



# **Technical Publications**

**Direction DOC0660253  
Revision 2**

## **Discovery NM/CT 670 and Discovery NM 630 DICOM CONFORMANCE STATEMENT**

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**LIST OF REVISIONS**

<b>REV</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PAGES</b>	<b>APPR.</b>
1	May 2010	Discovery NM/CT 670 Release	All	T. Cohen
2	Mar 2011	Discovery NM 630 Release Update Private Dictionary and content of NM Images created	Sections updated: 1.1 2.1 2.2.1 2.7 3.3 3.4 3.5 4.3 4.4 4.5 6.1	M. Mesh

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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 630 system is NM Standalone camera, which generates only NM Images. Its DICOM implementation is the same as the Discovery NM/CT 670 system working in NM standalone mode.

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. (See [Reference A](#) in Section 1.6).

The Discovery NM 630 DICOM implementation allows the user to send Nuclear Medicine 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.

The Discovery NM/CT 670 and Discovery NM 630 DICOM implementations support storage commitment for the already transferred data. This guarantees the user that the acquired data is safely archived for future use.

The Discovery NM/CT 670 and Discovery NM 630 DICOM implementations also support receiving Worklist information from a remote AE. They support receiving more than one Scheduled procedure step per study instance. Similarly, The Discovery NM/CT 670 and Discovery NM 630 support scheduling locally more than one protocol to be performed for a study.

The Discovery NM/CT 670 and Discovery NM 630 DICOM implementation also provide a verification mechanism by which a remote AE can verify application-level communication with Discovery NM/CT 670 or Discovery NM 630 DICOM Server. Also provided is a mechanism by which Discovery NM/CT 670 and Discovery NM 630 user can verify application-level communication with a remote AE.

Table 0.1 provides an overview of the network services supported by Discovery NM/CT 670 and Discovery NM 630.

**Table 0.1 – NETWORK SERVICES**

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

**Note:**

Modality Performed Procedure Step SOP Class is supported only by Discovery NM/CT 670 system in CT Standalone mode via BrightSpeed Elite 16 slices CT scanner .Refer to BRIGHTSPEED Conformance Statement ([Reference A](#) in Section 1.6.).

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## 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:

- 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 630 system is NM Standalone camera, which generates only NM Images. Its DICOM implementation is the same as the Discovery NM/CT 670 system working in NM standalone mode.

BrightSpeed Elite 16 slices CT scanner Conformance statement is described in a separate document ([Reference A](#) in Section 1.6 ).

The DICOM Conformance related to the NM Camera as well as DICOM behavior of the NM/CT hybrid scanning is described in this document

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

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

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

**Section 3 (NM Image Information Object Implementation)**, which specifies the GEHC equipment compliance to DICOM requirements for the implementation of a NM Image Information Object.

**Section 4 (Secondary Capture Image Information Object Implementation)**, which specifies the GEHC equipment compliance to DICOM requirements for the implementation of a SC Image Information Object.

**Section 5 (Modality Worklist Information Model)**, which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Modality Worklist service.

**Section 6 (Storage Commitment PUSH Model Implementation)**, which specifies the GEHC equipment compliance to DICOM requirements for the implementation of the Storage Commitment service.

**Section 7 (Modality Performed Procedure Step Model Implementation)**, which specifies the GEHC equipment compliance to DICOM requirements for the Discovery NM/CT 670 CT standalone implementation of the Modality Performed Procedure Step service.



This document specifies the DICOM implementation. It is entitled:

**Discovery NM/CT 670 and Discovery NM 630**  
Conformance Statement for DICOM  
Direction **DOC0660253**

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

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

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

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

### 1.3 INTENDED AUDIENCE

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

### 1.4 SCOPE AND FIELD OF APPLICATION

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

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

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

### 1.5 IMPORTANT REMARKS

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

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non-GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.

- **Validation** - Testing the complete range of possible interactions between any GE device and non-GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non-GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non-GE device and the stability of the image data for the intended applications.

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

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

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

## 1.6 REFERENCES

- NEMA PS3      Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>
- Reference A      DOC0636565 Discovery\* and BrightSpeed\* DICOM Conformance Statement

## 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

## 1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
AET	Application Entity Title
CSE	Customer Service Engineer
CT	Computerized Tomography
DHCP	Dynamic Host Configuration Protocol
DICOM	Digital Imaging and Communications in Medicine
DNS	Domain Name System
HIS	Hospital Information System
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
ISO	International Organization for Standards
JPEG	Joint Photographic Experts Group
LUT	Look-up Table
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
SDO	Series Data Object
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
UI	User Interface
UL	Upper Layer
US	Ultrasound
VM	Value Multiplicity
VR	Value Representation



## 2. NETWORK CONFORMANCE STATEMENT

### 2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the Discovery NM/CT 670 and the Discovery NM 630 compliance to DICOM requirements for Networking features.

The Discovery NM/CT 670 system is a combination of an NM camera and a BrightSpeed Elite 16 Slices ([Reference A](#) in Section 1.6).

It works in three different modes:

- 1) NM standalone
- 2) Hybrid NM-CT exams and
- 3) CT standalone exam scheduled via CT UI.

The Discovery NM 630 system is NM Standalone camera, which generates only NM Images. Its DICOM implementation is the same as the Discovery NM/CT 670 system working in NM standalone mode.

This section details the roles and DICOM Service Classes supported by the Discovery NM/CT 670 and the Discovery NM 630.

The Discovery NM/CT 670 DICOM implementation allows the user to acquire, store Nuclear Medicine Image data, CT Image data and Secondary Capture Objects, created as reports of several Quality Control (QC) operations, and send them to another DICOM station. The Discovery NM 630 DICOM implementation allows the user to acquire, store Nuclear Medicine Image data and Secondary Capture Objects, created as reports of several Quality Control (QC) operations, and send them to another DICOM station. In this situation Discovery NM/CT 670 and Discovery NM 630 provide the DICOM C-STORE service as a service class user (SCU).

The Discovery NM/CT 670 and Discovery NM 630 DICOM implementations support storage commitment for the already transferred data. This guarantees the user that the acquired image data are safely archived for future use. In this situation Discovery NM/CT 670 and Discovery NM 630 provide the DICOM Storage Commitment Service as Service Class User (SCU).

The Discovery NM/CT 670 and Discovery NM 630 DICOM implementations support receiving Worklist information from a remote AE. For NM standalone exams (Discovery NM/CT 670 and Discovery NM 630) and for hybrid exams (Discovery NM/CT 670) DICOM implementations support 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 and Discovery NM 630 support 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 Implementation uses two different AE titles, one for the NM Camera and one for the CT Scanner. A verification mechanism is provided, by which a remote application entity (AE) can verify

application-level communication with the NM Camera DICOM Server and CT Scanner 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.

The Discovery NM 630 DICOM implementation provides a verification mechanism by which a remote application entity (AE) can verify application-level communication with the Discovery NM 630 DICOM Server. Also provided is a mechanism by which a Discovery NM 630 user can verify application-level communication with a remote DICOM AE. In these situations, Discovery NM 630 provides the DICOM C-ECHO service as both a SCP and SCU, respectively.

## **2.2 IMPLEMENTATION MODEL**

### **2.2.1 Overview**

Two different Application Entities (AE) logically provide all DICOM functionality:

- **NM Camera AE** for Discovery NM/CT 670 and Discovery NM 630 NM standalone mode and for Discovery NM/CT 670 NM/CT Hybrid mode. The NM Camera AE is commanded to perform DICOM services through the use of the NM Camera user interface.
- **CT Scanner DICOM Server AE** for Discovery NM/CT 670 CT standalone mode.

The both AEs also listen on a pre-defined ports for incoming connections from remote DICOM AEs.

**Note:**                      **In this section term NM Camera AE DICOM implementation refers to DICOM implementation of Discovery NM/CT 670 in NM standalone mode and in Hybrid mode and the Discovery NM 630 products.**

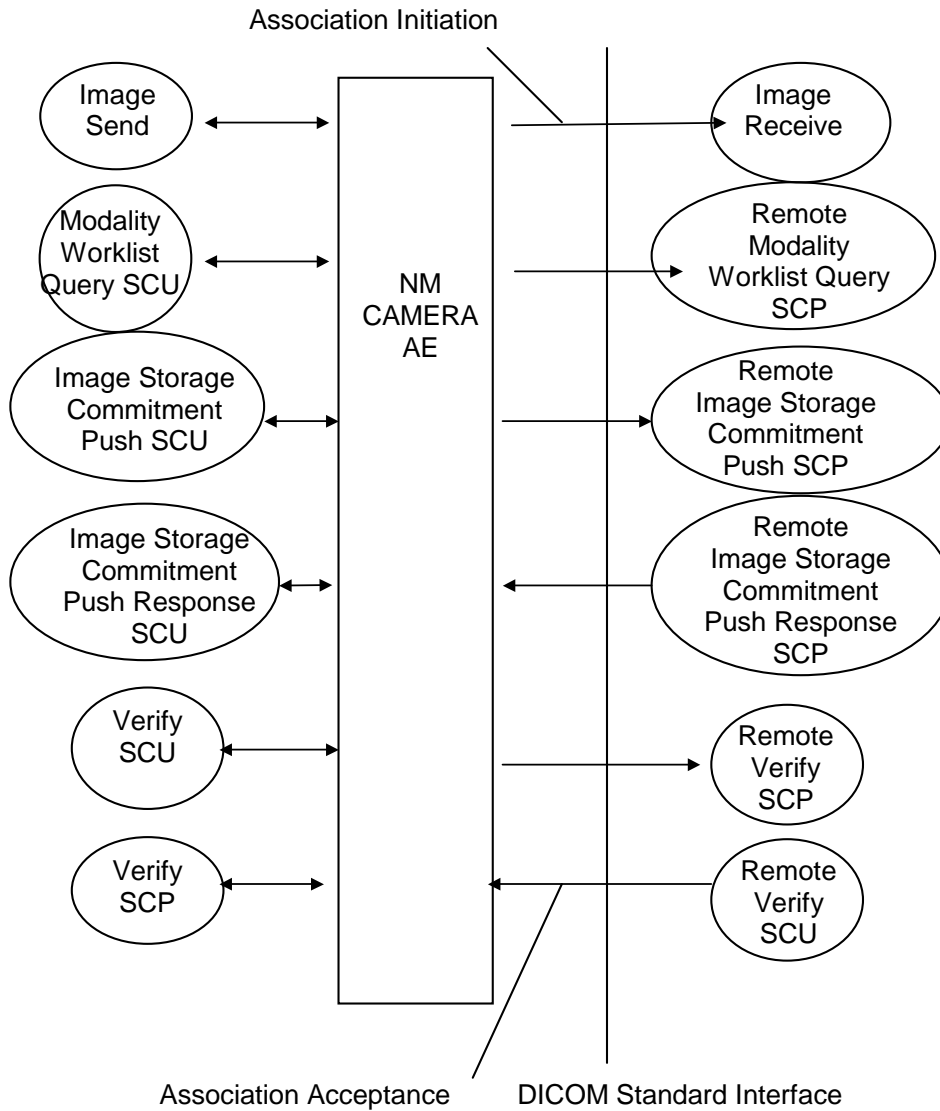
This section describes the only NM Camera Application Entity Implementation Model.

For CT Scanner DICOM Server Application Entity Implementation model, refer to BrightSpeed\* DICOM Conformance Statement ([Reference A](#) in Section 1.6.).

2.2.2 Application Data Flow Diagram

The network application model for the NM Camera DICOM Implementation is shown in the following Illustration:

ILLUSTRATION 2-1  
NM CAMERA NETWORK APPLICATION MODEL AND DATA FLOW DIAGRAM



**2.2.3 Functional Definition of AE's**

The NM Camera Application Entity (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 Camera 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 Camera 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 Camera AE will receive appropriate MWL responses via the C-FIND service.

The NM Camera 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 Camera AE.

**2.2.4 Sequencing of Real-World Activities**

The NM Camera 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\* DICOM Conformance Statement ([Reference A](#) in Section 1.6.)

**2.3.1 NM Camera AE Specification**

The NM Camera Application Entity provides Standard Conformance to the following DICOM SOP Classes as an SCU and/or as an SCP:

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	No
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	No
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Yes	No
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	No

**2.3.1.1 Association Establishment Policies**

**2.3.1.1.1 General**

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

<b>Application Context Name</b>	<b>1.2.840.10008.3.1.1.1</b>
---------------------------------	------------------------------

The maximum length PDU receive size for the NM Camera AE is:

<b>Maximum Length PDU</b>	<b>64234 (Not Configurable)</b>
---------------------------	---------------------------------

The SOP Class Extended Negotiation is not supported.

**2.3.1.1.2 Number of Associations**

The NM Camera AE (SCU) will initiate a single DICOM association to perform a single image send to a remote node. One association is opened per image both in manual send and in auto-send. Multiple Send operations can be performed. The Image Storage Commitment Request (SCU) initiates a new single association for all the images that were successfully stored on the remote AE. NM Camera AE can initiate a maximum of 5 simultaneous associations to remote nodes.

The NM Camera AE (SCP) can accept multiple DICOM associations opened simultaneously to service verifications. The NM Camera AE can support a maximum of 5 simultaneous associations initiated by remote nodes.

**2.3.1.1.3 Asynchronous Nature**

Asynchronous mode is not supported. All operations will be performed synchronously.

**2.3.1.1.4 Implementation Identifying Information**

The Implementation UID for this DICOM Implementation is:

<b>NM Camera Implementation UID</b>	<b>1.2.840.113619.6.280</b>
<b>NM Camera Implementation Version Name</b>	<b>MergeCOM3_321</b>

**2.3.1.2 Association Initiation Policy**

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

The NM Camera AE proposes only a single Transfer Syntax in each Presentation Context; i.e., for each Abstract Syntax in the following Presentation Context Tables, the AE proposes one Presentation Context for each specified Transfer Syntax.

The NM Camera AE initiates a new association in the following cases:

- Due to an image send operation being initiated from the NM Camera user interface, or by auto send option.
- Due to a storage commitment request operation being initiated from the NM Camera 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 NM Camera 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 ([Reference A](#) in Section 1.6.).

**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 Camera 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**

Presentation Context Table – Proposed by NM Camera AE for “Image Send “Activity					
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**

The NM Camera AE implementation includes optional data elements in the SOP Instances as described in Sections 3 and 4.

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

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.

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

Upon receiving a C-STORE confirmation containing a status other than Successful or Warning, this implementation will consider the current request to be a failure but will continue to attempt to send any remaining images in the request on a different association.

When NM Camera AE initiates an association to issue a C-STORE, the image will be transmitted by the NM Camera 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 a **Storage SCP** equipment :

<b>Service Status</b>	<b>Status Code</b>	<b>Further Meaning</b>	<b>Application Behavior When Receiving Status Code</b>
Failure	A700-A7FF	Refused: Out of resources	The message " JOB FAILED: error sending image" is displayed in Transfer Log.
	A900-A9FF	Error: Data Set does not match SOP Class	The message " JOB FAILED: error sending image" is displayed in Transfer Log
	C000-CFFF	Error: Cannot Understand	The message " JOB FAILED: error sending image" is displayed in Transfer Log
	0122	SOP Class Not Supported	The message " JOB FAILED: error sending image" is displayed in Transfer Log
Warning	B000	Coercion of Data Elements	The message "JOB SUCCEEDED" posted to the Transfer Log.
	B006	Elements Discarded	The message "JOB SUCCEEDED" posted to the Transfer Log.
	B007	Data Set does not match SOP Class	The message "JOB SUCCEEDED" posted to the Transfer Log.
Success	0000		The message "JOB SUCCEEDED" posted to the Transfer Log.
*	*	Any other status code.	The message " JOB FAILED: error sending image" is displayed in Transfer Log.

**2.3.1.2.2 Real-World Activity Modality Worklist Query SCU**

**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 ([Reference A](#) in Section 1.6.).

**2.3.1.2.2.1 Associated Real-World Activity**

NM Camera AE queries the remote AE for a Modality Worklist (MWL) in the following cases:

- When NM Camera application is started, MWL query is automatically performed for updating entries displayed in the NM Camera “To Do List”.
- User opens “Filter...” button in NM Camera UI. MWL Filter dialog is opened, user defines relevant MWL matching keys and presses on “Query” button.
- Users requires MWL query using latest MWL matching keys defined by pressing on “Refresh” button in the NM camera UI.
- Users requires MWL query using latest MWL matching keys defined to map of the MWL Requested or Scheduled Procedures to the NM Camera acquisition protocols .

**2.3.1.2.2.2 Proposed Presentation Context Table**

Presentation Context Table – Proposed by NM Camera AE for Modality Worklist Query SCU Activity					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

**2.3.1.2.2.2.1 SOP Specific DICOM Conformance Statement for the Modality Worklist Information Model - FIND SOP Class**

The NM Camera includes matching keys in the Modality Worklist queries as described in Section 5

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 default time-out value is 180 seconds.

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

Sending C-FIND CANCEL is not supported by the NM Camera AE.



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If NM Camera 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 Camera AE will show a pop-up message listing which tags are missing, the Worklist item will be rejected.

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

<b>Service Status</b>	<b>Status Code</b>	<b>Further Meaning</b>	<b>Application Behavior When Receiving Status Code</b>
Failure	A700	Refused: Out of resources	User receives a notification message. Only locally scheduled studies or studies which acquisition is in progress are displayed in the NM Camera "To Do List"
	A900	Error: Identifier does not match SOP Class	User receives a notification message. Only locally scheduled studies or studies which acquisition is in progress are displayed in the NM Camera "To Do List"
	C000-CFFF	Error: Unable to process	User receives a notification message. Only locally scheduled studies or studies which acquisition is in progress are displayed in the NM Camera "To Do List"
	0122	SOP Class Not Supported	User receives a notification message. Only locally scheduled studies or studies which acquisition is in progress are displayed in the NM Camera "To Do List"
Cancel	FE00	Matching terminated due to cancel	Not Applicable
Success	0000	Matching is complete - No final identifier is supplied	
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	"MWL query is in progress" notification is displayed along with MWL query progress indicator.
*	FF01	Matches are continuing - Warning that one or more Optional Keys were not supported for existence for this Identifier	"MWL query is in progress" notification is displayed along with MWL query progress indicator.
	*	Any other status code.	User receives a notification message. Only locally scheduled studies or studies which acquisition is in progress are displayed in the NM Camera "To Do List"

**2.3.1.2.3 Real-World Activity Image Storage Commitment Push SCU**

**Note:** For Real World activity Image Storage Commitment Push SCU of CT Scanner AE please refer to BrightSpeed\* Conformance Statement ([Reference A](#) in Section 1.6.).

**2.3.1.2.3.1 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 Camera AE 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 for all successfully transferred images.
- 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.

**2.3.1.2.3.2 Proposed Presentation Context Table**

<b>Presentation Context Table – Proposed by NM Camera AE for Image Storage Commitment Push SCU Activity</b>					
<b>Abstract Syntax</b>		<b>Transfer Syntax</b>		<b>Role</b>	<b>Extended Negotiation</b>
<b>Name</b>	<b>UID</b>	<b>Name List</b>	<b>UID List</b>		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

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

The storage commitment request (N-ACTION) can perform a storage commitment request for multiple images over a single association. A new association is initiated for the storage commitment request for every group of successfully transferred image(s).

Upon receiving a N-ACTION confirmation containing a “Successful” status, the next N-ACTION-RQ operation is performed for the new association.

Upon receiving a N-ACTION confirmation containing a “Refused” status, the association is terminated. The reason for

termination is recorded in the system log file.

Upon receiving a N-ACTION confirmation containing a status other than the DICOM standard defined values, the current request is considered to be a failure and will terminate the association. The reason for termination is recorded in the system log file.

The NM Camera AE uses DICOM network storage services to transfer SOP Instances which are to be committed.

The NM Camera AE may request Storage Commitment for Instances of any of the Composite SOP Classes it supports as an SCU (see Section 2.3.1).

The Storage Commitment Information Object is described in Section 6

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 the association is ended. The default time-out value is 10 minutes and is not configurable.

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

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

<b>Service Status</b>	<b>Status Code</b>	<b>Further Meaning</b>	<b>Application Behavior When Receiving Status Code</b>
Failure	0119	Class-instance conflict	The message " JOB FAILED: error storage commitment" is displayed in Transfer Log; Storage commitment will be considered as failed;
	0112	No such SOP Instance	The message " JOB FAILED: error storage commitment" is displayed in Transfer Log; Storage commitment will be considered as failed;
	0110	Processing failure	The message " JOB FAILED: error storage commitment" is displayed in Transfer Log; Storage commitment will be considered as failed;
	0213	Resource limitation	The message " JOB FAILED: error storage commitment" is displayed in Transfer Log; Storage commitment will be considered as failed;
	0122	Referenced SOP Class Not Supported	The message " JOB FAILED: error storage commitment" is displayed in Transfer Log; Storage commitment will be considered as failed;
	0131	Duplicate Transaction UID	The message " JOB FAILED: error storage commitment" is displayed in Transfer Log; Storage commitment will be considered as failed;
Success	0000		The message " JOB IN PROGRESS : waiting for commitment" is displayed in Transfer Log.  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 message " JOB FAILED: error storage commitment" is displayed in Transfer Log; Storage commitment will be considered as failed;

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

The receipt of a N-EVENT-REPORT on an association that NM Camera has initiated is not supported. The Remote AE (SCP) must initiate a new association in order to send the new N-EVENT-REPORT (see Section 2.3.1.3.2.2.1).

**2.3.1.2.4 Real-World Activity Verify SCU**

**Note:** For CT Scanner AE Real Time Activity: Verify refer to BrightSpeed Conformance Statement ([Reference A](#) in Section 1.6).

**2.3.1.2.4.1 Associated Real-World Activity**

Service personnel invoke the DICOM Station Configuration Utility from NM Camera UI. The user selects any of defined remote DICOM AE and presses on “Refresh status” button. The NM Camera AE initiates 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.

**2.3.1.2.4.2 Proposed Presentation Context Table**

Presentation Context Table – Proposed by NM Camera AE for Verify SCU Activity					
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	SCU	None

**2.3.1.2.4.2.1 SOP Specific DICOM Conformance Statement for Verification SOP Class**

The NM Camera 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.

**2.3.1.3 Association Acceptance Policy**

The NM Camera 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 Camera AE for the purpose of application level communication verification.

As part of the storage commitment implementation, the NM Camera AE Server responds to N-EVENT-REPORT received from the remote AE.

**2.3.1.3.1 Real-World Activity Verify SCP**

**2.3.1.3.1.1 Associated Real-World Activity**

The NM Camera 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**

<b>Presentation Context Table - Accepted by NM Camera AE for Verify SCP Activity</b>					
<b>Abstract Syntax</b>		<b>Transfer Syntax</b>		<b>Role</b>	<b>Extended Negotiation</b>
<b>Name</b>	<b>UID</b>	<b>Name List</b>	<b>UID List</b>		
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	SCP	None

**2.3.1.3.1.2.1 SOP Specific DICOM Conformance Statement for Verification SOP Class**

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

**2.3.1.3.2 Real-World Activity Image Storage Commitment Push Response SCU**

**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 Camera AE has initiated is not supported. The Remote AE (SCP) must initiate a new association in order to send the new N-EVENT-REPORT.

On reception of a successful N-EVENT-REPORT-RQ notification from the Storage Commitment Provider, the images are flagged as committed in the database.

**2.3.1.3.2.2 Accepted Presentation Context Table**

<b>Presentation Context Table - Accepted by NM Camera AE for Image Storage Commitment Push Response SCU Activity</b>					
<b>Abstract Syntax</b>		<b>Transfer Syntax</b>		<b>Role</b>	<b>Extended Negotiation</b>
<b>Name</b>	<b>UID</b>	<b>Name List</b>	<b>UID List</b>		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

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

The NM Camera AE will only accept the SCU role (which must be proposed via SCP/SCU Role Selection Negotiation) within a Presentation Context for the Storage Commitment Push Model SOP Class.

Upon receiving a Storage Commitment N-EVENT-REPORT (Storage Commitment Result), the NM Camera AE will validate the Transaction UID against its list of outstanding Storage Commitment Request Transaction UIDs. If it matches an outstanding Request, the AE will mark all SOP Instances for which a success status is indicated with an Archived flag, shown on the user interface as “Archive” Icon. User shall explicitly request deleting of Instances , which are not marked as “Archived”

If the Storage Commitment Result indicates any failure status the error will be written to the **/home/ctuser/neuvo/logfiles/nwscp.log** error log.

Any retry must be manually reinitiated as a new Storage request following by Storage Commitment Request (see Section 2.3.1.2.3). The list of specific Failure Reason Codes that this AE will be able to process is described in Section 6.1.2.1

Following are the status codes the Application may send back in the N-EVENT-REPORT response command to the Storage Commitment SCP Equipment that sent the N-EVENT-REPORT request:

<b>Service Status</b>	<b>Status Code</b>	<b>Further Meaning</b>	<b>Status Code Explanation</b>	<b>Related Fields Sent Back to the SCU</b>
Failure	0110	Processing failure	This status code is sent if SCANNER AE failed to understand N_EVENT_RESPONSE message	None
Success	0000		Send in case that SCANNER AE successfully processed N_EVENT_RESPONSE message	None

**2.3.1.3.2.3 Presentation Context Acceptance Criterion**

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

**2.3.1.3.2.4 Transfer Syntax Selection Policies**

Within each Presentation Context, the NM Camera AE 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 Supported Communication Stacks

The DICOM Upper Layer Protocol is supported using TCP/IP, as specified in DICOM PS3.8.

The TCP/IP stack is inherited from the Linux Operating System.

### 2.4.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

## 2.5 EXTENSIONS / SPECIALIZATIONS/ PRIVATIZATIONS

### 2.5.1 Standard Extended / Specialized / Private SOP Classes

#### 2.5.1.1 Standard Extended SOP Classes

The product provides Standard Extended Conformance to all supported SOP Classes, through the inclusion of additional Type 3 Standard Elements and Private Data Elements. The extensions are defined in Sections 3 and Section 4

#### 2.5.1.2 Private SOP Classes

The Discovery NM/CT 670 and Discovery NM 630 do not implement any Private SOP Classes.

### 2.5.2 Private Transfer Syntaxes

The Discovery NM/CT 670 and Discovery NM 630 do not implement any Private transfer syntax.

## 2.6 CONFIGURATION

The Discovery NM/CT 670 and Discovery NM 630 systems are 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 Ventri user interface.

### 2.6.1 AE Title/Presentation Address Mapping

The Discovery NM/CT 670 and Discovery NM 630 systems allow 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 Configurable Parameters

The following fields are configurable for NM Camera AE (local):

- Local AE Title

**Note:** Listening Port Number (default value is 4006), PDU length and any time-outs are not configurable for NM Camera AE. The configuration of IP routers and subnet mask is available on a OS level.

The following fields are configurable for every remote DICOM AE:

- Remote AE Title
- Remote IP Address
- Listening TCP/IP Port Number
- Remote AE functionality flags:
  - Send destination
  - Auto-send destination
  - Modality Worklist Provider
  - Storage Commit Server only
  - Auto-Processing destination (shall be used for Xeleris Workstations only)

**Note:** All configurations must be performed by a GE Field Engineer. The DICOM configuration items are configurable or re-configurable by a Field Service Engineer but are not accessible through the NM Camera user interface.

## 2.7 SUPPORT OF EXTENDED CHARACTER SETS

The NM Camera AE supports only a single single-byte extended character set ISO\_IR 100 (Latin alphabet Number 1 supplementary set).

The NM Camera user interface will allow the user to enter characters from the console keyboard that are within ASCII or the configured extended character set. The product specifies ISO\_IR 100 (Latin alphabet Number 1) extended character set in Specific Character Set (0008,0005) whether any such extended characters are included in SOP Instances or not.

The product will accept, as a Modality Worklist SCU, Scheduled Procedure Step Identifiers with any value of Specific Character Set (0008,0005) defined by DICOM standard. It will map that Specific Character Set value without change into the images created pursuant to that Scheduled Procedure Step. Text attributes of the Scheduled Procedure Step Identifier, including Patient and Physician names, that include extended characters will be displayed as described above. If Modality Worklist entries do not contain Specific Character Set (0008,0005) value, the NM Camera AE adds ISO\_IR 100 (Latin alphabet Number 1) extended character set in Specific Character Set (0008,0005) to the images created pursuant to that Scheduled Procedure Step.

## 2.8 CODES AND CONTROLLED TERMINOLOGY

### 2.8.1 Fixed Coded Terminology

The NM Camera AE uses the fixed (non-configurable, non-extensible) coded terminology in NM Image SOP Instance as described in Section 3

The NM Camera DICOM implementation is capable of supporting arbitrary coding schemes for Procedure and Protocol Codes. 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 the DICOM tags:

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

### 2.8.2 Mapped Coded Terminology

The product does not use any mapped coded terminology



### 2.8.3 Configurable Coded Terminology

The product does not use any 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))

### 3. NM INFORMATION OBJECT IMPLEMENTATION

#### 3.1 INTRODUCTION

**Note:** In this section term NM Camera AE DICOM implementation refers to DICOM implementation of Discovery NM/CT 670 in NM standalone mode and in Hybrid mode and the Discovery NM 630 products.

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.

#### 3.2 NM CAMERA MAPPING OF DICOM ENTITIES

The NM Camera AE maps DICOM Information Entities to local Information Entities in the product’s database and user interface.

**TABLE 3-1**  
**MAPPING OF DICOM ENTITIES TO NM CAMERA ENTITIES**

DICOM IE	NM Camera Entity
Patient	Patient
Study	Study
Series	Series
Image	Dataset

#### 3.3 IOD MODULE TABLE

The Nuclear Medicine Information Object Definition comprises the modules of the following table, plus Standard Extended and Private attributes. Standard Extended and Private attributes are described in Section 3.5.

**TABLE 3-2**  
**NM IMAGE IOD MODULES**

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used	3.4.1.1
	Clinical Trial Subject	Not Used	N/A
Study	General Study	Used	3.4.2.1
	Patient Study	Used	3.4.2.2
	Standard Extended Study	Used	3.4.2.3
	Private Study	Used	3.4.2.4
	Clinical Trial Study	Not Used	N/A
Series	General Series	Used	3.4.3.1
	Clinical Trial Series	Not Used	N/A
	Standard Extended Series	Used	3.4.3.2

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	NM/PET Patient Orientation	Used	3.4.3.3
	Private Series	Used	3.4.3.4
Frame of Reference	Frame of Reference	Used for images where Image Type (0008, 0008) Value 3 is TOMO or GATED TOMO	3.4.4.1
Equipment	General Equipment	Used	3.4.5.1
Image	General Image	Used	3.4.6.1
	Image Pixel	Used	3.4.6.2
	Acquisition Context	Used for Cardiac SPECT images only	3.4.6.3
	Device	Not Used	NA
	NM Image Pixel	Used	3.4.6.4
	Specimen	Not Used	N/A
	Multi-frame	Used	3.4.6.5
	NM Multi-frame	Used	3.4.6.6
	NM Image	Used	3.4.6.7
	NM Isotope	Used	3.4.6.8
	NM Detector	Used	3.4.6.9
	NM Tomo-Acquisition	Used for images where Image Type (0008, 0008) Value 3 is TOMO or GATED TOMO	3.4.6.10
	NM Multi-gated Acquisition	Used for images where Image Type (0008, 0008) Value 3 is GATED or GATED TOMO	3.4.6.11
	NM Phase	Used for images where Image Type (0008, 0008) Value 3 is DYNAMIC	3.4.6.12
	NM Reconstruction	Not Used	N/A
	Overlay Plane	Not Used	N/A
	Multi-frame Overlay	Not Used	N/A
	VOI LUT	Used	3.4.6.13
	SOP Common	Used	3.4.6.14
	Private Image	Used	3.4.6.15
Private NM Image	Used	3.4.6.16	
Private Image Tomo	Used for images where Image Type (0008, 0008) Value 3 is TOMO or GATED TOMO	3.4.6.17	
Private Image Multi-Gated	Used for images where Image Type (0008, 0008) Value 3 is GATED or GATED TOMO	3.4.6.18	
Private Image GSPECT	Used for images where Image Type (0008, 0008) Value 3 is GATED TOMO	3.4.6.19	



**3.4.2 Study Entity Modules**

**3.4.2.1 General Study Module**

**TABLE 3-4  
GENERAL STUDY MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Study Instance UID	(0020, 000D)	1	Unique identifier for the Study.(*)(***) Generated by the system for Locally Scheduled protocols
Study Date	(0008, 0020)	2	Date the Study started. Taken from the SPS Start date of the first SPS in the study – Tag (0040, 0002). (*) (***)
Study Time	(0008, 0030)	2	Time the Study started Taken from the SPS Start Time of the first SPS in the study – Tag (0040, 0003). (*) (***)
Accession Number	(0008, 0050)	2	A RIS generated number that identifies the order for the Study.(*) (**) Sent as ZERO LENGTH value if value is not received neither from MWL nor from user input. User can modify value received from MWL
Referring Physician's Name	(0008, 0090)	2	Name of the patient's referring physician (*) (**) Only Last and First Names received from MWL are displayed in UI and stored in image. Sent as ZERO LENGTH value if value is not received neither from MWL nor from user input. User can modify value received from MWL
Study ID	(0020, 0010)	2	User or equipment generated Study identifier. Automatically assigned to the short name of the first Protocol in the study for the Locally scheduled Protocols (**) May be updated by user
Study Description	(0008, 1030)	3	Study Description.(*) (**) Automatically assigned to the short name of the first Protocol in the study for the Locally Scheduled Protocols. Copied from Requested Procedure Description (0032, 1060) of the first SPS in the study when read from Worklist Sent as ZERO LENGTH value if value is not received neither from MWL nor from user input User can modify value received from MWL
Name of Physician(s) Reading Study	(0008, 1060)	3	Names of the physician(s) reading the

			Study.(**) First Name and/or Last Name are copied from user input if entered, otherwise sent as ZERO LENGTH.
Referenced Study Sequence	(0008, 1110)	3	Referenced Study Sequence.(*) NA for locally scheduled protocols. Only a single Item is permitted in this sequence.
>Include 'SOP Instance Reference Macro'			

**Note 1 :** (\*) - Attributes copied from the Worklist if the study source was actually copied from a Worklist query result.

**Note 2 :** (\*\*) - Attributes copied from the user input for Locally scheduled Protocols

**Note 3 :** (\*\*\*) - Cannot be modified by user if received from MWL

**3.4.2.2 Patient Study Module**

**TABLE 3-5  
PATIENT STUDY MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Admitting Diagnoses Description	(0008, 1080)	3	Description of the admitting diagnosis (diagnoses) (**) Sent as ZERO LENGTH value if value is not received from user input for locally scheduled protocols
Patient's Age	(0010, 1010)	3	Age of the Patient Calculated from Patient Birth Date if Patient Birth Date is not empty. Not sent if Patient Birth Date is not defined. Cannot be updated if Patient Birth Date is entered from MWL .
Patient's Size	(0010, 1020)	3	Length or size of the Patient, in meters.(*) (**) Sent as ZERO LENGTH value if value is not received neither from MWL nor from user input. User can modify value received from MWL
Patient's Weight	(0010, 1030)	3	Weight of the Patient, in kilograms.(*) (**) Sent as ZERO LENGTH value if value is not received neither from MWL nor from user input. User can modify value received from MWL

**Note 1 :** (\*) - Attributes copied from the Worklist if the study source was actually copied from a Worklist query result.

**Note 2 :** (\*\*) - Attributes copied from the user input for Locally scheduled Protocols

**3.4.2.3 Standard Extended Study Module**

**TABLE 3-6  
STANDARD EXTENDED STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Requested Procedure Comments	(0040, 1400)	3	User-defined Study notes Sent as ZERO LENGTH value if value is not received from user input
Allergies	(0010, 2110)	3	Description of prior reaction to contrast agents, or other patient allergies or adverse reactions.(*) (**) Sent as ZERO LENGTH value if value is not received neither from MWL nor from user input. User can modify value received from MWL
Pregnancy Status	(0010, 21C0)	3	Describes pregnancy state of patient.(*)(**) Enumerated Values: 0001 = not pregnant 0002 = possibly pregnant 0003 = definitely pregnant 0004 = unknown User can modify value received from MWL

**Note 1 :** (\*) - Attributes copied from the Worklist if the study source was actually copied from a Worklist query result.

**Note 2 :** (\*\*) - Attributes copied from the user input for Locally scheduled Protocols

**3.4.2.4 Private Study Module**

**TABLE 3-7  
PRIVATE STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator ID	Attribute Description
Auto-Processing Application	(0009, xx1E)	QUASAR_INTERNAL_USE	Auto-Processing Application Description. Sent if Auto-processing is defined for protocol
Acquisition flag	(0009, xx42)	QUASAR_INTERNAL_USE	Used for indicating if the study is acquired
Patient Unique Key	(0009, xx39)	QUASAR_INTERNAL_USE	Patient unique key

**3.4.3 Series Entity Modules**

**3.4.3.1 General Series Module**

**TABLE 3-8  
GENERAL SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008, 0060)	1	Type of equipment that originally acquired the data used to create the images in this Series.

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			Defined Terms used for data created on this system: NM = Nuclear Medicine
Series Instance UID	(0020, 000E)	1	Internally generated unique identifier of the Series.
Series Number	(0020, 0011)	2	A number that identifies this Series. Internally generated
Laterality	(0020, 0060)	2C	Laterality of (paired) body part examined. Copied from the user input. Not sent if value is not received from user input. Enumerated Values: R = right L = left
Performing Physicians' Name	(0008, 1050)	3	Name of the physician(s) administering this Series.(**) Sent as empty string if no user input provided.
Protocol Name	(0018, 1030)	3	User-defined description of the conditions under which the Series was performed. The full path of the performed protocol name. E.g. Factory&Service&Static Always sent.
Series Description	(0008, 103E)	3	Description of the Series Defined by the acquired Scan name
Operators' Name	(0008, 1070)	3	Name(s) of the operator(s) supporting the Series Copied from user input. Not sent if no user input provided.
Referenced Performed Procedure Step Sequence	(0008, 1111)	3	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related. The sequence has exactly 1 item. Sequence is added to all image(s) created by system.
>Referenced SOP Class UID	(0008, 1150)	1C	Set to "1.2.840.10008.3.1.2.3.3"
>Referenced SOP Instance UID	(0008, 1155)	1C	Uniquely identifies the referenced SOP Instance. Internally generated.
Body Part Examined	(0018, 0015)	3	Text description of the part of the body examined. Not sent if it is not received from user input Defined Terms used on this system: ABDOMEN ANKLE ARM BREAST CHEST CLAVICLE COCCYX



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			CSPINE ELBOW EXTREMITY FOOT HAND HEAD HEART HIP JAW KNEE LEG LSPINE NECK PELVIS SHOULDER SKULL SSPINE TSPINE
Request Attributes Sequence	(0040, 0275)	3	Sequence that contains attributes from the Imaging Service Request. The sequence has exactly 1 item. Used when Series as created as result of MWL request, not sent otherwise.
>Requested Procedure ID	(0040, 1001)	1C	Identifier that identifies the Requested Procedure in the Imaging Service Request.(*)
>Accession Number	(0008, 0050)	3	A RIS generated number that identifies the order for the Study.(*) May be updated by user manually .
>Study Instance UID	(0020, 000D)	3	Unique identifier for the Study.(*)(***)
>Referenced Study Sequence	(0008, 1110)	3	Uniquely identifies the Study SOP Instances associated with this SOP Instance. The sequence has exactly 1 item.(*)
<i>&gt;&gt; Include 'SOP Instance Reference Macro'</i>			
>Requested Procedure Description	(0032, 1060)	3	Institution-generated administrative description or classification of Requested Procedure.(*)
>Requested Procedure Code Sequence	(0032, 1064)	3	Not Used
>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.(*). The sequence has exactly 1 item. If MWL request contains more then 1 item, only the first item is copied.

>>Include 'Code Sequence Macro'			
Comments on the Performed Procedure Step	(0040, 0280)	3	User-defined comments on the Performed Procedure Step (**). Not sent if it is not received from user input
Performed Procedure Step ID	(0040, 0253)	3	Equipment generated identifier of the protocol carried out within this step. The PPS ID is unique within a study. For MWL scheduled protocols set with "W_" + <SPS ID>. For locally scheduled protocols set with "L_" + numbered id starting from 1 (L_1, L_2). Always sent
Performed Procedure Step Start Date	(0040, 0244)	3	PPS Start Date is the date that the protocol (SPS) acquisition actually started (doesn't matter if the protocol originated from MWL or was locally scheduled). A locally scheduled protocol is an SPS that is created/added in the camera. Always sent
Performed Procedure Step Start Time	(0040, 0245)	3	PPS Start Time is the time that the protocol (SPS) acquisition actually started (doesn't matter if the protocol originated from MWL or was locally scheduled). A locally scheduled protocol is an SPS that is created/added in the camera. Always sent
Performed Procedure Step Description	(0040, 0254)	3	The full path of the performed protocol name. E.g. Factory&Cardiology&One Day Always sent

**Note 1 :** (\*) - Attributes copied from the Worklist if the study source was actually copied from a Worklist query result (if available).

**Note 2 :** (\*\*) - Attributes copied from the user input for Locally scheduled Protocols

**Note 3 :** (\*\*\*) - Cannot be modified by user if received from MWL

**3.4.3.2 Standard Extended Series Module**

**TABLE 3-9  
STANDARD EXTENDED SERIES MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Patient Position	(0018, 5100)	3	Patient position descriptor relative to the Equipment: 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 Attribute is copied from the user input.
--	--	---

**3.4.3.3 NM/PET Patient Orientation Module**

**TABLE 3-10  
NM/PET PATIENT ORIENTATION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Patient Orientation Code Sequence	(0054,0410)	2	Describes the orientation of the patient with respect to gravity. Contains 1 items if Patient Position is one of the following: 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 Otherwise contain 0 items.
>Include Code Sequence Macro			Always (F-10450,99SDM, "recumbent") is sent
> Patient Orientation Modifier Code Sequence	(0054,0412)	2C	Patient Orientation Modifier. Required if needed to fully specify the orientation of the patient with respect to gravity. Contains exactly 1item, if sent
>>Include 'Code Sequence Macro'			The following codes are supported: (F-10310, 99SDM,"prone") (F-10340, 99SDM,"supine") (F-10317, 99SDM,"right lateral decubitus") (F-10319, 99SDM,"left lateral decubitus")
Patient Gantry Relationship Code Sequence	(0054,0414)	2	Describes the orientation of the patient with respect to the gantry. Contains 1 item if Patient Position is one of the following: 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

		Otherwise contain 0 items.
>Include Code Sequence Macro		The following codes are supported: (F-10470, 99SDM,"headfirst") (F-10480, 99SDM,"feet-first")

**3.4.3.4 Private Series Module**

**TABLE 3-11  
PRIVATE SERIES MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Private Creator ID</b>	<b>Attribute Description</b>
Sequence Type	(0009, xx13)	QUASAR_INTERNAL_USE	Acquired Sequence Type
Sequence Name	(0009, xx14)	QUASAR_INTERNAL_USE	Acquired Sequence Name
Protocol Scheduled Date	(0009, xx40)	QUASAR_INTERNAL_USE	Protocol Scheduled Date
Protocol Scheduled Time	(0009, xx41)	QUASAR_INTERNAL_USE	Protocol Scheduled Time
Matched protocol	(0009, xx43)	QUASAR_INTERNAL_USE	For Worklist items. The originally matched protocol vs. protocol name which is the protocol actually acquired
Private SPS ID	(0009, xx44)	QUASAR_INTERNAL_USE	Keeps the SPS ID for protocols that were appended to the original MWL protocol.
Pre-Medication	(0009, xx45)	QUASAR_INTERNAL_USE	Keeps the Pre-Medication as appears in the "To-Do" list (*) (**)
Anatomic Reference	(0009, xx48)	QUASAR_INTERNAL_USE	Keeps the anatomic reference for the specific scan (*). Not sent if not received from user input.
Series Data Sequence	(0033, xx70)	GEMS_XELPRV_01	Sequence of item contains information about acquisition parameters. May contain from 1 or more items. Each item describes specific parameters set.
>Object Type	(0033, xx08)	GEMS_XELPRV_01	Object Type. Contains string "SERIES DATA "
>Modified Flag	(0033, xx10)	GEMS_XELPRV_01	Default value = 0 (Not Modified)
>Name	(0033, xx11)	GEMS_XELPRV_01	SDO Name
>Database Object Unique ID	(0033, xx16)	GEMS_XELPRV_01	Database UID of SDO; contains value of SDO UID tag (0033, xx72) generated at time of object creation.
>Date	(0033, xx17)	GEMS_XELPRV_01	SDO Creation date
>Time	(0033, xx18)	GEMS_XELPRV_01	SDO Creation time
>Series Data Flags	(0033, xx19)	GEMS_XELPRV_01	SDO Flags. Default value = 0
>Protocol Name	(0033, xx1A)	GEMS_XELPRV_01	Name of Protocol created SDO
>Relevant Data UID	(0033, xx1B)	GEMS_XELPRV_01	UID(s) of SOP Instance(s) relative to SDO
>Bulk Data	(0033, xx1C)	GEMS_XELPRV_01	SDO parameter(s) stored as binary buffer(s)
>Int Data	(0033, xx1D)	GEMS_XELPRV_01	List of SDO parameters stored as integers
>Double Data	(0033, xx1E)	GEMS_XELPRV_01	List of SDO parameters stored as doubles
>String Data	(0033, xx1F)	GEMS_XELPRV_01	List of SDO parameters stored as list of strings

>Bulk Data Format	(0033, xx20)	GEMS_XELPRV_01	Format of bulk parameters; contains information about name and size of bulk buffers
>Int Data Format	(0033, xx21)	GEMS_XELPRV_01	Format of integer parameters; contains information about name and number of integers in list
>Double Data Format	(0033, xx22)	GEMS_XELPRV_01	Format of double parameters; contains information about name and number of doubles in list
>String Data Format	(0033, xx23)	GEMS_XELPRV_01	Format of string parameters; contains information about name and number of strings in list
>Description	(0033, xx24)	GEMS_XELPRV_01	User or equipment generated SDO description
>SDO Private SOP Class UID	(0033, xx71)	GEMS_XELPRV_01	SDO Private SOP Class UID- "1.2.840.113619.4.17"
>SDO Instance UID	(0033, xx72)	GEMS_XELPRV_01	SDO Instance UID; Internally generated

**Note 1 :** (\*) - Attributes copied from the Worklist if the study source was actually copied from a Worklist query result (if available).

**Note 2 :** (\*\*) - Attributes copied from the user input for Locally scheduled Protocols

### 3.4.4 Frame Of Reference Entity Modules

#### 3.4.4.1 Frame Of Reference Module

This section specifies the Attributes necessary to uniquely identify a Frame Of Reference which insures the spatial relationship of Images within a Series. It also allows Images across multiple Series to share the same Frame Of Reference. This Frame Of Reference (or coordinate system) shall be constant for all Images related to a specific Frame Of Reference.

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 "Acquisition Parent UID". In CT images, it is (0031,xx02) 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 Acquisition 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 Acquisition Parent UID attribute. The Acquisition 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 Acquisition 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 Acquisition 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 Acquisition 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. ([Reference A](#) in Section 1.6.).

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 3-12  
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	Sent as ZERO LENGTH value if it is not received from user input.

### 3.4.5 Equipment Entity Modules

#### 3.4.5.1 General Equipment Module

**TABLE 3-13  
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008, 0070)	2	Manufacturer of the equipment that produced the composite instances. Default Value "GE MEDICAL SYSTEMS"
Institution Name	(0008, 0080)	3	Institution where the equipment that produced the composite instances is located. Always taken from system configuration.

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			Sent as empty string if it is not received from user input.
Institution Address	(0008, 0081)	3	Mailing address of the institution where the equipment that produced the composite instances is located.  Always taken from system configuration Sent as empty string if it is not received from user input.
Institutional Department Name	(0008, 1040)	3	Department in the institution where the equipment that produced the composite instances is located.  Always taken from system configuration Sent as empty string if it is not received from user input.
Manufacturer's Model Name	(0008, 1090)	3	Manufacturer's model name of the equipment that produced the composite instances. Set to "Tandem_Discovery_670" for Discovery NM/CT 670 implementation Set to "Tandem_Discovery_630" for Discovery NM 630 implementation
Device Serial Number	(0018, 1000)	3	Manufacturer's serial number of the equipment that produced the composite instances.  Always taken from system configuration Sent as empty string if it is not received from user input.
Software Versions	(0018, 1020)	3	Manufacturer's designation of software version of the equipment that produced the composite instances  Software/Hardware versions of current release e.g. "1.003.033.0\HARDWARE_VERSION_1"
Spatial Resolution	(0018,1050)	3	The inherent limiting resolution in mm of the acquisition equipment for high contrast objects for the data gathering and reconstruction technique chosen.  Always taken from system configuration. Default value is 5. Always sent
Date of Last Calibration	(0018, 1200)	3	Date when the image acquisition device calibration was last changed in any way.  Always taken from system configuration Always Sent
Time of Last Calibration	(0018, 1201)	3	Time when the image acquisition device calibration was last changed in any way.  Always taken from system configuration Always Sent

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**3.4.6 Image Entity Modules**

**3.4.6.1 General Image Module**

**TABLE 3-14  
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020, 0013)	2	A number that identifies this image. Sent as ZERO Length value.
Patient Orientation	(0020, 0020)	2C	Not sent for NM (not required )
Content Date	(0008, 0023)	2C	The date the image pixel data creation started.
Content Time	(0008, 0033)	2C	The time the image pixel data creation started
Image Type	(0008, 0008)	3	See 3.4.6.7.1
Acquisition Date	(0008, 0022)	3	The date the acquisition of data that resulted in this image started
Acquisition Time	(0008, 0032)	3	The time the acquisition of data that resulted in this image started
Quality Control Image	(0028, 0300)	3	Indicates whether or not this image is a quality control or phantom image. Enumerated Values: YES NO

**3.4.6.2 Image Pixel Module**

**TABLE 3-15  
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028, 0002)	1	See 3.4.6.4 for NM Images
Photometric Interpretation	(0028, 0004)	1	See 3.4.6.4 for NM Images
Rows	(0028, 0010)	1	Number of rows in the image.
Columns	(0028, 0011)	1	Number of columns in the image
Bits Allocated	(0028, 0100)	1	See 3.4.6.4 for NM Images
Bits Stored	(0028, 0101)	1	See 3.4.6.4 for NM Images
High Bit	(0028, 0102)	1	See 3.4.6.4 for NM Images
Pixel Representation	(0028, 0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values used: 0000H = unsigned integer.
Pixel Data	(7FE0, 0010)	1	A data stream of the pixel samples that comprise the Image.
Planar Configuration	(0028, 0006)	1C	Not Used (number of Samples per Pixel is always 1)
Pixel Aspect Ratio	(0028, 0034)	1C	Not Used
Smallest Image Pixel Value	(0028, 0106)	3	The minimum actual pixel value encountered in this image.
Largest Image Pixel Value	(0028, 0107)	3	The maximum actual pixel value encountered in



		this image.
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**3.4.6.3 Acquisition Context Module**

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

**TABLE 3-16  
ACQUISITION CONTEXT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Acquisition Context Sequence	(0040,0555)	2	A sequence of Items that describes the conditions present during the acquisition of the data of the SOP Instance.  The Acquisition context sequence contains 0 items when acquisition context in scan is left "UNKNOWN", otherwise contains 1 item.
>Concept Name Code Sequence	(0040,A043)	1	A concept that constrains the meaning of (i.e. defines the role of) the Observation Value. This sequence contains 1 item
<i>&gt;&gt;Include 'Code Sequence Macro'</i>			(109054, DCM, "Patient State") is supported as defined in TID 3470
>Concept Code Sequence	(0040,A168)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept Name Code Sequence (0040,A043) is a Coded Value. This sequence contains 1 item
<i>&gt;&gt;Include 'Code Sequence Macro'</i>			DCID (3101) NM Procedural State Values is supported as defined in TID 3470: The following values are used: <ul style="list-style-type: none"> <li>• (F-01604 ,SRT ,"Resting State")</li> <li>• (F-05019 ,SRT ,"Cardiac Stress State")</li> <li>• (109092 ,DCM ,"Reinjection State")</li> <li>• (109093 ,DCM ,"Redistribution State")</li> <li>• (109094 ,DCM ,"Delayed Redistribution State")</li> </ul>

**3.4.6.4 NM Image Pixel Module**

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

**TABLE 3-17  
NM IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028, 0002)	1	Number of samples (planes) in this image. The value always set to 1.
Photometric Interpretation	(0028, 0004)	1	Specifies the intended interpretation of the pixel data  Enumerated Values supported :  MONOCHROME2
Bits Allocated	(0028, 0100)	1	Number of bits allocated for each pixel sample.

			Each sample shall have the same number of bits allocated. Enumerated Values supported : 16.
Bits Stored	(0028, 0101)	1	Number of bits stored for each pixel sample. Value equal to Bit Allocated (0028, 0100)
High Bit	(0028, 0102)	1	Most significant bit for pixel sample data. Value equal to Bit Stored (0028, 0101) - 1
Pixel Spacing	(0028, 0030)	2	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing, in mm.

**3.4.6.5 Multi-Frame Module**

**TABLE 3-18  
MULTI-FRAME MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028, 0008)	1	Number of frames in a Multi-frame Image.
Frame Increment Pointer	(0028, 0009)	1	See 3.4.6.6.1 for further specialization.

**3.4.6.6 NM Multi-frame Module**

**TABLE 3-19  
NM MULTI-FRAME MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028, 0009)	1	See 3.4.6.6.1 for further specialization.
Energy Window Vector	(0054, 0010)	1C	Defines energy set window to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Energy Window Vector (0054,0010).
Number of Energy Windows	(0054, 0011)	1	Number of energy set windows in SOP Instance. Possible values: 1, 2, 3 or 4.
Detector Vector	(0054, 0020)	1C	Defines detector to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Detector Vector (0054,0020).
Number of Detectors	(0054, 0021)	1	Number of detectors in SOP Instance. Possible values: 1 or 2.
Phase Vector	(0054, 0030)	1C	Defines phase to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Phase Vector (0054,0030).
Number of Phases	(0054, 0031)	1C	Number of phases in SOP Instance. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Phase Vector (0054,0030).

			Supported values: 1, 2, 3, 4, 5
Rotation Vector	(0054, 0050)	1C	Defines rotation to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Rotation Vector (0054,0050).
Number of Rotations	(0054, 0051)	1C	Number of Rotations in SOP Instance. Always set to 1. Sent if Image Type (0008,0008), Value 3 is TOMO and GATED TOMO.
R-R Interval Vector	(0054, 0060)	1C	Defines R-R Interval to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for R-R Interval Vector (0054,0060).
Number of R-R Intervals	(0054, 0061)	1C	Number of R-R Intervals in SOP Instance. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for R-R Interval Vector (0054,0060).
Time Slot Vector	(0054, 0070)	1C	Defines time slot, within cardiac cycle, to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Time Slot Vector (0054,0070).
Number of Time Slots	(0054, 0071)	1C	Number of time slots in SOP Instance. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Time Slot Vector (0054,0070).
Angular View Vector	(0054, 0090)	1C	Defines angular view number to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Angular View Vector (0054,0090).
Time Slice Vector	(0054, 0100)	1C	Defines frame numbers within each phase. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Time Slice Vector (0054,0100).

**3.4.6.6.1 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 3-20.

**TABLE 3-20  
ENUMERATED VALUES FOR FRAME INCREMENT POINTER**

<b>Image Type (0008, 0008), Value 3</b>	<b>Frame Increment Pointer (0028, 0009)</b>
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).

**3.4.6.7 NM Image Module**

**TABLE 3-21  
NM IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008, 0008)	1	See 3.4.6.7.1 for specialization.
Image ID	(0054, 0400)	3	User or equipment generated Image identifier. Taken from Scan name
Counts Accumulated	(0018, 0070)	2	Sum of all gamma events for all frames in the image.
Acquisition Termination Condition	(0018, 0071)	3	Description of how the data collection was stopped. (*) Defined Terms are used: CNTS = counts DENS = density, count limit reached within ROI MANU = manual TIME = time TRIG = physiological trigger
Actual Frame Duration	(0018, 1242)	1C	Elapsed time for one frame acquisition in msec.. Sent when the Image Type (0008, 0008), Value 3, is equal to STATIC or WHOLE BODY.
Count Rate	(0018, 1243)	3	Maximum count rate achieved during the acquisition in counts/sec
Whole Body Technique	(0018, 1301)	3	The type of scan performed. Sent if Image Type (0008, 0008), Value 3, contains the value WHOLE BODY . Enumerated Values used: 1PS = one pass 2PS = two pass PCN= patient contour following employed MSP= multiple static frames collected into a whole body frame.
Scan Velocity	(0018, 1300)	2C	The speed of the camera motion over the body in mm/sec. Sent as ZERO Length value if Image Type (0008, 0008) Value 3 contains the value WHOLE BODY and the WHOLEBODY is

			acquired in the Step-and-Shoot technique, where the table does not move during acquisition.
Scan Length	(0018, 1302)	2C	Size of the imaged area in the direction of scanning motion, in mm. Sent as ZERO Length value if Image Type (0008, 0008) Value 3 contains the value WHOLE BODY and the WHOLEBODY is acquired in the Step-and-Shoot technique, where the table does not move during acquisition.

**Note1:** (\*) – Attribute value is taken from user input

**3.4.6.7.1 Image Type**

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

Value 1 shall have the following Enumerated Values:

- ORIGINAL identifies an Original Image
- DERIVED identifies a Derived Image

Value 2 shall have the following Enumerated Value:

- PRIMARY identifies a Primary Image

The following Enumerated Values of Value 3 are created:

- 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 (SPECT) Image
- GATED TOMO - Identifies a Multi-gated Tomographic Image

The following Enumerated Values of Value 4 are created:

- EMISSION - Transmission source is NOT active during image acquisition
- TRANSMISSION- Transmission source is active during image acquisition

**3.4.6.8 NM Isotope Module**

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

**TABLE 3-22  
 NM ISOTOPE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Energy Window Information Sequence	(0054, 0012)	2	Sequence of Items that describe the energy window groups used. Contain from 1 to 4 Items. The number of items shall be equal to Number of Energy Windows (0054, 0011)
> Energy Window Name	(0054, 0018)	3	A user defined name which describes this Energy Window.
>Energy Window Range Sequence	(0054, 0013)	3	Sequence describing window energy limits. Contains from 1 to 16 items.
>> Energy Window Lower Limit	(0054, 0014)	3	The lower limit of the energy window in KeV.
>> Energy Window Upper Limit	(0054, 0015)	3	The upper limit of the energy window in KeV.
Radiopharmaceutical Information Sequence	(0054, 0016)	2	Information on radiopharmaceutical(s) used. Contains from 1 to 3 items
> Radionuclide Code Sequence	(0054, 0300)	2	Sequence that identifies the radionuclide. Always contains 0 items.
>> <i>Include 'Code Sequence Macro'</i>			<i>Not Used</i>
> Radiopharmaceutical Route	(0018, 1070)	3	Route of injection. (*)
> Administration Route Code Sequence	(0054, 0302)	3	Not Used
> Radiopharmaceutical Volume	(0018, 1071)	3	Volume of injection in cubic cm. (*)
> Radiopharmaceutical Start Time	(0018, 1072)	3	Time of start of injection. (*)
> Radiopharmaceutical Stop Time	(0018, 1073)	3	Time of end of injection. (*)
> Radionuclide Total Dose	(0018, 1074)	3	Total amount of radionuclide injected in MBq. (*)
> Radiopharmaceutical	(0018, 0031)	3	Name of the radiopharmaceutical. (*)
> Radiopharmaceutical Code Sequence	(0054, 0304)	3	Not Used
Intervention Drug Information Sequence	(0018, 0026)	3	Sequence of Items that describes the intervention drugs used. Contains from 1 to 3 Items. Sent as ZERO_LENGTH, if no user input exists.
>Intervention Drug Name	(0018, 0034)	3	Name of intervention drug. (*)
>Intervention Drug Code Sequence	(0018,0029)	3	Not Used
>Administration Route Code Sequence	(0054, 0302)	3	Not Used
>Intervention Drug Start Time	(0018, 0035)	3	Time of administration of the intervention drug, using the same time base as for the Acquisition Start Time (0008, 0032). (*)
>Intervention Drug Stop Time	(0018, 0027)	3	Time of completion of administration of the intervention drug, using the same time base as for the Acquisition Start Time (0008, 0032). (*)
>Intervention Drug Dose	(0018, 0028)	3	Intervention drug dose, in mg. (*)

**Note1:** (\*) – Attribute value is taken from user input if it's not empty, otherwise is not sent

**3.4.6.9 NM Detector Module**

**TABLE 3-23  
NM DETECTOR MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Detector Information Sequence	(0054, 0022)	2	Sequence of Items that describe the detectors used. Contains 1 or 2 Items.
> Collimator/Grid Name	(0018, 1180)	3	Label describing the collimator used, e.g. LEGP LEHR, etc.
> Collimator Type	(0018, 1181)	2	Collimator type. Defined Terms: PARA = Parallel (default) PINH = Pinhole FANB = Fan-beam CONE = Cone-beam SLNT = Slant hole ASTG = Astigmatic DIVG = Diverging NONE = No collimator UNKN = Unknown
> Focal Distance	(0018, 1182)	2	Focal distance, in mm. Default value is 0.
> Zoom Center	(0028, 0032)	3	The amount of offset from (0, 0) applied to each pixel in the image before application of the zoom factor, specified by a numeric pair (in mm).(*)
> Zoom Factor	(0028, 0031)	3	The amount of magnification applied to each pixel in the image.(*) Typical Range 1.0 to 4.0
> Distance Source to Detector	(0018, 1110)	2C	Distance in mm from transmission source to the detector face. Sent if Image Type (0008, 0008) Value 4 is TRANSMISSION and Value 3 is not TOMO.
> Start Angle	(0054, 0200)	3	Position of the detector about the patient for the start of the acquisition, in degrees. (*) Sent if Image Type (0008, 0008), Value 3, is other then TOMO or GATED TOMO
> Radial Position	(0018, 1142)	3	Not Sent
> Image Orientation (Patient)	(0020, 0037)	2	The direction cosines of the first row and the first column with respect to the patient. Set for first frame in dataset
> Image Position (Patient)	(0020, 0032)	2	The x, y, and z coordinates of the upper left hand corner (center of the first voxel transmitted) of the image, in mm. Set for first frame in dataset.

**Note1:** (\*) – Attribute value is taken from user input

**3.4.6.10 NM Tomo Acquisition Module**

This module is present when the Image Type (0008, 0008) Value 3, is equal to TOMO or GATED TOMO.

**TABLE 3-24  
NM TOMO ACQUISITION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Rotation Information Sequence	(0054, 0052)	2	Sequence of Items that describe TOMO rotational groups. Contain only 1 item.
> Start Angle	(0054, 0200)	1	Position of the detector about the patient for the start of the acquisition, in degrees. (*)
> Angular Step	(0018, 1144)	1	The angular scan arc step between views of the TOMO acquisition, in degrees (*)
> Rotation Direction	(0018, 1140)	1	Direction of rotation of the detector about the patient. (*) Enumerated Values: CW = clockwise (decreasing angle) CC = counter-clockwise (increasing angle).
> Scan Arc	(0018, 1143)	1	The effective angular range of the scan data in degrees. (*) The value is always positive.
> Actual Frame Duration	(0018, 1242)	1	Nominal acquisition time per angular position, in msec.
> Radial Position	(0018, 1142)	3	Radial distance of the detector from the center of rotation, in mm. Sent as list – one value per angular view.
> Distance Source to Detector	(0018, 1110)	2C	Distance in mm from transmission source to the detector face. Sent if Image Type (0008, 0008) Value 4 is TRANSMISSION.
> Number of Frames in Rotation	(0054, 0053)	1	Number of angular views in this rotation. (*)
> Table Traverse	(0018, 1131)	3	Table longitudinal position at acquisition start .in mm.
> Table Height	(0018, 1130)	3	The distance in mm of the top of the patient table to the center of rotation. Sent in Discovery NM/CT 670 implementation only. In a hybrid scan it is expressed relative to CT iso center, and in non-hybrid scan it is expressed as in normal NM only - measured from floor and up.
Type of Detector Motion	(0054, 0202)	3	Describes the detector motion during acquisition. (*) Enumerated Values: STEP AND SHOOT = Interrupted motion, acquire only while stationary. CONTINUOUS = Gantry motion and acquisition are simultaneous and continuous. ACQ DURING STEP = Interrupted motion, acquisition is continuous.

**Note1:** (\*) – Attribute value is taken from user input.



**3.4.6.11 NM Multi-gated Acquisition Module**

Describe the conditions under which this module is present in this implementation Module applies to a GATED Multi-frame Image. This module is present when the Image Type (0008, 0008) Value 3, is equal to GATED or GATED TOMO

**TABLE 3-25  
NM MULTI-GATED ACQUISITION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Beat Rejection Flag	(0018, 1080)	3	Heart beat duration sorting has been applied. Enumerated Values: Y = yes N = no
PVC Rejection	(0018, 1085)	3	Description of type of arrhythmic beat rejection criteria used. Always sent as "Reject beats out of pvc window"
Skip Beats	(0018, 1086)	3	Number of beats skipped after a detected arrhythmia
Heart Rate	(0018, 1088)	3	Average number of heart beats per minute for the collection period for these frames
Gated Information Sequence	(0054, 0062)	2C	Sequence of Items that describe R-R intervals. Sent if the Frame Increment Pointer (0028,0009) contains the Tag for R-R Interval Vector (0054,0060)  Contains only 1 item if presents
> Cardiac Framing Type	(0018, 1064)	3	Description of type of framing performed.
> Data Information Sequence	(0054, 0063)	2	Sequence of Items that describe gating criteria. Contains only 1 item.
>> Frame Time	(0018, 1063)	1	Nominal time per individual frame in msec
>> Low R-R Value	(0018, 1081)	3	R-R interval lower limit for beat rejection, in msec
>> High R-R Value	(0018, 1082)	3	R-R interval upper limit for beat rejection, in msec
>> Intervals Acquired	(0018, 1083)	3	Number of heartbeats that fall within Low R-R Value (0018, 1081) and High R-R Value (0018, 1082), and were therefore accepted and contribute gamma events to this R-R Interval.
>> Intervals Rejected	(0018, 1084)	3	Number of heartbeats that fall outside Low R-R (0018, 1081) and High R-R Value (0018, 1082), and do not contribute gamma events to this R-R Interval.
>> Time Slot Information Sequence	(0054, 0072)	2C	Sequence of Items that describe Time Slot Information. Sent if the Frame Increment Pointer (0028,0009) contains the Tag for Time Slot vector (0054,0070)  Contains 1 or more items if presents, the number of items is equal to Number of Time Slots (0054,0071).
>>> Time Slot Time	(0054, 0073)	3	Not Used

**3.4.6.12 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. New phase may be defined by user from Scan setup. Default number of phases is 1.

**TABLE 3-26  
 NM PHASE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Phase Information Sequence	(0054, 0032)	2C	Sequence of Items that describes each dynamic phase. Sent if the Frame Increment Pointer (0028,0009) contains the Tag for Phase Vector (0054,0030). Contains 1 to 5 items., if presents.
> Phase Delay	(0054, 0036)	1	Time paused between the last frame of the previous phase and the first frame of this phase, in msec. (*) Set to 0 for 1 <sup>st</sup> phase.
> Actual Frame Duration	(0018, 1242)	1	Nominal time of acquisition per individual frame, in msec.(*)
> Pause Between Frames	(0054, 0038)	1	Time paused between each frame of this phase (in msec).(*)
> Number of Frames in Phase	(0054, 0033)	1	Number of frames in this phase. (*)

**Note1:** (\*) – Attribute value is taken from user input

**3.4.6.13 VOI LUT Module**

**TABLE 3-27  
 VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Window Center	(0028, 1050)	1C	Window Center for display. Only single value is present. Calculated from actually acquired maximal and minimal pixel values. Always sent
Window Width	(0028, 1051)	1C	Window Width for display. Only single value is present. Calculated from actually acquired maximal and minimal pixel values. Always sent.

**3.4.6.14 SOP Common Module**

**TABLE 3-28  
 SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008, 0016)	1	Uniquely identifies the SOP Class. Always set to "1.2.840.10008.5.1.4.1.1.20"
SOP Instance UID	(0008, 0018)	1	Uniquely identifies the SOP Instance. Internally generated.
Specific Character Set	(0008, 0005)	1C	Character Set that expands or replaces the Basic Graphic Set. Defined Terms include for locally created

			images: ISO_IR 100 = Latin Alphabet No. 1 For images created from MWL, the value is copied from value provided in MWL, if not empty, otherwise ISO_IR 100 is used. Always included into image
Instance Number	(0020, 0013)	3	See 3.4.6.1 for more specialization

**3.4.6.15 Private Image Module**

**TABLE 3-29  
PRIVATE IMAGE MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Private Creator ID</b>	<b>Attribute Description</b>
Origin	(0009, xx12)	QUASAR_INTERNAL_USE	The origin of the image. "isWorklist" if scheduled in MWL, "regular" if locally scheduled.
Image Type	(0009, xx1B)	QUASAR_INTERNAL_USE	Image type string as passed in the scan request
Stop Reason	(0009, xx1D)	QUASAR_INTERNAL_USE	Defines condition that image was installed to db
YOffset	(0037,xx71)	QUASAR_INTERNAL_USE	CT to NM Y difference In Discovery NM/CT 670 implementation is also used for correct registration. For more details about NM/CT registration refer to Section 3.4.4.1. In Discovery NM 630 implementation is always sent as 0.
Image Position Corrections Flag	(0037,xx72)	QUASAR_INTERNAL_USE	Defined if image position corrections are performed. In Discovery NM/CT 670 implementation is also used for correct registration. For more details about NM/CT registration refer to Section 3.4.4.1. Possible values: "true" "false" In Discovery NM 630 implementation is always sent as "false"
NM Bed Position	(0037,xx73)	QUASAR_INTERNAL_USE	Distance from NM FOV center to the position on bed where landmark was set. In Discovery NM/CT 670 implementation is also used for correct registration. For more details about NM/CT registration refer to Section 3.4.4.1. In Discovery NM 630 implementation is always sent as 0
XOffset	(0037,xx78)	QUASAR_INTERNAL_USE	CT to NM X difference In Discovery NM/CT 670 implementation is also used for correct registration.

			For more details about NM/CT registration refer to Section 3.4.4.1. In Discovery NM 630 implementation is always sent as 0.
Source Translator	(0013, xx11)	GEMS_GENIE_1	Internal code of product DICOM implementation. Enumerated Value = 11.
Acquisition Parent UID	(0011, xx31)	GEMS_GENIE_1	Shared by all images created by same scan In Discovery NM/CT 670 implementation is also used for correct registration. For more details about NM/CT registration refer to Frame Of Reference, Section 3.4.4.1

**3.4.6.16 Private NM Image Module**

**TABLE 3-30  
PRIVATE NM IMAGE MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Private Creator ID</b>	<b>Attribute Description</b>
Rate Vector	(0009, xx01)	QUASAR_INTERNAL_USE	Rate for each frame
Count Vector	(0009, xx02)	QUASAR_INTERNAL_USE	Counts accumulated for each frame
Time Vector	(0009, xx03)	QUASAR_INTERNAL_USE	Time for each frame
Camera Shape	(0009, xx08)	QUASAR_INTERNAL_USE	Camera Shape: H mode, L mode
Whole Body Spots	(0009, xx10)	QUASAR_INTERNAL_USE	Defines if WB Spots are created. Sent in images created by WB Scans.
Collimator SQ	(0037,xx10)	QUASAR_INTERNAL_USE	Contains information of collimators parameters. May contain 0 or 1 item.
>Hole Diameter	(0037,xx1B)	QUASAR_INTERNAL_USE	Collimator hole diameter
>Hole Length	(0037,xx30)	QUASAR_INTERNAL_USE	Collimator hole length
>Collimator Thickness	(0037,xx40)	QUASAR_INTERNAL_USE	Collimator thickness
>Septal Thickness	(0037,xx50)	QUASAR_INTERNAL_USE	Collimator septal thickness
>Intrinsic Resolution	(0037,xx60)	QUASAR_INTERNAL_USE	Collimator intrinsic resolution
>Blurring Slope	(0037,xx70)	QUASAR_INTERNAL_USE	Collimator blurring slope
Radio Nuclide Name	(0011, xx0D)	GEMS_GENIE_1	Name of radionuclide used.
Dataset Name	(0011, xx12)	GEMS_GENIE_1	List of dataset names
Detector Number	(0011, xx15)	GEMS_GENIE_1	Detector number image was acquired by.. Sent when image is acquired using one detector only.
Bed Position	(0027,xx11)	APEX_PRIVATE	Linear position of table.

**3.4.6.17 Private Image Tomo Module**

**TABLE 3-31  
PRIVATE IMAGE TOMO MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Private Creator ID</b>	<b>Attribute Description</b>
Angle Vector	(0009, xx07)	QUASAR_INTERNAL_USE	Angle for each TOMO frame. For each frame is tells what is the angle of the detector
Raw Time Vector	(0009, xx1A)	QUASAR_INTERNAL_USE	Raw time vector

Send Joined Flag	(0009, xx23)	QUASAR_INTERNAL_USE	Defines if image shall be joined on send. Set to 1 - for Tomo and GATED TOMO images, for other image types is not sent.
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**3.4.6.18 Private Image Multi-Gated Module**

**TABLE 3-32  
PRIVATE IMAGE MULTI-GATED MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator ID	Attribute Description
Triggers Modification Flag	(0033,xx30)	GEMS_GENIE_1	Triggers Modification Flag
Number of triggers	(0033,xx33)	GEMS_GENIE_1	Number of triggers
Trigger size	(0033,xx34)	GEMS_GENIE_1	Size of one Trigger data slot
Trigger Data size	(0033,xx35)	GEMS_GENIE_1	Size of Trigger Data size
Trigger Data	(0033,xx36)	GEMS_GENIE_1	Buffer with trigger data information
Starting Heart Rate	(0009, xx37)	GEMS_GENIE_1	Heart rate at start of acquisition.

**3.4.6.19 Private Image GSPECT Module**

**TABLE 3-33  
PRIVATE IMAGE GSPECT MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator ID	Attribute Description
Average RR Time Vector	(0009, xx15)	QUASAR_INTERNAL_USE	Average r-r time vector
Low Limit Vector	(0009, xx16)	QUASAR_INTERNAL_USE	Low window limit vector
High Limit Vector	(0009, xx17)	QUASAR_INTERNAL_USE	High window limit vector
Begin Index Vector	(0009, xx18)	QUASAR_INTERNAL_USE	Begin index vector: link to heart beat vector
End Index Vector	(0009, xx19)	QUASAR_INTERNAL_USE	End index vector: link to heart beat vector
Perfusion SOP Instance UID	(0009, xx47)	QUASAR_INTERNAL_USE	Summed image UID

**3.5 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES**

The Product supports the Standard and Private Attributes defined in the following sections in Standard Extended NM SOP Instances as Type 3 data elements.

**3.5.1 Standard Attributes**

The Product supports the following attributes, not specified in the NM IOD, in SOP Instances as Type 3 data elements.

**TABLE 3-34  
STANDARD EXTENDED ATTRIBUTES**

<b>Information Entity Name</b>	<b>Attribute Name</b>	<b>Tag</b>	<b>Use</b>
Study	Allergies	(0010, 2110)	Description of prior reaction to contrast agents, or other patient allergies or adverse reactions.
	Pregnancy Status	(0010, 21C0)	Describes pregnancy state of patient Enumerated Values: 0001 = not pregnant 0002 = possibly pregnant 0003 = definitely pregnant 0004 = unknown
	Requested Procedure Comments	(0040, 1400)	User-defined Study notes
Series	Patient Position	(0018, 5100)	Patient position descriptor relative to the Equipment.

**3.5.2 Private Group QUASAR\_INTERNAL\_USE**

**TABLE 3-35  
PRIVATE GROUP QUASAR INTERNAL USE**

<b>Attribute Name</b>	<b>Tag</b>	<b>VR</b>	<b>VM</b>	<b>Attribute Description and Use</b>
Private Creator Identification	(0009, 00xx)	LO	1	QUASAR_INTERNAL_USE
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.
Camera Shape	(0009, xx08)	US	1	Camera Shape
Whole Body Spots	(0009, xx10)	US	1	Defines if WB Spots are created. Sent in images created by WB Scans.
Origin	(0009, xx12)	LO	1	The origin of the image.
Sequence Type	(0009, xx13)	ST	1	Acquired Sequence Type
Sequence Name	(0009, xx14)	ST	1	Acquired Sequence Name
Average 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
Raw Time Vector	(0009, xx1A)	UL	1-n	Raw time vector
Image Type	(0009, xx1B)	LO	1	Image type string as passed in the scan request
Stop Reason	(0009, xx1D)	US	1	Defines condition that image was installed to db
Auto-Processing Application	(0009, xx1E)	ST	1	Auto-Processing Application Description

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Send Joined Flag	(0009, xx23)	US	1	Defines if image shall be joined on send. Sent for TOMO and GATED TOMO images only
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	The originally matched protocol vs. protocol name which is the protocol actually acquired
Private SPS ID	(0009, xx44)	SH	1	SPS ID for protocols that were appended to the original MWL protocol.
Pre-Medication	(0009, xx45)	LO	1	Keeps the Pre-Medication as appears in the "To Do" list
Perfusion SOP Instance UID	(0009, xx47)	UI	1	Summed image UID .Sent for GATED TOMO images only
Anatomic Reference	(0009, xx48)	LO	1	Keeps the anatomic reference for the specific scan
Private Creator Identification	(0037, 00xx)	LO	1	QUASAR_INTERNAL_USE
Collimator SQ	(0037,xx10)	SQ	1	Contains information of collimators parameters.
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
YOffset	(0037,xx71)	FD	1	CT to NM Y difference
Image Position Corrections Flag	(0037,xx72)	SH	1	Defined if image position corrections are performed.
NM Bed Position	(0037,xx73)	FD	1	Distance from NM FOV center to the position on bed where landmark was set.
XOffset	(0037,xx78)	FD	1	CT to NM X difference

**3.5.3 Private Group GEMS\_GENIE\_1**

**TABLE 3-36  
PRIVATE GROUP GEMS\_GENIE\_1**

Attribute Name	Tag	VR	VM	Attribute Description and Use
Private Creator Identification	(0009, 00xx)	LO	1	GEMS_GENIE_1
Starting Heart Rate	(0009, xx37)	SL	1	Heart rate at start of acquisition.
Private Creator Identification	(0011, 00xx)	LO	1	GEMS_GENIE_1
Radio Nuclide Name	(0011, xx0D)	LO	1	Name of radionuclide used.
Dataset Name	(0011, xx12)	LO	1-n	List of Dataset names.
Detector Number	(0011, xx15)	SL	1-n	Sent when image is acquired using one detector only.

Acquisition Parent UID	(0011, xx31)	LO	1-n	Shared by all images created by same scan
Private Creator Identification	(0013, 00xx)	LO	1	GEMS_GENIE_1
Source Translator	(0013, xx11)	SL	1	Internal code of product DICOM implementation. Enumerated Value = 11.
Private Creator Identification	(0033, 00xx)	LO	1	GEMS_GENIE_1
Triggers Modification Flag	(0033,xx30)	SL	1	Triggers Modification Flag
Number of triggers	(0033,xx33)	SL	1	Number of triggers
Trigger size	(0033,xx34)	SL	1	Size of one Trigger data slot
Trigger Data size	(0033,xx35)	SL	1	Size of Trigger Data size
Trigger Data	(0033,xx36)	OB	1	Buffer with trigger data information

**3.5.4 Private Group GEMS\_XELPRV\_01**

**TABLE 3-37  
PRIVATE GROUP GEMS\_XELPRV\_01**

<b>Attribute Name</b>	<b>Tag</b>	<b>VR</b>	<b>VM</b>	<b>Attribute Description and Use</b>
Private Creator Identification	(0033, 00xx)	LO	1	GEMS_XELPRV_01
Object Type	(0033, xx08)	CS	1	Object Type. Contains string "SERIES DATA "
Modified Flag	(0033, xx10)	SL	1	Default value = 0 (Not Modified)
Name	(0033, xx11)	LO	1	SDO Name
Database Object Unique ID	(0033, xx16)	LO	1	Database UID of SDO; contains value of SDO UID tag (0033, xx72) generated at time of object creation
Date	(0033, xx17)	SH	1	SDO Creation date
Time	(0033, xx18)	SH	1	SDO Creation time
SeriesDataFlags	(0033, xx19)	UL	1	SDO Flags. Default value = 0
ProtocolName	(0033, xx1A)	LO	1	Name of Protocol created SDO
RelevantDataUID	(0033, xx1B)	LO	1	UID(s) of SOP Instance(s) relative to SDO
BulkData	(0033, xx1C)	OB	1	SDO parameter(s) stored as binary buffer(s)
IntData	(0033, xx1D)	SL	1-n	List of SDO parameters stored as integers
Double Data	(0033, xx1E)	FD	1-n	List of SDO parameters stored as doubles
String Data	(0033, xx1F)	OB	1	List of SDO parameters stored as list of strings
BulkDataFormat	(0033, xx20)	OB	1	Format of bulk parameters; contains information about name and size of bulk buffers
IntDataFormat	(0033, xx21)	OB	1	Format of integer parameters; contains information about name and number of integers in list
DoubleDataFormat	(0033, xx22)	OB	1	Format of double parameters; contains information about name and number of doubles



				in list
StringDataFormat	(0033, xx23)	OB	1	Format of string parameters; contains information about name and number of strings in list
Description	(0033, xx24)	LT	1	User or equipment generated SDO 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.
SDO Private SOP Class UID	(0033, xx71)	UI	1	SDO Private SOP Class UID- "1.2.840.113619.4.17"
SDO Instance UID	(0033, xx72)	UI	1	SDO Instance UID; Internally generated

**3.5.5 Private Group APEX\_PRIVATE**

**TABLE 3-38  
PRIVATE GROUP APEX\_PRIVATE**

<b>Attribute Name</b>	<b>Tag</b>	<b>VR</b>	<b>VM</b>	<b>Attribute Description and Use</b>
Private Creator Identification	(0027, 00xx)	LO	1	APEX_PRIVATE
Bed Position	(0027,xx11)	DS	1	Linear position of table.

## 4. SECONDARY CAPTURE INFORMATION OBJECT IMPLEMENTATION

### 4.1 INTRODUCTION

**Note:** In this section term NM Camera AE DICOM implementation refers to DICOM implementation of Discovery NM/CT 670 in NM standalone mode and in Hybrid mode and the Discovery NM 630 products.

This section specifies the use of the DICOM SC Image IOD to represent the information included in SC Images produced by this implementation. Corresponding attributes are conveyed using the module construct.

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.

### 4.2 NM CAMERA MAPPING OF DICOM ENTITIES

NM Camera AE maps DICOM Information Entities to local Information Entities in the product's database and user interface.

TABLE 4-1  
MAPPING OF DICOM ENTITIES TO NM CAMERA ENTITIES

DICOM IE	NM Camera Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image

### 4.3 IOD MODULE TABLE

The Secondary Capture Information Object Definition comprises the modules of the following table, plus Standard Extended and Private attributes. Standard Extended and Private attributes are described in Section 4.5.

TABLE 4-2  
SC IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used	4.4.1.1
	Clinical Trial Subject	Not Used	N/A
Study	General Study	Used	4.4.2.1
	Patient Study	Not Used	N/A
	Standard Extended Study	Used	4.4.2.2
	Clinical Trial Study	Not Used	N/A
Series	General Series	Used	4.4.3.1
	Clinical Trial Series	Not Used	N/A
Equipment	General Equipment	Used	4.4.4.1
	SC Equipment	Used	4.4.4.2
Image	General Image	Used	4.4.5.1
	Image Pixel	Used	4.4.5.2
	Device	Not Used	N/A
	Specimen	Not Used	N/A
	SC Image	Used	4.4.5.3
	Overlay Plane	Not Used	N/A
	Modality LUT	Not Used	N/A
	VOI LUT	Not Used	N/A
	SOP Common	Used	4.4.5.4
	Standard Extended Image	Used	4.4.5.5
	Private SC Image	Used	4.4.5.6

#### 4.4 INFORMATION MODULE DEFINITIONS

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

**4.4.1 Patient Entity Modules**

**4.4.1.1 Patient Module**

**TABLE 4-3  
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	Contains Description of QC test performed. For example, "NM Daily QC", "Uniformity Test", "COR Test", etc.
Issuer of Patient ID	(0010,0021)	3	Not Used
Issuer of Patient ID Qualifiers Sequence	(0010, 0024)	3	Not Used
Patient's Birth Date	(0010,0030)	2	Execution date of the QC Test
Patient's Sex	(0010,0040)	2	Always sent as empty string
Other Patient IDs	(0010,1000)	3	Not Used
Other Patient IDs Sequence	(0010,1002)	3	Not Used

**4.4.2 Study Entity Modules**

**4.4.2.1 General Study Module**

**TABLE 4-4  
GENERAL STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Unique identifier for the Study. Internally generated by the system.
Study Date	(0008,0020)	2	Date the Study started.
Study Time	(0008,0030)	2	Time the Study started
Referring Physician's Name	(0008,0090)	2	Name of the patient's referring physician. Sent as empty string.
Study ID	(0020,0010)	2	Equipment generated Study identifier Automatically assigned to the description of the QC test performed. For example, "NM Daily QC", "Uniformity Test", "COR Test", etc
Accession Number	(0008,0050)	2	Accession Number. Sent as an empty string
Study Description	(0008,1030)	3	Study Description. Automatically assigned to default Value "QC-protocol"

**4.4.2.2 Study Standard Extended Module**

**TABLE 4-5  
STUDY STANDARD EXTENDED ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Scheduled Study Location	(0032, 1020)	3	Study status , Set to "acquired".

**4.4.3 Series Entity Modules**

**4.4.3.1 General Series Module**

**TABLE 4-6  
GENERAL SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	SC Images created by Discovery NM/CT 670 and Discovery NM 630 implementations generally have this attribute set to the value found in the original image.  Defined Terms: NM = Nuclear Medicine
Series Instance UID	(0020,000E)	1	Internally generated unique identifier of the Series.
Series Number	(0020,0011)	2	A number that identifies this Series. Set as ZERO LENGTH value.
Series Date	(0008,0021)	3	Date the Series started. Not Sent
Series Time	(0008,0031)	3	Time the Series started. Not Sent
Series Description	(0008,103E)	3	Description of the Series.  Defined by the name of QC report.

**4.4.4 Equipment Entity Modules**

**4.4.4.1 General Equipment Module**

This module is used to describe information of the equipment generating the current derived instance

**TABLE 4-7  
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Manufacturer of the equipment that produced the SC instances.  Default Value "GE MEDICAL SYSTEMS"

**4.4.4.2 SC Equipment Module**

**TABLE 4-8  
SC EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Use
Conversion Type	(0008,0064)	1	Specify Defined Terms used: SI = Scanned Image
Modality	(0008,0060)	3	SC Images created by NM Camera AE generally have this attribute set to the value found in the original image.  Defined Terms: NM = Nuclear Medicine

**4.4.5 Image Entity Modules**

**4.4.5.1 General Image Module**

**TABLE 4-9  
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	A number that identifies this image. Sent as ZERO Length value
Content Date	(0008,0023)	2C	The date the SC Image pixel data creation started
Content Time	(0008,0033)	2C	The time the SC image pixel data creation started
Quality Control Image	(0028,0300)	3	Indicates that this image is a quality control image. Enumerated Values: YES
Image Type	(0008,0008)	3	See 4.4.5.1.1

**4.4.5.1.1 Image Type**

The following Enumerated Value of Value 1 is supported:

- DERIVED identifies a Derived Image

The following Enumerated Value of Value 2 is supported:

- SECONDARY identifies a Secondary Image

**4.4.5.2 Image Pixel Module**

**TABLE 4-10  
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. Always set to 3
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data  Defined Terms supported: RGB
Rows	(0028,0010)	1	Number of rows in the image. Always set to 878
Columns	(0028,0011)	1	Number of columns in the image Always set to 1004
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated.  Enumerated Values supported : 8
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Value equal to Bit Allocated (0028,0100)

High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Value equal to Bit Stored (0028,0101) - 1
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values: 0000H = unsigned integer.
Pixel Data	(7FE0,0010)	1	A data stream of the pixel samples that comprise the Image.
Planar Configuration	(0028,0006)	1C	Enumerated Values: 0000H = color-by-pixel

**4.4.5.3 SC Image Module**

**TABLE 4-11  
SC IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Use
Pixel Spacing	(0028,0030)	1C	Not sent. Secondary Capture images created by product are not calibrated images, contain screen captures of QC result tables.

**4.4.5.4 SOP Common Module**

**TABLE 4-12  
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Uniquely identifies the SOP Class. Always set to "1.2.840.10008.5.1.4.1.1.7"
SOP Instance UID	(0008,0018)	1	Uniquely identifies the SOP Instance. Internally generated.
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set.  Defined Terms include for locally created images: ISO_IR 100 = Latin Alphabet No. 1 Always sent.
Instance Number	(0020,0013)	3	Sent as empty String

**4.4.5.5 Standard Extended Image Module**

**TABLE 4-13  
IMAGE STANDARD EXTENDED ATTRIBUTES**

Attribute Name	Tag	Use
Counts Accumulated	(0018,0070)	Sent as ZERO Length

**4.4.5.6 Private SC Image Module**

**TABLE 4-14  
PRIVATE SC IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator ID	Attribute Description
Sequence Name	(0009, xx14)	QUASAR_INTERNAL_USE	Acquired Sequence Type

Patient Unique Key	(0009, xx39)	QUASAR_INTERNAL_USE	Patient unique key
Dataset Name	(0011, xx12)	GEMS_GENIE_1	List of Dataset names

**4.5 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES**

The Product supports the Standard and Private Attributes defined in the following sections in Standard Extended SC SOP Instances as Type 3 data elements.

**4.5.1 Standard Attributes**

The Product supports the following attributes, not specified in the SC IOD, in SOP Instances as Type 3 data elements.

**TABLE 4-15  
STANDARD EXTENDED ATTRIBUTES**

Information Entity Name	Attribute Name	Tag	Use
Study	Scheduled Study Location	(0032, 1020)	Study status , Set to “acquired”.
Image	Counts Accumulated	(0018,0070)	

**4.5.2 Private Group QUASAR\_INTERNAL\_USE**

Private Group QUASAR\_INTERNAL\_USE is modeled as part of the Image Information Entity.

**TABLE 4-16  
PRIVATE GROUP QUASAR INTERNAL USE**

Attribute Name	Tag	VR	VM	Attribute Description and Use
Private Creator Identification	(0009, 00xx)	LO	1	QUASAR_INTERNAL_USE
Sequence Name	(0009, xx14)	ST	1	Acquired Sequence Type
Patient Unique Key	(0009, xx39)	UI	1	Patient unique key

**4.5.3 Private Group GEMS\_GENIE\_1**

Private Group GEMS\_GENIE\_1 is modeled as part of the Image Information Entity.

**TABLE 4-17  
PRIVATE GROUP GEMS GENIE 1**

Attribute Name	Tag	VR	VM	Attribute Description and Use
Private Creator Identification	(0011, 00xx)	LO	1	GEMS_GENIE_1
Dataset Name	(0011, xx12)	LO	1-n	List of Dataset names.

**4.6 STANDARD EXTENDED AND PRIVATE CONTEXT GROUPS**

NM Camera AE does not support any coded terminology.



## 5. MODALITY WORKLIST QUERY IMPLEMENTATION

### 5.1 INTRODUCTION

The Discovery NM/CT 670 implementation (for NM standalone exams and NM/CT hybrid exams) and Discovery NM 630 implementation (for NM standalone exams) map DICOM Information Entities to local Information Entities in the product’s database and user interface.

In the Discovery NM/CT 670 implementation for CT standalone exams, Worklist query is performed via the CT scanner console. For Modality Worklist Information Model Definition, refer to BRIGHTSPEED Conformance Statement ([Reference A](#) in Section 1.6 )

**Note:** In this section term NM Camera AE DICOM implementation refers to DICOM implementation of Discovery NM/CT 670 in NM standalone mode and in Hybrid mode and the Discovery NM 630 products.

This section specifies the use of the DICOM Modality Worklist Information Model used to organize data and against which a Modality Worklist Query will be performed.

### 5.2 NM CAMERA MAPPING OF DICOM ENTITIES

The NM Camera AE maps DICOM Information Entities to local Information Entities in the product’s database and user interface.

**TABLE 5-1**  
**MAPPING OF DICOM ENTITIES TO NM CAMERA ENTITIES**

DICOM	NM Camera Entity
Scheduled Procedure Step	Protocol
Requested Procedure	Study
Imaging Service Request	Study
Visit	Study
Patient	Patient

Matching Requested Procedure Step to NM Camera 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 - Code Meaning

The default configuration is (0040,0007) – Scheduled Procedure Step Description

If Scheduled Protocol Code Sequence - tag (0040,0008) - is selected for mapping, the protocol will be mapped according to the value of Code Meaning - tag (0008,0104).

### 5.3 WORKLIST QUERY MODULE TABLE

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

**TABLE 5-2  
 MODALITY WORKLIST INFORMATION MODEL MODULES**

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	5.4.1.1
	Scheduled Procedure Step	5.4.1.2
Requested Procedure	Requested Procedure	5.4.2.1
Imaging Service Request	Imaging Service Request	5.4.3.1
Visit	Visit Identification	5.4.4.1
	Visit Status	5.4.4.2
	Visit Relationship	5.4.4.3
	Visit Admission	5.4.4.4
Patient	Patient Relationship	5.4.5.1
	Patient Identification	5.4.5.2
	Patient Demographic	5.4.5.3
	Patient Medical	5.4.5.4

**5.4 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.

Note that in all tables below information in “**Mapped into Instance**” column is referenced to NM images only (not SC objects).

**5.4.1 Common Scheduled Procedure Step Entity Modules**

**5.4.1.1 SOP Common Module**

**TABLE 5-3  
 SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Specific Character Set	(0008,0005)	O	1C	Yes	See 5.4.1.1.1

**5.4.1.1.1 Specific Character Set**

The NM Scanner AE will use any Specific Character Set value returned in a Scheduled Procedure Step Identifier in the images created pursuant to that Scheduled Procedure Step. Text attributes, including Patient and Physician names, that include non-ASCII characters will be displayed as described in Section 2.7

5.4.1.2 Scheduled Procedure Step Module

**TABLE 5-4**  
**SCHEDULED PROCEDURE STEP MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Scheduled Procedure Step Sequence	(0040,0100)	R	1	No	Only one Item is supported
>Scheduled Station AE Title	(0040,0001)	R	1	No	Single Value matching is used.
>Scheduled Procedure Step Start Date	(0040,0002)	R	1 *	Yes	Specified as range of date of the form: from Date - To Date. SPS Start Date is mapped into private attribute "Protocol Scheduled Date" in the image – Tag (0009, xx40), QUASAR_INTERNAL_USE Mapped to Study Date (0008,0020) Cannot be modified in UI if received from MWL
>Scheduled Procedure Step Start Time	(0040,0003)	R	1 *	Yes	Matching is not supported. Mapped to Study Time (0008,0030) SPS Start Time is mapped into private attribute "Protocol Scheduled Time" in the image - tag (0009, xx41), QUASAR_INTERNAL_USE Cannot be modified in UI if received from MWL.
>Modality	(0008,0060)	R	1 *	No	Single value and Wildcard value matching is allowed. Possible Values: NM, CT, *
>Scheduled Performing Physician's Name	(0040,0006)	R	2	Yes	Wildcard matching is allowed by Last Name and First Name separately. User may enter matching values for Last Name and/or First Name separately in UI. The value sent in MWL request is created according to the following template : < Last Name>^< First Name>
>Scheduled Procedure Step Description	(0040,0007)	O	1C *	No	Always included in the MWL request. May be used for Protocol Mapping. If Protocol Mapping is configured to use this tag: <ul style="list-style-type: none"> <li>• Never displayed and stored in DB for mapped protocols.</li> <li>• If protocol is not mapped - displayed in "Scheduled Study" column in "To Do" List</li> </ul>

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>Scheduled Protocol Code Sequence	(0040,0008)	O	1C	No	Always included in the MWL request.
>>Code Value	(0008,0100)	O	1	No	Requested explicitly
>>Coding Scheme Designator	(0008,0102)	O	1	No	Requested explicitly
>>Coding Scheme Version	(0008,0103)	O	3	No	Requested explicitly
>>Code Meaning	(0008,0104)	O	3 *	No	Requested explicitly . Returned non-empty value may be used for Protocol Mapping If Protocol Mapping is configured to use this tag: <ul style="list-style-type: none"> <li>• Never displayed and stored in DB for mapped protocols.</li> <li>• If protocol is not mapped - displayed in "Scheduled Study" column in " To Do" List;</li> </ul>
>Pre-Medication	(0040,0012)	O	2C*	Yes	Always included in the MWL request. Mapped into private attribute Pre-Medication – tag (0009,xx45)“QUASAR_INTERNAL_USE”
>Scheduled Procedure Step ID	(0040,0009)	O	1	Yes	Always included in the MWL request.
>Requested Contrast Agent	(0032,1070)	O	2C	No	Always included in the MWL request.
>Scheduled Procedure Step Status	(0040,0020)	O	3	No	Always included in the MWL request.

**Note:** \* in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

**5.4.2 Common Requested Procedure Entity Modules**

**5.4.2.1 Requested Procedure Module**

**TABLE 5-5  
REQUESTED PROCEDURE MODULE ATTRIBUTES**

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Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Requested Procedure ID	(0040,1001)	O	1 *	Yes	Single value and Wildcard value matching is allowed. Displayed in the "To Do" list.
Requested Procedure Description	(0032,1060)	O	1 *	Yes	Always included in the MWL request. Matching is not supported . May be used for Protocol Mapping. If Protocol Mapping is configured to use this tag: <ul style="list-style-type: none"> <li>• If protocol is not mapped - displayed in "Scheduled Study" column in "To Do" List.</li> <li>• Mapped to Study Description tag (0008,1030), if belongs to first Protocol in the Study</li> </ul>
Requested Procedure Code Sequence	(0032,1064)	O	1	Yes	Always included in the MWL request as ZERO Length Sequence Copied to Procedure Code Sequence (0008,1032)
>Code Value	(0008,0100)	O	1	Yes	Not Requested explicitly Copied to Procedure Code Sequence (0008,1032)
>Coding Scheme Designator	(0008,0102)	O	1	Yes	Not Requested explicitly Copied to Procedure Code Sequence (0008,1032)
>Coding Scheme Version	(0008,0103)	O	3	Yes	Not Requested explicitly Copied to Procedure Code Sequence (0008,1032)
>Code Meaning	(0008,0104)	O	3	Yes	Not Requested explicitly Copied to Procedure Code Sequence (0008,1032)
Study Instance UID	(0020,000D)	O	1	Yes	Always included in the MWL request.
Referenced Study Sequence	(0008,1110)	O	2	Yes	Always included in the MWL request as ZERO Length Sequence
>Referenced SOP Class UID	(0008,1150)	O	1C	Yes	Not Requested explicitly
>Referenced SOP Instance UID	(0008,1155)	O	1C	Yes	Not Requested explicitly

**Note:** \* in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

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**5.4.3 Common Imaging Service Request Entity Modules**

**5.4.3.1 Imaging Service Request Module**

**TABLE 5-6  
IMAGING SERVICE REQUEST MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Accession Number	(0008,0050)	O	2 *	Yes	Single Value and Wildchar matching may be requested for this data element
Requesting Physician	(0032,1032)	O	2	No	Always included in the MWL request.
Referring Physician's Name	(0008,0090)	O	2 *	Yes	Always included in the MWL request Only First Name and Last Name are displayed on screen and stored in image; User can modify value arrived from MWL.
Placer Order Number / Imaging Service Request	(0040,2016)	O	3	No	Always included in the MWL request.
Filler Order Number / Imaging Service Request	(0040,2017)	O	3	No	Always included in the MWL request.

**Note:** \* in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

**5.4.4 Common visit Entity Modules**

**5.4.4.1 Visit Identification**

**TABLE 5-7  
VISIT IDENTIFICATION MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Admission ID	(0038,0010)	O	2	No	Always included in the MWL request
Institution Name	(0008,0080)	O	3	No	Always included in the MWL request . Value from MWL response is not stored in the image – used value from System configuration instead.

**5.4.4.2 Visit Status**

**TABLE 5-8  
VISIT STATUS MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Current Patient Location	(0038,0300)	O	2	No	Always included in the MWL request

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**5.4.4.3 Visit Relationship**

**TABLE 5-9  
 VISIT RELATIONSHIP MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Referenced Patient Sequence	(0008,1120)	O	2	Yes	Not requested

**5.4.4.4 Visit Admission**

**TABLE 5-10  
 VISIT ADMISSION MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Referring Physician's Name	(0008,0090)	O	3	Yes	Always included in the MWL request Only First Name and Last Name are displayed on screen and stored in image; User can modify value arrived from MWL.

**5.4.5 Common Patient Entity Modules**

**5.4.5.1 Patient Relationship**

**TABLE 5-11  
 PATIENT RELATIONSHIP MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Referenced Visit Sequence	(0008,1125)	O	3	No	Always included in MWL request
Referenced Patient Alias Sequence	(0038,0004)	O	3	No	Always included in MWL request

**5.4.5.2 Patient Identification**

**TABLE 5-12  
 PATIENT IDENTIFICATION MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Patient's Name	(0010,0010)	R	1 *	Yes	Single Value or Wildchar matching is allowed Last name and First Name separately; Only First Name and Last Name are displayed on screen and stored into image. User cannot modify value received from MWL
Patient ID	(0010,0020)	R	1 *	Yes	Only Single Value matching is allowed for this data element. User cannot modify value received from MWL

Issuer of Patient ID	(0010,0021)	O	3	No	Always included in the MWL request
Other Patient IDs Sequence	(0010, 1002)	O	3	No	Not Used
Issuer of Patient ID Qualifiers Sequence	(0010, 0024)	O	3	No	Not Used
Other Patient IDs	(0010,1000)	O	3	No	Always included in the MWL request

**Note:** \* in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

**5.4.5.3 Patient Demographic**

**TABLE 5-13  
PATIENT DEMOGRAPHIC MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Patients Birth Date	(0010,0030)	O	2 *	Yes	Always included in the MWL request User cannot modify value received from MWL
Patient's Sex	(0010,0040)	O	2 *	Yes	Always included in the MWL request User cannot modify value received from MWL
Patient's Weight	(0010,1030)	O	2*	Yes	Always included in the MWL request User can modify value received from MWL
Patient's Size	(0010,1020)	O	2*	Yes	Always included in the MWL request User can modify value received from MWL
Patient's Age	(0010,1010)	O	3	No	Always included in the MWL request Value calculated from Patient Birth Date is displayed on screen stored into image.
Confidentiality Constraint on Patient Data Description	(0040, 3001)	O	3	No	Always included in the MWL request

**Note:** \* in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

**5.4.5.4 Patient Medical**

**TABLE 5-14  
PATIENT MEDICAL MODULE ATTRIBUTES**

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into Instance	Note
Patient State	(0038,0500)	O	2	No	Always included in the MWL request
Pregnancy Status	(0010,21C0)	O	2*	Yes	Always included in the MWL request
Medical Alerts	(0010,2000)	O	2	No	Always included in the MWL request
Contrast Allergies	(0010,2110)	O	2*	Yes	Always included in the MWL request
Special Needs	(0038,0050)	O	2	No	Always included in the MWL request



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Additional Patient History	(0010,21B0)	O	3	No	Always included in the MWL request
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**Note:** \* in the *Expected Return Key Type* column indicates that this information is displayed on screen, if available

## 6. STORAGE COMMITMENT PUSH MODEL IMPLEMENTATION

### 6.1 STORAGE COMMITMENT PUSH MODEL INFORMATION OBJECT DEFINITION

**Note:** In this section term NM Camera AE DICOM implementation refers to DICOM implementation of Discovery NM/CT 670 in NM standalone mode and in Hybrid mode and the Discovery NM 630 products.

This section describes NM Camera AE Storage Commitment Push Model Implementation.

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

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

Note that requesting storage commitment for CT data is performed via the CT Scanner console. Refer to Discovery\* and BrightSpeed\* DICOM Conformance Statement ([Reference A](#) in Section 1.6).

#### 6.1.1 STORAGE COMMITMENT MODULE FOR N-ACTION

TABLE 6-1  
 STORAGE COMMITMENT MODULE FOR N-ACTION

Attribute Name	Tag	SCU Use
Transaction UID	(0008,1195)	Internally generated.
Storage Media File-Set ID	(0088,0130)	Not used
Storage Media File-Set UID	(0088,0140)	Not used
Referenced SOP Sequence	(0008,1199)	May contain 1 or more items
>Referenced SOP Class UID	(0008,1150)	Storage SOP classes supported as SCU: 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)	SOP Instance UID of the Image which Storage Commitment is required for.
>Storage Media File-Set ID	(0088,0130)	Not used
>Storage Media File-Set UID	(0088,0140)	Not used

#### 6.1.2 STORAGE COMMITMENT MODULE FOR N-EVENT-REPORT

TABLE 6-2  
 STORAGE COMMITMENT MODULE FOR N-EVENT-REPORT

Attribute Name	Tag	SCU Use
Transaction UID	(0008,1195)	Used to identify the N-ACTION Request which N-EVENT-REPORT is relevant to.
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)	Used to identify the images which storage commitment was successful and mark them as Archived.
>Referenced SOP Class UID	(0008,1150)	
>Referenced SOP Instance UID	(0008,1155)	
>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)	Used to identify the images which storage commitment was failed to prevent marking them as Archived.
>Referenced SOP Class UID	(0008,1150)	
>Referenced SOP Instance UID	(0008,1155)	
>Failure Reason	(0008,1197)	See Section 6.1.2.1 for the list of processed values.

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

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:

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

**Note:** (\*) - 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.

## **7. MODALITY PERFORMED PROCEDURE STEP IMPLEMENTATION**

**Note:** Performed Procedure Step is supported only by CT Scanner. Refer to BRIGHTSPEED Conformance Statement ([Reference A](#) in Section 1.6.). Please note that for NM/CT hybrid exams, the Modality Performed Procedure Step option is disabled.