



Technical Publications

**Direction DOC2068940
Revision 2**

SmartConsole™ Application DICOM CONFORMANCE STATEMENT

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LIST OF REVISIONS

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2	October, 2018	Fixes after external review	Section 3.4.5.1 Section 3.4.6.14 Section 4.4.2.4.1 Section 4.4.2.6 All subsections of 5.4 Section 5.4.3.5 Section 5.4.3.4.1	M. Mesh

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CONFORMANCE STATEMENT OVERVIEW

The **SmartConsole™ Application** is software that accepts inputs from the scanner and then generates NM transaxial and PET slices , with various corrections applied. It provides reconstruction of SPECT and SPECT-CT data, including data display, quality control, quantification and automatic sending of the outputs to various DICOM destinations using **SmartConsole™ Data Manager**

The system is intended for use by Nuclear Medicine (NM) or Radiology practitioners.

Table 0.1 provides an overview of the network services supported by the **SmartConsole™ Application**.

Table 0.1 – APPLICATION

SOP Classes	User of Object Instances	Creator of Object Instances
Transfer		
Nuclear Medicine Image Storage	Yes	Yes
Computerized Tomography Image Storage	Yes	No
Positron Emission Tomography Image Storage	No	Yes

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1. INTRODUCTION

1.1 OVERVIEW

The **SmartConsole™ Application** is software that accepts inputs from the scanner and then generates NM transaxial and PET slices , with various corrections applied. It provides reconstruction of SPECT and SPECT-CT data, including data display, quality control, quantification and automatic sending of the outputs to various DICOM destinations using **SmartConsole™ Data Manager**. For a complete description of the networking conformance, refer to the "SmartConsole™ DICOM Conformance statement " (see **Reference A** in [Section 1.6](#)).

The system is intended for use by Nuclear Medicine (NM) or Radiology practitioners.

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

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

Section 2 (Conformance Statement), which specifies the GEHC equipment compliance to the DICOM requirements for the implementation

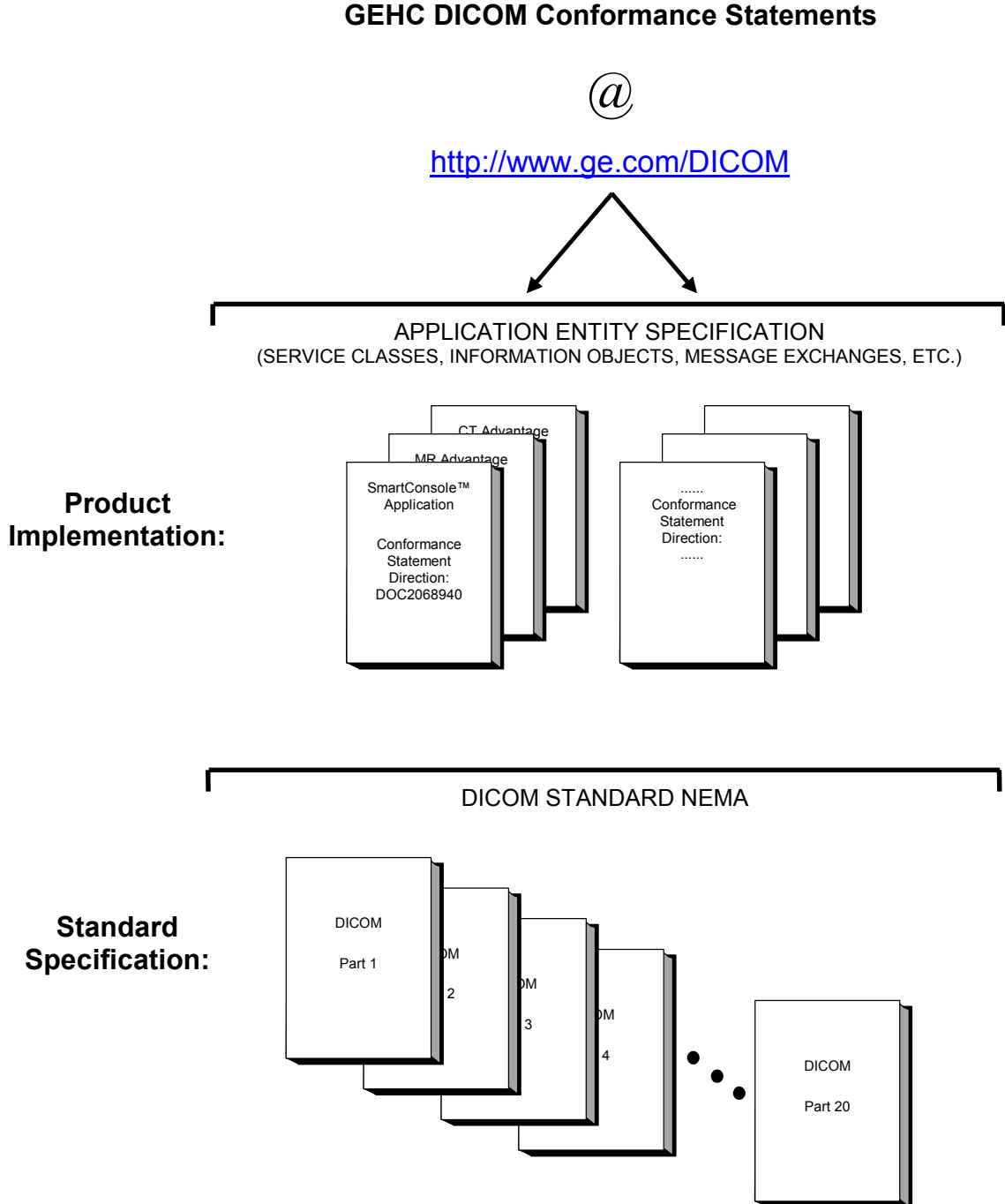
Section 3 (NM Image Information Object Implementation), which specifies the GEHC equipment compliance to DICOM requirements for the implementation of a NM Image Information Object

Section 4 (CT Image Information Object Implementation), which specifies the GEHC equipment compliance to DICOM requirements for the implementation of a CT Image Information Object

Section 5 (PET Image Information Object Implementation), which specifies the GEHC equipment compliance to DICOM requirements for the PET Image Information Object

1.2 ALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

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



This document specifies the DICOM implementation. It is entitled:

SmartConsole™ Application
Conformance Statement for DICOM
Direction **DOC2068940**

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

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

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

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

1.3 INTENDED AUDIENCE

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

1.4 SCOPE AND FIELD OF APPLICATION

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

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

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

1.5 IMPORTANT REMARKS

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

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

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

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

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

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

1.6 REFERENCES

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

Reference A SmartConsole™ Data Manager DICOM Conformance Statement, DOC2068936

1.7 DEFINITIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
AET	Application Entity Title
CSE	Customer Service Engineer
CT	Computerized Tomography
DICOM	Digital Imaging and Communications in Medicine
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
ISO	International Organization for Standards
NM	Nuclear Medicine
O	Optional (Key Attribute)
PACS	Picture Archiving and Communication System
PET	Positron Emission Tomography
R	Required (Key Attribute)
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
UI	User Interface
VM	Value Multiplicity
VR	Value Representation

1.9 TERMS DEFINITIONS

In the following conformance statement, the following terms describe the use of each of the DICOM tags.

When SmartConsole™ Application is loading DICOM data files, we use the following terms:

- **Ignored:** the software will ignore the value of the tag

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- **Used:** the software might use at some point the value of this tag; the value could be used for computations, for display, or to regenerate the value of a secondary capture
- **Mandatory:** the software will need a valid value for this tag; this value will be used for computations and an invalid value will prevent the software to load the data.

When the application is saving some reformatted images, we use the following terms:

- **Removed:** the tag is removed of the module and will be absent from the data set
- **Generated:** the software will generate a value, generally by computing a new value
- **Copied:** the software will try as much as possible to duplicate the value found in the source images if the value is the same on all the source images; if the value is not consistent, the tag will be absent from the data set if "Ignored" at load or possibly regenerated if "Used" at load

2. CONFORMANCE STATEMENT

2.1 INTRODUCTION

The SmartConsole™ Application is software application, running from SmartConsole™ Data Manager. This means that networking and media storage features are inherited from this platform. For a complete description of the networking conformance, refer to the “SmartConsole™ DICOM Conformance statement “ (see **Reference A** in [Section 1.6](#))

The application use NM and CT DICOM images to display and processing.

The images created by the applications (NM and PET) are saved in DICOM format. These images can be loaded and displayed by other GE HEALTHCARE applications or by other non-GE applications conformant to the DICOM Standard.

The goal of this document is to give a detailed description of:

- The DICOM NM IODs that are required for use with and saved by the SmartConsole™ Application ([Section 3](#))
- The DICOM CT IODs that are required for use with the SmartConsole™ Application ([Section 4](#))
- The DICOM PET IODs that are saved by the SmartConsole™ Application ([Section 5](#))

The **SmartConsole™** is a one-stop shop for processing volumetric data, including NM SPECT and hybrid SPECT-CT.

The SmartConsole™ Application main features include:

- Complete SPECT and GATED SPECT projections processing support: OSEM Trans Axial Reconstruction , attenuation and scatter corrections, and OSEM with Resolution Recovery (licensed option), as well as Multi FOV Pasting.
- Hybrid QC
- Converting NM Transaxial reconstructed images to PET format.

The SmartConsole™ Application requires the NM and CT images as its input. The images can be any conforming image.

The following types of input datasets are supported:

- TOMO and GATED TOMO image types are supported for NM IODs:
 - ✓ NM planar emission projections (single or Multi-FOV)
 - ✓ NM scatter projections
- Hybrid SPECT CT (single or Multi-FOV) with or without attenuation maps

SOP Class Name	SOP Class UID
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
CT Image Storage	1.2.840.10008.5.1.4.1.1.2

The **SmartConsole™ Application** creates the following outputs:

- NM RECON TOMO and RECON GATED TOMO image types
- PET Slices , derived from RECON TOMO and RECON GATED TOMO images

SOP Class Name	SOP Class UID
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
PET Image Storage	1.2.840.10008.5.1.4.1.1.128

2.2 SPECIFIC CHARACTER SETS SUPPORTED

SmartConsole™ Application support input images and creates output images encoded using the following character sets:

- Latin alphabet No. 1 "ISO_IR 100"
- Latin alphabet No. 2 "ISO_IR 101"

Input images containing Character Set attribute (0008,0005) other than mentioned above will be rejected.

3. 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 read and produced by this implementation. Corresponding attributes are conveyed using the module construct.

3.2 SMARTCONSOLE™ APPLICATION MAPPING OF DICOM ENTITIES

The SmartConsole™ Application map DICOM Information Entities to local Information Entities in the product's database and user interface.

TABLE 3-1
MAPPING OF DICOM ENTITIES TO SMARTCONSOLE™ APPLICATION ENTITIES

DICOM IE	SmartConsole™ Application Entity
Patient	Patient
Study	Study
Series	Series
Image	Image

3.3 IOD MODULE TABLE

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

TABLE 3-2
NM IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used	3.4.1.1
	Clinical Trial Subject	Not Used	N/A
Study	General Study	Used	3.4.2.1
	Patient Study	Used	3.4.2.2
	Standard Extended Study	Used	3.4.2.3
	Clinical Trial Study	Not Used	N/A
Series	General Series	Used	3.4.3.1
	Clinical Trial Series	Not Used	N/A
	Standard Extended Series	Used	3.4.3.2
	NM/PET Patient Orientation	Used	3.4.3.3
	Private Series	Used	3.4.3.4
Frame of Reference	Frame of Reference	Used	3.4.4.1
Equipment	General Equipment	Used	3.4.5.1
Image	General Image	Used	3.4.6.1
	Image Pixel	Used	3.4.6.2
	NM Image Pixel	Used	3.4.6.3
	Acquisition Context	Used	3.4.6.4
	Device	Not Used	N/A
	Specimen	Not Used	N/A

Multi-frame	Used	3.4.6.5
NM Multi-frame	Used	3.4.6.6
NM Image	Used	3.4.6.7
NM Isotope	Used	3.4.6.8
NM Detector	Used	3.4.6.9
NM Tomo Acquisition	Used for images where Image Type (0008,0008) Value 3 is TOMO, RECON TOMO, GATED TOMO or RECON GATED TOMO	3.4.6.10
NM Multi-gated Acquisition	Used for images where Image Type (0008,0008) Value 3 is GATED TOMO or RECON GATED TOMO	3.4.5.11
NM Phase	Not Used	N/A
NM Reconstruction	Used for images where Image Type (0008,0008) Value 3 is RECON TOMO or RECON GATED TOMO	3.4.6.12
Overlay Plane	Not Used	N/A
Multi-frame Overlay	Not Used	N/A
VOI LUT	Used	3.4.6.13
SOP Common	Used	3.4.6.14
Private Image	Used	3.4.6.15

3.4 INFORMATION MODULE DEFINITIONS

Please refer to DICOM Part 3 (Information Object Definitions) for a description of each of the entities, modules, and attributes contained within the 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 when generating the instance. It should be noted that they are the same ones as defined in the DICOM Standard Part 3 (Information Object Definitions).

SmartConsole™ Application private attributes are defined in private modules, each of which follows the related Standard module. Private data element tags are assigned following the rules given in Part 5 of the DICOM v3.0 Standard, and are identified using the (ggg, xxe) format, where xx represents a reserved block of element numbers within the group ggg.

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

3.4.1 Patient Entity Modules

3.4.1.1 Patient Module

**TABLE 3-3
PATIENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Patient's Name	(0010,0010)	2	Patient's full name.	Used/ Copied
Patient ID	(0010,0020)	2	Primary hospital identification number or code for the patient.	Mandatory/ Copied
Issuer of Patient ID	(0010,0021)	3	Not Used	Ignored / Removed
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	3	Not Used	Ignored / Removed
Patient's Birth Date	(0010,0030)	2	Birth date of the patient.	Used/ Copied
Patient's Sex	(0010,0040)	2	Sex of the named patient.	Used/ Copied

Other Patient IDs	(0010,1000)	3	Other identification numbers or codes used to identify the patient.	Ignored/Copied
Other Patient Names	(0010,1001)	3	Other names used to identify the patient.	Ignored/Copied
Other Patient IDs Sequence	(0010,1002)	3	Not Used	Ignored / Removed
Ethnic Group	(0010,2160)	3	Ethnic group or race of the patient.	Ignored /Copied
Patient Comments	(0010,4000)	3	User-defined additional information about the patient.	Ignored / Removed

3.4.2 Study Entity Modules

3.4.2.1 General Study Module

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Study Instance UID	(0020,000D)	1	Unique identifier for the Study.	Mandatory / Copied
Study Date	(0008,0020)	2	Date the Study started.	Used / Copied
Study Time	(0008,0030)	2	Time the Study started	Used / Copied
Accession Number	(0008,0050)	2	A RIS generated number that identifies the order for the Study.	Used / Copied
Referring Physician's Name	(0008,0090)	2	Name of the patient's referring physician.	Used/ Copied
Study ID	(0020,0010)	2	User or equipment generated Study identifier.	Used/ Copied
Study Description	(0008,1030)	3	Study Description.	Ignored / Copied
Name of Physician(s) Reading Study	(0008,1060)	3	Names of the physician(s) reading the Study.	Ignored / Copied
Procedure Code Sequence.	(0008,1032)	3	Procedure Code Sequence.(*). Mapped without change from Modality Worklist Requested Procedure Code Sequence (0032,1064). May present in locally protocols appended to study with already scheduled MWL protocol.	Ignored / Removed
> Include 'Code Sequence Macro'				
Referenced Study Sequence	(0008,1110)	3	Referenced Study Sequence.(*) Only a single item is permitted in this sequence, if sent. Copied from 1 st valid item of Referenced Study Sequence sent in Worklist. If no valid items exist, not sent. May present in locally protocols appended to study with already scheduled MWL protocol.	Ignored / Removed
>Include 'SOP Instance Reference Macro'				

3.4.2.2 Patient Study Module

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Admitting Diagnoses Description	(0008,1080)	3	Description of the admitting diagnosis (diagnoses)	Ignored / Removed
Patient's Age	(0010,1010)	3	Age of the Patient.	Used / Copied
Patient's Size	(0010,1020)	3	Length or size of the Patient, in meters.	Used / Copied
Patient's Weight	(0010,1030)	3	Weight of the Patient, in kilograms	Used / Copied

Occupation	(0010,2180)	3	Patient Occupation.	Ignored / Copied
Additional Patient's History	(0010,21B0)	3	Additional information about the Patient's medical history.	Ignored /Copied

3.4.2.3 Standard Extended Study Module

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Requested Procedure Comments	(0040,1400)	3	User-defined Study notes Sent as ZERO LENGTH value if value is not received from user input	Ignored/Copied
Allergies	(0010,2110)	3	Description of prior reaction to contrast agents, or other patient allergies or adverse reactions (*) (**) Sent as ZERO LENGTH value if value is not received either from MWL or from user input. User can modify value received from MWL	Ignored/Copied
Pregnancy Status	(0010,21C0)	3	Describes pregnancy state of patient. (*)(**) Enumerated Values: 0001 = not pregnant 0002 = possibly pregnant 0003 = definitely pregnant 0004 = unknown Sent as "unknown" if value is not received either from MWL or from user input and if tag (0010,1040) - Patient's Sex - is other than "F" (Female) User can modify value received from MWL if tag (0010,1040) - Patient's Sex - is "F" (Female) only	Ignored/Copied

3.4.3 Series Entity Modules

3.4.3.1 General Series Module

**TABLE 3-7
GENERAL SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. Defined Terms used: NM = Nuclear Medicine (for NM IOD) PT= Positron Emission Tomography (for PET IOD)	Mandatory/ Generated
Series Instance UID	(0020,000E)	1	Internally generated unique identifier of the Series.	Mandatory/ Generated
Series Number	(0020,0011)	2	A number that identifies this Series.	Ignored/ Generated
Series Date	(0008,0021)	3	Date the Series started.	Used/Generated (Current Date)

Series Time	(0008,0031)	3	Time the Series started.	Used/Generated (Current Time)
Laterality	(0020,0060)	2C	Laterality of (paired) body part examined.	Ignored/ Copied
Performing Physicians' Name	(0008,1050)	3	Name of the physician(s) administering this Series.	Ignored/ Copied
Patient Position	(0018,5100)	3	Patient position descriptor relative to the equipment	Used/ Copied
Protocol Name	(0018,1030)	3	User-defined description of the conditions under which the Series was performed.	Used/ Generated
Series Description	(0008,103E)	3	Description of the Series	Used/Generated (application generated on save)
Operators' Name	(0008,1070)	3	Name(s) of the operator(s) supporting the Series	Used / Copied
Body Part Examined	(0018,0015)	3	Text description of the part of the body examined.	Used/Copied

3.4.3.2 Standard Extended Series Module

**TABLE 3-8
STANDARD EXTENDED SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Patient Position	(0018,5100)	3	Patient position descriptor relative to the equipment	Used/ Copied

3.4.3.3 NM/PET Patient Orientation Module

**TABLE 3-9
NM/PET PATIENT ORIENTATION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Patient Orientation Code Sequence	(0054,0410)	2	Describes the orientation of the patient with respect to gravity.	Used/Copied
>Include Code Sequence Macro			Baseline ID 19	Used/Copied
> Patient Orientation Modifier Code Sequence	(0054,0412)	2C	Patient Orientation Modifier.	Used/Copied
>>Include 'Code Sequence Macro'			Baseline ID 20	Used/Copied
Patient Gantry Relationship Code Sequence	(0054,0414)	2	Describes the orientation of the patient with respect to the gantry.	Used/Copied
>Include Code Sequence Macro			Baseline ID 21	Used/Copied

3.4.3.4 Private Series Module

**TABLE 3-10
PRIVATE SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator ID	Attribute Description	Attribute Usage
Effective Series Duration	(0011,xx0B)	GEMS_GENIE_1	Calculated duration of series.	Used/Copied
Series Data Sequence	(0033,xx70)	GEMS_XELPRV_01	Sequence of item contains information about processing parameters.	Used/Copied
>Object Type	(0033,xx08)	GEMS_XELPRV_01	Object Type. Contains string "SERIES DATA "	Used/Copied
>Modified	(0033,xx10)	GEMS_XELPRV_01	Default value = 0 (Not Modified). Possible Values 0,1	Used/Copied

>Name	(0033,xx11)	GEMS_XELPRV_01	SDO Name	Used/Copied
>Database Object Unique ID	(0033,xx16)	GEMS_XELPRV_01	Database UID of SDO; contains value of SDO UID tag (0033,xx72) generated at time of object creation.	Used/Copied
>Date	(0033,xx17)	GEMS_XELPRV_01	SDO Creation date	Used/Copied
>Time	(0033,xx18)	GEMS_XELPRV_01	SDO Creation time	Used/Copied
>Series Data Flags	(0033,xx19)	GEMS_XELPRV_01	SDO Flags. Default value = 0	Used/Copied
>Protocol Name	(0033,xx1A)	GEMS_XELPRV_01	Name of Protocol created SDO	Used/Copied
>Relevant Data UID	(0033,xx1B)	GEMS_XELPRV_01	UID(s) of SOP Instance(s) relative to SDO	Used/Copied
>Bulk Data	(0033,xx1C)	GEMS_XELPRV_01	SDO parameter(s) stored as binary buffer(s)	Used/Copied
>Int Data	(0033,xx1D)	GEMS_XELPRV_01	List of SDO parameters stored as integers	Used/Copied
>Double Data	(0033,xx1E)	GEMS_XELPRV_01	List of SDO parameters stored as doubles	Used/Copied
>String Data	(0033,xx1F)	GEMS_XELPRV_01	List of SDO parameters stored as list of strings	Used/Copied
>Bulk Data Format	(0033,xx20)	GEMS_XELPRV_01	Format of bulk parameters; contains information about name and size of bulk buffers	Used/Copied
>Int Data Format	(0033,xx21)	GEMS_XELPRV_01	Format of integer parameters; contains information about name and number of integers in list	Used/Copied
>Double Data Format	(0033,xx22)	GEMS_XELPRV_01	Format of double parameters; contains information about name and number of doubles in list	Used/Copied
>String Data Format	(0033,xx23)	GEMS_XELPRV_01	Format of string parameters; contains information about name and number of strings in list	Used/Copied
>Description	(0033,xx24)	GEMS_XELPRV_01	User or equipment generated SDO description	Used/Copied
>SDO Private SOP Class UID	(0033,xx71)	GEMS_XELPRV_01	SDO Private SOP Class UID- "1.2.840.113619.4.17"	Used/Copied
>SDO Instance UID	(0033,xx72)	GEMS_XELPRV_01	SDO Instance UID; Internally generated	Ignored/Generated

3.4.4 Frame Of Reference Entity Modules

3.4.4.1 Frame Of Reference Module

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

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

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that the images are spatially related and that the imaged body was scanned spatially aligned between the two images.

The Frame of Reference Module Attributes appear for TOMO,GATED TOMO,RECON TOMO and RECON GATED TOMO scan types.

**TABLE 3-11
FRAME OF REFERENCE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Frame of Reference UID	(0020,0052)	1	Uniquely identifies the frame of reference for a Series.	Used/Copied
Position Reference Indicator	(0020,1040)	2	Part of the patient's anatomy used as a reference.	Ignored /Copied

3.4.5 Equipment Entity Modules

3.4.5.1 General Equipment Module

**TABLE 3-12
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Manufacturer	(0008,0070)	2	Manufacturer of the equipment that produced the composite instances. Possible Values: "GE MEDICAL SYSTEMS, NUCLEAR"	Ignored /Generated
Institution Name	(0008,0080)	3	Institution where the equipment that produced the composite instances is located.	Used/Copied
Manufacturer's Model Name	(0008,1090)	3	Manufacturer's model name of the equipment of the input image.	Used /Copied
Device Serial Number	(0018,1000)	3	Manufacturer's serial number of the equipment that produced the composite instances.	Ignored /Generated
Station Name	(0008,1010)	3	User defined name identifying the machine that produced the composite instances.	Ignored /Generated
Software Versions	(0018,1020)	3	Manufacturer's designation of software version of the equipment that produced the composite instances	Ignored /Generated

3.4.6 Image Entity Modules

3.4.6.1 General Image Module

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Instance Number	(0020,0013)	2	A number that identifies this image.	Ignored/Generated
Content Date	(0008,0023)	2C	The date the image pixel data creation started.	Used/Generated (Current Date)
Content Time	(0008,0033)	2C	The time the image pixel data creation started	Used/Generated (Current Time)
Image Type	(0008,0008)	3	See 3.4.6.7.1	Used / Generated
Acquisition Date	(0008,0022)	3	The date the acquisition of data that resulted in this image started	Used/ Copied
Acquisition Time	(0008,0032)	3	The time the acquisition of data that resulted in this image started	Used/ Copied
Image Comments	(0020,4000)	3	Contains additional information about image. Used value from original data to append to.	Used/Generated

3.4.6.2 Image Pixel Module

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Samples per Pixel	(0028,0002)	1	See 3.4.6.3 for NM Images	
Photometric Interpretation	(0028,0004)	1	See 3.4.6.3 for NM Images	
Rows	(0028,0010)	1	Number of rows in the image.	Used / Generated
Columns	(0028,0011)	1	Number of columns in the image	Used / Generated
Bits Allocated	(0028,0100)	1	See 3.4.6.3 for NM Images	
Bits Stored	(0028,0101)	1	See 3.4.6.3 for NM Images	
High Bit	(0028,0102)	1	See 3.4.6.3 for NM Images	
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples.	Used / Generated
Pixel Data	(7FE0,0010)	1	A data stream of the pixel samples that comprise the Image.	Used /Generated
Planar Configuration	(0028,0006)	1C	Not Used (number of Samples per Pixel is always 1)	Ignored / Removed
Pixel Aspect Ratio	(0028,0034)	1C	Not Used	Ignored / Removed
Smallest Image Pixel Value	(0028,0106)	3	The minimum actual pixel value encountered in this image.	Used /Generated
Largest Image Pixel Value	(0028,0107)	3	The maximum actual pixel value encountered in this image.	Used /Generated

3.4.6.3 NM Image Pixel Module

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

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. The value always set to 1.	Used/ Generated
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data Enumerated Values supported : MONOCHROME2	Used/Generated
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. Enumerated Values supported : 16.	Used / Generated
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Value equal to Bit Allocated (0028,0100)	Used / Generated
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Value equal to Bit Stored (0028,0101) – 1	Used / Generated
Pixel Spacing	(0028,0030)	2	Physical distance in the patient between the center of each pixel, specified by a numeric pair – adjacent row spacing (delimiter) adjacent column spacing, in mm.	Used / Copied

3.4.6.4 Acquisition Context Module

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

TABLE 3-16
ACQUISITION CONTEXT MODULE ATTRIBUTES

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

3.4.6.5 Multi-Frame Module

TABLE 3-17
MULTI-FRAME MODULE ATTRIBUTES

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

3.4.6.6 NM Multi-frame Module

TABLE 3-18
NM MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Frame Increment Pointer	(0028,0009)	1	See 3.4.6.6.1 for further specialization.	Used / Generated
Energy Window Vector	(0054,0010)	1C	Defines energy set window to which each	Used /Removed

			frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Energy Window Vector (0054,0010).	
Number of Energy Windows	(0054,0011)	1	Number of energy set windows in SOP Instance. Possible values: 1	Used / Generated
Detector Vector	(0054,0020)	1C	Defines detector to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Detector Vector (0054,0020).	Used / Removed
Number of Detectors	(0054,0021)	1	Number of detectors in SOP Instance. Possible values: 1.	Used / Generated
Rotation Vector	(0054,0050)	1C	Defines rotation to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Rotation Vector (0054,0050).	Used / Removed
Number of Rotations	(0054,0051)	1C	Number of Rotations in SOP Instance. Always set to 1. Sent if Image Type (0008,0008), Value 3 is RECON TOMO or RECON GATED TOMO.	Used / Generated
Slice Vector	(0054,0080)	1C	An array which contains the spatial slice number for each frame. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Slice Vector (0054,0080)	Used / Generated
Number of Slices	(0054,0081)	1C	Number of images slices in SOP Instance. Sent if Image Type (0008,0008), Value 3 is RECON TOMO or RECON GATED TOMO.	Used / Generated
Angular View Vector	(0054,0090)	1C	Defines angular view number to which each frame belongs. Sent if the value of the Frame Increment Pointer (0028,0009) includes the Tag for Angular View Vector (0054,0090).	Used / Removed

3.4.6.6.1 Frame Increment Pointer

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

**TABLE 3-19
ENUMERATED VALUES FOR FRAME INCREMENT POINTER**

Image Type (0008,0008), Value 3	Frame Increment Pointer (0028,0009)	Image Types Usage
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)	Used
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).	Used
RECON TOMO	0054H 0080H Sequencing is by Slice Vector (0054,0080)	Used/Generated
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)	Used/Generated

3.4.6.7 NM Image Module

**TABLE 3-20
NM IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Image Type	(0008,0008)	1	See 3.4.6.7.1 for specialization.	Used / Generated
Image ID	(0054,0400)	3	User or equipment generated Image identifier.	Used / Generated
Counts Accumulated	(0018,0070)	2	Sum of all gamma events for all frames in the image.	Used / Generated
Acquisition Termination Condition	(0018,0071)	3	Description of how the data collection was stopped. Defined Terms are used: CNTS = counts DENS = density, count limit reached within ROI MANU = manual TIME = time TRIG = physiological trigger	Used / Copied
Count Rate	(0018,1243)	3	Maximum count rate achieved during the acquisition in counts/sec	Used/ Copied
Corrected Image	(0028, 0051)	3	Corrections have been applied to the image. Defined Terms are used: UNIF = flood corrected COR = center of rotation corrected ATTN, ATT_MEASURED, ATT_CHANG0 = attenuation corrected SCAT = scatter corrected NRGY = energy corrected LIN = linearity corrected CLN = count loss normalization MOTN=motion corrected	Used / Copied

3.4.6.7.1 Image Type

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

Value 1 shall have the following Enumerated Values:

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

Value 2 shall have the following Enumerated Value:

- PRIMARY identifies a Primary Image

The following Enumerated Values of Value 3 are used:

- TOMO - Identifies a Tomographic (SPECT) Image
- RECON TOMO - Identifies a reconstructed Tomographic Image
- GATED TOMO - Identifies a Gated Tomographic (SPECT) Image
- RECON GATED TOMO - Identifies a reconstructed Gated Tomographic Image

The following Enumerated Values of Value 4 are used:

- EMISSION - Transmission source is NOT active during image acquisition

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

Value 1 may have the following Enumerated Values:

- DERIVED identifies a Derived Image

Value 2 may have the following Enumerated Value:

- PRIMARY identifies a Primary Image

Value 3 may have the following Enumerated Values:

- RECON TOMO - Identifies a reconstructed Tomographic Image

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- RECON GATED TOMO - Identifies a reconstructed Gated Tomographic Image
- Value 4 may have the following Enumerated Value:
- EMISSION - Transmission source is NOT active during image acquisition

3.4.6.8 NM Isotope Module

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

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Energy Window Information Sequence	(0054,0012)	2	Sequence of Items that describe the energy window groups used. 1 item is supported for this SQ.	Used / Copied
> Energy Window Name	(0054,0018)	3	A user defined name which describes this Energy Window.	Ignored / Copied
>Energy Window Range Sequence	(0054,0013)	3	Sequence describing window energy limits. May contain 1 or more items.	Used / Copied
>> Energy Window Lower Limit	(0054,0014)	3	The lower limit of the energy window in KeV.	Used / Copied
>> Energy Window Upper Limit	(0054,0015)	3	The upper limit of the energy window in KeV.	Used / Copied
Radiopharmaceutical Information Sequence	(0054,0016)	2	Information on radiopharmaceutical(s) used.	Used/Generated
> Radionuclide Code Sequence	(0054,0300)	2	Sequence that identifies the radionuclide.	Only first valid item is Used / Copied.
>> <i>Include 'Code Sequence Macro'</i>	<i>Baseline CID is 18 "Isotopes in Radiopharmaceuticals".</i>			Used / Copied
> Radiopharmaceutical Route	(0018,1070)	3	Route of injection.	Ignored / Removed
> Administration Route Code Sequence	(0054,0302)	3	Not Used	Ignored / Removed
> Radiopharmaceutical Volume	(0018,1071)	3	Volume of injection in cubic cm.	Ignored / Removed
> Radiopharmaceutical Start Time	(0018,1072)	3	Time of start of injection.	Ignored / Removed
> Radiopharmaceutical Stop Time	(0018,1073)	3	Time of end of injection.	Ignored / Removed
> Radionuclide Total Dose	(0018,1074)	3	Total amount of radionuclide injected in MBq.	Used / Copied
> Radiopharmaceutical	(0018,0031)	3	Name of the radiopharmaceutical.	Used / Copied
> Radiopharmaceutical Code Sequence	(0054,0304)	3	Sequence that identifies the radiopharmaceutical.	Ignored / Copied
>> <i>Include 'Code Sequence Macro'</i>	<i>Baseline ID 25 "Radiopharmaceuticals"</i>			Ignored / Copied
Intervention Drug Information Sequence	(0018,0026)	3	Sequence of Items that describes the intervention drugs used..	Ignored / Removed

3.4.6.9 NM Detector Module

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

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Detector Information Sequence	(0054,0022)	2	Sequence of Items that describe the detectors used. 1 item is supported in the SQ.	Used / Copied
> Collimator/Grid Name	(0018,1180)	3	Label describing the collimator used	Ignored / Copied
> Collimator Type	(0018,1181)	2	Collimator type. The following values are supported:	Used / Copied

			PARA = Parallel PINH = Pinhole FANB = Fan-beam CONE = Cone-beam SLNT = Slant hole ASTG = Astigmatic DIVG = Diverging NONE = No collimator UNKN = Unknown	
> Field of View Shape	(0018,1147)	3	Shape of FOV The following values are supported: RECTANGLE ROUND	Ignored / Copied
> Field of View Dimension(s)	(0018,1149)	3	Dimensions of the field of view in mm.	Ignored / Copied
> Focal Distance	(0018,1182)	2	Focal distance, in mm.	Ignored / Copied
> X Focus Center	(0018,1183)	3	Center of focus along a row.	Used / Copied
> Y Focus Center	(0018,1184)	3	Center of focus along a column.	Used / Copied
> Zoom Center	(0028,0032)	3	The amount of offset from (0, 0) applied to each pixel in the image before application of the zoom factor, specified by a numeric pair (in mm).	Used / Copied
> Zoom Factor	(0028,0031)	3	The amount of magnification applied to each pixel in the image.	Used / Copied
> Center of Rotation Offset	(0018,1145)	3	Offset between detector center and mechanical center	Used / Copied
> Gantry/Detector Tilt	(0018,1120)	3	Angle of tilt in degrees of the detector.	Used / Copied
> Image Orientation (Patient)	(0020,0037)	2	The direction cosines of the first row and the first column with respect to the patient. Set for first frame in dataset	Ignored / Generated
> Image Position (Patient)	(0020,0032)	2	The x, y, and z coordinates of the upper left hand corner (center of the first voxel transmitted) of the image, in mm. Set for first frame in dataset.	Ignored / Generated
> View Code Sequence	(0054,0220)	3	Sequence that describes the projection of the anatomic region of interest on the image receptor.	Ignored / Removed

3.4.6.10 NM Tomo Acquisition Module

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

**TABLE 3-23
NM Tomo Acquisition Module Attributes**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Rotation Information Sequence	(0054,0052)	2	Sequence of Items that describe TOMO rotational groups. May contain 0 or 1 item.	Used / Copied
> Start Angle	(0054,0200)	1	Position of the detector about the patient for the start of the acquisition, in degrees.	Used / Copied
> Angular Step	(0018,1144)	1	The angular scan arc step between views of the TOMO acquisition, in degrees	Used / Copied
> Rotation Direction	(0018,1140)	1	Direction of rotation of the detector about the patient. Enumerated Values: CW = clockwise (decreasing angle)	Used / Copied

			CC = counter-clockwise (increasing angle).	
> Scan Arc	(0018,1143)	1	The effective angular range of the scan data in degrees.	Used / Copied
> Actual Frame Duration	(0018,1242)	1	Nominal acquisition time per angular position, in msec.	Used / Copied
> Radial Position	(0018,1142)	3	Radial distance of the detector from the center of rotation, in mm.	Used / Copied
> Number of Frames in Rotation	(0054,0053)	1	Number of angular views in this rotation.	Used / Copied
> Table Traverse	(0018,1131)	3	Table longitudinal position at acquisition start .in mm.	Used / Copied
> Table Height	(0018,1130)	3	The distance in mm of the top of the patient table to the center of rotation.	Used / Copied
Type of Detector Motion	(0054,0202)	3	Describes the detector motion during acquisition. Enumerated Values: STEP AND SHOOT = Interrupted motion, acquire only while stationary. CONTINUOUS = Gantry motion and acquisition are simultaneous and continuous. ACQ DURING STEP = Interrupted motion, acquisition is continuous.	Ignored / Copied

3.4.6.11 NM Multi-gated Acquisition Module

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

**TABLE 3-24
NM MULTI-GATED ACQUISITION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Beat Rejection Flag	(0018,1080)	3	Heart beat duration sorting has been applied. Enumerated Values: Y = yes N = no Always sent.	Ignored / Copied
PVC Rejection	(0018,1085)	3	Description of type of arrhythmic beat rejection criteria used. Always sent as "Reject beats out of pvc window"	Ignored / Copied
Skip Beats	(0018,1086)	3	Number of beats skipped after a detected arrhythmia Always sent.	Ignored / Copied
Heart Rate	(0018,1088)	3	Average number of heart beats per minute for the collection period for these frames Always sent.	Ignored / Copied
Gated Information Sequence	(0054,0062)	2C	Sequence of Items that describe R-R intervals. Sent if the Frame Increment Pointer (0028,0009) contains the Tag for R-R Interval Vector (0054,0060) Contains only 1 item if presents	Used / Copied
> Cardiac Framing Type	(0018,1064)	3	Description of type of framing performed.	Ignored /

			Always sent.	Removed
> Data Information Sequence	(0054,0063)	2	Sequence of Items that describe gating criteria. Contains only 1 item.	Used / Copied
>> Frame Time	(0018,1063)	1	Nominal time per individual frame in msec	Used / Copied
>> Low R-R Value	(0018,1081)	3	R-R interval lower limit for beat rejection, in msec Always sent.	Used / Copied
>> High R-R Value	(0018,1082)	3	R-R interval upper limit for beat rejection, in msec Always sent.	Used / Copied
>> Intervals Acquired	(0018,1083)	3	Number of heartbeats that fall within Low R-R Value (0018,1081) and High R-R Value (0018,1082), and were therefore accepted and contribute gamma events to this R-R Interval. Always sent.	Used / Copied
>> Intervals Rejected	(0018,1084)	3	Number of heartbeats that fall outside Low R-R (0018,1081) and High R-R Value (0018,1082), and do not contribute gamma events to this R-R Interval. Always sent.	Used / Copied
>> Time Slot Information Sequence	(0054,0072)	2C	Sequence of Items that describe Time Slot Information. Sent if the Frame Increment Pointer (0028,0009) contains the Tag for Time Slot vector (0054,0070) Contains 1 or more items if it presents, the number of items is equal to Number of Time Slots (0054,0071).	Used / Copied
>>> Time Slot Time	(0054,0073)	3	Not Used	Ignored / Copied

3.4.6.12 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.

**TABLE 3-25
NM RECONSTRUCTION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Spacing Between Slices	(0018,0088)	2	Spacing between slices, in mm, measured from center-to-center of each slice along the normal to the first image.	Used / Generated
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm.	Used / Generated

3.4.6.13 VOI LUT Module

**TABLE 3-26
VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Window Center	(0028,1050)	1C	Window Center for display. Calculated from actually maximal and minimal pixel	Used / Generated

			values	
Window Width	(0028,1051)	1C	Window Width for display. Calculated from actually maximal and minimal pixel values.	Used / Generated

3.4.6.14 SOP Common Module

This section defines the Attributes which are required for proper functioning and identification of the associated SOP Instances.

**TABLE 3-27
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
SOP Class UID	(0008,0016)	1	Uniquely identifies the SOP Class. Always set to "1.2.840.10008.5.1.4.1.1.20"	Ignored / Generated
SOP Instance UID	(0008,0018)	1	Uniquely identifies the SOP Instance.	Mandatory / Generated
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set. Defined Terms used: refer to Section 2.2	Used / Generated
Instance Creation Date	(0008,0012)	3	Date of instance creation.	Ignored / Removed
Instance Creation Time	(0008,0013)	3	Time of instance creation.	Ignored / Removed
Instance Creator UID	(0008,0014)	3	The Implementation UID for this DICOMImplementation Set to the 1.2.840.113619.6.441	Ignored / Generated
Instance Number	(0020,0013)	3	See 3.4.6.1 for more specialization	Ignored / Generated

3.4.6.15 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 3-28
PRIVATE IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator	Attribute Description	Attribute Usage
Dataset Name	(0011,xx12)	GEMS_GENIE_1	Dataset Name	Used /Generated
Acquisition Parent UID	(0011,xx31)	GEMS_GENIE_1	Acquisition Parent UID	Used / Copied
Processing Parent UID	(0011,xx32)	GEMS_GENIE_1	Processing Parent UID	Used / Generated
Request ID	(0039,xx10)	GEMS_RECONBOXPRV_1	Request ID	Used / Generated
Transformation Matrix	(0039,xx12)	GEMS_RECONBOXPRV_1	Transformation Matrix	Used / Generated
Pixel Scale	(0011,xx3B)	GEMS_GENIE_1	Set to 1.0	Ignored /Generated

3.5 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES

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

3.5.1 Standard Extended Attributes

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

TABLE 3-29
STANDARD EXTENDED ATTRIBUTES

Information Entity Name	Attribute Name	Tag	Use	
Study	Requested Procedure Comments	(0040,1400)	User-defined Study notes	Ignored/Copied
	Allergies	(0010,2110)		Ignored/Copied
	Pregnancy Status	(0010,21C0)		Ignored/Copied
Series	Patient Position	(0018,5100)	Patient position descriptor relative to the Equipment.	Used/ Copied

3.5.2 Private Group GEMS_GENIE_1

TABLE 3-30
PRIVATE GROUP GEMS_GENIE_1

Attribute Name	Tag	VR	VM	Attribute Description	Attribute Usage
Private Creator Id	(0011, xx10)	LO	1	GEMS_GENIE_1	
Effective Series Duration	(0011,xx0B)	SL	1	Calculated duration of series.	Used/Generated
Dataset Name	(0011,xx12)	LO	1-n	Dataset Name	Used /Generated
Acquisition Parent UID	(0011,xx31)	LO	1-n	Acquisition Parent UID	Used / Copied
Processing Parent UID	(0011,xx32)	LO	1-n	Processing Parent UID	Used / Copied
Pixel Scale	(0011,xx3B)	FD	1-n		Ignored /Generated

3.5.3 Private Group GEMS_XELPRV_01

TABLE 3-31
PRIVATE GROUP GEMS_XELPRV_01

Attribute Name	Tag	VR	VM	Attribute Description	Attribute Usage
Private Creator Identification	(0033,00xx)	LO	1	GEMS_XELPRV_01	Ignored/Copied
Object Type	(0033,xx08)	CS	1	Object Type. Contains string "SERIES DATA "	Ignored/Copied
Modified Flag	(0033,xx10)	SL	1	Default value = 0 (Not Modified)	Ignored/Copied
Name	(0033,xx11)	LO	1	SDO Name	Ignored/Copied
Database Object Unique ID	(0033,xx16)	LO	1	Database UID of SDO; contains value of SDO UID tag (0033,xx72) generated at time of object creation	Ignored/Copied
Date	(0033,xx17)	SH	1	SDO Creation date	Ignored/Copied
Time	(0033,xx18)	SH	1	SDO Creation time	Ignored/Copied
SeriesDataFlags	(0033,xx19)	UL	1	SDO Flags. Default value = 0	Ignored/Copied
ProtocolName	(0033,xx1A)	LO	1	Name of Protocol created SDO	Ignored/Copied
RelevantDataUID	(0033,xx1B)	LO	1	UID(s) of SOP Instance(s) relative to SDO	Ignored/Copied
BulkData	(0033,xx1C)	OB	1	SDO parameter(s) stored as binary buffer(s)	Ignored/Copied
IntData	(0033,xx1D)	SL	1-n	List of SDO parameters stored	Ignored/Copied

				as integers	
Double Data	(0033,xx1E)	FD	1-n	List of SDO parameters stored as doubles	Ignored/Copied
String Data	(0033,xx1F)	OB	1	List of SDO parameters stored as list of strings	Ignored/Copied
BulkDataFormat	(0033,xx20)	OB	1	Format of bulk parameters; contains information about name and size of bulk buffers	Ignored/Copied
IntDataFormat	(0033,xx21)	OB	1	Format of integer parameters; contains information about name and number of integers in list	Ignored/Copied
DoubleDataFormat	(0033,xx22)	OB	1	Format of double parameters; contains information about name and number of doubles in list	Ignored/Copied
StringDataFormat	(0033,xx23)	OB	1	Format of string parameters; contains information about name and number of strings in list	Ignored/Copied
Description	(0033,xx24)	LT	1	User or equipment generated SDO description	Ignored/Copied
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.	Ignored/Copied
SDO Private SOP Class UID	(0033,xx71)	UI	1	SDO Private SOP Class UID- "1.2.840.113619.4.17"	Ignored/Copied
SDO Instance UID	(0033,xx72)	UI	1	SDO Instance UID; Internally generated	Ignored/Copied

3.5.4 Private Group GEMS_RECONBOXPRV_1

TABLE 3-32
PRIVATE GROUP GEMS_RECONBOXPRV_1

Attribute Name	Tag	VR	VM	Attribute Description	Attribute Usage
Private Creator Identification	(0039,00xx)	LO	1	GEMS_RECONBOXPRV_1	Used / Generated
Reconstruction ID	(0039,xx10)	UI	1	Unique Identifier of Reconstruction Job	Used / Generated
Transformation Matrix	(0039,xx12)	LO	1	Transformation Matrix	Used / Generated

3.6 STANDARD EXTENDED AND PRIVATE CONTEXT GROUPS

SmartConsole™ Application do not support any coded terminology

4. CT INFORMATION OBJECT IMPLEMENTATION

4.1 INTRODUCTION

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

4.2 SMARTCONSOLE™ APPLICATION MAPPING OF DICOM ENTITIES

The SmartConsole™ Application map DICOM Information Entities to local Information Entities in the product’s database and user interface.

TABLE 4-1
MAPPING OF DICOM ENTITIES TO SMARTCONSOLE™ APPLICATION ENTITIES

DICOM IE	SmartConsole™ Application Entity
Patient	Patient
Study	Study
Series	Series
Image	Dataset

4.3 IOD MODULE TABLE

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

TABLE 4-2
CT IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used (same description as for NM IOD)	3.4.1.1
	Clinical Trial Subject	Not Used	N/A
Study	General Study	Used (same description as for NM IOD)	3.4.2.1
	Patient Study	Used (same description as for NM IOD)	3.4.2.2
	Clinical Trial Study	Not Used	N/A
Series	General Series	Used	4.4.1.1
	Clinical Trial Series	Not Used	N/A
Frame of Reference	Frame of Reference	Used (same description as for NM IOD)	3.4.4.1
Equipment	General Equipment	Used (same description as for NM IOD)	3.4.5.1
Image	General Image	Used	4.4.2.1
	Image Plane	Used	4.4.2.2
	Image Pixel	Used	4.4.2.3
	Contrast/Bolus	Not Used	N/A
	Device	Not Used	N/A
	CT Image	Used	4.4.2.4
	Overlay Plane	Not Used	N/A
	VOI LUT	Used	4.4.2.5
	SOP Common	Used	4.4.2.6

	Private Image	Used	4.4.2.7
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4.4 INFORMATION MODULE DEFINITIONS

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

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

SmartConsole™ Application private attributes are defined in private modules, each of which follows the related Standard module. Private data element tags are assigned following the rules given in Part 5 of the DICOM v3.0 Standard, and are identified using the (gggg, xxee) format, where xx represents a reserved block of element numbers within the group 9999.

4.4.1 Series Entity Modules

4.4.1.1 General Series Module

TABLE 4-3
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. Defined Terms used: CT = Computed Tomography (for CT IOD) MR = Magnetic Resonance(for MR IOD)
Series Instance UID	(0020,000E)	1	Internally generated unique identifier of the Series.
Series Number	(0020,0011)	2	A number that identifies this Series.
Series Date	(0008,0021)	3	Date the Series started.
Series Time	(0008,0031)	3	Time the Series started.
Laterality	(0020,0060)	2C	Laterality of (paired) body part examined.
Performing Physicians' Name	(0008,1050)	3	Name of the physician(s) administering this Series.
Protocol Name	(0018,1030)	3	User-defined description of the conditions under which the Series was performed.
Series Description	(0008,103E)	3	Description of the Series
Operators' Name	(0008,1070)	3	Name(s) of the operator(s) supporting the Series
Referenced Performed Procedure Step Sequence	(0008,1111)	3	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related.
Body Part Examined	(0018,0015)	3	Text description of the part of the body examined.
Patient Position	(0018,5100)	3	Patient position descriptor relative to the equipment
Request Attributes Sequence	(0040,0275)	3	Sequence that contains attributes from the Imaging Service Request.
Comments on the Performed Procedure Step	(0040,0280)	3	User-defined comments on the Performed Procedure Step
Performed Procedure Step ID	(0040,0253)	3	Equipment generated identifier of the protocol carried out within this step.
Performed Procedure Step Start Date	(0040,0244)	3	The date that the protocol (SPS) acquisition actually started
Performed Procedure Step	(0040,0245)	3	The time that the protocol (SPS) acquisition actually started

Start Time			
Performed Procedure Step Description	(0040,0254)	3	The full path of the performed protocol name.
Performed Protocol Code Sequence	(0040,0260)	3	Not Used

4.4.2 Image Entity Modules

4.4.2.1 General Image Module

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

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	A number that identifies this image.
Patient Orientation	(0020,0020)	2C	Patient Orientation
Content Date	(0008,0023)	2C	The date the image pixel data creation started.
Content Time	(0008,0033)	2C	The time the image pixel data creation started
Image Type	(0008,0008)	3	See 4.4.2.4.1
Acquisition Date	(0008,0022)	3	The date the acquisition of data that resulted in this image started
Acquisition Time	(0008,0032)	3	The time the acquisition of data that resulted in this image started
Image Comments	(0020,4000)	3	Contains additional information about image.
Quality Control Image	(0028,0300)	3	Indicates whether or not this image is a quality control or phantom image.

4.4.2.2 Image Plane Module

**TABLE 4-5
IMAGE PLANE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.
Image Orientation (Patient)	(0020,0037)	1	The direction cosines of the first row and the first column with respect to the patient.
Image Position (Patient)	(0020,0032)	1	The x, y, and z coordinates of the upper left hand corner (center of the first voxel transmitted) of the image, in mm
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm
Slice Location	(0020,1041)	3	Relative position of the image plane expressed in mm.

4.4.2.3 Image Pixel Module

**TABLE 4-6
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	See 4.4.2.4 for CT Images
Photometric Interpretation	(0028,0004)	1	See 4.4.2.4 for CT Images
Rows	(0028,0010)	1	Number of rows in the image
Columns	(0028,0011)	1	Number of columns in the image
Bits Allocated	(0028,0100)	1	See 4.4.2.4 for CT Images
Bits Stored	(0028,0101)	1	See 4.4.2.4 for CT Images
High Bit	(0028,0102)	1	See 4.4.2.4 for CT Images

Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values used: 0000H = unsigned integer. 0001H = 2's complement
Pixel Data	(7FE0,0010)	1	A data stream of the pixel samples that comprise the Image.
Planar Configuration	(0028,0006)	1C	Not Used (number of Samples per Pixel is always 1)
Pixel Aspect Ratio	(0028,0034)	1C	Not Used

4.4.2.4 CT Image Module

**TABLE 4-7
CT IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	See 4.4.2.4.1
Samples per Pixel	(0028,0002)	1	Shall be 1.
Photometric Interpretation	(0028,0004)	1	Always set to MONOCHROME2
Bits Allocated	(0028,0100)	1	Shall be 16.
Bits Stored	(0028,0101)	1	Shall be 12 or 16.
High Bit	(0028,0102)	1	Shall have only the Enumerated Value of one less than the value sent in Bits Stored.
Rescale Intercept	(0028,1052)	1	The value b in relationship between stored values (SV) and the output units. Output units = $m \cdot SV + b$
Rescale Slope	(0028,1053)	1	The value m in the equation specified in Rescale Intercept (0028,1052).
Rescale Type	(0028,1054)	1C	Specifies the output units of Rescale Slope (0028,1053) and Rescale Intercept (0028,1052). Required if the Rescale Type is not HU (Hounsfield Units).
KVP	(0018,0060)	2	Peak kilo voltage output of the x-ray generator used.
Acquisition Number	(0020,0012)	2	A number identifying the single continuous gathering of data over a period of time which resulted in this image.
Scan Options	(0018,0022)	3	Parameters of scanning sequence.
Data Collection Diameter	(0018,0090)	3	The diameter in mm of the region over which data were collected.
Data Collection Center (Patient)	(0018,9313)	3	The x, y, and z coordinates (in the patient coordinate system) in mm of the center of the region in which data were collected.
Reconstruction Diameter	(0018,1100)	3	Diameter in mm of the region from within which data were used in creating the reconstruction of the image.
Reconstruction Target Center (Patient)	(0018,9318)	3	The x, y, and z coordinates (in the patient coordinate system) of the reconstruction center target point as used for reconstruction in mm.
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center.
Distance Source to Patient	(0018,1111)	3	Distance in mm from source to iso-center (center of field of view).
Gantry/Detector Tilt	(0018,1120)	3	Nominal angle of tilt in degrees of the scanning gantry.
Table Height	(0018,1130)	3	The distance in mm of the top of the patient table to the center of rotation.
Rotation Direction	(0018,1140)	3	Direction of rotation of the source when relevant, about nearest principal axis of equipment.
Exposure Time	(0018,1150)	3	Time of x-ray exposure in msec.
X-ray Tube Current	(0018,1151)	3	X-Ray Tube Current in mA.

Exposure	(0018,1152)	3	The exposure expressed in mAs, for example calculated from Exposure Time and X-Ray Tube Current.
Filter Type	(0018,1160)	3	Label for the type of filter inserted into the x-ray beam.
Generator Power	(0018,1170)	3	Power in kW to the x-ray generator.
Focal Spot	(0018,1190)	3	Size of the focal spot in mm.
Convolution Kernel	(0018,1210)	3	A label describing the convolution kernel or algorithm used to reconstruct the data.
Revolution Time	(0018,9305)	3	The time in seconds of a complete revolution of the source around the gantry orbit.
Single Collimation Width	(0018,9306)	3	The width of a single row of acquired data (in mm).
Total Collimation Width	(0018,9307)	3	The width of the total collimation (in mm) over the area of active x-ray detection. Note: This will be equal the number of effective detector rows multiplied by single collimation width.
Table Speed	(0018,9309)	3	The distance in mm that the table moves in one second during the gathering of data that resulted in this image.
Table Feed per Rotation	(0018,9310)	3	Motion of the table (in mm) during a complete revolution of the source around the gantry orbit.
Spiral Pitch Factor	(0018,9311)	3	Ratio of the Table Feed per Rotation (0018,9310) to the Total Collimation Width (0018,9307).
Exposure Modulation Type	(0018,9323)	3	A label describing the type of exposure modulation used for the purpose of limiting the dose.
Estimated Dose Saving	(0018,9324)	3	A percent value of dose saving due to the use of Exposure Modulation Type (0018,9323). A negative percent value of dose savings reflects an increase of exposure. Sent, if Image Type (0008,0008) Value 3 is AXIAL. Sent as "0" if Exposure Modulation Type is "NONE"
CTDIvol	(0018,9345)	3	Computed Tomography Dose Index (CTDIvol), in mGy. It describes the average dose for this image for the selected CT conditions of operation.
CTDI Phantom Type Code Sequence	(0018,9346)	3	The type of phantom used for CTDI Measurement. Only a single Item shall be permitted in this Sequence.

4.4.2.4.1 Image Type

The following Enumerated Values of Value 1 are used:

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

The following Enumerated Values of Value 2 are used:

- PRIMARY identifies a Primary Image

The following Defined Terms of Value 3 are used:

- AXIAL identifies a CT Axial Image
- LOCALIZER identifies a CT Localizer Image

4.4.2.5 VOI LUT module

**TABLE 4-8
VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	1C	Not Used
Window Center	(0028,1050)	1C	Window Center for display. Only single value is present. Required if VOI LUT Sequence (0028,3010) is not present.

Window Width	(0028,1051)	1C	Window Width for display. Only single value is present. Required if Window Center (0028,1050) is sent.
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4.4.2.6 SOP Common Module

**TABLE 4-9
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Usage
SOP Class UID	(0008,0016)	1	Uniquely identifies the SOP Class. "1.2.840.10008.5.1.4.1.1.2"
SOP Instance UID	(0008,0018)	1	Uniquely identifies the SOP Instance.
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set. Defined Terms used: Refer to Section 2.2
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	The Implementation UID for this DICOM Implementation
Instance Number	(0020,0013)	3	See 4.4.2.1 for more specialization

4.4.2.7 Private Image Module

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

Attribute Name	Tag	Private Creator	Attribute Description
Acquisition Parent UID	(0011,xx31)	GEMS_GENIE_1	Acquisition Parent UID
Acq Parent UID	(0031,xx02)	GEHC_HYBRID_01	CT Acquisition Parent UID

4.5 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES

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

4.5.1 Private Group GEMS_GENIE_1

**TABLE 4-11
PRIVATE GROUP GEMS_GENIE_1**

Attribute Name	Tag	VR	VM	Attribute Usage
Private Creator Identification	(0009,00xx)	LO	1	GEMS_GENIE_1
Acquisition Parent UID	(0011,xx31)	LO	1-n	Acquisition Parent UID

4.5.2 Private Group GEHC_HYBRID_01

**TABLE 4-12
PRIVATE GROUP GEHC_HYBRID_01**

Attribute Name	Tag	VR	VM	Attribute Description
Private Creator Identification	(0031,00xx)	LO	1	GEHC_HYBRID_01
Acq. Parent UID	(0031,xx02)	UI	1	CT Acquisition Parent UID

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4.6 STANDARD EXTENDED AND PRIVATE CONTEXT GROUPS

SmartConsole™ Application do not support any coded terminology

5. PET INFORMATION OBJECT IMPLEMENTATION

5.1 INTRODUCTION

This section specifies the use of the DICOM Positron Emission Tomography (PET) Image IOD to represent the information included in PET Images produced by this implementation. Corresponding attributes are conveyed using the module construct.

5.2 SMARTCONSOLE™ APPLICATION MAPPING OF DICOM ENTITIES

The SmartConsole™ Application map DICOM Information Entities to local Information Entities in the product's database and user interface.

TABLE 5-1
MAPPING OF DICOM ENTITIES TO SMARTCONSOLE™ APPLICATION ENTITIES

DICOM IE	SmartConsole™ Application Entity
Patient	Patient
Study	Study
Series	Series
Image	Dataset

5.3 IOD MODULE TABLE

The Positron Emission Tomography Information Object Definition comprises the modules of the following table, plus Standard Extended and Private attributes. Standard Extended and Private attributes are described in Section 5.5

TABLE 5-2
PET IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Used (same description as for NM IOD)	3.4.1.1
	Clinical Trial Subject	Not Used	N/A
Study	General Study	Used (same description as for NM IOD)	3.4.2.1
	Patient Study	Used (same description as for NM IOD)	3.4.2.2
	Standard Extended Study	Used (same description as for NM IOD)	3.4.2.3
	Clinical Trial Study	Not Used	N/A
Series	General Series	Used (same description as for NM IOD)	3.4.3.1
	Clinical Trial Series	Not Used	N/A
	PET Series	Used	5.4.1.1
	PET Isotope	Used	5.4.1.2
	PET Multi-gated Acquisition	Not Used	N/A
	NM/PET Patient Orientation	Used (same description as for NM IOD)	3.4.3.2
Frame of Reference	Frame of Reference	Used	5.4.2.1
Equipment	General Equipment	Used (same description as for NM IOD)	3.4.5.1
Image	General Image	Used	5.4.3.1
	Image Plane	Used	5.4.3.2
	Image Pixel	Used	5.4.3.3
	Device	Not Used	N/A

PET Image	Used	5.4.3.4
Overlay Plane	Not Used	N/A
VOI LUT	Used (same description as for CT IOD)	4.4.2.5
Acquisition Context	Not Used	N/A
SOP Common	Used	5.4.3.5
Private Image	Used	5.4.3.6
Private PET Image	Used	5.4.3.7

5.4 INFORMATION MODULE DEFINITIONS

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

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

SmartConsole™ Application private attributes are defined in private modules, each of which follows 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, xxeel) format, where xx represents a reserved block of element numbers within the group gggg.

5.4.1 Series Entity Modules

5.4.1.1 PET Series Module

**TABLE 5-3
PET SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Series Date	(0008,0021)	1	Date the Series started.	Generated
Series Time	(0008,0031)	1	Time the Series started.	Generated
Units	(0054,1001)	1	Pixel value units. Defined Terms: CNTS, NONE, CM2, PCNT, CPS, BQML, MGMINML, UMOLMINML, MLMING, MLG, 1CM, UMOLML, PROPCNTS, PROPCPS, MLMINML, MLML, GML, STDDEV	Generated
Counts Source	(0054,1002)	1	The primary source of counts. Enumerated Values: EMISSION TRANSMISSION	Generated
Series Type	(0054,1000)	1	A multi-valued indicator of the type of Series. See 5.4.1.1.1 for specialization.	Generated
Number of Slices	(0054,0081)	1	The maximum number of Slices that may exist in this Series.	Generated
Corrected Image	(0028,0051)	2	One or more values that indicate which, if any, corrections have been applied to the images in this series.	Generated
Attenuation Correction	(0054,1101)	3	A textual description of the attenuation	Generated

Method			correction processing.	
Scatter Correction Method	(0054,1105)	3	A textual description of the scatter correction processing.	Generated
Decay Correction	(0054,1102)	1	The real-world event to which images in this Series were decay corrected.	Generated
Reconstruction Method	(0054,1103)	3	Textual description of reconstruction Processing.	Generated
Type of Detector Motion	(0054,0202)	3	Describes the detector motion during acquisition.	Copied
Collimator Type	(0018,1181)	2	Collimator Type	Copied

5.4.1.1.1 Series Type

The following values of Series Type (0054,1000) are generated:

Value 1 Enumerated Values:

- STATIC
- WHOLE BODY

Value 2 Enumerated Values:

- IMAGE
- REPROJECTION

5.4.1.2 PET Isotope Module

**TABLE 5-4
PET ISOTOPE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Radiopharmaceutical Information Sequence	(0054,0016)	2	Information on radiopharmaceutical(s) used.	Copied Only 1 st valid item is used /All items from input image are copied to output image(s) created by SmartConsole™ Application
> Radionuclide Code Sequence	(0054,0300)	2	Sequence that identifies the radionuclide. May contain 0 or 1 item.	Copied
>> Include 'Code Sequence Macro'	<i>Baseline Context ID is 4020</i>			Copied
> Radiopharmaceutical Volume	(0018,1071)	3	Volume of injection in cubic cm.	Copied
> Radionuclide Total Dose	(0018,1074)	3	The radiopharmaceutical dose administered to the patient measured in Becquerels (Bq) at the Radiopharmaceutical Start Time (0018,1072).	Copied
> Radiopharmaceutical	(0018,0031)	3	Name of the radiopharmaceutical.	Copied
> Radiopharmaceutical Code Sequence	(0054,0304)	3	Sequence that identifies the radiopharmaceutical. May contain 0 or 1 item	Copied
>> Include 'Code Sequence Macro'	<i>Baseline Context ID is 4021</i>			Copied

5.4.2 Frame Of Reference Entity Modules

5.4.2.1 Frame Of Reference Module

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

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

**TABLE 5-5
FRAME OF REFERENCE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Frame of Reference UID	(0020,0052)	1	Uniquely identifies the frame of reference for a Series.	Copied
Position Reference Indicator	(0020,1040)	2	Part of the patient's anatomy used as a reference.	Copied

5.4.3 Image Entity Modules

5.4.3.1 General Image Module

**TABLE 5-6
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Instance Number	(0020,0013)	2	A number that identifies this image.	Generated
Content Date	(0008,0023)	2C	The date the image pixel data creation started.	Generated (Current Date)
Content Time	(0008,0033)	2C	The time the image pixel data creation started	Generated (Current Time)
Image Type	(0008,0008)	3	See 5.4.3.4 for PET Images	
Acquisition Date	(0008,0022)	3	See 5.4.3.4 for PET Images	
Acquisition Time	(0008,0032)	3	See 5.4.3.4 for PET Images	
Image Comments	(0020,4000)	3	Contains additional information about image.	Copied

5.4.3.2 Image Plane Module

**TABLE 5-7
IMAGE PLANE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Pixel Spacing	(0028,0030)	1	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.	Generated

Image Orientation (Patient)	(0020,0037)	1	The direction cosines of the first row and the first column with respect to the patient.	Generated
Image Position (Patient)	(0020,0032)	1	The x, y, and z coordinates of the upper left hand corner (center of the first voxel transmitted) of the image, in mm	Generated
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm	Generated
Slice Location	(0020,1041)	3	Relative position of the image plane expressed in mm.	Generated

5.4.3.3 Image Pixel Module

**TABLE 5-8
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Samples per Pixel	(0028,0002)	1	See 5.4.3.4 for PET Images	
Photometric Interpretation	(0028,0004)	1	See 5.4.3.4 for PET Images	
Rows	(0028,0010)	1	Number of rows in the image	Generated
Columns	(0028,0011)	1	Number of columns in the image	Generated
Bits Allocated	(0028,0100)	1	See 5.4.3.4 for PET Images	
Bits Stored	(0028,0101)	1	See 5.4.3.4 for PET Images	
High Bit	(0028,0102)	1	See 5.4.3.4 for PET Images	
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values used: 0000H = unsigned integer. 0001H = 2's complement	Generated
Pixel Data	(7FE0, 0010)	1	A data stream of the pixel samples that comprise the Image.	Generated
Smallest Image Pixel Value	(0028,0106)	3	The minimum actual pixel value encountered in this image.	Generated
Largest Image Pixel Value	(0028,0107)	3	The maximum actual pixel value encountered in this image.	Generated

5.4.3.4 PET Image Module

**TABLE 5-9
PET IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
Image Type	(0008,0008)	1	See 5.4.3.4.1	Generated
Samples per Pixel	(0028,0002)	1	Always set be 1.	Generated
Photometric Interpretation	(0028,0004)	1	Always set to MONOCHROME2	Generated
Bits Allocated	(0028,0100)	1	Shall be 16.	Generated
Bits Stored	(0028,0101)	1	Shall be 16.	Generated
High Bit	(0028,0102)	1	Shall have only the Enumerated Value of one less than the value sent in Bits Stored.	Generated
Rescale Intercept	(0028,1052)	1	The value b in relationship between stored values (SV) and pixel value units (U) defined in Units (0054,1001): $U = m*SV+b$. Always set to 0.	Generated
Rescale Slope	(0028,1053)	1	The value m in the equation specified in Rescale Intercept (0028,1052).	Generated
Frame Reference Time	(0054,1300)	1	The time that the pixel values in the image occurred.	Generated

Intervals Acquired	(0018,1083)	3	Number of heartbeats that fall within Low R-R Value (0018,1081) and High R-R Value (0018,1082), and were therefore accepted and contribute coincidence events to this R-R Interval. Always sent as 0 due to historical reasons.	Generated
Intervals Rejected	(0018,1084)	3	Number of heartbeats that fall outside Low R-R Value (0018,1081) and High R-R Value (0018,1082), and do not contribute coincidence events to this R-R Interval. However, they may contribute coincidence events to other R-R Intervals. Always sent as 0 due to historical reasons.	Generated
Image Index	(0054,1330)	1	An index identifying the position of this image within a PET Series.	Generated
Acquisition Date	(0008,0022)	2	The date the acquisition of data that resulted in this image started	Generated
Acquisition Time	(0008,0032)	2	The time the acquisition of data that resulted in this image started	Generated
Actual Frame Duration	(0018,1242)	2	Elapsed time of the data acquisition for this image, in msec.	Generated
Decay Factor	(0054,1321)	1C	The decay factor that was used to scale image. Required if Decay Correction (0054,1102) is other than NONE.	Generated

5.4.3.4.1 Image Type

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

Value 1 Enumerated Values:

- DERIVED identifies a Derived Image

Value 2 Enumerated:

- PRIMARY identifies a Primary Image

5.4.3.5 SOP Common Module

**TABLE 5-10
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description	Attribute Usage
SOP Class UID	(0008,0016)	1	Uniquely identifies the SOP Class. "1.2.840.10008.5.1.4.1.1.128"	Generated
SOP Instance UID	(0008,0018)	1	Uniquely identifies the SOP Instance.	Generated
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set. Defined Terms used: refer to Section 2.2	Generated
Instance Creation Date	(0008,0012)	3	Date of instance creation.	Generated
Instance Creation Time	(0008,0013)	3	Time of instance creation.	Generated
Instance Creator UID	(0008,0014)	3	The Implementation UID for this DICOMImplementation Set to the 1.2.840.113619.6.441	Generated
Instance Number	(0020,0013)	3	See 5.4.3.1 for more specialization	

5.4.3.6 Private Image Module

**TABLE 5-11
PRIVATE IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator	Attribute Description	Attribute Usage
Processing Parent UID	(0011,xx32)	GEMS_GENIE_1	Processing Parent UID	Generated
Effective Series Duration	(0011,xx0B)	GEMS_GENIE_1	Effective Series Duration	Generated
Acquisition Parent UID	(0011,xx31)	GEMS_GENIE_1	Acquisition Parent UID	Copied
Request ID	(0039,xx10)	GEMS_RECONBOXPRV_1	Request ID	Generated

5.4.3.7 Private PET Image Module

**TABLE 5-12
PRIVATE PET IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Private Creator	Attribute Description	Attribute Usage
RadioPharmaceuticalTotalDose	(0009,xx38)	GEMS_PETD_01		Copied
Tracer	(0009,xx36)	GEMS_PETD_01	Tracer	Copied
MeasuredDateTime	(0009,xx39)	GEMS_PETD_01		Copied
AdminDateTime	(0009,xx3B)	GEMS_PETD_01		Copied
PostInjectionActivity	(0009,xx3C)	GEMS_PETD_01		Copied
PostInjectionDateTime	(0009,xx3D)	GEMS_PETD_01		Copied
Radionuclide	(0009,xx3E)	GEMS_PETD_01		Copied
StartScanTime	(0009,xx0D)	GEMS_PETD_01		Copied
HalfLife	(0009,xx3f)	GEMS_PETD_01	Half Life	Copied

5.5 STANDARD EXTENDED AND PRIVATE DATA ATTRIBUTES

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

5.5.1 Private Group GEMS_GENIE_1

**TABLE 5-13
PRIVATE GROUP GEMS_GENIE_1**

Attribute Name	Tag	VR	VM	Attribute Description	Attribute Usage
Private Creator Id	(0011,00xx)	LO	1	GEMS_GENIE_1	
Processing Parent UID	(0011,xx32)	LO	1-n	Processing Parent UID	Generated
Effective Series Duration	(0011,xx0B)	SL	1	Calculated duration of series.	Generated

5.5.2 Private Group GEMS_PETD_01

**TABLE 5-14
PRIVATE GROUP GEMS_PETD_01**

Attribute Name	Tag	VR	VM	Attribute Description	Attribute Usage
Private Creator Id	(0009,00xx)	LO	1	GEMS_PETD_01	
RadioPharmaceuticalTotalDose	(0009,xx38)	FL	1		Copied
MeasuredDateTime	(0009,xx39)	DT	1		Copied
AdminDateTime	(0009,xx3B)	DT	1		Copied
PostInjectionActivity	(0009,xx3C)	FL	1		Copied
PostInjectionDateTime	(0009,xx3D)	DT	1		Copied

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Radionuclide	(0009,xx3E)	SH	1		Copied
Tracer	(0009,xx36)	LO	1		Copied
Start Scan Time	(0009,xx0D)	DT	1		Copied
HalfLife	(0009,xx3F)	FL	1		Copied

5.5.3 Private Group GEMS_RECONBOXPRV_1

TABLE 5-15
PRIVATE GROUP GEMS_RECONBOXPRV_1

Attribute Name	Tag	VR	VM	Attribute Description	Attribute Usage
Private Creator Id	(0039,00xx)	LO	1	GEMS_RECONBOXPRV_1	
Request ID	(0039,xx10)	UI	1	Reconstruction Request ID	Generated

5.6 STANDARD EXTENDED AND PRIVATE CONTEXT GROUPS

SmartConsole™ Application do not support any coded terminology.