator intrinsic resolution
> Blurring Slope	(0037,xx70)	3	"QUASAR_INTERNAL_USE"	collimator blurring slope
Radio Nuclide Name	(0011, xx0D)	3	"GEMS_GENIE_1"	Name of radionuclide used.
Dataset Name	(0011, xx12)	3	"GEMS_GENIE_1"	
Acquisition Parent UID	(0011, xx31)	3	"GEMS_GENIE_1"	Used for correct registration. For NM/CT registration refer to Frame Of Reference, Section 3.5.4.1. In NM/CT hybrid scans, the Acq Parent UID is saved also in CT images.
Software Translator	(0013, xx11)	3	"GEMS_GENIE_1"	Internal code of product DICOM implementation. Enumerated Value = 11.
Bed Position	(0027,xx11)	1	"APEX_PRIVATE"	Linear position of table.

3.5.6.3 Image Pixel Module

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

Table 3-17. Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	See Table 3-21, "NM Image Pixel Module Attributes," on page 3-19.
Photometric Interpretation	(0028,0004)	1	See Table 3-21, "NM Image Pixel Module Attributes," on page 3-19.
Rows	(0028,0010)	1	Rows
Columns	(0028,0011)	1	Columns
Bits Allocated	(0028,0100)	1	See Table 3-21, "NM Image Pixel Module Attributes," on page 3-19.
Bits Stored	(0028,0101)	1	See Table 3-21, "NM Image Pixel Module Attributes," on page 3-19.
High Bit	(0028,0102)	1	See Table 3-21, "NM Image Pixel Module Attributes," on page 3-19.
Pixel Representation	(0028,0103)	1	Always 0 (unsigned integer)
Pixel Data	(7FE0,0010)	1	A data stream of the pixel samples that comprise the Image
Smallest Image Pixel Value	(0028,0106)	3	Set to minimum pixel value in image.
Largest Image Pixel Value	(0028,0107)	3	Set to maximum pixel value in image.

3.5.6.4 Multi-Frame Module

This section specifies the Attributes of a Multi-frame pixel data Image.

Table 3-18. Multi-Frame Module Attributes

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Set to total number of frames in image.
Frame Increment Pointer	(0028,0009)	1	See Section 3.5.8.2.1 for further explanation.

3.5.6.5 Acquisition Context Module

This section specifies Attributes for the description of the conditions present during data acquisition.

Table 3-19. Acquisition Context Module Attributes

Attribute Name	Tag	Type	Attribute Description
Acquisition context sequence	(0040,0555)	2	Acquisition context information has single item
Concept-Name Code Sequence	(0040,A043)	1C	*
Concept Code Sequence	(0040,A168)	1C	*

* The Acquisition Context Module is required for cardiac stress/rest images. The module is not present if scan type is other than Tomo or gated Tomo or when acquisition context is left "Unknown". Otherwise, the Concept Name Code Sequence (0040,A043) contains (DCM, 109055, "Patient State"); the Concept Code Sequence (0040,A168) uses values from the following list:

Coding Scheme

Designator	Code Value	Code Meaning
SRT	F-01604	Resting State
DCM	109091	Cardiac Stress State
DCM	109092	Reinjection State
DCM	109093	Redistribution State
DCM	109094	Delayed Redistribution State

3.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

3.5.7.1 SOP Common Module

This section defines the Attributes which are required for proper functioning and identification of the associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD.

Table 3-20. SOP Common Module Attributes

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Set to "1.2.840.10008.5.1.4.1.1.20", Nuclear Medicine Image Storage SOP Class UID.
SOP Instance UID	(0008,0018)	1	Internally generated.
Specific Character Set	(0008,0005)	1C	Not used when the default character set (ISO 646) is used. Set to "ISO_IR 100" when extended character sets are used.

Table 3-20. SOP Common Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Instance Creation Date	(0008,0012)	3	Date of instance creation.
Instance Creation Time	(0008,0013)	3	Time of instance creation.
Instance Creator UID	(0008,0014)	3	Set to the Implementation UID (see Section 2.3.1.1.4)
Instance Number	(0020,0013)	3	Instance Number. Set with NULL value.

3.5.8 Nuclear Medicine Modules

This Section describes NM Image Modules. These Modules contain Attributes that are specific to the NM Image IOD.

NM images always use the NM Multi-frame module and the appropriate frame vectors even if there is only one frame in the Image sent. If the user selects an entire Series for one Send operation, individual datasets in the Series will be combined into multi-frame NM Images as appropriate.

If the user selects and sends individual datasets within a Series, then each is sent as a separate DICOM Image.

3.5.8.1 NM Image Pixel Module

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

Table 3-21. NM Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Samples per Pixel (always 1 for NM)
Photometric Interpretation	(0028,0004)	1	Photometric Interpretation (always MONOCHROME2)
Bits Allocated	(0028,0100)	1	Bits Allocated (16)
Bits Stored	(0028,0101)	1	Bits Stored (same as Bits Allocated)
High Bit	(0028,0102)	1	High Bit (15)
Pixel Spacing	(0028,0030)	2	Pixel Spacing

3.5.8.2 NM Multi-Frame Module

This section specifies the Attributes of a NM Multi-frame Image. This module is always included in a NM SOP instance, even if there is only one frame in the image.

Table 3-22. NM Multi-Frame Module Attributes

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1	See for specialization by NM image type (see Section 3.5.8.2.1).
Energy Window Vector	(0054,0010)	1C	Defines energy set window to which each frame belongs.
Number of Energy Windows	(0054,0011)	1	Number of energy set windows in SOP Instance.
Detector Vector	(0054,0020)	1C	Defines detector to which each frame belongs.
Number of Detectors	(0054,0021)	1	Number of detectors in SOP Instance. Value may be 1 or 2.
Phase Vector	(0054,0030)	1C	Defines phase to which each frame belongs.
Number of Phases	(0054,0031)	1C	Number of phases in SOP Instance.
Rotation Vector	(0054,0050)	1C	Defines rotation to which each frame belongs. Number of elements as number of frames.
Number of Rotations	(0054,0051)	1C	Number of Rotations in SOP Instance. Value is always 1.
R-R Interval Vector	(0054,0060)	1C	Defines R-R Interval to which each frame belongs.
Number of R-R Intervals	(0054,0061)	1C	Number of R-R Intervals in SOP Instance.
Time Slot Vector	(0054,0070)	1C	Defines time slot, within cardiac cycle, to which each frame belongs.
Number of Time Slots	(0054,0071)	1C	Number of time slots in SOP Instance.
Angular View Vector	(0054,0090)	1C	Defines angular view number to which each frame belongs.
Time Slice Vector	(0054,0100)	1C	Defines frame numbers within each phase.

3.5.8.2.1 NM Multi-Frame Attribute Description

3.5.8.2.1.1 Frame Increment Pointer

The Frame Increment Pointer (0028,0009) defines which frame index vectors are present in the NM Image instance. The Frame Increment Pointer is supported per the DICOM specification for all image types defined in [Table 3-23](#).

Table 3-23. Enumerated Values for Frame Increment Pointer

Image Type (0008,0008), Value 3	Frame Increment Pointer (0028,0009)
STATIC or WHOLE BODY	0054H 0010H \ 0054H 0020H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020)
DYNAMIC	0054H 0010H \ 0054H 0020H \ 0054H 0030H \ 0054H 0100H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020) Phase Vector (0054,0030), Time Slice Vector (0054,0100)
GATED	0054H 0010H \ 0054H 0020H \ 0054H 0060H \ 0054H 0070H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020), R-R Interval Vector (0054,0060), Time Slot Vector (0054,0070)
TOMO	0054H 0010H \ 0054H 0020H \ 0054H 0050H \ 0054H 0090H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020), Rotation Vector (0054,0050), Angular View Vector (0054,0090)
GATED TOMO	0054H 0010H \ 0054H 0020H \ 0054H 0050H \ 0054H 0060H \ 0054H 0070H \ 0054H 0090H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020), Rotation Vector (0054,0050), R-R Interval Vector (0054,0060), Time Slot Vector (0054,0070), Angular View Vector (0054,0090).

3.5.8.3 NM Image Module

This section contains the Attributes that describe Nuclear Medicine Images.

Table 3-24. NM Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Dataset Type (See Section 3.5.8.3.1.1)
Image ID	(0054,0400)	3	Set to name of imageset.
Scan Velocity	(0018,1300)	2C	Zero Length. The WHOLEBODY is acquired in the Step-and-Shoot technique, where the table does not move during acquisition.
Scan Length	(0018,1302)	2C	Zero Length.

Table 3-24. NM Image Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Counts Accumulated	(0018,0070)	2	Detector Counts (number of counts in imageset)
Acquisition Termination Condition	(0018,0071)	3	Defined Terms used: CNTS = count limit reached DENS = count limit reached within ROI MANU = manual TIME = time limit reached TRIG = number of beats limit reached
Actual Frame Duration	(0018,1242)	1C	Duration of each frame in imageset. Sent when when the Image Type (0008,0008), Value 3, is equal to STATIC or WHOLE BODY.
Count Rate	(0018,1243)	3	Maximum count rate during image acquisition.

3.5.8.3.1 NM Image Module Attribute Description

3.5.8.3.1.1 Image Type

The following Image Type (0008,0008) values are sent:

- Value 1 has the following Enumerated Value:
 - ORIGINAL Identifies an Original Image
- Value 2 has the following Enumerated Value:
 - PRIMARY Identifies a Primary Image
- Value 3 has one of the following Enumerated Values:
 - STATIC Identifies a Static Image
 - DYNAMIC Identifies a Dynamic Image
 - GATED Identifies a Multi-gated Image
 - WHOLE BODY Identifies a Whole Body Image
 - TOMO Identifies a Tomographic Image
 - GATED TOMO Identifies a Multi-gated Tomographic Image
- Value 4 has one of the following Enumerated Values:
 - EMISSION Transmission source NOT active during image acquisition
 - TRANSMISSION Transmission source active during image acquisition

3.5.8.4 NM Isotope Module

This section contains Attributes that describe the isotope administered for the acquisition.

Table 3-25. NM Isotope Module Attributes

Attribute Name	Tag	Type	Attribute Description
Energy Window Information Sequence	(0054,0012)	2	Energy window information. May contain 1-4 items.
>Energy Window Range Sequence	(0054,0013)	3	Sequence describing window energy limits. May contain from 1 to 16 items.
>> Energy Window Lower Limit	(0054,0014)	3	Lower energy limit in KeV.
>> Energy Window Upper Limit	(0054,0015)	3	Upper energy limit in KeV.
Radiopharmaceutical Information Sequence	(0054,0016)	2	Information on radiopharmaceutical(s) used. May contain from 1 to 3 items.
> Radionuclide Code Sequence	(0054,0300)	2	Null Sequence

3.5.8.5 NM Detector Module

This section contains IOD Attributes that describe Nuclear Medicine Detectors used to produce an image.

Table 3-26. NM Detector Module Attributes

Attribute Name	Tag	Type	Attribute Description
Detector Information Sequence	(0054,0022)	2	Detector information. May contain 1 or 2 items.
> Collimator/Grid Name	(0018,1180)	3	Name of collimator used on this detector.
> Collimator Type	(0018,1181)	2	Defined Terms used: PARA = Parallel PINH = Pinhole FANB = Fan-beam CONE = Cone-beam SLNT = Slant hole ASTG = Astigmatic DIVG = Diverging NONE = No collimator UNKN = Unknown
> Field of View Shape	(0018,1147)	3	Defined Terms used: RECTANGLE ROUND HEXAGONAL

Table 3-26. NM Detector Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
> Field of View Dimension(s)	(0018,1149)	3	Dimensions of the field of view.
> Focal Distance	(0018,1182)	2	Focal distance. Value 0 may be sent.
> X Focus Center	(0018,1183)	3	Center point of the focus position.
> Y Focus Center	(0018,1184)	3	Center point of the focus position.
> Zoom Center	(0028,0032)	3	Image center offset from field of view center.
> Zoom Factor	(0028,0031)	3	Zoom factor, typical range: 1.00 to 4.00.
> Center of Rotation Offset	(0018,1145)	3	Offset between detector center and mechanical center
> Gantry/Detector Tilt	(0018,1120)	3	Detector tilt position
> Distance Source to Detector	(0018,1110)	2C	Distance between transmission source and detector during transmission scanning. Sent when Image Type (0008,0008) Value 4 is TRANSMISSION, Value 3 is not TOMO.
> Start Angle	(0054,0200)	3	Start Angle
> Radial Position	(0018,1142)	3	Detector radial position at start of acquisition.
> Image Orientation (Patient)	(0020,0037)	2	Set for first frame in dataset
> Image Position (Patient)	(0020,0032)	2	Set for first frame in dataset

3.5.8.6 NM TOMO Acquisition Module

This section contains Attributes that describe Rotation information of a tomographic image performed on the patient. This module is present when the Image Type (0008,0008) Value 3, is equal to TOMO, GATED TOMO.

Table 3-27. NM TOMO Acquisition Module Attributes

Attribute Name	Tag	Type	Attribute Description
Rotation Information Sequence	(0054,0052)	2	Provides TOMO rotation information. Contains only 1 item.
> Start Angle	(0054,0200)	1	Detector start angle at start of acquisition.
> Angular Step	(0018,1144)	1	Incremental rotational angle change per view.
> Rotation Direction	(0018,1140)	1	Direction of rotation.
> Scan Arc	(0018,1143)	1	Total rotation angle.
> Actual Frame Duration	(0018,1242)	1	Duration of a view.
> Distance Source to Detector	(0018,1110)	2C	Distance between transmission source and detector during transmission scanning. Sent when Image Type (0008,0008) Value 4 is TRANSMISSION.
> Number of Frames in Rotation	(0054,0053)	1	Number of tomographic views acquired.
> Table Traverse	(0018,1131)	3	Table longitudinal position at acquisition start.

3.5.8.7 Discovery NM/CT 670 Private TOMO Acquisition Module

This module is present only when the Image Type (0008,0008), Value 3, is equal to TOMO or GATED TOMO. The module contains private Attributes that convey information not contained in the related DICOM Standard v3.0 NM TOMO Acquisition Module.

Table 3-28. Discovery NM/CT 670 Private TOMO Acquisition Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Rate Vector	(0009, xx01)	3	"QUASAR_INTERNAL_USE"	Rate for each frame
Count Vector	(0009, xx02)	3	"QUASAR_INTERNAL_USE"	Counts accumulated for each frame
Time Vector	(0009, xx03)	3	"QUASAR_INTERNAL_USE"	Time for each frame
Angle Vector	(0009, xx07)	3	"QUASAR_INTERNAL_USE"	Angle for each TOMO frame. For each frame is tells what is the angle of the detector

Table 3-28. Discovery NM/CT 670 Private TOMO Acquisition Module Attributes (Continued)

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Raw Time Vector	(0009, xx1A)	3	"QUASAR_INTERNAL_USE"	Raw time vector

3.5.8.8 NM Multi-Gated Acquisition Module

This section contains Attributes that describe a multi-gated acquisition performed on the patient. This refers to frames acquired while the patient is connected to a gating device. This module is present when the Image Type (0008,0008) Value 3, is equal to GATED or GATED TOMO.

Table 3-29. NM Multi-Gated Acquisition Module Attributes

Attribute Name	Tag	Type	Attribute Description
Beat Rejection Flag	(0018,1080)	3	Whether a bad beat rejection algorithm used. Enumerated values: Y = bad beat rejection algorithm used N = bad beat rejection algorithm NOT used
Skip Beats	(0018,1086)	3	Beats skipped for each rejected beat
Heart Rate	(0018,1088)	3	Average heart rate during acquisition.
Gated Information Sequence	(0054,0062)	2C	One set of attributes per R-R acceptance window. Contains only 1 item. Sent always.
> Data Information Sequence	(0054,0063)	2	Only one set is used.
>> Frame Time	(0018,1063)	1	Gated frame duration in the imageset.
>> Low R-R Value	(0018,1081)	3	Minimum R-R interval value accepted. In msec.
>> High R-R Value	(0018,1082)	3	Maximum R-R interval value accepted. In msec
>> Intervals Acquired	(0018,1083)	3	Number of accepted intervals.
>> Intervals Rejected	(0018,1084)	3	Number of rejected intervals.
>> Time Slot Information Sequence	(0054,0072)	2C	Sent always as Null sequence.

3.5.8.9 Discovery NM/CT 670 Private Multi-Gated Acquisition Module

This module is present only when the Image Type (0008,0008), Value 3, is equal to GATED and GATED TOMO. The module contains private Attributes that convey information not contained in the related DICOM Standard v3.0 NM Multi-Gated Acquisition Module.

Table 3-30. Discovery NM/CT 670 Private Multi-GATED Acquisition Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Triggers Modification Flag	(0033,xx30)	3	"GEMS_GENIE_1"	Triggers Modification Flag
Number of triggers	(0033,xx33)	3	"GEMS_GENIE_1"	Number of triggers
Trigger size	(0033,xx34)	3	"GEMS_GENIE_1"	Size of one Trigger data slot
Trigger Data size	(0033,xx35)	3	"GEMS_GENIE_1"	Size of Trigger Trigger Data size
Trigger Data	(0033,xx36)	3	"GEMS_GENIE_1"	Buffer with trigger data information

3.5.8.10 Discovery NM/CT 670 Private GSPECT Acquisition Module

This module is present only when the Image Type (0008,0008), Value 3, is equal to GATED TOMO. The module contains private Attributes that convey information not contained in the related DICOM Standard v3.0 NM Multi-Gated Acquisition Module.

Table 3-31. Discovery NM/CT 670 Private GSPECT Acquisition Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Avr RR Time Vector	(0009, xx15)	3	"QUASAR_INTERNAL_USE"	Average r-r time vector
Low Limit Vector	(0009, xx16)	3	"QUASAR_INTERNAL_USE"	Low window limit vector
High Limit Vector	(0009, xx17)	3	"QUASAR_INTERNAL_USE"	High window limit vector
Begin Index Vector	(0009, xx18)	3	"QUASAR_INTERNAL_USE"	begin index vector: link to heart beat vector
End Index Vector	(0009, xx19)	3	"QUASAR_INTERNAL_USE"	end index vector: link to heart beat vector
Starting Heart Rate	(0009, xx37)	3	"GEMS_GENIE_1"	Heart rate at start of acquisition.

3.5.8.11 NM Phase Module

This section contains Attributes that describe dynamic phases of a dynamic acquisition image performed on the patient. This module is present when the Image Type (0008,0008) Value 3, is equal to DYNAMIC.

Table 3-32. NM Phase Module Attributes

Attribute Name	Tag	Type	Attribute Description
Phase Information Sequence	(0054,0032)	2C	One sequence item per dynamic phase.
> Phase Delay	(0054,0036)	1	Phase Delay
> Actual Frame Duration	(0018,1242)	1	Frame Duration (same for all frames in this phase)
> Pause Between Frames	(0054,0038)	1	Pause Between Frames
> Number of Frames in Phase	(0054,0033)	1	Number of frames in this phase.

SECTION 4: MODALITY WORKLIST QUERY IMPLEMENTATION

4.1 DISCOVERY NM/CT 670 MAPPING OF DICOM ENTITIES

For NM standalone exams and NM/CT hybrid exams, Discovery NM/CT 670 maps DICOM Information Entities to local Information Entities in the product’s database and user interface.

For CT standalone exams, Worklist query is performed via the CT scanner console. For Modality Worklist Information Model Definition, refer to BRIGHTSPEED Conformance Statement. See Reference A- See “Overview” on page 1-1.

Table 4-1. Mapping of DICOM Entities to Discovery NM/CT 670 Entities

DICOM	Discovery NM/CT 670 Entity
Scheduled Procedure Step	Protocol
Requested Procedure	Study
Imaging Service Request	Study
Visit	Study
Patient	Patient

Matching Requested Procedure Step to Discovery NM/CT 670 protocol is done according to predefined configuration.

The configuration contains the following tags

(0040,0007) – Scheduled Procedure Step Description

(0032,1060) – Requested Procedure Description

(0040,0008) – Scheduled Protocol Code Sequence

The default configuration is (0040,0007)

4.1.1 WORKLIST QUERY MODULE TABLE

See DICOM PS 3.3 and PS 3.4 for a complete definition of the entities, modules, and attributes.

Table 4-2. MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Scheduled Procedure Step	Scheduled Procedure Step	Section 4.1.2.1

Table 4-2. MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Requested Procedure	Requested Procedure	Section 4.1.2.2
Imaging Service Request	Imaging Service Request	Section 4.1.2.2.1
Visit	Visit Identification	Section 4.1.2.2.2
	Visit Status	Section 4.1.2.2.3
	Visit Relationship	Section 4.1.2.2.4
	Visit Admission	Section 4.1.2.2.5
Patient	Patient Relationship	Section 4.1.2.2.6
	Patient Identification	Section 4.1.2.2.7
	Patient Demographic	Section 4.1.2.2.8
	Patient Medical	Section 4.1.2.2.9

4.1.2 WORKLIST QUERY MODULE DEFINITIONS

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) for a description of each of the query key attributes contained within the Modality Worklist Information Model.

4.1.2.1 Scheduled Procedure Step Module

Table 4-3. Scheduled Procedure Step Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Scheduled Procedure Step Sequence	(0040,0100)	R	1	No	
>Scheduled Station AE Title	(0040,0001)	R	1	No	Matching supported. Shown in the Worklist filter dialog. User can specify AE title when filtering modality worklist entries.

Table 4-3. Scheduled Procedure Step Module Attributes (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
>Scheduled Procedure Step Start Date	(0040,0002)	R	1	Yes	Matching Supported. Shown in the Worklist filter dialog. Specified as range of date of the form: Date-Date where Date is specified as: yyyyMMdd. SPS Start Date is mapped into private attribute "Protocol Scheduled Date" in the image - tag (0009, xx40), "QUASAR_INTERNAL_USE"
>Scheduled Procedure Step Start Time	(0040,0003)	R	1	Yes	Matching not supported. SPS Start Time is mapped into private attribute "Protocol Scheduled Time" in the image - tag (0009, xx41), "QUASAR_INTERNAL_USE"
>Modality	(0008,0060)	R	1	Yes	Matching Supported. Single value matching performed. Shown in the Worklist filter dialog. Value can be one of: CT, NM, *
>Scheduled Performing Physician's Name	(0040,0006)	R	2	Yes	Matching Supported. Single Value or Wildcard. User can define scheduled performing physician last name and/or first name in the Worklist filter dialog. The returned value is set in To Do List, can be modified and is stored in the image in performing physician tag.
>Scheduled Procedure Step Description	(0040,0007)	O	1C	No	
>Scheduled Station Name	(0040,0010)	O	2	No	No matching supported. Matched only by AE.
>Scheduled Protocol Code Sequence	(0040,0008)	O	1C	Yes	
>> 'Code Sequence Macro'					
>Scheduled Procedure Step ID	(0040,0009)	O	1	Yes	
>Pre-Medication	(0040,0012)	O	2C	No	

Table 4-3. Scheduled Procedure Step Module Attributes (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
>Scheduled Procedure Step Status	(0040,0020)	O	1	No	
>Requested Contrast Agent	(0032,1070)	O	2C	No	

4.1.2.2 Requested Procedure Module

Table 4-4. Requested Procedure Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Requested Procedure ID	(0040,1001)	O	1	Yes. Copied to Study ID (0020,0010)	Matching supported Single value, Wildcard. Displayed in the ToDo list UI.
Requested Procedure Description	(0032,1060)	O	1C	Yes	Matching is not supported
Requested Procedure Code Sequence	(0032,1064)	O	1C	Yes. Copied to Procedure Code Sequence (0008,1032)	
> <i>'Code Sequence Macro'</i>				Yes. Copied to Procedure Code Sequence (0008,0032)	
Study Instance UID	(0020,000D)	O	1	Yes	
Referenced Study Sequence	(0008,1110)	O	2	Yes	
>Referenced SOP Class UID	(0008,1150)	O	1C	Yes	
>Referenced SOP Instance UID	(0008,1155)	O	1C	Yes	
Confidentiality Code	(0040,1008)	O	3	No	
Reporting Priority	(0040,1009)	O	3	No	

4.1.2.2.1 Imaging Service Request Module

Table 4-5. Imaging Service Request Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Accession Number	(0008,0050)	O	2	Yes	Matching Supported. Single Value, Wildcard. Displayed in the ToDo list UI.
Requesting Physician	(0032,1032)	O	2	No	
Referring Physician's Name	(0008,0090)	O	2	Yes	
Reason for the Imaging Service Request	(0040,2001)	O	3	No	
Imaging Service Request Comments	(0040,2400)	O	3	No	
Issue Date of Imaging Service Request	(0040,2004)	O	3	No	
Issue Time of Imaging Service Request	(0040,2005)	O	3	No	
Placer Order Number / Imaging Service Request	(0040,2016)	O	3	No	
Filler Order Number / Imaging Service Request	(0040,2017)	O	3	No	
Order entered by...	(0040,2008)	O	3	No	
Order Enterer's Location	(0040,2009)	O	3	No	
Order Callback Phone Number	(0040,2010)	O	3	No	

4.1.2.2.2 Visit Identification

TABLE 4-6. VISIT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Admission ID	(0038,0010)	O	2	No	
Institution Address	(0008,0081)	O	3	No	
Institution Code Sequence	(0008,0082)	O	3	No	
Issuer of Admission ID	(0038,0011)	O	3	No	

4.1.2.2.3 Visit Status

Table 4-7. Visit Status Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Current Patient Location	(0038,0300)	O	2	No	
Visit Status ID	(0038,0008)	O	3	No	
Patient's Institution Residence	(0038,0400)	O	3	No	
Visit Comments	(0038,4000)	O	3	No	

4.1.2.2.4 Visit Relationship

NM DICOM Server AE does not use **Visit Relationship Module Attributes** in the **Worklist** query.

4.1.2.2.5 Visit Admission

Table 4-8. VISIT ADMISSION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Referring Physician's Name	(0008,0090)	O	3	Yes	
Referring Physician's Address	(0008,0092)	O	3	No	
Referring Physician's Phone Numbers	(0008,0094)	O	3	No	
Admitting Diagnoses Description	(0008,1080)	O	3	No	
Admitting Diagnoses Code Sequence	(0008,1084)	O	3	No	
Route of Admissions	(0038,0016)	O	3	No	
Admitting Date	(0038,0020)	O	3	No	
Admitting Time	(0038,0021)	O	3	No	

4.1.2.2.6 Patient Relationship

TABLE 4-9. PATIENT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Referenced Visit Sequence	(0008,1125)	O	3	No	

TABLE 4-9. PATIENT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Referenced Patient Alias Sequence	(0038,0004)	O	3	No	

4.1.2.2.7 Patient Identification**Table 4-10. PATIENT IDENTIFICATION MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patient's Name	(0010,0010)	R	1	Yes	Matching supported. User can define patient last name and/or patient first name. Mapped to image field (0010,0010) Patient's Name. Displayed in the ToDo list UI.
Patient ID	(0010,0020)	R	1	Yes	Matching by Single Value supported. Displayed in the ToDo list UI.
Issuer of Patient ID	(0010,0021)	O	3	No	
Other Patient IDs	(0010,1000)	O	3	No	
Other Patient Names	(0010,1001)	O	3	No	
Patient's Birth Name	(0010,1005)	O	3	No	
Patient's Mother's Birth Name	(0010,1060)	O	3	No	
Medical Record Locator	(0010,1090)	O	3	No	

4.1.2.2.8 Patient Demographic

Table 4-11. PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patients Birth Date	(0010,0030)	O	2	Yes	
Patient's Birth Time	(0010,0032)	O	2	No	
Patient's Sex	(0010,0040)	O	2	Yes	
Patient's Weight	(0010,1030)	O	2	Yes	
Confidentiality constraint on patient data	(0040,3001)	O	2	No	
Patient's Size	(0010,1020)	O	3	Yes	
Patient's Address	(0010,1040)	O	3	No	
Patient's Telephone Numbers	(0010,2154)	O	3	No	
Patient's Age	(0010,1010)	O	3	Yes	
Occupation	(0010,2180)	O	3	No	
Patient's Birth Time	(0010,0032)	O	3	No	
Patient's Insurance Plan Code Sequence	(0010,0050)	O	3	No	
Patient's Primary Language Code Sequence	(0010,0101)	O	3	No	
> Patient's Primary Language Code Modifier Sequence	(0010,0102)	O	3	No	
Military Rank	(0010,1080)	O	3	No	
Branch of Service	(0010,1081)	O	3	No	

Table 4-11. PATIENT DEMOGRAPHIC MODULE ATTRIBUTES (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Country of Residence	(0010,2150)	O	3	No	
Region of Residence	(0010,2152)	O	3	No	
Ethnic Group	(0010,2160)	O	3	No	
Patient's Religious Preference	(0010,21F0)	O	3	No	
Patient Comments	(0010,4000)	O	3	No	

4.1.2.2.9 Patient Medical**Table 4-12. PATIENT MEDICAL MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patient State	(0038,0500)	O	2	No	
Pregnancy Status	(0010,21C0)	O	2	No	
Medical Alerts	(0010,2000)	O	2	No	
Contrast Allergies	(0010,2110)	O	2	No	
Special Needs	(0038,0050)	O	2	No	
Smoking Status	(0010,21A0)	O	3	No	
Additional Patient History	(0010,21B0)	O	3	No	
Last Menstrual Date	(0010,21D0)	O	3	No	

SECTION 5: DISCOVERY NM/CT 670 STORAGE COMMITMENT PUSH MODEL IMPLEMENTATION

5.1 INTRODUCTION

This section describes the Discovery NM/CT 670 storage commitment information object definition. The storage commitment information object is used both for N-action storage commitment request by the SCU and N-event report storage commitment notifications by the SCP. Note that requesting storage commit for CT data is performed via the CT scanner console. Refer to Discovery* and BrightSpeed* Dicom Conformance Statement (Reference A – “Overview” on page 1-1).

5.2 IOD MODULE TABLE

5.2.1 Storage Commitment Module for N-action

Table 5-1. Storage Commitment Module for N-action

Attribute Name	Tag	Attribute Description
Transaction UID	(0008,1195)	Internally generated
Referenced SOP Sequence	(0008,1199)	
>Referenced SOP Class UID	(0008,1150)	1.2.840.10008.5.1.4.1.1.20 Nuclear Medicine Image Storage SOP Class UID. 1.2.840.10008.5.1.4.1.1.7 - Secondary Capture Image Storage SOP Class UID
>Referenced SOP Instance UID	(0008,1155)	Internally generated.

5.2.2 Storage Commitment Module For N-Event Report

For the Storage Commitment Module For N-EVENT-REPORT, refer to [Table 2-2 on page 2-10](#).

When receiving a N-Event-Report request with a 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:

Table 5-2. Storage Commitment Failure Reasons Module for N-Event-Report

Failure Reason	Meaning	Application Behavior When Receiving Reason Code
0110H.	Processing failure.	Appropriate error message is logged in nwscp.log file.
0112H.	No such object instance.	Error logged.
0213H.	Resource limitation.	Error logged.
0122H.	Referenced SOP Class not supported.	Error logged.
0119H.	Class / Instance conflict.	Error logged.
0131H.	Duplicate transaction UID.	Error logged.
*	Other Failure Reason code values.	Error logged.

In all failure reasons an Appropriate error message is logged in **/home/ctuser/neuvo/logfiles/nwscp.log**.

If the error message contains failed sop instance uid's those will be logged in the log file. The image/series/studies will not be marked as archived in the Data Management Panel.

SECTION 6: PERFORMED PROCEDURE STEP CONFORMANCE STATEMENT

Note

Performed Procedure Step is supported only by CT scanner.
Refer to BRIGHTSPEED Conformance Statement (See Reference A- See "Overview" on page 1-1).
Please note that for NM/CT hybrid exams, the Modality Performed Procedure Step option is disabled.

SECTION 7: SC INFORMATION OBJECT IMPLEMENTATION

7.1 INTRODUCTION

This section specifies the use of the DICOM SC Image IOD to represent the information included in SC images produced by this implementation. SC Object attributes are conveyed using the module construct. The contents of this section are:

- [Section 7.2: SC IOD Implementation on page 7-1](#)
- [Section 7.3: SC Entity-Relationship Model on page 7-1](#)
- [Section 7.4: IOD Module Table on page 7-3](#)
- [Section 7.5: Information Module Definitions on page 7-4](#)

7.2 SC IOD IMPLEMENTATION

Screen Save images created on the Discovery NM/CT 670 system, as reports of several Quality Control Operations (Daily QC, Weekly QC, etc.), are sent as DICOM Secondary Capture images.

Only single frame Secondary Capture Image IOD is supported.

7.3 SC ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the SC Image interoperability schema is shown in [Illustration 7-1](#). In this figure, the following diagrammatic convention is established to represent the information organization:

- Each entity is represented by a rectangular box
- Each relationship is represented by a diamond shaped box.
- The fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. For example, the relationship between Series and SC Image can have up to n SC Images per Series, but the SC Image can only belong to 1 Series.

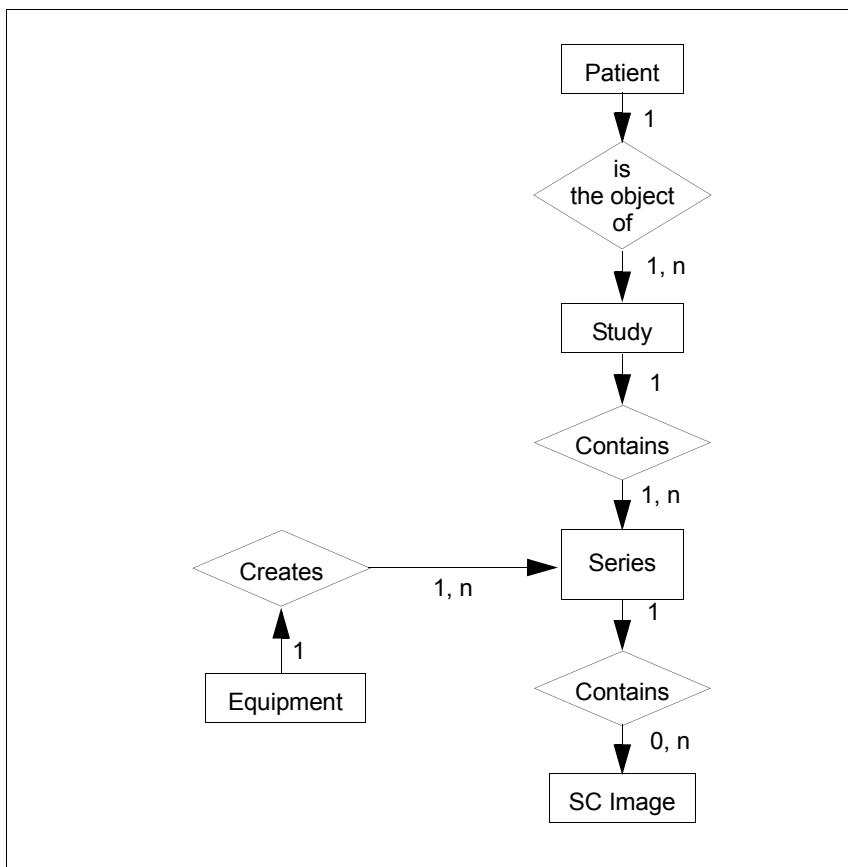


Illustration 7-1. SC Image Entity Relationship Diagram

7.3.1 Entity Descriptions

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the SC Information Object.

7.3.1.1 Patient Entity Description

The Patient Entity defines the characteristics of a patient who is the subject of one or more medical studies which produce medical images.

7.3.1.2 Study Entity Description

The Study Entity describes the characteristics of a medical study performed on a patient. A study is a collection of one or more series of medical images which are logically related for the purpose of diagnosing a patient. Each study is associated with exactly one patient.

7.3.1.3 Series Entity Description

The Series Entity defines the attributes which are used to group images into distinct logical sets. Each series is associated with exactly one study.

7.3.1.4 Equipment Entity Description

The Equipment Entity describes the particular imaging device which produced the series of images. An imaging device may produce one or more series within a study. The Equipment Entity does not describe the data acquisition or image creation Attributes used to generate images within a series.

7.3.1.5 SC Image Entity Description

The SC Image Entity defines the attributes which describe the pixel data of a Secondary Capture image. The pixel data is derived from an original image through image processing steps (a DERIVED image). An image is defined by its image plane, pixel data characteristics, gray scale and/or color mapping characteristics and modality specific characteristics (acquisition parameters and image creation information)

7.3.2 Discovery NM/CT 670 Mapping of DICOM Entities

Table 7-1. Mapping DICOM Entities to Discovery NM/CT 670 Entities

DICOM	Discovery NM/CT 670 Entity
Patient	Patient
Study	Exam
Series	Series
Equipment	Equipment
Image	Dataset

7.4 IOD MODULE TABLE

Within an entity of the DICOM v3.0 SC IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into DICOM datasets.

[Table 7-2](#) identifies the defined modules within the entities which comprise the DICOM v3.0 SC IOD. Modules are identified by Module Name.

See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes. Modules which are not listed here are not used

Table 7-2. SC Image IOD Modules

Entity Name	Module Name	Reference
Patient	Patient	Section 7.5.1.1
Study	General Study	Section 7.5.2.1
Series	General Series	Section 7.5.3.1
Equipment	General Equipment	Section 7.5.4.1
	SC Equipment	Section 7.5.6.2

Table 7-2. SC Image IOD Modules (Continued)

Entity Name	Module Name	Reference
Image	General Image	Section 7.5.5.1
	Discovery NM/CT 670 Private SC Image	Section 7.5.5.2
	Image Pixel	Section 7.5.5.3
	SOP Common	Section 7.5.6.1

7.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the SC Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Attributes from the DICOM Standard modules are also included for completeness and to define what values they may take and where these values are obtained from. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

Note

Note that any element not listed in table(s) means that it is not supported (not stored in the created images).

7.5.1 Common Patient Entity Modules

7.5.1.1 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 7-3. Patient Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Name of user that performed the QC protocol. For example, "Service^^^^ "
Patient ID	(0010,0020)	2	Description of QC test performed. For example, "NM Daily QC", "Uniformity Test", "COR Test", etc.
Patient's Birth Date	(0010,0030)	2	Execution date of the QC Test
Patient's Sex	(0010,0040)	2	NULL value

7.5.2 Common Study Entity Modules

The following Study IE Modules are common to all Composite Image IODs which reference the Study IE. These Module contain Attributes of the patient and study that are needed for diagnostic interpretation of the image.

7.5.2.1 General Study Module

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

Table 7-4. General Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Study Instance UID, internally generated
Study Date	(0008,0020)	2	Study Date
Study Time	(0008,0030)	2	Study Time
Referring Physician's Name	(0008,0090)	2	Referring Physician's Name. Set as an empty string.
Study ID	(0020,0010)	2	Study ID. Description of the QC test performed. For example, "NM Daily QC", "Uniformity Test", "COR Test", etc.
Accession Number	(0008,0050)	2	Accession Number. Set as an empty string.
Study Description	(0008,1030)	3	Study Description. Default Value "QC-protocol"

7.5.3 Common Series Entity Modules

The following Series IE Modules are common to all Composite Image IODs which reference the Series IE.

7.5.3.1 General Series Module

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

Table 7-5. General Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	SC Images created by Discovery NM/CT 670 generally have this attribute set to the value found in the original image. Defined Terms: NM = Nuclear Medicine
Series Instance UID	(0020,000E)	1	Series Instance UID. Internally generated.
Series Number	(0020,0011)	2	Series Number. Set as NULL value.
Series Description	(0008,103E)	3	Series Description. Internally generates the name of the QC report.

7.5.4 Common Equipment Entity Modules

The following Equipment IE Module is common to all Composite Image IODs which reference the Equipment IE

7.5.4.1 General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced a Series of Images. If the SC object instance was derived from Discovery NM/CT 670 original images, then some of the attributes listed in the table below may be set to values copied from the original images.

Table 7-6. General Equipment Module Attributes

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Manufacturer. Default value is "GE MEDICAL SYSTEMS"

7.5.5 Common Image Entity Modules

The following Image IE Modules are common to all Composite Image IODs which reference the Image IE.

7.5.5.1 General Image Module

This section specifies the Attributes which identify and describe an image within a particular series.

Table 7-7. General Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	Image Number. Set with NULL value.
Image Date	(0008,0023)	2C	Image Date
Image Time	(0008,0033)	2C	Image Time
Image Type	(0008,0008)	3	Image Type, See Section 7.5.5.1.1.1
Quality Control Image	(0028,0300)	3	Indicates that this image is a quality control image. Enumerated Values: YES

7.5.5.1.1 General Image Attribute Description

7.5.5.1.1.1 Image Type

Value 1 has the following Enumerated Value:

DERIVED identifies a Derived Image

Value 2 has the following Enumerated Value:

SECONDARY identifies a Secondary Image

7.5.5.2 Discovery NM/CT 670 SC Private Image Module

This section specifies the Attributes which identify and describe a Secondary Capture (SC) image within a particular series. This Module contains *private* Attributes that convey information not contained in the related DICOM Standard

v3.0 Module. The private attributes are required for full fidelity transfer between Discovery NM/CT 670 and Xeleris workstation systems.

Table 7-8. Discovery NM/CT 670 Private SC Image Module Attributes

Attribute Name	Tag	Type	Private Creator	Attribute Description
Sequence Name	(0009, xx14)	3	"QUASAR INTERNAL USE"	Acquired Sequence Name
Patient Unique Key	(0009, xx39)	3	"QUASAR INTERNAL USE"	Patient unique key
Dataset Name	(0011, xx12)	3	"GEMS GENIE 1"	

7.5.5.3 Image Pixel Module

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

Table 7-9. Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	3 (for RGB)
Photometric Interpretation	(0028,0004)	1	Defined Terms: RGB
Rows	(0028,0010)	1	Set to 878
Columns	(0028,0011)	1	Set to 1004
Bits Allocated	(0028,0100)	1	Set to 8
Bits Stored	(0028,0101)	1	Set to 8
High Bit	(0028,0102)	1	Set to 7
Pixel Representation	(0028,0103)	1	Set to 0
Pixel Data	(7FE0,0010)	1	
Planar Configuration	(0028,0006)	1C	Set to 0

7.5.6 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

7.5.6.1 SOP Common Module

This section defines the Attributes which are required for proper functioning and identification of the associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD.

Table 7-10. SOP Common Module Attributes

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	SOP Class UID. Set to "1.2.840.10008.5.1.4.1.1.7"
SOP Instance UID	(0008,0018)	1	SOP Instance UID. Internally generated.
Specific Character Set	(0008,0005)	1C	Not used when the default character set (ISO 646) is used. Set to "ISO_IR 100" when extended character sets are used.
Instance Number	(0020,0013)	3	Null value

7.5.6.2 SC Image Equipment Module

This Module describes equipment used to convert SC images into a DICOM format.

Table 7-11. SC Image Equipment Module Attributes

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	Set to "SI"
Modality	(0008,0060)	3	Modality. Set to "NM".

APPENDIX A: DISCOVERY NM/CT 670 PRIVATE DATA DICTIONARY

This section provides value representation and multiplicity information for all of the Private Attributes used by this implementation. Private Attributes contained within the Information Model are described in the preceding sections.

**Table A-1. Discovery NM/CT 670 Private Creator Identification
"QUASAR_INTERNAL_USE"**

Attribute Name	Tag	VR	VM	Attribute Description
Rate Vector	(0009, xx01)	UL	1-n	Rate for each frame
Count Vector	(0009, xx02)	UL	1-n	Counts accumulated for each frame
Time Vector	(0009, xx03)	UL	1-n	Time for each frame
Angle Vector	(0009, xx07)	UL	1-n	Angle for each TOMO frame. For each frame is tells what is the angle of the detector
Camera Shape	(0009, xx08)	US	1	Camera Shape: H mode, L mode
Origin	(0009, xx12)	LO	1	The origin of the image."isWorklist" if scheduled in MWL. "regular" if locally scheduled.
Sequence Type	(0009, xx13)	ST	1	Acquired Sequence Type
Sequence Name	(0009, xx14)	ST	1	Acquired Sequence Name
Raw Time Vector	(0009, xx1A)	UL	1-n	Raw time vector
Image Type	(0009, xx1B)	LO	1	Image type string
Stop Reason	(0009, xx1D)	US	1	Defines condition that image was installed to db
Patient Unique Key	(0009, xx39)	UI	1	Patient unique key
Protocol Scheduled Date	(0009, xx40)	DA	1	Protocol Scheduled Date
Protocol Scheduled Time	(0009, xx41)	TM	1	Protocol Scheduled Time
Acquisition flag	(0009, xx42)	LO	1	Used for indicating if the study is acquired
Matched protocol	(0009, xx43)	LO	1	For Worklist items. The originally matched protocol vs. protocol name which is the protocol actually acquired
Pre-Medication	(0009,xx45)	LO	1	Keeps the Pre-Medication as appears in the ToDo list

**Table A-1. Discovery NM/CT 670 Private Creator Identification
"QUASAR_INTERNAL_USE" (Continued)**

Attribute Name	Tag	VR	VM	Attribute Description
Auto Application	(0009, xx1E)	ST	1	Auto application to be invoked on Xeleris
Avr RR Time Vector	(0009, xx15)	UL	1-n	Average r-r time vector
Low Limit Vector	(0009, xx16)	UL	1-n	Low window limit vector
High Limit Vector	(0009, xx17)	UL	1-n	High window limit vector
Begin Index Vector	(0009, xx18)	UL	1-n	Begin index vector: link to heart beat vector
End Index Vector	(0009, xx19)	UL	1-n	End index vector: link to heart beat vector
Private SPS ID	(0009, xx44)	SH	1	Keeps the SPS ID for protocols that were appended to the original MWL protocol.
Collimator SQ	(0037,xx10)	SQ	1	Contains information of collimators parameters. Contains 1 item.
Hole Diameter	(0037,xx1B)	LO	1	collimator hole diameter
Hole Length	(0037,xx30)	LO	1	collimator hole length
Collimator Thickness	(0037,xx40)	LO	1	collimator thickness
Septal Thickness	(0037,xx50)	LO	1	collimator septal thickness
Intrinsic Resolution	(0037,xx60)	LO	1	collimator intrinsic resolution
Blurring Slope	(0037,xx70)	LO	1	collimator blurring slope

**Table A-2. Discovery NM/CT 670 Private Creator Identification
"GEMS_GENIE_1"**

Attribute Name	Tag	VR	VM	Attribute Description
Starting Heart Rate	(0009, xx37)	SL	1	Heart rate at start of acquisition.

**Table A-2. Discovery NM/CT 670 Private Creator Identification
"GEMS_GENIE_1" (Continued)**

Attribute Name	Tag	VR	VM	Attribute Description
Radio Nuclide Name	(0011, xx0D)	LO	1	Name of radionuclide used.
Dataset Name	(0011, xx12)	LO	1-n	
Acquisition Parent UID	(0011, xx31)	LO	1-n	Used for correct registration. For NM/CT registration, refer to Section 3.5.4.1: Frame of Reference Modules on page 3-12 . In NM/CT hybrid scans, the Acq Parent UID is saved also in CT images.
Software Translator	(0013, xx11)	SL	1	Internal code of product DICOM implementation. Enumerated Value = 11
DoubleDataFormat	(0033,xx22)	OB	1	Format of double parameters; contains information about name and number of doubles in list
Triggers Modification Flag	(0033,xx30)	UL	1	Triggers Modification Flag
Number of triggers	(0033,xx33)	UL	1	Number of triggers
Trigger size	(0033,xx34)	UL	1	Size of one Trigger data slot
Trigger Data size	(0033,xx35)	UL	1	Size of Trigger Trigger Data size
Trigger Data	(0033,xx36)	OB	1	Buffer with trigger data information

**Table A-3. Discovery NM/CT 670 Private Creator Identification
"APEX_PRIVATE"**

Attribute Name	Tag	VR	VM	Attribute Description
Bed Position	(0027,xx11)	DS	1	

**Table A-4. Discovery NM/CT 670 Private Creator Identification
"GEMS_XELPRV_01"**

Attribute Name	Tag	VR	VM	Attribute Description
Series Data Sequence	(0033,xx70)	SQ	1	Sequence of item contains information about acquisition parameters. May contain from 1 to n Items. Each Items describes specific parameters set.

**Table A-4. Discovery NM/CT 670 Private Creator Identification
"GEMS_XELPRV_01" (Continued)**

Attribute Name	Tag	VR	VM	Attribute Description
Object Type	(0033,xx08)	CS	1	
Modified Flag	(0033,xx10)	SL	1	
Name	(0033,xx11)	LO	1	
Series Data UID	(0033,xx16)	LO	1	
Date	(0033,xx17)	SH	1	
Time	(0033,xx18)	SH	1	
Series Data Flags	(0033,xx19)	UL	1	
ProtocolName	(0033,xx1A)	LO	1	
Relevant data UID	(0033,xx1B)	LO	1	
Int Data	(0033,xx1D)	UL	1-n	
Double Data	(0033,xx1E)	FD	1-n	
StringData	(0033,xx1F)	OB	1	
IntDataFormat	(0033,xx21)	OB	1	
StringDataFormat	(0033,xx23)	OB	1	
SDO Description	(0033,xx24)	LT	1	
Seriesdata Private SOPClassUID	(0033,xx71)	UI	1	
Seriesdata InstanceUID	(0033,xx72)	UI	1	