GE Medical Systems

Technical Publications

Direction 2290660-100
Revision A

CT/PET FUSION DICOM CONFORMANCE STATEMENT for DICOM V3.0

NETWORK CONFORMANCE STATEMENT

CT INFORMATION OBJECT IMPLEMENTATION

PET INFORMATION OBJECT IMPLEMENTATION

NUCLEAR MEDICINE (NM) INFORMATION OBJECT IMPLEMENTATION

3D MODEL INFORMATION OBJECT IMPLEMENTATION

SC INFORMATION OBJECT IMPLEMENTATION

RT STRUCTURE SET INFORMATION OBJECT IMPLEMENTATION

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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 (Conformance Statement), which defines the subset of options selected from those offered by the DICOM standard.

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

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

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

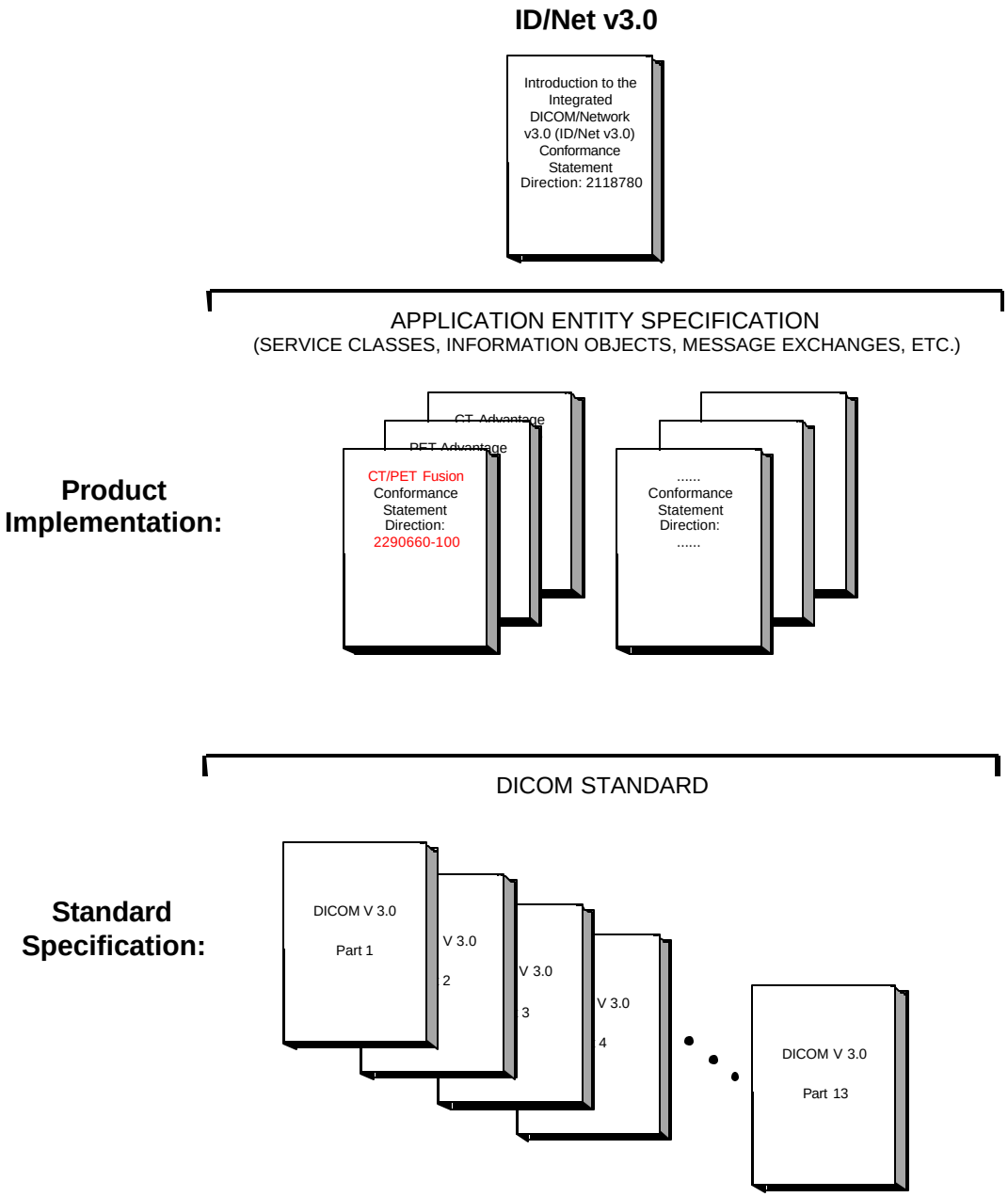
Section 6 (3D Model Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a 3D Model Information Object (GEMS private DICOM Information Object)

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

Section 8 (RTSS Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of the Radio Therapy Structure Sets Information Object Implementation.

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.



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

CT/PET FUSION
Conformance Statement for DICOM v3.0
*Direction **2290660-100***

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
Dat_Wall@nema.org

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, PET Information Object, NM 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 ID/Net 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 ID/Net DICOM Conformance Statements**. The **user** should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

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

1.6 REFERENCES

A list of references 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*.

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the conformance statement (CS) specifies the CT/PET Fusion compliance to DICOM Media Interchange. It details the DICOM Media Storage Application Profiles and roles which are supported by this product.

CT/PET Fusion is a software application designed to be used on the Advantage workstation. It uses DICOM images to reconstructs 3-dimensional volume on CT or PET or NM series. The views of 3-dimensional volumes displayed by the application are saved in DICOM format (Secondary Capture). These Secondary Captures can be loaded and displayed by other GEMS applications (such as the Image Viewer).

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 CT/PET Fusion at a later date for follow-up processings.

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

- the DICOM IODs (CT, PET and NM) that are required to reconstruct a 3-dimensional volume (sections 3 and 4),
- the private IOD (3D Model) that contains the information of a 3-dimensional volume (section 5),
- the SC IOD (Secondary Capture image) generated from the view of a 3-dimensional volume (section 6),
- the RTSS IOD (RT Structure Sets) generated from contours on the reconstructed models (section 7).

Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

3. CT INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

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

3.2 - IOD Description

3.3 - IOD Entity-Relationship Model

3.4 - IOD Module Table

3.5 - IOD Module Definition

3.2 CT IOD IMPLEMENTATION

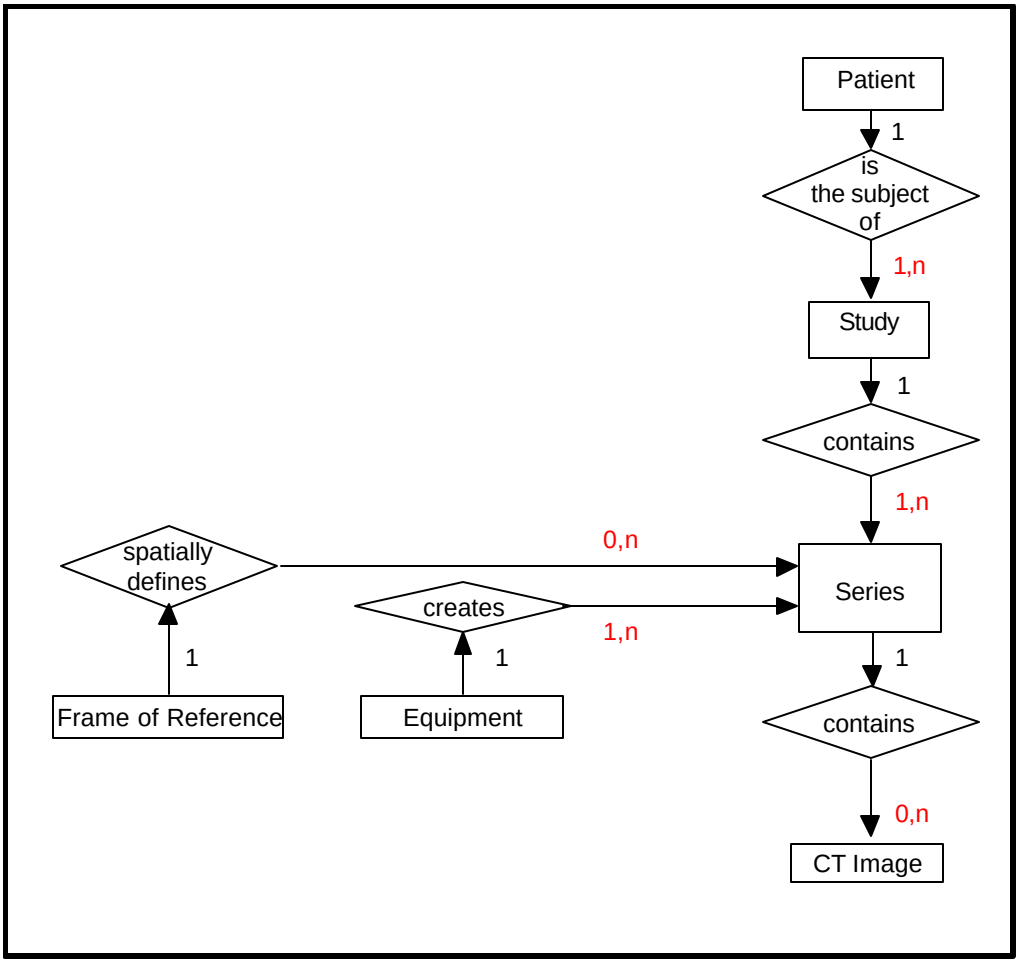
3.3 CT ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the CT Image interoperability schema is shown in Illustration 3.3-1**.** 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 3.3-1
CT IMAGE ENTITY RELATIONSHIP DIAGRAM



3.3.1 ENTITY DESCRIPTIONS

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

3.3.1.1 Patient Entity Description

3.3.1.2 Study Entity Description

3.3.1.3 Series Entity Description

3.3.1.4 Equipment Entity Description

3.3.1.5 Frame of Reference Entity Description

3.3.1.6 CT Image Entity Description

3.3.1.7 Overlay Entity Description

3.3.1.8 VOI Lookup Table Entity Description

3.3.2 CT/PET Fusion Mapping of DICOM entities

TABLE 3.3-1
MAPPING OF DICOM ENTITIES TO CT/PET FUSION ENTITIES

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

3.4 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 3.4-1 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. Note that some attributes that are type 2 or 3 **are mandatory here** : they are needed to achieve the 3-dimensional reconstruction.

TABLE 3.4-1
CT IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	3.5.1.1
Study	General Study	3.5.2.1
	Patient Study	3.5.2.2
Series	General Series	3.5.3.1
Frame of Reference	Frame of Reference	3.5.4.1
Equipment	General Equipment	3.5.5.1
Image	General Image	3.5.6.1
	Image Plane	3.5.6.2
	Image Pixel	3.5.6.3
	Contrast/Bolus	3.5.6.4
	CT Image	3.5.8.1
	SOP Common	3.5.7.1

3.5 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).

3.5.1 Common Patient Entity Modules

3.5.1.1 Patient Module

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

TABLE 3.5-1
PATIENT MODULE ATTRIBUTES

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

3.5.2 Common Study Entity Modules

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

3.5.2.1 General Study Module

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

TABLE 3.5-2
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Used, default empty
Study Date	(0008,0020)	2	Used, default empty
Study Time	(0008,0030)	2	Used, default empty
Referring Physician's Name	(0008,0090)	2	Used, default empty
Study ID	(0020,0010)	2	Used, default empty
Accession Number	(0008,0050)	2	Not Used
Study Description	(0008,1030)	3	Used, default empty

3.5.2.2 Patient Study Module

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

TABLE 3.5-3
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Used
Patient's Weight	(0010,1030)	3	Used

3.5.3 Common Series Entity Modules

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

3.5.3.1 General Series Module

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

TABLE 3.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Not used, should be « CT »
Series Instance UID	(0020,000E)	1	Not used
Series Number	(0020,0011)	2	Used, default empty
Patient Position	(0018,5100)	2C	Required for CT images

3.5.4 Common Frame Of Reference Entity Modules

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

3.5.4.1 Frame Of Reference 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.

TABLE 3.5-5
FRAME OF REFERENCE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Used, default empty
Position Reference Indicator	(0020,1040)	2	Not Used

3.5.5 Common Equipment Entity Modules

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

3.5.5.1 General Equipment Module

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

TABLE 3.5-6
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Not Used
Institution Name	(0008,0080)	3	Used, default empty
Institution Address	(0008,0081)	3	Not Used
Station Name	(0008,1010)	3	Used, default empty
Institutional Department Name	(0008,1040)	3	Not Used
Manufacturer's Model Name	(0008,1090)	3	Used, default empty
Device Serial Number	(0018,1000)	3	Not Used
Software Versions	(0018,1020)	3	Not Used
Spatial Resolution	(0018,1050)	3	Not Used
Date of Last Calibration	(0018,1200)	3	Not Used
Time of Last Calibration	(0018,1201)	3	Not Used
Pixel Padding Value	(0028,0120)	3	Used, default 0

3.5.6 Common Image Entity Modules

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

3.5.6.1 General Image Module

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

TABLE 3.5-7
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Mandatory
Patient Orientation	(0020,0020)	2C	Not Used
Image Date	(0008,0023)	2C	Not Used
Image Time	(0008,0033)	2C	Not Used
Image Type	(0008,0008)	3	Not Used
Acquisition Number	(0020,0012)	3	Not Used
Acquisition Date	(0008,0022)	3	Not Used
Acquisition Time	(0008,0032)	3	Not Used
Referenced Image Sequence	(0008,1140)	3	Not Used
>Referenced SOP Class UID	(0008,1150)	1C	Not Used
>Referenced SOP Instance UID	(0008,1155)	1C	Not Used
Derivation Description	(0008,2111)	3	Not Used
Source Image Sequence	(0008,2112)	3	Not Used

>Referenced SOP Class UID	(0008,1150)	1C	Not Used
>Referenced SOP Instance UID	(0008,1155)	1C	Not Used
Images in Acquisition	(0020,1002)	3	Not Used
Image Comments	(0020,4000)	3	Not Used
Lossy Image Compression	(0028,2110)	3	Not Used

3.5.6.2 Image Plane Module

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

TABLE 3.5-8
IMAGE PLANE MODULE ATTRIBUTES

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

3.5.6.3 Image Pixel Module

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

TABLE 3.5-9
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Not Used
Photometric Interpretation	(0028,0004)	1	Not Used
Rows	(0028,0010)	1	Used, default 0
Columns	(0028,0011)	1	Used, default 0
Bits Allocated	(0028,0100)	1	Not Used
Bits Stored	(0028,0101)	1	Not Used
High Bit	(0028,0102)	1	Not Used
Pixel Representation	(0028,0103)	1	Not Used
Pixel Data	(7FE0,0010)	1	Used
Smallest Image Pixel Value	(0028,0106)	3	Used, default 0
Largest Image Pixel Value	(0028,0107)	3	Used, default 4095

3.5.6.4 Contrast/Bolus Module

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

TABLE 3.5-10
CONTRAST/BOLUS MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	Used, default empty

3.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

3.5.7.1 SOP Common Module

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

TABLE 3.5-11
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used, should be 1.2.840.10008.5.1.4.1.1.2
SOP Instance UID	(0008,0018)	1	Not Used

3.5.8 CT Modules

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

3.5.8.1 CT Image Module

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

TABLE 3.5-12
CT IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Not Used
Samples per Pixel	(0028,0002)	1	Not used, shall be 1
Photometric Interpretation	(0028,0004)	1	Not Used
Bits Allocated	(0028,0100)	1	Not used, shall be 16
Bits Stored	(0028,0101)	1	Not Used
High Bit	(0028,0102)	1	Not Used
Rescale Intercept	(0028, 1052)	1	Used, default -1024
Rescale Slope	(0028,1053)	1	Used, default 1
KVP	(0018,0060)	2	Mandatory
Acquisition Number	(0020,0012)	2	Not Used
Gantry/Detector Tilt	(0018,1120)	3	Mandatory
Exposure Time	(0018,1150)	3	Not Used
X-ray Tube Current	(0018,1151)	3	Mandatory
Convolution Kernel	(0018,1210)	3	Mandatory

3.6 LIST OF MANDATORY ATTRIBUTES REQUIRED BY THIS APPLICATION

Following table recalls the list of attributes that are used by this application to achieve the 3D processings. Note that some of them are not type 1 in DICOM standard. Besides, some type 1 attributes do not appear in the following table because they are not explicitly used by the application, yet they must be included in the Data Set of the CT Image Information Object.

TABLE 3.6-1
CT IMAGE IOD ATTRIBUTES REQUIRED BY THIS APPLICATION

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used, should be 1.2.840.10008.5.1.4.1.1.2
Patient's Name	(0010,0010)	2	Used, default empty
Patient ID	(0010,0020)	2	Used, default empty
Slice Thickness	(0018,0050)	2	Mandatory
KVP	(0018,0060)	2	Mandatory
Patient Position	(0018,5100)	2C	Mandatory
Gantry/Detector Tilt	(0018,1120)	3	Mandatory
X-ray Tube Current	(0018,1151)	3	Mandatory
Convolution Kernel	(0018,1210)	3	Mandatory
Image Position (Patient)	(0020,0032)	1	Used

Image Orientation (Patient)	(0020,0037)	1	Used
Frame of Reference UID	(0020,0052)	1	Used, default empty
Study Instance UID	(0020,000D)	1	Used, default empty
Rows	(0028,0010)	1	Used
Columns	(0028,0011)	1	Used
Pixel Spacing	(0028,0030)	1	Used
Rescale Intercept	(0028, 1052)	1	Used, default -1024
Rescale Slope	(0028,1053)	1	Used, default 1
Pixel Data	(7FE0,0010)	1	Used

4. PET INFORMATION OBJECT IMPLEMENTATION

See Advance™ 4.1Conformance Statement for DICOM V3.0, 2270669-100, rev. 1.0, section 3.

5. NUCLEAR MEDICINE (NM) INFORMATION OBJECT IMPLEMENTATION

See GENIE™ 4.1 Acquisition R2.1 and R2.2 Conformance Statement for DICOM V3.0, 2227918-100, rev. 0, section 3.

6. 3D MODEL INFORMATION OBJECT IMPLEMENTATION

6.1 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:

3.2 - IOD Description

3.3 - IOD Entity-Relationship Model

3.4 - IOD Module Table

3.5 - IOD Module Definition

6.2 3D MODEL IOD IMPLEMENTATION

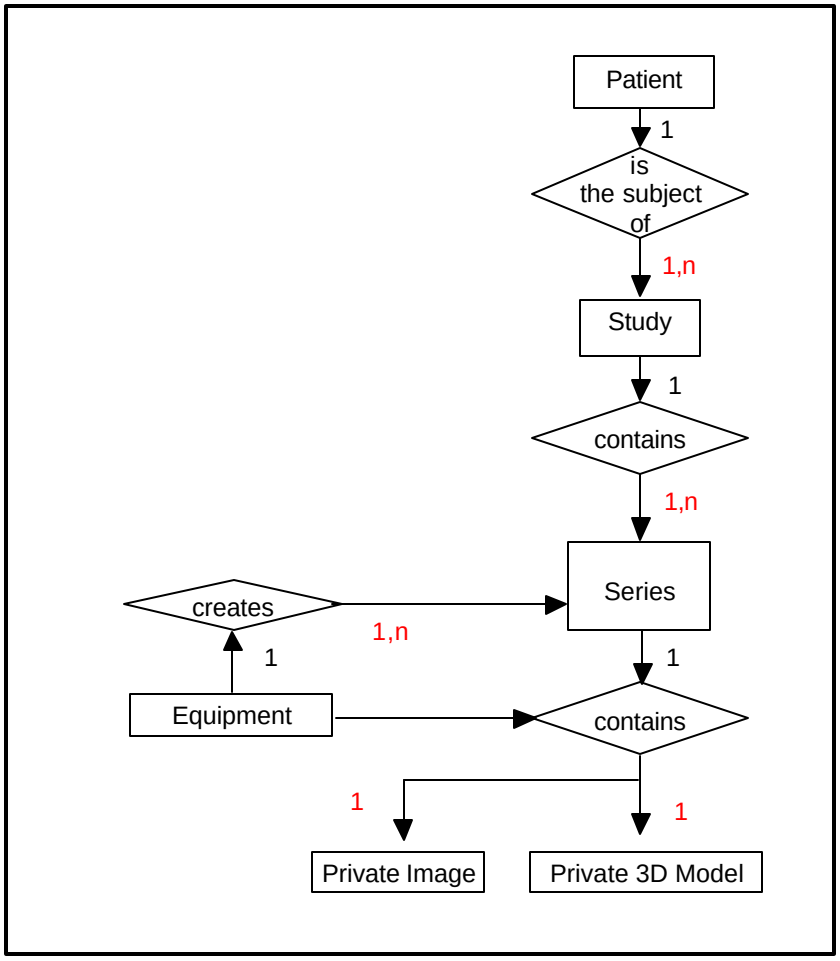
6.3 3D MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the 3D Model interoperability schema is shown in Illustration 3.3-1**.** 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 3.3-1
3D MODEL ENTITY RELATIONSHIP DIAGRAM



6.3.1 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).

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 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.

6.3.1.6 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.

6.3.2 CT/PET Fusion Mapping of DICOM entities

TABLE 6.3-1
MAPPING OF DICOM ENTITIES TO CT/PET FUSION ENTITIES

DICOM	CT/PET Fusion Entity
Patient	Patient
Study	Exam
Series	Series
Image	Private Image

6.4 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 3.4-1 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, PET or NM images used to generate the 3-dimensional volume),
- Empty : this attribute is saved but is empty,
- Not Saved : this attribute is not saved.

TABLE 6.4-2
3D MODEL IOD MODULES

Entity Name	Module Name	Reference	Usage
Patient	Patient	3.5.1.1	M
Study	General Study	3.5.2.1	M
	Patient Study	3.5.2.2	U
Series	General Series	3.5.3.1	M
Equipment	General Equipment	3.5.5.1	M
Private Image	Image Pixel	5.5.6.1	M
Private 3D Model	Common Private Entity	5.5.5.1	M
	Reconstruction Parameter Sequence > CT Reconstruction Parameters	5.5.5.2 5.5.5.2	M C - Required if modality = CT
	> PET Reconstruction Parameters	5.5.5.2	C- Required if modality = PET
	> NM Reconstruction Parameters	5.5.5.2	C- Required if modality = NM
	> XA Reconstruction Parameters	5.5.5.2	C- Required if modality = XA
	Volumic Data	5.5.5.3	M
	SOP Common	3.5.7.1	M

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 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.

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	Original
Patient ID	(0010,0020)	2	Original
Patient's Birth Date	(0010,0030)	2	Original
Patient's Sex	(0010,0040)	2	Original

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	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

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
Patient's Age	(0010,1010)	3	Original
Patient's Weight	(0010,1030)	3	Original

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	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

6.5.4 Common Equipment Entity Modules

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

6.5.4.1 General Equipment Module

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

TABLE 6.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Generated
Institution Name	(0008,0080)	3	Generated
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

6.5.5 3D Model Entity Modules

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

6.5.5.1 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_vxtl »
Private Entity Type	(0039,xxAA)	1	Generated: « 3DDPO »

6.5.5.1.1 Common Private Entity Attribute Descriptions

6.5.5.1.1.1 Private Entity Number

Identifies the private entity instance.

6.5.5.1.1.2 Private Entity Date

Defines the creation date of this private entity.

6.5.5.1.1.3 Private Entity Time

Defines the creation time of this private entity.

6.5.5.1.1.4 Private Entity Launch Command

Defines the command that should be called to launch the application corresponding to the Private Entity (CT/PET Fusion, in our case).

6.5.5.1.1.5 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.

6.5.5.2 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 semantic 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, PET and NM 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 PET or NM 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 which corresponds to the Data Element (0x47, 0xXX01)

TABLE 5.5-8
RECONSTRUCTION PARAMETER SEQUENCE MODULE ATTRIBUTES
(FOR PET OR NM MODALITY ORIGINAL IMAGES)

NOTE: THIS TABLE IS TBD.

Attribute Name	Tag	Type	Attribute Description

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 which 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 which 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

6.5.5.2.1 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 following documents :

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

- PET Images related private attributes : see **Advance™ 4.1Conformance Statement for DICOM V3.0** (direction 2270669-100),
- NM Images related private attributes : see **GENIE™ 4.1 Acquisition R2.1 and R2.2 Conformance Statement for DICOM V3.0** (direction 2227918-100),
- CT Images related private attributes : see **HiSpeed Advantage CT/i Conformance Statement** (direction 2162114-100).

6.5.5.2.1.1 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.

6.5.5.2.1.2 Acquisition DLX identifier

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

6.5.5.2.1.3 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.

6.5.5.2.1.4 Frame Count

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

6.5.5.2.1.5 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.

6.5.5.2.1.6 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 within 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.

6.5.5.2.1.7 Exposure Time List

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

6.5.5.2.2 Number of injections

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

6.5.5.2.3 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.

6.5.5.2.4 Used frames

Identifies the Frames of the current Series that were used to achieve the 3dimensional 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 »).

6.5.5.2.5 Reconstruction Algorithm Name

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

6.5.5.2.6 Reconstruction Algorithm Version

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

6.5.5.2.7 DLX Calibration Date

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

6.5.5.2.8 DLX Calibration Time

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

6.5.5.2.9 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 ».

6.5.5.2.10 Transform Count

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

6.5.5.2.11 Transform Sequence

Each Item of this Sequence attribute describes a geometrical transform. 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.

6.5.5.2.12 Transform Rotation Matrix

Defines the rotation matrix that corresponds to the current transform.

6.5.5.2.13 Transform Translation Vector

Defines the translation vector that corresponds to the current transform.

6.5.5.2.14 Transform Label

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

6.5.5.3 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

6.5.5.3.1 Volumic Data Attribute Descriptions

6.5.5.3.1.1 Volume Color

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

6.5.5.3.1.2 Voxel Count

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

6.5.5.3.1.3 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-valued : each value gives the number of segments of each volume.

6.5.5.3.1.4 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.

6.5.5.3.1.5 Threshold Value

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

6.5.5.3.1.6 Ratio

Defines the ratio between slice spacing and voxel size.

6.5.5.3.1.7 Voxel size

Defines the size of a voxel (cubic element).

6.5.5.3.1.8 Z Position size

Defines the z location of the original slices.

6.5.5.3.1.9 Base Line

3x3 matrix that defines the slices orientation.

6.5.5.3.1.10 Center Point

Defines the coordinates of the volume center point.

6.5.5.3.1.11 Registration Transform Rotation Matrix

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

6.5.5.3.1.12 Registration Transform Translation Vector

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

6.5.5.3.1.13 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 referential.

6.5.5.3.1.14 Slice To RAS Rotation Matrix

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

6.5.5.3.1.15 Upper Left High Corner TLOC

6.5.5.3.1.16 Segment List

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

6.5.5.3.1.17 Gradient List

Describes the gradients for each voxel of the Segment List.

6.5.5.3.1.18 Density List

Defines the value of each voxel of the Segment List.

6.5.5.3.1.19 Z Position List

Defines the Z location of original slices.

6.5.5.3.1.20 Original Index List

Defines the rank index list of original slices.

6.5.5.4 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

6.5.5.4.1 wireframe Attribute Descriptions

6.5.5.4.1.1 Wireframe Count

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

6.5.5.4.1.2 Location System

Enumerated value that defines the location system for which 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.

6.5.5.4.1.3 Wireframe List

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

6.5.5.4.1.4 Wireframe Name

Label that identifies the wireframe (type 3 attribute).

6.5.5.4.1.5 Wireframe Group Name

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

6.5.5.4.1.6 Wireframe Color

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

6.5.5.4.1.7 Wireframe Attributes

Defines the attributes of the wireframe.

6.5.5.4.1.8 Wireframe Point Count

Defines the number of points that compose this wireframe..

6.5.5.4.1.9 Wireframe Timestamp

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

6.5.5.4.1.10 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.

6.5.5.4.1.11 Point Coordinates

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

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 that identify and describe an image within a particular series.

TABLE 6.5-13
GENERAL IMAGE MODULE ATTRIBUTES

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

6.5.6.2 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 6.5-14
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

6.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

6.5.7.1 SOP Common Module

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

TABLE 6.5-15
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

6.6 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 « GEMS_ACQU_01 **»**	(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 «DLX_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_DPO1 »	(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 « GEMS_PARM_01 **»**	(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

7. SC INFORMATION OBJECT IMPLEMENTATION

7.1 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:

7.2 - IOD Description

7.3 - IOD Entity-Relationship Model

7.4 - IOD Module Table

7.5 - IOD Module Definition

7.2 SC IOD IMPLEMENTATION

This section defines the implementation of SC image information object. It refers to the DICOM Standard, Part 3 (Information Object definition).

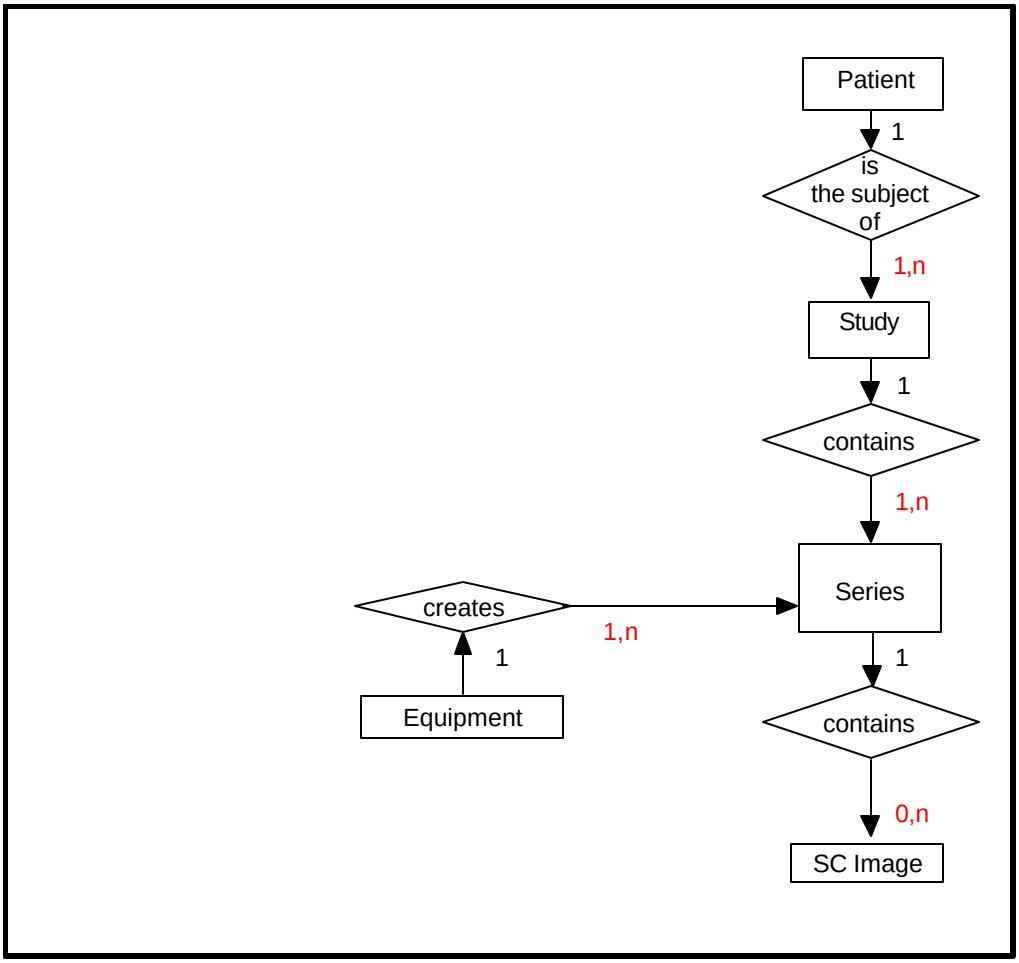
7.3 SC ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the SC Image interoperability schema is shown in Illustration 7.3-1. 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 7.3-1
SC 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 SC Information Object.

7.3.2 CT/PET Fusion Mapping of DICOM entities

TABLE 7.3-1
MAPPING OF DICOM ENTITIES TO CT/PET FUSION ENTITIES

DICOM	CT/PET Fusion Entity
Patient Entity	Patient Entity
Study Entity	Examination Entity
Series Entity	Series Entity
Secondary Capture Image Entity	Screen Save Image

7.4 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 7.4-1 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 7.4-1
SC 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
Equipment	General Equipment	7.5.4.1
	SC Equipment	7.5.8.1
Image	General Image	7.5.5.1
	Image Pixel	7.5.5.2
	SC Image	7.5.8.2
	Modality LUT	7.5.6.2
	VOI LUT	7.5.6.1
	SOP Common	7.5.7.1

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 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).

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	Original
Patient ID	(0010,0020)	2	Original
Patient's Birth Date	(0010,0030)	2	Original
Patient's Sex	(0010,0040)	2	Original

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	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	Empty

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
Patient's Age	(0010,1010)	3	Original
Patient's Weight	(0010,1030)	3	Original

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	Original
Series Instance UID	(0020,000E)	1	Generated
Series Number	(0020,0011)	2	Generated
Laterality	(0020,0060)	3	Empty
Series Description	(0008,103E)	3	Generated
Patient Position	(0018,5100)	2C	Original, required for CT, PET and NM images

7.5.4 Common Equipment Entity Modules

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

7.5.4.1 General Equipment Module

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

TABLE 7.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Empty
Institution Name	(0008,0080)	3	Original
Station Name	(0008,1010)	3	Original
Manufacturer's Model Name	(0008,1090)	3	Original

7.5.5 Common Image Entity Modules

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

7.5.5.1 General Image Module

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

TABLE 7.5-6
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Generated
Patient Orientation	(0020,0020)	2C	Empty.
Image Date	(0008,0023)	2C	Generated
Image Time	(0008,0033)	2C	Generated
Image Type	(0008,0008)	3	Generated DERIVED\SECONDARY\3D

7.5.5.2 Image Pixel Module

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

TABLE 7.5-7
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Rows	(0028,0010)	1	Generated
Columns	(0028,0011)	1	Generated
Bits Allocated	(0028,0100)	1	16
Bits Stored	(0028,0101)	1	16
High Bit	(0028,0102)	1	15
Pixel Representation	(0028,0103)	1	1
Pixel Data	(7FE0,0010)	1	Generated

7.5.6 Common Lookup Table Modules

7.5.6.1 VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

TABLE 7.5-8
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Window Center	(0028,1050)	3	Generated
Window Width	(0028,1051)	1C	Generated

7.5.6.2 Modality LUT module

This section specifies the Attributes that describe the Modality LUT.

TABLE 7.5-9
MODALITY LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Rescale Intercept	(0028,1052)	1C	Generated
Rescale Slope	(0028,1053)	1C	1

7.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

7.5.7.1 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 7.5-10
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	(0008,0018)	1	Generated

7.5.8 SC Modules

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

7.5.8.1 SC Equipment Module

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

TABLE 7.5-11
SC IMAGE EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	2	WSD

7.5.8.2 SC Image Module

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

TABLE 7.5-12
SC IMAGE MODULE ATTRIBUTES

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

8. RT STRUCTURE SET INFORMATION OBJECT IMPLEMENTATION

8.1 INTRODUCTION

This section specifies the use of the DICOM RT Structure Set IOD to represent the information included in structure sets produced by this implementation. Corresponding attributes are conveyed using the module construct.

8.2 RT STRUCTURE SET IOD IMPLEMENTATION

This section defines the implementation of the RT Structure Set information object in the CT/PET Fusion application. It refers to the DICOM Standard 1998 Part 3 (Information Object Definitions). RT Structure Set Entity Relationship Diagram

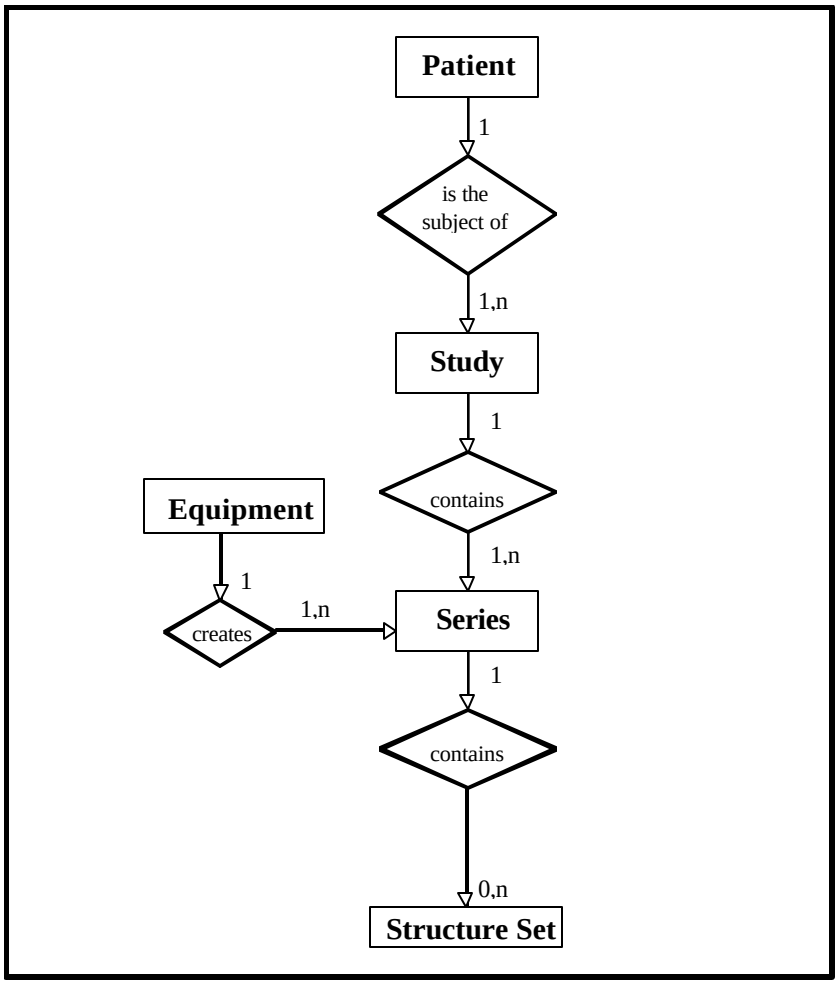
8.3 RT STRUCTURE SET IOD ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the RT Structure Set interoperability schema is shown in Illustration 7.3-1. 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. See DICOM Part 3 Section 5.1.2 for an explanation of the entity-relationship notation.

ILLUSTRATION 8.3-1
RT STRUCTURE SET ENTITY RELATIONSHIP DIAGRAM



8.3.1 Entities Description

Refer to DICOM Standard 1998 Part 3 (Information Object Definitions) for a description of each of the entities contained within the RT Structure Set information object.

8.3.2 CT/PET Fusion Mapping of DICOM entities

DICOM entities map to the CT/PET Fusion entities in the following manner :

DICOM	CT/PET Fusion
Patient Entity	Patient Entity (Advantage Workstation)
Study Entity Series Entity	Examination Entity (Advantage Workstation) Series Entity (Advantage Workstation)
Equipment Entity	Workstation on which CT/PET Fusion application is running
Structure Set	CT/PET Fusion geometric information relating

	to defined structures

8.4 RT STRUCTURE SET IOD MODULE TABLE

Within an entity of the DICOM RT Structure Set Information Object Definition, 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 1-1 identifies the defined modules within the entities which comprise the DICOM RT Structure Set Information Object Definition. Modules are identified by Module Name.

See DICOM Standard 1998 Part 3 for a complete definition of the entities, modules, and attributes.

TABLE 8.4-1
RT STRUCTURE SET INFORMATION OBJECT DEFINITION (IOD) MODULE TABLE

Entity Name	Module Name	Usage	Reference
Patient	Patient	M	7.5.1.1
Study	General Study	M	7.5.2.1
	Patient Study	U	not used
Series	RT Series	M	7.5.2.3
Equipment	General Equipment	M	7.5.3.1
Structure Set	Structure Set	M	7.5.4.1
	ROI Contour	M	7.5.4.2
	RT ROI Observations	M	7.5.4.3
	Approval	U	not used
	Audio	U	not used
	SOP Common	M	7.5.4.4

8.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM Standard 1998 Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the RT Structure Set Information Object.

8.5.1 Patient Entity Modules

8.5.1.1 Patient Module

Attribute Name	Element Tag	TP	Notes
Patient's Name	(0010,0010)	2	Duplicated from CT patient model images.
Patient ID	(0010,0020)	2	Duplicated from CT patient model images.
Patient's Birth Date	(0010,0030)	2	Duplicated from CT patient model images.
Patient's Sex	(0010,0040)	2	Duplicated from CT patient model images.

8.5.2 Study Entity Modules

8.5.2.1 General Study

Attribute Name	Element Tag	TP	Notes
Study Instance UID	(0020,000D)	1	Duplicated from CT patient model images
Study Date	(0008,0020)	2	Duplicated from CT patient model images if present in those images, otherwise zero-length
Study Time	(0008,0030)	2	Duplicated from CT patient model images if present in those images, otherwise zero-length
Referring Physicians' Name	(0008,0090)	2	Zero-length
Study ID	(0020,0010)	2	Duplicated from CT patient model images if present in those images, otherwise zero-length
Accession number	(0008,0050)	2	Duplicated from CT patient model images if present in those images, otherwise zero-length

8.5.2.2 Series Entity Modules

8.5.2.3 RT Series

Attribute Name	Element Tag	TP	Notes
Modality	(0008,0060)	1	'RTSTRUCT'
Series Instance UID	(0020,000E)	1	Created for first RT Structure Set in series, otherwise copied from existing ones in series
Series Number	(0020,0011)	2	107, if it is not already the number of the CT patient model images series, 1107, if it is
Series Description	(0008,103E)	3	'CT/PET Fusion RT Structure Sets'

8.5.3 Equipment Entity Modules

8.5.3.1 General Equipment

Attribute Name	Element Tag	TP	Notes
Manufacturer	(0008,0070)	2	'GE MEDICAL SYSTEMS'
Station Name	(0008,1010)	3	<station host name>
Manufacturer's Model Name	(0008,1090)	3	'CT/PET Fusion'
Device Serial Number	(0018,1000)	3	<station host ID>
Software Versions	(0018,1020)	3	'1.0.x' (single-valued) to be defined

8.5.4 Structure Set Entity Modules

8.5.4.1 Structure Set

Attribute Name	Element Tag	TP	Notes
Structure Set Label	(3006,0002)	1	CT/PET Fusion RTSS
Structure Set Name	(3006,0004)	3	Equal to comment entered when saving RT Structure Set object (non-truncated)

Structure Set Date	(3006,0008)	2	Date of creation
Structure Set Time	(3006,0009)	2	Time of creation
Referenced Frame of Reference Sequence	(3006,0010)	3	Sequence will always contain exactly one item, corresponding to the frame of reference of the CT images
>Frame of Reference UID	(0020,0052)	1C	Duplicated from patient model images if present in those images, otherwise a unique UID will be created by CT/PET Fusion application
>RT Referenced Study Sequence	(3006,0012)	3	Sequence will always contain exactly one item, corresponding to the Study containing the CT images
>>Referenced SOP Class UID	(0008,1150)	1C	1.2.840.10008.3.1.2.3.1
>>Referenced SOP Instance UID	(0008,1155)	1C	Duplicated from CT reference examination
>>RT Referenced Series Sequence	(3006,0014)	1C	Sequence will always contain exactly one item, corresponding to the Series containing the CT images
>>>Series Instance UID	(0020,000E)	1C	Duplicated from CT reference series
>>>Contour Image Sequence	(3006,0016)	1C	Sequence will contain all images used in building the CT patient model, even if some images have no corresponding contour
>>>>Referenced SOP Class UID	(0008,1150)	1C	Duplicated from CT reference SOP class
>>>>Referenced SOP Instance UID	(0008,1155)	1C	Duplicated from CT reference image
Structure Set ROI Sequence	(3006,0020)	3	Always provided
>ROI Number	(3006,0022)	1C	Always 1 (Only one structure is provided by CT/PET Fusion corresponding to the GTV contour)
>Referenced Frame of Reference UID	(3006,0024)	1C	Equal to Frame of Reference UID (0020,0052) above
>ROI Name	(3006,0026)	2C	structure name (always : tumor)
>ROI Generation Algorithm	(3006,0036)	2C	Zero-length

8.5.4.2 ROI Contour

Attribute Name	**Element Tag**	**TP**	**Notes**
ROI Contour Sequence	(3006,0039)	1	Sequence will always contain all the structures defined in the Structure Set Module, in the same sequential order
>Referenced ROI Number	(3006,0084)	1	Always 1.
>ROI Display Color	(3006,002A)	3	Contains RGB values corresponding to color used for displaying contour when reloading them. color proposed Yellow (255\255\0)
>Contour Sequence	(3006,0040)	3	Always Provided (ROI must have contours which have been defined by CT/PET Fusion)
>>Contour Image Sequence	(3006,0016)	3	Sequence will always contain exactly one item (referenced CT image)
>>>Referenced SOP Class UID	(0008,1150)	1C	Duplicated from CT Patient model images.

>>>Referenced SOP Instance UID	(0008,1155)	1C	Duplicated from CT Patient model images.
>>Contour Geometric Type	(3006,0042)	1C	'CLOSED_PLANAR' for structures
>>Contour Slab Thickness	(3006,0044)	3	For structures, equal to the sum of the zplus and zminus half thicknesses in CT/PET Fusion.
>>Number of Contour Points	(3006,0046)	1C	In CT/PET Fusion application there is no limit imposed on the number of points in a contour shape
>>Contour Data	(3006,0050)	1C	Z coordinate of contour data may differ slightly from Z coordinate of referenced slice. This variation should be of the order of half the (x,y) resolution of the reconstructed patient model. Coordinates are in DICOM coordinate system, *not* Voxtool RAS coordinate system.

8.5.4.3 RT ROI Observations

Attribute Name	Element Tag	TP	Notes
RT ROI Observations Sequence	(3006,0080)	1	Sequence will always contain all the structures defined in the Structure Set Module, in the same sequential order
>Observation Number	(3006,0082)	1	Always 1 (Only one structure is provided by CT/PET Fusion corresponding to the GTV contour)
>Referenced ROI Number	(3006,0084)	1	Always 1.
>ROI Observation Label	(3006,0085)	3	Structure name (always : tumor)
>RT ROI Interpreted Type	(3006,00A4)	2	Supported types are EXTERNAL, PTV, CTV, GTV, AVOIDANCE, ORGAN, CONTRAST_AGENT, CAVITY, and MARKER. Will always be set to GTV.
>ROI Interpreter	(3006, 00A6)	2	Zero-length

8.5.4.4 SOP Common

Attribute Name	Element Tag	TP	Notes
SOP Class UID	(0008,0016)	1	'1.2.840.10008.5.1.4.1.1.481.3'
SOP Instance UID	(0008,0018)	1	A unique identifier created by CT/PET Fusion.
Specific Character Set	(0008,0005)	1C	'ISO_IR 100'
Instance Creation Date	(0008,0012)	3	Creation date provided by CT/PET Fusion.
Instance Creation Time	(0008,0013)	3	Creation time provided by CT/PET Fusion.
Instance Creator UID	(0008,0014)	3	1.2.840.113619.6.73