Technical
Publications

Direction 2189176-100
Revision 0

FuncTool
DICOM CONFORMANCE STATEMENT
for DICOM V3.0

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REVISION HISTORY

REV	DATE	REASON FOR CHANGE
0	May 7th, 1997	Initial Release (Functool v1.0).

LIST OF EFFECTIVE PAGES

SECTION	NUMBER	SECTION	NUMBER
Title page	0		
Table of contents	0		
1 - Introduction	0		
2- Network Conformance Statement	0		
3- CT Information Object Implementation	0		
4- MR Information Object Implementation	0		
5- Secondary Capture Information Object Implementation	0		

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TABLE OF CONTENTS

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1. INTRODUCTION

1.1 OVERVIEW

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

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

Section 2 (Network Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Networking features. Conformance Statement 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 (MR Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a MR Information Object.

Section 5 (SC Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of the Secondary Capture Information Object Implementation.
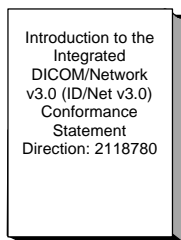
1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

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

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

FuncTool
Conformance
Statement
Direction:
2189176-100

......
Conformance
Statement
Direction:
......
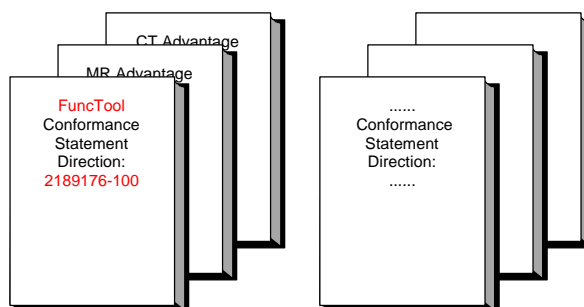
DICOM STANDARD

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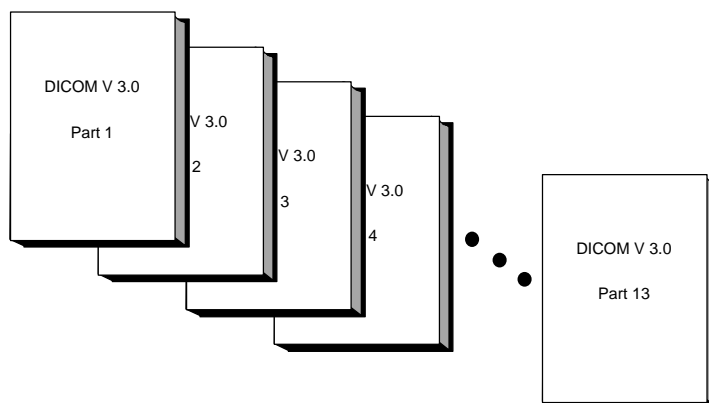
This document specifies the DICOM v3.0 implementation. It is entitled:

> *FuncTool*
> *Conformance Statement for DICOM v3.0*
> *Direction **2189176-100***

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, 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 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.*

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2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

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

FuncTool is a software application designed to be used on the Advantage workstation. It can load DICOM images to study the evolution of pixel intensities over time. Graphs and functional images can be saved in DICOM format and recalled later in the Advantage Windows image viewer.

FuncTool does not have intrinsic network feature. It does not directly invoke the DICOM Server AE. For detailed informations on the DICOM features of the Advantage Workstation, refer to the respective Conformance Statement :

- Advantage Review Station 1.2 Conformance Statement for DICOM (ID/Net v3.0), Direction 2120980.

- Advantage Review Station 2.0 Conformance Statement for DICOM (ID/Net v3.0), Direction 2150453-100

- Advantage Workstation 3.0 Conformance Statement for DICOM (ID/Net v3.0), Direction 2182402-100.

The goal of this document is to give a detailed description of the content of the DICOM IODs (CT & MR), that are required for 3D processing. Note that some DICOM attributes, which are type 2 or 3 are mandatory.

Section 5 describe the SC IOD which is generated by this implementation. Again, refer to the platform DICOM Conformance Statement for a complete description of the associated Presentation Context Table.

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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
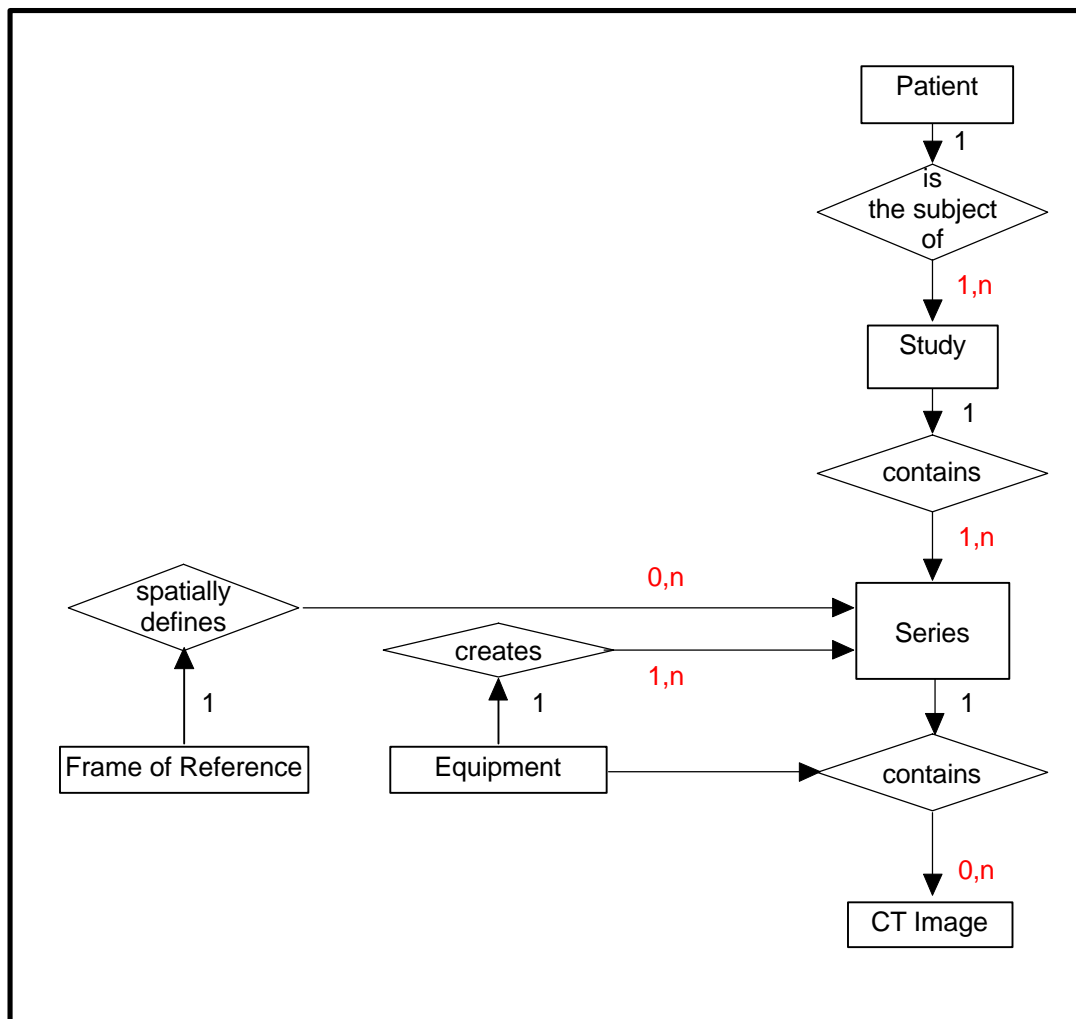
3.3.1 ENTITY DESCRIPTIONS

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 FuncTool Mapping of DICOM entities

TABLE 3.3-1
MAPPING OF DICOM ENTITIES TO FUNCTOOL 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.

The Attribute description can take several values:

- **Mandatory** : this attribute is required for the 3D processing,

- **Used, default is XXX** : this attribute is used, if it is not present a default value is assumed,

- **Not Used** : this attribute is not used actually.

Note: the default value empty is used for a string with 0 length.

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	Mandatory
Patient ID	(0010,0020)	2	Mandatory
Patient's Birth Date	(0010,0030)	2	Used, default empty
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	Used, default empty
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, default empty
Patient's Weight	(0010,1030)	3	Used, default empty

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	Mandatory
Series Instance UID	(0020,000E)	1	Not Used
Series Number	(0020,0011)	2	Used, default empty
Patient Position	(0018,5100)	2C	Used, default empty

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	Used, default empty

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	Used, default empty
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	Not Used

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	Mandatory
Image Time	(0008,0033)	2C	Mandatory
Image Type	(0008,0008)	3	Not Used
Acquisition Number	(0020,0012)	3	Used, default empty
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, default empty
Image Orientation (Patient)	(0020,0037)	1	Used, default empty
Image Position (Patient)	(0020,0032)	1	Used, default empty
Slice Thickness	(0018,0050)	2	Used, default empty

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, default 0
Smallest Image Pixel Value	(0028,0106)	3	Not Used
Largest Image Pixel Value	(0028,0107)	3	Not Used

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, default empty
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
Photometric Interpretation	(0028,0004)	1	Not Used
Bits Allocated	(0028,0100)	1	Not Used
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	Used, default empty
Acquisition Number	(0020,0012)	2	Not Used
Gantry/Detector Tilt	(0018,1120)	3	Used, default empty
Exposure Time	(0018,1150)	3	Not Used
X-ray Tube Current	(0018,1151)	3	Not Used
Convolution Kernel	(0018,1210)	3	Not Used

3.6 LIST OF MANDATORY ATTRIBUTES REQUIRED BY THIS APPLICATION

This table is a synthesis of the required attributes.

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Mandatory
Patient ID	(0010,0020)	2	Mandatory
Study Instance UID	(0020,000D)	1	Used, default empty
Frame of Reference UID	(0020,0052)	1	Used, default empty
Image Number	(0020,0013)	2	Mandatory
Pixel Spacing	(0028,0030)	1	Used, default empty
Image Orientation (Patient)	(0020,0037)	1	Used, default empty
Image Position (Patient)	(0020,0032)	1	Used, default empty
Rows	(0028,0010)	1	Used, default 0
Columns	(0028,0011)	1	Used, default 0
Pixel Data	(7FE0,0010)	1	Used, default 0

SOP Class UID	(0008,0016)	1	Used, default empty
Rescale Intercept	(0028, 1052)	1	Used, default -1024
Rescale Slope	(0028,1053)	1	Used, default 1
Image Date	(0008,0023)	2C	Mandatory
Image Time	(0008,0033)	2C	Mandatory

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4. MR INFORMATION OBJECT IMPLEMENTATION

4.1 INTRODUCTION

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

4.2 - IOD Description

4.3 - IOD Entity-Relationship Model

4.4 - IOD Module Table

4.5 - IOD Module Definition

4.2 MR IOD IMPLEMENTATION

4.3 MR ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the MR 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
MR IMAGE ENTITY RELATIONSHIP DIAGRAM
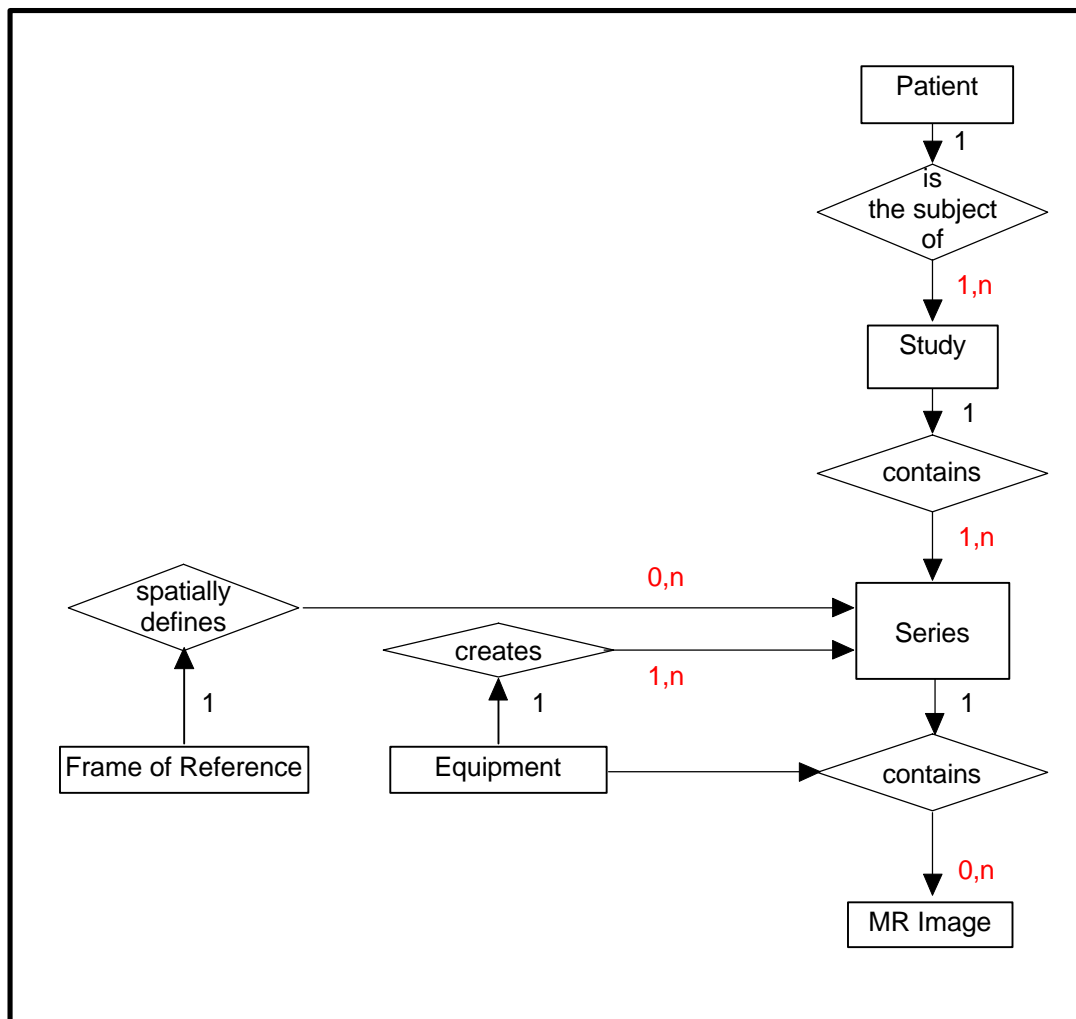
4.3.1 ENTITY DESCRIPTIONS

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

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 MR Image Entity Description

4.3.1.7 Overlay Entity Description

4.3.1.8 VOI Lookup Table Entity Description

4.3.2 FuncTool Mapping of DICOM entities

TABLE 4.3-1
MAPPING OF DICOM ENTITIES TO FUNCTOOL ENTITIES

DICOM	FuncTool 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 MR IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 4.4-1 identifies the defined modules within the entities 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.

The Attribute description can take several values:

- **Mandatory** : this attribute is required for the 3D processing,

- **Used, if not default is XXX** : this attribute is used, if it is not present a default value is assumed,

- **Not Used** : this attribute is not used actually.

Note: the default value empty is used for a string with 0 length.

TABLE 4.4-1
MR 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
	MR Image	4.5.8.1
	SOP Common	3.5.7.1

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 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).

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	Mandatory
Patient ID	(0010,0020)	2	Mandatory
Patient's Birth Date	(0010,0030)	2	Used, default empty
Patient's Sex	(0010,0040)	2	Used, default empty

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	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	Used, default empty
Study Description	(0008,1030)	3	Used, default empty

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
Patient's Age	(0010,1010)	3	Used, default empty
Patient's Weight	(0010,1030)	3	Used, default empty

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.

TABLE 4.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Mandatory
Series Instance UID	(0020,000E)	1	Not Used
Series Number	(0020,0011)	2	Used, default empty
Patient Position	(0018,5100)	2C	Used, default empty

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

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 4.5-5
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	Used, default empty

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.

TABLE 4.5-6
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Used, default empty
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	Not Used

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
Patient Orientation	(0020,0020)	2C	Not Used
Image Date	(0008,0023)	2C	Mandatory
Image Time	(0008,0033)	2C	Mandatory
Image Type	(0008,0008)	3	Not Used
Acquisition Number	(0020,0012)	3	Used, default empty
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

4.5.6.1.1 General Image Attribute Descriptions

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	Used, default empty
Image Orientation (Patient)	(0020,0037)	1	Used, default empty
Image Position (Patient)	(0020,0032)	1	Used, default empty
Slice Thickness	(0018,0050)	2	Used, default empty

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	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, default 0
Smallest Image Pixel Value	(0028,0106)	3	Not Used
Largest Image Pixel Value	(0028,0107)	3	Not Used

4.5.6.4 Contrast/Bolus Module

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

TABLE 4.5-10
CONTRAST/BOLUS MODULE ATTRIBUTES

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

4.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

4.5.7.1 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 4.5-11
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Used, default empty
SOP Instance UID	(0008,0018)	1	Not Used

4.5.8 MR Modules

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

4.5.8.1 MR Image Module

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

TABLE 4.5-12
MR IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Not Used
Samples per Pixel	(0028,0002)	1	Not Used
Photometric Interpretation	(0028,0004)	1	Not Used
Bits Allocated	(0028,0100)	1	Not Used
Scanning Sequence	(0018,0020)	1	Used, default empty
Sequence Variant	(0018,0021)	1	Used, default empty
Scan Options	(0018,0022)	2	Used, default empty
MR Acquisition Type	(0018,0023)	2	Used, default empty
Repetition Time	(0018,0080)	2C	Mandatory
Echo Time	(0018,0081)	2C	Used, default empty
Echo Train Length	(0018,0091)	2	Used, default empty
Inversion Time	(0018,0082)	2C	Used, default empty
Trigger Time	(0018,1060)	2C	Used, default empty
Number of Averages	(0018,0083)	3	Used, default 0
Imaging Frequency	(0018,0084)	3	Not Used
Echo Number	(0018,0086)	3	Not Used
Magnetic Field Strength	(0018,0087)	3	Not Used
Percent Sampling	(0018,0093)	3	Not Used
Acquisition Matrix	(0018,1310)	3	Not Used
Flip Angle	(0018,1314)	3	Not Used

4.6 LIST OF MANDATORY ATTRIBUTES REQUIRED BY THIS APPLICATION

This table is a synthesis of the required attributes.

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Mandatory
Patient ID	(0010,0020)	2	Mandatory
Study Instance UID	(0020,000D)	1	Used, default empty
Frame of Reference UID	(0020,0052)	1	Used, default empty
Image Number	(0020,0013)	2	Mandatory

Pixel Spacing	(0028,0030)	1	Used, default empty
Image Orientation (Patient)	(0020,0037)	1	Used, default empty
Image Position (Patient)	(0020,0032)	1	Used, default empty
Rows	(0028,0010)	1	Used, default 0
Columns	(0028,0011)	1	Used, default 0
Pixel Data	(7FE0,0010)	1	Used, default 0
SOP Class UID	(0008,0016)	1	Used, default empty
Scanning Sequence	(0018,0020)	1	Used, default empty
Repetition Time	(0018,0080)	2C	Mandatory
Image Date	(0008,0023)	2C	Mandatory
Image Time	(0008,0033)	2C	Mandatory

5. SC INFORMATION OBJECT IMPLEMENTATION

5.1 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:

5.2 - IOD Description

5.3 - IOD Entity-Relationship Model

5.4 - IOD Module Table

5.5 - IOD Module Definition

5.2 SC IOD IMPLEMENTATION

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

5.3 SC ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the SC 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
SC IMAGE ENTITY RELATIONSHIP DIAGRAM
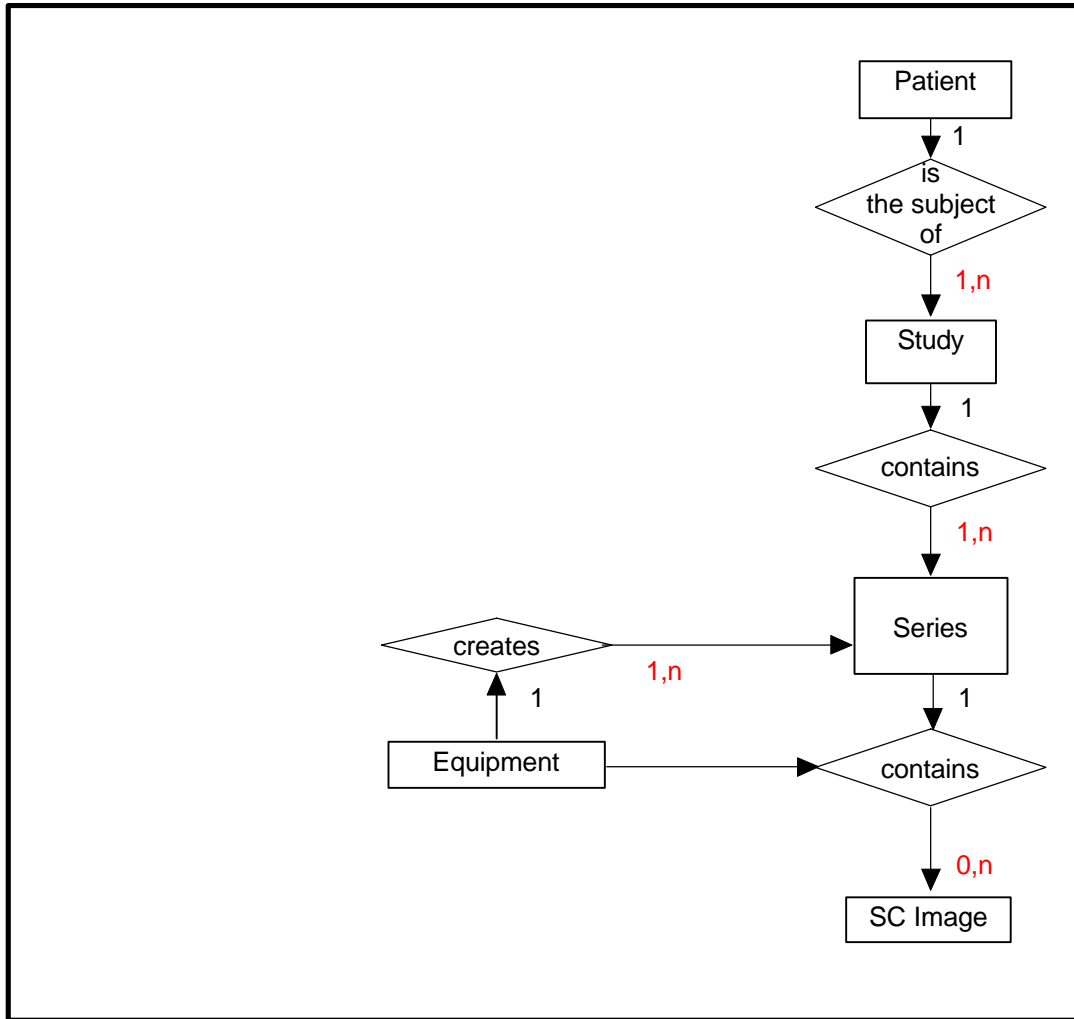
5.3.1 ENTITY DESCRIPTIONS

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

5.3.2 FuncTool Mapping of DICOM entities

TABLE 5.3-1
MAPPING OF DICOM ENTITIES TO FUNCTOOL ENTITIES

DICOM	FuncTool Entity
Patient Entity	Patient Entity
Study Entity	Examination Entity
Series Entity	Series Entity
Secondary Capture Image Entity	Screen Save Image, Report Image

Note : FuncTool creates "Report Image". This images are Secondary Capture with some private elements.

5.4 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 5.4-1 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.

The Attribute description can take several values :

- **Generated** : this attribute is generated by the application,

- **Original** : this attribute is a copy of the original (present in the CT or MR image),

- **Empty** : this attribute is saved on the SC but it is empty,

- **Not saved** : this attribute is not saved in the current release,

- **XXXXXX** : this attribute is saved with this value XXXXXX

TABLE 5.4-1
SC 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
Equipment	General Equipment	5.5.4.1
	SC Equipment	5.5.8.1
Image	General Image	5.5.5.1
	Image Pixel	5.5.5.2
	SC Image	5.5.8.2
	Modality LUT	5.5.6.2
	VOI LUT	5.5.6.1
	SOP Common	5.5.7.1

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 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).

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

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	Original
Study Date	(0008,0020)	2	Original
Study Time	(0008,0030)	2	Original
Referring Physician's Name	(0008,0090)	2	Original
Study ID	(0020,0010)	2	Original
Accession Number	(0008,0050)	2	Original

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

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

5.5.4 Common Equipment Entity Modules

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

5.5.4.1 General Equipment Module

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

TABLE 5.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

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

5.5.5 Common Image Entity Modules

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

5.5.5.1 General Image Module

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

TABLE 5.5-6
GENERAL IMAGE MODULE ATTRIBUTES

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

Patient Orientation	(0020,0020)	2C	Original
Image Date	(0008,0023)	2C	Generated
Image Time	(0008,0033)	2C	Generated
Image Type	(0008,0008)	3	Generated DERIVED\SECONDARY\PROCESSED DERIVED\SECONDARY\SCREEN SAVE

5.5.5.2 Image Pixel Module

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

TABLE 5.5-7
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	12 or 16
High Bit	(0028,0102)	1	7 or 11
Pixel Representation	(0028,0103)	1	1
Pixel Data	(7FE0,0010)	1	0

5.5.6 Common Lookup Table Modules

5.5.6.1 VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

TABLE 5.5-8
VOI LUT MODULE ATTRIBUTES

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

5.5.6.2 Modality LUT module

This section specifies the Attributes that describe the Modality LUT.

TABLE 5.5-9
MODALITY LUT MODULE ATTRIBUTES

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

5.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

5.5.7.1 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 5.5-10
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	1.2.840.10008.5.1.4.1.1.2 1.2.840.10008.5.1.4.1.1.4 1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	(0008,0018)	1	Generated

5.5.8 SC Modules

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

5.5.8.1 SC Equipment Module

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

TABLE 5.5-11
SC IMAGE EQUIPMENT MODULE ATTRIBUTES

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

5.5.8.2 SC Image Module

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

TABLE 5.5-12
SC IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Date of Secondary Capture	(0018,1012)	3	Not Saved

Time of Secondary Capture	(0018,1014)	3	Not Saved

5.6 PRIVATE DATA DICTIONARY

No private attributes are generated.