

# Technical Publications

Direction: 5401845-100  
**Revision 1**

## NeuroMarQ DICOM CONFORMANCE STATEMENT

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**REVISION HISTORY**

<b>REV</b>	<b>DATE</b>	<b>REASON FOR CHANGE</b>
1	24 November 2010	Initial Creation of Reviewed Document

**CONFORMANCE STATEMENT OVERVIEW**

NeuroMarQ is a PET image display and analysis application developed for use on the GE Advantage Workstation Revision 4.5 and higher. NeuroMarQ does not provide or use any network services directly. NeuroMarQ reads and displays PET, CT and MR images from the Advantage Workstation database. The images are stored on the Advantage Workstation database as DIOCOM Part 10 files. All network services are provided by the Advantage Workstation directly. For a complete description of the networking services of the Advantage Workstation, refer to the AW 4.6 Conformance Statement, Direction 5324648-100.

Table 0.1 provides an overview of the network services supported by NeuroMarQ

**Table 0.1 – NETWORK SERVICES**

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
<b>Transfer</b>		
CT Image Storage	Yes	No
MR Image Storage	Yes	No
Secondary Capture Image Storage	Yes	No
Positron Emission Tomography Image Storage	Yes	No

There are no Media Storage Application Profiles supported by NeuroMarQ.

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## 1. INTRODUCTION

### 1.1 OVERVIEW

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

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

**Section 2 (Media Storage Conformance Statement)**, which specifies the GE HEALTHCARE equipment compliance to the DICOM requirements for the implementation of Media Storage features.

**Section 3 (CT Information Object Implementation)**, which specifies the GE HEALTHCARE equipment compliance to DICOM requirements for the implementation of a CT Information Object.

**Section 4 (MR Information Object Implementation)**, which specifies the GE HEALTHCARE equipment compliance to DICOM requirements for the implementation of a MR Information Object.

**Section 5 (PET Information Object Implementation)**, which specifies the GE HEALTHCARE equipment compliance to DICOM requirements for the implementation of a PET Information Object.

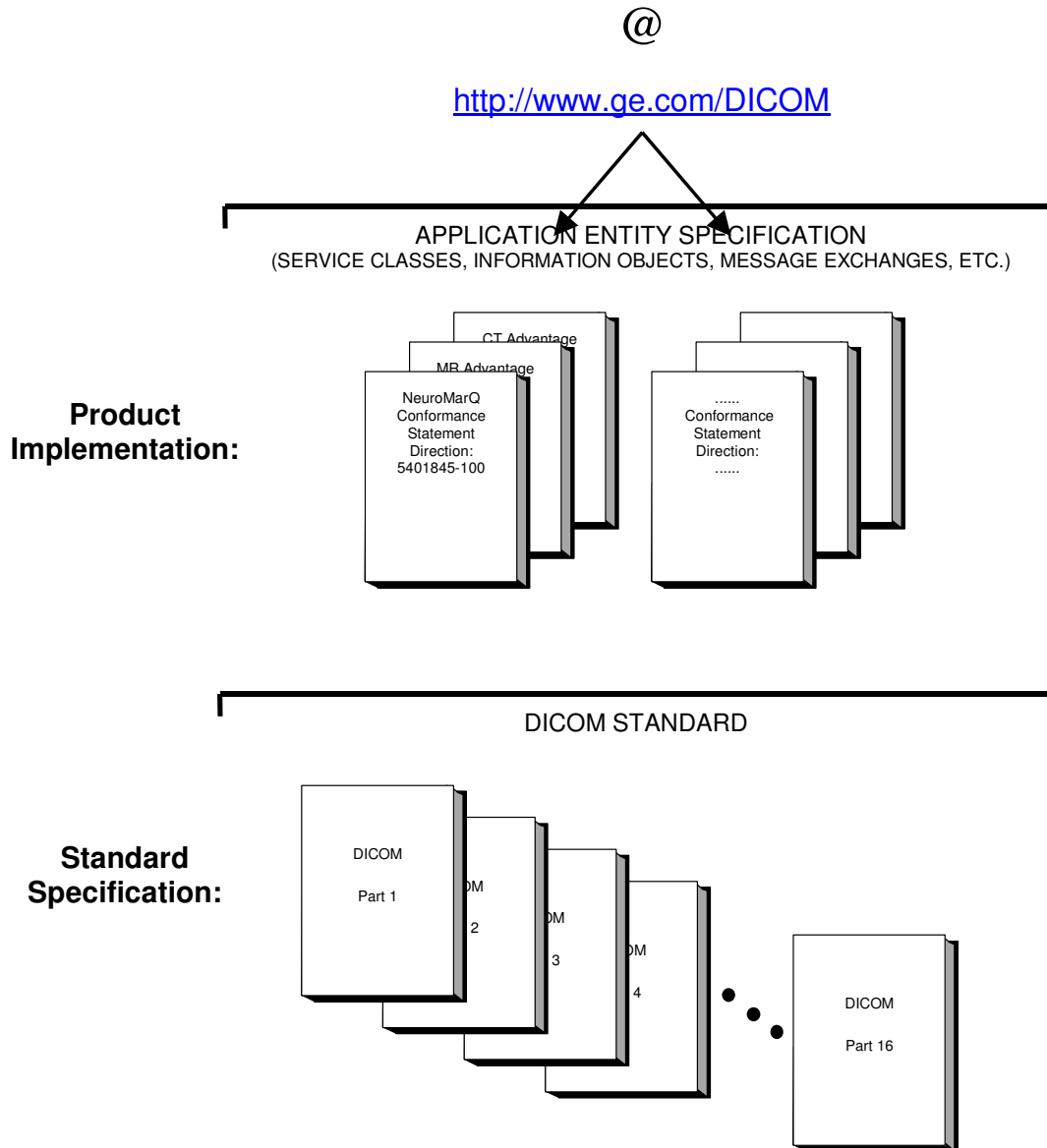
**Section 6 (Secondary Capture Information Object Implementation)**, which specifies the GE HEALTHCARE equipment compliance to DICOM requirements for the implementation of a Secondary Capture Information Object.



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 the Illustration below.

GEHC DICOM Conformance Statements



This document specifies the DICOM implementation. It is entitled:

*NeuroMarQ Rev 1.0*  
*Conformance Statement for DICOM*  
*Direction: 5401845-100*

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

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

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

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

### 1.3 INTENDED AUDIENCE

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

### 1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document, in conjunction with the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, 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 ensure 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 DICOM Conformance Statement should be aware that different GE HEALTHCARE devices are capable of using different Information Object Definitions. For example, a GE HEALTHCARE 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 GE HEALTHCARE implementation. If the user encounters unspecified private data elements while parsing a GE HEALTHCARE 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 GE HEALTHCARE 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 GE HEALTHCARE 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 DICOM Conformance Statements.** The **user** should ensure that any non-GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.
- **Interaction** - It is the sole responsibility of the **non-GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

**1.6 REFERENCES**

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

**1.7 DEFINITIONS**

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

**Abstract Syntax** – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples : Verification

SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

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

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

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

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

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

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

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

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

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

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

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

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

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

**Service Class Provider (SCP)** – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*). Examples: Picture Archiving and

Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

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

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

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

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

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

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

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

**1.8 SYMBOLS AND ABBREVIATIONS**

CT	Computed Tomography
DICOM	Digital Imaging and Communications in Medicine
IOD	Information Object Definition
ISO	International Organization for Standards
IO	Intra-oral X-ray
JPEG	Joint Photographic Experts Group
LUT	Look-up Table
MAR	Medication Administration Record
MPEG	Moving Picture Experts Group
MPR	Multi-Plane Reformat
MR	Magnetic Resonance Imaging
NM	Nuclear Medicine

PACS	Picture Archiving and Communication System
PET	Positron Emission Tomography
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SR	Structured Reporting
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)

**1.9 TERMS DEFINITIONS**

In the following conformance statement, the following terms describe the use of each of the DICOM tags. When *NeuroMarQ* is loading DICOM data files, we use the following terms:

- **Ignored:** the software will ignore the value of the tag. Data elements not present in the defined tables are assumed to be ignored.
- **Used:** the software might use at some point the value of this tag; the value could be use 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 or secondary capture 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

*NeuroMarQ* is a software application developed for use on the Advantage Windows workstation, versions AW4.5 and higher. This means that networking and media storage features are inherited from this platform.

The application uses DICOM images to create reformatted slices. The slices displayed by the application may be saved in DICOM format (Secondary Capture) to the AW database. These SC images may be transferred via any means available to the AW to other DICOM stations or PACS. They may also be displayed in any application capable of displaying DICOM SC images.

The typical workflow surrounding the NeuroMarQ application is that of an analysis and review application. The user is typically a physician, may be a technologist. The PET, CT and MR studies exist in the AW database, typically transferred ahead of time. The images are processed and viewed in the application. For the purpose of sharing images in a report or with the patient or referring physician, the user may manually select specific slices or views for saving to SC images.

For a complete description of the media storage conformance, refer to the AW 4.5 conformance statement, direction 5324648-100 Rev 2.

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

- The DICOM CT IODs that are required to reconstruct a 3-dimensional volume (section 3),
- The DICOM MR IODs that are required to reconstruct a 3-dimensional volume (section 4),
- The DICOM PET IODs that are required to reconstruct a 3-dimensional volume (section 5),
- The DICOM SC IODs written by the application (section 6).

SOP Classes Used as Input:

Modality	SOP Class	Remarks
CT	1.2.840.10008.5.1.4.1.1.2	
PET	1.2.840.10008.5.1.4.1.1.128	
MR	1.2.840.10008.5.1.4.1.1.4	

SOP Classes Used as Output:

Modality	SOP Class	Remarks
SC	1.2.840.10008.5.1.4.1.1.7	

### 3. CT INFORMATION OBJECT IMPLEMENTATION

#### 3.1 INTRODUCTION

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

3.2 CT Entity-Relationship Model

3.3 IOD MODULE TABLE

3.4 INFORMATION MODULE DEFINITIONS

#### 3.2 CT ENTITY-RELATIONSHIP MODEL

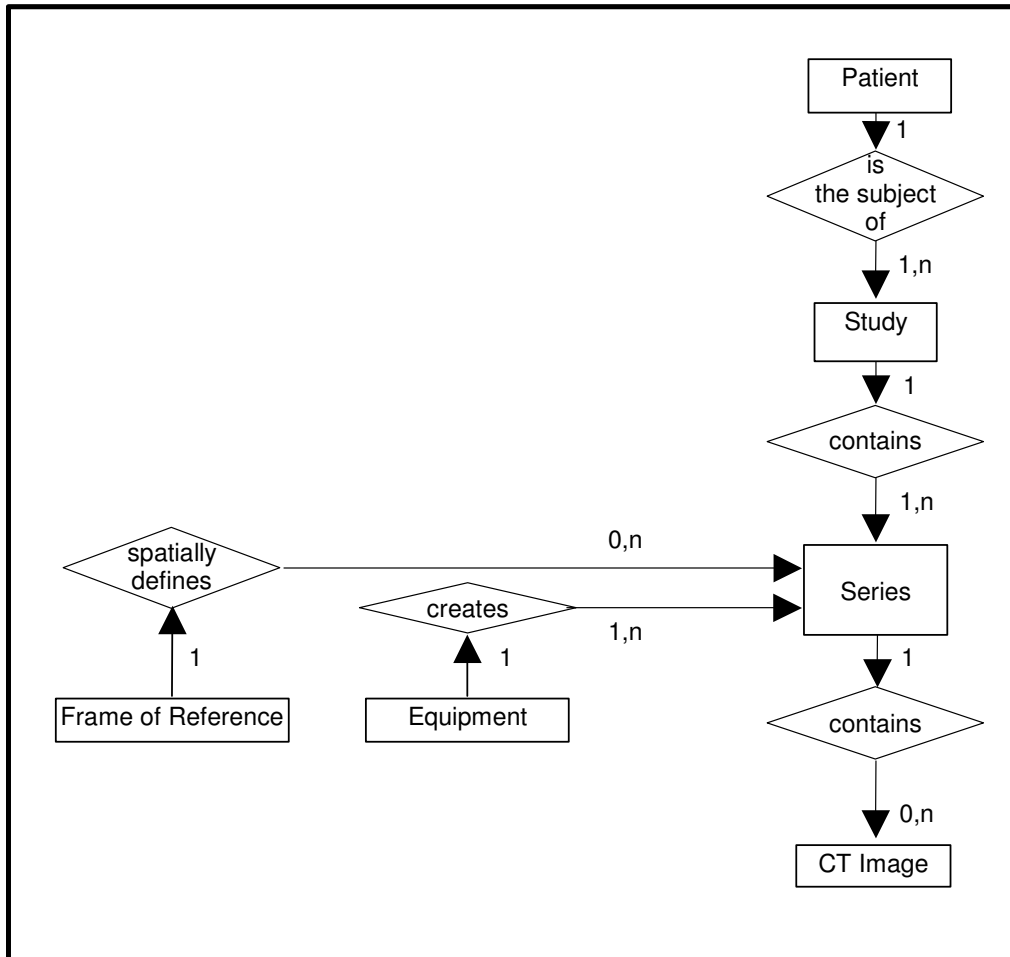
The Entity-Relationship diagram for the CT Image interoperability schema is shown in Illustration 3.2-1. In this figure, the following diagrammatic convention is established to represent the information organization:

- 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. In other words, the relationship between Series and Image can have up to n Images per Series, but the Patient to Study relationship has 1 Patient for each Study (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).



ILLUSTRATION 3.2-1  
 CT IMAGE ENTITY RELATIONSHIP DIAGRAM



3.2.1 ENTITY DESCRIPTIONS

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

3.2.2 Mapping of DICOM entities

TABLE 3.2-1  
 MAPPING OF DICOM ENTITIES TO APPLICATION ENTITIES

DICOM	Application Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

3.3 IOD MODULE TABLE

Within an entity of the DICOM v3.0 CT IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the

understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 3.3-1 identifies the defined modules within the entities which comprise the DICOM v3.0 CT IOD. Modules are identified by Module Name.

See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes.

**TABLE 3.3-1  
CT IMAGE IOD MODULES**

<b>Entity Name</b>	<b>Module Name</b>	<b>Reference</b>
Patient	Patient	3.4.1.1
Study	General Study	3.4.2.1
	Patient Study	3.4.2.2
Series	General Series	3.4.3.1
Frame of Reference	Frame of Reference	3.4.4.1
Equipment	General Equipment	3.4.5.1
Image	General Image	3.4.6.1
	Image Plane	3.4.6.2
	Image Pixel	3.4.6.3
	Contrast/Bolus	3.4.6.3
	CT Image	3.4.9.1
	Overlay Plane	Not Used
	VOI LUT	3.4.7.1
	SOP Common	3.4.8.1

**3.4 INFORMATION MODULE DEFINITIONS**

Please refer to DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the CT 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 from where these values are obtained. Associated tables contain expectations of the use of entities within the application. No CT images are generated by the application. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

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**3.4.1 Common Patient Entity Modules**

**3.4.1.1 Patient Module**

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

**TABLE 3.4-1  
PATIENT MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Patient's Name	(0010,0010)	2	Used
Patient ID	(0010,0020)	2	Used
Issuer of Patient ID	(0010,0021)	3	Used
Patient's Birth Date	(0010,0030)	2	Used
Patient's Sex	(0010,0040)	2	Used
Referenced Patient Sequence	(0008,1120)	3	Used
>Referenced SOP Class UID	(0008,1150)	1C	Used
>Referenced SOP Instance UID	(0008,1155)	1C	Used
Patient's Birth Time	(0010,0032)	3	Ignored
Other Patient IDs	(0010,1000)	3	Used
Other Patient IDs Sequence	(0010,1002)	3	Used
>Patient ID	(0010,0020)	1	Used
>Issuer of Patient ID	(0010,0021)	1	Used
>Type of Patient ID	(0010,0022)	1	Used
Other Patient Names	(0010,1001)	3	Used
Ethnic Group	(0010,2160)	3	Ignored
Patient Comments	(0010,4000)	3	Ignored

**3.4.2 Common Study Entity Modules**

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

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**3.4.2.1 General Study Module**

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

**TABLE 3.4-2  
GENERAL STUDY MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Study Instance UID	(0020,000D)	1	Mandatory
Study Date	(0008,0020)	2	Used
Study Time	(0008,0030)	2	Used
Referring Physician's Name	(0008,0090)	2	Ignored
Study ID	(0020,0010)	2	Used
Accession Number	(0008,0050)	2	Used
Study Description	(0008,1030)	3	Used
Physician(s) of Record	(0008,1048)	3	Ignored
Name of Physician(s) Reading Study	(0008,1060)	3	Ignored
Referenced Study Sequence	(0008,1110)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Procedure Code Sequence	(0008,1032)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

**3.4.2.2 Patient Study Module**

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

**TABLE 3.4-3  
PATIENT STUDY MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Admitting Diagnoses Description	(0008,1080)	3	Ignored
Patient's Age	(0010,1010)	3	Ignored
Patient's Size	(0010,1020)	3	Ignored
Patient's Weight	(0010,1030)	3	Ignored
Occupation	(0010,2180)	3	Ignored
Additional Patient's History	(0010,21B0)	3	Ignored

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**3.4.3 Common Series Entity Modules**

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

**3.4.3.1 General Series Module**

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

**TABLE 3.4-4  
GENERAL SERIES MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Modality	(0008,0060)	1	Used Defined Terms: CT = Computed Tomography
Series Instance UID	(0020,000E)	1	Mandatory
Series Number	(0020,0011)	2	Used
Laterality	(0020,0060)	2C	Ignored
Series Date	(0008,0021)	3	Used
Series Time	(0008,0031)	3	Used
Performing Physicians' Name	(0008,1050)	3	Ignored
Protocol Name	(0018,1030)	3	Ignored
Series Description	(0008,103E)	3	Used
Operators' Name	(0008,1070)	3	Ignored
Referenced Performed Procedure Step Sequence	(0008,1111)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Related Series Sequence	(0008,1250)	3	Ignored
Body Part Examined	(0018,0015)	3	Ignored
Patient Position	(0018,5100)	2C	Used 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	Ignored
Largest Pixel Value in Series	(0028,0109)	3	Ignored
Request Attributes Sequence	(0040,0275)	3	Ignored
>Requested Procedure ID	(0040,1001)	1C	
>Accession Number	(0008,0050)	3	
>Study Instance UID	(0020, 000D)	3	
>Referenced Study Sequence	(0008,1110)	3	
>>Referenced SOP Class UID	(0008,1150)	1C	

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>>Referenced SOP Instance UID	(0008,1155)	1C	
>Requested Procedure Description	(0032,1050)	3	
>Requested Procedure Code Sequence	(0032,1064)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>Reason for the Requested Procedure	(0040,1002)	3	
>Reason for Requested Procedure Code Sequence	(0040,100A)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>Scheduled Procedure Step ID	(0040,0009)	1C	
>Scheduled Procedure Step Description	(0040,0007)	3	
>Scheduled Protocol Code Sequence	(0040,0008)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>>Protocol Context Sequence	(0040,0440)	3	
>>Content Item Modifier Sequence	(0040,0441)	3	
Performed Procedure Step ID	(0040,0253)	3	Ignored
Performed Procedure Step Start Date	(0040,0244)	3	Ignored
Performed Procedure Step Start Time	(0040,0245)	3	Ignored
Performed Procedure Step Description	(0040,0254)	3	Ignored
Performed Protocol Code Sequence	(0040,0260)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

**3.4.4 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.

**3.4.4.1 Frame Of Reference Module**

CT images should share the same Frame Of Reference UID as a necessary condition to be in the same 3D model. However, this is not sufficient, because images have also to share the same geometry (be parallel with compatible centers), have the same size, the same pixel size, the same tilt, the same study ID, the same reconstruction algorithm, and the same patient name.

**TABLE 3.4-5  
FRAME OF REFERENCE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Mandatory
Position Reference Indicator	(0020,1040)	2	Ignored

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**3.4.5 Common Equipment Entity Modules**

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

**3.4.5.1 General Equipment Module**

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

**TABLE 3.4-6  
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Used
Institution Name	(0008,0080)	3	Used
Institution Address	(0008,0081)	3	Ignored
Station Name	(0008,1010)	3	Ignored
Institutional Department Name	(0008,1040)	3	Ignored
Manufacturer's Model Name	(0008,1090)	3	Used
Device Serial Number	(0018,1000)	3	Ignored
Software Versions	(0018,1020)	3	Ignored
Spatial Resolution	(0018,1050)	3	Ignored
Date of Last Calibration	(0018,1200)	3	Ignored
Time of Last Calibration	(0018,1201)	3	Ignored
Pixel Padding Value	(0028,0120)	3	Ignored

**3.4.6 Common Image Entity Modules**

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

**3.4.6.1 General Image Module**

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

**TABLE 3.4-7  
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Used
Patient Orientation	(0020,0020)	2C	Used
Image Date	(0008,0023)	2C	Used
Image Time	(0008,0033)	2C	Used
Image Type	(0008,0008)	3	Used (expect ORIGINAL\PRIMARY)
Acquisition Number	(0020,0012)	3	Used
Acquisition Date	(0008,0022)	3	Used
Acquisition Time	(0008,0032)	3	Used
Referenced Image Sequence	(0008,1140)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	

Derivation Description	(0008,2111)	3	Ignored
Source Image Sequence	(0008,2112)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Images in Acquisition	(0020,1002)	3	Ignored
Image Comments	(0020,4000)	3	Ignored
Quality Control Image	(0028,0300)	3	Ignored
Burned In Annotations	(0028,0301)	3	Ignored
Lossy Image Compression	(0028,2110)	3	Ignored
Lossy Image Compression Ratio	(0028,2112)	3	Ignored

**3.4.6.1.1.1 Lossy Image Compression**

Application does not support reading compressed images.

**3.4.6.2 Image Plane Module**

This section specifies the Attributes which define the transmitted pixel array of a two dimensional image plane.

**TABLE 3.4-8  
IMAGE PLANE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Mandatory
Image Orientation (Patient)	(0020,0037)	1	Mandatory
Image Position (Patient)	(0020,0032)	1	Mandatory
Slice Thickness	(0018,0050)	2	Used
Slice Location	(0020,1041)	3	Ignored

**3.4.6.2.1 Image Position**

The Image Position is treated as the position of the upper left hand corner of the first pixel of the image for images coming from GE (Manufacturer is “GE MEDICAL SYSTEMS”). Otherwise the Image Position is treated as the position of the center of the first pixel of the image.

**3.4.6.3 Image Pixel Module**

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

**TABLE 3.4-9  
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Ignored (expect “1”)
Photometric Interpretation	(0028,0004)	1	Ignored (expect “MONOCHROME2”)
Rows	(0028,0010)	1	Mandatory (expect from 256 to 1024)
Columns	(0028,0011)	1	Mandatory (expect from 256 to 1024)
Bits Allocated	(0028,0100)	1	Ignored (expect “16”)
Bits Stored	(0028,0101)	1	Ignored
High Bit	(0028,0102)	1	Ignored



Pixel Representation	(0028,0103)	1	Ignored (expect "1")
Pixel Data	(7FE0,0010)	1	Used
Planar Configuration	(0028,0006)	1C	Ignored
Pixel Aspect Ratio	(0028,0034)	1C	Ignored
Smallest Image Pixel Value	(0028,0106)	3	Ignored
Largest Image Pixel Value	(0028,0107)	3	Ignored
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Ignored
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Ignored
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Ignored
Red Palette Color Lookup Table Data	(0028,1201)	1C	Ignored
Green Palette Color Lookup Table Data	(0028,1202)	1C	Ignored
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Ignored

TABLE 3.4-10  
CONTRAST/BOLUS MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	Used
Contrast/Bolus Agent Sequence	(0018,0012)	3	Ignored
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	
Contrast/Bolus Route	(0018,1040)	3	Used
Contrast/Bolus Administration Route Sequence	(0018,0014)	3	Ignored
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	
>Additional Drug Sequence	(0018,002A)	3	
>>Code Value	(0008,0100)	1C	
>>Coding Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
Contrast/Bolus Volume	(0018,1041)	3	Ignored
Contrast/Bolus Start Time	(0018,1042)	3	Ignored
Contrast/Bolus Stop Time	(0018,1043)	3	Ignored
Contrast/Bolus Total Dose	(0018,1044)	3	Ignored
Contrast Flow Rate(s)	(0018,1046)	3	Ignored
Contrast Flow Duration(s)	(0018,1047)	3	Ignored
Contrast/Bolus Ingredient	(0018,1048)	3	Ignored
Contrast/Bolus Ingredient Concentration	(0018,1049)	3	Ignored

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**3.4.7 Common Lookup Table Modules**

**3.4.7.1 VOI LUT module**

This section specifies the Attributes that describe the VOI LUT.

**TABLE 3.4-11  
VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	3	Ignored
>LUT Descriptor	(0028,3002)	1C	
>LUT Explanation	(0028,3003)	3	
>LUT Data	(0028,3006)	1C	
Window Center	(0028,1050)	3	Ignored at load (an automatic W/L is computed on the whole series).
Window Width	(0028,1051)	1C	Ignored at load (an automatic W/L is computed on the whole series).
Window Center & Width Explanation	(0028,1055)	3	Ignored

**3.4.8 General Modules**

The SOP Common Module is mandatory for all DICOM IODs.

**3.4.8.1 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 3.4-12  
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used
SOP Instance UID	(0008,0018)	1	Used
Specific Character Set	(0008,0005)	1C	Used Only the "ISO_IR 100" character set is supported.
Instance Creation Date	(0008,0012)	3	Ignored
Instance Creation Time	(0008,0013)	3	Ignored
Instance Creator UID	(0008,0014)	3	Ignored
Time zone Offset From UTC	(0008,0201)	3	Ignored
Instance Number	(0020,0013)	3	Used
SOP Instance Status	(0100,0410)	3	Ignored
SOP Authorization Date and Time	(0100,0420)	3	Ignored
SOP Authorization Comment	(0100,0414)	3	Ignored
Authorization Equipment Certification Number	(0100,0416)	3	Ignored

**3.4.9 CT Modules**

This Section describes CT Series, Equipment, and Image Modules. These Modules contain Attributes that are specific to CT Image IOD.

**3.4.9.1 CT Image Module**

The table in this Section contains IOD Attributes that describe CT images.

**TABLE 3.4-13  
CT IMAGE MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Image Type	(0008,0008)	1	Used (Expect ORIGINAL\PRIMARY)
Samples per Pixel	(0028,0002)	1	Shall be 1.
Photometric Interpretation	(0028,0004)	1	Ignored (expect "MONOCHROME2")
Bits Allocated	(0028,0100)	1	Shall be 16.
Bits Stored	(0028,0101)	1	Ignored (expect 16)
High Bit	(0028,0102)	1	Ignored (expect 15)
Rescale Intercept	(0028, 1052)	1	Used (default to -1024 if not found)
Rescale Slope	(0028,1053)	1	Used
KVP	(0018,0060)	2	Ignored
Acquisition Number	(0020,0012)	2	Ignored
Scan Options	(0018,0022)	3	Ignored
Data Collection Diameter	(0018,0090)	3	Ignored
Reconstruction Diameter	(0018,1100)	3	Used
Distance Source to Detector	(0018,1110)	3	Ignored
Distance Source to Patient	(0018,1111)	3	Ignored
Gantry/Detector Tilt	(0018,1120)	3	Used
Table Height	(0018,1130)	3	Used
Rotation Direction	(0018,1140)	3	Ignored
Exposure Time	(0018,1150)	3	Ignored
X-ray Tube Current	(0018,1151)	3	Ignored
Exposure	(0018,1152)	3	Ignored
Exposure in $\mu$ As	(0018,1152)	3	Ignored
Filter Type	(0018,1160)	3	Ignored
Generator Power	(0018,1170)	3	Ignored
Focal Spot	(0018,1190)	3	Ignored
Convolution Kernel	(0018,1210)	3	Ignored

**3.5 PRIVATE DATA**

All private elements are ignored within the application.

## 4. MR INFORMATION OBJECT IMPLEMENTATION

### 4.1 INTRODUCTION

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

5.2 PET IOD DESCRIPTION

5.3 PET ENTITY-RELATIONSHIP MODEL

5.4 IOD MODULE TABLE

5.5 INFORMATION MODULE DEFINITIONS

### 4.2 MR IOD DESCRIPTION

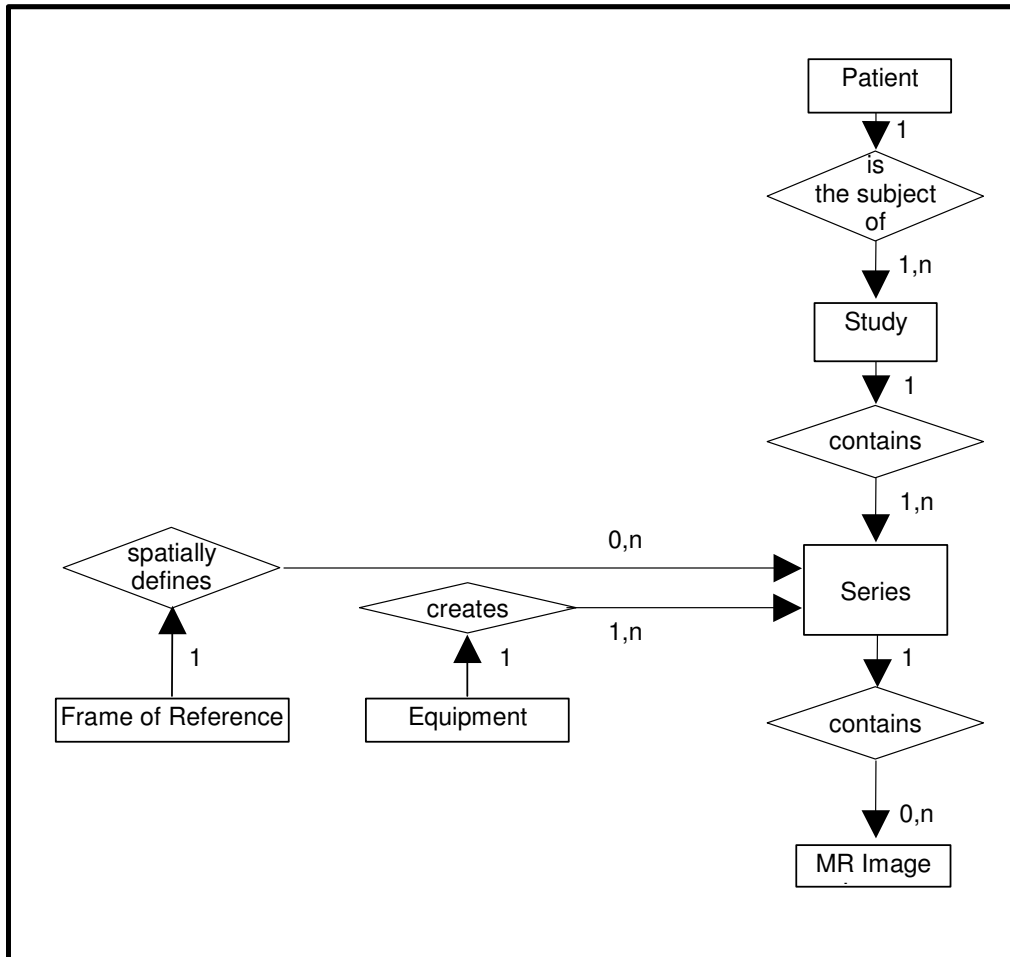
### 4.3 MR ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the MR Image interoperability schema is shown in. In this figure Illustration-4.3.1, 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. In other words, the relationship between Series and Image can have up to n Images per Series, but the Patient to Study relationship has 1 Patient for each Study (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).

ILLUSTRATION -4.3-1  
 MR IMAGE ENTITY RELATIONSHIP DIAGRAM



4.3.1 Entity Descriptions

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

TABLE 4.3-1  
 MAPPING OF DICOM ENTITIES TO APPLICATION ENTITIES

DICOM	Application Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

4.4 IOD MODULE TABLE

Within an entity of the DICOM MR IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are

related with each other. A module grouping does not infer any encoding of information into datasets.

Table 4.4-1 identifies the defined modules within the entities that comprise the DICOM MR IOD. Modules are identified by Module Name.

See DICOM Part 3 for a complete definition of the entities, modules, and attributes.

**TABLE 4.4-1  
MR IMAGE IOD MODULES**

<b>Entity Name</b>	<b>Module Name</b>	<b>Reference</b>
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Frame of Reference	Frame of Reference	4.5.4.1
Equipment	General Equipment	4.5.5.1
Image	General Image	4.5.6.1
	Image Plane	4.5.6.3
	Image Pixel	4.5.6.4
	Contrast/Bolus	4.5.6.4
	MR Image	4.5.9.1
	Overlay Plane	Not Used
	VOI LUT	4.5.7.1
	SOP Common	4.5.8.1

**4.5 INFORMATION MODULE DEFINITIONS**

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the MR 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. Associated tables contain expectations of the use of entities within the application. It should be noted that they are the same ones as defined in the DICOM Standard Part 3 (Information Object Definitions). No MR images are generated by the application.

**4.5.1 Common Patient Entity Modules**

**4.5.1.1 Patient Module**

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

TABLE 4.5-1  
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Used
Patient ID	(0010,0020)	2	Used
Issuer of Patient ID	(0010,0021)	3	Used
Patient's Birth Date	(0010,0030)	2	Used
Patient's Sex	(0010,0040)	2	Used
Referenced Patient Sequence	(0008,1120)	3	Used
>Referenced SOP Class UID	(0008,1150)	1C	Used
>Referenced SOP Instance UID	(0008,1155)	1C	Used
Patient's Birth Time	(0010,0032)	3	Ignored
Other Patient IDs	(0010,1000)	3	Used
Other Patient IDs Sequence	(0010,1002)	3	Used
>Patient ID	(0010,0020)	1	Used
>Issuer of Patient ID	(0010,0021)	1	Used
>Type of Patient ID	(0010,0022)	1	Used
Other Patient Names	(0010,1001)	3	Used
Ethnic Group	(0010,2160)	3	Ignored
Patient Comments	(0010,4000)	3	Ignored

4.5.2 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.

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**4.5.2.1 General Study Module**

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

**TABLE 4.5-2  
GENERAL STUDY MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Study Instance UID	(0020,000D)	1	Mandatory
Study Date	(0008,0020)	2	Used
Study Time	(0008,0030)	2	Used
Referring Physician's Name	(0008,0090)	2	Ignored
Study ID	(0020,0010)	2	Used
Accession Number	(0008,0050)	2	Ignored
Study Description	(0008,1030)	3	Used
Physician(s) of Record	(0008,1048)	3	Ignored
Name of Physician(s) Reading Study	(0008,1060)	3	Ignored
Referenced Study Sequence	(0008,1110)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Procedure Code Sequence	(0008,1032)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

**4.5.2.2 Patient Study Module**

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

**TABLE 4.5-3  
PATIENT STUDY MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Admitting Diagnoses Description	(0008,1080)	3	Ignored
Patient's Age	(0010,1010)	3	Ignored
Patient's Size	(0010,1020)	3	Ignored
Patient's Weight	(0010,1030)	3	Ignored
Occupation	(0010,2180)	3	Ignored
Additional Patient's History	(0010,21B0)	3	Ignored



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**4.5.3 Common Series Entity Modules**

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

**4.5.3.1 General Series Module**

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

**TABLE 4.5-4  
GENERAL SERIES MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Modality	(0008,0060)	1	Used Defined Terms: MR = Magnetic Resonance
Series Instance UID	(0020,000E)	1	Mandatory
Series Number	(0020,0011)	2	Used
Laterality	(0020,0060)	2C	Ignored
Series Date	(0008,0021)	3	Used
Series Time	(0008,0031)	3	Used
Performing Physicians' Name	(0008,1050)	3	Ignored
Protocol Name	(0018,1030)	3	Ignored
Series Description	(0008,103E)	3	Used
Operators' Name	(0008,1070)	3	Ignored
Referenced Study Component Sequence	(0008,1111)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Body Part Examined	(0018,0015)	3	Ignored
Patient Position	(0018,5100)	2C	Ignored
Smallest Pixel Value in Series	(0028,0108)	3	Ignored
Largest Pixel Value in Series	(0028,0109)	3	Ignored
Request Attributes Sequence	(0040,0275)	3	Ignored
>Requested Procedure ID	(0040,1001)	1C	
>Scheduled Procedure Step ID	(0040,0009)	1C	
>Scheduled Procedure Step Description	(0040,0007)	3	
>Scheduled Protocol Code Sequence	(0040,0008)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
Performed Procedure Step ID	(0040,0253)	3	Ignored
Performed Procedure Step Start Date	(0040,0244)	3	Ignored
Performed Procedure Step Start Time	(0040,0245)	3	Ignored
Performed Procedure Step Description	(0040,0254)	3	Ignored
Performed Action Item Sequence	(0040,0260)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	

>Code Meaning	(0008,0104)	1C	

**4.5.4 Common Frame Of Reference Entity Modules**

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

**4.5.4.1 Frame Of Reference Module**

MR Images do not need to share the same Frame Of Reference UID with the PET or CT.

**TABLE 4.5-5  
FRAME OF REFERENCE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Mandatory
Position Reference Indicator	(0020,1040)	2	Ignored

**4.5.5 Common Equipment Entity Modules**

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

**4.5.5.1 General Equipment Module**

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

**TABLE 4.5-6  
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Used
Institution Name	(0008,0080)	3	Used
Institution Address	(0008,0081)	3	Ignored
Station Name	(0008,1010)	3	Ignored
Institutional Department Name	(0008,1040)	3	Ignored
Manufacturer's Model Name	(0008,1090)	3	Used
Device Serial Number	(0018,1000)	3	Ignored
Software Versions	(0018,1020)	3	Ignored
Spatial Resolution	(0018,1050)	3	Ignored
Date of Last Calibration	(0018,1200)	3	Ignored
Time of Last Calibration	(0018,1201)	3	Ignored
Pixel Padding Value	(0028,0120)	3	Ignored

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**4.5.6 Common Image Entity Modules**

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

**4.5.6.1 General Image Module**

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

**TABLE 4.5-7  
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	Used
Patient Orientation	(0020,0020)	2C	Ignored
Content Date	(0008,0023)	2C	Used
Content Time	(0008,0033)	2C	Used
Image Type	(0008,0008)	3	Used
Acquisition Number	(0020,0012)	3	Ignored
Acquisition Date	(0008,0022)	3	Ignored
Acquisition Time	(0008,0032)	3	Ignored
Referenced Image Sequence	(0008,1140)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Derivation Description	(0008,2111)	3	Ignored
Source Image Sequence	(0008,2112)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Images in Acquisition	(0020,1002)	3	Ignored
Image Comments	(0020,4000)	3	Ignored
Quality Control Image	(0028,0300)	3	Ignored
Burned In Annotations	(0028,0301)	3	Ignored
Lossy Image Compression	(0028,2110)	3	Ignored
Lossy Image Compression Ratio	(0028,2112)	3	Ignored

**4.5.6.2 Lossy Image Compression**

Application does not support compressed images.

**4.5.6.3 Image Plane Module**

This section specifies the Attributes that define the transmitted pixel array of a two dimensional image plane.

**TABLE 4.5-8  
IMAGE PLANE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Mandatory /Used
Image Orientation (Patient)	(0020,0037)	1	Mandatory
Image Position (Patient)	(0020,0032)	1	Mandatory

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Slice Thickness	(0018,0050)	2	Used
Slice Location	(0020,1041)	3	Used

**4.5.6.3.1 Image Position**

The Image Position is treated as the position of the upper left hand corner of the first pixel of the image for images coming from GE (Manufacturer is “GE MEDICAL SYSTEMS”), which software version (first value of Software Version) is earlier than 11.

The Image Position is treated as the position of the center of the first pixel of the image for images coming from other manufacturer than GE or MR GE systems that have MR 11.0 software (Excite II, ...) and above.

**4.5.6.4 Image Pixel Module**

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

**TABLE 4.5-9  
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Ignored (expect “1”)
Photometric Interpretation	(0028,0004)	1	Ignored (expect “MONOCHROME2”)
Rows	(0028,0010)	1	Mandatory (expect from 128 to 256 )
Columns	(0028,0011)	1	Mandatory (expect from 128 to 256)
Bits Allocated	(0028,0100)	1	Ignored (expect “16”)
Bits Stored	(0028,0101)	1	Ignored (expect “16”)
High Bit	(0028,0102)	1	Ignored (expect “15”)
Pixel Representation	(0028,0103)	1	Ignored (expect “1”)
Pixel Data	(7FE0,0010)	1	Used
Planar Configuration	(0028,0006)	1C	Ignored
Pixel Aspect Ratio	(0028,0034)	1C	Ignored
Smallest Image Pixel Value	(0028,0106)	3	Used
Largest Image Pixel Value	(0028,0107)	3	Used
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Ignored
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Ignored
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Ignored
Red Palette Color Lookup Table Data	(0028,1201)	1C	Ignored
Green Palette Color Lookup Table Data	(0028,1202)	1C	Ignored
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Ignored

**TABLE 4.5-10  
CONTRAST/BOLUS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	Ignored
Contrast/Bolus Agent Sequence	(0018,0012)	3	Ignored
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	
Contrast/Bolus Route	(0018,1040)	3	Ignored
Contrast/Bolus Administration Route Sequence	(0018,0014)	3	Ignored
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	
>Additional Drug Sequence	(0018,002A)	3	
>>Code Value	(0008,0100)	1C	
>>Coding Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
Contrast/Bolus Volume	(0018,1041)	3	Ignored
Contrast/Bolus Start Time	(0018,1042)	3	Ignored
Contrast/Bolus Stop Time	(0018,1043)	3	Ignored
Contrast/Bolus Total Dose	(0018,1044)	3	Ignored
Contrast Flow Rate(s)	(0018,1046)	3	Ignored
Contrast Flow Duration(s)	(0018,1047)	3	Ignored
Contrast/Bolus Ingredient	(0018,1048)	3	Ignored
Contrast/Bolus Ingredient Concentration	(0018,1049)	3	Ignored

**4.5.7 Common Lookup Table Modules**

**4.5.7.1 VOI LUT module**

This section specifies the Attributes that describe the VOI LUT.

**TABLE 4.5-11  
VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	3	Ignored
>LUT Descriptor	(0028,3002)	1C	
>LUT Explanation	(0028,3003)	3	
>LUT Data	(0028,3006)	1C	
Window Center	(0028,1050)	3	Ignored at load (an automatic W/L is computed on the whole series)
Window Width	(0028,1051)	1C	Ignored at load (an automatic W/L is computed on the whole series)
Window Center & Width Explanation	(0028,1055)	3	Ignored

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**4.5.8 General Modules**

The SOP Common Module is mandatory for all DICOM IODs.

**4.5.8.1 SOP Common Module**

This section defines the Attributes that 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 4.5-12  
SOP COMMON MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
SOP Class UID	(0008,0016)	1	Used
SOP Instance UID	(0008,0018)	1	Used
Specific Character Set	(0008,0005)	1C	Used Only the "ISO_IR 100" character set is supported.
Instance Creation Date	(0008,0012)	3	Ignored
Instance Creation Time	(0008,0013)	3	Ignored
Instance Creator UID	(0008,0014)	3	Ignored
Time zone Offset From UTC	(0008,0201)	3	Ignored
Instance Number	(0020,0013)	3	Used
SOP Instance Status	(0100,0410)	3	Ignored
SOP Authorization Date and Time	(0100,0420)	3	Ignored
SOP Authorization Comment	(0100,0414)	3	Ignored
Authorization Equipment Certification Number	(0100,0416)	3	Ignored

**4.5.9 MR Modules**

This Section describes MR Series, Equipment, and Image Modules. These Modules contain Attributes that are specific to MR Image IOD.

**4.5.9.1 MR Image Module**

The table in this Section contains IOD Attributes that describe MR Images.

**TABLE 4.5-13  
MR IMAGE MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Image Type	(0008,0008)	1	Used (Expect ORIGINAL\PRIMARY)
Samples per Pixel	(0028,0002)	1	Ignored (expect "1")
Photometric Interpretation	(0028,0004)	1	Ignored (Expect "MONOCHROME2")
Bits Allocated	(0028,0100)	1	Ignored (expect "16")
Scanning Sequence	(0018,0020)	1	Ignored
Sequence Variant	(0018,0021)	1	Ignored
Scan Options	(0018,0022)	2	Ignored
MR Acquisition Type	(0018,0023)	2	Ignored
Repetition Time	(0018,0080)	2C	Ignored
Echo Time	(0018,0081)	2	Ignored
Echo Train Length	(0018,0091)	2	Ignored
Inversion Time	(0018,0082)	2C	Ignored
Trigger Time	(0018,1060)	2C	Ignored
Sequence Name	(0018,0024)	3	Ignored
Angio Flag	(0018,0025)	3	Ignored
Number of Averages	(0018,0083)	3	Ignored
Imaging Frequency	(0018,0084)	3	Ignored
Imaged Nucleus	(0018,0085)	3	Ignored
Echo Number	(0018,0086)	3	Ignored
Magnetic Field Strength	(0018,0087)	3	Ignored
Spacing Between Slices	(0018,0088)	3	Used
Number of Phase Encoding Steps	(0018,0089)	3	Ignored
Percent Sampling	(0018,0093)	3	Ignored
Percent Phase Field of View	(0018,0094)	3	Ignored
Pixel Bandwidth	(0018,0095)	3	Ignored
Nominal Interval	(0018,1062)	3	Ignored
Beat Rejection Flag	(0018,1080)	3	Ignored
Low R-R Value	(0018,1081)	3	Ignored
High R-R Value	(0018,1082)	3	Ignored
Intervals Acquired	(0018,1083)	3	Ignored
Intervals Rejected	(0018,1084)	3	Ignored
PVC Rejection	(0018,1085)	3	Ignored
Skip Beats	(0018,1086)	3	Ignored

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Heart Rate	(0018,1088)	3	Ignored
Cardiac Number of Images	(0018,1090)	3	Ignored
Trigger Window	(0018,1094)	3	Ignored
Reconstruction Diameter	(0018,1100)	3	Used
Receiving Coil	(0018,1250)	3	Ignored
Transmitting Coil	(0018,1251)	3	Ignored
Acquisition Matrix	(0018,1310)	3	Ignored
Phase Encoding Direction	(0018,1312)	3	Ignored
Flip Angle	(0018,1314)	3	Ignored
SAR	(0018,1316)	3	Ignored
Variable Flip Angle Flag	(0018,1315)	3	Ignored
dB/dt	(0018,1318)	3	Ignored
Temporal Position Identifier	(0020,0100)	3	Ignored
Number of Temporal Positions	(0020,0105)	3	Ignored
Temporal Resolution	(0020,0110)	3	Ignored

**4.6 PRIVATE DATA**

The application ignores all private elements.



## 5. PET INFORMATION OBJECT IMPLEMENTATION

### 5.1 INTRODUCTION

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

#### 5.2 PET IOD DESCRIPTION

#### 5.3 PET ENTITY-RELATIONSHIP MODEL

#### 5.4 IOD MODULE TABLE

#### 5.5 INFORMATION MODULE DEFINITIONS

### 5.2 PET IOD DESCRIPTION

The Positron Emission Tomography (PET) Image Information Object Definition specifies an image which has been created by a Positron Tomograph imaging device, including dedicated PET cameras and Nuclear Medicine imaging devices operating in coincidence mode. This includes data created by external detection devices which create images of the distribution of administered radioactive materials, specifically positron emitters, in the body. Depending on the specific radiopharmaceuticals administered and the particular imaging procedure performed, problems involving changes in metabolism, function, or physiology can be investigated and various region pathologies can be studied. For these problems, quantitation of image data in absolute activity and physiological units is important. In addition, the PET Image IOD specifies attenuation (transmission) images used for correction and anatomical reference of emission images.

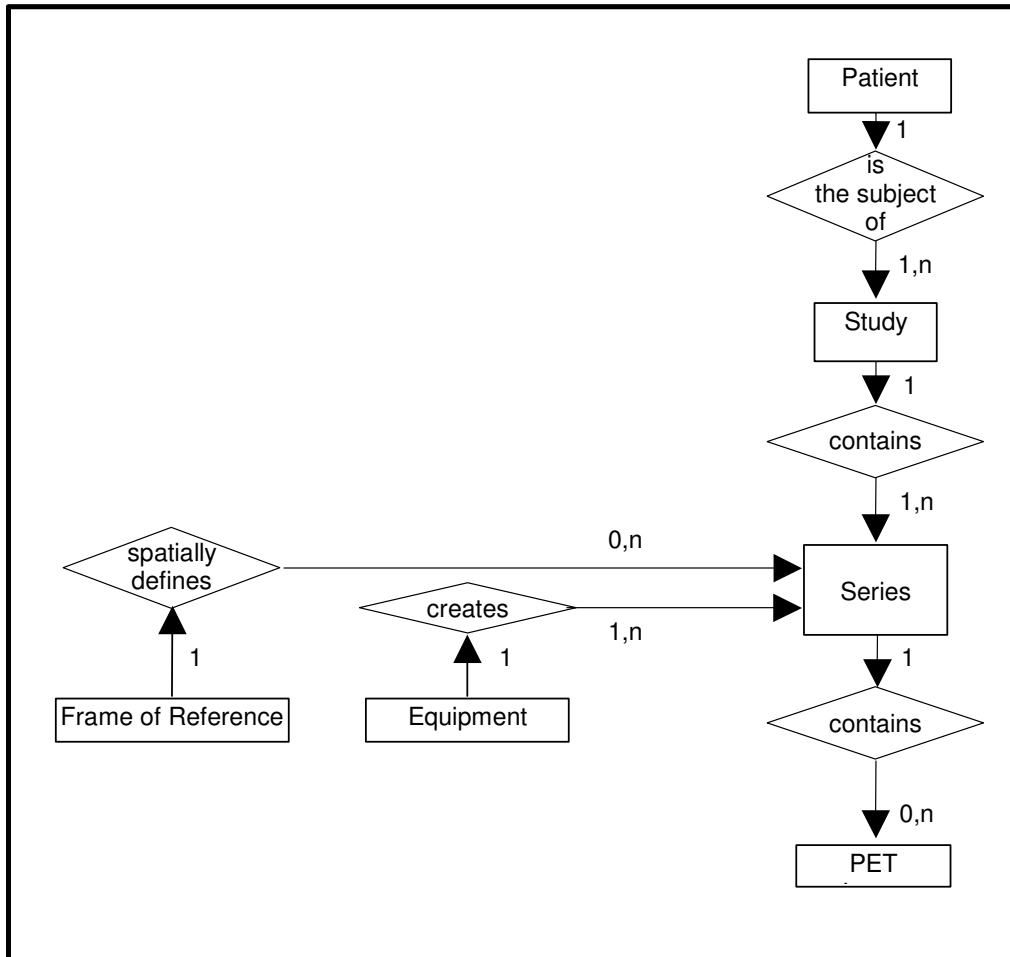
### 5.3 PET ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the PET Image interoperability schema is shown in. In this figure Illustration-4.3.1, 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. In other words, the relationship between Series and Image can have up to n Images per Series, but the Patient to Study relationship has 1 Patient for each Study (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).

ILLUSTRATION – 5.3-1  
 PET IMAGE ENTITY RELATIONSHIP DIAGRAM



5.3.1 Entity Descriptions

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

5.3.2 NeuroMarQ Mapping of DICOM entities

TABLE 5.3-1  
 MAPPING OF DICOM ENTITIES TO NEUROMARQ ENTITIES

DICOM	NeuroMarQ Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

5.4 IOD MODULE TABLE

Within an entity of the DICOM PET IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the

understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 5.4-1 identifies the defined modules within the entities that comprise the DICOM PET IOD. Modules are identified by Module Name.

See DICOM Part 3 for a complete definition of the entities, modules, and attributes.

**TABLE 5.4-1  
PET IMAGE IOD MODULES**

Entity Name	Module Name	Reference
Patient	Patient	5.5.1.1
Study	General Study	5.5.2.1
	Patient Study	5.5.2.2
Series	General Series	5.5.3.1
	PET Series	5.5.9.1
	PET Isotope	5.5.9.2
	PET Multi-gated Acquisition	5.5.9.3
	NM/PET Patient Orientation	5.5.9.4
Frame of Reference	Frame of Reference	5.5.4.1
Equipment	General Equipment	5.5.5.1
Image	General Image	5.5.6.1
	Image Plane	5.5.6.2
	Image Pixel	4.5.6.3
	PET Image	5.5.9.5
	Overlay Plane	Not Used
	VOI LUT	5.5.7.1
	SOP Common	5.5.8.1

**5.5 INFORMATION MODULE DEFINITIONS**

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the PET 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. Associated tables contain expectations of the use of entities within the application. No PET images are generated by the application. It should be noted that they are the same ones as defined in the DICOM Standard Part 3 (Information Object Definitions).

**5.5.1 Common Patient Entity Modules**

**5.5.1.1 Patient Module**

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

**TABLE 5.5-1  
PATIENT MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Patient's Name	(0010,0010)	2	Used
Patient ID	(0010,0020)	2	Used
Issuer of Patient ID	(0010,0021)	3	Used
Patient's Birth Date	(0010,0030)	2	Used
Patient's Sex	(0010,0040)	2	Used
Referenced Patient Sequence	(0008,1120)	3	Used
>Referenced SOP Class UID	(0008,1150)	1C	Used
>Referenced SOP Instance UID	(0008,1155)	1C	Used
Patient's Birth Time	(0010,0032)	3	Ignored
Other Patient Ids	(0010,1000)	3	Used
Other Patient IDs Sequence	(0010,1002)	3	Used
>Patient ID	(0010,0020)	1	Used
>Issuer of Patient ID	(0010,0021)	1	Used
>Type of Patient ID	(0010,0022)	1	Used
Other Patient Names	(0010,1001)	3	Used
Ethnic Group	(0010,2160)	3	Ignored
Patient Comments	(0010,4000)	3	Ignored

**5.5.2 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.

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**5.5.2.1 General Study Module**

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

**TABLE 5.5-2  
GENERAL STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Mandatory
Study Date	(0008,0020)	2	Used
Study Time	(0008,0030)	2	Used
Referring Physician's Name	(0008,0090)	2	Used
Referring Physician's Identification Sequence	(0008,0096)	3	Ignored
Study ID	(0020,0010)	2	Used
Accession Number	(0008,0050)	2	Used
Issuer of Accession Number Sequence	(0008,0051)	3	Ignored
Study Description	(0008,1030)	3	Used
Physician(s) of Record	(0008,1048)	3	Ignored
Physician(s) of Record Identification Sequence	(0008,1049)	3	Ignored
Name of Physician(s) Reading Study	(0008,1060)	3	Ignored
Physician(s) Reading Study Identification Sequence	(0008,1062)	3	Ignored
Requesting Service Code Sequence	(0032,1034)	3	Ignored
Referenced Study Sequence	(0008,1110)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Procedure Code Sequence	(0008,1032)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	
Reason For Performed Procedure Code Sequence	(0040,1012)	3	Ignored

**5.5.2.2 Patient Study Module**

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

**TABLE 5.5-3  
PATIENT STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Admitting Diagnoses Description	(0008,1080)	3	Ignored
Patient's Age	(0010,1010)	3	Used
Patient's Size	(0010,1020)	3	Ignored

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Patient's Weight	(0010,1030)	3	Ignored
Occupation	(0010,2180)	3	Ignored
Additional Patient's History	(0010,21B0)	3	Ignored

**5.5.3 Common Series Entity Modules**

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

**5.5.3.1 General Series Module**

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

**TABLE 5.5-4  
GENERAL SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Used Defined Terms: PT = Positron Emission Tomography
Series Instance UID	(0020,000E)	1	Mandatory
Series Number	(0020,0011)	2	Used
Laterality	(0020,0060)	2C	Ignored
Series Date	(0008,0021)	3	Used
Series Time	(0008,0031)	3	Used
Performing Physicians' Name	(0008,1050)	3	Ignored
Protocol Name	(0018,1030)	3	Ignored
Series Description	(0008,103E)	3	Used
Operators' Name	(0008,1070)	3	Ignored
Referenced Performed Procedure Sequence	(0008,1111)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Related Series Sequence	(0008,1250)	3	Ignored
Body Part Examined	(0018,0015)	3	Ignored
Patient Position	(0018,5100)	2C	Ignored
Smallest Pixel Value in Series	(0028,0108)	3	Ignored
Largest Pixel Value in Series	(0028,0109)	3	Ignored
Request Attributes Sequence	(0040,0275)	3	Ignored
>Requested Procedure ID	(0040,1001)	1C	
>Accession Number	(0008,0050)	3	
>Study Instance UID	(0020, 000D)	3	
>Referenced Study Sequence	(0008,1110)	3	
>>Referenced SOP Class UID	(0008,1150)	1C	

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>>Referenced SOP Instance UID	(0008,1155)	1C	
>Requested Procedure Description	(0032,1050)	3	
>Requested Procedure Code Sequence	(0032,1064)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>Reason for the Requested Procedure	(0040,1002)	3	
>Reason for Requested Procedure Code Sequence	(0040,100A)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>Scheduled Procedure Step ID	(0040,0009)	1C	
>Scheduled Procedure Step Description	(0040,0007)	3	
>Scheduled Protocol Code Sequence	(0040,0008)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>>Protocol Context Sequence	(0040,0440)	3	
>>Content Item Modifier Sequence	(0040,0441)	3	
Performed Procedure Step ID	(0040,0253)	3	Ignored
Performed Procedure Step Start Date	(0040,0244)	3	Ignored
Performed Procedure Step Start Time	(0040,0245)	3	Ignored
Performed Procedure Step Description	(0040,0254)	3	Ignored
Performed Protocol Code Sequence	(0040,0260)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

**5.5.4 Common Frame Of Reference Entity Modules**

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

**5.5.4.1 Frame Of Reference Module**

**TABLE 5.5-5  
FRAME OF REFERENCE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Mandatory
Position Reference Indicator	(0020,1040)	2	Ignored

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**5.5.4.1.1 Frame Of Reference UID**

Images should share the same Frame Of Reference UID as a necessary condition to be in the same 3D model.

**5.5.5 Common Equipment Entity Modules**

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

**5.5.5.1 General Equipment Module**

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

**TABLE 5.5-6  
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Used
Institution Name	(0008,0080)	3	Used
Institution Address	(0008,0081)	3	Ignored
Station Name	(0008,1010)	3	Ignored
Institutional Department Name	(0008,1040)	3	Ignored
Manufacturer's Model Name	(0008,1090)	3	Used
Device Serial Number	(0018,1000)	3	Ignored
Software Versions	(0018,1020)	3	Ignored
Spatial Resolution	(0018,1050)	3	Ignored
Date of Last Calibration	(0018,1200)	3	Ignored
Time of Last Calibration	(0018,1201)	3	Ignored
Pixel Padding Value	(0028,0120)	3	Ignored

**5.5.6 Common Image Entity Modules**

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

**5.5.6.1 General Image Module**

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

**TABLE 5.5-7  
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	Used
Patient Orientation	(0020,0020)	2C	Ignored
Content Date	(0008,0023)	2C	Used
Content Time	(0008,0033)	2C	Used
Image Type	(0008,0008)	3	Used
Acquisition Number	(0020,0012)	3	Ignored
Acquisition Date	(0008,0022)	3	Used
Acquisition Time	(0008,0032)	3	Used



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Referenced Image Sequence	(0008,1140)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Derivation Description	(0008,2111)	3	Ignored
Source Image Sequence	(0008,2112)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Images in Acquisition	(0020,1002)	3	Ignored
Image Comments	(0020,4000)	3	Ignored
Quality Control Image	(0028,0300)	3	Ignored
Burned In Annotations	(0028,0301)	3	Ignored
Lossy Image Compression	(0028,2110)	3	Ignored
Lossy Image Compression Ratio	(0028,2112)	3	Ignored

**5.5.6.1.1 General Image Attribute Descriptions**

**5.5.6.1.1.1 Patient Orientation**

The application uses Image Orientation Patient (0020,0037) and Image Position Patient (0020,0032).

**5.5.6.1.1.2 Image Type**

The expected image type for used images is

Value 1 has the following value:

- ORIGINAL all images used are original images from the PET image acquisition system. Application does not support source data (raw scan data).

Value 2 has the following value:

- PRIMARY assumes all images used are part of initial patient examination.

Value 3 has the following value:

- AXIAL assumes all images used contain a transaxial orientation as part of initial patient examination.

**5.5.6.2 Image Plane Module**

This section specifies the Attributes that define the transmitted pixel array of a two dimensional image plane.

**TABLE 5.5-8  
IMAGE PLANE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Mandatory /Used
Image Orientation (Patient)	(0020,0037)	1	Mandatory /Used
Image Position (Patient)	(0020,0032)	1	Mandatory /Used
Slice Thickness	(0018,0050)	2	Used
Slice Location	(0020,1041)	3	Ignored

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**5.5.6.2.1 Image Position**

The Image Position is treated as the position of the upper left hand corner of the first pixel of the image for images coming from GE (Manufacturer is “GE MEDICAL SYSTEMS”) where the Manufacturer Model Name is “Advance”, “Discovery LS” or “Discovery QX/i”.

Otherwise, the Image Position is treated as the position of the center of the first pixel of the image.

**5.5.6.3 Image Pixel Module**

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

**TABLE 5.5-9  
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Ignored (expect “1”)
Photometric Interpretation	(0028,0004)	1	Ignored (expect “MONOCHROME2”)
Rows	(0028,0010)	1	Mandatory (expect from 64 to 256)
Columns	(0028,0011)	1	Mandatory (expect from 64 to 256)
Bits Allocated	(0028,0100)	1	Ignored (expect “16”)
Bits Stored	(0028,0101)	1	Ignored (expect “16”)
High Bit	(0028,0102)	1	Ignored (expect “15”)
Pixel Representation	(0028,0103)	1	Ignored (expect “1”)
Pixel Data	(7FE0,0010)	1	Used
Planar Configuration	(0028,0006)	1C	Ignored
Pixel Aspect Ratio	(0028,0034)	1C	Ignored
Smallest Image Pixel Value	(0028,0106)	3	Ignored
Largest Image Pixel Value	(0028,0107)	3	Ignored
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Ignored
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Ignored
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Ignored
Red Palette Color Lookup Table Data	(0028,1201)	1C	Ignored
Green Palette Color Lookup Table Data	(0028,1202)	1C	Ignored
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Ignored

**5.5.7 Common Lookup Table Modules**

**5.5.7.1 VOI LUT module**

This section specifies the Attributes that describe the VOI LUT.

**TABLE 5.5-10  
VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	3	Ignored
>LUT Descriptor	(0028,3002)	1C	
>LUT Explanation	(0028,3003)	3	

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>LUT Data	(0028,3006)	1C	
Window Center	(0028,1050)	3	Ignored at load (an automatic W/L is computed on the whole series)
Window Width	(0028,1051)	1C	Ignored at load (an automatic W/L is computed on the whole series)
Window Center & Width Explanation	(0028,1055)	3	Ignored

**5.5.8 General Modules**

The SOP Common Module is mandatory for all DICOM IODs.

**5.5.8.1 SOP Common Module**

This section defines the Attributes that 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 5.5-11  
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used
SOP Instance UID	(0008,0018)	1	Used
Specific Character Set	(0008,0005)	1C	Used Only the "ISO_IR 100" character set is supported.
Instance Creation Date	(0008,0012)	3	Ignored
Instance Creation Time	(0008,0013)	3	Ignored
Instance Creator UID	(0008,0014)	3	Ignored
Time zone Offset From UTC	(0008,0201)	3	Ignored
Instance Number	(0020,0013)	3	Used
SOP Instance Status	(0100,0410)	3	Ignored
SOP Authorization Date and Time	(0100,0420)	3	Ignored
SOP Authorization Comment	(0100,0414)	3	Ignored
Authorization Equipment Certification Number	(0100,0416)	3	Ignored

**5.5.9 PET Modules**

This Section describes PET Series, Equipment, and Image Modules. These Modules contain Attributes that are specific to PET Image IOD.

**5.5.9.1 PET Series**

The table in this Section contains IOD Attributes that describe PET Series.

**TABLE 5.5-12  
PET SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
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Series Date	(0008,0021)	1	Used
Series Time	(0008,0031)	1	Used
Units	(0054,1001)	1	Used
Counts Source	(0054,1002)	1	Ignored
Series Type	(0054,1000)	1	Used
Reprojection Method	(0054,1004)	2C	Ignored
Number of R-R Intervals	(0054,0061)	1C	Ignored
Number of Time Slots	(0054,0071)	1C	Ignored
Number of Time Slices	(0054,0101)	1C	Ignored
Number of Slices	(0054,0081)	1	Used
Corrected Image	(0028,0051)	2	Used
Randoms Correction Method	(0054,1100)	3	Ignored
Attenuation Correction Method	(0054,1101)	3	Ignored
Scatter Correction Method	(0054,1105)	3	Ignored
Decay Correction	(0054,1102)	1	Ignored
Reconstruction Diameter	(0018,1100)	3	Used
Convolution Kernel	(0018,1210)	3	Ignored
Reconstruction Method	(0054,1103)	3	Ignored
Detector Lines of Response Used	(0054,1104)	3	Ignored
Acquisition Start Condition	(0018,0073)	3	Ignored
Acquisition Start Condition Data	(0018,0074)	3	Ignored
Acquisition Termination Condition	(0018,0071)	3	Ignored
Acquisition Termination Condition Data	(0018,0075)	3	Ignored
Field of View Shape	(0018,1147)	3	Ignored
Field of View Dimensions	(0018,1149)	3	Ignored
Gantry/Detector Tilt	(0018,1120)	3	Used
Gantry/Detector Slew	(0018,1121)	3	Ignored
Type of Detector Motion	(0054,0202)	3	Ignored
Collimator Type	(0018,1181)	2	Ignored
Collimator/Grid Name	(0018,1180)	3	Ignored
Axial Acceptance	(0054,1200)	3	Ignored
Axial Mash	(0054,1201)	3	Ignored
Transverse Mash	(0054,1202)	3	Ignored
Detector Element Size	(0054,1203)	3	Ignored
Coincidence Window Width	(0054,1210)	3	Ignored
Energy Window Range Sequence	(0054,0013)	3	Ignored
>Energy Window Lower Limit	(0054,0014)	3	Ignored
>Energy Window Upper Limit	(0054,0015)	3	Ignored
Secondary Counts Type	(0054,1220)	3	Ignored

**5.5.9.2 PET Isotope**

The table in this Section contains IOD Attributes that describe PET Series.

TABLE 5.5-13  
PET ISOTOPE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Radiopharmaceutical Information Sequence	(0054,0016)	2	Used
>Radionuclide Code Sequence	(0054,0300)	2	Ignored
>>Code Value	(0008,0100)	1C	Ignored
>>Code Scheme Designator	(0008,0102)	1C	Ignored
>>Code Meaning	(0008,0104)	3	Ignored
>Radiopharmaceutical Route	(0018,1070)	3	Ignored
>Administration Route Code Sequence	(0054,0302)	3	Ignored
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
>Radiopharmaceutical Volume	(0018,1071)	3	Ignored
>Radiopharmaceutical Start Time	(0018,1072)	3	Used
>Radiopharmaceutical Stop Time	(0018,1073)	3	Ignored
>Radionuclide Total Dose	(0018,1074)	3	Used
>Radionuclide Half Life	(0018,1075)	3	Used
>Radionuclide Positron Fraction	(0018,1076)	3	Ignored
>Radiopharmaceutical Specific Activity	(0018,1077)	3	Ignored
>Radiopharmaceutical	(0018,0031)	3	Used
>Radiopharmaceutical Code Sequence	(0054,0304)	3	Used
>>Code Value	(0008,0100)	1C	Used
>>Code Scheme Designator	(0008,0102)	1C	Used
>>Code Meaning	(0008,0104)	3	Used
Intervention Drug Information Sequence	(0018,0026)	3	Ignored
>Intervention Drug Name	(0018,0034)	3	Ignored
>Intervention Drug Code Sequence	(0018,0029)	3	Ignored
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
>Intervention Drug Start Time	(0018,0035)	3	Ignored
>Intervention Drug Stop Time	(0018,0027)	3	Ignored
>Intervention Drug Dose	(0018,0028)	3	Ignored

5.5.9.3 PET Multi-gated Acquisition

The table in this Section contains IOD Attributes that describe PET Series.

TABLE 5.5-14  
PET MULTI-GATED ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Beat Rejection Flag	(0018,1080)	2	Ignored
Trigger Source or Type	(0018,1061)	3	Ignored

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PVC Rejection	(0018,1085)	3	Ignored
Skip Beats	(0018,1086)	3	Ignored
Heart Rate	(0018,1088)	3	Ignored
Cardiac Framing Type	(0018,1064)	3	Ignored

**5.5.9.4 NM/PET Patient Orientation**

The table in this Section contains IOD Attributes that describe NM/PET Patient Orientation.

**TABLE 5.5-15  
NM/PET PATIENT ORIENTATION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Patient Orientation Code Sequence	(0054,0410)	2	Ignored
> Code Value	(0008,0100)	1C	
> Coding Scheme Designator	(0008,0102)	1C	
> Code Meaning	(0008,0104)	3	
> Patient Orientation Modifier Code Sequence	(0054,0412)	2C	Ignored
>> Code value	(0008,0100)	1C	
>> Coding Scheme Designator	(0008,0102)	1C	
>> Code Meaning	(0008,0104)	3	
Patient Gantry Relationship Code Sequence	(0054,0414)	2	Ignored
> Code Value	(0008,0100)	1C	
> Coding Scheme Designator	(0008,0102)	1C	
> Code Meaning	(0008,0104)	3	

**5.5.9.5 PET Image Module**

The table in this Section contains IOD Attributes that describe PET images.

**TABLE 5.5-16  
PET IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Used
Samples per Pixel	(0028,0002)	1	Ignored (expect 1)
Photometric Interpretation	(0028,0004)	1	Ignored (expect "MONOCHROME2")
Bits Allocated	(0028,0100)	1	Ignored (expect 16)
Bits Stored	(0028,0101)	1	Ignored (expect 16)
High Bit	(0028,0102)	1	Ignored (expect 15)
Rescale Intercept	(0028,1052)	1	Used
Rescale Slope	(0028,1053)	1	Used
Frame Reference Time	(0054,1300)	1	Ignored
Trigger Time	(0018,1060)	1C	Ignored
Frame Time	(0018,1063)	1C	Ignored
Low R-R Value	(0018,1081)	1C	Ignored

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High R-R Value	(0018,1082)	1C	Ignored
Lossy Image Compression	(0028,2110)	1C	Ignored
Image Index	(0054,1330)	1	Used
Acquisition Date	(0008,0022)	2	Used
Acquisition Time	(0008,0032)	2	Used
Actual Frame Duration	(0018,1242)	2	Ignored
Nominal Interval	(0018,1062)	3	Ignored
Intervals Acquired	(0018,1083)	3	Ignored
Intervals Rejected	(0018,1084)	3	Ignored
Primary (Prompts) Counts Accumulated	(0054,1310)	3	Ignored
Secondary Counts Accumulated	(0054,1311)	3	Ignored
Slice Sensitivity Factor	(0054,1320)	3	Ignored
Decay Factor	(0054,1321)	1C	Ignored
Dose Calibration Factor	(0054,1322)	3	Ignored
Scatter Fraction Factor	(0054,1323)	3	Ignored
Dead Time Factor	(0054,1324)	3	Ignored
Anatomic Region Sequence	(0008,2218)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	
>Anatomic Region Modifier Sequence	(0008,2220)	3	Ignored
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
Primary Anatomic Structure Sequence	(0008,2228)	3	Ignored
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	
>Primary Anatomic Structure Modifier Sequence	(0008,2230)	3	Ignored
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
View Code Sequence	(0054,0220)	3	Ignored
> Code Value	(0008,0100)	1C	
> Coding Scheme Designator	(0008,0102)	1C	
> Code Meaning	(0008,0104)	3	
Slice Progression Direction	(0054,0500)	3	Ignored

## 6. SECONDARY CAPTURE INFORMATION OBJECT IMPLEMENTATION

### 6.1 INTRODUCTION

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

6.2 SC IOD Implementation

6.3 SC Entity-Relationship Model

6.4 IOD MODULE TABLE

6.5 INFORMATION MODULE DEFINITIONS

### 6.2 SC IOD IMPLEMENTATION

The Secondary Image (SC) Image Information Object Definition (IOD) specifies images that are converted from a non-DICOM format to a modality independent DICOM format.

In the NeuroMarQ application, displays PET, CT and MR image volumes in MPR (Multi-Plane Reformat) views. It also provides viewing of PET and CT fused, or PET and MR fused images. To allow for results of the analysis to be shared with other physicians, the application provides a feature for the user to save a view of a particular image or screen layout as a DICOM Secondary Capture IOD. The images are saved to the Advantage Workstation database as DICOM Part 10 files. Once in the database, any network function provided by the AW is available for the images, such as viewing or filming in the AW viewer or Filmer, archival to a PACS, or storage on a DICOM removable media.

In addition to directly creating the Secondary Capture images, the NeuroMarQ application can send views of images to the AW filmer directly. From the AW filmer they can be filmed or saved to the AW database.

### 6.3 SC ENTITY-RELATIONSHIP MODEL

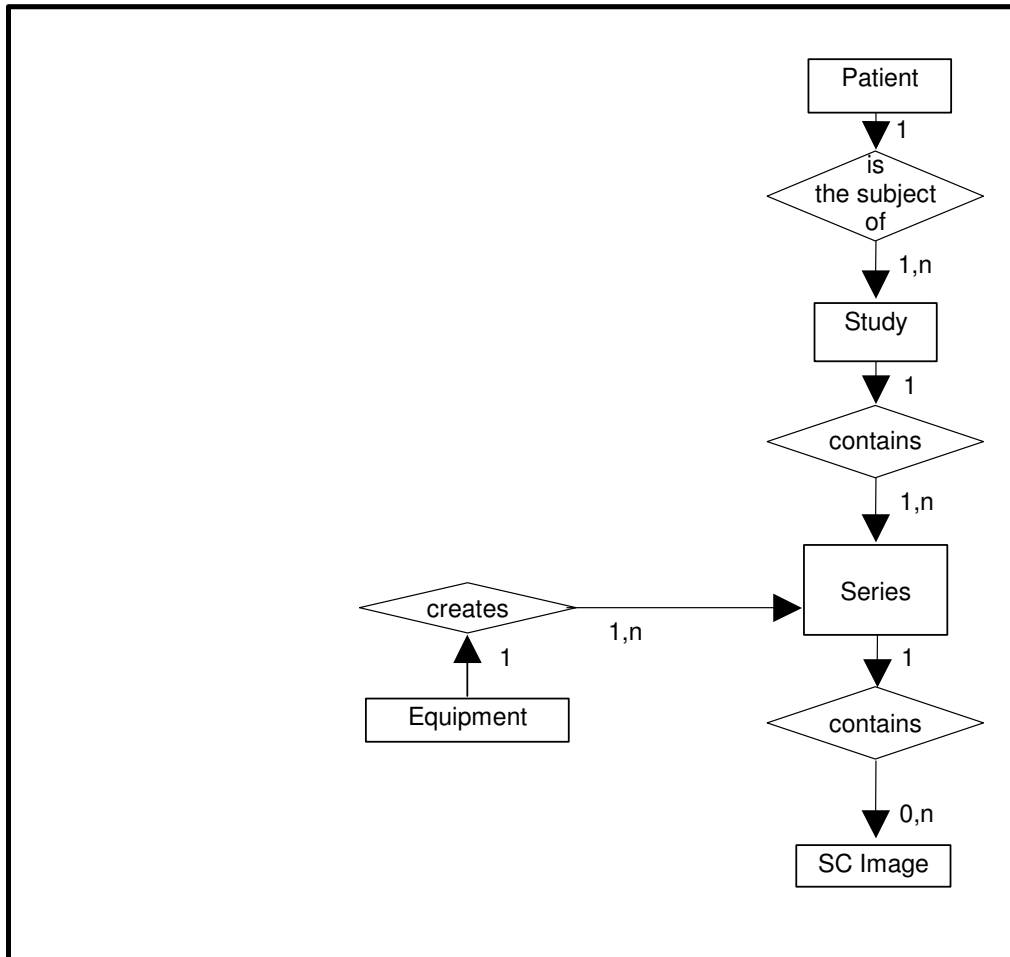
The Entity-Relationship diagram for the SC Image interoperability schema is shown in Illustration 6.3-1. In this figure, the following diagrammatic convention is established to represent the information organization:

- 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. In other words, the relationship between Series and Image can have up to n Images per Series, but the Patient to Study relationship has 1 Patient for each Study (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).



ILLUSTRATION 6.3-1  
 SC IMAGE ENTITY RELATIONSHIP DIAGRAM



6.3.1 ENTITY DESCRIPTIONS

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

6.3.2 Mapping of DICOM entities

TABLE 6.3-1  
 MAPPING OF DICOM ENTITIES TO APPLICATION ENTITIES

DICOM	Application Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

6.4 IOD MODULE TABLE

Within an entity of the DICOM v3.0 SC IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the

understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 6.4-1 identifies the defined modules within the entities which comprise the DICOM v3.0 SC IOD. Modules are identified by Module Name.

See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes.

All elements described as “Copied” are copied from the originating series for PET, MR or CT secondary captures, respectively. For the creation of a fused image secondary capture or full screen capture, the application copies all elements from the originating PET image series.

**TABLE 6.4-1  
SC IMAGE IOD MODULES**

<b>Entity Name</b>	<b>Module Name</b>	<b>Reference</b>
Patient	Patient	6.5.1.1
Study	General Study	6.5.2.1
	Patient Study	6.5.2.2
Series	General Series	6.5.3.1
	SC Series	6.5.3.2
Equipment	General Equipment	6.5.4.1
	SC Equipment	6.5.8.1
Image	General Image	6.5.5.1
	Image Pixel	6.5.5.2
	SC Image	6.5.8.2
	Overlay Plane	Not Sent
	Modality LUT	6.5.6.2
	VOI LUT	6.5.6.1
	SOP Common	6.5.7.1

**6.5 INFORMATION MODULE DEFINITIONS**

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

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. 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 ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

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**6.5.1 Common Patient Entity Modules**

**6.5.1.1 Patient Module**

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

**TABLE 6.5-1  
PATIENT MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Patient's Name	(0010,0010)	2	Copied
Patient ID	(0010,0020)	2	Copied
Issuer of Patient ID	(0010,0021)	3	Copied
Patient's Birth Date	(0010,0030)	2	Copied
Patient's Sex	(0010,0040)	2	Copied
Referenced Patient Sequence	(0008,1120)	3	Copied
>Referenced SOP Class UID	(0008,1150)	1C	Copied
>Referenced SOP Instance UID	(0008,1155)	1C	Copied
Patient's Birth Time	(0010,0032)	3	Ignored
Other Patient IDs	(0010,1000)	3	Copied
Other Patient IDs Sequence	(0010,1002)	3	Copied
>Patient ID	(0010,0020)	1	Copied
>Issuer of Patient ID	(0010,0021)	1	Copied
>Type of Patient ID	(0010,0022)	1	Copied
Other Patient Names	(0010,1001)	3	Copied
Ethnic Group	(0010,2160)	3	Ignored
Patient Comments	(0010,4000)	3	Ignored

**6.5.2 Common Study Entity Modules**

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

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**6.5.2.1 General Study Module**

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

**TABLE 6.5-2  
GENERAL STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Copied
Study Date	(0008,0020)	2	Copied
Study Time	(0008,0030)	2	Copied
Referring Physician's Name	(0008,0090)	2	Copied
Study ID	(0020,0010)	2	Copied
Accession Number	(0008,0050)	2	Copied
Study Description	(0008,1030)	3	Copied
Physician(s) of Record	(0008,1048)	3	Copied
Name of Physician(s) Reading Study	(0008,1060)	3	Copied
Referenced Study Sequence	(0008,1110)	3	Copied
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Procedure Code Sequence	(0008,1032)	3	Copied
>Code Value	(0008,0100)	1C	
>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

**6.5.2.2 Patient Study Module**

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

**TABLE 6.5-3  
PATIENT STUDY MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Admitting Diagnoses Description	(0008,1080)	3	Copied
Patient's Age	(0010,1010)	3	Copied
Patient's Size	(0010,1020)	3	Copied
Patient's Weight	(0010,1030)	3	Copied
Occupation	(0010,2180)	3	Copied
Additional Patient's History	(0010,21B0)	3	Copied

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**6.5.3 Common Series Entity Modules**

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

**6.5.3.1 General Series Module**

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

**TABLE 6.5-4  
GENERAL SERIES MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Modality	(0008,0060)	1	Generated Defined Terms: PT = Positron Emission Tomography CT = Computed Tomography MR = Magnetic Resonance OT = Other for Fused viewports
Series Instance UID	(0020,000E)	1	Generated
Series Number	(0020,0011)	2	Generated
Laterality	(0020,0060)	2C	Generated: "" empty since the software cannot know the laterality.
Series Date	(0008,0021)	3	Generated
Series Time	(0008,0031)	3	Generated
Performing Physicians' Name	(0008,1050)	3	Copied
Protocol Name	(0018,1030)	3	Copied
Series Description	(0008,103E)	3	Generated
Operators' Name	(0008,1070)	3	Generated
Referenced Performed Procedure Sequence	(0008,1111)	3	Removed
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Related Series Sequence	(0008,1250)	3	Copied (Refer to Section 6.5.3.1.1.1)
>Study Instance UID	(0020,000D)	1	copied
>Series Instance UID	(0020,000E)	1	copied
>Purpose of Reference Code Sequence	(0040,A170)	2	copied
>>Includes Code Sequence Macro			copied

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Body Part Examined	(0018,0015)	3	Copied
Patient Position	(0018,5100)	2C	Copied for CT and MR 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	Removed
Largest Pixel Value in Series	(0028,0109)	3	Removed
Request Attributes Sequence	(0040,0275)	3	Removed
>Requested Procedure ID	(0040,1001)	1C	
>Accession Number	(0008,0050)	3	
>Study Instance UID	(0020, 000D)	3	
>Referenced Study Sequence	(0008,1110)	3	
>>Referenced SOP Class UID	(0008,1150)	1C	
>>Referenced SOP Instance UID	(0008,1155)	1C	
>Requested Procedure Description	(0032,1050)	3	
>Requested Procedure Code Sequence	(0032,1064)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>Reason for the Requested Procedure	(0040,1002)	3	
>Reason for Requested Procedure Code Sequence	(0040,100A)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>Scheduled Procedure Step ID	(0040,0009)	1C	
>Scheduled Procedure Step Description	(0040,0007)	3	
>Scheduled Protocol Code Sequence	(0040,0008)	3	
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>>Protocol Context Sequence	(0040,0440)	3	
>>Content Item Modifier Sequence	(0040,0441)	3	
Performed Procedure Step ID	(0040,0253)	3	Removed
Performed Procedure Step Start Date	(0040,0244)	3	Removed
Performed Procedure Step Start Time	(0040,0245)	3	Removed
Performed Procedure Step Description	(0040,0254)	3	Removed
Performed Protocol Code Sequence	(0040,0260)	3	Removed
>Code Value	(0008,0100)	1C	

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>Code Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

**6.5.3.1.1 General Series Attribute Descriptions**

**6.5.3.1.1.1 Related Series Sequence**

This sequence is only present if Image Type(0008,0008) has NMQ\_STATE in value 4 (Refer to Section 6.5.5.1.1.3).

**6.5.4 Common Equipment Entity Modules**

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

**6.5.4.1 General Equipment Module**

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

**TABLE 6.5-5  
GENERAL EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Generated
Institution Name	(0008,0080)	3	Generated
Institution Address	(0008,0081)	3	Generated
Station Name	(0008,1010)	3	Generated
Institutional Department Name	(0008,1040)	3	Generated
Manufacturer's Model Name	(0008,1090)	3	Generated
Device Serial Number	(0018,1000)	3	Removed
Software Versions	(0018,1020)	3	Generated
Spatial Resolution	(0018,1050)	3	Removed
Date of Last Calibration	(0018,1200)	3	Removed
Time of Last Calibration	(0018,1201)	3	Removed
Pixel Padding Value	(0028,0120)	3	Removed

**6.5.5 Common Image Entity Modules**

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

**6.5.5.1 General Image Module**

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

**TABLE 6.5-6  
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Generated
Patient Orientation	(0020,0020)	2C	Generated. See 6.5.5.1.1.1

Image Date	(0008,0023)	2C	Empty. See 6.5.5.1.1.2
Image Time	(0008,0033)	2C	Empty. See 6.5.5.1.1.2
Image Type	(0008,0008)	3	Generated. See 6.5.5.1.1.3
Acquisition Number	(0020,0012)	3	Copied
Acquisition Date	(0008,0022)	3	Copied
Acquisition Time	(0008,0032)	3	Copied
Referenced Image Sequence	(0008,1140)	3	Copied
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Derivation Description	(0008,2111)	3	Generated Defined Terms: SCREEN CAPTURE NEUROMARQ PROCESSING
Source Image Sequence	(0008,2112)	3	Generated. See 6.5.5.1.1.4
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Images in Acquisition	(0020,1002)	3	Removed
Image Comments	(0020,4000)	3	Removed
Quality Control Image	(0028,0300)	3	Removed
Burned In Annotations	(0028,0301)	3	Generated The Defined Terms are: YES = Annotations burned in NO = Annotations not burned in
Lossy Image Compression Ratio	(0028,2112)	3	Removed 6.5.5.1.1.5
Lossy Image Compression	(0028,2110)	3	Removed

**6.5.5.1.1 General Image Attribute Descriptions**

**6.5.5.1.1.1 Patient Orientation**

Since Secondary Captures do not include the patient orientation, this field must be present. This field will be filled for 2D reformatted and 3D views, and will be empty (zero length) for other views.

The precision depth could be up to 3 characters, for example “LAF\FAR ”, but can be less if the view is oriented along a baseline, like “LFA” or “LAF ”.

**6.5.5.1.1.2 Image Date and Time**

When the application is saving a secondary capture:

- the condition to set these tags should be used if the image are temporally related, but is not clearly met for reformatted images ; anyway, since most AE will expect this tag to be present, we have decided to set this tag
- Application might set this content date to the time the reformatted image is created, but then might move away from the purpose of this date which is linked to the acquisition
- Application might set it to the original image date, but it does not make sense for reformatted images which are derived from several images

For these reasons, the application will set an empty tag to avoid possible ambiguities.



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**6.5.5.1.1.3 Image Type**

Value 1 has the following value:

- DERIVED identifies a Derived Image

Value 2 has the following value:

- SECONDARY identifies a Secondary Image

Value 3 has the following value:

- CAPTURE identifies Screen Capture Image

Value 4 has the following value:

- NMQ\_STATE identifies a 3D state SC Capture from NeuroMarQ

**6.5.5.1.1.4 Source Image Sequence**

When Image Type(0008,0008) has NMQ\_STATE in value 4 (Refer to Section 6.5.5.1.1.3), then this sequence will contain the instances for the images loaded into the application to create the save state.

**6.5.5.1.1.5 Lossy Image Compression**

The application does not use compression when saving images, nor does it decompress images. The application will ignore these tags.

**6.5.5.2 Image Pixel Module**

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

**TABLE 6.5-7  
IMAGE PIXEL MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Generated <ul style="list-style-type: none"> <li>• "1" for grayscale images</li> <li>• "3" for color images</li> </ul>
Photometric Interpretation	(0028,0004)	1	Generated <ul style="list-style-type: none"> <li>• "MONOCHROME2" or "MONOCHROME1" for grayscale images</li> <li>• "RGB" for color images</li> </ul>
Rows	(0028,0010)	1	Generated (256, 512, 1024)
Columns	(0028,0011)	1	Generated (256, 512, 1024)
Bits Allocated	(0028,0100)	1	Generated <ul style="list-style-type: none"> <li>• "16" for grayscale images</li> <li>• "8" for color images</li> </ul>
Bits Stored	(0028,0101)	1	Generated <ul style="list-style-type: none"> <li>• "16" for grayscale images</li> <li>• "8" for color images</li> </ul>
High Bit	(0028,0102)	1	Generated <ul style="list-style-type: none"> <li>• "15" for grayscale images</li> <li>• "7" for color images</li> </ul>
Pixel Representation	(0028,0103)	1	Generated <ul style="list-style-type: none"> <li>• "1" for grayscale images</li> <li>• "0" for color images</li> </ul>

Pixel Data	(7FE0,0010)	1	Used
Planar Configuration	(0028,0006)	1C	Generated <ul style="list-style-type: none"> <li>Removed for grayscale images</li> <li>“0” for color images</li> </ul>
Pixel Aspect Ratio	(0028,0034)	1C	Removed
Smallest Image Pixel Value	(0028,0106)	3	Removed
Largest Image Pixel Value	(0028,0107)	3	Removed
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Removed
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Removed
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Removed
Red Palette Color Lookup Table Data	(0028,1201)	1C	Removed
Green Palette Color Lookup Table Data	(0028,1202)	1C	Removed
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Removed

**6.5.6 Common Lookup Table Modules**

**6.5.6.1 VOI LUT module**

This section specifies the Attributes that describe the VOI LUT.

This module is not saved for color (“RGB”) images.

**TABLE 6.5-8  
VOI LUT MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
VOI LUT Sequence	(0028,3010)	3	Removed
>LUT Descriptor	(0028,3002)	1C	
>LUT Explanation	(0028,3003)	3	
>LUT Data	(0028,3006)	1C	
Window Center	(0028,1050)	3	Generated from the current value used in the saved view
Window Width	(0028,1051)	1C	Generated from the current value used in the saved view
Window Center & Width Explanation	(0028,1055)	3	Removed

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**6.5.6.2 Modality LUT module**

This section specifies the Attributes that describe the Modality LUT.

**This module is not saved for color (“RGB”) images.**

**TABLE 6.5-9  
MODALITY LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Modality LUT Sequence	(0028,3000)	3	Removed
>LUT Descriptor	(0028,3002)	1C	Specify values created or supported.
>LUT Explanation	(0028,3003)	3	
>Modality LUT Type	(0028,3004)	1C	Specify Defined Terms used: OD = Optical density US = Unspecified
>LUT Data	(0028,3006)	1C	
Rescale Intercept	(0028,1052)	1C	Generated
Rescale Slope	(0028,1053)	1C	Generated “1”
Rescale Type	(0028,1054)	1C	Generated <ul style="list-style-type: none"> <li>• “HU” for CT</li> <li>• “US” for other modalities</li> </ul>

**6.5.7 General Modules**

The SOP Common Module is mandatory for all DICOM IODs.

**6.5.7.1 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 6.5-10  
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Generated 1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	(0008,0018)	1	Generated To generate a unique ID, the process concatenates the Implementation Root UID, serial number, the process ID number, the timestamp and a counter incremented each time.
Specific Character Set	(0008,0005)	1C	Copied Only the “ISO_IR 100” character set is supported.
Instance Creation Date	(0008,0012)	3	Generated: current date
Instance Creation Time	(0008,0013)	3	Generated: current time
Instance Creator UID	(0008,0014)	3	Removed
Time zone Offset From UTC	(0008,0201)	3	Generated
Contributing Equipment Sequence	(0018,A001)	3	Generated

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>Purpose of Reference Code Sequence	(0040,A170)	1	Generated
>>Code Value	(0008,0100)	1C	
>>Coding Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	1C	
>Manufacturer	(0008,0070)	1	Copied
>Institution Name	(0008,0080)	3	Copied
>Institution Address	(0008,0081)	3	Copied
>Station Name	(0008,1010)	3	Copied
>Institutional Department Name	(0008,1040)	3	Copied
>Manufacturer's Model Name	(0008,1090)	3	Copied
>Device Serial Number	(0018,1000)	3	Copied
>Software Versions	(0018,1020)	3	Copied
>Spatial Resolution	(0018,1050)	3	Copied
>Date of Last Calibration	(0018,1200)	3	Copied
>Time of Last Calibration	(0018,1201)	3	Copied
>Contribution DateTime	(0018,A002)	3	Removed
>Contribution Description	(0018,A003)	3	Removed
Instance Number	(0020,0013)	3	Generated
SOP Instance Status	(0100,0410)	3	Removed
SOP Authorization Date and Time	(0100,0420)	3	Removed
SOP Authorization Comment	(0100,0414)	3	Removed
Authorization Equipment Certification Number	(0100,0416)	3	Removed

**6.5.8 SC Modules**

This Section describes SC Equipment, and Image Modules. These Modules contain Attributes that are specific to SC Image IOD.

**6.5.8.1 SC Equipment Module**

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

**TABLE 6.5-11  
SC IMAGE EQUIPMENT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	Generated: WSD = Workstation
Modality	(0008,0060)	3	Generated See 6.5.3.1 for Enumerated Values.
Secondary Capture Device ID	(0018,1010)	3	Generated from gethostname()
Secondary Capture Device Manufacturer	(0018,1016)	3	Generated "GE Healthcare"
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	3	Generated: the name of the application. <b>NeuroMarQ</b>
Secondary Capture Device Software Version	(0018,1019)	3	Generated: App Version "#.##-#α"
Video Image Format Acquired	(0018,1022)	3	Removed
Digital Image Format Acquired	(0018,1023)	3	Removed

**6.5.8.2 SC Image Module**

The table in this Section contains IOD Attributes that describe SC images.

**TABLE 6.5-12  
SC IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Date of Secondary Capture	(0018,1012)	3	Generated: current date
Time of Secondary Capture	(0018,1014)	3	Generated: current time

**6.6 SC PRIVATE DATA**

The processed results state of the application is saved in a SC image and is read only if the Image Type(0008,0008) has NMQ\_STATE in value 4 (Refer to Section 6.5.5.1.1.3).

The following private tags are used to save and restore the state of the application.

**TABLE 6.6-13  
SC PRIVATE DATA ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Private Group Creator	(0025,00xx)	3	Used / Generated defines the private group, GEMS_NMQSTATE_001
Software Version	(0025,xx50)	3	Used / Generated
Template Version	(0025,xx51)	3	Used / Generated

GRC Transformation	(0025,xx5a)	3	Used / Generated
MDx Transformation	(0025,xx5b)	3	Used / Generated
Reference Region	(0025,xx5c)	3	Used / Generated
Baseline Used	(0025,xx5d)	3	Used / Generated (YES, NO)
Baseline Data Transform	(0025,xx5e)	3	Used / Generated
Manual Reorientation Transform	(0025,xx5f)	3	Used / Generated
Loaded Volume Sequence	(0025,xx60)	3	Used / Generated
>Private Group Creator	(0025,00xx)	3	Used / Generated defines the private group, GEMS_NMQSTATE_001
>Volume Type	(0025,xx61)	3	Used / Generated PET           Source PET volume CT            Source CT volume MR            Source MR volume BASELINE    Baseline volume
>Referenced Study Description	(0025,xx62)	3	Used / Copied from source series
>Referenced Study Date Time	(0025,xx63)	3	Used / Copied from source series
>Referenced Series Description	(0025,xx64)	3	Used / Copied from source series
>Referenced Series Date Time	(0025,xx65)	3	Used / Copied from source series
>Referenced Study Instance UID	(0020,000D)	3	Used / Copied from source series
>Referenced Series Instance UID	(0020,000E)	3	Used / Copied from source series
>Referenced Instance Sequence	(0008,114A)	3	Used / Generated
>>Referenced SOP Class UID	(0008,1150)	3	Used / copied from source image instance
>>Referenced SOP Instance UID	(0008,1155)	3	Used / copied from source image instance

**TABLE 6.6-14  
DATA DICTIONARY FOR GROUP 25 PRIVATE ELEMENTS**

<b>Attribute Name</b>	<b>Tag</b>	<b>VR</b>	<b>VM</b>
Private Group Creator	(0025,00xx)	LO	1
Software Version	(0025,xx50)	LO	1
Template Version	(0025,xx51)	LO	1
GRC Transformation	(0025,xx5a)	ST	1
MDx Transformation	(0025,xx5b)	OB	1
Reference Region	(0025,xx5c)	LO	1
Baseline Used	(0025,xx5d)	CS	1
Baseline Data Transform	(0025,xx5e)	OB	1
Manual Reorientation Transform	(0025,xx5f)	ST	1
Loaded Volume Sequence	(0025,xx60)	SQ	1
>Private Group Creator	(0025,00xx)	LO	1
>Volume Type	(0025,xx61)	CS	1
>Referenced Study Description	(0025,xx62)	LO	1
>Referenced Study Date Time	(0025,xx63)	LO	1
>Referenced Series Description	(0025,xx64)	LO	1
>Referenced Series Date Time	(0025,xx65)	LO	1