



GE Medical Systems

Technical Publications

**Direction 2329613-100
Revision 0**

CT PERFUSION 4 DICOM CONFORMANCE STATEMENT for DICOM

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REVISION HISTORY

REV	DATE	REASON FOR CHANGE
0(A)	10/30/06	First version to be reviewed.

LIST OF EFFECTIVE PAGES

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Title page	1		
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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.

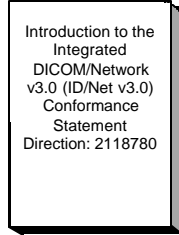
Section 3 (CT Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a CT Information Object.

Section 4 (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

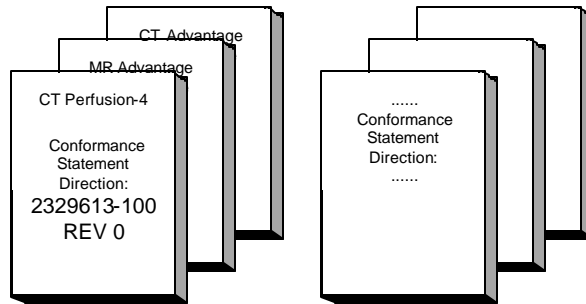
The Documentation Structure of the GEMS Conformance Statements and their relationship with the DICOM Conformance Statements is shown in the Illustration below.

ID/Net v3.0



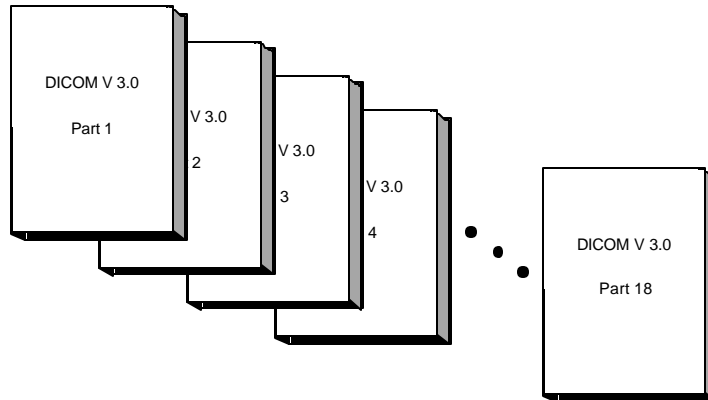
APPLICATION ENTITY SPECIFICATION
(SERVICE CLASSES, INFORMATION OBJECTS, MESSAGE EXCHANGES, ETC.)

Product Implementation:



DICOM STANDARD

Standard Specification:



This document specifies the DICOM implementation. It is entitled:

CT Perfusion-4
Conformance Statement for DICOM
Direction 2329613-100

This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required inter-operating 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 Part 8 standard.

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

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

DICOM Secretariat
NEMA
1300 N. 17th Street, Suite 1847
Rosslyn, VA 22209
USA
Phone: +1.703.841.3200

1.3 INTENDED AUDIENCE

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

If readers are unfamiliar with DICOM terminology they should first refer to the document listed below, then read the DICOM 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 Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical data exchanged using DICOM. 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, 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 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 Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non-GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.
- **Validation** - Testing the complete range of possible interactions between any GE device and non-GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non-GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non-GE device and the stability of the image data for the intended applications.
Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.
- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM as specified in each ID/Net DICOM Conformance Statement. Evolution of the Standard may require changes to devices, which have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) reflected on by these ID/Net DICOM Conformance Statements**. The **user** should ensure that any non-GE provider, who connects with GE devices, also plans for the future evolution of the DICOM Standard. Failures to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.
- **Interaction** - It is the sole responsibility of the **non-GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1.6 REFERENCES

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 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.

CT Perfusion-4 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.

CT Perfusion-4 does not have intrinsic network feature. It does not directly invoke the DICOM Server AE. For more detailed information on the DICOM features of the Advantage Workstation, refer to the respective Conformance Statement:

- Advantage Workstation 3.1 Conformance Statement for DICOM (ID/Net v3.0), Direction 2201403-100, Rev. 3.
- Advantage Workstation 4.0 Conformance Statement for DICOM (ID/Net v3.0), Direction 2261302-100, Rev. 1.

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

Section describes 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.

2.2 REAL WORLD ACTIVITIES: LOADING / PROCESSING / SAVING OF IMAGE DATA

The operator selects in the BROWSER one Perfusion Series to be loaded and processed. Then, the user can either click on the 'CT Perfusion 4' button or use the 'New Protocol' if CT Perfusion 4 is already loaded in memory. The following sequence describes the workflow of the CT Perfusion 4 application:

1. Selection and loading of image data set.
 - Selection of any time-series or "dynamic" data set (up to 3000 total images).
 - Automatic loading of the selected series, including all slice locations and time points.
 - Image matrix sizes (n x m) ranging from 32 to 2048, both inclusive, for both n and m.
2. Definition of cursor and ROI size and location.
 - Consistent ROI definition process as in the AW viewer.
 - Interrogation of time-intensity information via either a cursor or a region-of-interest (ROI).
 - Automatic or semi-automatic selection of both artery and vein.
3. Display and plotting of time-intensity information.
 - Display and plotting of time-intensity information based on the algorithm chosen.
4. Parametric image creation / Creation of graphs.
 - Creation of parametric images; Image intensity values in the parametric image represents the result of a calculation process that generates a single valued parameter at each pixel location in the original data set.
 - Display of a parametric image in color or gray scale.
5. Overlay of a parametric image onto a Reference Image. Creation of a fused display of the colored parametric image and a reference gray scale CT reference image.
6. Display of functional data.

- Display of the statistical information for all ROI's in table format.
7. Saving and printing of processed data.
- All of the images and graphs may be saved and printed to film or color paper printer.
 - Created ROI's may be saved as DICOM objects in the patient/ exam folder or as template ROI's.
 - Time-intensity output as well as functional data may be saved to files in TEXT format.
 - State of a protocol may be saved as DICOM objects in the patient/ exam folder.

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

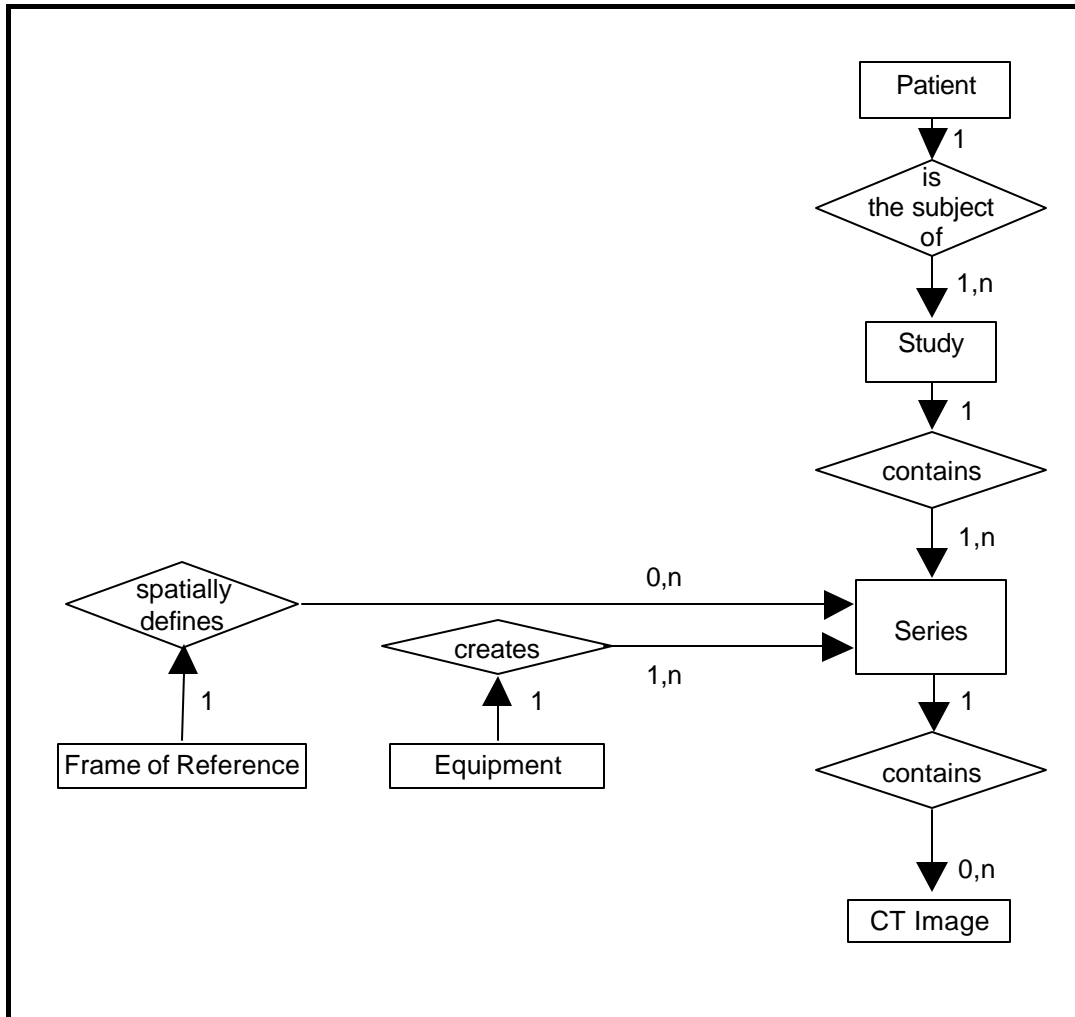
3.3 CT ENTITY-RELATIONSHIP MODEL

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.

3.3.2 CT Perfusion-4 Mapping of DICOM entities

TABLE 3.3-1
MAPPING OF DICOM ENTITIES TO CT PERFUSION 4 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 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 data sets.

Table 3.4-2 identifies the defined modules within the entities, which comprise the DICOM CT IOD. Modules are identified by Module Name.

See DICOM 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 actually used.

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

TABLE 3.4-2
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
	SOP Common	3.5.7.1
	CT Image	3.5.8.1

3.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the 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 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 3.5-3
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 Modules 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 3.5-4
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 3.5-5
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 3.5-6
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 3.5-7
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 3.5-8
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 3.5-9
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 3.5-10
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 3.5-11
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 3.5-12
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 3.5-13
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 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 3.5-14
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

4. SC INFORMATION OBJECT IMPLEMENTATION

4.1 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:

4.2 - IOD Description

4.3 - IOD Entity-Relationship Model

4.4 - IOD Module Table

4.5 - IOD Module Definition

4.2 SC IOD IMPLEMENTATION

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

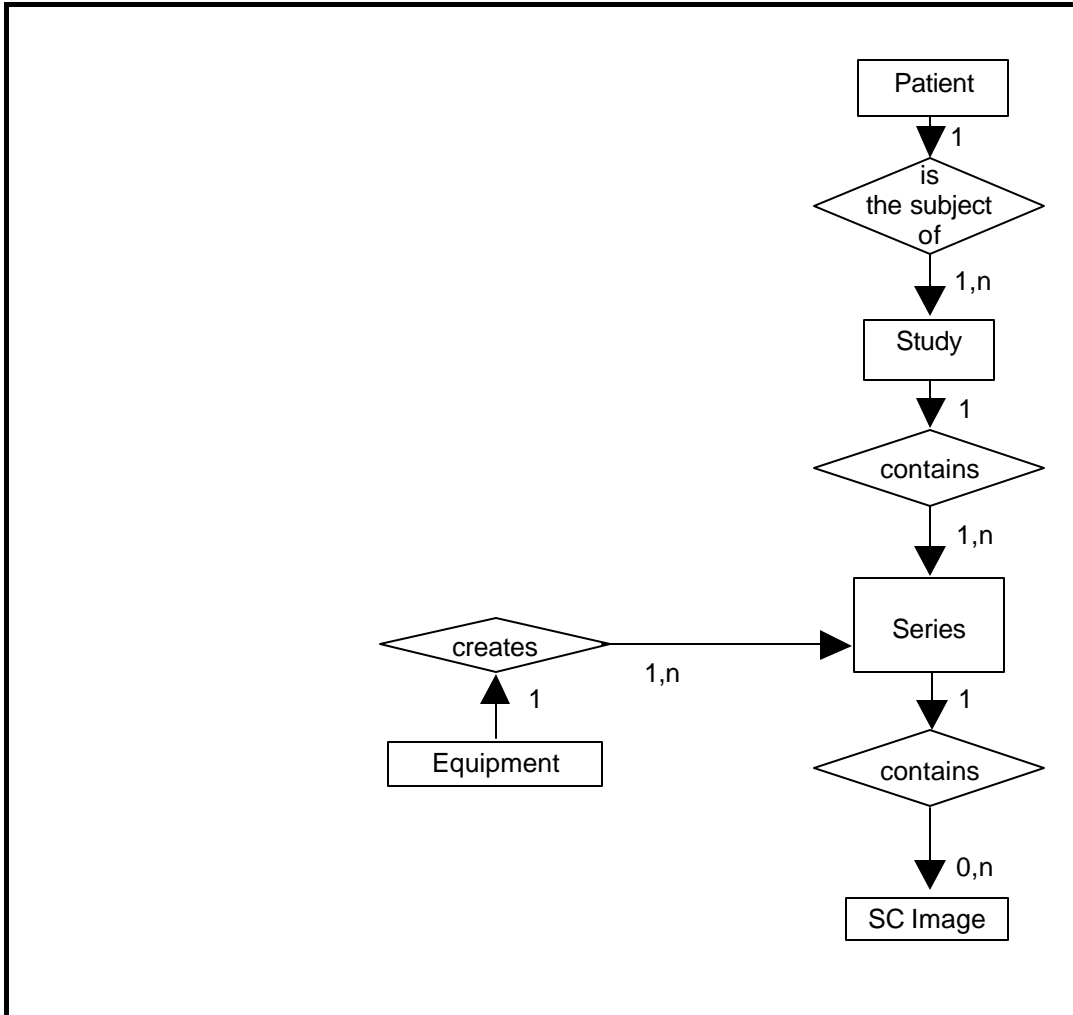
4.3 SC ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the SC Image interoperability schema is shown in Illustration 4.3-2. 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 4.3-2
SC 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 SC Information Object.

4.3.2 CT PERFUSION 4 Mapping of DICOM entities

TABLE 4.3-15
MAPPING OF DICOM ENTITIES TO CT PERFUSION 4 ENTITIES

DICOM	CT PERFUSION 4 Entity
Patient Entity	Patient Entity
Study Entity	Examination Entity
Series Entity	Series Entity
Secondary Capture Image Entity	Screen Save Image, Report Image

Note: CT PERFUSION 4 creates “Report Image”. These images are Secondary Capture with some private elements.

4.4 IOD MODULE TABLE

Within an entity of the DICOM 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 data sets.

Table 4.4-16 identifies the defined modules within the entities, which comprise the DICOM SC IOD. Modules are identified by Module Name.

See DICOM 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 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 4.4-16
SC IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Equipment	General Equipment	4.5.4.1
	SC Equipment	4.5.8.1
Image	General Image	4.5.5.1
	Image Pixel	4.5.5.2
	SC Image	4.5.8.2
	Modality LUT	4.5.8.2
	VOI LUT	4.5.6.1
	SOP Common	4.5.7.1
	SC Equipment	4.5.7.1
	SC Image	4.5.7.1
	CT Perfusion-4 map	4.5.7.1

4.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the 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 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 4.5-17
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

4.5.2 Common Study Entity Modules

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

4.5.2.1 General Study Module

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

TABLE 4.5-18
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

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 4.5-19
PATIENT STUDY MODULE ATTRIBUTES

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

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 4.5-20
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

4.5.4 Common Equipment Entity Modules

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

4.5.4.1 General Equipment Module

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

TABLE 4.5-21
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Manufacturer
Institution Name	(0008,0080)	3	Original
Station Name	(0008,1010)	3	Advantage Workstation
Manufacturer's Model Name	(0008,1090)	3	3.1, 4.0

4.5.5 Common Image Entity Modules

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

4.5.5.1 General Image Module

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

TABLE 4.5-22
GENERAL IMAGE MODULE ATTRIBUTES

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

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

4.5.5.2 Image Pixel Module

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

TABLE 4.5-23
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

4.5.6 Common Lookup Table Modules

4.5.6.1 VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

TABLE 4.5-24
VOI LUT MODULE ATTRIBUTES

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

4.5.6.2 Modality LUT module

This section specifies the Attributes that describe the Modality LUT.

TABLE 4.5-25
MODALITY LUT MODULE ATTRIBUTES

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

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 4.5-26
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

4.5.8 SC Modules

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

4.5.8.1 SC Equipment Module

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

TABLE 4.5-27
SC IMAGE EQUIPMENT MODULE ATTRIBUTES

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

4.5.8.2 SC Image Module

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

TABLE 4.5-28
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

4.5.9 CT Perfusion-4 map Module

This Section describes the CT Perfusion-4 Module. This Module contains Attributes that are specific to CT Perfusion-4 output maps. Group 51 of private DICOM tags has been dedicated to it.

TABLE 4.5-29
CT PERFUSION 4 MAP MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Private creator	(0051,0010)	3	“GEMS_FUNCTOOL_01”
Group name	(0051,1001)	3	CT Perfusion-4 classifies its functions into groups of functions like Perfusion, Standard, and General...
Function name	(0051,1002)	3	Name of the function used to get the current functional map
Bias	(0051,1003)	3	Bias to be applied to data, i.e. Real value = (data + bias) * scale
Scale	(0051,1004)	3	Scale to be applied to data, i.e. Real value = (data + bias) * scale
Parameter count	(0051,1005)	3	Length in characters of the parameter string element 0x05
Parameters	(0051,1006)	3	String containing functional parameters; parameters are delimited by character ESC=0x1B, and are stored in the order of their declaration in functional procedures.
Version	(0051,1007)	3	String containing the software version (for example, 2.5.30)
Color ramp index	(0051,1008)	3	Color ramp index (0=rainbow, 1=Hot iron,...)
Window width	(0051,1009)	3	Window width of the view from which the functional map has been saved
Window level	(0051,100A)	3	Window level of the view from which the functional map has been saved
Binary data size	(0051,100C)	3	Bytes size of the data saved in binary format
Binary data	(0051,100D)	3	Binary data containing description of wizard states.

4.6 PRIVATE DATA DICTIONARY

This section describes the private attributes of this IOD.

TABLE 4.6-30
PRIVATE CREATOR IDENTIFICATION: GEMS_FUNCTOOL_01

Attribute Name	Tag	VR	VM	Attribute Description
Private creator	(0051,0010)	LO	1	“GEMS_FUNCTOOL_01”
Group name	(0051,1001)	LO	1	CT Perfusion-4 classifies its functions into groups of functions like Perfusion, Standard, and General...

Function name	(0051,1002)	LO	1	Name of the function used to get the current functional map
Bias	(0051,1003)	SL	1	Bias to be applied to data, i.e. Real value = (data + bias) * scale
Scale	(0051,1004)	FL	1	Scale to be applied to data, i.e. Real value = (data + bias) * scale
Parameter count	(0051,1005)	SL	1	Length in characters of the parameter string element 0x05
Parameters	(0051,1006)	LT	1	String containing functional parameters; parameters are delimited by character ESC=0x1B, and are stored in the order of their declaration in functional procedures.
Version	(0051,1007)	LO	1	String containing the software version (for example, 2.5.30)
Color ramp index	(0051,1008)	SL	1	Color ramp index (0=rainbow, 1=Hot iron,...)
Window width	(0051,1009)	SL	1	Window width of the view from which the functional map has been saved
Window level	(0051,100A)	SL	1	Window level of the view from which the functional map has been saved
Wizard state data size	(0051,100C)	SL	1	Bytes size of the wizard state data saved in binary format.
Wizard State	(0051,100D)	OB	1	Binary data containing description of wizard state.