GE Healthcare

Technical Publications

Direction DOC0374470

Discovery NM530c
Conformance Statement for DICOM

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SECTION 1: INTRODUCTION

1.1 OVERVIEW

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

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

Section 2 - Network Conformance Statement, is the DICOM Conformance Statement related to this product Conformance Statements defines the subset of options selected from those offered by the DICOM standard..

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

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

Section 5- Discovery NM 530c Storage Commitment PUSH Model Implementation, which is used both for N-action storage commitment requests by the SCU and N-event report storage commitment notifications by the SCP.

Section 6 - Discovery NM 530c Private Data Object Implementation, which specifies compliance to DICOM requirements for the implementation of a Discovery NM530c private Data Object.

Section 7 - Discovery NM 530c Modality Performed Procedure Step SOP Class Definition allows a Modality Performed Procedure Step Message to be communicated to the Hospital/Radiology information system. The PPS feature is providing the DICOM Modality Performed Procedure Step service as a service class user (SCU).

Appendix A - Discovery NM 530c Private Data Dictionary specifies the private data element definition for Discovery NM 530c.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The documentation structure of the GE Healthcare Conformance Statements and their relationship with the DICOM Conformance Statements is shown in Illustration 1-1.

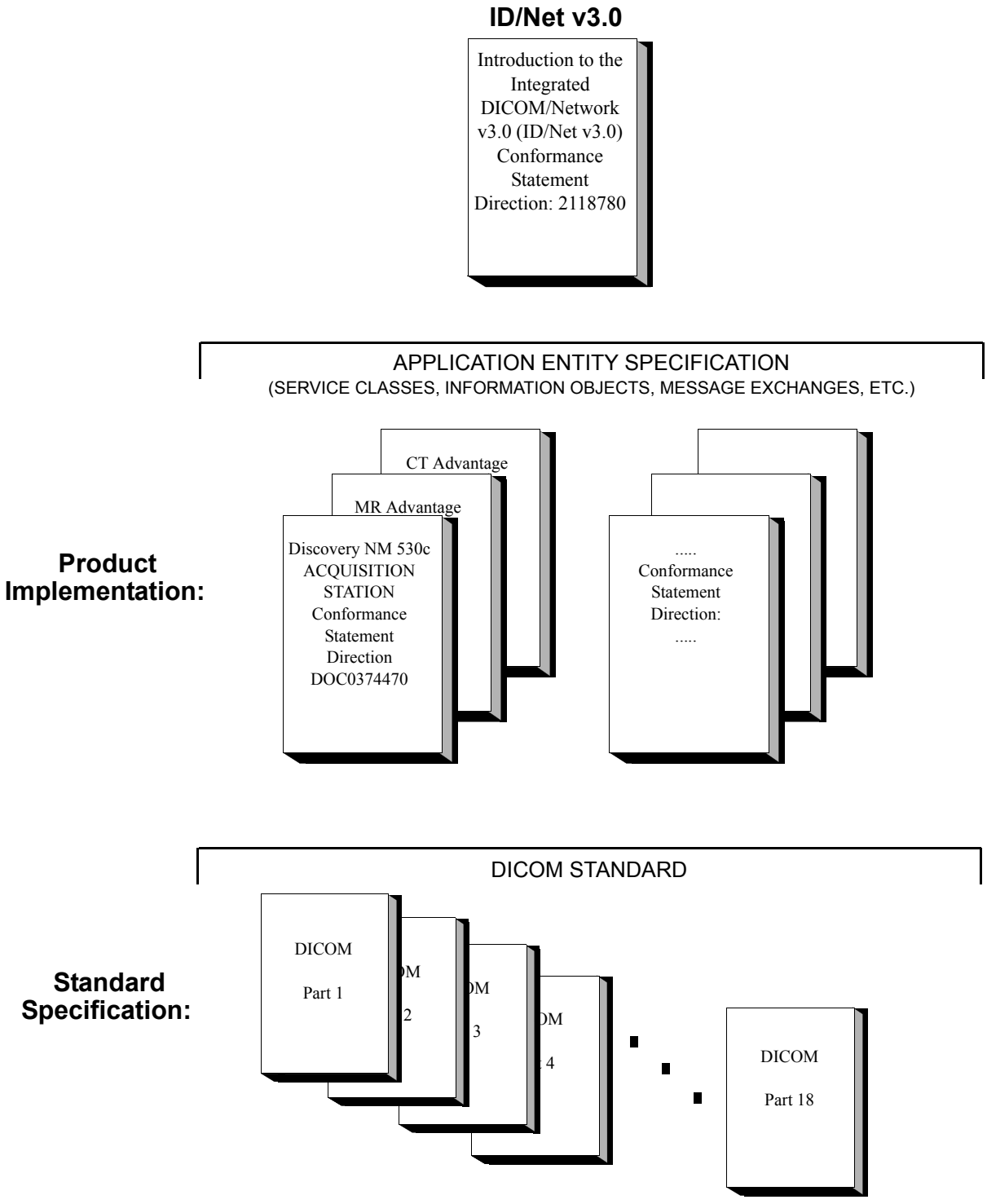

Illustration 1-1. Documentation Structure

This document specifies the DICOM implementation supported by Discovery NM530c. It is entitled:

Discovery NM530c
Conformance Statement for DICOM
Direction DOC0374470

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

Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement
Direction: 2118780.

This introduction familiarizes the reader with DICOM terminology and general concepts. It should be read prior to reading individual products' GE Healthcare Conformance Statements.

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

For more information including Network Architecture and basic DICOM concepts, please refer to the Introduction.

For the convenience of software developers, there is "collector" Direction available. By ordering the collector, the Introduction described above and all of the currently published GEMS Product Conformance Statements will be received. The collector Direction is:

DICOM Conformance Statements
Direction: 2117016

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

DICOM Secretariat
NEMA
1300 North 17th Street, Suite 1847
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 Standards and with the terminology and concepts which are used in those Standards.

If readers are unfamiliar with DICOM terminology they should first refer to the document listed below, then read the DICOM Standard itself, prior to reading this DICOM Conformance Statement document.

Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0)
Conformance Statement
Direction: 2118780

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document, in conjunction with the Introduction to the Integrated DICOM/Network (ID/Net v3.0) Conformance Statements Direction 2118780, to provide an unambiguous specification for GE Healthcare implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to insure proper processing and interpretation of GE Healthcare medical data exchanged using DICOM.

The GE Healthcare Conformance Statements are available to the public. The reader of this conformance statement should be aware that different GE devices are capable of using different Information Object Definitions. For example, a GE CT scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this Conformance Statement are Module Definitions that define all data elements used by the GE Healthcare implementation. If the user encounters unspecified private data elements while parsing a GE 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 retransmit all of the private data elements that are sent by GE 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), 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 GEMS 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) reflected on by these ID/Net 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

A list of references that are applicable to all GE Healthcare Conformance Statements is included in the *Introduction to the Integrated DICOM/Network (ID/Net v3.0) Conformance Statements Direction 2118780*.

1.7 DEFINITIONS

A set of definitions applicable to all GE Healthcare Conformance Statements is included in the Introduction to the *Integrated DICOM/Network (ID/Net v3.0) Conformance Statements Direction 2118780*.

1.8 SYMBOLS AND ABBREVIATIONS

A list of symbols and abbreviations that are applicable to all ID/Net v3.0 Conformance Statements is included in the *Introduction to the Integrated DICOM/Network (ID/Net v3.0) Conformance Statements Direction 2118780*.

SECTION 2: NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant **Networking** features on this product. Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

Discovery NM530c systems provide sophisticated acquisition, image processing and storage functions of nuclear image data acquired through the front end acquisition system.

This section details the roles and DICOM Service Classes supported by the Discovery NM530c.

The Discovery NM530c DICOM implementation allows the user to send Nuclear Medicine image data, acquired through the front-end acquisition system to another DICOM station. For example, the user may wish to send data to another DICOM station. In this situation Discovery NM530c is providing the DICOM C-STORE service as a service class user (SCU).

The Discovery NM530c DICOM implementation supports storage commitment for the already transferred data. This guarantees the user that the acquired Nuclear Medicine image data is safely archived for future use. In this situation Discovery NM530c provides the DICOM Storage Commitment service as Service Class user.

The Discovery NM530c DICOM implementation also provides a verification mechanism by which a remote application entity (AE) can verify application-level communication with the Discovery NM530c DICOM Server. Also provided is a mechanism by which a Discovery NM530c user can verify application-level communication with a remote DICOM AE. In these situations, Discovery NM530c provides the DICOM C-ECHO service as both a SCP and SCU, respectively.

The Discovery NM530c DICOM implementation supports receiving Worklist information from and sending Modality Performed Procedure Step information to a remote AE. Receiving Worklist information is associated with the real world activity: Modality Worklist Query. When a query is performed, the remote AE Worklist items matching the query request are received.

The Discovery NM530c DICOM implementation supports receiving more than one Scheduled procedure step per study instance, enabling the acquisition of their matching number of protocols for this study. Similarly, Discovery NM530c supports scheduling locally more than one protocol to be performed for a study.

The Discovery NM530c DICOM implementation creates and updates Modality Performed Procedure Step 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.

2.2 IMPLEMENTATION MODEL

All DICOM functionality on the Discovery NM530c product is logically provided by the DICOM Server AE. The DICOM Server AE is commanded to perform DICOM services through the use of the Discovery NM530c user interface. The DICOM Server AE also listens on a pre-defined port for incoming connections from remote DICOM AEs.

2.2.1 Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in Illustration 2-1, below.

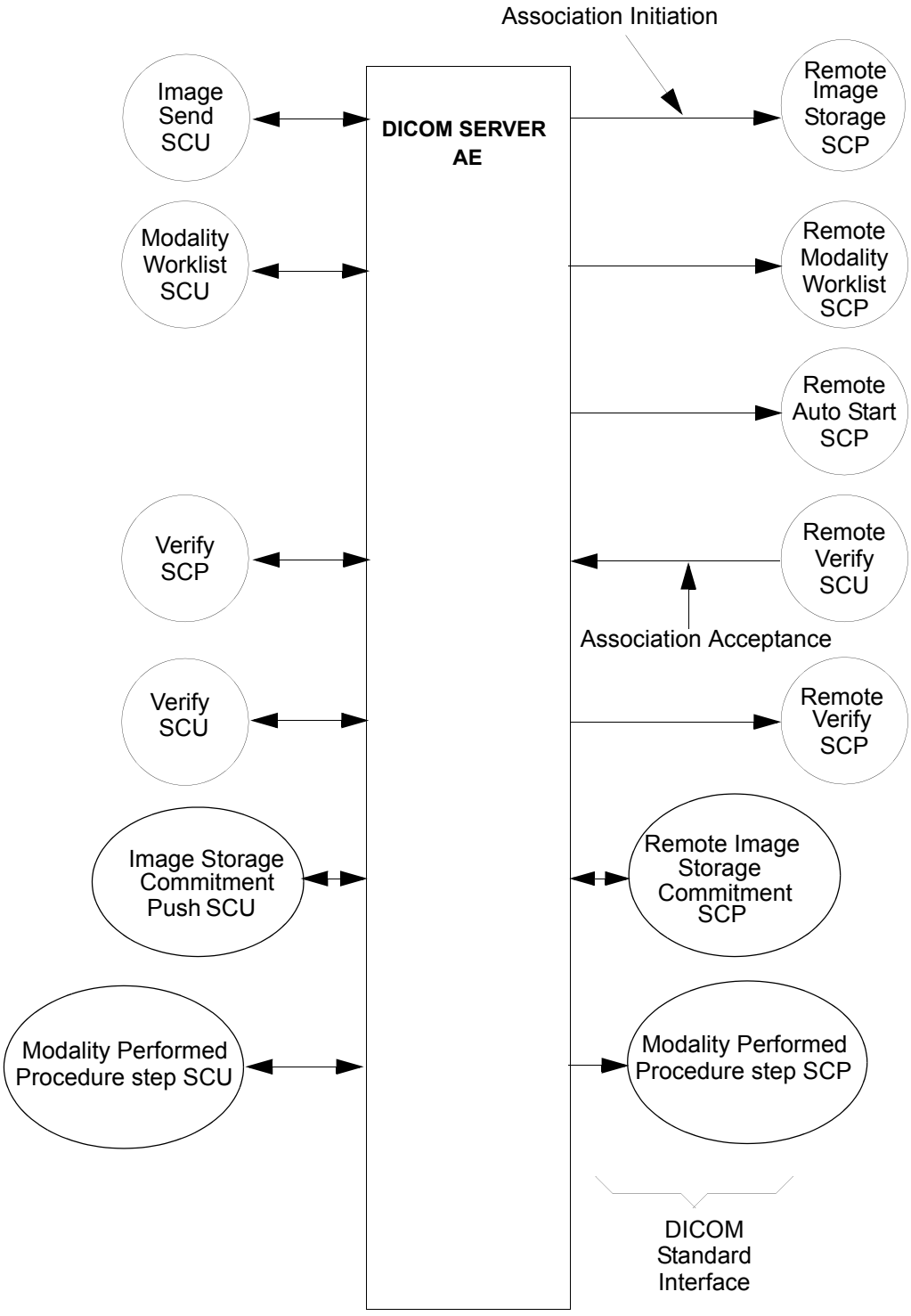

Illustration 2-1. Basic and Specific Application Models

2.2.2 Functional Definitions of Application Entities

The Discovery NM530c DICOM Server 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 DICOM Server 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 DICOM server 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 Worklist (MWL)*: Initiates a DICOM association in order to query the Worklist from a remote AE. If the remote AE accepts a presentation context applicable to the modality Worklist request being sent, the DICOM Server will Receive appropriate MWL responses via the C-FIND service.
- *Modality Performed Procedure Step (MPPS):* Initiates a DICOM association in order to report the progress of the procedure step. When starting the acquisition of the first scan in the protocol, Discovery NM530c DICOM implementation creates an MPPS instance and updates this instance whenever a scan's acquisition is completed for this protocol and when the operator marks this protocol as completed or discontinued.

The Discovery NM530c DICOM Server AE responds to the following functions:

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

2.2.3 Sequencing of Real-World Activities

The Discovery NM530c Application Entity queries the remote station for the modality Worklist; performs acquisition according to local schedules, or by Worklist procedures; stores images; reports the progress of procedure using MPPS; and then requests Storage Commitment for previously stored images.

2.3 AE SPECIFICATIONS

2.3.1 DICOM Server AE Specification

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

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

SOP Class Name	SOP Class UID
Verification - SOP Class	1.2.840.10008.1.1
Modality Worklist Information Model - Find	1.2.840.10008.5.1.4.31
Modality Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3
Private SOP Class	1.2.840.113619.4.27

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

SOP Class Name	SOP Class UID
Verification - ECHO	1.2.840.10008.1.1

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

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

Application Context Name	1.2.840.10008.3.1.1.1

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

Maximum Length PDU	28672 bytes

The SOP Class Extended Negotiation is not supported.

The maximum number of Presentation Context Items that will be proposed is 6. Note that the same Abstract Syntax may be offered multiple times with different Transfer Syntaxes.

The user information items sent by this product are:

- The PDU Maximum length is 28672, and is not configurable
- Implementation UID

2.3.1.1.2 Number of Associations

The DICOM Server AE (SCU) will initiate a single DICOM association to perform a single image store to a remote AE. One association is opened per image both in manual send and in auto-send. Multiple Send operations can be performed. The Storage Commitment Request (SCU) initiates a new single association for all the images that were successfully stored on the remote AE. The Modality Performed Procedure Step Message (SCU) initiates a new DICOM association for each MPPS message. The Maximum Number of associations that the DICOM Server AE (SCU) can open in parallel is 5.

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

2.3.1.1.3 Asynchronous Nature

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

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM Implementation is:

Discovery NM530c Acquisition Station Implementation UID	1.2.840.113619.6.253

2.3.1.2 Association Initiation Policy

The DICOM Server AE initiates a new association

- Due to an image send operation being initiated from the Discovery NM530c user interface, or by auto send option.
- Due to a storage commitment request operation being initiated from the Discovery NM530c user interface upon successful image transfer or by auto send option
- Due to a Verify operation initiated to determine whether the remote DICOM station is operational.
- Due to modality worklist request being initiated from the Discovery NM530c user interface
- Due to Auto Start request being initiated, if the option is enabled, after a study was transferred successfully to the remote AE.
- A new association is initiated for each PPS message.

2.3.1.2.1 Real-World Activity: Image Send

2.3.1.2.1.1 Associated Real-World Activity

The operator must both select image(s) to be transferred from the Patient Selector and select a destination by pressing the destination button. Once these selections have been made, the operator pushes the “Destination” button to initiate an image send operation. The DICOM Server will then initiate an association(s) with the remote AE in order to send the selected image(s) – one image per association – and will accept and interparty responses received from the remote AE.

Note that for each send operation, typically one association is established. The exception to this is that, if an image send fails, the current association is closed and another is opened for sending the remaining image(s).

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

2.3.1.2.1.2 Proposed Presentation Context Table

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

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

2.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for all Storage SOP Classes

This implementation can perform single C-STORE operations 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 15 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 3000 seconds.

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 Successful status, this implementation will close the current association and perform the next C-STORE operation(s).

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

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 image(s) in the request on a different association(s).

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

Service Status	Status Codes	Further Meaning	Application Behavior When receiving Status Codes
Refused	A700	Out of resources.	The message “DICOM Protocol Error” posted on the Log
	A710	Out of resources.	The message “Remote Database could not write dataset” posted to the Log.
	A720	Out of resources.	The message “Internal Error on the Remote Station” posted to the Log.
	A730	Out of resources.	The message “Error! Translation Failed. Cannot send Dataset” posted to the Log.
	A740	Out of resources.	The message “Error! Remote Station could not find Pixel Data” posted to the Log.
Error	C000	Cannot Understand	The message “Unknown Error returned from Remote Station” posted to the Log.
	A900	Data Set does not match SOP Class	The message “Warning!! Dataset does not match SOP Class or Coercion of data elements” posted to the Log. The report about store failure is also posted to the Log
Warning	B000	Coercion of Data Elements	The message “Warning!! Dataset does not match SOP Class or Coercion of data elements” posted to the Log.
	B007	Data Set does not match SOP Class	The message “Warning!! Dataset does not match SOP Class or Coercion of data elements” posted to the Log.
	B006	Elements Discarded	The message “Warning!! Dataset does not match SOP Class or Coercion of data elements” posted to the Log.
Success	0000		The message “Dataset Transfer Completed” posted to the Log.

Note

The error codes A700-A740 are Discovery NM530c Private Status Codes. Discovery NM530c stations will process one of the above mentioned status codes (Refused and Error) in case of Image Send Failure. DICOM PS3.4 provides the flexibility of returning private status codes. Discovery NM530c uses them to provide more information to the Discovery NM530c user in case of an Image Send failure.

If Non-Discovery NM530c stations SCP return the same status code, Discovery NM530c SCU will interpret them as per the table above. The non-Discovery NM530c station’s interpretation of the status code will not be considered.

2.3.1.2.2 Real -world Activity: Storage Commitment Push Model

2.3.1.2.2.1 Associated Real-World Activity

The operator must both select image(s) to be transferred from the Patient Selector 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. The DICOM Server will then initiate the multiple associations with the remote AE in order to send the selected image(s) and will accept interparty responses received from the remote AE. If

the destination is configured as storage commitment capable or the destination is configured to use other storage commitment capable devices, the DICOM Server will initiate one separate association with the remote storage commitment capable AE in order to request a storage commitment for all the successfully transferred image(s).

Note The storage commitment request it will always use a new association for requesting a commitment for the successfully transferred image(s). The storage commitment response will always require the remote AE to initiate a new association with the DICOM Server AE.

The UI shows the status of the storage commitment request progress. The status can be either PENDING, SUCCESS, or FAILURE. The associated error messages due to a failure can be found in the system log.

2.3.1.2.2.2 Proposed Presentation Context Table

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

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

2.3.1.2.2.3 SOP Specific DICOM Conformance Statement for Storage Commitment SOP Classes

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).

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.

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 360 seconds 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.

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.

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

No service class specific status values are defined for the N-ACTION Service. See PS 3.7 for general response status codes.

Table 2-1. Storage Commitment Failure Reasons Module for N-action

Failure Reason	Meaning	SCU Behavior
0110H	Processing failure	Error logged
0112H	No such object instance	Error logged
0213H	Resource limitation	Error logged
0122H	Referenced SOP Class not supported	Error logged
0119H	Class / Instance conflict	Error logged
0131H	Duplicate transaction UID	Error logged

2.3.1.2.3 Real-world Activity: Verify

2.3.1.2.3.1 Associated real-World Activity

Service personnel invoke the DICOM Station Configuration Utility from the Discovery NM530c user interface. The AE Title of the remote is supplied on the command line along with the IP address and the port number of the remote DICOM station.The DICOM Server will initiate an association with the remote DICOM AE in order to verify communication at the application level. The success or failure of the verification process is displayed to the user.

2.3.1.2.3.2 Proposed Presentation Context Table

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

2.3.1.2.3.2.1 SOP Specific DICOM Conformance Statement for Verification SOP Class

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

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

2.3.1.2.4 Real-World Activity: Modality Worklist

2.3.1.2.4.1 Associated Real-World Activity

The user requests Discovery NM530c to query the remote AE for a worklist.

2.3.1.2.4.2 Proposed Presentation Context Table

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

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List		Negotiation
Modality Worklist C - FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

2.3.1.2.4.2.1 SOP Specific DICOM Conformance Statement for all Query SOP Classes

Discovery NM530c provides standard conformance to the DICOM Modality Worklist Service Class as an SCU for the following SOP Classes:

- Modality Worklist C-FIND, UID = 1.2.840.10008.5.1.4.31

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

All the operations used by this SOP class support an **Association Timer**. This timer is started when the association request is sent, and is stopped when the respective response is received. The default time-out value is 15 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 360 seconds.

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

2.3.1.2.5 Real-World Activity: Performed Procedure Step creation and update

2.3.1.2.5.1 Associated Real-World Activity

DICOM Server AE generates an association establishment request upon the following events:

- In order to issue an N-CREATE message with Performed Procedure Step status = IN-PROGRESS when the acquisition of the first scan in the protocol is started.

Note In the acquisition station terminology "Protocol" means "Scheduled Procedure Step".

Upon starting additional scans acquisition in the same protocol, no additional MPPS message is sent.

- In order to issue an N-SET message with Performed Procedure Step status = IN-PROGRESS upon every scan acquisition completion. Note that an N-SET message is sent only upon successful completion of a scan. No MPPS message is sent when operator quits a scan or when the scan is aborted due to an error.

- In order to send a final intermediate N-SET message with Performed Procedure Step status = COMPLETED in the following events:

  -1When the operator presses the "Protocol Completed" button for a selected protocol.

  -2When the operator presses the "Protocol Completed" button where a study instance is selected, the N-SET message is sent for all protocols in a study that has acquired data. Note that pressing "Protocol Completed" when the protocol has no additional images that were not reported by PPS will not result in sending additional MPPS message.

  -3When the acquisition of the last scan in a protocol is completed leaving no non-acquired scans in the protocol, the protocol is automatically considered completed.

- In order to send a final N-SET message with Performed Procedure Step status = DISCONTINUED when the operator presses the "Discontinue Protocol" button for a selected protocol or for all of the protocols in a study when study is selected. The message will be set with the reason for discontinuing the protocol as selected by the operator.

2.3.1.2.5.2 Proposed Presentation Contexts

The following table shows the proposed presentation contexts for the DICOM Server AE after any of the real-world activities listed in Section 2.3.1.2.5.1 are initiated.

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

2.3.1.2.5.3 SOP Specific Conformance statement for MPPS SOP class

- When sending a PPS message, the system looks for stations configured to act as PPS manager. Upon association, if the remote AE does not support the proposed Presentation context, an appropriate error message is logged. Only one association is opened at a time.
- All the operations used by this SOP class support an association timer. The timer is started when a request (N-CREATE request or N-SET request) is sent, and stopped when the respective response is received. The default time-out value is 15 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 3000 seconds, and is not configurable.
- If any of the above timers expires the association is aborted and the operation in-progress is considered FAILED. The user can see if the PPS message was received successfully or unsuccessfully, using the "Transfer Log" screen.
- If the N-CREATE operation fails, the system marks the condition to enable sending N-CREATE again upon next scan's acquisition start.
- If the immediate N-SET operation fails upon scan's acquisition completion, an error is logged. The operator is not informed in any way. This is an intermediate update that will be reported again by sending of the final N-SET COMPLETE or DISCONTINUE message or by sending additional immediate N-SET message(s) after completion of the next scan(s) of the same protocol.
- The PPS N-SET request can inform of completion of multiple images over a single association. A new association is initiated for the PPS request upon a scan completion that may result in multiple images. And upon pressing "Protocol completed" or 'Discontinue protocol" which may encapsulate multiple series and images.

2.3.1.3 Association Acceptance Policy

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

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

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

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

2.3.1.3.1 Real-World Activity: Verify SCP

2.3.1.3.1.1 Associated Real-World Activity

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

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

2.3.1.3.1.2 Accepted Presentation Context Table

Presentation Context Table - Accepted					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended**
Name	**UID**	**Name List**	**UID List**		**Negotiation**
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 DICOM Server AE provides standard conformance to the DICOM verification service class. The DICOM Server AE (SCP) does not have any time-outs defined for the implementation of Verification SOP Class.

2.3.1.3.1.3 Presentation Context Acceptance Criterion

The Presentation Context that will be accepted by the DICOM Server will be the one to which the remote Storage SCP has accorded the highest priority and that is supported by the DICOM Server.

2.3.1.3.1.4 Transfer Syntax Selection Policies

The transfer syntax selection policy is as follows:

- Only the following transfer syntaxes are accepted: Implicit VR Little Endian (1.2.840.10008.1.2), Explicit VR Little Endian (1.2.840.10008.1.2.1)
- Among all proposed transfer syntaxes, the explicit Little Endian transfer syntax is chosen first.

2.4 COMMUNICATION PROFILES

2.4.1 Support Communication Stacks (PS 3.8, PS 3.9)

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

2.4.2 OSI Stack

The OSI Communication Stack is not supported by this implementation.

2.4.3 TCP/IP Stack

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

2.4.3.1 API

Not applicable to this product.

2.4.3.2 Physical Media Support

Ethernet 802.3 provides the physical network layer for this product.

2.4.4 Point-to-Point Stack

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

2.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

2.5.1 Standard Extended/Specialized/Private SOPs

2.5.1.1 Standard Extended SOP Classes

Discovery NM530c NM Images are Standard Extended NM Image Storage SOP Class (see Section 3.6 for a complete description).

2.5.1.2 Private SOP Class

Discovery NM530c implements a Private SOP Class for sending Private Series Data objects (acquisition Raw data – List data) to Remote AE for processing and archiving purposes.

Series data objects are not visible on the Discovery NM530c patient selector, but are generally sent automatically with image data if the entire series is selected for transfer. For details of the Discovery NM530c Private Data Objects refer to Section 6.

2.5.1.3 Private Transfer Syntaxes

Discovery NM530c does not implement any private transfer syntaxes.

2.6 CONFIGURATION

The Discovery NM530c system is configured by GEMS Field Service Engineers.

2.6.1 AE Title/Presentation Address Mapping

Discovery NM530c allows for the configuration of the mapping of remote AE titles to IP addresses and ports. The IP address of a remote AE may be in a different subnet (using routing). A router is configurable to ensure communication from one sub-net to another. This configuration is performed by GEMS Field Service Engineers.

2.6.2 Configuration Parameters

The following parameters are configurable for the DICOM Server AE:

- Local AE Title – default value is UFC_SCANNER
- Local IP address
- Local DICOM Port Number – default value is 104

Note that PDU length and any time-outs are not configurable for Discovery NM530c. The configuration of IP routers and subnet mask is available on a OS level.

The following parameters are configurable for the Remote DICOM AE:

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

2.7 SUPPORT OF EXTENDED CHARACTER SETS

Discovery NM530c will support only the ISO_IR 100 (ISO 8859-1:1987 Latin alphabet N 1. supplementary set) as extended character sets.

2.8 CODES AND CONTROLLED TERMINOLOGY

2.8.1 Fixed Coded Terminology

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

- (0040,0555) - Acquisition Context Module (See Section 3.5.6.2)
- (0054, 0300) - Radionuclide Code Sequence (See Section 3.5.8.4 NM ISotope Module)
- (0054, 0412) - Patient Orientation Modifier (See Section 3.5.3.3 NM/PET Patient Orientation Module)

The Discovery NM530c DICOM implementation is capable of supporting arbitrary coding schemes for Procedure and Protocol Codes. The contents of Requested Procedure Code Sequence (0032,1064) and Scheduled Protocol Code Sequence (0040,0008) supplied in Worklist Items will be mapped to Image IOD and MPPS attributes as described in DICOM Standard. During installation, a service technician will establish a mapping between the site-specific codes and the Protocol Names used internally to identify acquisition protocols. A remote AE station configured to act as Worklist provider is configured to map according to one of three tags:

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

The contents of Performed Procedure Step Discontinuation Reason Code Sequence (0040,0281) for a discontinued MPPS will be filled with a code selected by the user from a fixed list corresponding to Context Group 9300.

2.8.2 Mapped Coded Terminology

The product uses no mapped coded terminology

2.8.3 Configurable Coded Terminology

The product uses no configurable coded terminology

2.9 SECURITY PROFILES

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

It is recommended that the product is used within a secured environment that 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)).

SECTION 3: NUCLEAR MEDICINE (NM) INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

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

3.2 - NM IOD Implementation

3.3 - NM Entity-Relationship Mode

3.4 - IOD Module Table

3.5 - Information Module Definitions

3.2 NM IOD IMPLEMENTATION

The Discovery NM530c implementation of DICOM uses the Nuclear Medicine multi-frame image format when creating image objects. In order to preserve full fidelity when transferring data to a Xeleris/eNTEGRA station, some specialized database information is encoded as private DICOM attributes. All of the Standard and private attributes used are defined in the module tables. The Discovery NM530c private data dictionary is included in Appendix A.

3.3 NM ENTITY-RELATIONSHIP MODE

The Entity-Relationship diagram for the NM Image inter-operability schema is shown in Illustration 3-1**.** In this figure, the following diagrammatic convention is established to represent the information organization:

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

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

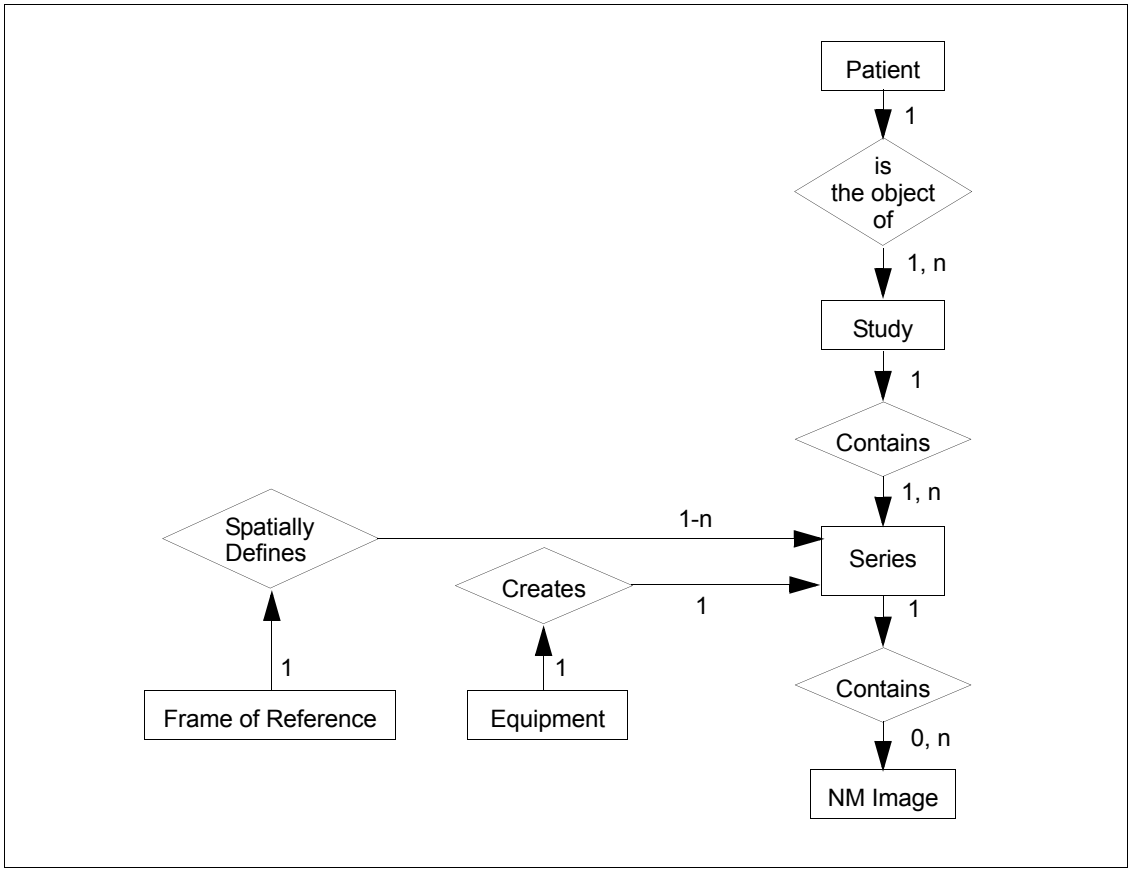

Illustration 3-1. NM Image Entity Relationship Diagram

3.3.1 Entity Descriptions

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

3.3.1.1 Patient Entity Description

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

3.3.1.2 Study Entity Description

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

3.3.1.3 Series Entity Description

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

3.3.1.4 Equipment Entity Description

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

3.3.1.5 Frame of Reference Entity Description

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

3.3.1.6 NM Image Entity Description

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

3.3.2 Discovery NM530c Mapping of DICOM Entities

Table 3-1. Mapping of DICOM Entities to Discovery NM530c Entities

DICOM	Discovery NM530c Entity
Patient	Patient
Study	Study
Series	Series
Image	Imageset
Frame	Not Applicable

3.4 IOD MODULE TABLE

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

Table 3-2 identifies the defined modules within the entities which comprise the DICOM NM IOD. Modules are identified by Module Name.

Please refer to the DICOM Standard Part 3 for a complete definition of the entities, modules, and attributes.

Table 3-2. NM Image IOD Modules

Entity Name	Module Name	Reference
Patient	Patient	Section 3.5.1.1
Study	General Study	Section 3.5.2.1
	Patient Study	Section 3.5.2.2
Series	General Series	Section 3.5.3.1
	Discovery NM530c Private Series	Section 3.5.8.11
	NM/PET Patient orientation	Section 3.5.3.3
Frame of Reference	Frame of Reference	Section 3.5.4.1
Equipment	General Equipment	Section 3.5.5.1
Image	General Image	Section 3.5.6.1
	Discovery NM530c Private Image	Section 3.5.6.3
	Acquisition Context	Section 3.5.6.2
	Image Pixel	Section 3.5.6.4
	NM Image Pixel	Section 3.5.8.1
	Multi-frame	Section 3.5.6.5
	NM Multi-frame	Section 3.5.8.2
	NM Image	Section 3.5.8.3
	NM Isotope	Section 3.5.8.4
	NM Detector	Section 3.5.8.5
	NM TOMO Acquisition	Section 3.5.8.6
	Discovery NM530c Private TOMO Acquisition	Section 3.5.8.7
	NM Multi-gated Acquisition	Section 3.5.8.8
	Discovery NM530c Private GSPECT Acquisition	Section 3.5.8.9

Table 3-2. NM Image IOD Modules (Continued)

Entity Name	Module Name	Reference
	NM Reconstruction	Section 3.5.8.10
	Discovery NM530c Private SPECT Reconstruction	Section 3.5.8.11
	SOP Common	Section 3.5.7.1

3.5 INFORMATION MODULE DEFINITIONS

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

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from. It should be noted that they are the same as those defined in the DICOM Standard Part 3 (Information Object Definitions).

Discovery NM530c Private attributes are defined in private modules, each of which follow the related Standard module. Private data element tags are assigned following the rules given in Part 5 of the DICOM Standard, and are identified using the (gggg,xxnn) format, where xx represents a reserved block of element numbers within the group gggg.

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

3.5.1 Common Patient Entity Modules

3.5.1.1 Patient Module

This section specifies the Attributes of the patient that describe and identify the patient who is the subject of a diagnostic Study. This Module contains Attributes of the patient that are needed for diagnostic interpretation of the Image and are common for all studies performed on the patient. The fields in the Patient Module which can be copied from user input or the worklist will be updated to reflect the possible sources.

Table 3-3. Patient Module Attributes

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

Table 3-3. Patient Module Attributes (Continued)

Referenced Patient Sequence	(0008,1120)	3	Referenced Patient Sequence *
Patient's Birth Time	(0010,0032)	3	
Other Patient IDs	(0010,1000)	3	Other Patient IDs*
Other Patient Names	(0010,1001)	3	Other Patient Names
Ethnic Group	(0010,2160)	3	Ethnic Group
Patient Comments	(0010,4000)	3	Patient Comments field.

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

3.5.2 Common Study Entity Modules

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

3.5.2.1 General Study Modules

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

Table 3-4. General Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Unique identifier to be used to identify the Study. * Generated by the system for Locally Scheduled protocols.
Study Date	(0008,0020)	2	Creation date of study entity. Study date is taken from the SPS Start date of the first SPS in the study – Tag (0040, 0002).
Study Time	(0008,0030)	2	Creation time of study entity. Study time is taken from the SPS Start time of the first SPS in the study – Tag (0040, 0003).
Referring Physician's Name	(0008,0090)	2	Name of the patient's referring physician.*
Study ID	(0020,0010)	2	Study Name (Processing Tag field).*
Accession Number	(0008,0050)	2	A RIS generated number that identifies the order for the Study.* Can be modified in user interface.
Study Description	(0008,1030)	3	Institution-generated description or classification of the Study (component) performed.

Table 3-4. General Study Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Name of Physician(s) Reading Study	(0008,1060)	3	Names of the physician(s) reading the Study.
Procedure Code Sequence	(0008,1032)	3	A Sequence that conveys the type of procedure performed.* NA for locally scheduled protocols
>Include 'Code Sequence Macro'			
Referenced Study Sequence	(0008,1110)	3	A sequence that provides reference to a Study SOP Class/Instance pair.* NA for locally scheduled protocols. May have only 1 item.
>Include SOP Instance Reference Macro			

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

3.5.2.2 Patient Study Modules

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

Table 3-5. Patient Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Patient Age field.
Patient's Size	(0010,1020)	3	Patient Height field.
Patient's Weight	(0010,1030)	3	Patient Weight field.*
Occupation	(0010,2180)	3	Patient Occupation field.
Additional Patient's History	(0010,21B0)	3	Other Patient History field.*

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

3.5.3 Common Series Entity Modules

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

3.5.3.1 General Series Module

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

Table 3-6. General Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Internally set to “NM”.
Series Instance UID	(0020,000E)	1	Internally generated.
Series Number	(0020,0011)	2	Internally generated.
Laterality	(0020,0060)	2C	Body Part Laterality, if present.
Series Date	(0008,0021)	3	Date of Series Creation.
Series Time	(0008,0031)	3	Time of Series Creation.
Performing Physicians’ Name	(0008,1050)	3	Name of the physician(s) administering the Series. Used for MWL query only, not stored in the image.
Protocol Name	(0018,1030)	3	User-defined description of the protocol identification performed for the Series creation.
Series Description	(0008,103E)	3	User provided description of the Series.
Operators' Name	(0008,1070)	3	Operator’s Name
Referenced Performed Procedure Step Sequence	(0008,1111)	3	Uniquely identifies the Modality 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 even no PPS server is configured on system.
>Referenced SOP Class UID	(0008,1150)	1C	Set with "1.2.840.10008.3.1.2.3.3”.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance of the associated MPPS message
Body Part Examined	(0018,0015)	3	Body Part field.

Table 3-6. General Series Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Patient Position	(0018,5100)	2C	Patient Position The Defined Terms are: HFP = Head First-Prone HFS = Head First-Supine HFDR = Head First-Decubitus Right HFDL = Head First-Decubitus Left FFDR = Feet First-Decubitus Right FFDL = Feet First-Decubitus Left FFP = Feet First-Prone FFS = Feet First-Supine
Smallest Pixel Value in Series	(0028,0108)	3	Min Pixel field
Largest Pixel Value in Series	(0028,0109)	3	Max Pixel field
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.
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.
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 "WLPID_" + <SPS ID> For locally scheduled protocols set with "LCPID_" + numbered id starting from 1 (LCPID_1, LCPID_2).
Performed Procedure Step Description	(0040,0254)	3	The full path of the performed protocol name. E.g. Factory&MPH Cardiology&One Day
Performed Protocol Code Sequence	(0040,0260)	3	Assisted protocol setting is not supported.
Request Attributes Sequence	(0040,0275)	3	The sequence has exactly 1 item. Relevant only for items deriving from MWL.
>Accession Number	(0008,0050)	3	An identifier of the Imaging Service Request for this Requested Procedure.* May be set in User Interface.

Table 3-6. General Series Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
>Study Instance UID	(0020,000D)	3	The unique identifier for the Study provided for this Requested Procedure.*
>Requested Procedure Description	(0032,1060)	3	Institution-generated administrative description or classification of Requested Procedure.*
>Scheduled Procedure Step ID	(0040,0009)	1C	Identifier that identifies the Scheduled Procedure Step.*
>Scheduled Procedure Step Description	(0040,0007)	3	Institution-generated description or classification of the Scheduled Procedure Step to be performed.*
>Scheduled Protocol Code Sequence	(0040,0008)	3	Sequence describing the Scheduled Protocol following a specific coding scheme.*
> Requested Procedure ID	(0040,1001)	1C	Identifier that identifies the Requested Procedure in the Imaging Service Request.*
>Referenced Study Sequence	(0008,1110)	3	Uniquely identifies the Study SOP Instances associated with this SOP Instance. One or more items may be included.*
>Requested Procedure Code Sequence	(0032,1064)	3	A sequence that conveys the Procedure Type of the requested procedure. The Requested Procedure Code Sequence shall contain only a single item. Not stored in the image.

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

3.5.3.2 Discovery NM530c Private Series Module

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

Table 3-7. Discovery NM530c Private Series Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Matched protocol	(0009, xx43)	3	"QUASAR_INTERNAL_USE"	For Worklist items. The originally matched protocol vs. protocol name which is the protocol actually acquired
Series Data Sequence	(0033,xx70)	3	"GEMS_XELPRV_01"	Sequence of item contains information about acquisition parameters. May contain from 1 to n Items. Each Items describes specific parameters set.
>Object Type	(0033,xx08)	3	"GEMS_XELPRV_01"	

Table 3-7. Discovery NM530c Private Series Module Attributes (Continued)

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
>Modified Flag	(0033,xx10)	3	"GEMS_XELPRV_01"	
>Name	(0033,xx11)	3	"GEMS_XELPRV_01"	
>Series Data UID	(0033,xx16)	3	"GEMS_XELPRV_01"	
>Date	(0033,xx17)	3	"GEMS_XELPRV_01"	
>Time	(0033,xx18)	3	"GEMS_XELPRV_01"	
>Series Data Flags	(0033,xx19)	3	"GEMS_XELPRV_01"	
>ProtocolName	(0033,xx1A)	3	"GEMS_XELPRV_01"	
>Relevant data UID	(0033,xx1B)	3	"GEMS_XELPRV_01"	
>Bulk Data	(0033,xx1C)	3	"GEMS_XELPRV_01"	
>Int Data	(0033,xx1D)	3	"GEMS_XELPRV_01"	
>DoubleData	(0033,xx1E)	3	"GEMS_XELPRV_01"	
>StringData	(0033,xx1F)	3	"GEMS_XELPRV_01"	
>BulkDataFormat	(0033,xx20)	3	"GEMS_XELPRV_01"	
>IntDataFormat	(0033,xx21)	3	"GEMS_XELPRV_01"	
>DoubleDataFormat	(0033,xx22)	3	"GEMS_XELPRV_01"	
>StringDataFormat	(0033,xx23)	3	"GEMS_XELPRV_01"	
>Seriesdata Private SOPClassUID	(0033,xx71)	3	"GEMS_XELPRV_01"	
>Seriesdata InstanceUID	(0033,xx72)	3	"GEMS_XELPRV_01"	

3.5.3.3 NM/PET Patient Orientation Module

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

Table 3-8. 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.
> 'Code Sequence Macro'			Baseline Context ID is 19
> 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.
>> `Code Sequence Macro'			Baseline Context ID is 20
Patient Gantry Relationship Code Sequence	(0054,0414)	2	Describes the orientation of the patient with respect to the gantry.
> `Code Sequence Macro'			Baseline Context ID is 21

3.5.4 Common Frame of Reference Entity Modules

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

3.5.4.1 Frame of Reference Modules

This section specifies the Attributes necessary to 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.

Discovery NM530c systems group spatially and/or temporally related Images in the same Series. Acquisition data created on other systems may be missing frame of reference information, and for these cases the attribute contains a null value.

Table 3-9. Frame of Reference Module Attributes

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Frame of Reference UID. Appears for all scan types: TOMO, GATED TOMO, RECON TOMO and RECON GATED TOMO
Position Reference Indicator	(0020,1040)	2	Position Reference Indicator, if available.

3.5.5 Common Equipment Entity Modules

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

3.5.5.1 General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced a Series of Images. For Series created on the Discovery NM530c system, the values are generally copied from the original data.

Table 3-10. General Equipment Module Attributes

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	GE MEDICAL SYSTEMS
Institution Name	(0008,0080)	3	Copied from the Worklist if the study source was actually copied from a worklist query result. Otherwise taken from system configuration
Institution Address	(0008,0081)	3	Taken from system configuration.
Station Name	(0008,1010)	3	Station Name
Institutional Department Name	(0008,1040)	3	Taken from system configuration
Manufacturer's Model Name	(0008,1090)	3	UFC
Device Serial Number	(0018,1000)	3	Taken from system configuration
Software Versions	(0018,1020)	3	Software Versions. e.g. 1.003.018.0 HARDWARE_VERSION_1

3.5.6 Common Image Entity Modules

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

3.5.6.1 General Image Module

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

Table 3-11. General Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	Dataset Image Number
Patient Orientation	(0020,0020)	2C	Not required for NM.
Content Date	(0008,0023)	2C	Image Date

Table 3-11. General Image Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Content Time	(0008,0033)	2C	Image Time
Image Type	(0008,0008)	3	See "NM Image Module" on page 20.
Acquisition Date	(0008,0022)	3	Dataset Start Date
Acquisition Time	(0008,0032)	3	Dataset Start Time
Image Comments	(0020,4000)	3	Dataset Comments

3.5.6.2 Acquisition Context Module

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

Table 3-12. Acquisition Context Module Attributes

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

* The Acquisition Context Module and the Acquisition Context Sequence (0040,0555) contained within it are required for cardiac images. The Acquisition context sequence is empty when acquisition context is left "Unknown". Otherwise, the Concept Name Code Sequence (0040,A043) contains (DCM, 109054, "Patient State"); the Concept Code Sequence (0040,A168) uses values from the following list:

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

3.5.6.3 Discovery NM530c Private Image Module

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

Table 3-13. Discovery NM530c Private Image Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Camera Shape	(0009, xx08)	3	"QUASAR_INTERNAL_USE"	Camera Shape: H mode, L mode
Origin	(0009, xx12)	3	"QUASAR_INTERNAL_USE"	The origin of the image."isWorklist" if scheduled in MWL. "regular" if locally scheduled.
Sequence Type	(0009, xx13)	3	"QUASAR_INTERNAL_USE"	Acquired Sequence Type
Sequence Name	(0009, xx14)	3	"QUASAR_INTERNAL_USE"	Acquired Sequence Name
Image Type	(0009, xx1B)	3	"QUASAR_INTERNAL_USE"	Image type string as passed in the scan request
Stop Reason	(0009, xx1D)	3	"QUASAR_INTERNAL_USE"	Defines condition that image was installed to db
Patient Unique Key	(0009, xx39)	3	"QUASAR_INTERNAL_USE"	Patient unique key
Protocol Scheduled Date	(0009, xx40)	3	"QUASAR_INTERNAL_USE"	Protocol Scheduled Date
Protocol Scheduled Time	(0009, xx41)	3	"QUASAR_INTERNAL_USE"	Protocol Scheduled Time
Acquisition flag	(0009, xx42)	3	"QUASAR_INTERNAL_USE"	Used for indicating if the study is acquired
Private SPS ID	(0009, xx44)	3	"QUASAR_INTERNAL_USE"	Keeps the SPS ID for protocols that were appended to the original MWL protocol.
Collimator SQ	(0037,xx10)	3	"QUASAR_INTERNAL_USE"	Contains information of collimators parameters. Contains 1 item.
> Hole Diameter	(0037,xx1B)	3	"QUASAR_INTERNAL_USE"	collimator hole diameter
>Hole Length	(0037,xx30)	3	"QUASAR_INTERNAL_USE"	collimator hole length
>Collimator Thickness	(0037,xx40)	3	"QUASAR_INTERNAL_USE"	collimator thickness
>Septal Thickness	(0037,xx50)	3	"QUASAR_INTERNAL_USE"	collimator septal thickness

Table 3-13. Discovery NM530c Private Image Module Attributes (Continued)

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
>Intrinsic Resolution	(0037,xx60)	3	"QUASAR_INTERNAL_USE"	collimator intrinsic resolution
> Blurring Slope	(0037,xx70)	3	"QUASAR_INTERNAL_USE"	collimator blurring slope
Radio Nuclide Name	(0011, xx0D)	3	"GEMS_GENIE_1"	Name of radionuclide used.
Dataset Name	(0011, xx12)	3	"GEMS_GENIE_1"	
Acquisition Parent UID	(0011, xx31)	3	"GEMS_GENIE_1"	
Pixel Scale	(0011, xx3B)	3	"GEMS_GENIE_1"	
Software Translator	(0013, xx11)	3	"GEMS_GENIE_1"	Internal code of product DICOM implementation. Enumerated Value = 12.
Private Detector Information Sequence	(0055,xx22)	3	"GEMS_GENIE_1"	Contains additional information about camera detectors. Contains only 1 Item
>FOV Shape	(0011,xx3E)	3	"GEMS_GENIE_1"	GEMS NM system detector type. The Defined Term is: 27 - Discovery NM530c
Bed Position	(0027,xx11)	3	"APEX_PRIVATE"	

3.5.6.4 Image Pixel Module

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

Table 3-14. Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	See NM Image Pixel module (Table 3-17 on page 18).
Photometric Interpretation	(0028,0004)	1	See NM and SC Image Pixel modules (Table 3-17 on page 18).
Rows	(0028,0010)	1	Rows
Columns	(0028,0011)	1	Columns

Table 3-14. Image Pixel Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Bits Allocated	(0028,0100)	1	See NM Image Pixel module (Table 3-17 on page 18).
Bits Stored	(0028,0101)	1	See NM Image Pixel module (Table 3-17 on page 18).
High Bit	(0028,0102))	1	See NM Image Pixel module (Table 3-17 on page 18).
Pixel Representation	(0028,0103)	1	Pixel Representation
Pixel Data	(7FE0,0010)	1	Pixel Data
Smallest Image Pixel Value	(0028,0106))	3	Set to minimum pixel value in image.
Largest Image Pixel Value	(0028,0107)	3	Set to maximum pixel value in image.

3.5.6.5 Multi-Frame Module

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

Table 3-15. Multi-Frame Module Attributes

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

3.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

3.5.7.1 SOP Common Module

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

Table 3-16. SOP Common Module Attributes

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Set to “1.2.840.10008.5.1.4.1.1.20”, Nuclear Medicine Image Storage SOP Class UID.
SOP Instance UID	(0008,0018)	1	Internally generated.

Table 3-16. SOP Common Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Not used when the default character set (ISO 646) is used. Set to "ISO_IR 100" when extended character sets are used.
Instance Creation Date	(0008,0012)	3	Date of instance creation.
Instance Creation Time	(0008,0013)	3	Time of instance creation.
Instance Creator UID	(0008,0014)	3	Set to the Implementation UID (see Section 2.3.1.1.4)

3.5.8 Nuclear Medicine Modules

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

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

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

3.5.8.1 NM Image Pixel Module

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

Table 3-17. NM Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Samples per Pixel (always 1 for NM)
Photometric Interpretation	(0028,0004)	1	Photometric Interpretation (always MONOCHOME2)
Bits Allocated	(0028,0100)	1	Bits Allocated (16)
Bits Stored	(0028,0101)	1	Bits Stored (same as Bits Allocated)
High Bit	(0028,0102)	1	High Bit (15)
Pixel Spacing	(0028,0030)	2	Pixel Spacing

3.5.8.2 NM Multi-Frame Module

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

Table 3-18. NM Multi-Frame Module Attributes

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1	See for specialization by NM image type (see Section 3.5.8.2.1).
Energy Window Vector	(0054,0010)	1C	Defines energy set window to which each frame belongs.
Number of Energy Windows	(0054,0011)	1	Number of energy set windows in SOP Instance.
Detector Vector	(0054,0020)	1C	Defines detector to which each frame belongs.
Number of Detectors	(0054,0021)	1	Number of detectors in SOP Instance. Always set to 1.
Rotation Vector	(0054,0050)	1C	Defines rotation to which each frame belongs.
Number of Rotations	(0054,0051)	1C	Number of Rotations in SOP Instance. Always set to 1.
R-R Interval Vector	(0054,0060)	1C	Defines R-R Interval to which each frame belongs.
Number of R-R Intervals	(0054,0061)	1C	Number of R-R Intervals in SOP Instance.
Time Slot Vector	(0054,0070)	1C	Defines time slot, within cardiac cycle, to which each frame belongs.
Number of Time Slots	(0054,0071)	1C	Number of time slots in SOP Instance.
Slice Vector	(0054,0080)	1C	Defines image slice to which each frame belongs.
Number of Slices	(0054,0081)	1C	Number of images slices in SOP Instance.
Angular View Vector	(0054,0090)	1C	Defines angular view number to which each frame belongs.

3.5.8.2.1 NM Multi-Frame Attribute Description

3.5.8.2.1.1 Frame Increment Pointer

The Frame Increment Pointer (0028,0009) defines which frame index vectors are present in the NM Image instance. The Frame Increment Pointer is supported per the DICOM specification for all image types defined in Table 3-19.

Table 3-19. Enumerated Values for Frame Increment Pointer

Image Type (0008,0008), Value 3	Frame Increment Pointer (0028,0009)
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).
RECON TOMO	0054H 0080H Sequencing is by Slice Vector (0054,0080)
RECON GATED TOMO	0054H 0060H \ 0054H 0070H \ 0054H 0080H Sequencing is by R-R Interval Vector (0054,0060), Time Slot Vector (0054,0070), Slice Vector (0054,0080)

3.5.8.3 NM Image Module

This section contains the Attributes that describe Nuclear Medicine Images.

Table 3-20. NM Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Dataset Type (See Section 3.5.8.3.1.1)
Image ID	(0054,0400)	3	Set to name of imageset.
Counts Accumulated	(0018,0070)	2	Detector Counts (number of counts in imageset)
Acquisition Termination Condition	(0018,0071)	3	Defined Terms used: CNTS = count limit reached DENS = count limit reached within ROI MANU = manual TIME = time limit reached TRIG = number of beats limit reached
Actual Frame Duration	(0018,1242)	1C	Duration of each frame in imageset.

Table 3-20. NM Image Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
Count Rate	(0018,1243)	3	Maximum count rate during image acquisition.
Trigger Source or Type	(0018,1061)	3	Defined Terms used: EKG

3.5.8.3.1 NM Image Module Attribute Description

3.5.8.3.1.1 Image Type

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

- Value 1 shall have one of the following Enumerated Values:

  -1 ORIGINAL Identifies an Original Image

  -2 DERIVED An image modified by processing steps

- Value 2 shall have the following Enumerated Value:

  -1 PRIMARY Identifies a Primary Image

- Value 3 shall have the following Enumerated Values:

  -1 TOMO Identifies a Tomographic Image

  -2 GATED TOMO Identifies a Multi-gated Tomographic Image

  -3 RECON TOMO Identifies Reconstructive Tomographic Image

  -4 RECON GATED TOMO Identifies Reconstructive Gated Tomographic Image

- Value 4 shall have the following Enumerated Values:

  -1 EMISSION Transmission source NOT active during image acquisition

  -2 TRANSMISSION Transmission source active during image acquisition

3.5.8.4 NM ISotope Module

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

Table 3-21. NM Isotope Module Attributes

Attribute Name	Tag	Type	Attribute Description
Energy Window Information Sequence	(0054,0012)	2	Energy window information. May contain from 1 to 8 items.
>Energy Window Range Sequence	(0054,0013)	3	Sequence describing window energy limits. May contain from 1 to 16 items.
>> Energy Window Lower Limit	(0054,0014)	3	Lower energy limit in KeV.
>> Energy Window Upper Limit	(0054,0015)	3	Upper energy limit in KeV.
Radiopharmaceutical Information Sequence	(0054,0016)	2	Information on radiopharmaceutical(s) used. May contain from 1 to 3 items.
> Radionuclide Code Sequence	(0054,0300)	2C	Null Sequence
> Radionuclide Total Dose	(0018,1074)	3	Total Dose field.
> Radiopharmaceutical	(0018,0031)	3	Entered on Energy|Isotope card, Pharm field.

3.5.8.5 NM Detector Module

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

Table 3-22. NM Detector Module Attributes

Attribute Name	Tag	Type	Attribute Description
Detector Information Sequence	(0054,0022)	2	Detector information. Contains only 1 item.
> Collimator/Grid Name	(0018,1180)	3	Name of collimator used on this detector.
> Collimator Type	(0018,1181)	2C	Defined Terms used: PARA = Parallel PINH = Pinhole FANB = Fan-beam CONE = Cone-beam SLNT = Slant hole ASTG = Astigmatic DIVG = Diverging NONE = No collimator UNKN = Unknown

Table 3-22. NM Detector Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
> Field of View Shape	(0018,1147)	3	Defined Terms used: RECTANGLE ROUND HEXAGONAL
> Field of View Dimension(s)	(0018,1149)	3	Dimensions of the field of view.
> Focal Distance	(0018,1182)	2C	Focal distance. Value 0 may be sent.
> X Focus Center	(0018,1183)	3	Center point of the focus position.
> Y Focus Center	(0018,1184)	3	Center point of the focus position.
> Zoom Center	(0028,0032)	3	Image center offset from field of view center.
> Zoom Factor	(0028,0031)	3	Zoom factor, typical range: 1.00 to 4.00.
> Center of Rotation Offset	(0018,1145)	3	Offset between detector center and mechanical center
> Gantry/Detector Tilt	(0018,1120)	3	Detector tilt position
> Image Orientation (Patient)	(0020,0037)	2C	Set for first frame in dataset
> Image Position (Patient)	(0020,0032)	2C	Set for first frame in dataset

3.5.8.6 NM TOMO Acquisition Module

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

Table 3-23. NM TOMO Acquisition Module Attributes

Attribute Name	Tag	Type	Attribute Description
Rotation Information Sequence	(0054,0052)	2	Provides TOMO rotation information. Contains only Only 1 item.
> Start Angle	(0054,0200)	1C	Detector start angle at start of acquisition.
> Angular Step	(0018,1144)	1C	Incremental rotational angle change per view.
> Rotation Direction	(0018,1140)	1C	Direction of rotation.

Table 3-23. NM TOMO Acquisition Module Attributes (Continued)

Attribute Name	Tag	Type	Attribute Description
> Scan Arc	(0018,1143)	1C	Total rotation angle.
> Actual Frame Duration	(0018,1242)	1C	Duration of a view.
> Radial Position	(0018,1142)	3	Detector radial position at start of acquisition.
> Number of Frames in Rotation	(0054,0053)	1C	Number of tomographic views acquired.
> Table Traverse	(0018,1131)	3	Table longitudinal position at acquisition start.
> Table Height	(0018,1130)	3	Height of table above floor at acquisition start.
Type of Detector Motion	(0054,0202)	3	Enumerated Values used: STEP AND SHOOT CONTINUOUS ACQ DURING STEP

3.5.8.7 Discovery NM530c Private TOMO Acquisition Module

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

Table 3-24. Discovery NM530c Private TOMO Acquisition Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Rate Vector	(0009, xx01)	3	"QUASAR_INTERNAL_USE"	Rate for each frame
Count Vector	(0009, xx02)	3	"QUASAR_INTERNAL_USE"	Counts accumulated for each frame
Time Vector	(0009, xx03)	3	"QUASAR_INTERNAL_USE"	Time for each frame
Angle Vector	(0009, xx07)	3	"QUASAR_INTERNAL_USE"	Angle for each TOMO frame. For each frame is tells what is the angle of the detector
Raw Time Vector	(0009, xx1A)	3	"QUASAR_INTERNAL_USE"	Raw time vector
Effective Series Duration	(0011, xx0B)	3	"GEMS_GENIE_1"	Duration of acquisition.

3.5.8.8 NM Multi-Gated Acquisition Module

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

Table 3-25. NM Multi-Gated Acquisition Module Attributes

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

3.5.8.9 Discovery NM530c Private GSPECT Acquisition Module

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

Table 3-26. Discovery NM530c Private GSPECT Acquisition Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Avr RR Time Vector	(0009, xx15)	3	"QUASAR_INTERNAL_USE"	Average r-r time vector

Table 3-26. Discovery NM530c Private GSPECT Acquisition Module Attributes (Continued)

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Low Limit Vector	(0009, xx16)	3	"QUASAR_INTERNAL_USE"	Low window limit vector
High Limit Vector	(0009, xx17)	3	"QUASAR_INTERNAL_USE"	High window limit vector
Begin Index Vector	(0009, xx18)	3	"QUASAR_INTERNAL_USE"	begin index vector: link to heart beat vector
End Index Vector	(0009, xx19)	3	"QUASAR_INTERNAL_USE"	end index vector: link to heart beat vector
Perfusion SOP Instance UID	(0011, xx33)	3	"QUASAR_INTERNAL_USE"	
Starting Heart Rate	(0009, xx37)	3	"GEMS_GENIE_1"	Heart rate at start of acquisition.
Triggers Modification Flag	(0033,xx30)	3	"GEMS_GENIE_1"	Triggers Modification Flag
Number of triggers	(0033,xx33)	3	"GEMS_GENIE_1"	Number of triggers
Trigger size	(0033,xx34)	3	"GEMS_GENIE_1"	Size of one Trigger data slot
Trigger Data size	(0033,xx35)	3	"GEMS_GENIE_1"	Size of Trigger Data size
Trigger Data	(0033,xx36)	3	"GEMS_GENIE_1"	Buffer with trigger data information

3.5.8.10 NM Reconstruction Module

This section contains Attributes that describe Nuclear Medicine reconstructed volumes. Reconstructed volumes are created by applying a transformation (reconstruction) process to the acquired TOMO frames. Define the conditions under which this module is present. This module is present only when the Image Type (0008,0008), Value 3, is equal to RECON TOMO or RECON GATED TOMO**.**

Table 3-27. NM Reconstruction Module Attributes

Attribute Name	Tag	Type	Attribute Description
Spacing Between Slices	(0018,0088)	2	Spacing Between Slices
Slice Thickness	(0018,0050)	2	Slice Thickness

3.5.8.11 Discovery NM530c Private SPECT Reconstruction Module

This section contains Attributes that describe Nuclear Medicine reconstructed volumes. Reconstructed volumes are created by applying a transformation (reconstruction) process to the acquired TOMO frames. This module is present only when the Image Type (0008,0008), Value 3, is equal to RECON TOMO or RECON GATED TOMO**.** This Module contains *private* Attributes that convey information not contained in the related DICOM Standard v3.0 Module. Note that each of these attributes may have multiple values when gated reconstructed data is combined into a single DICOM dataset.

Table 3-28. Discovery NM530c Private SPECT Reconstruction Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Normalization Factor	(0009, xx22)	3	"QUASAR_INTERNAL_USE"	Image normalization factor
Processing Parent UID	(0011, xx32)	3	"GEMS_GENIE_1"	Parent projections UID for a recon image

SECTION 4: DISCOVERY NM530C STORAGE COMMITMENT PUSH MODEL IMPLEMENTATION

4.1 INTRODUCTION

This section describes the Discovery NM530c storage commitment information object definition. The storage commitment information object is used both for N-action storage commitment request by the SCU and N-event report storage commitment notifications by the SCP.

4.2 IOD MODULE TABLE

4.2.1 Storage Commitment Module for N-action

Table 4-1. Storage Commitment Module for N-action

Attribute Name	Tag	Attribute Description
Transaction UID	(0008,1195)	Internally generated
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)	
>Referenced SOP Class UID	(0008,1150)	1.2.840.10008.5.1.4.1.1.20 Nuclear Medicine Image Storage SOP Class UID.
>Referenced SOP Instance UID	(0008,1155)	Internally generated.
>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)	NULL sequence

4.2.2 Storage Commitment Module For N-event Report

Table 4-2. Storage Commitment Module For N-event Report

Event Type Name	Event Type ID	Attribute	Tag	Requirement Type SCU/SCP
Storage Commitment Request Successful	1	Transaction UID	(0008,1195)	-/1
		Retrieve AE Title	(0008,0054)	Ignored
		Storage Media File-Set ID	(0088,0130)	Ignored
		Storage Media File-Set UID	(0088,0140)	Ignored
		Referenced SOP Sequence	(0008,1199)	-/1
		>Referenced SOP Class UID	(0008,1150)	-/1
		>Referenced SOP Instance UID	(0008,1155)	-/1
		>Retrieve AE Title	(0008,0054)	Ignored
		>Storage Media File-Set ID	(0088,0130)	Ignored
		>Storage Media File-Set UID	(0088,0140)	Ignored

Table 4-2. Storage Commitment Module For N-event Report (Continued)

Event Type Name	Event Type ID	Attribute	Tag	Requirement Type SCU/SCP
Storage Commitment Request Complete - Failures Exist	2	Transaction UID	(0008,1195)	-/1
		Retrieve AE Title	(0008,0054)	Ignored
		Storage Media File-Set ID	(0088,0130)	Ignored
		Storage Media File-Set UID	(0088,0140)	Ignored
		Referenced SOP Sequence	(0008,1199)	-/1C
		>Referenced SOP Class UID	(0008,1150)	-/1
		>Referenced SOP Instance UID	(0008,1155)	-/1
		>Retrieve AE Title	(0008,0054)	Ignored
		>Storage Media File-Set ID	(0088,0130)	Ignored
		>Storage Media File-Set UID	(0088,0140)	Ignored
		Failed SOP Sequence	(0008,1198)	-/1. SOP Instances failed to commitment are not marked as archived in the system Patient Browser.
		>Referenced SOP Class UID	(0008,1150)	-/1
		>Referenced SOP Instance UID	(0008,1155)	-/1
		>Failure Reason	(0008,1197)	-/1

SECTION 5: MODALITY WORKLIST QUERY IMPLEMENTATION

5.1 DISCOVERY NM530C MAPPING OF DICOM ENTITIES

The Discovery NM530c maps DICOM Information Entities to local Information Entities in the product's database and user interface.

Table 5-1. Mapping of DICOM Entities to Discovery NM530c Entities

DICOM	Discovery NM530c Entity
Scheduled Procedure Step	Protocol
Requested Procedure	Study
Imaging Service Request	Study
Visit	Study
Patient	Patient

Matching requested procedure Step to Discovery NM530c protocol is done according to predefined configuration.

The configuration contains the following tags

(0040,0007) – Scheduled Procedure Step Description

(0040,0008) – Scheduled Protocol Code Sequence. The protocol name is given in code Value (0008,0100)

(0032,1060) – Requested Procedure Code Sequence

The default configuration is (0040,0007)

If (0040,0007) or (0040,0008) which are part of Scheduled Procedure Step Sequence is used protocol will be mapped according to the defined tag value.

Discovery NM530c also allows mapping of Worklist requested procedure Step to protocol according to Requested Procedure Description (0032,1060).

5.1.1 WORKLIST QUERY MODULE TABLE

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

Table 5-1. MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	Section 5.1.2.1
	Scheduled Procedure Step	Section 5.1.2.2
Requested Procedure	Requested Procedure	Section 5.1.2.3
Imaging Service Request	Imaging Service Request	Section 5.1.2.3.1
Visit	Visit Identification	Section 5.1.2.3.2
	Visit Status	Section 5.1.2.3.3
	Visit Relationship	Section 5.1.2.3.4
	Visit Admission	Section 5.1.2.3.5
Patient	Patient Relationship	Section 5.1.2.3.6
	Patient Identification	Section 5.1.2.3.7
	Patient Demographic	Section 5.1.2.3.7
	Patient Medical	Section 5.1.2.3.9

5.1.2 WORKLIST QUERY MODULE DEFINITIONS

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

5.1.2.1 SOP Common Module

TABLE 5-2. SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Specific Character Set	(0008,0005)	O	1C	No	

5.1.2.2 Scheduled Procedure Step Module

Table 5-3. Scheduled Procedure Step Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Scheduled Procedure Step Sequence	(0040,0100)	R	1	No	
>Scheduled Station AE Title	(0040,0001)	R	1	No	Matching supported. User can specify AE title when flittering modality worklist entries.
>Scheduled Procedure Step Start Date	(0040,0002)	R	1	Yes	Matching Supported. Specified as range of date of the form: Date-Date where Date is specified as: yyyyMMdd. SPS Start Date is mapped into private attribute "Protocol Scheduled Date" in the image - tag (0009, xx40), "QUASAR_INTERNAL_USE"
>Scheduled Procedure Step Start Time	(0040,0003)	R	1	Yes	Matching not supported. SPS Start Time is mapped into private attribute "Protocol Scheduled Time" in the image - tag (0009, xx41), "QUASAR_INTERNAL_USE"
>Scheduled Procedure Step End Date	(0040,0004)	O	3	No	
>Scheduled Procedure Step End Time	(0040,0005)	O	3	No	
>Modality	(0008,0060)	R	1	Yes	Matching Supported. Single value matching performed.
>Scheduled Referring Physician Name	(0008,0090)	O	2	Yes	Matching not Supported.
>Scheduled Performing Physician's Name	(0040,0006)	R	2	No	Matching Supported. Single or Wildcard. User can define performing physician last name and/or first name in the MWL request, but returned value is not stored in the image..

Table 5-3. Scheduled Procedure Step Module Attributes (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
>Scheduled Procedure Step Description	(0040,0005)	O	1C	No	
>Scheduled Station Name	(0040,0010)	O	2	No	No matching supported. Matched only by AE.
>Scheduled Procedure Step Location	(0040,0011)	O	2	No	
>Scheduled Protocol Code Sequence	(0040,0008)	O	1C	No	
>> 'Code Sequence Macro'					
>Scheduled Procedure Step ID	(0040,0009)	O	1	No	
>Pre-Medication	(0040,0012)	O	2C	No	
>Scheduled Procedure Step Status	(0040,0020)	O	1	No	
>Comments on the Scheduled Procedure Step	(0040,0400)	O	3	No	
>Requested Contrast Agent	(0032,1070)	O	2C	No	

5.1.2.3 Requested Procedure Module

Table 5-4. Requested Procedure Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Requested Procedure ID	(0040,1001)	O	1	Yes. Copied to Study ID (0020,0010)	Matching supported Single value, Wildcard.
Requested Procedure Description	(0032,1060)	O	1C	Yes	Matching is not supported

Table 5-4. Requested Procedure Module Attributes (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Requested Procedure Code Sequence	(0032,1064)	O	1C	Yes. Copied to Procedure Code Sequence (0008,1032	
> *'Code Sequence Macro'*				Yes. Copied to Procedure Code Sequence (0008,0032	
Study Instance UID	(0020,000D)	O	1	Yes	
Referenced Study Sequence	(0008,1110)	O	2	Yes	
>Referenced SOP Class UID	(0008,1150)	O	1C	Yes	
>Referenced SOP Instance UID	(0008,1155)	O	1C	Yes	
Requested Procedure Priority	(0040,1003)	O	2	No	
Patient Transport Arrangements	(0040,1004)	O	2	No	
Requested Procedure Location	(0040,1005)	O	3	No	
Confidentiality Code	(0040,1008)	O	3	No	
Reporting Priority	(0040,1009)	O	3	No	
Names of Intended Recipients of Results	(0040,1010)	O	3	No	
Reason for the Requested Procedure	(0040,1002)	O	3	No	
Requested Procedure Comments	(0040,1400)	O	3	No	

5.1.2.3.1 Imaging Service Request Module

Table 5-5. Imaging Service Request Module Attributes

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Use
Accession Number	(0008,0050)	O	2	Yes	Matching Supported. Single Value, Wildcard.
Requesting Physician	(0032,1032)	O	2	No	
Referring Physician's Name	(0008,0090)	O	2	Yes	
Requesting Service	(0032,1033)	O	3	No	
Reason for the Imaging Service Request	(0040,2001)	O	3	No	
Imaging Service Request Comments	(0040,2400)	O	3	No	
Issue Date of Imaging Service Request	(0040,2004)	O	3	No	
Issue Time of Imaging Service Request	(0040,2005)	O	3	No	
Placer Order Number / Imaging Service Request	(0040,2016)	O	3	No	
Filler Order Number / Imaging Service Request	(0040,2017)	O	3	No	
Order entered by...	(0040,2008)	O	3	No	
Order Enterer’s Location	(0040,2009)	O	3	No	
Order Callback Phone Number	(0040,2010)	O	3	No	

5.1.2.3.2 Visit Identification

TABLE 5-6. VISIT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Admission ID	(0038,0010)	O	2	No	
Institution Name	(0008.0080)	O	3	Yes	
Institution Address	(0008,0081)	O	3	No	
Institution Code Sequence	(0008,0082)	O	3	No	Sent as NULL Sequence.
Issuer of Admission ID	(0038,0011)	O	3	No	

5.1.2.3.3 Visit Status

Table 5-7. Visit Status Module Attributes

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

5.1.2.3.4 Visit Relationship

TABLE 5-8. VISIT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Referenced Patient Sequence	(0008,1120)	O	2	No	
>Referenced SOP Class UID	(0008,1150)	O	1C	No	
>Referenced SOP Instance UID	(0008,1155)	O	1C	No	

5.1.2.3.5 Visit Admission

Table 5-9. VISIT ADMISSION MODULE ATTRIBUTES

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

Table 5-9. VISIT ADMISSION MODULE ATTRIBUTES (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Admitting Time	(0038,0021)	O	3	No	

5.1.2.3.6 Patient Relationship

TABLE 5-10. PATIENT RELATIONSHIP MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Referenced Visit Sequence	(0008,1125)	O	3	No	
>Referenced SOP Class UID	(0008,1150)	O	3	No	
>Referenced SOP Instance UID	(0008,1155)	O	3	No	
Referenced Patient Alias Sequence	(0038,0004)	O	3	No	
>Referenced SOP Class UID	(0008,1150)	O	3	No	
>Referenced SOP Instance UID	(0008,1155)	O	3	No	

5.1.2.3.7 Patient Identification

Table 5-11. PATIENT IDENTIFICATION MODULE ATTRIBUTES

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

5.1.2.3.8 Patient Demographic

Table 5-12. PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patients Birth Date	(0010,0030)	O	2	Yes	
Patient's Sex	(0010,0040)	O	2	Yes	

Table 5-12. PATIENT DEMOGRAPHIC MODULE ATTRIBUTES (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patient's Weight	(0010,1030)	O	2	Yes	
Confidentiality constraint on patient data	(0040,3001)	O	2	No	
Patient’s Size	(0010,1020)	O	3	No	
Patient’s Address	(0010,1040)	O	3	No	
Patient’s Telephone Numbers	(0010,2154)	O	3	No	
Patient's Age	(0010,1010)	O	3	No	
Occupation	(0010,2180)	O	3	No	
Patient’s Birth Time	(0010,0032)	O	3	No	
Patient's Insurance Plan Code Sequence	(0010,0050)	O	3	No	Sent as NULL Sequence
Patient’s Primary Language Code Sequence	(0010,0101)	O	3	No	Sent as NULL Sequence
> Patient’s Primary Language Code Modifier Sequence	(0010,0102)	O	3	No	Sent as NULL Sequence
Military Rank	(0010,1080)	O	3	No	
Branch of Service	(0010,1081)	O	3	No	
Country of Residence	(0010,2150)	O	3	No	
Region of Residence	(0010,2152)	O	3	No	
Ethnic Group	(0010,2160)	O	3	No	
Patient's Religious Preference	(0010,21F0)	O	3	No	

Table 5-12. PATIENT DEMOGRAPHIC MODULE ATTRIBUTES (Continued)

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patient Comments	(0010,4000)	O	3	No	

5.1.2.3.9 Patient Medical

Table 5-13. PATIENT MEDICAL MODULE ATTRIBUTES

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

SECTION 6: DISCOVERY NM530C PRIVATE DATA OBJECT IMPLEMENTATION

6.1 INTRODUCTION

The Discovery NM530c non–image DICOM Private Series data objects IOD (SDO) described in this section are implemented using a Discovery NM530c Private DICOM SOP class. The object type is determined by the use of an object type attribute, as defined in the tables.

6.2 DISCOVERY NM530C PRIVATE DATA IOD IMPLEMENTATION

The Discovery NM530c private Series data objects (SDO) are used for storage of additional information acquired by system during the scan that relevant to Series and cannot be sent with the specific Image. SDO is transferred to Xeleris Workstation using Discovery NM530c Private SOP Class. Xeleris uses this information in several Applications dedicated to processing of Discovery NM530c NM Images.

Due to internal usage of SDO, these objects are not referenced by PPS.

6.3 IOD MODULE TABLE

This section of the mapping document defines a Discovery NM530c private Protocol Data Object that consists of the DICOM standard Patient, Study, Series, and SOP Common modules, and the Discovery NM530c Private Series Data Module.

The Discovery NM530c Private Series Data Object Module Table is shown below. The Patient, Study, and other standard modules use all of the standard mapping tables defined in the image data parts of the mapping document. The Nuclear Medicine specific tables and the Discovery NM530c private tables from the image IODs are not a part of the Protocol Data Object. Only the modules shown are included in the private object.

The Discovery NM530c Series Data Object contains the modules listed in table Table 6-1.

Table 6-1. Private Series Data IOD Modules

Entity	Module	Reference
Patient	Patient	Section 3.5.1.1
Study	General Study	Section 3.5.2.1
Series	General Series	Section 3.5.3.1
Discovery NM530c	Discovery NM530c Private Series Data	Section 6.4.1
SDO	SOP Common	Section 3.5.7.1

6.4 INFORMATION MODULE DEFINITIONS

The table below shows the Discovery NM530c to DICOM mappings for the Series Data Object.

6.4.1 Discovery NM530c Private Series Data Object Modules

6.4.1.1 Private Series Module

The following table shows the mapping for SDO to the Discovery NM530c object.

Table 6-2. Discovery NM530c Series Data Module Attributes

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
Object Type	(0033,xx08)	3	"GEMS_GENIE_1"	Defined term is "SERIES DATA"
Modified Flag	(0033,xx10)	3	"GEMS_GENIE_1"	Default value = 0 (Not Modified)
Name	(0033,xx11)	3	"GEMS_GENIE_1"	SDO Name
Series Data UID	(0033,xx16)	3	"GEMS_GENIE_1"	Internally generated UID of SDO
Date	(0033,xx17)	3	"GEMS_GENIE_1"	SDO Creation date
Time	(0033,xx18)	3	"GEMS_GENIE_1"	SDO Creation time
Series Data Flags	(0033,xx19)	3	"GEMS_GENIE_1"	Default value = 0
ProtocolName	(0033,xx1A)	3	"GEMS_GENIE_1"	Name of Protocol created SDO
Relevant data UID	(0033,xx1B)	3	"GEMS_GENIE_1"	UID of SOP Instance relative to SDO
Bulk Data	(0033,xx1C)	3	"GEMS_GENIE_1"	SDO parameter(s) stored as binary buffer(s)
Int Data	(0033,xx1D)	3	"GEMS_GENIE_1"	List of SDO parameters stored as integers
DoubleData	(0033,xx1E)	3	"GEMS_GENIE_1"	List of SDO parameters stored as integers
StringData	(0033,xx1F)	3	"GEMS_GENIE_1"	List of SDO parameters stored as list of strings
BulkDataFormat	(0033,xx20)	3	"GEMS_GENIE_1"	Format of bulk parameters; contains information about name and size of bulk bufferters
IntDataFormat	(0033,xx21)	3	"GEMS_GENIE_1"	Format of integer parameters; contains information about name and number of integers in list
DoubleDataFormat	(0033,xx22)	3	"GEMS_GENIE_1"	Format of double parameters; contains information about name and number of doubles in list

Table 6-2. Discovery NM530c Series Data Module Attributes (Continued)

Attribute Name	Tag	Type	Private Creator ID	Attribute Description
StringDataFormat	(0033,xx23)	3	"GEMS_GENIE_1"	Format of string parameters; contains information about name and number of strings in list

6.4.1.2 SOP Common Module

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

Table 6-3. SOP Common Module Attributes

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Set to “1.2.840.113619.4.27”, Private SOP Class UID.
SOP Instance UID	(0008,0018)	1	Internally generated.
Specific Character Set	(0008,0005)	1C	Not used when the default character set (ISO 646) is used. Set to “ISO_IR 100” when extended character sets are used.
Instance Creation Date	(0008,0012)	3	Date of instance creation.
Instance Creation Time	(0008,0013)	3	Time of instance creation.
Instance Creator UID	(0008,0014)	3	Set to the Implementation UID (see Section 2.3.1.1.4)

6.4.2 General Mapping Rules for Series Data

All of the Discovery NM530c database attributes in the Patient, Study, and Series modules are copied directly to the DICOM object as defined in the mapping tables for the parent Patient/Study/Series.

6.4.3 Export Notes for Protocol Datasets

Every Discovery NM530c database attribute in the protocol data module is copied directly into the DICOM dataset. There are no defaults on export. If there is no value in the database, then the elements may be left out of the DICOM dataset.

6.4.4 Import Notes for Protocol Datasets

A Discovery NM530c PDO or SDO is created, header attributes are copied, created or set by default, and the protocol data and data formats are copied directly. There are no mandatory attributes

SECTION 7: PERFORMED PROCEDURE STEP CONFORMANCE STATEMENT

7.1 INTRODUCTION

The PPS option allows a Modality Performed Procedure Step to be communicated to the Hospital/Radiology information system. The PPS feature is providing the DICOM Modality Performed Procedure Step service as a service class user (SCU).

This capability works in conjunction with DICOM Modality Worklist feature. However the conformance of the Modality Performed Procedure Step is independent of Modality Worklist feature. For information on conformance of Modality Worklist to DICOM standard please refer to Section 5 of this document.

7.2 IOD MODULE TABLE

7.2.1 Modality Performed Procedure Step IOD Module

The table below lists the Modality Performed Procedure Step attributes, which appears in the MPPS message.

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
Requested Procedure Step Relationship Module						
Scheduled Step Attribute Sequence	(0040,0270)	Y	N			
>Study instance UID	(0020,000D)	Y	N	Copied from MWL	Locally generated Unique ID	Y (Study module)
> Referenced Study Sequence	(0008,1110)	Y	N	Copied from MWL	null	Y (Study module)
>>Referenced SOP Class UID	(0008,1150)	Y	N	Copied from MWL	NA	Y
>>Referenced SOP instance UID	(0008,1155)	Y	N	Copied from MWL	NA	Y

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS (Continued)

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
>Accession Number	(0008,0050)	Y	N	Copied from MWL. Operator can modify value in user interface	Operator can set accession number value manually in user interface, but, if none was set during scheduling, Accession Number remains empty string.	Y (Study module)
>Requested Procedure ID	(0040,1001)	Y	N	Copied from MWL	Null	Y (In Request Attributes Sequence (0040,0175) in series module)
>Requested Procedure Description	(0032,1060)	Y	N	Copied from MWL	Null	Y (In Request Attributes Sequence (0040,0275) in series module)
Requested Procedure Code Sequence	(0032,1064)	N	N	Copied From MWL	Null	Y (In Procedure code sequence (0008, 1032) General Study Module)
>Scheduled Procedure Step ID	(0040,0009)	Y	N	Copied from MWL	Null	Y (In Request Attributes Sequence (0040,0275) in series module)
>Scheduled Procedure Step Description	(0040,0007)	Y	N	Copied from MWL	Null	Y (In Request Attributes Sequence (0040,0275) in series module)

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS (Continued)

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
>Scheduled Protocol Code Sequence	(0040,0008)	Y	N	Copied from MWL	Null	Y (In Request Attributes Sequence (0040,0275) in series module)
>>Code Value	(0008,0100)	Y	N	Copied from MWL	NA	Y
>>Code Scheme Designator	(0008,0102)	Y	N	Copied from MWL	NA	Y
>>Code Scheme Version	(0008,0103)	Y	N	Copied from MWL	NA	Y
>>Code Meaning	(0008,0104)	Y	N	Copied from MWL, if presented; otherwise remains empty string.	NA	Y
Patient Name	(0010,0010)	Y	N	Copied from MWL. Operator can modify value in user interface, before any image in study is acquired.	Locally set	Y (Patient module)
Patient ID	(0010,0020)	Y	N	Copied from MWL. Operator can modify value in user interface, before any image in study is acquired.	Locally set	Y (Patient module)
Patient's Birth Date	(0010,0030)	Y	N	Copied from MWL. Operator can modify value in user interface	Locally set	Y (Patient module)
Patient’s Sex	(0010,0040)	Y	N	Copied from MWL. Operator can modify value in user interface	Locally set	Y (Patient module)

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS (Continued)

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
Referenced Patient Sequence	(0008,1120)	Y	N	Copied from MWL	Null	Y (Patient Module)
Admission ID	(0038,0010)	Y	N	Copied from MWL. Operator can modify value in user interface	Null	N
Issuer of Admission ID	(0038,0011)	Not Used		Not Used	Not Used	Not Used
Performed Procedure Step Information						
Performed Procedure Step ID	(0040,0253)	Y	N	"WLPID_" + <SPS ID>	“LCPID_" + numbered id starting from 1 (i.e. LCPID_1, LCPID_2)	Same * (In General series module)
Performed Station AE Title	(0040,0241)	Y	N	AE Title as configured	Same *	N/A
Performed Station Name	(0040,0242)	Y	N	Computer name	Same *	N/A
Performed Location	(0040,0243)	Y	N	The institution address as configured in	Same *	N/A
Performed Procedure Step Start Date	(0040,0244)	Y	N	Equals to study date.	Same *	
Performed Procedure Step Start Time	(0040,0245)	Y	N	Equals to Study Time	Same *	

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS (Continued)

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
Performed Procedure Step Status	(0040,0252)	Y	Y	"IN PROGRESS" when acquisition starts, and after the end of each scan in the protocol. "COMPLETED" when operator presses "Protocol Completed" or when all the scans in the protocol are completed. "DISCONTINUED" when operator marks protocol as Discontinued	Same *	
Performed Procedure Step Description	(0040,0254)	Y	Y	The full path of the protocol name e.g. "Factory&MPH Cardiology&One Day"	Same *	Same * (In General series module)
Performed Procedure Type Description	(0040,0255)	Y	Y	Null	Null	N
Procedure Code Sequence	(0008,1032)	Y	Y	Read from Requested Procedure Code Sequence (0032,1064). If the protocol originally matched from MWL was not changed.	Null	Y (when not null) (General Study Module)
>Code Value	(0008,0100)	Y	Y	Read from Requested Procedure Code Sequence (0032,1064). If the protocol originally matched from MWL was not changed.	NA	N

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS (Continued)

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
>Coding Scheme Designator	(0008,0102)	Y	Y	Read from Requested Procedure Code Sequence (0032,1064). If the protocol originally matched from MWL was not changed.	NA	N
>Code Meaning	(0008,0104)	Y	Y	Read from Requested Procedure Code Sequence (0032,1064). If the protocol originally matched from MWL was not changed. Otherwise, zero length	NA	N
Performed Procedure Step End Date	(0040,0250)	Y (null)	Y (if final state)	The time at which the PPS Status was set to "COMPLETED" or "DISCONTINUED"	Same *	N/A
Performed Procedure Step End Time	(0040,0251)	Y (null)	Y (if final state)	The date at which the PPS Status was set to "COMPLETED" or "DISCONTINUED"	Same *	N/A
Comments on the Performed Procedure Step	(0040,0280)	N	N	Not Used	Not Used	N (General Series Module)

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS (Continued)

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
Performed Procedure Step Discontinuation Reason Code Sequence	(0040,0281)	Y (null)	Y (if final state is other than DISCONTINUED, sent as Null Sequence. Refer to Table 7-2 on page 8 for more information.)	As selected by the operator when pressing "Protocol Discontinued"	Same *	N/A
Image Acquisition Results						
Modality	(0008,0060)	Y	N			Y (General Series Module)
Study ID	(0020,0010)	Y	N	Copied from the first 16 characters of the Requested Procedure ID (0040,1001)	Equals to the short version of protocol name of the first protocol in the study. If Sort version of Protocol Name is longer than 16 characters, only the first 16 characters are used.	
Performed Protocol Code Sequence	(0040,0260)	Y	Y	Empty (Currently Assisted Protocol Settings option is not supported)	Same *	N (General Series Module)
Performed Series Sequence	(0040,0340)	Y (null)	Y	One or more items	Same *	N/A
>Performing Physician's Name	(0008,1050)	N	Y (Zero Length)	Zero length	Same *	N (General Series Modules)

Table 7-1. Supported N-Set/ N-Create Request Attributes for MPPS (Continued)

Attribute Name	Tag	N-Create	N-Set	Acquisition w MWL Data	Acquisition w/o MWL Data	Image IOD
>Protocol Name	(0018,1030)	N	Y	The full path of the protocol name e.g. "Factory&MPH Cardiology&One Day"	Same *	Y (General Series Modules)
>Operator's Name	(0008,1070)	N	Y	Zero length	Same *	N/A
>Series Instance UID	(0020,000E)	N	Y	Locally generated unique UID	Same *	Y (General Series Modules)
>Series Description	(0008,103E)	N	Y	Series Description e.g. "Rest"	Same *	Y (General Series Modules)
>Retrieve AE Title	(0008,0054)	N	Y	Zero length	Same *	N/A
>Referenced Image Sequence	(0008,1140)	N	Y	Number of items as number of acquired images in this series (1 or more item)	Same *	N/A
>>Referenced SOP Class UID	(0008,1150)	N	Y	1.2.840.10008.5.1.4.1.1.20	Same *	Y (SOP Common Module)
>>Referenced SOP Instance UID	(0008,1155)	N	Y	Locally generated unique UID of this image.	Same *	Y(SOP Common Module)
>Referenced Standalone SOP Instance Sequence	(0040,0220)	N	N	N/A no non-images instances	Same *	N/A

* Same as Acquisition with MWL Data

Table 7-2. Performed Procedure Discontinue Reasons

Reason description	Code
"Doctor cancelled procedure"	110500

Table 7-2. Performed Procedure Discontinue Reasons (Continued)

Reason description	Code
"Nursing unit cancel"	110511
"Incorrect procedure ordered"	110502
"Change of procedure for correct charging"	110509
"Duplicate order"	110510
"Incorrect worklist entry selected"	110514
"Patient allergic to media/contrast"	110503
"Patient refused to continue procedure"	110505
"Patient condition prevented continuing"	110515
"Patient taken for treatment or surgery"	110506
"Patient did not arrive"	110507
"Patient pregnant"	110508
"Patient died"	110504
"Equipment failure"	110501
"Equipment change"	110516
"Discontinued for unspecified reason"	110513

APPENDIX A: DISCOVERY NM530C PRIVATE DATA DICTIONARY

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

Table A-1. Discovery NM530c Private Creator Identification "QUASAR_INTERNAL_USE"

Attribute Name	Tag	VR	VN	Attribute Description
Rate Vector	(0009, xx01)	UL	1-n	Rate for each frame
Count Vector	(0009, xx02)	UL	1-n	Counts accumulated for each frame
Time Vector	(0009, xx03)	UL	1-n	Time for each frame
Angle Vector	(0009, xx07)	UL	1-n	Angle for each TOMO frame. For each frame is tells what is the angle of the detector
Camera Shape	(0009, xx08)	US	1	Camera Shape: H mode, L mode
Origin	(0009, xx12)	LO	1	The origin of the image."isWorklist" if scheduled in MWL. "regular" if locally scheduled.
Sequence Type	(0009, xx13)	ST	1	Acquired Sequence Type
Sequence Name	(0009, xx14)	ST	1	Acquired Sequence Name
Avr RR Time Vector	(0009, xx15)	UL	1-n	Average r-r time vector
Low Limit Vector	(0009, xx16)	UL	1-n	Low window limit vector
High Limit Vector	(0009, xx17)	UL	1-n	High window limit vector
Begin Index Vector	(0009, xx18)	UL	1-n	begin index vector: link to heart beat vector
End Index Vector	(0009, xx19)	UL	1-n	end index vector: link to heart beat vector
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
Normalization Factor	(0009, xx22)	FL		Image normalization factor
Patient Unique Key	(0009, xx39)	UI	1	Patient unique key
Protocol Scheduled Date	(0009, xx40)	DT	1	Protocol Scheduled Date

Table A-1. Discovery NM530c Private Creator Identification "QUASAR_INTERNAL_USE" (Continued)

Attribute Name	Tag	VR	VN	Attribute Description
Protocol Scheduled Time	(0009, xx41)	TM	1	Protocol Scheduled Time
Acquisition flag	(0009, xx42)	LO	1	Used for indicating if the study is acquired
Matched protocol	(0009, xx43)	LO	1	For Worklist items. The originally matched protocol vs. protocol name which is the protocol actually acquired
Private SPS ID	(0009, xx44)	SH	1	Keeps the SPS ID for protocols that were appended to the original MWL protocol.
Perfusion SOP Instance UID	(0011, xx33)	LO	1	
Collimator SQ	(0037,xx10)	SQ	1	Contains information of collimators parameters. Contains 1 item.
DO	(0037,xx1B)	LO	1	collimator hole diameter
>Hole Length	(0037,xx30)	LO	1	collimator hole length
>Collimator Thickness	(0037,xx40)	LO	1	collimator thickness
>Septal Thickness	(0037,xx50)	LO	1	collimator septal thickness
>Intrinsic Resolution	(0037,xx60)	LO	1	collimator intrinsic resolution
> Blurring Slope	(0037,xx70)	LO	1	collimator blurring slope

Table A-2. Discovery NM530c Private Creator Identification "GEMS_GENIE_1"

Attribute Name	Tag	VR	VN	Attribute Description
Starting Heart Rate	(0009, xx37)	SL	1	Heart rate at start of acquisition.
Effective Series Duration	(0011, xx0B)	SL	1	Duration of acquisition.
Radio Nuclide Name	(0011, xx0D)	LO	1	Name of radionuclide used.
Dataset Name	(0011, xx12)	LO	1-n	

Table A-2. Discovery NM530c Private Creator Identification "GEMS_GENIE_1" (Continued)

Attribute Name	Tag	VR	VN	Attribute Description
Acquisition Parent UID	(0011, xx31)	LO	1-n	
Processing Parent UID	(0011, xx32)	LO	1-n	Parent projections UID for a recon image
Pixel Scale	(0011, xx3B)	FD	1-n	
FOV Shape	(0011,xx3E)	SL	1	GEMS NM system detector type. The Defined Term is: 27 - Discovery NM530c
Software Translator	(0013, xx11)	SL	1	Internal code of product DICOM implementation. Enumerated Value = 12.
Object Type	(0033,xx08)	CS	1	Defined term is "SERIES DATA"
Modified Flag	(0033,xx10)	SL	1	Default value = 0 (Not Modified)
Name	(0033,xx11)	LO	1	SDO Name
Series Data UID	(0033,xx16)	LO	1	Internally generated UID of SDO
Date	(0033,xx17)	SH	1	SDO Creation date
Time	(0033,xx18)	SH	1	SDO Creation time
Series Data Flags	(0033,xx19)	UL	1	Default value = 0
ProtocolName	(0033,xx1A)	LO	1	Name of Protocol created SDO
Relevant data UID	(0033,xx1B)	LO	1	UID of SOP Instance relative to SDO
Bulk Data	(0033,xx1C)	OB	1	SDO parameter(s) stored as binary buffer(s)
Int Data	(0033,xx1D)	UL	1-n	List of SDO parameters stored as integers
DoubleData	(0033,xx1E)	FD	1-n	List of SDO parameters stored as integers
StringData	(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 bufferters
IntDataFormat	(0033,xx21)	OB	1	Format of integer parameters; contains information about name and number of integers in list

Table A-2. Discovery NM530c Private Creator Identification "GEMS_GENIE_1" (Continued)

Attribute Name	Tag	VR	VN	Attribute Description
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
Triggers Modification Flag	(0033,xx30)	UL	1	Triggers Modification Flag
Number of triggers	(0033,xx33)	UL	1	Number of triggers
Trigger size	(0033,xx34)	UL	1	Size of one Trigger data slot
Trigger Data size	(0033,xx35)	UL	1	Size of Trigger Trigger Data size
Trigger Data	(0033,xx36)	OB	1	Buffer with trigger data information
Private Detector Information Sequence	(0055,xx22)	SQ	1	Contains additional information about camera detectors. Contains only 1 Item

Table A-3. Discovery NM530c Private Creator Identification "GEMS_XELPRV_01"

Attribute Name	Tag	VR	VN	Attribute Description
Series Data Sequence	(0033,xx70)	SQ	1	Sequence of item contains information about acquisition parameters. May contain from 1 to n Items. Each Items describes specific parameters set.
>Object Type	(0033,xx08)	CS	1	
>Modified Flag	(0033,xx10)	SL	1	
>Name	(0033,xx11)	LO	1	
>Series Data UID	(0033,xx16)	LO	1	
>Date	(0033,xx17)	SH	1	
>Time	(0033,xx18)	SH	1	
>Series Data Flags	(0033,xx19)	UL	1	

Table A-3. Discovery NM530c Private Creator Identification "GEMS_XELPRV_01" (Continued)

Attribute Name	Tag	VR	VN	Attribute Description
>ProtocolName	(0033,xx1A)	LO	1	
>Relevant data UID	(0033,xx1B)	LO	1	
>Bulk Data	(0033,xx1C)	OB	1	
>Int Data	(0033,xx1D)	UL	1-n	
>DoubleData	(0033,xx1E)	FD	1-n	
>StringData	(0033,xx1F)	OB	1	
>BulkDataFormat	(0033,xx20)	OB	1	
>IntDataFormat	(0033,xx21)	OB	1	
>DoubleDataFormat	(0033,xx22)	OB	1	
>StringDataFormat	(0033,xx23)	OB	1	
>Seriesdata Private SOPClassUID	(0033,xx71)	UI	1	
>Seriesdata InstanceUID	(0033,xx72)	UI	1	

Table A-4. Discovery NM530c Private Creator Identification "APEX_PRIVATE"

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