GE Medical Systems

# Technical Publications

Direction 2328297-100
Revision 0

Volume Analysis 2
and its applications
CONFORMANCE STATEMENT
for DICOM V3.0

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TABLE OF CONTENTS

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

Section 3 (Media Storage Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Media Storage features.

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

Section 5 (MR Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a MR Information Object.

Section 6 (Nuclear Medicine Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a Nuclear Medicine Information Object.

Section 7 (Secondary Capture Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a Secondary Capture Information Object.

Section 8 (PET Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a PET Information Object.

Section 9 (3D Information Object Implementation), which specifies the GEMS equipment description of the private implementation of the 3D information Object.

1.2   **OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE**

The Documentation Structure of the GEMS Conformance Statements and their relationship with the DICOM v3.0 Conformance Statements is shown in the Illustration below.

ID/Net v3.0

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

APPLICATION ENTITY SPECIFICATION
(SERVICE CLASSES, INFORMATION OBJECTS, MESSAGE EXCHANGES, ETC.)

Product Implementation:

CT Advantage

MR Advantage

Volume Analysis 2 Conformance Statement Direction: 2328297-100 **+** AW 4.x Conformance Statement Direction: 2261302-100

...... Conformance Statement Direction: ......

DICOM STANDARD

Standard Specification:

DICOM V 3.0 Part 1

V 3.0 2

V 3.0 3

V 3.0 4

DICOM V 3.0 Part 13

This document specifies the DICOM v3.0 implementation. It is entitled:

> *Volume Analysis 2*
> *Conformance Statement for DICOM v3.0*
> *Direction 2328297-100*

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

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

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

The GEMS 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 v3.0 Part 8 standard.

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

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

> *ID/Net v3.0 Conformance Statements*
> *Direction: 2117016*

For more information regarding DICOM v3.0, copies of the Standard may be obtained by written request or phone by contacting:

> NEMA Publication
> 1300 North 17th Street
> Suite 1847
> Rosslyn, VA 22209
> USA
> Phone: (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 v3.0 Standards and with the terminology and concepts which are used in those Standards.

If readers are unfamiliar with DICOM v3.0 terminology they should first refer to the document listed below, then read the DICOM v3.0 Standard itself, prior to reading this DICOM Conformance Statement document.

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

1.4   SCOPE AND FIELD OF APPLICATION

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

The reader of this DICOM Conformance Statement should be aware that different GEMS devices are capable of using different Information Object Definitions. For example, a GEMS 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 GEMS implementation. If the user encounters unspecified private data elements while parsing a GEMS Data Set, the user is well advised to ignore those data elements (per the DICOM v3.0 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 GEMS devices.

1.5   IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM v3.0 Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

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

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

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

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM v3.0 Standard. DICOM v3.0 will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM v3.0 as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM v3.0. **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.

- **To be informed of the evolution of the implementation described in this document, the User is advised to regularly check the GE Internet Server, accessible via anonymous ftp (GE Internet Server Address: ftp.med.ge.com, 192.88.230.11).**

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

1.6   REFERENCES

A list of references which is applicable to all GEMS Conformance Statements is included in the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780.*

The information object implementation refers to DICOM PS 3.3 (Information Object Definition).

1.7   DEFINITIONS

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

1.8   SYMBOLS AND ABBREVIATIONS

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

1.9   TERMS DEFINITIONS

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

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

- **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 thee 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 Volume Analysis 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 constant, the tag will be absent from the data set if "Ignored" at load or possibly regenerated if "Used" at load

2. NETWORK CONFORMANCE STATEMENT

Volume Analysis 2 is a software application designed to be used on the Advantage Windows workstation. This means that networking and media storage features are inherited from this platform. Volume Analysis 2 uses DICOM images to reconstructs 3-dimensional volume. The views of 3-dimensional volumes displayed by the application are saved in DICOM format (Secondary Capture or modality reformatted images). These images can be loaded and displayed by other GEMS applications (such as the Image Viewer).

For a complete description of the networking conformance, refer to the AW 4.0 conformance statement, direction 2261302-100.

Besides, the complete information of a 3-dimensional volume can be saved in DICOM format (3D Model), creating thus a private DICOM Information Object. Such 3D Models can be loaded on Voxtool at a later date for follow-up processing

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 and post processed reformatted CT IODs written by the application (section 4),

- the DICOM MR IODs that are required to reconstruct a 3-dimensional volume and post processed reformatted MR IODs written by the application (section 5),

- the DICOM NM IODs that are required to reconstruct a 3-dimensional volume (section 6),

- the DICOM PET IODs that are required to reconstruct a 3-dimensional volume (section 7),

- the DICOM SC IODs written by the application (section 8),

- the DICOM 3D private IODs that are required to reconstruct a 3-dimensional volume and written by the application (section 9),

3. MEDIA STORAGE CONFORMANCE STATEMENT

Volume Analysis 2 is a software application designed to be used on the Advantage Windows workstation. This means that networking and media storage features are inherited from this platform. Volume Analysis 2 uses DICOM images to reconstructs 3-dimensional volume. The views of 3-dimensional volumes displayed by the application are saved in DICOM format (Secondary Capture or modality reformatted images). These images can be loaded and displayed by other GEMS applications (such as the Image Viewer).

For a complete description of the media storage conformance, refer to the AW 4.0 conformance statement, direction 2261302-100.

Besides, the complete information of a 3-dimensional volume can be saved in DICOM format (3D Model), creating thus a private DICOM Information Object. Such 3D Models can be loaded on Voxtool at a later date for follow-up processing

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 and post processed reformatted CT IODs written by the application (section 4),

- the DICOM MR IODs that are required to reconstruct a 3-dimensional volume and post processed reformatted MR IODs written by the application (section 5),

- the DICOM NM IODs that are required to reconstruct a 3-dimensional volume (section 6),

- the DICOM PET IODs that are required to reconstruct a 3-dimensional volume (section 7),

- the DICOM SC IODs written by the application (section 8),

- the DICOM 3D private IODs that are required to reconstruct a 3-dimensional volume and written by the application (section 9),

4. CT INFORMATION OBJECT IMPLEMENTATION

4.1   INTRODUCTION

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

4.2 - IOD Description

4.3 - IOD Entity-Relationship Model

4.4 - IOD Module Table

4.5 - IOD Module Definition

4.2   CT IOD IMPLEMENTATION

4.3   CT ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the CT Image interoperability schema is shown in Illustration 4.3-1. 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 Study for each Patient (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
CT IMAGE ENTITY RELATIONSHIP DIAGRAM
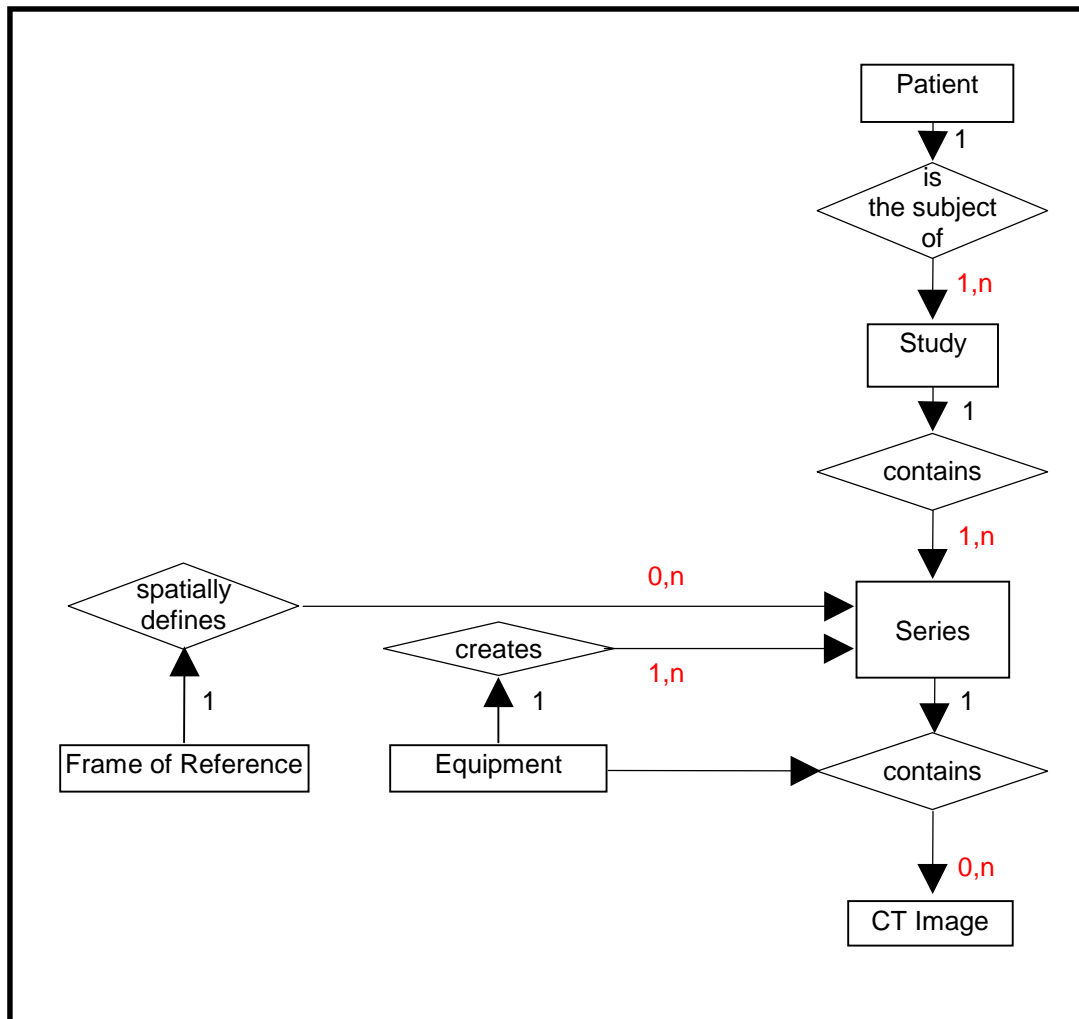
4.3.1 ENTITY DESCRIPTIONS

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

4.3.1.1   **Patient Entity Description**

4.3.1.2   **Study Entity Description**

4.3.1.3   **Series Entity Description**

4.3.1.4   **Equipment Entity Description**

4.3.1.5   **Frame of Reference Entity Description**

4.3.1.6   **CT Image Entity Description**

4.3.1.7   **Overlay Entity Description**

4.3.1.8   **VOI Lookup Table Entity Description**

4.3.2   **Volume Analysis 2 Mapping of DICOM entities**

TABLE 4.3-1
MAPPING OF DICOM ENTITIES TO VOLUME ANALYSIS 2 ENTITIES

DICOM	Volume Analysis 2 Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

4.4   **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 4.4-1 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 4.4-1
CT IMAGE IOD MODULES

Entity Name	Module Name	Reference
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	4.5.6.2
	Image Pixel	4.5.6.3
	Contrast/Bolus	4.5.6.4
	CT Image	4.5.10.1
	Overlay Plane	4.5.7.1
	VOI LUT	4.5.8.1
	SOP Common	4.5.9.1

4.5   **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 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 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).

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 / Copied
Patient ID	(0010,0020)	2	Used / Copied
Patient's Birth Date	(0010,0030)	2	Used / Copied
Patient's Sex	(0010,0040)	2	Used / Copied
Referenced Patient Sequence	(0008,1120)	3	Ignored / Copied
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Patient's Birth Time	(0010,0032)	3	Ignored / Copied
Other Patient IDs	(0010,1000)	3	Ignored / Copied
Other Patient Names	(0010,1001)	3	Ignored / Copied
Ethnic Group	(0010,2160)	3	Ignored / Copied
Patient Comments	(0010,4000)	3	Ignored / Copied

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 Module contain Attributes of the patient and study that are needed for diagnostic interpretation of the image.

4.5.2.1 **General Study Module**

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

TABLE 4.5-2
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Mandatory / Copied
Study Date	(0008,0020)	2	Used / Copied
Study Time	(0008,0030)	2	Used / Copied
Referring Physician's Name	(0008,0090)	2	Used / Copied
Study ID	(0020,0010)	2	Used / Copied
Accession Number	(0008,0050)	2	Used / Copied
Study Description	(0008,1030)	3	Used / Copied
Physician(s) of Record	(0008,1048)	3	Ignored / Copied
Name of Physician(s) Reading Study	(0008,1060)	3	Used / Copied
Referenced Study Sequence	(0008,1110)	3	Ignored / Copied
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	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

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

4.5.3   **Common Series Entity Modules**

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

4.5.3.1   **General Series Module**

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

<div align="center">

TABLE 4.5-4
GENERAL SERIES MODULE ATTRIBUTES

</div>

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Used / Copied Defined Terms: CT = Computed Tomography
Series Instance UID	(0020,000E)	1	Mandatory / Generated
Series Number	(0020,0011)	2	Used / Generated
Laterality	(0020,0060)	2C	Ignored / Generated: ""
Series Date	(0008,0021)	3	Used / Generated: current date
Series Time	(0008,0031)	3	Used / Generated: current time
Performing Physicians' Name	(0008,1050)	3	Used / Copied
Protocol Name	(0018,1030)	3	Ignored / Removed
Series Description	(0008,103E)	3	Used / Generated
Operators' Name	(0008,1070)	3	Used / Copied
Referenced Study Component Sequence	(0008,1111)	3	Ignored / Removed
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Body Part Examined	(0018,0015)	3	Ignored / Copied

Patient Position	(0018,5100)	2C	Used / Copied
			
			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 / Removed
Largest Pixel Value in Series	(0028,0109)	3	Ignored / Removed
Performed Procedure Step ID	(0040,0253)	3	Ignored / Removed
Performed Procedure Step Start Date	(0040,0244)	3	Ignored / Removed
Performed Procedure Step Start Time	(0040,0245)	3	Ignored / Removed
Performed Procedure Step Description	(0040,0254)	3	Ignored / Removed
Performed Action Item Sequence	(0040,0260)	3	Ignored / Removed

4.5.4   **Common Frame Of Reference Entity Modules**

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

4.5.4.1   **Frame Of Reference Module**

Images should share the same Frame Of Reference UID as a necessary conditions 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, the same patient name.

TABLE 4.5-5
FRAME OF REFERENCE MODULE ATTRIBUTES

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

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 which identify and describe the piece of equipment which produced a Series of Images.

As Voxtool can simulate the generation of an image by the scanner, we have chosen to copy this module, but to omit the fields that could be altered by the reformation

TABLE 4.5-6
GENERAL EQUIPMENT MODULE ATTRIBUTES

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

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 which identify and describe an image within a particular series.

TABLE 4.5-7
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Mandatory / Generated
Patient Orientation	(0020,0020)	2C	Ignored / Removed See 4.5.6.1.1.1
Image Date	(0008,0023)	2C	Used / Generated: current date
Image Time	(0008,0033)	2C	Used / Generated: current time
Image Type	(0008,0008)	3	Used / Generated. See 4.5.6.1.1.2.
Acquisition Number	(0020,0012)	3	Ignored / Copied if unique across source series
Acquisition Date	(0008,0022)	3	Used / Copied
Acquisition Time	(0008,0032)	3	Used / Copied
Referenced Image Sequence	(0008,1140)	3	Ignored / Copied
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Derivation Description	(0008,2111)	3	Ignored / Removed. See 4.5.6.1.1.3
Source Image Sequence	(0008,2112)	3	Ignored / Removed. See 4.5.6.1.1.3
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Images in Acquisition	(0020,1002)	3	Ignored / Removed
Image Comments	(0020,4000)	3	Ignored / Removed
Quality Control Image	(0028,0300)	3	Ignored / Removed
Burned In Annotations	(0028,0301)	3	Ignored / Removed
Lossy Image Compression	(0028,2110)	3	Used / Copied See 4.5.6.1.1.4.
Lossy Image Compression Ratio	(0028,2112)	3	Ignored / Copied

4.5.6.1.1   **General Image Attribute Descriptions**

4.5.6.1.1.1   **Patient Orientation**

> Since the coordinates of the image are always written, this field is never present in the created images.

4.5.6.1.1.2   Image Type

As an FSC, here are the values that may be sent.

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:

− REFORMATTED   identifies a Reformatted Image

Value 4, if defined, can have the following values:

− MIP   identifies a thick Maximum Intensity Projection Image

− MIN IP   identifies a thick Minimum Intensity Projection Image

− AVERAGE   identifies a thick Average Image

− VOLREN   identifies a thick Volume Rendered Image

4.5.6.1.1.3   Derivation Description and Source Image Sequence

These tags are not yet used.

4.5.6.1.1.4   Lossy Image Compression

Volume Analysis does not use compression when saving images, nor it decompress images. So this field is just copied.

4.5.6.2   Image Plane Module

This section specifies the Attributes which 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 / Generated
Image Orientation (Patient)	(0020,0037)	1	Mandatory / Generated
Image Position (Patient)	(0020,0032)	1	Mandatory / Generated
Slice Thickness	(0018,0050)	2	Used / Generated
Slice Location	(0020,1041)	3	Ignored / Removed

4.5.6.3   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") / Generated "1
Photometric Interpretation	(0028,0004)	1	Ignored (expect "MONOCHROME2") / Generated "MONOCHROME2"

Rows	(0028,0010)	1	Mandatory (expect from 256 to 1024) / Generated (256, 512, 1024)
Columns	(0028,0011)	1	Mandatory (expect from 256 to 1024) / Generated (256, 512, 1024)
Bits Allocated	(0028,0100)	1	Ignored (expect "16") / Generated "16"
Bits Stored	(0028,0101)	1	Ignored (expect "16") / Generated "16"
High Bit	(0028,0102)	1	Ignored (expect "15") / Generated "15"
Pixel Representation	(0028,0103)	1	Ignored (expect "1") / Generated "1"
Pixel Data	(7FE0,0010)	1	
Planar Configuration	(0028,0006)	1C	Ignored / Removed (see Samples per Pixels)
Pixel Aspect Ratio	(0028,0034)	1C	Ignored / Removed (Image Plane is mandatory for CT)
Smallest Image Pixel Value	(0028,0106)	3	Ignored / Removed
Largest Image Pixel Value	(0028,0107)	3	Ignored / Removed
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Ignored / Removed
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Ignored / Removed
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Ignored / Removed
Red Palette Color Lookup Table Data	(0028,1201)	1C	Ignored / Removed
Green Palette Color Lookup Table Data	(0028,1202)	1C	Ignored / Removed
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Ignored / Removed

4.5.6.4 Contrast/Bolus Module

This section specifies the Attributes that describe the contrast /bolus used in the acquisition of the Image.

4.5.6.4.1 Contrast annotation mark (+c)

The "+c" annotation appears if a contrast agent is present ((0018,0010) in the data set) and the Contrast/Bolus Route contains "IV" or something different than "Oral". This means that if the Contrast/Bolus Route contains "Oral", the "+c" annotation will not appear.

TABLE 4.5-10
CONTRAST/BOLUS MODULE ATTRIBUTES

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

4.5.7   **Common Overlay Modules**

4.5.7.1   **Overlay plane module**

This section contains Attributes that describe characteristics of an Overlay Plane.

This module is not currently supported by Voxtool products and will be ignored.

TABLE 4.5-11
OVERLAY PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Overlay Rows	(60xx,0010)	1	Module Unsupported
Overlay Columns	(60xx,0011)	1	Module Unsupported
Overlay Type	(60xx,0040)	1	Module Unsupported
Origin	(60xx,0050)	1	Module Unsupported
Overlay Bits Allocated	(60xx,0100)	1	Module Unsupported
Bit Position	(60xx,0102)	1	Module Unsupported
Overlay Data	(60xx,3000)	1C	Module Unsupported
Overlay Description	(60xx,0022)	3	Module Unsupported
Overlay Subtype	(60xx,0045)	3	Module Unsupported
Overlay Label	(60xx,1500)	3	Module Unsupported
ROI Area	(60xx,1301)	3	Module Unsupported
ROI Mean	(60xx,1302)	3	Module Unsupported
ROI Standard Deviation	(60xx,1303)	3	Module Unsupported
Overlay Descriptor - Gray	(60xx,1100)	3	Module Unsupported
Overlay Descriptor - Red	(60xx,1101)	3	Module Unsupported
Overlay Descriptor - Green	(60xx,1102)	3	Module Unsupported
Overlay Descriptor - Blue	(60xx,1103)	3	Module Unsupported
Overlays - Gray	(60xx,1200)	3	Module Unsupported
Overlays - Red	(60xx,1201)	3	Module Unsupported
Overlays - Green	(60xx,1202)	3	Module Unsupported
Overlays - Blue	(60xx,1203)	3	Module Unsupported

4.5.8   **Common Lookup Table Modules**

4.5.8.1   **VOI LUT module**

This section specifies the Attributes that describe the VOI LUT.

TABLE 4.5-12
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	3	Ignored / Removed
>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). At save, Generated from the current value used in the saved view.
Window Width	(0028,1051)	1C	Ignored at load (an automatic W/L is computed on the whole series). At save, Generated from the current value used in the saved view.
Window Center & Width Explanation	(0028,1055)	3	Ignored / Removed

4.5.9 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

4.5.9.1 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 4.5-13
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used / Generated
SOP Instance UID	(0008,0018)	1	Ignored / 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	Used / Copied Only the "ISO_IR 100" character sets is supported.
Instance Creation Date	(0008,0012)	3	Ignored / Generated: current date
Instance Creation Time	(0008,0013)	3	Ignored / Generated: current time
Instance Creator UID	(0008,0014)	3	Ignored / Removed
Time zone Offset From UTC	(0008,0014)	3	Ignored / Removed
Instance Number	(0020,0013)	3	Used / Generated
SOP Instance Status	(0100,0410)	3	Ignored / Removed
SOP Authorization Date and Time	(0100,0420)	3	Ignored / Removed
SOP Authorization Comment	(0100,0414)	3	Ignored / Removed
Authorization Equipment Certification Number	(0100,0416)	3	Ignored / Removed

4.5.10 **CT Modules**

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

4.5.10.1 **CT Image Module**

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

TABLE 4.5-14
CT IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	See 4.5.10.1.1.1.
Samples per Pixel	(0028,0002)	1	Shall be 1.
Photometric Interpretation	(0028,0004)	1	Ignored (expect "MONOCHROME2") / Generated (write "MONOCHROME2")
Bits Allocated	(0028,0100)	1	Shall be 16.
Bits Stored	(0028,0101)	1	Ignored (expect 16) / Generated (write 16)
High Bit	(0028,0102)	1	Ignored (expect 15) / Generated (write 15)
Rescale Intercept	(0028, 1052)	1	Used (default to –1024 if not found) / Generated
Rescale Slope	(0028,1053)	1	Used / Generated (write 1)
KVP	(0018,0060)	2	Used / Copied
Acquisition Number	(0020,0012)	2	Ignored / Copied
Scan Options	(0018,0022)	3	Used / Copied
Data Collection Diameter	(0018,0090)	3	Used / Copied
Reconstruction Diameter	(0018,1100)	3	Ignored / Generated
Distance Source to Detector	(0018,1110)	3	Ignored / Copied
Distance Source to Patient	(0018,1111)	3	Ignored / Copied
Gantry/Detector Tilt	(0018,1120)	3	Used / Copied
Table Height	(0018,1130)	3	Ignored / Copied
Rotation Direction	(0018,1140)	3	Ignored / Copied
Exposure Time	(0018,1150)	3	Used / Copied
X-ray Tube Current	(0018,1151)	3	Used / Copied
Exposure	(0018,1152)	3	Ignored / Copied
Exposure in µAs	(0018,1152)	3	Ignored / Copied
Filter Type	(0018,1160)	3	Ignored / Copied
Generator Power	(0018,1170)	3	Ignored / Copied
Focal Spot	(0018,1190)	3	Ignored / Copied
Convolution Kernel	(0018,1210)	3	Used / Copied

4.5.10.1.1   CT Image Attribute Descriptions

4.5.10.1.1.1   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:

- REFORMATTED   identifies a Reformatted Image

Value 4, if defined, indicates that the image has a slice thickness superior to the pixel size; the rendering algorithm over the thickness can have the following values:

- MIP   identifies a thick Maximum Intensity Projection Image
- MIN IP   identifies a thick Minimum Intensity Projection Image
- AVERAGE   identifies a thick Average Image
- VOLREN   identifies a thick Volume Rendered Image

ILLUSTRATION 4.5-1
CT IMAGE TYPE DECISION TREE
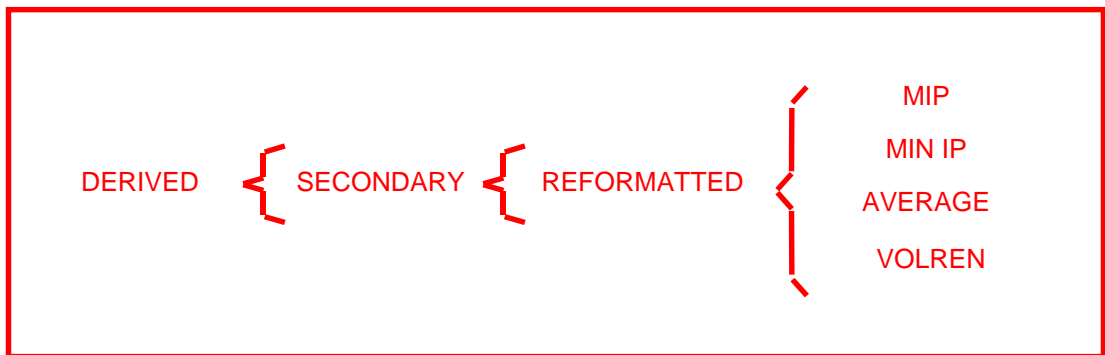
4.6   PRIVATE DATA

In the case of a GE image (manufacturer 0008,0070 starts with GE MEDICAL SYSTEMS), the following private groups are copied:

0x9, 0x19, 0x21, 0x23, 0x27, 0x43, 0x45

This should ensure that these images can be pushed back on GE non DICOM native consoles.

5. MR INFORMATION OBJECT IMPLEMENTATION

5.1 INTRODUCTION

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

5.2 - IOD Description

5.3 - IOD Entity-Relationship Model

5.4 - IOD Module Table

5.5 - IOD Module Definition

5.2 MR IOD IMPLEMENTATION

5.3 MR ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the MR Image interoperability schema is shown in Illustration 5.3-1. 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 Study for each Patient (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
MR IMAGE ENTITY RELATIONSHIP DIAGRAM
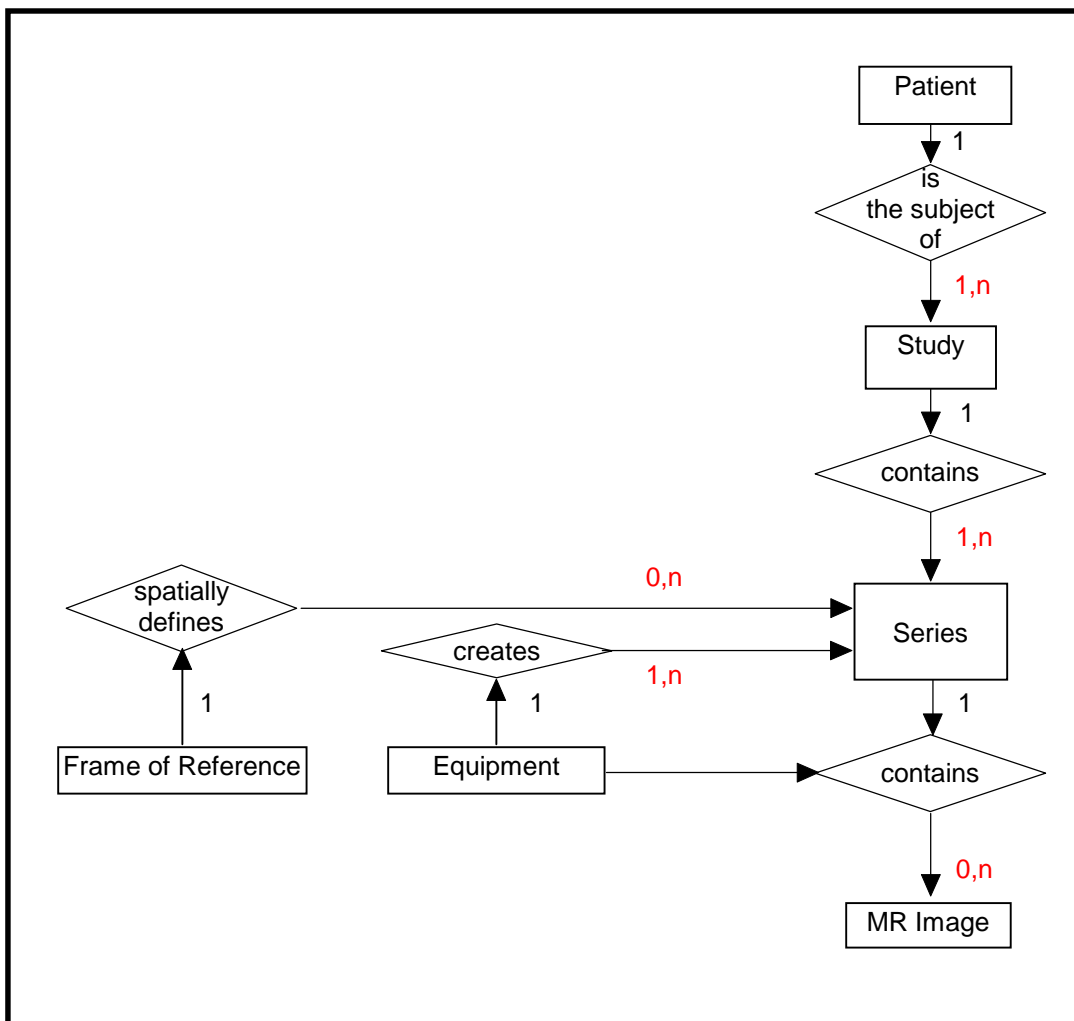
5.3.1 ENTITY DESCRIPTIONS

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

5.3.1.1   Patient Entity Description

5.3.1.2   Study Entity Description

5.3.1.3   Series Entity Description

5.3.1.4   Equipment Entity Description

5.3.1.5   Frame of Reference Entity Description

5.3.1.6   MR Image Entity Description

5.3.1.7   Overlay Entity Description

5.3.1.8   VOI Lookup Table Entity Description

5.3.2   Volume Analysis 2 Mapping of DICOM entities

TABLE 5.3-1
MAPPING OF DICOM ENTITIES TO VOLUME ANALYSIS 2 ENTITIES

DICOM	Volume Analysis 2 Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

5.4   IOD MODULE TABLE

Within an entity of the DICOM v3.0 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 5.4-1 identifies the defined modules within the entities which comprise the DICOM v3.0 MR IOD. Modules are identified by Module Name.

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

TABLE 5.4-1
MR 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
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	5.5.6.3
	Contrast/Bolus	5.5.6.4
	MR Image	5.5.10.1
	Overlay Plane	5.5.7.1
	VOI LUT	5.5.8.1
	SOP Common	5.5.9.1

5.5   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 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 from. It should be noted that they are the same ones as defined in the DICOM v3.0 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

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

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 Module contain Attributes of the patient and study that are needed for diagnostic interpretation of the image.

5.5.2.1   **General Study Module**

This section specifies the Attributes which 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 / Copied
Study Date	(0008,0020)	2	Used / Copied
Study Time	(0008,0030)	2	Used / Copied
Referring Physician's Name	(0008,0090)	2	Used / Copied
Study ID	(0020,0010)	2	Used / Copied
Accession Number	(0008,0050)	2	Used / Copied
Study Description	(0008,1030)	3	Used / Copied
Physician(s) of Record	(0008,1048)	3	Ignored / Copied
Name of Physician(s) Reading Study	(0008,1060)	3	Used / Copied
Referenced Study Sequence	(0008,1110)	3	Ignored / Copied
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	

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 / Copied
Patient's Age	(0010,1010)	3	Used / Copied
Patient's Size	(0010,1020)	3	Ignored / Copied
Patient's Weight	(0010,1030)	3	Used / Copied
Occupation	(0010,2180)	3	Ignored / Copied
Additional Patient's History	(0010,21B0)	3	Used / Copied

5.5.3   **Common Series Entity Modules**

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

5.5.3.1   **General Series Module**

> This section specifies the Attributes which 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 / Copied Defined Terms: MR = Magnetic Resonance
Series Instance UID	(0020,000E)	1	Mandatory / Generated
Series Number	(0020,0011)	2	Used / Generated
Laterality	(0020,0060)	2C	Ignored / Generated: ""
Series Date	(0008,0021)	3	Used / Generated: current date
Series Time	(0008,0031)	3	Used / Generated: current time
Performing Physicians' Name	(0008,1050)	3	Used / Copied
Protocol Name	(0018,1030)	3	Ignored / Removed
Series Description	(0008,103E)	3	Used / Generated
Operators' Name	(0008,1070)	3	Used / Copied
Referenced Study Component Sequence	(0008,1111)	3	Ignored / Removed
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Body Part Examined	(0018,0015)	3	Ignored / Copied

Patient Position	(0018,5100)	2C	Used / Copied
			
			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 / Removed
Largest Pixel Value in Series	(0028,0109)	3	Ignored / Removed
Performed Procedure Step ID	(0040,0253)	3	Ignored / Removed
Performed Procedure Step Start Date	(0040,0244)	3	Ignored / Removed
Performed Procedure Step Start Time	(0040,0245)	3	Ignored / Removed
Performed Procedure Step Description	(0040,0254)	3	Ignored / Removed
Performed Action Item Sequence	(0040,0260)	3	Ignored / Removed

5.5.4   Common Frame Of Reference Entity Modules

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

5.5.4.1   Frame Of Reference Module

Images should share the same Frame Of Reference UID as a necessary conditions 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, the same patient name.

TABLE 5.5-5
FRAME OF REFERENCE MODULE ATTRIBUTES

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

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 which identify and describe the piece of equipment which produced a Series of Images.

TABLE 5.5-6
GENERAL EQUIPMENT MODULE ATTRIBUTES

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

5.5.6   Common Image Entity Modules

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

5.5.6.1   General Image Module

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

TABLE 5.5-7
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Mandatory / Generated
Patient Orientation	(0020,0020)	2C	Ignored / Removed. See 5.5.6.1.1.1
Image Date	(0008,0023)	2C	Used / Generated: current date
Image Time	(0008,0033)	2C	Used / Generated: current time
Image Type	(0008,0008)	3	Used / Generated. See 5.5.6.1.1.2
Acquisition Number	(0020,0012)	3	Ignored / Copied
Acquisition Date	(0008,0022)	3	Used / Copied
Acquisition Time	(0008,0032)	3	Used / Copied
Referenced Image Sequence	(0008,1140)	3	Ignored / Copied
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Derivation Description	(0008,2111)	3	Ignored / Removed. See 5.5.6.1.1.3
Source Image Sequence	(0008,2112)	3	Ignored / Removed. See 5.5.6.1.1.3
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Images in Acquisition	(0020,1002)	3	Ignored / Removed
Image Comments	(0020,4000)	3	Ignored / Removed
Quality Control Image	(0028,0300)	3	Ignored / Removed
Burned In Annotations	(0028,0301)	3	Ignored / Removed
Lossy Image Compression	(0028,2110)	3	Used / Copied. See 5.5.6.1.1.4
Lossy Image Compression Ratio	(0028,2110)	3	Ignored / Copied

5.5.6.1.1   General Image Attribute Descriptions

5.5.6.1.1.1   Patient Orientation

Since the coordinates of the image are always present, this field is never used

5.5.6.1.1.2   Image Type

As an FSC, here are the values that may be sent.

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:

   – REFORMATTED   identifies a Reformatted Image

Value 4, if defined, can have the following values:

   – MIP   identifies a thick Maximum Intensity Projection Image

   – MIN IP   identifies a thick Minimum Intensity Projection Image

   – AVERAGE   identifies a thick Average Image

   – VOLREN   identifies a thick Volume Rendered Image

5.5.6.1.1.3   Derivation Description and Source Image Sequence

These tags are not yet used.

5.5.6.1.1.4   Lossy Image Compression

Volume Analysis does not use compression when saving images, nor it decompress images. So this field is just copied.

5.5.6.2   Image Plane Module

This section specifies the Attributes which 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 / Generated
Image Orientation (Patient)	(0020,0037)	1	Mandatory / Generated
Image Position (Patient)	(0020,0032)	1	Mandatory / Generated
Slice Thickness	(0018,0050)	2	Used / Generated
Slice Location	(0020,1041)	3	Ignored / Removed

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") / Generated "1"
Photometric Interpretation	(0028,0004)	1	Ignored (expect "MONOCHROME2") / Generated "MONOCHROME2"
Rows	(0028,0010)	1	Mandatory (expect from 256 to 1024) / Generated (256, 512, 1024)
Columns	(0028,0011)	1	Mandatory (expect from 256 to 1024) / Generated (256, 512, 1024)
Bits Allocated	(0028,0100)	1	Ignored (expect "16") / Generated "16"
Bits Stored	(0028,0101)	1	Ignored (expect "16") / Generated "16"
High Bit	(0028,0102)	1	Ignored (expect "15") / Generated "15"
Pixel Representation	(0028,0103)	1	Ignored (expect "1") / Generated "1"

Pixel Data	(7FE0,0010)	1	
Planar Configuration	(0028,0006)	1C	Ignored / Removed (see Samples per Pixels)
Pixel Aspect Ratio	(0028,0034)	1C	Ignored / Removed (Image Plane is mandatory for MR)
Smallest Image Pixel Value	(0028,0106)	3	Used / Removed
Largest Image Pixel Value	(0028,0107)	3	Used / Removed
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Ignored / Removed
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Ignored / Removed
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Ignored / Removed
Red Palette Color Lookup Table Data	(0028,1201)	1C	Ignored / Removed
Green Palette Color Lookup Table Data	(0028,1202)	1C	Ignored / Removed
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Ignored / Removed

5.5.6.4 Contrast/Bolus Module

5.5.6.4.1 Contrast annotation mark (+c)

The "+c" annotation appears if a contrast agent is present ((0018,0010) in the data set) and the Contrast/Bolus Route contains "IV" or something different than "Oral". This means that if the Contrast/Bolus Route contains "Oral", the "+c" annotation will not appear.

TABLE 5.5-10
CONTRAST/BOLUS MODULE ATTRIBUTES

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

5.5.7   Common Overlay Modules

5.5.7.1   Overlay plane module

This section contains Attributes that describe characteristics of an Overlay Plane.

This module is not currently supported by Voxtool products and will be ignored.

TABLE 5.5-11
OVERLAY PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Overlay Rows	(60xx,0010)	1	Module Unsupported
Overlay Columns	(60xx,0011)	1	Module Unsupported
Overlay Type	(60xx,0040)	1	Module Unsupported
Origin	(60xx,0050)	1	Module Unsupported
Overlay Bits Allocated	(60xx,0100)	1	Module Unsupported
Bit Position	(60xx,0102)	1	Module Unsupported
Overlay Data	(60xx,3000)	1C	Module Unsupported
Overlay Description	(60xx,0022)	3	Module Unsupported
Overlay Subtype	(60xx,0045)	3	Module Unsupported
Overlay Label	(60xx,1500)	3	Module Unsupported
ROI Area	(60xx,1301)	3	Module Unsupported
ROI Mean	(60xx,1302)	3	Module Unsupported
ROI Standard Deviation	(60xx,1303)	3	Module Unsupported
Overlay Descriptor - Gray	(60xx,1100)	3	Module Unsupported
Overlay Descriptor - Red	(60xx,1101)	3	Module Unsupported
Overlay Descriptor - Green	(60xx,1102)	3	Module Unsupported
Overlay Descriptor - Blue	(60xx,1103)	3	Module Unsupported
Overlays - Gray	(60xx,1200)	3	Module Unsupported
Overlays - Red	(60xx,1201)	3	Module Unsupported
Overlays - Green	(60xx,1202)	3	Module Unsupported
Overlays - Blue	(60xx,1203)	3	Module Unsupported

5.5.8   Common Lookup Table Modules

5.5.8.1   VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

TABLE 5.5-12
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	3	Ignored / Removed
>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). At save, Generated from the current value used in the saved view.
Window Width	(0028,1051)	1C	Ignored at load (an automatic W/L is computed on the whole series). At save, Generated from the current value used in the saved view.
Window Center & Width Explanation	(0028,1055)	3	Ignored / Removed

5.5.9   General Modules

The SOP Common Module is mandatory for all DICOM IODs.

5.5.9.1   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 5.5-13
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used / Generated
SOP Instance UID	(0008,0018)	1	Ignored / 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	Used / Copied Only the "ISO_IR 100" character sets is supported.
Instance Creation Date	(0008,0012)	3	Ignored / Generated: current date
Instance Creation Time	(0008,0013)	3	Ignored / Generated: current time
Instance Creator UID	(0008,0014)	3	Ignored / Removed
Time zone Offset From UTC	(0008,0014)	3	Ignored / Removed
Instance Number	(0020,0013)	3	Used / Generated
SOP Instance Status	(0100,0410)	3	Ignored / Removed
SOP Authorization Date and Time	(0100,0420)	3	Ignored / Removed
SOP Authorization Comment	(0100,0414)	3	Ignored / Removed
Authorization Equipment Certification Number	(0100,0416)	3	Ignored / Removed

5.5.10   **MR Modules**

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

5.5.10.1   **MR Image Module**

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

TABLE 5.5-14
MR IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	See 5.5.10.1.1.1.
Samples per Pixel	(0028,0002)	1	Shall be 1.
Photometric Interpretation	(0028,0004)	1	Ignored (expect "MONOCHROME2") / Generated (write "MONOCHROME2")
Bits Allocated	(0028,0100)	1	Shall be 16.
Scanning Sequence	(0018,0020)	1	Used / Copied
Sequence Variant	(0018,0021)	1	Used / Copied
Scan Options	(0018,0022)	2	Used / Copied
MR Acquisition Type	(0018,0023)	2	Used / Copied
Repetition Time	(0018,0080)	2C	Used / Copied
Echo Time	(0018,0081)	2	Used / Copied
Echo Train Length	(0018,0091)	2	Used / Copied
Inversion Time	(0018,0082)	2C	Used / Copied
Trigger Time	(0018,1060)	2C	Used / Copied
Sequence Name	(0018,0024)	3	Ignored / Copied
Angio Flag	(0018,0025)	3	Ignored / Copied
Number of Averages	(0018,0083)	3	Used / Copied
Imaging Frequency	(0018,0084)	3	Used / Copied
Imaged Nucleus	(0018,0085)	3	Ignored / Copied
Echo Number	(0018,0086)	3	Used / Copied
Magnetic Field Strength	(0018,0087)	3	Used / Copied
Spacing Between Slices	(0018,0088)	3	Ignored / Removed
Number of Phase Encoding Steps	(0018,0089)	3	Ignored / Copied
Percent Sampling	(0018,0093)	3	Used / Copied
Percent Phase Field of View	(0018,0094)	3	Ignored / Copied
Pixel Bandwidth	(0018,0095)	3	Used / Copied
Nominal Interval	(0018,1062)	3	Ignored / Copied
Beat Rejection Flag	(0018,1080)	3	Ignored / Copied
Low R-R Value	(0018,1081)	3	Ignored / Copied
High R-R Value	(0018,1082)	3	Ignored / Copied
Intervals Acquired	(0018,1083)	3	Ignored / Copied
Intervals Rejected	(0018,1084)	3	Ignored / Copied
PVC Rejection	(0018,1085)	3	Ignored / Copied

Skip Beats	(0018,1086)	3	Ignored / Copied
Heart Rate	(0018,1088)	3	Ignored / Copied
Cardiac Number of Images	(0018,1090)	3	Used / Copied
Trigger Window	(0018,1094)	3	Ignored / Copied
Reconstruction Diameter	(0018,1100)	3	Ignored / Generated
Receiving Coil	(0018,1250)	3	Used / Copied
Transmitting Coil	(0018,1251)	3	Ignored / Copied
Acquisition Matrix	(0018,1310)	3	Used / Copied
Phase Encoding Direction	(0018,1312)	3	Ignored / Copied
Flip Angle	(0018,1314)	3	Used / Copied
SAR	(0018,1316)	3	Ignored / Copied
Variable Flip Angle Flag	(0018,1315)	3	Ignored / Copied
dB/dt	(0018,1318)	3	Ignored / Copied
Temporal Position Identifier	(0020,0100)	3	Ignored / Removed
Number of Temporal Positions	(0020,0105)	3	Ignored / Removed
Temporal Resolution	(0020,0110)	3	Ignored / Removed

5.5.10.1.1   MR Image Attribute Descriptions

5.5.10.1.1.1   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:

    − PJN   identifies a MIP reconstructed image

    − REFORMATTED   identifies a Multi Planar Reformatted Image

    PJN is the same than PROJECTION IMAGE, and REFORMATTED is the same than MPR, but it kept in order to ensure the image can be pushed on old GE MR system.

Value 4, if defined, indicates that the image has a slice thickness superior to the pixel size; the rendering algorithm over the thickness can have the following values:

    − MIP   identifies a thick Maximum Intensity Projection Image

    − MIN IP   identifies a thick Minimum Intensity Projection Image

    − AVERAGE   identifies a thick Average Image

    − VOLREN   identifies a thick Volume Rendered Image

ILLUSTRATION 5.5-1
MR IMAGE TYPE DECISION TREE

DERIVED { SECONDARY { REFORMATTED { MIP
MIN IP
AVERAGE
VOLREN
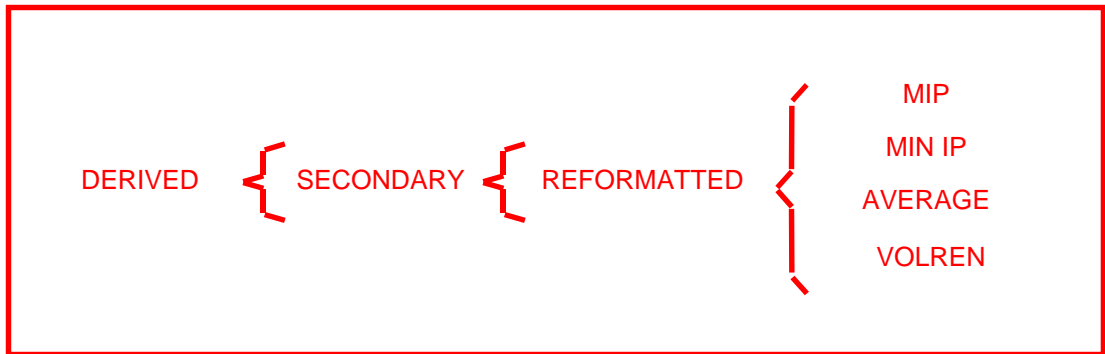
5.6   **PRIVATE DATA DICTIONARY**

In the case of a GE image (manufacturer 0008,0070 starts with GE MEDICAL SYSTEMS), the following private groups are copied:

0x9, 0x11, 0x19, 0x21, 0x23, 0x25, 0x27, 0x29, 0x43

This should ensure that these images can be pushed back on GE non DICOM native consoles.

6. NUCLEAR MEDICINE (NM) INFORMATION OBJECT IMPLEMENTATION

6.1   INTRODUCTION

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

6.2 - IOD Description

6.3 - IOD Entity-Relationship Model

6.4 - IOD Module Table

6.5 - IOD Module Definition

6.2   NM IOD IMPLEMENTATION

6.3   NM ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the NM 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 Study for each Patient (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
NM IMAGE ENTITY RELATIONSHIP DIAGRAM
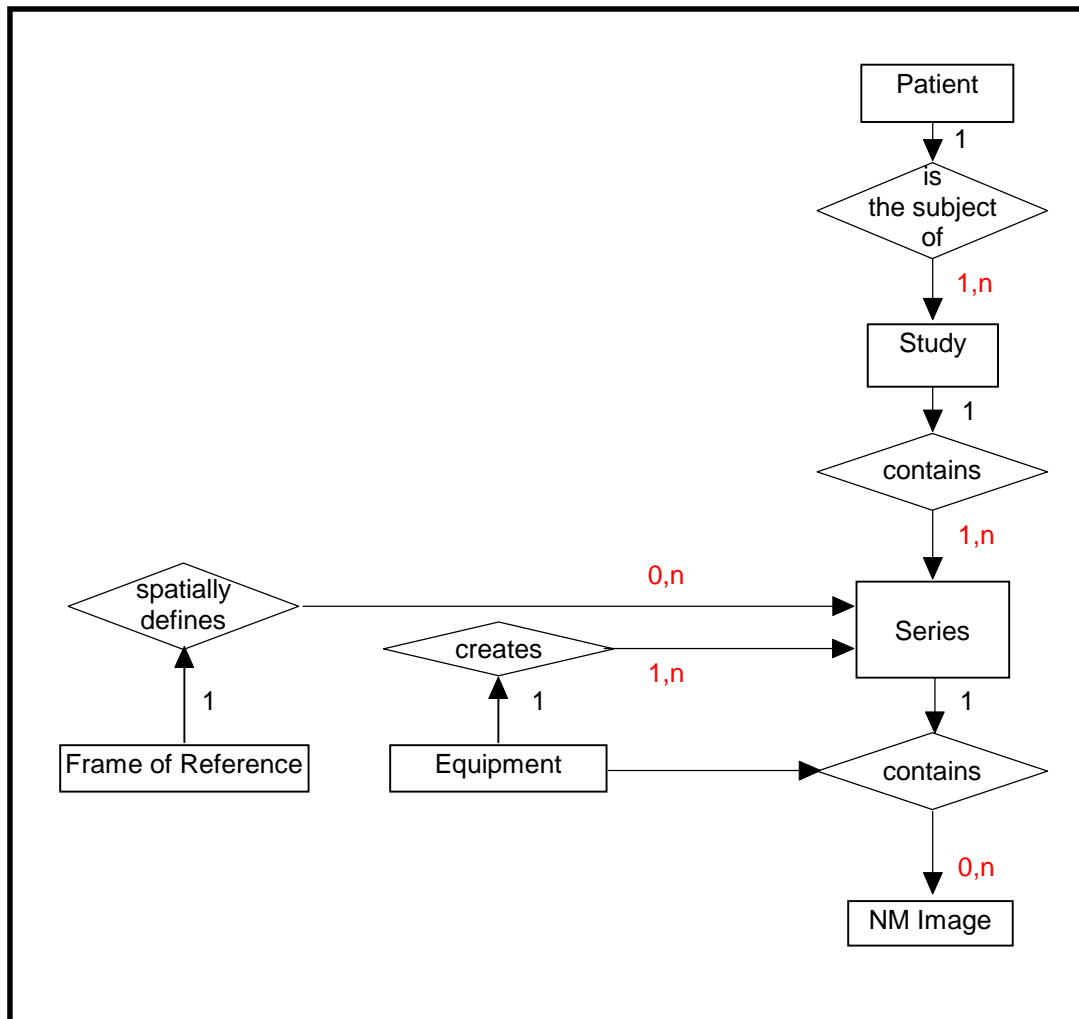
6.3.1 ENTITY DESCRIPTIONS

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

6.3.1.1 **Patient Entity Description**

6.3.1.2 **Study Entity Description**

6.3.1.3 **Series Entity Description**

6.3.1.4 **Equipment Entity Description**

6.3.1.5 **Frame of Reference Entity Description**

6.3.1.6 **NM Image Entity Description**

6.3.1.7 **Overlay Entity Description**

6.3.1.8 **VOI Lookup Table Entity Description**

6.3.1.9 **Curve Entity Description**

6.3.2 **Volume Analysis 2 Mapping of DICOM entities**

TABLE 6.3-1
MAPPING OF DICOM ENTITIES TO VOLUME ANALYSIS 2 ENTITIES

DICOM	Volume Analysis 2 Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

TABLE 6.3-2
MAPPING OF DICOM ENTITIES TO VOLUME ANALYSIS 2 ENTITIES

DICOM	Volume Analysis 2 Entity
Patient	Exam
Study	Exam
Series	Exam
Image	Series
Frame	Image

6.4 **IOD MODULE TABLE**

Within an entity of the DICOM v3.0 NM 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 NM IOD. Modules are identified by Module Name.

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

TABLE 6.4-1
NM IMAGE IOD MODULES

Entity Name	Module Name	Reference
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
	NM Series	6.5.11.1
Frame of Reference	Frame of Reference	6.5.4.1
Equipment	General Equipment	6.5.5.1
Image	General Image	6.5.6.1
	Image Pixel	6.5.6.2
	NM Image Pixel	6.5.11.2
	Multi-frame	6.5.6.3
	NM Multi-frame	6.5.11.3
	NM Image	6.5.11.4
	NM Isotope	6.5.11.5
	NM Detector	6.5.11.6
	NM TOMO Acquisition	6.5.11.7
	NM Multi-gated Acquisition	6.5.11.8
	NM Phase	6.5.11.9
	NM Reconstruction	6.5.11.10
	Overlay Plane	6.5.7.1
	Multi-frame Overlay	6.5.7.2
	Curve	6.5.8.1
	VOI LUT	6.5.9.1
	SOP Common	6.5.10.1

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 NM Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

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

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Used
Patient ID	(0010,0020)	2	Used
Patient's Birth Date	(0010,0030)	2	Used
Patient's Sex	(0010,0040)	2	Used
Referenced Patient Sequence	(0008,1120)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Patient's Birth Time	(0010,0032)	3	Ignored
Other Patient IDs	(0010,1000)	3	Ignored
Other Patient Names	(0010,1001)	3	Ignored
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.

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	Mandatory
Study Date	(0008,0020)	2	Used
Study Time	(0008,0030)	2	Used
Referring Physician's Name	(0008,0090)	2	Used
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	Used
Referenced Study Sequence	(0008,1110)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	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	Ignored
Patient's Age	(0010,1010)	3	Used
Patient's Size	(0010,1020)	3	Ignored
Patient's Weight	(0010,1030)	3	Used
Occupation	(0010,2180)	3	Ignored
Additional Patient's History	(0010,21B0)	3	Used

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

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Used Defined Terms: NM = Nuclear Medicine
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	Used
Protocol Name	(0018,1030)	3	Ignored
Series Description	(0008,103E)	3	Used
Operators' Name	(0008,1070)	3	Used
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	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
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

6.5.4   Common Frame Of Reference Entity Modules

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

6.5.4.1   Frame Of Reference Module

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

Since NM objects are multi frame, all the frames share automatically the same Frame Of Reference.

TABLE 6.5-5
FRAME OF REFERENCE MODULE ATTRIBUTES

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

6.5.5   Common Equipment Entity Modules

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

6.5.5.1   General Equipment Module

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

TABLE 6.5-6
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	Used
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

6.5.6 **Common Image Entity Modules**

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

6.5.6.1 **General Image Module**

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

TABLE 6.5-7
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Mandatory
Patient Orientation	(0020,0020)	2C	Ignored
Image Date	(0008,0023)	2C	Used
Image Time	(0008,0033)	2C	Used
Image Type	(0008,0008)	3	Used See 6.5.6.1.1.1.
Acquisition Number	(0020,0012)	3	Ignored
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 See 6.5.6.1.1.2.
Source Image Sequence	(0008,2112)	3	Ignored See 6.5.6.1.1.2.
>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
Burned In Annotations	(0028,0301)	3	Ignored
Lossy Image Compression	(0028,2110)	3	Used See 6.5.6.1.1.3
Lossy Image Compression Ratio	(0028,2110)	3	Ignored

6.5.6.1.1 **General Image Attribute Descriptions**

6.5.6.1.1.1 **Image Type**

This software only accepts a value 3 of "RECON TOMO".

6.5.6.1.1.2 **Derivation Description and Source Image Sequence**

These tags are not yet used.

6.5.6.1.1.3 **Lossy Image Compression**

Volume Analysis does not use compression when saving images, nor it decompress images. So this field is just copied.

6.5.6.2   Image Pixel Module

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

TABLE 6.5-8
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 (expect "16")
High Bit	(0028,0102)	1	Ignored (expect "15")
Pixel Representation	(0028,0103)	1	Ignored (expect "1")
Pixel Data	(7FE0,0010)	1	
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

6.5.6.3   Multi-Frame Module

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

TABLE 6.5-9
MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Mandatory
Frame Increment Pointer	(0028,0009)	1	Mandatory See 6.5.6.3.1.1 for further explanation.

6.5.6.3.1   Multi-Frame Attribute Descriptions

6.5.6.3.1.1   Number Of Frames And Frame Increment Pointer

Only the "RECON TOMO" image type is supported and can be loaded in this software. This means that only a single attribute reference (0054,0080) is supported for the Frame Increment Pointer.

6.5.6.4   **Frame Pointers Module**

This section specifies the attributes of a Frame Pointer Module.

This module is not used by this software.

TABLE 6.5-10
FRAME POINTERS MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Representative Frame Number	(0028,6010)	3	Ignored
Frame Numbers Of Interest (FOI)	(0028,6020)	3	Ignored
Frame Of Interest Description	(0028,6022)	3	Ignored

6.5.7   Common Overlay Modules

6.5.7.1   Overlay plane module

This section contains Attributes that describe characteristics of an Overlay Plane.

This module is not used by this software.

TABLE 6.5-11
OVERLAY PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Overlay Rows	(60xx,0010)	1	Module Unsupported
Overlay Columns	(60xx,0011)	1	Module Unsupported
Overlay Type	(60xx,0040)	1	Module Unsupported
Origin	(60xx,0050)	1	Module Unsupported
Overlay Bits Allocated	(60xx,0100)	1	Module Unsupported
Bit Position	(60xx,0102)	1	Module Unsupported
Overlay Data	(60xx,3000)	1C	Module Unsupported
Overlay Description	(60xx,0022)	3	Module Unsupported
Overlay Subtype	(60xx,0045)	3	Module Unsupported
Overlay Label	(60xx,1500)	3	Module Unsupported
ROI Area	(60xx,1301)	3	Module Unsupported
ROI Mean	(60xx,1302)	3	Module Unsupported
ROI Standard Deviation	(60xx,1303)	3	Module Unsupported
Overlay Descriptor - Gray	(60xx,1100)	3	Module Unsupported
Overlay Descriptor - Red	(60xx,1101)	3	Module Unsupported
Overlay Descriptor - Green	(60xx,1102)	3	Module Unsupported
Overlay Descriptor - Blue	(60xx,1103)	3	Module Unsupported
Overlays - Gray	(60xx,1200)	3	Module Unsupported
Overlays - Red	(60xx,1201)	3	Module Unsupported
Overlays - Green	(60xx,1202)	3	Module Unsupported
Overlays - Blue	(60xx,1203)	3	Module Unsupported

6.5.7.2   Multi-frame Overlay Module

This section specifies the Attributes of a Multi-frame overlay.

This module is not used by this software.

TABLE 6.5-12
MULTI-FRAME OVERLAY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number of Frames in Overlay	(60xx,0015)	1	Module Unsupported
Image Frame Origin	(60xx,0051)	3	Module Unsupported

6.5.8   Common Curve Modules

6.5.8.1   Curve module

This Module defines Attributes of Curves.

This module is not used by this software.

Table 6.5-13
CURVE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Curve Dimensions	(50xx,0005)	1	Module Unsupported
Number of Points	(50xx,0010)	1	Module Unsupported
Type of Data	(50xx,0020)	1	Module Unsupported
Data Value Representation	(50xx,0103)	1	Module Unsupported
Curve Data	(50xx,3000)	1	Module Unsupported
Curve Description	(50xx,0022)	3	Module Unsupported
Axis Units	(50xx,0030)	3	Module Unsupported
Axis Labels	(50xx,0040)	3	Module Unsupported
Module Unsupported	(50xx,0104)	3	Module Unsupported
Maximum Coordinate Value	(50xx,0105)	3	Module Unsupported
Curve Range	(50xx,0106)	3	Module Unsupported
Curve Data Descriptor	(50xx,0110)	1C	Module Unsupported
Coordinate Start Value	(50xx,0112)	1C	Module Unsupported
Coordinate Step Value	(50xx,0114)	1C	Module Unsupported
Curve Label	(50xx,2500)	3	Module Unsupported
Referenced Overlay Sequence	(56xx,2600)	3	Module Unsupported
>Referenced SOP Class UID	(0008,1150)	1	Module Unsupported
>Referenced SOP Instance UID	(0008,1155)	1	Module Unsupported
>Referenced Overlay Group	(50xx,2610)	1	Module Unsupported

6.5.9   Common Lookup Table Modules

6.5.9.1   VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

TABLE 6.5-14
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 (an automatic W/L is computed)
Window Width	(0028,1051)	1C	Ignored (an automatic W/L is computed)
Window Center & Width Explanation	(0028,1055)	3	Ignored

6.5.10   General Modules

The SOP Common Module is mandatory for all DICOM IODs.

6.5.10.1   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 6.5-15
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Mandatory
SOP Instance UID	(0008,0018)	1	Ignored
Specific Character Set	(0008,0005)	1C	Used Only the "ISO_IR 100" character sets 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	(0008,0014)	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

6.5.11   Nuclear Medicine Modules

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

6.5.11.1   NM Series Module

This section specifies the Attributes that describe the NM Series.

TABLE 6.5-16
NM SERIES 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	

6.5.11.2   NM Image Pixel Module

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

TABLE 6.5-17
NM IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	The value shall be 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)
Pixel Spacing	(0028,0030)	2	Mandatory

6.5.11.3   NM Multi-frame Module

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

Only the "RECON TOMO" image type is supported and can be loaded in this software. This means that only a single attribute reference (0054,0080) is supported for the Frame Increment Pointer.

TABLE 6.5-18
NM MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1	Mandatory See 6.5.11.3.1.1
Energy Window Vector	(0054,0010)	1C	Ignored
Number of Energy Windows	(0054,0011)	1	Ignored
Detector Vector	(0054,0020)	1C	Ignored
Number of Detectors	(0054,0021)	1	Ignored
Phase Vector	(0054,0030)	1C	Ignored
Number of Phases	(0054,0031)	1C	Ignored
Rotation Vector	(0054,0050)	1C	Ignored
Number of Rotations	(0054,0051)	1C	Ignored
R-R Interval Vector	(0054,0060)	1C	Ignored
Number of R-R Intervals	(0054,0061)	1C	Ignored
Time Slot Vector	(0054,0070)	1C	Ignored
Number of Time Slots	(0054,0071)	1C	Ignored
Slice Vector	(0054,0080)	1C	Mandatory
Number of Slices	(0054,0081)	1C	Mandatory
Angular View Vector	(0054,0090)	1C	Ignored
Time Slice Vector	(0054,0100)	1C	Ignored

6.5.11.3.1 NM Multi-Frame Attribute Descriptions

6.5.11.3.1.1 Frame Increment Pointer

Only the "RECON TOMO" for the value 3 of Image Type is supported and can be loaded in this software. This means that only a single attribute reference (0054,0080) is supported in the Frame Increment Pointer. See Table 6.5-19 for other enumerated values.

TABLE 6.5-19
ENUMERATED VALUES FOR FRAME INCREMENT POINTER

Image Type (0008,0008), Value 3	Frame Increment Pointer (0028,0009)
STATIC or WHOLE BODY	0054H 0010H \ 0054H 0020H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020).
DYNAMIC	0054H 0010H \ 0054H 0020H \ 0054H 0030H \ 0054H 0100H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020), Phase Vector (0054,0030), Time Slice Vector (0054,0100)
GATED	0054H 0010H \ 0054H 0020H \ 0054H 0060H \ 0054H 0070H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020), R-R Interval Vector(0054,0060), Time Slot Vector (0054,0070)
TOMO	0054H 0010H \ 0054H 0020H \ 0054H 0050H \ 0054H 0090H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020), Rotation Vector (0054,0050), Angular View Vector (0054,0090)
GATED TOMO	0054H 0010H \ 0054H 0020H \ 0054H 0050H \ 0054H 0060H \ 0054H 0070H \ 0054H 0090H Sequencing is by Energy Window Vector (0054,0010), Detector Vector (0054,0020), Rotation Vector (0054,0050), R-R Interval Vector (0054,0060), Time Slot Vector (0054,0070), Angular View Vector (0054,0090).
RECON TOMO	0054H 0080H Sequencing is by Slice Vector (0054,0080)
RECON GATED TOMO	0054H 0060H \ 0054H 0070H \ 0054H 0080H Sequencing is by R-R Interval Vector (0054,0060), Time Slot Vector (0054,0070), Slice Vector (0054,0080)

6.5.11.4   **NM Image Module**

This section contains the Attributes that describe Nuclear Medicine Images.

TABLE 6.5-20
NM IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Mandatory See 6.5.11.4.1.1 for specialization.
Image ID	(0054,0400)	3	Ignored
Lossy Image Compression	(0028,2110)	1C	Ignored
Counts Accumulated	(0018,0070)	2	Ignored
Acquisition Termination Condition	(0018,0071)	3	Ignored
Table Height	(0018,1130)	3	Ignored
Table Traverse	(0018,1131)	3	Ignored
Actual Frame Duration	(0018,1242)	1C	Ignored
Count Rate	(0018,1243)	3	Ignored
Processing Function	(0018,5020)	3	Ignored
Corrected Image	(0028,0051)	3	Ignored
Whole Body Technique	(0018,1301)	3	Ignored
Scan Velocity	(0018,1300)	2C	Ignored
Scan Length	(0018,1302)	2C	Ignored
Referenced Overlay Sequence	(0008,1130)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Referenced Curve Sequence	(0008,1145)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Trigger Source or Type	(0018,1061)	3	Ignored
Anatomic Region Sequence	(0008,2218)	3	Ignored
> Code Value	(0008,0100)	1C	
> Coding Scheme Designator	(0008,0102)	1C	
> Code Meaning	(0008,0104)	3	
> Anatomic Region Modifier Sequence	(0008,2220)	3	Ignored
>> Code Value	(0008,0100)	1C	
>> Coding Scheme Designator	(0008,0102)	1C	
>> Code Meaning	(0008,0104)	3	
Primary Anatomic Structure Sequence	(0008,2228)	3	Ignored
> Code Value	(0008,0100)	1C	
> Coding Scheme Designator	(0008,0102)	1C	
> Code Meaning	(0008,0104)	3	
> Primary Anatomic Structure Modifier Sequence	(0008,2230)	3	Ignored
>> Code Value	(0008,0100)	1C	
>> Coding Scheme Designator	(0008,0102)	1C	

>> Code Meaning	(0008,0104)	3	

6.5.11.4.1   NM Image Module Attribute Descriptions

6.5.11.4.1.1   Image Type

Define the values of Image Type (0008,0008) that may be sent and under what circumstances, or refer to the more general description in the General Image Module.

Value 1 may have the following Enumerated Values:
– ORIGINAL   identifies an Original Image
– DERIVED   identifies a Derived Image

Value 2 may have the following Enumerated Value:
– PRIMARY   identifies a Primary Image

Value 3 may have the following Enumerated Value:
– RECON TOMO

Value 5 may have the following Enumerated Value:
– EMISSION
– TRANSMISSION

6.5.11.5   NM Isotope Module

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

TABLE 6.5-21
NM ISOTOPE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Energy Window Information Sequence	(0054,0012)	2	Ignored
> Energy Window Name	(0054,0018)	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
Radiopharmaceutical Information Sequence	(0054,0016)	2	Ignored
> Radionuclide Code Sequence	(0054,0300)	2C	Ignored
>> Code Value	(0008,0100)	1C	
>> Coding Scheme Designator	(0008,0102)	1C	
>> Code Meaning	(0008,0104)	3	
> Radiopharmaceutical Route	(0018,1070)	3	Ignored
> Administration Route Code Sequence	(0054,0302)	3	Ignored
>> Code Value	(0008,0100)	1C	
>> Coding Scheme Designator	(0008,0102)	1C	
>> Code Meaning	(0008,0104)	3	
> Radiopharmaceutical Volume	(0018,1071)	3	Ignored
> Radiopharmaceutical Start Time	(0018,1072)	3	Ignored
> Radiopharmaceutical Stop Time	(0018,1073)	3	Ignored
> Radionuclide Total Dose	(0018,1074)	3	Ignored
> Calibration Data Sequence	(0054,0306)	3	Ignored
>> Energy Window Number	(0054,0308)	1C	Ignored
>> Syringe Counts	(0018,1045)	3	Ignored
>> Residual Syringe Counts	(0054,0017)	3	Ignored
> Radiopharmaceutical	(0018,0031)	3	Ignored
> Radiopharmaceutical Code Sequence	(0054,0304)	3	Ignored
>> Code Value	(0008,0100)	1C	
>> Coding Scheme Designator	(0008,0102)	1C	
>> Code Meaning	(0008,0104)	3	
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	
>> Coding Scheme Designator	(0008,0102)	1C	
>> Code Meaning	(0008,0104)	3	
> Administration Route Code Sequence	(0054,0302)	3	Ignored
>> Code Value	(0008,0100)	1C	

>> Coding 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

6.5.11.6   NM Detector Module

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

TABLE 6.5-22
NM DETECTOR MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Detector Information Sequence	(0054,0022)	2	Mandatory
> Collimator/Grid Name	(0018,1180)	3	Ignored
> Collimator Type	(0018,1181)	2C	Ignored
> Field of View Shape	(0018,1147)	3	Ignored
> Field of View Dimension(s)	(0018,1149)	3	Ignored
> Focal Distance	(0018,1182)	2C	Ignored
> X Focus Center	(0018,1183)	3	Ignored
> Y Focus Center	(0018,1184)	3	Ignored
> Zoom Center	(0028,0032)	3	Ignored
> Zoom Factor	(0028,0031)	3	Ignored
> Center of Rotation Offset	(0018,1145)	3	Ignored
> Gantry/Detector Tilt	(0018,1120)	3	Ignored
> Distance Source to Detector	(0018,1110)	2C	Ignored
> Start Angle	(0054,0200)	3	Ignored
> Radial Position	(0018,1142)	3	Ignored
> Image Orientation (Patient)	(0020,0037)	2C	Mandatory
> Image Position (Patient)	(0020,0032)	2C	Mandatory
> View Code Sequence	(0054,0220)	3	Ignored
>> Code Value	(0008,0100)	1C	Ignored
>> Coding Scheme Designator	(0008,0102)	1C	Ignored
>> Code Meaning	(0008,0104)	3	Ignored
>> View Angulation Modifier Code Sequence	(0054,0222)	2C	Ignored
>>> Code value	(0008,0100)	1C	Ignored
>>> Coding Scheme Designator	(0008,0102)	1C	Ignored
>>> Code Meaning	(0008,0104)	3	Ignored

6.5.11.7 NM TOMO Acquisition Module

This section contains IOD Attributes that describe Nuclear TOMO Acquisition module used to produce an image.

TABLE 6.5-23
NM TOMO ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Rotation Information Sequence	(0054,0052)	2	Ignored
> Start Angle	(0054,0200)	1C	Ignored
> Angular Step	(0018,1144)	1C	Ignored
> Rotation Direction	(0018,1140)	1C	Ignored
> Scan Arc	(0018,1143)	1C	Ignored
> Actual Frame Duration	(0018,1242)	1C	Ignored
> Radial Position	(0018,1142)	3	Ignored
> Distance Source to Detector	(0018,1110)	2C	Ignored
> Number of Frames in Rotation	(0054,0053)	1C	Ignored
> Table Traverse	(0018,1131)	3	Ignored
> Table Height	(0018,1130)	3	Ignored
Type of Detector Motion	(0054,0202)	3	Ignored

6.5.11.8 NM Multi-gated Acquisition Module

This section contains Attributes that describe a multi-gated acquisition image performed on the patient. This refers to frames acquired while the patient is connected to a gating device.

TABLE 6.5-24
NM MULTI-GATED ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Beat Rejection Flag	(0018,1080)	3	Ignored
PVC Rejection	(0018,1085)	3	Ignored
Skip Beats	(0018,1086)	3	Ignored
Heart Rate	(0018,1088)	3	Ignored
Gated Information Sequence	(0054,0062)	2C	Ignored
> Trigger Time	(0018,1060)	3	Ignored
> Framing Type	(0018,1064)	3	Ignored
> Data Information Sequence	(0054,0063)	2C	Ignored
>> Frame Time	(0018,1063)	1C	Ignored
>> Nominal Interval	(0018,1062)	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
>> Time Slot Information Sequence	(0054,0072)	2C	Ignored
>>> Time Slot Time	(0054,0073)	3	Ignored

6.5.11.9   NM Phase Module

This section contains Attributes that describe dynamic phases of a dynamic acquisition image performed on the patient.

TABLE 6.5-25
NM PHASE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Phase Information Sequence	(0054,0032)	2C	Ignored
> Phase Delay	(0054,0036)	1C	Ignored
> Actual Frame Duration	(0018,1242)	1C	Ignored
> Pause Between Frames	(0054,0038)	1C	Ignored
> Number of Frames in Phase	(0054,0033)	1C	Ignored
>Trigger Vector	(0054,0210)	3	Ignored
>Number of Triggers in Phase	(0054,0211)	1C	Ignored

6.5.11.10   NM Reconstruction Module

This section contains Attributes that describe Nuclear Medicine reconstructed volumes. Reconstructed volumes are created by applying a transformation (reconstruction) process to the acquired TOMO frames.

TABLE 6.5-26
NM RECONSTRUCTION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Spacing Between Slices	(0018,0088)	2	Mandatory
Reconstruction Diameter	(0018,1100)	3	Ignored
Convolution Kernel	(0018,1210)	3	Ignored
Slice Thickness	(0018,0050)	2	Used
Slice Location	(0020,1041)	3	Ignored

7. PET INFORMATION OBJECT IMPLEMENTATION

7.1   INTRODUCTION

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

4.2 - IOD Description

4.3 - IOD Entity-Relationship Model

4.4 - IOD Module Table

4.5 - IOD Module Definition

7.2   PET IOD IMPLEMENTATION

7.3   PET ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the PET Image interoperability schema is shown in Illustration 4.3-1. 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 Study for each Patient (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
PET IMAGE ENTITY RELATIONSHIP DIAGRAM
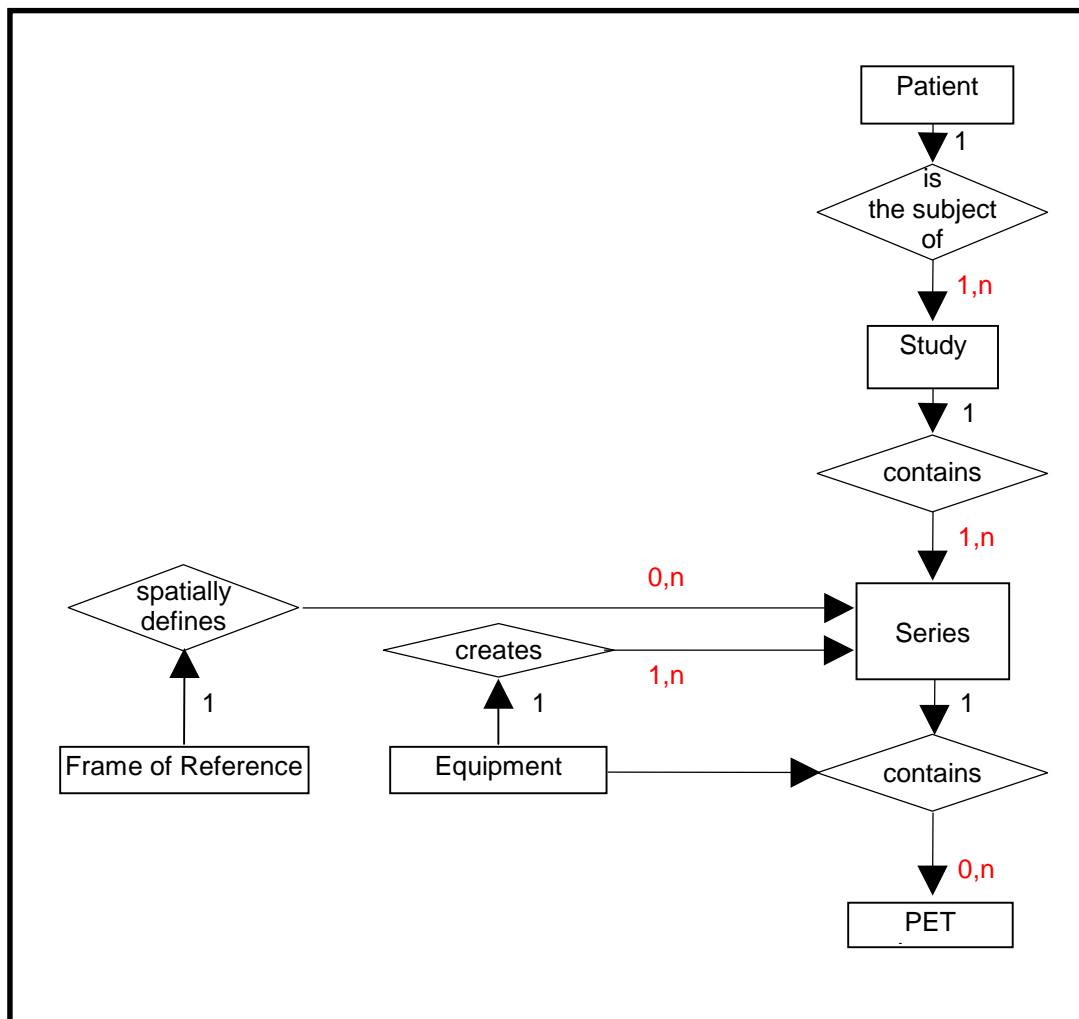
7.3.1   ENTITY DESCRIPTIONS

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

7.3.1.1   Patient Entity Description

7.3.1.2   Study Entity Description

7.3.1.3   Series Entity Description

7.3.1.4   Equipment Entity Description

7.3.1.5   Frame of Reference Entity Description

7.3.1.6   PET Image Entity Description

7.3.1.7   Overlay Entity Description

7.3.1.8   VOI Lookup Table Entity Description

7.3.2   Volume Analysis 2 Mapping of DICOM entities

TABLE 7.3-1
MAPPING OF DICOM ENTITIES TO VOLUME ANALYSIS 2 ENTITIES

DICOM	Volume Analysis 2 Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

7.4   IOD MODULE TABLE

Within an entity of the DICOM v3.0 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 4.4-1 identifies the defined modules within the entities which comprise the DICOM v3.0 PET IOD. Modules are identified by Module Name.

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

TABLE 7.4-1
PET IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	7.5.1.1
Study	General Study	7.5.2.1
	Patient Study	7.5.2.2
Series	General Series	7.5.3.1
	PET Series	7.5.10.1
	PET Isotope	7.5.10.2
	PET Multi-gated Acquisition	7.5.10.3
	NM/PET Patient Orientation	7.5.10.4
Frame of Reference	Frame of Reference	7.5.4.1
Equipment	General Equipment	7.5.5.1
Image	General Image	7.5.6.1
	Image Plane	7.5.6.2
	Image Pixel	7.5.6.3
	PET Image	7.5.10.5
	Overlay Plane	7.5.7.1
	VOI LUT	7.5.8.1
	SOP Common	7.5.9.1

7.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the 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 from. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

7.5.1   **Common Patient Entity Modules**

7.5.1.1   **Patient Module**

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

TABLE 7.5-1
PATIENT MODULE ATTRIBUTES

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

7.5.2   **Common Study Entity Modules**

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

7.5.2.1   General Study Module

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

TABLE 7.5-2
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
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	Used
Referenced Study Sequence	(0008,1110)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	

7.5.2.2   Patient Study Module

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

TABLE 7.5-3
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
Patient's Weight	(0010,1030)	3	Used
Occupation	(0010,2180)	3	Ignored
Additional Patient's History	(0010,21B0)	3	Used

7.5.3   Common Series Entity Modules

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

7.5.3.1   General Series Module

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

TABLE 7.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Used Defined Terms: PET = 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	Used
Protocol Name	(0018,1030)	3	Ignored
Series Description	(0008,103E)	3	Used
Operators' Name	(0008,1070)	3	Used
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	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
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

7.5.4   Common Frame Of Reference Entity Modules

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

7.5.4.1   Frame Of Reference Module

Images should share the same Frame Of Reference UID as a necessary conditions 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, the same patient name.

TABLE 7.5-5
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

7.5.5   Common Equipment Entity Modules

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

7.5.5.1   General Equipment Module

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

As Voxtool can simulate the generation of an image by the scanner, we have chosen to copy this module, but to omit the fields that could be altered by the reformation

TABLE 7.5-6
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	Used
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

7.5.6   **Common Image Entity Modules**

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

7.5.6.1   **General Image Module**

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

TABLE 7.5-7
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Mandatory
Patient Orientation	(0020,0020)	2C	Ignored
Image Date	(0008,0023)	2C	Used
Image 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
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	Used
Lossy Image Compression Ratio	(0028,2112)	3	Ignored

7.5.6.2   **Image Plane Module**

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

TABLE 7.5-8
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

7.5.6.3   Image Pixel Module

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

TABLE 7.5-9
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 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 (expect "16")
High Bit	(0028,0102)	1	Ignored (expect "15")
Pixel Representation	(0028,0103)	1	Ignored (expect "1")
Pixel Data	(7FE0,0010)	1	
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

7.5.7 Common Overlay Modules

7.5.7.1 Overlay plane module

This section contains Attributes that describe characteristics of an Overlay Plane.

This module is not currently supported by Voxtool products and will be ignored.

TABLE 7.5-10
OVERLAY PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Overlay Rows	(60xx,0010)	1	Module Unsupported
Overlay Columns	(60xx,0011)	1	Module Unsupported
Overlay Type	(60xx,0040)	1	Module Unsupported
Origin	(60xx,0050)	1	Module Unsupported
Overlay Bits Allocated	(60xx,0100)	1	Module Unsupported
Bit Position	(60xx,0102)	1	Module Unsupported
Overlay Data	(60xx,3000)	1C	Module Unsupported
Overlay Description	(60xx,0022)	3	Module Unsupported
Overlay Subtype	(60xx,0045)	3	Module Unsupported
Overlay Label	(60xx,1500)	3	Module Unsupported
ROI Area	(60xx,1301)	3	Module Unsupported
ROI Mean	(60xx,1302)	3	Module Unsupported
ROI Standard Deviation	(60xx,1303)	3	Module Unsupported
Overlay Descriptor - Gray	(60xx,1100)	3	Module Unsupported
Overlay Descriptor - Red	(60xx,1101)	3	Module Unsupported
Overlay Descriptor - Green	(60xx,1102)	3	Module Unsupported
Overlay Descriptor - Blue	(60xx,1103)	3	Module Unsupported
Overlays - Gray	(60xx,1200)	3	Module Unsupported
Overlays - Red	(60xx,1201)	3	Module Unsupported
Overlays - Green	(60xx,1202)	3	Module Unsupported
Overlays - Blue	(60xx,1203)	3	Module Unsupported

7.5.8 Common Lookup Table Modules

7.5.8.1 VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

TABLE 7.5-11
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

7.5.9 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

7.5.9.1 SOP Common Module

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

TABLE 7.5-12
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used
SOP Instance UID	(0008,0018)	1	Ignored
Specific Character Set	(0008,0005)	1C	Used Only the "ISO_IR 100" character sets 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	(0008,0014)	3	Ignored
Instance Number	(0020,0013)	3	Mandatory
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

7.5.10   PET Modules

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

7.5.10.1   PET Series

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

TABLE 7.5-13
PET SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Series Date	(0008,0021)	1	Used
Series Time	(0008,0031)	1	Used
Units	(0054,1001)	1	Ignored
Counts Source	(0054,1002)	1	Ignored
Series Type	(0054,1000)	1	Ignored
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	Ignored
Corrected Image	(0028,0051)	2	Ignored
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	Ignored
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	Ignored
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

`

7.5.10.2 PET Isotope

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

TABLE 7.5-14
PET ISOTOPE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Radiopharmaceutical Information Sequence	(0054,0016)	2	Ignored
>Radionuclide Code Sequence	(0054,0300)	2	Ignored
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
>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	Ignored
>Radiopharmaceutical Stop Time	(0018,1073)	3	Ignored
>Radionuclide Total Dose	(0018,1074)	3	Ignored
>Radionuclide Half Life	(0018,1075)	3	Ignored
>Radionuclide Positron Fraction	(0018,1076)	3	Ignored
>Radiopharmaceutical Specific Activity	(0018,1077)	3	Ignored
>Radiopharmaceutical	(0018,0031)	3	Ignored
>Radiopharmaceutical Code Sequence	(0054,0304)	3	Ignored
>>Code Value	(0008,0100)	1C	
>>Code Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
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

7.5.10.3 PET Multi-gated Acquisition

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

TABLE 7.5-15
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
PVC Rejection	(0018,1085)	3	Ignored
Skip Beats	(0018,1086)	3	Ignored
Heart Rate	(0018,1088)	3	Ignored
Framing Type	(0018,1064)	3	Ignored

7.5.10.4 NM/PET Patient Orientation

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

TABLE 7.5-16
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	

7.5.10.5 **PET Image Module**

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

TABLE 7.5-17
PET IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Used
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	Ignored (recomputed)
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
High R-R Value	(0018,1082)	1C	Ignored
Lossy Image Compression	(0028,2110)	1C	Used
Image Index	(0054,1330)	1	Ignored
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
Referenced Overlay Sequence	(0008,1130)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Referenced Curve Sequence	(0008,1145)	3	Ignored
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
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	

8. SC INFORMATION OBJECT IMPLEMENTATION

8.1   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:

8.2 - IOD Description

8.3 - IOD Entity-Relationship Model

8.4 - IOD Module Table

8.5 - IOD Module Definition

8.2   SC IOD IMPLEMENTATION

8.3   SC ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the SC Image interoperability schema is shown in Illustration 8.3-1**.** 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 Study for each Patient (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 8.3-1
SC IMAGE ENTITY RELATIONSHIP DIAGRAM
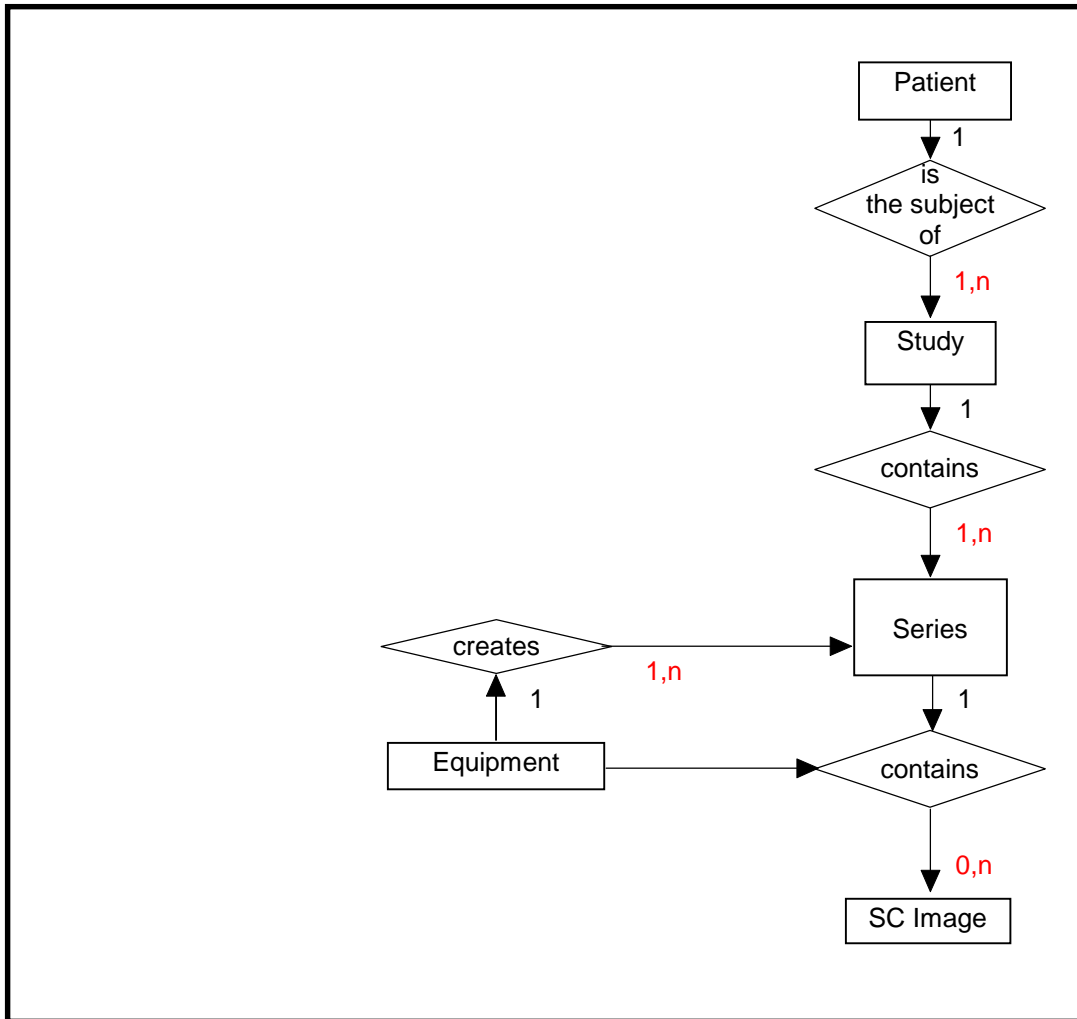
8.3.1 ENTITY DESCRIPTIONS

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

8.3.1.1   Patient Entity Description

8.3.1.2   Study Entity Description

8.3.1.3   Series Entity Description

8.3.1.4   Equipment Entity Description

8.3.1.5   SC Image Entity Description

8.3.1.6   Overlay Entity Description

8.3.1.7   VOI Lookup Table Entity Description

8.3.2   Volume Analysis 2 Mapping of DICOM entities

TABLE 8.3-1
MAPPING OF DICOM ENTITIES TO VOLUME ANALYSIS 2 ENTITIES

DICOM	Volume Analysis 2 Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image
Frame	Not Applicable

8.4   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 8.4-1 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.

TABLE 8.4-1
SC IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	8.5.1.1
Study	General Study	8.5.2.1
	Patient Study	8.5.2.2
Series	General Series	8.5.3.1
Equipment	General Equipment	8.5.4.1
	SC Equipment	8.5.9.1
Image	General Image	8.5.5.1
	Image Pixel	8.5.5.2
	SC Image	8.5.9.2
	Overlay Plane	8.5.6.1
	Modality LUT	8.5.7.2
	VOI LUT	8.5.7.1
	SOP Common	8.5.8.1

8.5   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).

8.5.1   **Common Patient Entity Modules**

8.5.1.1   **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 8.5-1
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Copied
Patient ID	(0010,0020)	2	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	
>Referenced SOP Instance UID	(0008,1155)	1C	
Patient's Birth Time	(0010,0032)	3	Copied
Other Patient IDs	(0010,1000)	3	Copied
Other Patient Names	(0010,1001)	3	Copied
Ethnic Group	(0010,2160)	3	Copied
Patient Comments	(0010,4000)	3	Copied

8.5.2   **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.

8.5.2.1   General Study Module

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

TABLE 8.5-2
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	

8.5.2.2   Patient Study Module

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

TABLE 8.5-3
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

8.5.3 Common Series Entity Modules

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

8.5.3.1 General Series Module

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

TABLE 8.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Copied Defined Terms: CT = Computed Tomography MR = Magnetic Resonance NM = Nuclear Medicine PT = PET XA = X-Ray Angiography
Series Instance UID	(0020,000E)	1	Generated
Series Number	(0020,0011)	2	Generated
Laterality	(0020,0060)	2C	Generated: ""
Series Date	(0008,0021)	3	Generated: current date
Series Time	(0008,0031)	3	Generated: current time
Performing Physicians' Name	(0008,1050)	3	Copied
Protocol Name	(0018,1030)	3	Removed
Series Description	(0008,103E)	3	Used / Generated (see section 8.6)
Operators' Name	(0008,1070)	3	Copied
Referenced Study Component Sequence	(0008,1111)	3	Removed
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Body Part Examined	(0018,0015)	3	Copied
Patient Position	(0018,5100)	2C	Copied 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
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

8.5.4 Common Equipment Entity Modules

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

8.5.4.1 General Equipment Module

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

TABLE 8.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	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	Removed
Date of Last Calibration	(0018,1200)	3	Copied
Time of Last Calibration	(0018,1201)	3	Copied
Pixel Padding Value	(0028,0120)	3	Copied

8.5.5 Common Image Entity Modules

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

8.5.5.1 General Image Module

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

TABLE 8.5-6
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Generated
Patient Orientation	(0020,0020)	2C	Generated. See 8.5.5.1.1.1
Image Date	(0008,0023)	2C	Generated, empty "". See 8.5.5.1.1.2
Image Time	(0008,0033)	2C	Generated, empty "". See 8.5.5.1.1.2
Image Type	(0008,0008)	3	Generated. See 8.5.5.1.1.3
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	Removed. See 8.5.5.1.1.4
Source Image Sequence	(0008,2112)	3	Used / Removed. See 8.5.5.1.1.4 and 8.6
>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	Removed
Lossy Image Compression Ratio	(0028,2112)	3	Copied. See 8.5.5.1.1.5
Lossy Image Compression	(0028,2110)	3	Copied

8.5.5.1.1 General Image Attribute Descriptions

8.5.5.1.1.1 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 "L\FA" or "L\F ".

8.5.5.1.1.2 Image Date and Time

When Volume Analysis 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

- Volume Analysis 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

- Volume Analysis 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, Volume Analysis will set an empty tag to avoid possible ambiguities.

8.5.5.1.1.3 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:

- SCREEN SAVE   identifies a Multi Planar Reformatted Image
- 3D   identifies a 3D view

Value 4, if defined, indicates the rendering algorithm of the view, and can have the following values:

- MIP   identifies a Maximum Intensity Projection Image
- MIN IP   identifies a Minimum Intensity Projection Image
- AVERAGE   identifies a Average Image
- VOLREN   identifies a Volume Rendered Image
- SURFACE   identifies a surface shaded Image
- RAYSUM   identifies a RaySum Image
- INTEGRAL   identifies a Integral Image

8.5.5.1.1.4 Derivation Description and Source Image Sequence

The Derivation Description tag is not used.

The Source Image Sequence is used only when the secondary capture comes from the Direct3D / Volume Auto View software. In this case, the Series Description contains "Direct3D State" and the actual Direct3D state is stored in the private group 0x0047 "GEMS_3DSTATE_001" (see the private dictionary at section 8.6). This state contains all the parameters useful to reconstruct a Volume Rendered view similar to the one shown in this secondary capture. The Source Image Sequence address the list of the original images used.

8.5.5.1.1.5 Lossy Image Compression

Volume Analysis does not use compression when saving images, nor it decompress images. So this field is just copied.

8.5.5.2 Image Pixel Module

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

TABLE 8.5-7
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Generated • "1" for black and white images • "3" for color images
Photometric Interpretation	(0028,0004)	1	Generated • "MONOCHROME2" for black and white images • "RGB" for color images
Rows	(0028,0010)	1	Generated (256, 512, 1024)
Columns	(0028,0011)	1	Generated (256, 512, 1024)

Bits Allocated	(0028,0100)	1	Generated • "16" for black and white images • "8" for color images
Bits Stored	(0028,0101)	1	Generated • "16" for black and white images • "8" for color images
High Bit	(0028,0102)	1	Generated • "15" for black and white images • "7" for color images
Pixel Representation	(0028,0103)	1	Generated • "1" for black and white images • "0" for color images
Pixel Data	(7FE0,0010)	1	
Planar Configuration	(0028,0006)	1C	Generated • Removed for black and white images • "0" for color images
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

8.5.6 **Common Overlay Modules**

8.5.6.1 **Overlay plane module**

This section contains Attributes that describe characteristics of an Overlay Plane.

This module is not currently supported by Voxtool products.

TABLE 8.5-8
OVERLAY PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Overlay Rows	(60xx,0010)	1	Unsupported module
Overlay Columns	(60xx,0011)	1	Unsupported module
Overlay Type	(60xx,0040)	1	Unsupported module
Origin	(60xx,0050)	1	Unsupported module
Overlay Bits Allocated	(60xx,0100)	1	Unsupported module
Bit Position	(60xx,0102)	1	Unsupported module
Overlay Data	(60xx,3000)	1C	Unsupported module
Overlay Description	(60xx,0022)	3	Unsupported module
Overlay Subtype	(60xx,0045)	3	Unsupported module
Overlay Label	(60xx,1500)	3	Unsupported module
ROI Area	(60xx,1301)	3	Unsupported module
ROI Mean	(60xx,1302)	3	Unsupported module
ROI Standard Deviation	(60xx,1303)	3	Unsupported module
Overlay Descriptor - Gray	(60xx,1100)	3	Unsupported module
Overlay Descriptor - Red	(60xx,1101)	3	Unsupported module
Overlay Descriptor - Green	(60xx,1102)	3	Unsupported module
Overlay Descriptor - Blue	(60xx,1103)	3	Unsupported module
Overlays - Gray	(60xx,1200)	3	Unsupported module
Overlays - Red	(60xx,1201)	3	Unsupported module
Overlays - Green	(60xx,1202)	3	Unsupported module
Overlays - Blue	(60xx,1203)	3	Unsupported module

8.5.7 **Common Lookup Table Modules**

8.5.7.1 **VOI LUT module**

This section specifies the Attributes that describe the VOI LUT.

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

TABLE 8.5-9
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
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

8.5.7.2 Modality LUT module

This section specifies the Attributes that describe the Modality LUT.

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

TABLE 8.5-10
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 • "HU" for CT • "US" for other modalities

8.5.8 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

8.5.8.1 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 8.5-11
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Generated
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 sets 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	(0008,0014)	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

8.5.9   SC Modules

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

8.5.9.1   SC Equipment Module

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

TABLE 8.5-12
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 8.5.3.1 for Enumerated Values.
Secondary Capture Device ID	(0018,1010)	3	Removed
Secondary Capture Device Manufacturer	(0018,1016)	3	Generated "GE MEDICAL SYSTEMS"
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	3	Removed
Secondary Capture Device Software Version	(0018,1019)	3	Generated: Voxtool version "vxtl_x_y_z"
Video Image Format Acquired	(0018,1022)	3	Removed
Digital Image Format Acquired	(0018,1023)	3	Removed

8.5.9.2   SC Image Module

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

TABLE 8.5-13
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

8.6 **PRIVATE DATA DICTIONARY**

In the case of a secondary capture coming from the Direct3D software, the following private group is read. Note that this group is read only if the Series Description contains "Direct3D State".

For a complete description of the tags, see the conformance statement of Direct3D.

TABLE 8.6-14
3D STATE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
General Description	(0047,xxD6)	3	Used
TDRT	(0047,xxD7)	3	Used
NVRP	(0047,xxD8)	3	Used
CVRPN	(0047,xxD9)	3	Used
Volume Rendering Presets Sequence	(0047,xxDA)	3	Used
> Preset Name	(0047,xxDB)	3	Used
> Opacity Curve X	(0047,xxDC)	3	Used
> Opacity Curve Y	(0047,xxDD)	3	Used
> NOCP	(0047,xxDE)	3	Used
> Color Curve X	(0047,xxDF)	3	Used
> Color Curve Y	(0047,xxE0)	3	Used
> NCCP	(0047,xxE1)	3	Used
> GSA	(0047,xxE2)	3	Used
> VRSF	(0047,xxE3)	3	Used
> AF	(0047,xxE4)	3	Ignored
> DF	(0047,xxE5)	3	Ignored
> SCF	(0047,xxE6)	3	Ignored
> SPF	(0047,xxE7)	3	Ignored
Orthogonal Clipping Planes	(0047,xxE8)	3	Used
CP	(0047,xxE9)	3	Used
CFP	(0047,xxEA)	3	Used
CVU	(0047,xxEB)	3	Used
RFOV	(0047,xxEC)	3	Used
PPRP	(0047,xxED)	3	Ignored
3DWW	(0047,xxEE)	3	Used
3DWL	(0047,xxEF)	3	Used
BBV	(0047,xxF0)	3	Ignored
ERF	(0047,xxF1)	3	Used
TDRMS	(0047,xxF2)	3	Ignored
TDSSS	(0047,xxF3)	3	Ignored

8.6.1   3D State Attribute Descriptions

8.6.1.1   General Description

A simple text field which gives a general, free form description of the current study.

8.6.1.2   TDRT - 3D Rendering Type

Enumerated parameter which records type of rendering to be applied.

VRSF: {1, 2, 3, 4, 5}   1=Volume Rendering, 2=MIP, 3=MinIP, 4=RaySum, 5=Integral.

Note: The typical setting will be Volume Rendering for the first release of VAV, although MIP could also be selected.

8.6.1.3   NVRP - Number of Volume Rendering Presets

The number of volume rendering presets, NVRP, defined in the VAV 3D state object. It will be desirable to save as many as 5 presets which are applicable to the current study.

NVRP: [0 .. 5].   0: Volume Rendering is not applicable.

Note: NVRP will routinely be 5 for a VAV study.

8.6.1.4   CVRPN - Current Volume Rendering Preset Number

Set number preset number, CVRPN, which specifies which of the defined presets is currently applied.

CVRPN: [1 - NVRP]

8.6.1.5   Volume Rendering Presets Sequence

Set of volume rendering presets

8.6.1.6   Preset Name

Simple textual name associated with this preset.   Appropriate for labeling a preset button on the user interface of the 3D application for example.

8.6.1.7   Opacity Curve X

The X   values of the opacity curve coordinates.   This field must contain NOCP values (see 2.5.8.3.1.9).

Hounsfield units (a CT#), [-1024 .. 3071]

8.6.1.8   **Opacity Curve Y**

The Y values of the opacity curve coordinates. This field must contain NOCP values (see 2.5.8.3.1.9).

A measure of opacity / mm, [0.0 .. 1.0]

8.6.1.9   **NOCP -** Number of Opacity Curve Points

The number of points which make up the opacity curve. NOCP: [2 .. 64].

8.6.1.10   **Color Curve X**

The X values of the color curves. This field must contain NCCP values (see 2.5.8.3.1.12).

Hounsfield units (a CT#), [-1024 .. 3071]

Linear interpolation is always applied between points along a color curve. (i.e., if a step function is desirable, it will be built into to VAV curve itself)

For all Hounsfield values less than the smallest X contained in the above set of points, a color of (0, 0, 0) should be assigned. For all Hounsfield values greater than the largest X contained in the above set of points, a color of (0, 0, 0) should be assigned.

8.6.1.11   **Color Curve Y**

The Y values of the color curves. This field must contain 3*NCCP values (see 2.5.8.3.1.12).

A color value represented as an RGB floating point triplet, ([0.0..1.0], [0.0..1.0], [0.0..1.0])

8.6.1.12   **NCCP -** Number of Color Curve Points

NCCP: [2 - 64]

8.6.1.13   **GSA -** Gray Scale Applied

Simple boolean flag, GSA, which specifies if gray scale rendering is currently being applied (versus 3 channel color) for this preset.

GSA: [0, 1]

Note: If the gray scale flag is set, each point of the VAV color curve will be an RGB triplet corresponding to a gray scale value (i.e., R=G=B). If shading is also on (see parameter below), a non-zero gray scale flag should map to Voxtool's monochrome option being applied.

8.6.1.14   **VRSF -** Volume Rendering Shading Flag

Simple boolean flag, VRSF, which specifies whether shading (gray scale or color) is applied for this preset.

VRSF: [0, 1]

Note: Voxtool does not currently support an optimized path for gray scale shading. But this case should be addressed in that each point of the VAV color curve will be an RGB triplet to a gray scale value (i.e., R=G=B).

8.6.1.15 **AF** - Ambient Factor

The ambient factor term in the general lighting equation, applicable if shading is On.

AF: a percentage, [0.0 ... 1.0]

Constraint: AF + DF + SCF <= 1.0

8.6.1.16 **DF -** Diffuse Factor

The diffuse factor term in the general lighting equation, applicable if shading is On.

DF: a percentage, [0.0 ... 1.0]

Constraint: AF + DF + SCF <= 1.0

8.6.1.17 **SCF -** Specular Contribution Factor

The specular contribution factor term in the general lighting equation, applicable if shading is On.

SCF: a percentage, [0.0 ... 1.0]

Constraint: AF + DF + SCF <= 1.0

Note: For the initial release of VAV, the SCF term will always be zero. Likewise, Voxtool does not currently support specular lighting.

8.6.1.18 **SPF -** Specular Power Factor

The specular power factor term in the general lighting equation, applicable if shading is On.

SPF: a floating point value >= 0.0

8.6.1.19 **Orthogonal Clipping Planes**

Specifies up to six clipping planes which define our sub volume of interest. The general equation for a plane in the RAS system will be utilized.

$$A_1 r + B_1 a + C_1 s + D_1 = 0$$

$$A_2 r + B_2 a + C_2 s + D_2 = 0$$

$$A_3 r + B_3 a + C_3 s + D_3 = 0$$

$$A_4\, r + B_4\, a + C_4\, s + D_4 = 0$$

$$A_5\, r + B_5\, a + C_5\, s + D_5 = 0$$

$$A_6\, r + B_6\, a + C_6\, s + D_6 = 0$$

A total of 24 floating point coefficients define the 6 arbitrary planes. The sign convention regarding the plane normals is as follows: the normal for a given clipping plane should point away from the portion of the volume that we wish to cut away.

These 24 points will be stored as a list of floats (A1, B1, C1, D1, A2, B2, ..., C6, D6).

If fewer than 6 clipping planes are required, each coefficient for an unused clipping plane should be set to zero.

Note: For the first release of VAV, only simple orthogonal clipping planes will be utilized. Thus the general plane equations above reduces to the following (where only the non-zero terms are shown):

$$A_1\, r + D_1 = 0$$

$$A_2\, r + D_2 = 0$$

$$B_3\, a + D_3 = 0$$

$$B_4\, a + D_4 = 0$$

$$C_5\, s + D_5 = 0$$

$$C_6\, s + D_6 = 0$$

8.6.1.20   **CP -** Camera Position

RAS Location of camera

CP: patient relative 3D point, (R, A, S) in mm.

8.6.1.21   **CFP -** Camera Focal Point

RAS Location of camera focal point, CFP, essentially the center of the 3D scene.

CFP: patient relative 3D point, (R, A, S) in mm.

Note: The camera position and focal point uniquely define the camera viewing vector.

8.6.1.22   **CVU -** Camera "View Up" Vector

Unit length RAS vector, CVU, which, when combined with the computed camera viewing vector, uniquely defines the orientation of the the 3D projection image.

CVU: patient relative unit length vector, $(R_{grad}, A_{grad}, S_{grad})$.

8.6.1.23   **RFOV -** Rendering Field Of View

Field of View, RFOV, of the 3D projection image.

RFOV: floating point value in mm.

8.6.1.24   **PPRP -** Camera Position

Flag, PPRR, which specifies where perspective or parallel ray rendering is done.

PPRR: (0, 1),   0 = Parallel, 1 = Perspective.

Note: The perspective mode, the camera viewing angle, or frustum, can be calculated from the above camera parameters. The RFOV in this case is measured in the plane which includes the CFP and is normal to the viewing vector.

8.6.1.25   **3DWW**

Window Width parameter describing how to display the 3D projection image.

3DWW: [0.0 ... 4096.0]

8.6.1.26   **3DWL**

Window Level parameter describing how to display the 3D projection image.

3DWL: [-1024.0 ... 3071.0]

8.6.1.27   **BBV -** Bounding Box Visible

Simple boolean flag, BBV, which specifies whether the volume bound box should be visible in the resultant 3D image.

BBV: [0. 1]

8.6.1.28   **ERF -** Enhanced Resolution Flag

Simple boolean flag, ERF, which specifies if volume rendering should be perfomed in "enhanced resolution" mode

ERF: [0. 1]

8.6.1.29   **TDRMS -** 3D Render Matrix Size

The size of the image matrix used during the 3D rendering process (not to be confused with the window size which displays the final 3D result).

TDRMS: {128, 256, 512, 768, 1024}

Note: TDRMS will typically be 512 for a VAV study.

8.6.1.30   **TDSSS -** 3D Sample Step Size

The distance between samples, TDSSS (along a ray or between parallel textures) in mm used during 3D processing.

TDSSS: > 0.0 mm

8.6.2   **3D State Private Dictionary**

TABLE 8.6-15
PRIVATE CREATOR IDENTIFICATION (GEMS_3DSTATE_001)

Attribute Name	Tag	VR	VM
General Description	(0047,xxD6)	ST	1
TDRT	(0047,xxD7)	CS	1
NVRP	(0047,xxD8)	US	1
CVRPN	(0047,xxD9)	US	1
Volume Rendering Presets Sequence	(0047,xxDA)	SQ	1
Preset Name	(0047,xxDB)	LO	1
Opacity Curve X	(0047,xxDC)	SS	1-n
Opacity Curve Y	(0047,xxDD)	FL	1-n
NOCP	(0047,xxDE)	US	1
Color Curve X	(0047,xxDF)	SS	1-n
Color Curve Y	(0047,xxE0)	FL	3-3*n
NCCP	(0047,xxE1)	US	1
GSA	(0047,xxE2)	CS	1
VRSF	(0047,xxE3)	CS	1
AF	(0047,xxE4)	FL	1
DF	(0047,xxE5)	FL	1
SCF	(0047,xxE6)	FL	1
SPF	(0047,xxE7)	FL	1
Orthogonal Clipping Planes	(0047,xxE8)	FL	24
CP	(0047,xxE9)	FL	3
CFP	(0047,xxEA)	DS	3
CVU	(0047,xxEB)	DS	3
RFOV	(0047,xxEC)	FL	1
PPRP	(0047,xxED)	CS	1
3DWW	(0047,xxEE)	DS	1
3DWL	(0047,xxEF)	DS	1
BBV	(0047,xxF0)	CS	1
ERF	(0047,xxF1)	CS	1
TDRMS	(0047,xxF2)	US	1
TDSSS	(0047,xxF3)	FL	1

9. 3D MODEL INFORMATION OBJECT IMPLEMENTATION

9.1   INTRODUCTION

This section specifies the use of the GEMS private DICOM 3D Model IOD to represent the information included in 3-dimensional volumes produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

4.2 - IOD Description

4.3 - IOD Entity-Relationship Model

4.4 - IOD Module Table

4.5 - IOD Module Definition

9.2   3D MODEL IOD IMPLEMENTATION

9.3   3D MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the 3D Model interoperability schema is shown in **Illustration 4.3-1.** 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 Study for each Patient (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
3D MODEL ENTITY RELATIONSHIP DIAGRAM
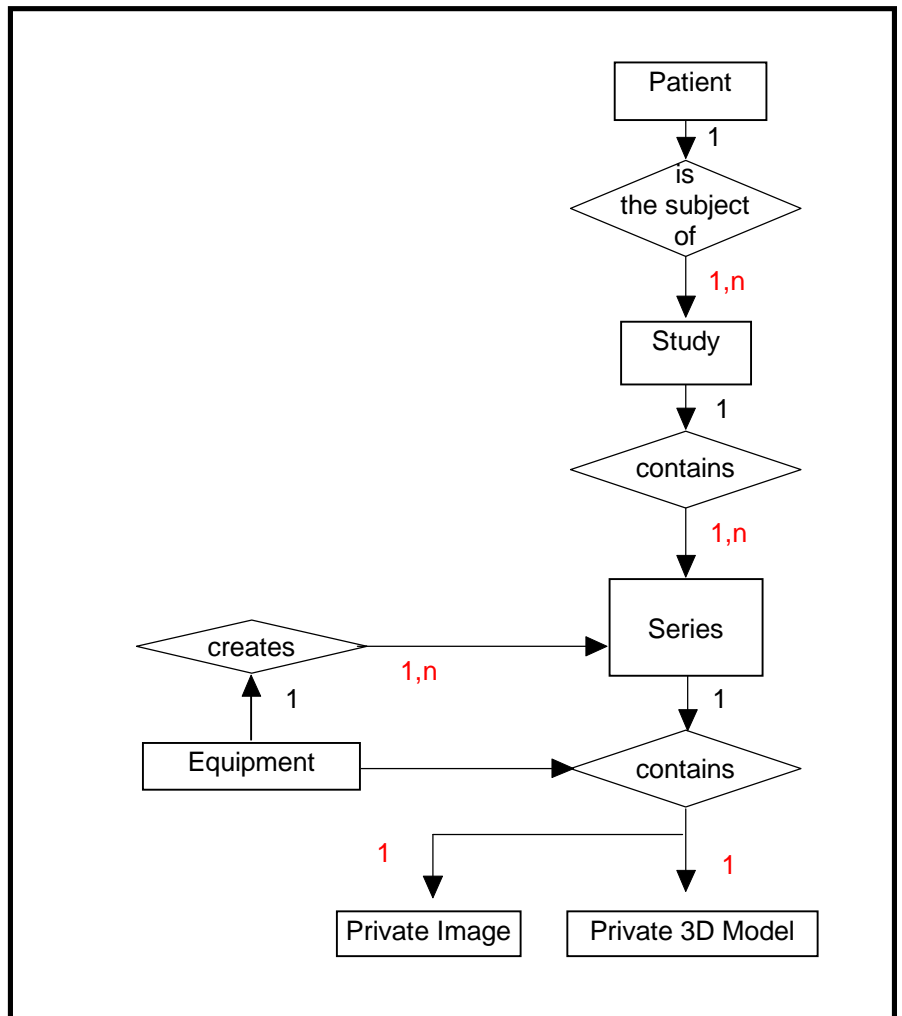
9.3.1 ENTITY DESCRIPTIONS

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of the entities contained within the 3D Model Information Object (except GEMS private 3D Model and Image entities).

9.3.1.1 Patient Entity Description

9.3.1.2 Study Entity Description

9.3.1.3 Series Entity Description

9.3.1.4 Equipment Entity Description

9.3.1.5 Private Image Entity Description

The Private Image Information Entity defines the attributes that describe the pixel data of an image that represents a view of the 3-dimensional volume generated by the application. Unlike DICOM Image Information Entity, this

Private Image Information Entity does not convey modality specific characteristics : this information is already contained in the 3D Model Entity Description.

9.3.1.6   3D Model Entity Description

The 3D Model Information Entity (GEMS private) describes the 3-dimensional volume reconstructed by this application. This Information Entity also contains a description of the parameters used to achieve such reconstruction. Most of these data are described by **DICOM v3.0 attributes**, but some of them are described by GEMS **private attributes**. A list of all private attributes defined here can be found at the end of this section.

9.3.2   Voxtool 2.0 Mapping of DICOM entities

TABLE 9.3-1
MAPPING OF DICOM ENTITIES TO VOXTOOL 2.0 ENTITIES

DICOM	Voxtool Entity
Patient	Patient
Study	Exam
Series	Series
Image	Private Image

9.4   IOD MODULE TABLE

Within an entity of the GEMS private 3D Model 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 which comprise the 3D Model IOD. Modules are identified by Module Name.

See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes (except GEMS private ones). Note that some attributes of the 3D Model entity are GEMSE **private attributes**.

The attributes description can take one of the following values :

- Generated : this attribute is generated by the application,

- Generated : XXX : this attribute is generated by the application, its value is XXX,

- Original : this attribute is a copy of the original (present in the CT or MR images used to generate the 3-dimensional volume),

- Empty : this attribute is saved but is empty,

- Not Saved : this attribute is not saved.

TABLE 9.4-2
3D MODEL IOD MODULES

Entity Name	Module Name	Reference	Usage
Patient	Patient	9.5.1.1	M
Study	General Study	9.5.2.1	M
	Patient Study	9.5.2.2	U
Series	General Series	9.5.3.1	M
Equipment	General Equipment	9.5.4.1	M
Private Image	General Image	9.5.6.1	M
	Image Pixel	9.5.6.2	M
Private 3D Model	Common Private Entity	9.5.5.1	M
	Reconstruction Parameter Sequence	9.5.5.2	M
	> CT Reconstruction Parameters		C - Required if modality = CT
	> MR Reconstruction Parameters		C- Required if modality = MR
	> XA Reconstruction Parameters		C- Required if modality = XA
	Volumic Data	9.5.5.3	M
	Wireframe data	9.5.5.4	U
	SOP Common	9.5.7.1	M

9.5   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 3D Model Information Object (except GEMS private 3D Model related module).

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). **Type 3 attributes that are not mentioned are not saved** by the application.

9.5.1 Common Patient Entity Modules

9.5.1.1 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 9.5-1
PATIENT MODULE ATTRIBUTES

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

9.5.2 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.

9.5.2.1 General Study Module

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

TABLE 9.5-2
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Original
Study Date	(0008,0020)	2	Generated
Study Time	(0008,0030)	2	Generated
Referring Physician's Name	(0008,0090)	2	Original
Study ID	(0020,0010)	2	Original
Accession Number	(0008,0050)	2	Empty
Study Description	(0008,1030)	3	Generated

9.5.2.2 Patient Study Module

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

TABLE 9.5-3
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Original

Patient's Weight	(0010,1030)	3	Original

9.5.3 Common Series Entity Modules

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

9.5.3.1 General Series Module

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

TABLE 9.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Original
Series Instance UID	(0020,000E)	1	Generated
Series Number	(0020,0011)	2	Generated
Laterality	(0020,0060)	2C	Empty
Series Description	(0008,103E)	3	Generated
Patient Position	(0018,5100)	2C	Original

9.5.4 Common Equipment Entity Modules

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

9.5.4.1 General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced the 3D Model.

TABLE 9.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Generated
Institution Name	(0008,0080)	3	Generated
Station Name	(0008,1010)	3	Generated
Manufacturer's Model Name	(0008,1090)	3	Generated
Device Serial Number	(0018,1000)	3	Empty
Software Versions	(0018,1020)	3	Generated

9.5.5 3D Model Entity Modules

The following Modules specify all the attributes wich describe a 3-dimensional volume reconstructed by the application.

9.5.5.1 Common Private Entity Module

This section specifies the attributes that are common to all GEMSE Private DICOM Entities.

TABLE 5.5-6
COMMON PRIVATE ENTITY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Private Entity Number	(0039,xx80)	1	Generated
Private Entity Date	(0039,xx85)	1	Generated
Private Entity Time	(0039,xx90)	1	Generated
Private Entity Launch Command	(0039,xx95)	2	Generated: « start_volan »
Private Entity Type	(0039,xxAA)	1	Generated: « 3DDPO »

9.5.5.1.1 Common Private Entity Attribute Descriptions

9.5.5.1.1.1 Private Entity Number

Identifies the private entity instance.

9.5.5.1.1.2 Private Entity Date

Defines the creation date of this private entity.

9.5.5.1.1.3 Private Entity Time

Defines the creation time of this private entity.

9.5.5.1.1.4 Private Entity Launch Command

Defines the command that should be called to launch the application corresponding to the Private Entity (Voxtool 2.0, in our case).

9.5.5.1.1.5 Private Entity Type

Defines the type of this private entity. Here we use the string « 3DDPO » to indicate that this private entity corresponds to a 3-dimensional volume.

9.5.5.2 Reconstruction Parameter Sequence Module

This section specifies the Attributes which describe the parameters that where used to achieve the 3-dimensional reconstruction.

Note that these attributes are **encapsulated in a private Sequence** item : we use standard attributes to code the reconstruction parameters. In DICOM Standard, these attributes are related to the Image Entity, whereas here they are related to the 3D Model Private Entity. The encapsulation avoids possible semantical confusions.

Next table gives the reconstruction parameters that do not depend on the type of the original images used to build the 3-dimensional volume. These attributes are saved for all 3D Models. The description of GEMS private attribute is given at the end of this section.

TABLE 5.5-7
RECONSTRUCTION PARAMETER SEQUENCE MODULE ATTRIBUTES
(FOR ALL ORIGINAL IMAGES TYPES)

Attribute Name	Tag	Type	Attribute Description
Reconstruction Parameters Sequence	(0047, xx01)	1	Generated
> Contrast/Bolus Agent	(0018,0010)	2	Original
> Slice thickness	(0018, 0050)	2	Original
> Spacing between Slices	(0018, 0088)	3	Original
> Contrast/Bolus Route	(0018,1040)	3	Original
> Patient Position	(0018, 5100)	2C	Original, required for CT and MR modalities
> Pixel Spacing	(0028, 0030)	1	Original
> Pixel Padding Value	(0028, 0120)	3	Original
> Largest Image Value	(0028, 0107)	3	Original

Next table gives the reconstruction parameters that are saved only when the 3-dimensional volume has been reconstructed from MR Images. Hence, all these attributes are conditional type. Remember that they are all encapsulated in the Reconstruction Parameters Sequence attribute. The description of GEMS private attribute is given at the end of this section.

NOTE: Following Module is intended to be part of a sequence item of the Reconstruction Parameter Sequence wich corresponds to the Data Element (0x47, 0xXX01)

TABLE 5.5-8
RECONSTRUCTION PARAMETER SEQUENCE MODULE ATTRIBUTES
(FOR MR MODALITY ORIGINAL IMAGES)

Attribute Name	Tag	Type	Attribute Description
Scanning Sequence	(0018, 0020)	1	Original
Scan Options	(0018, 0022)	2	Original
MR Acquisition Type	(0018, 0023)	2	Original
Repetition Time	(0018, 0080)	3	Original

Echo Time	(0018, 0081)	3	Original
Inversion Time	(0018, 0082)	3	Original
Number of Averages	(0018, 0083)	3	Original
Imaging Frequency	(0018, 0084)	3	Original
Echo Number	(0018, 0086)	3	Original
Magnetic Field Strength	(0018, 0087)	3	Original
Trigger Time	(0018, 1060)	3	Original
Cardiac Number of images	(0018, 1090)	3	Original
Echo Train Length	(0018, 0091)	2	Original
Pixel Bandwidth	(0018, 0095)	3	Original
Receiving Coil	(0018, 1250)	3	Original
Acquisition Matrix	(0018,1310)	3	Original
Flip	(0018, 1314)	3	Original
Swap Phase / Frequency Axis	(0019, xx8F)	3	Original
Pulse Sequence Name	(0019, xx9C)	3	Original
Coil Type	(0019, xx9F)	3	Original
SAT fat/water/none	(0019, xxA4)	3	Original
Bitmap of SAT Selections	(0019, xxC0)	3	Original
Surfacel Coil Intensity Correction Flag	(0019, xxC1)	3	Original
Phase Contrast Flow Axis	(0019, xxCB)	3	Original
Phase Contrast Velocity Encoding	(0019, xxCC)	3	Original
Fractional Echo	(0019, xxD5)	3	Original
Cardiac phases	(0019, xxD7)	3	Original
Variable Echo Flag	(0019, xxD8)	3	Original
Concatenated Sat	(0019, xxD9)	3	Original
Number of Phases	(0019, xxF2)	3	Original

Next table gives the reconstruction parameters that are saved only when the 3-dimensional volume has been reconstructed from CT Images. Hence, all these attributes are conditional type. Remember that they are all **encapsulated** in the Reconstruction Parameters Sequence attribute. The description of GEMS private attribute is given at the end of this section.

NOTE: Following Module is intended to be part of a sequence item of the Reconstruction Parameter Sequence wich corresponds to the Data Element (0x47, 0xXX01)

TABLE 5.5-9
RECONSTRUCTION PARAMETER SEQUENCE MODULE ATTRIBUTES
(FOR CT MODALITY ORIGINAL IMAGES)

Attribute Name	Tag	Type	Attribute Description
KPV	(0018, 0060)	3	Original
Gantry Tilt	(0018, 1120)	3	Original

Exposure Time	(0018, 1150)	3	Original
X-Ray Tube Current	(0018, 1151)	3	Original
Convolution Kernel	(0018, 1210)	3	Original
Axial Type	(0019, xx39)	3	Original
Delta Start Time	(0043, xx1E)	3	Original
Pitch Ratio	(0043, xx27)	3	Original

Next table gives the reconstruction parameters that are saved only when the 3-dimensional volume has been reconstructed from X-Ray Series. Hence, all these attributes are conditional type. Remember that they are all **encapsulated** in the Reconstruction Parameters Sequence attribute. The description of GEMS private attribute is given at the end of this section.

NOTE: Following Module is intended to be part of a sequence item of the Reconstruction Parameter Sequence wich corresponds to the Data Element (0x47, 0xXX01)

TABLE 5.5-10
RECONSTRUCTION PARAMETER SEQUENCE MODULE ATTRIBUTES
(FOR XA MODALITY ORIGINAL IMAGES)

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008, 0070)	3	Original
Manufacturer Model Name	(0008, 1090)	3	Original
Software Versions	(0018,1020)	3	Original
Intensifier Size	(0018, 1162)	3	Original
Acquisition DLX Identifier	(0047, xx80)	3	Original
Acquisition DLX 2D Series Count	(0047, xx81)	1	Original
Acquisition DLX 2D Series Sequence	(0047, xx85)	1C	Original, required if Acquisition DLX 2D Series Count is greater than zero
> Series Date	(0008, 0021)	3	Original
> Series Time	(0008, 0031)	3	Original
> Contrast Flow Rates	(0018, 1046)	3	Original
> Injections Duration	(0018, 1047)	3	Original
> Frame Delay	(0018, 1066)	3	Original
> Frame Time Vector	(0018, 1065)	3	Original
> Sid	(0018, 1110)	3	Original
> Table Height	(0018, 1130)	3	Original
> Table Traverse	(0018, 1131)	3	Original
> Table Motion	(0018, 1134)	2	Original
> Table Vertical Increment	(0018, 1135)	3	Original
> Table Lateral Increment	(0018, 1136)	3	Original

> Table Longitudinal Increment	(0018, 1137)	3	Original
> Table Angle	(0018, 1138)	3	Original
> Fov	(0018, 1149)	3	Original
> Positioner Motion	(0018, 1500)	2C	Original, required if multi-frame data
> Positioner Primary Angle	(0018,1510)	3	Original
> Positioner Secondary Angle	(0018,1511)	3	Original
> Positioner Primary Angle Increment	(0018,1520)	3	Original
> Positioner Secondary Angle Increment	(0018,1521)	3	Original
> DLX Series Number	(0020, 0011)	3	Original
>Series Identifier	(0020, 000E)	3	Original
> Rows	(0028, 0010)	3	Original
> Columns	(0028, 0011)	3	Original
> Bits Stored	(0028, 0101)	3	Original
> Angle Value 1	(0019, xx01)	3	Original
> Angle Value 2	(0019, xx02)	3	Original
> Angle Value 3	(0019, xx03)	3	Original
> Angle Label 1	(0019, xx04)	3	Original
> Angle Label 2	(0019, xx05)	3	Original
> Angle Label 3	(0019, xx06)	3	Original
> Dlx Exam Name	(0019, xx08)	3	Original
> Dlx Record View	(0019, xx0A)	3	Original
> Dlx Injector Delay	(0019, xx10)	3	Original
> Dlx Dose	(0019, xx1C)	3	Original
> KPV List	(0047, xx70)	3	Original
>X-Ray Tube Current List	(0047, xx71)	3	Original
> Exposure Time List	(0019, xx72)	3	Original
> Number Of Injections	(0047, xx8A)	2	Original
> Frame Count	(0047, xx8B)	3	Original
> Contrast Agent Volume List	(0047, xx89)	3	Original
> Used Frames	(0047, xx96)	3	Original
XA 3D Reconstruction Algorithm Name	(0047, xx91)	3	Original
XA 3D Reconstruction Algorithm Version	(0047, xx92)	3	Original
DLX Calibration Date	(0047, xx93)	3	Original
DLX Calibration Time	(0047, xx94)	3	Original
DLX Calibration Status	(0047, xx95)	3	Original
Transform Count	(0047, xx98)	1	Original
Transform Sequence	(0047, xx99)	1C	Original, required if Transform Count > 0
> Transform Rotation Matrix	(0047, xx9A)	1C	Original, required if Transform Count > 0
> Transform Translation Vector	(0047, xx9B)	1C	Original, required if Transform Count > 0
> Transform Label	(0047, xx9C)	1C	Original, required if Transform Count > 0

9.5.5.2.1   Reconstruction Parameters Attribute Descriptions

We describe here only the new GEMS private attributes, whose group number is (0x0047). A complete description of other GEMS private attributes can be found in the foolowing documents :

- DLX related private attributes : see **Advantx DLX DICOM V3.0 Conformance Statement** (direction 2142506-100),

- MR Images related private attributes : see **HiSpeed Advantage CT/i Conformance Statement** (direction 2162114-100),

- CT Images related private attributes : see **HiSpeed Advantage CT/i Conformance Statement** (direction 2162114-100).

9.5.5.2.1.1   Reconstruction Parameters Sequence

This GEMSE private Sequence contains only one Sequence Item. This item is used to encapsulate the reconstruction parameters attributes to avoid possible confusions with the Image Entity.

9.5.5.2.1.2   Acquisition DLX identifier

Identifies the DLX device that acquired the images used to generate the 3-dimensional volume.

9.5.5.2.1.3   Acquisition DLX 2D Series Sequence

Each Item contained in this Sequence Data Element describes a Series acquired by the DLX device. These Series were used to build the 3-dimensional volume. One or more Frames are acquired within each Series.

9.5.5.2.1.4   Frame Count

Defines the number of Frames that were acquired within the current Series.

9.5.5.2.1.5   KPV List

Defines the value of KPV used to acquire each Frame of the Acquisition Series. Since this value may change within the same Acquisition Series, this attribute is described by a multi-valued string. We use a private attribute instead of the KPV data element (0018, 0060) in order to allow a Value Multiplicity greater than one.

9.5.5.2.1.6   X-ray Tube Current List

Defines the value of X-ray tube current used to acquire each Frame of the Acquisition Series. Since this value may change whitin the same Acquisition Series, this attribute is described by a multi-valued string. We use a private attribute instead of the X-ray Tube Current attribute (0018, 1151) in order to allow a Value Multiplicity greater than one.

9.5.5.2.1.7   Exposure Time List

Defines the value of exposure time used to acquire each Frame of the Acquisition Series. Since this value may change whitin the same Acquisition

Series, this attribute is described by a multi-valued string. We use a private attribute instead of the Exposure Time attribute (0018, 1152) in order to allow a Value Multiplicity greater than one.

9.5.5.2.2 Number of injections

Defines the number of contrast agent injections performed during the current Series.

9.5.5.2.3 Contrast Agent Volume List

Defines the volume of contrast agent corresponding to each injection. We use a private attribute instead of the Contrast/Bolus Volume Data Element (0018, 1041) in order to allow a Value Multiplicity greater than one.

9.5.5.2.4 Used frames

Identifies the Frames of the current Series that were used to chieve the 3-dimensional reconstruction. this attribute is described by a multi-valued integer string. Each item of this string codes the index of one of these frames (first frame of the Series is represented by « 1 »).

9.5.5.2.5 Reconstruction Algorithm Name

Defines the algorithm used to reconstruct the 3-dimensional volume from all the acquired Series. This attribute is described by a mono-valued string whose value is user-defined.

9.5.5.2.6 Reconstruction Algorithm Version

Identifies the version of the algorithm used to reconstruct the 3-dimensional volume from all the acquired Series.

9.5.5.2.7 DLX Calibration Date

Date of last measure of the helix used to reconstruct the 3-dimensional volume.

9.5.5.2.8 DLX Calibration Time

Time of last measure of the helix used to reconstruct the 3-dimensional volume.

9.5.5.2.9 DLX Calibration Status

Defines the validity of the DLX device calibration when the Series were acquired. This attribute is described by a string. Three terms are defined: « VALID », « OLD » and « UNKNOWN ».

9.5.5.2.10 Transform Count

Some geometrical transforms can be related to the 3-dimensional reconstruction from the aquired DLX Series. The Transform Count attribute defines the number of geometrical transforms.

9.5.5.2.11   Transform Sequence

Each Item of this Sequence attribute describes a geometrical tranform. The geometrical parameters that define such a transform are a rotation matrix and a translation vector. These geometrical parameters are related to the slice-relative referential.

9.5.5.2.12   Transform Rotation Matrix

Defines the rotation matrix that corresponds to the current transform.

9.5.5.2.13   Transform Translation Vector

Defines the translation vector that corresponds to the current transform.

9.5.5.2.14   Transform Label

Identifies the current transform. The value of this label is user-defined.

9.5.5.3   Volumic Data Module

This section specifies the Attributes which describe the 3-dimensional volumic data. Most of them are GEMS private.

TABLE 5.5-11
VOLUMIC DATA MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Volume Color	(0047, xx49)	3	Generated
Volume Voxel Count	(0047, xx50)	1	Generated
Volume Segment Count	(0047, xx51)	1	Generated
Volume Slice Size	(0047, xx53)	1	Generated
Volume Slice Count	(0047, xx54)	1	Generated
Volume Threshold Value	(0047, xx55)	2C	Generated
Volume Voxel Ratio	(0047, xx57)	1	Generated
Volume Voxel Size	(0047, xx58)	1	Generated
Volume Z Position Size	(0047, xx59)	1	Generated
Volume Base Line	(0047, xx60)	1	Generated
Volume Center Point	(0047, xx61)	1	Generated
Volume Skew Base	(0047, xx63)	1	Generated
Volume Registration Transform Rotation Matrix	(0047, xx64)	3	Generated
Volume Registration Transform Translation Vector	(0047, xx65)	3	Generated
Volume Upper Left High Corner RAS	(0047, xxC0)	1	Generated
Volume Slice to RAS Rotation Matrix	(0047, xxC1)	1	Generated
Volume Upper Left High Corner TLOC	(0047, xxC2)	1	Generated
Volume Volume Segment List	(0047, xxD1)	1	Generated
Volume Gradient List	(0047, xxD2)	1	Generated

Volume Density List	(0047, xxD3)	1	Generated
Volume Z Position List	(0047, xxD4)	1	Generated
Volume Original Index List	(0047, xxD5)	1	Generated

9.5.5.3.1 Volumic Data Attribute Descriptions

9.5.5.3.1.1 Volume Color

Multi-valued string that describes the color used to display the three-dimensional model. This color is described through the RGB code.

9.5.5.3.1.2 Voxel Count

Defines the number of volumic elements (« voxels ») used to describe the three-dimensional reconstruction.

9.5.5.3.1.3 Segment Count

The voxels are grouped into sets called « segments ». This attribute defines the number of segments used to describe the three-dimensional reconstruction. In multi-volume mode, this value is multi-valuated : each value gives the number of segments of each volume.

9.5.5.3.1.4 Slice Count

The 3-dimensional volume can be seen as a superposition of voxel slices. This attribute defines the number of slices used to describe the three-dimensional reconstruction.

9.5.5.3.1.5 Threshold Value

Defines the value of the threshold applied to the volumic data. If no threshold is applied, set this attribute to zero.

9.5.5.3.1.6 Ratio

Defines the ratio between slice spacing and voxel size.

9.5.5.3.1.7 Voxel size

Defines the size of a voxel (cubic element).

9.5.5.3.1.8 Z Position size

Defines the z location of the original slices.

9.5.5.3.1.9 Base Line

3x3 matrix that defines the slices orientation.

9.5.5.3.1.10 Center Point

Defines the coordinates of the volume center point.

9.5.5.3.1.11   Registration Transform Rotation Matrix

3x3 matrix that defines the rotation matrix associated to the transform from the slice-relative refernetial to another arbitrary referential. Set to null matrix if no transformation is defined.

9.5.5.3.1.12   Registration Transform Translation Vector

3x1 vector that defines the translation vector associated to the transform from the slice-relative refernetial to another arbitrary referential. Set to null vector if no transformation is defined.

9.5.5.3.1.13   Upper Left High Corner RAS

3x1 vector that defines the coordinates of the Upper Left High Corner (i.e. first voxel of the first slice) in the RAS refernetial.

9.5.5.3.1.14   Slice To RAS Rotation Matrix

3x3 matrix that defines the rotation matrix associated to the transform from the RAS referential to slice-relative referential.

9.5.5.3.1.15   Upper Left High Corner TLOC

9.5.5.3.1.16   Segment List

Describes the list of segments used to describe the three-dimensional reconstruction.

9.5.5.3.1.17   Gradient List

Describes the gradients for each voxel of the Segment List.

9.5.5.3.1.18   Density List

Defines the value of each voxel of the Segment List.

9.5.5.3.1.19   Z Position List

Defines the Z location of original slices.

9.5.5.3.1.20   Original Index List

Defines the rank index list of original slices.

9.5.5.4   Wireframe Module

This section specifies the attributes which describe the 3-dimensional wireframes (if any) attached to 3-dimensional volume. All of them are GEMS private.

TABLE 5.5-12
WIREFRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Wireframe Count	(0047, xxB1)	1	Generated
Location System	(0047, xxB2)	2C	Generated
Wireframe List	(0047, xxB0)	1C	Generated
> Wireframe Name	(0047, xxB5)	3	Generated
> Wireframe Group Name	(0047, xxB6)	3	Generated
> Wireframe Color	(0047, xxB7)	3	Generated
> Wireframe Attributes	(0047, xxB8)	3	Generated
> Wireframe Point Count	(0047, xxB9)	1	Generated
> Wireframe Timestamp	(0047, xxBA)	3	Generated
> Wireframe Point List	(0047, xxBB)	1C	Generated
> > Wireframe Points Coordinates	(0047, xxBC)	1	Generated

9.5.5.4.1   wireframe Attribute Descriptions

9.5.5.4.1.1   Wireframe Count

Defines the number of wireframes attached to the three-dimensional reconstruction.

9.5.5.4.1.2   Location System

Enumerated value that defines the location system for wich the points coordinates are given. The defined values are:

0: slice relative, 1: center relative, 2: RAS relative, 3: auxiliar relative, 4: auxiliar relative (polar), 5: registration relative, 6: registration relative(polar). Default value is 0.

Required if Wireframe Count has a non-null value.

9.5.5.4.1.3   Wireframe List

Describes each wireframe as a Sequence Item. Required if Wireframe Count has a non-null value.

9.5.5.4.1.4   Wireframe Name

Label that identifies the wirefame (type 3 attribute).

9.5.5.4.1.5   Wireframe Group Name

Label that identifies the group of the wirefame (type 3 attribute).

9.5.5.4.1.6   Wireframe Color

Label that defines the wirefame's color (type 3 attribute).

9.5.5.4.1.7   Wireframe Attributes

Defines the attributes of the wireframe.

9.5.5.4.1.8   Wireframe Point Count

Defines the number of points that compose this wireframe..

9.5.5.4.1.9   Wireframe Timestamp

Defines a time stamp attached to the wireframe (type 3 attribute).

9.5.5.4.1.10   Wireframe Point List

Describes each point of the wireframe as a Sequence Item. There is as many Sequence Items as points. Required if Wireframe Point Count has a non-null value.

9.5.5.4.1.11   Point Coordinates

3x1 vector that describes the point coordinates relative to the location system specified by the Location System attribute.

9.5.6   Common Image Entity Modules

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

9.5.6.1   General Image Module

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

TABLE 9.5-13
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Generated

9.5.6.2   Image Pixel Module

This section specifies the Attributes that describe the pixel data of the image. This image represents a view of the 3-dimensional volume.

TABLE 9.5-14
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description

Samples per Pixel	(0028,0002)	1	Generated:1
Photometric Interpretation	(0028,0004)	1	Generated: « MONOCHROME2 »
Rows	(0028,0010)	1	Generated: 64
Columns	(0028,0011)	1	Generated: 64
Bits Allocated	(0028,0100)	1	Generated: 8
Bits Stored	(0028,0101)	1	Generated: 8
High Bit	(0028,0102)	1	Generated: 8
Pixel Representation	(0028,0103)	1	Generated: 0
Pixel Data	(7FE0,0010)	1	Generated

9.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

9.5.7.1 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 9.5-15
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Generated: « 1.2.840.113619.4.26 »
SOP Instance UID	(0008,0018)	1	Generated

9.6   **PRIVATE DATA DICTIONARY**

The Type of a Private Attribute is determined by the module of the IOD in which it is used, and hence is not listed in this dictionary. Private Attributes contained within these list are described in the preceding sections in the appropriate module.

TABLE 5.6-1
3D MODEL IOD PRIVATE ATTRIBUTES

Attribute Name	Tag	VR	VM
Private Creator « GE_GENESIS_REV3.0 »	(0019, 00xx)	LO	1
Axial Type	(0019, xx39)	SS	1
Swap Phase / Frequency Axis	(0019, xx8F)	SS	1
Pulse Sequence Name	(0019, xx9C)	SS	1
Coil Type	(0019, xx9F)	SS	1
SAT fat/water/none	(0019, xxA4)	SS	1
Bitmap of SAT Selections	(0019, xxC0)	SS	1
Surfacel Coil Intensity Correction Flag	(0019, xxC1)	SS	1
Phase Contrast Flow Axis	(0019, xxCB)	SS	1
Phase Contrast Velocity Encoding	(0019, xxCC)	SS	1
Fractional Echo	(0019, xxD5)	SS	1
Variable Echo Flag	(0019, xxD8)	SS	1
Concatenated Sat	(0019, xxD9)	DS	1
Number of Phases	(0019, xxF2)	SS	1
Private Creator « SERIE_01 »	(0019, 00xx)	LO	1
Angle Value 1	(0019, xx01)	DS	1
Angle Value 2	(0019, xx02)	DS	1
Angle Value 3	(0019, xx03)	DS	1
Angle Label 1	(0019, xx04)	CS	1
Angle Label 2	(0019, xx05)	CS	1
Angle Label 3	(0019, xx06)	CS	1
DLX Exam Name	(0019, xx08)	ST	1
Dlx Record View	(0019, xx0A)	IS	1
Dlx Injector Delay	(0019, xx10)	DS	1
Dlx Dose	(0019, xx1C)	CS	1
Private Creator « GEMS_ADWSoft_DPO »	(0039, 00xx)	LO	1

Private Entity Number	(0039,xx80)	IS	1
Private Entity Date	(0039,xx85)	DA	1
Private Entity Time	(0039,xx90)	TM	1
Private Entity Launch Command	(0039,xx95)	LO	1
Private Entity Type	(0039,xxAA)	CS	1
Private Creator « GE_GENESIS_REV3.0 »	(0043, 00xx)	LO	1
Delta Start Time	(0043, xx1E)	DS	1
Pitch Ratio	(0043, xx27)	SH	1
Private Creator « GEMS_ADWSoft_3D1 »	(0047, 00xx)	LO	1
Reconstruction Parameters Sequence	(0047, xx01)	SQ	1
Volume Color	(0047, xx49)	UL	3-N
Volume Voxel Count	(0047, xx50)	UL	1
Volume Segment Count	(0047, xx51)	UL	1-N
Volume Slice Size	(0047, xx53)	US	1
Volume Slice Count	(0047, xx54)	US	1
Volume Threshold Value	(0047, xx55)	SL	1
Volume Voxel Ratio	(0047, xx57)	DS	1
Volume Voxel Size	(0047, xx58)	DS	1
Volume Z Position Size	(0047, xx59)	US	1
Volume Base Line	(0047, xx60)	DS	9
Volume Center Point	(0047, xx61)	DS	3
Volume Skew Base	(0047, xx63)	SL	1
Volume Registration Transform Rotation Matrix	(0047, xx64)	DS	9
Volume Registration Transform Translation Vector	(0047, xx65)	DS	3
KPV List	(0047, xx70)	DS	1-N
X-Ray Tube Current List	(0047, xx71)	IS	1-N
Exposure List	(0047, xx72)	IS	1-N
Acquisition DLX Identifier	(0047, xx80)	LO	1
Acquisition DLX 2D Series Count	(0047, xx81)	IS	1
Acquisition DLX 2D Series Sequence	(0047, xx85)	SQ	1
Contrast Agent Volume List	(0047, xx89)	DS	1-N
Number Of Injections	(0047, xx8A)	US	1
Frame Count	(0047, xx8B)	US	1
Used Frames	(0047, xx96)	IS	1-N
XA 3D Reconstruction Algorithm Name	(0047, xx91)	LO	1
XA 3D Reconstruction Algorithm Version	(0047, xx92)	CS	1
DLX Calibration Date	(0047, xx93)	DA	1
DLX Calibration Time	(0047, xx94)	TM	1
DLX Calibration Status	(0047, xx95)	CS	1

Transform Count	(0047, xx98)	US	1
Transform Sequence	(0047, xx99)	SQ	1
Transform Rotation Matrix	(0047, xx9A)	DS	9
Transform Translation Vector	(0047, xx9B)	DS	3
Transform Label	(0047, xx9C)	LO	1
Wireframe Count	(0047, xxB1)	US	1
Location System	(0047, xxB2)	US	1
Wireframe List	(0047, xxB0)	SQ	1
Wireframe Name	(0047, xxB5)	LO	1
Wireframe Group Name	(0047, xxB6)	LO	1
Wireframe Color	(0047, xxB7)	LO	1
Wireframe Attributes	(0047, xxB8)	SL	1
Wireframe Point Count	(0047, xxB9)	SL	1
Wireframe Timestamp	(0047, xxBA)	SL	1
Wireframe Point List	(0047, xxBB)	SQ	1
Wireframe Points Coordinates	(0047, xxBC)	DS	3
Volume Upper Left High Corner RAS	(0047, xxC0)	DS	3
Volume Slice To RAS Rotation Matrix	(0047, xxC1)	DS	9
Volume Upper Left High Corner TLOC	(0047, xxC2)	DS	1
Volume Segment List	(0047, xxD1)	OB	1
Volume Gradient List	(0047, xxD2)	OB	1
Volume Density List	(0047, xxD3)	OB	1
Volume Z Position List	(0047, xxD4)	OB	1
Volume Original Index List	(0047, xxD5)	OB	1