GE Medical Systems

Technical Publications

Direction 2153427–100

Revision 0

DLX DICOM GateWay

DICOM Conformance Statement

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REVISION HISTORY

REV	DATE	REASON FOR CHANGE
0	April 1996	Initial release to Direction Stock.
1	August 1997	Made various changes to text for accuracy and usability
2	November 1997	Release updated for coherence with software.

LIST OF EFFECTIVE PAGES

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Title Page	2
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SECTION 1 – INTRODUCTION

1–0 OVERVIEW

Section 1, *Introduction*, provides general information about the content and scope of this document.

Section 2, *Conformance Statement*, is the DICOM v3.0 Conformance Statement related to this product. Conformance Statements defines the subset of options selected from those offered by the DICOM v3.0 standard.

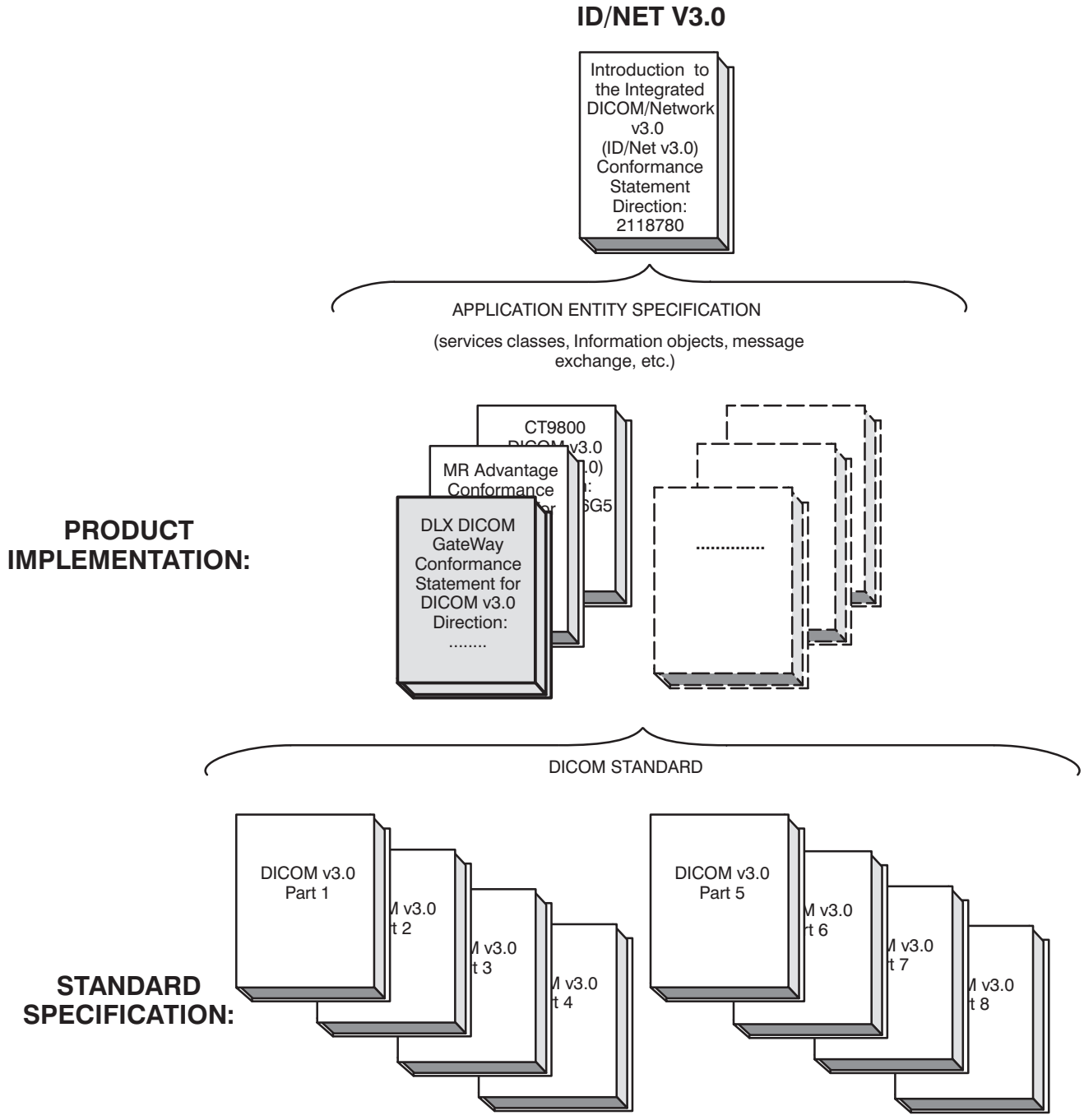
Section 3, *DLX DICOM GateWay XRAY Angiographic Information Object Implementation* defines the technical specifications required to interoperate with a DICOM v3.0 network interface. They define the technical details of the Information Object Definitions (IOD's) listed in the Conformance Statement. This section contains also the description of the private elements used in this implementation.

Section 4, *Secondary Capture Image Information Object implementation*, defines the technical specifications required to interoperate with a DICOM v3.0 network interface. They define the technical details of the Information Object definition (IOD's) listed in the Conformance statement.This section contains also the description of the private elements used in this implementation.

1–1 OVERALL 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 Illustration 1–1.

ILLUSTRATION 1–1
DOCUMENTATION STRUCTURE



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

DLX DICOM GateWay
Conformance Statement for DICOM v3.0
Direction .....# 2153427–100

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

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

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

The GEMS Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM v3.0 Part 8 standard.

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

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

ID/Net v3.0 Conformance Statements
Direction: 2117016

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

NEMA Publication
1300 North 17th Street
Suite 1847
Rosslyn, VA 22209
USA
Phone: (703) 841–3200

1–2 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 Conformance Statement document.

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

1−3 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 image data exchanged using DICOM v3.0. The GEMS Conformance Statements are available to the public.

The reader of this 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 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 retransmit all of the private data elements which are sent by GEMS devices.

1−4 IMPORTANT REMARKS

The use of these 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 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. ID/Net v3.0 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.
- **To be informed of the evolution of the implementation described in this document, the User is advised to regularly check the GE Internet Server, accessible via anonymous ftp:**
  (GE Internet Server Address: ftp.med.ge.com, 192.88.230.11)
- **Interaction** − It is the sole responsibility of the **non-GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1−5 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 the XRAY Angiographic Image Object Definition (DICOM v3.0 Standart Supplement 6) to Part 3 (Information Object Definition)

1−6 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.*

1−7 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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SECTION 2 – CONFORMANCE STATEMENT

2–0 INTRODUCTION

This conformance statement (CS) specifies the GE DLX DICOM GateWay (so–called DGW in the rest of this document) compliance to DICOM v3.0. It details the DICOM Service Classes and roles which are supported by this product.

Advantx DLX is an Integrated Digital Vascular Imaging System for both Angiography and Cardiac applications. The first implementation of the DLX DGW uses DICOM services to export cardiac images only to remote workstations.

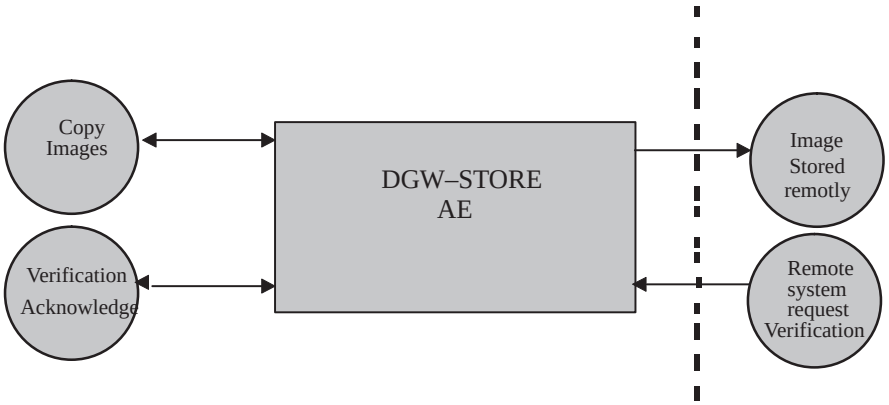
Note that the format of this section strictly follows the format of DICOM Standard Part 2 (Conformance) Annex A. Please refer to that part of the standard while reading this section.

2–1 IMPLEMENTATION MODEL

2–1–1 Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in Ill. 2–1 .

ILLUSTRATION 2–1
SPECIFIC AE APPLICATION MODEL



The DGW–STORE Application Entity (AE) is an application which handles DICOM protocol communication. DGW–STORE AE is automatically brought up when the Digital Angiographic system (DLX) is powered on.

The remote DICOM's AE must be manually configured on the DLX, usually at the software installation time, by a GE field engineer.

There is 1 local real world activity Copy Image (CI), which can cause the DGW–STORE AE to initiate a DICOM association to store an Image

CI consists of an operator selection of one or several images to be sent to the Remote System. Selection of Images is done from the Operator console screens (known as BROWSER and VIEWER); Visualisation of the transfer status is done on a specific menu (known as TRANSFER menu) . Remote Workstation can be any DICOM compliant WorkStation.

2−1−2 Functional Definition of AE's

The DGW–STORE Application Entity supports the following functions:

- Access to patient demographics and Pixel Data in the local database.
- Initiation of a DICOM association in order to send the image(s).
- Image(s) Send.

2−1−3 Sequencing of Real−World Activities

Not Applicable

2−2 AE SPECIFICATIONS

2−2−1 AE Specification

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCU**:

SOP Class Name	SOP Class UID
X−Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7

X–Ray Angiographic Image Storage is implemented as a Standard Extended SOP Class. It contains type 3 private Data Elements.

Standard conformance as an SCP is not applicable for this Application Entity.

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classs as an SCP :

SOP Class Name	SOP Class UID
Verification Service Class	1.2.840.10008.1.1

2−2−1−1 Association Establishment Policies

2−2−1−1−1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

Application Context Name	1.2.840.10008.3.1.1.1

The maximum Length PDU negotiation is included in all association establishment requests.

The maximum length PDU for an association initiated by the DGW–STORE AE is:

Maximum Length PDU	16 Kbytes

The SOP class Extended Negotiation is not supported.

The maximum number of Presentation Contexts Items that will be proposed is 2.

The user info items sent by this product are:

- Maximum PDU Length
- Implementation UID

Note: Max PDU length can be configured at installation time.

2–2–1–1–2 Number of Associations

The DGW–STORE AE will initiate only one DICOM association to perform an image storage as an SCU to a remote host in one at a time manner.

Otherwise, the DGW–STORE AE will not support multiple associations open simultaneously.

2–2–1–1–3 Asynchronous Nature

Asynchronous mode is not supported. All operations will be performed synchronously. with the exception that a single C–Echo response may occur in parallel with other operations.

2–2–1–1–4 Implementation Identifying Information

The Implementation UID for this ID/Net v3.0 Implementation is:

DLX DICOM GateWay Implementation UID	1.2.840.113619.6.26

2–2–1–2 Association Initiation Policy

DGW–STORE AE attempts to initiate a new association for each image it attempts to transfer. This association corresponds to 1 Real–World Activity : Copy Images (CI).

2–2–1–2–1 Real–World Activity ”Copy Image”

The DGW–STORE AE sends user selected XA and SC IODs to a preselected remote AE one at a time.

2–2–1–2–1–1 Associated Real–World Activity

The destination is set at installation time by the Field Service Engineer.

The Operator selects Image(s) to be sent by selection in both BROWSER (at patient level), or VIEWER (at sequence or photo level).

This operation will cause

- the DGW−STORE AE to initiate a DICOM association, select the appropriate Abstract and Transfer syntax from those accepted by the remote AE
- the DGW−STORE AE to emit C−STORE command to send the image.
- the DGW to build a DICOM image from its compressed raw data on the fly during the transfer.

2−2−1−2−1−2 Proposed Presentation Contexts

Presentation Context Table − Proposed					
Abstract Syntax		Transfer Syntax		Role	Expanded
Name	UID	Name List	UID List		Negotiation
XRAY Angio Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
XRAY Angio Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

2−2−1−2−1−2−1 SOP Specific Conformance Statement for Image Storage SOP Class

This implementation performs a single C–STORE operation over an association.

If the AE doesn't receive a C–ECHO confirmation, this implementation will terminate the association. The transfer is considered as failed, no association for C–STORE will be attempted.

Upon receiving a C–STORE confirmation containing an Error or a Refused status, this implementation will terminate the association. The current C–STORE is considered as failed.

Upon receiving a C–STORE confirmation containing a Warning Status, this implementation will treat it as an Error or Refused response.

Each C–STORE operation supports an " Association Timer ". This timer starts when the association request is sent and stops when the association is established. This timer is set to 30 seconds.

Each C–STORE operation supports an " Operation Inactivity Timer ".. This timer starts once a C–STORE request has been issued and stops once a C–STORE confirmation has been received. This Timer is set to 180 seconds.

If any of the 2 timers expires, the connection is closed and the operation is considered as failed.

2−2−1−3 Association Acceptance Policy

The DGW–STORE AE provides only DICOM Verification Service Class.

2−2−1−3−1 Real−World Activity "Verification acknowledge"

DGW echoes to a Verification request from any DICOM node. This function is transparent to the user (no user interface, a message is just logged in a file by the DICOM server).

2−2−1−3−1−1 Associated Real−World Activity

The Echo requester must address the DGW properly by the installed ATM IP address (or hostname) using the local DGW hostname on the ATM network as application title and sending to TCP/IP port 4006.

2−2−1−3−1−2 Accepted Presentation Contexts

Presentation Context Table − Accepted					
Abstract Syntax		Transfer Syntax		Role	Expanded
Name	UID	Name List	UID List		Negotiation
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

2−2−1−3−1−2−1 SOP Specific Conformance Statement for Verification SOP Class

The DGW–STORE AE provides standard conformance to the DICOM Verification Service Class.

2−3 COMMUNICATION PROFILES

2−3−1 Supported Communication Stacks (parts 8,9)

DICOM Upper Layer (Part 8) is supported using TCP/IP.

2−3−2 TCP/IP Stack

The TCP/IP stack is inherited from a UNIX Operating System.

2−3−2−1 API

Not applicable to this product.

2−3−2−2 Physical Media Support

The DGW supports an Aynchronous Transfer Mode (ATM) network interface using OC–3c multimode fiber. It supports Classical IP over AAL5 in accordance with RFC–1577 and signaling in accordance with ATM Forum UNI 3.1. DGW supports either Switched Virtual Channel and Permanent Virtual Channel.

2−3−3 Point−to−Point Stack

A 50–pin ACR–NEMA connection is not applicable to this product.

2–4 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

Refer to Section 3 for the description of DGW Private DICOM Data Dictionary

Refer to Section 4 for the description of Secondary capture Private DICOM Data Dictionary

2–5 CONFIGURATION

2–5–1 AE Title/Presentation Address Mapping

The Local AE Title is configurable as the DGW hostname on the ATM network. The remote AE title is configurable. This must be configured by a GEMS Field Service Engineer during DGW installation.

2–5–2 Configurable Parameters

The following fields are configurable for this AE (local):

- Local IP Address
- Remote AE Title
- Remote IP Address
- Responding TCP/IP Port

Note: All configuration must be performed by a GE Field Engineer.

2–6 SUPPORT OF EXTENDED CHARACTER SETS

This implementation supports the following extended character set:
ISO–IR–100

SECTION 3 XA INFORMATION OBJECT IMPLEMENTATION

3−0 INTRODUCTION

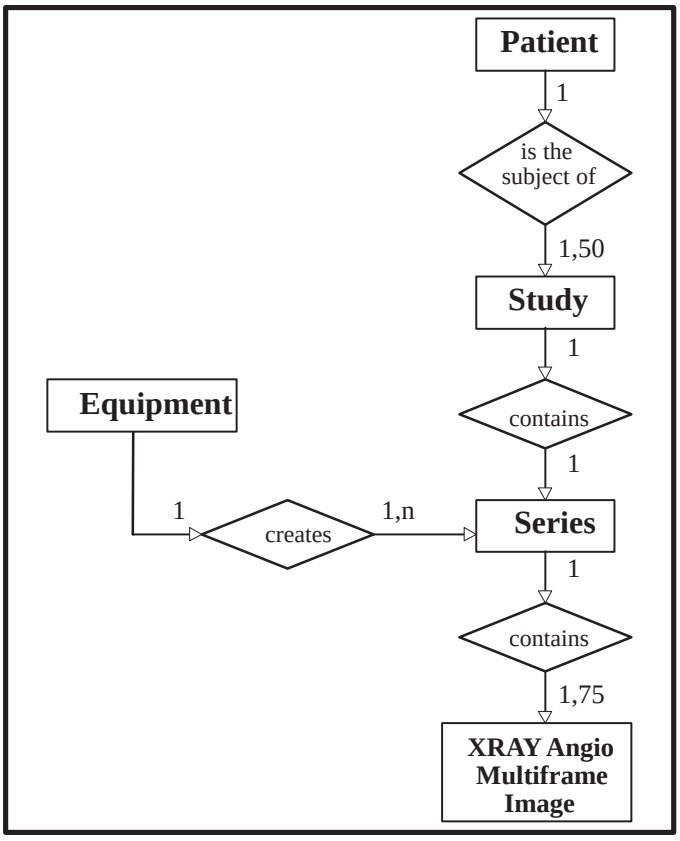
This section specifies the use of the DICOM v3.0 XRAY Angiographic Image IOD to represent the information included in XRAY Angiographic images produced by this implementation. Corresponding attributes are conveyed using the module construct.

3−1 XA IMAGE IOD IMPLEMENTATION

This section defines the implementation of XA image information object. It refers to the DICOM V3.0 Standard, Supplement 4 (Oct 21, 1995) to Part 3 (Information Object definition).

3−2 XA IMAGE IOD ENTITY−RELATIONSHIP MODEL

Illustration 3–1
XRAY Angiographic Image Entity Relationship Diagram



The Entity–Relationship diagram for the XRAY Angiographic Image interoperability schema is shown in Illustartion 3–1. In this figure, the following diagrammatic convention is established to represent the information organisation :

- each entiy is represented by a rectanglar box
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two enties is depicted by lines connecting the corresponding entity boxes to the relationsip boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown.

3–2–1 Entities Description

Refer to DICOM Standard Supplement 4 (Oct 21, 1995) to Part 3 (Information Object Definitions) for a descripion of the entities contained within this Information object.

3–2–2 DLX Mapping of DICOM entities

DICOM entities map to the DLX entities in respect to the following :

DICOM	DLX
Patient Entity	Patient Entity
Study Entity	Examination Entity
Series Entity	no match, there is a one to one relationship between DICOM Study and Series
Multiframe Image Entity	Sequence Entity
Frame	Image

3–3 XA IMAGE IOD MODULE TABLE

Within an entity of the DICOM v3.0 XRAY Angio Image Information Object Definition, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module acilitates 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 2 identifies the defined modules within the entities which comprise the DICOM v3.0 XRAY Angio Image Information object Definition. Modules are identified by Module Name.

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

Table 2
XRAY Angiographic Image Information Object Definition (IOD) Module Table

IE	Module Name	Reference
Patient	Patient	3.4.1.1
Study	General Study	3.4.2.1
	Patient Study	3.4.2.2
Series	General Series	3.4.3.1
Equipment	General Equipment	3.4.4.1
Image	General Image	3.4.5.1
	Image Pixel	3.4.5.2
	Cine	3.4.5.3
	Multi−Frame	3.4.5.4
	Frame Pointers	3.4.5.5
	Mask	3.4.5.6
	Display Shutter	3.4.5.7
	Device	3.4.5.8
	X−Ray Image	3.4.5.9
	X−Ray Acquisition	3.4.5.10
	X−Ray Collimator	3.4.5.11
	X−Ray Table	3.4.5.12
	XA Positioner	3.4.5.13
	Curve	3.4.5.14
	SOP Common	3.4.5.15

3−4 INFORMATION MODULE DEFINITIONS

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

Modules contain also **type 3 Private elements**.

3−4−1 Patient Entity Module

3−4−1−1 Patient Module

Attribute Name	Element Tag	TP	Notes
Patient's Name	0010, 0010	2	From user interface, restricted to 48 char.
Patient ID	0010, 0020	2	From user interface, restricted to 64 char.
Patient's Birth Date	0010, 0030	2	From user interface, no value if wrong format
Patient's Sex	0010, 0040	2	From user interface, "M", "F" or "O"
Patient DOB	0011, xx01	3	Patient Date of Birth in free form.

3–4–2 Study Entity Module

3–4–2–1 General Study

Attribute Name	Element Tag	TP	Notes
Study Instance UID	0020, 000D	1	Restricted to 64 char.
Study Date	0008, 0020	2	YYYYMMDD, restricted to 8 char.
Study Time	0008, 0030	2	HHMMSS.XXX, restricted to 10 char.
Referring Physicians' Name	0008, 0090	2	From user interface, restricted to 48 char.
Study ID	0020, 0010	2	From user interface, restricted to 64 char.
Accession number	0008, 0050	2	May have a value if comming from worklist already filled, restricted to 16 char.
Study Description	0008, 1030	3	From user interface, restricted to 16 char.

3–4–2–2 Patient Study

Attribute Name	Element Tag	TP	Notes
Patient's Size	0010, 1020	3	From user interface.
Patient's Weight	0010, 1030	3	From user interface, restricted to 16 char.
Additional Patient's History	0010, 21B0	3	From user interface, restricted to 252 char.
Patient address	0010, 1040	3	From user interface, restricted to 252 char.
Patient telephone	0010, 2154	3	From user interface, restricted to 32 char.

3–4–3 Series Entity Module

3–4–3–1 General Series

Attribute Name	Element Tag	TP	Notes
Modality	0008, 0060	1	XA
Series Instance UID	0020, 000E	1	Restricted to 64 char. Study instance UID + '.1'
Series Number	0020, 0011	2	1
Series Date	0008, 0021	3	YYYYMMDD, restricted to 8 char.
Series Time	0008, 0031	3	HHMMSS.XXX, restricted to 10 char.
Performing Physician's Name	0008, 1050	3	From user interface, restricted to 48 char.
Series Description	0008, 103E	3	From user interface, restricted to 16 char.
Operators' Name	0008, 1070	3	From user interface, restricted to 48 char.

3−4−4 Equipment Entity Module

3−4−4−1 General Equipment

Attribute Name	Element Tag	TP	Notes
Manufacturer	0008, 0070	3	GE MEDICAL SYSTEMS
Institution Name	0008, 0080	3	Generated by DLXINSTAL during acquisition
Manufacturer Model Name	0008, 1090	3	DLX
Software versions	0018, 1020	3	Database version, internal to DLX

3−4−5 Image Entity Module

3−4−5−1 General Image

Attribute Name	Element Tag	TP	Notes
Image Number	0020,0013	2	Image number in the series
Image Date	0008,0023	2C	YYYYMMDD, restricted to 8 char.
Image Time	0008,0033	2C	HHMMSS.XXX, restricted to 10 char.
Image Type	0008,0008	3	ORIGINAL\PRIMARY\ either SINGLE PLANE, BIPLANE A or BIPLANE B
Acquisition Date	0008,0022	3	YYYYMMDD, restricted to 8 char.
Acquisition Time	0008,0032	3	HHMMSS.XXX, restricted to 10 char.
Patient Orientation	0020,0020	2	No value, Zero length
Image comments	0020,4000	3	From user interface, restricted to 16 char.
Referenced Image Sequence	0008, 1140	3	In case of DLX biplane acquisition, used to identify the related plane Image (LATeral if FRonTal or FRonTal if LATeral)
>Referenced SOP Class UID	0008, 1150	1C	1.2.840.10008.5.1.4.1.1.12.1
>Referenced SOP Instance UID	0008, 1155	1C	Restricted to 64 char. Series_UID if monoplane, Series_UID + '.1' if frontal from biplane, Series_UID + '.2' if lateral from biplane
Lossy Image Compression	0028, 2110	3	00
Side_mark	0019, xx1D	3	represents patient orientation as 2 characters located on the left and right side of the displayed frame. Encoding is the following : 0 : not defined 1, 4, 6 : Left of the patient is on the left side of the frame 2, 3, 5 : Right of the patient is on the left side of the frame

3−4−5−2 Image Pixel

Attribute Name	Element Tag	TP	Notes
Samples per Pixel	0028, 0002	1	1
Photometric Interpretation	0028, 0004	1	MONOCHROME1 if reverse video, or MONOCHROME2 otherwise
Rows	0028, 0010	1	512
Columns	0028, 0011	1	512
Bits Allocated	0028, 0100	1	8
Bits Stored	0028, 0101	1	8
High Bit	0028, 0102	1	7
Pixel Representation	0028, 0103	1	0
Pixel Data	7FE0, 0010	1	

3−4−5−3 Cine

Attribute Name	Element Tag	TP	Notes
Frame Time Vector	0018, 1065	1C	Generated by acquisition system
Start Trim	0008, 2142	1	Generated by acquisition system
Stop Trim	0008, 2143	1	Generated by acquisition system
Recommended Display Frame Rate	0008, 2144	1	Generated by acquisition system
Frame Delay	0018, 1066	1	0.0
Cine Rate	0018, 0040	1	Generated by acquisition system

3−4−5−4 Multi−Frame

Attribute Name	Element Tag	TP	Notes
Number of Frames	0028, 0008	1	Generated by acquisition system
Frame Increment pointer	0028, 0009	1	0018, 1065

3−4−5−5 Frame Pointers

Attribute Name	Element Tag	TP	Notes
Representative Frame Number	0028, 6010	3	Initialized as the frame number located at the 1/3rd of the multiframe image.
Cur_spatial_filter_strength	0019, xx17	3	
Zoom_factor	0019, xx18	3	1, 2 or 4
X_zoom	0019, xx19	3	coordinate of the center of the zoomed area
Y_zoom	0019, xx1A	3	coordinate of the center of the zoomed area
Text_annotation	70nn, xx04	3	There could be up to 5 annoatation per images
Box	70nn, xx05	3	Coordinates of the lower left corner of the first character of the annotation (x, y)
Arrow end	70nn, xx07	3	Coordinates of extrems of the arrow (x, y), the arrow always starts from the annotation text. Arrows is always a staight line. (0,0) value means 'no arrow' is attached to the annotation.

3−4−5−6 Mask

Attribute Name	Element Tag	TP	Notes
Mask Subtraction Sequence	0028, 6100	1	
>Mask Operation	0028, 6101	1	NONE or AVG_SUB
>Applicable Frame Range	0028, 6102	3	generated by acquisition system
>Mask Frame Numbers	0028, 6110	1C	Number of mask image: from user interface or generated by acquisition system (depending on acquisition mode)
>Mask Sub−pixel shift	0028, 6114	3	Xpixel shift / Ypixel shift: from user interface
Recommended viewing mode	0028, 1090	2	SUB/NAT
Percentage_landscape	0019, xx1E	3	Percentage of mask applied

3−4−5−7 Display Shutter

Attribute Name	Element Tag	TP	Notes
Shutter Shape	0018, 1600	1	CIRCULAR or RECTANGULAR. Combined Rectangular and Circular could exist and is represented by both CIRCULAR\RECTANGULAR attributes.
Display Shutter Left Vertical Edge	0018, 1602	1C	From user interface
Display Shutter Right Vertical Edge	0018, 1604	1C	From user interface
Display Shutter Upper Horizontal Edge	0018, 1606	1C	From user interface
Display Shutter Lower Horizontal Edge	0018, 1608	1C	From user interface

Center of Circular Display Shutter	0018, 1610	1C	From user interface
Radius of Circular Display Shutter	0018, 1612	1C	From user interface

3–4–5–8 Device

Attribute Name	Element Tag	TP	Notes
Device Sequence	0050, 0010	3	
>Code Value	0008, 0100	1C	BALL or CATHETER
>Coding Scheme Designator	0008, 0102	1C	99DEV
>Device Diameter	0050, 0016	3	Set in DLXINSTAL for BALL, from user interface for CATHETER
>Device Diameter Units	0050, 0017	2C	MM
Stenos_calibr_ratio;	0015, xx01	3	Calibration ratio for Stenosis Quantification, expressed for a 1024 pixel matrix.
Stenos_magnification;	0015, xx02	3	Calibration ratio for Length measurement
Cardiac_calibr_ratio;	0015, xx03	3	Calibration ratio for VG quantification

3–4–5–9 X–Ray Image

Attribute Name	Element Tag	TP	Notes
Frame Increment pointer	0028, 0009	1C	
Lossy Image Compression	0028,2110	1C	00
Image Type	0008, 0008	1	ORIGINAL\PRIMARY\ either SINGLE PLANE, BIPLANE A or BIPLANE B
Pixel Intensity Relationship	0028, 1040	1	value : LIN, or DISP. In DISP mode, only spatial measurements are available.
Samples per Pixel	0028,0002	1	1
Photometric interpretation	0028,0004	1	MONOCHROME1 if reverse video, MONOCHROME2 otherwise
Bits allocated	0028, 0100	1	8
Bits stored	0028, 0101	1	8
High Bit	0028, 0102	1	7
Pixel Representation	0028, 0103	1	0
Reference Image Sequence	0008, 1140	1C	Used to identify the related plane Image in case of Biplane acquisition (LATeral if FRonTal or FRonTal if LATeral)
>Reference SOP class UID	0008, 1150	1C	1.2.840.10008.5.1.4.1.1.12.1
>Reference SOP instance UID	0008, 1155	1C	Restricted to 64 char. Series_UID if monoplane, Series_UID + '.2' if frontal from biplane, Series_UID + '.1' if lateral from biplane
R Wave Pointer	0028, 6040	3	
Scan Options	0018, 0022	3	EKG or STEP, or CHASE, or ROTA or no value
Calibration Image	0050, 0004	3	No value, zero length

3−4−5−10 X−Ray Acquisition

Attribute Name	Element Tag	TP	Notes
KVP	0018, 0060	2	Generated by acquisition system
Field of view Shape	0018, 1147	3	ROUND
Field of View Dimension	0018, 1149	3	Generated by acquisition system, multiplied by 25.4
Grid	0018, 1166	3	IN
Radiation Mode	0018, 115A	3	PULSED
Radiation Setting	0018, 1155	1	GR
Exposure Time	0018, 1150	2C	Generated by acquisition system
X−ray Tube Current	0018, 1151	2C	Restricted to 8 char.
Intensifier Size	0018, 1162	3	Set in DLXINSTAL, multiplied by 25.4
Adx_procedure_name	0019, xx07	3	free text information
Adx_exam_name	0019, xx08	3	free text information
Adx_patient_size	0019 , xx09	3	LOW, MEDIUM, ADULT
Adx_injector_delay	0019, xx10	3	delay in start of injection in 1/10th of seconds
Adx_auto_inject	0019, xx11	3	1 if autoinjection, 0 if not
Adx_acq_mode	0019, xx14	3	0,1 for vascular 2..7 for cardiac 8..13 for DSA stepping 14..19, 26 for Bolus Chasing 20..25 for HSS acquisition
Adx_camera_rotation _enable	0019, xx15	3	0..3 rotation disabled 4..7 rotation enabled
Adx_reverse_sweep	0019, xx16	3	0,4 no reverse sweep 1, 5 vertical reverse sweep 2, 6 horizontal reverse sweep 3, 7 Horizontal & Vertical sweep
Adx_focus	0019, xx1B	3	focus on frontal plane
Adx_dose	0019, xx1C	3	0, 1, 2, 3 for dose A, B, C, D
Adx_exposure_duration	0019, xx1F	3	in ms.
Acq_Record View	0019, 000A	3	1 Frontal, 2 Lateral 3 Biplane

3−4−5−11 X−Ray Collimator

Attribute Name	Element Tag	TP	Notes
Collimator shape	0018,1700	1	value : CIRCULAR
Center of circular collimator	0018,1710	1C	512\512 or 256\256
Radius of circular Collimator	0018,1712	1C	Set in DLXINSTAL

3−4−5−12 X−Ray table

Attribute Name	Element Tag	TP	Notes
Table Motion	0018, 1134	2	DYNAMIC or STATIC
Table Vertical Increment	0018, 1135	2C	0
Table Longitudinal Increment	0018, 1137	2C	Generated by acquisition system
Table Lateral Increment	0018, 1136	2C	0

3−4−5−13 XA Positioner

Attribute Name	Element Tag	TP	Notes
Distance Source to Patient	0018, 1111	3	Generated by acquisition system
Distance Source to detector	0018, 1110	3	Generated by acquisition system
Estimated Radiographic Magnification factor	0018, 1114	3	(0018, 1110) divided by (0018, 1111)
Positioner Motion	0018, 1500	2C	STATIC or DYNAMIC
Positioner Primary Angle	0018, 1510	2	Calculated with (0019, 0006), (0019, 0001), (0019, 0002), (0019, 0003)
Positioner Secondary Angle	0018, 1511	2	Calculated with (0019, 0006), (0019, 0001), (0019, 0002), (0019, 0003)
Positioner Primary Angle Increment	0018, 1520	2C	Generated by acquisition system
Positioner Secondary Angle Increment	0018, 1521	2C	Generated by acquisition system
Angle_value_1	0019, xx01	3	Positioner angle for L arm in degrees
Angle_value_2	0019, xx02	3	Positioner angle for P arm in degrees
Angle_value_3	0019, xx03	3	Positioner angle for C arm in degrees
Angle_label_1	0019, xx04	3	L
Angle_label_2	0019, xx05	3	CAU, CRA
Angle_label_3	0019, xx06	3	LAO, RAO

3−4−5−14 Curve

Attribute Name	Element Tag	TP	Notes
Curve Dimensions	50xx, 0005	1	1 for PHYSIO, 2 for ROI
Number of points	50xx, 0010	1	Generated by acquisition system for PHYSIO, from user interface for ROI
Type of Data	50xx, 0020	1	ROI or PHYSIO
Data Value Representation	50xx, 0103	1	0
Curve Data	50xx, 3000	1	
Curve Description	50xx, 0022	3	only if Type of Data (50xx, 0020) = ROI, then DIASTOLE or SYSTOLE

Curves can be either Cardiac Contours (1 diastolic and 1 systolic per multiframe image), or a physiological curve (e.g. EKG). For a Multiframe Image, there could be 2 Cardiac contour and 2 physiological curves.

3−4−5−15 SOP Common

Attribute Name	Element Tag	TP	Notes
SOP Class UID	0008, 0016	1	1.2.840.10008.5.1.4.1.1.12.1
SOP Instance UID	0008, 0018	1	Restricted to 64 char. Series_UID if monoplane, Series_UID + '.1' if frontal from biplane, Series_UID + '.2' if lateral from biplane
Specific Character	0008, 0005	1C	ISO−IR−100

3–5 PRIVATE DATA DICTIONARY

Attribute Name	Data Element Tag	VR	VM
Private Creator PATIENT_01	**0011, 00xx**	**LO**	**1**
Patient DOB	0011, xx01	LT	1
Private Creator EXAM_01	**0015,00xx**	**LO**	**1**
Stenos_calibr_ratio;	0015, xx01	DS	1
Stenos_magnification;	0015, xx02	DS	1
Cardiac_calibr_ratio;	0015, xx03	DS	1
Private Creator SERIE_01	**0019,00xx**	**LO**	**1**
Angle_value_1	0019, xx01	DS	1
Angle_value_2	0019, xx02	DS	1
Angle_value_3	0019, xx03	DS	1
Angle_label_1	0019, xx04	CS	1
Angle_label_2	0019, xx05	CS	1
Angle_label_3	0019, xx06	CS	1
Adx_procedure_name	0019, xx07	ST	1
Adx_exam_name	0019, xx08	ST	1
Adx_patient_size	0019, xx09	SH	1
Acq_record view	0019, 000A	IS	1
Adx_injector_delay	0019, xx10	DS	1
Adx_auto_inject	0019, xx11	CS	1
Adx_acq_mod	0019, xx14	IS	1
Adx_camera_rotation_enable	0019, xx15	CS	1
Adx_reverse_sweep	0019, xx16	CS	1
Cur_spatial_filter_strength	0019, xx17	IS	1
Zoom_factor	0019, xx18	IS	1
X_zoom	0019, xx19	IS	1
Y_zoom	0019, xx1A	IS	1
Adx_focus	0019, xx1B	DS	1
Adx_dose	0019, xx1C	CS	1
Side_mark	0019, xx1D	IS	1
Percentage_landscape	0019, xx1E	IS	1
Adx_exposure_duration	0019, xx1F	DS	1

Private Creator ANNOT_01	**70nn,00xx**	**LO**	**1**
Text_annotation	70nn, xx04	ST	1
Box	70nn, xx05	IS	2
Arrow end	70nn, xx07	IS	2

Attribute Name	**Data Element Tag**	**Value**
Private Creator PATIENT_01	0011,00xx	DLX_PATNT_01
Private Creator EXAM_01	0015,00xx	DLX_EXAMS_01
Private Creator SERIE_01	0019,00xx	DLX_SERIE_01
Private Creator ANNOT_01	70nn,00xx	DLX_ANNOT_01

SECTION 4 – SECONDARY CAPTURE IMPLEMENTATION

4–0 INTRODUCTION

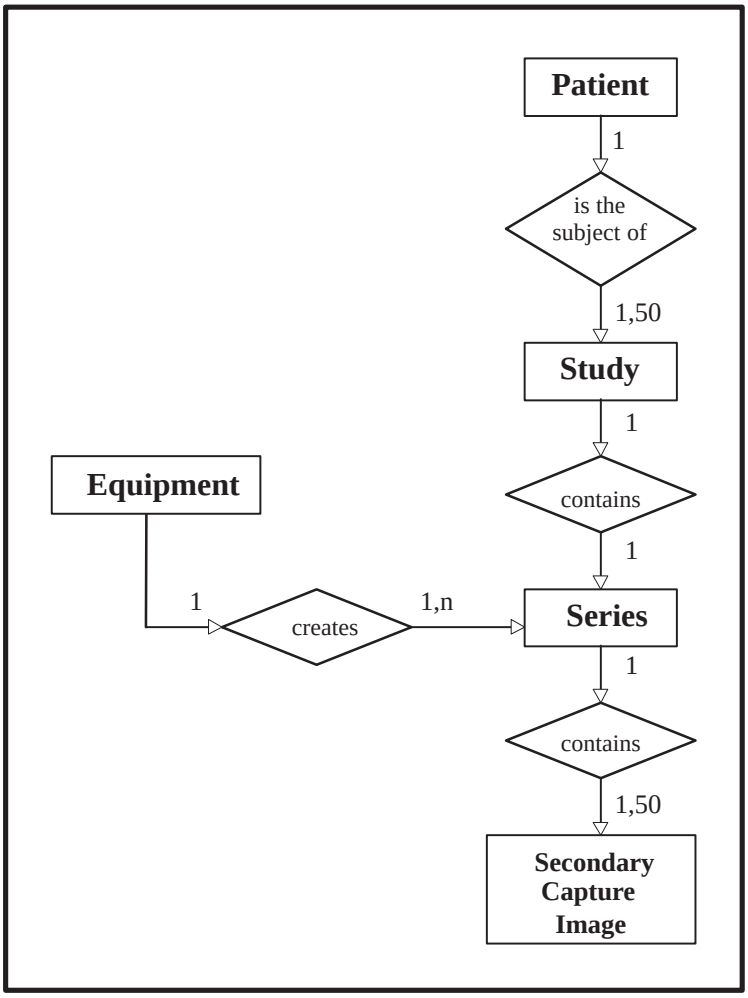
This section specifies the use of the DICOM v3.0 Secondary Capture Image IOD to represent the information included in Secondary Capture images produced by this implementation. Corresponding attributes are conveyed using the module construct.

4–1 SC IMAGE IOD IMPLEMENTATION

This section defines the implementation of SC image information object. It refers to the DICOM V3.0 Standard, Part 3 (Information Object definition).

4–2 SC IMAGE IOD ENTITY–RELATIONSHIP MODEL

Illustration 4–1
SC Image Entity Relationship Diagram



The Entity–Relationship diagram for the SC Image interoperability schema is shown in Illustration 4–1. The following diagrammatic convention is established to represent the information organisation :

- each entity is represented by a rectanglar 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.

4–2–1 Entities Description

Refer to DICOM Standard Part 3 (Information Object Definitions) for a descripion of each of the entities contained within the Secondary Capture Image Information Object Definition.

4–2–2 DGW Mapping of DICOM entities

DICOM entities map to the DLX entities in respect to the following :

DICOM	DLX
Patient Entity	Patient Entity
Study Entity	Examination Entity
Serie Entity	no match, there is a one to one relationship between DICOM Study and Serie
Secondary Image Entity	Photo Entity

4–3 SC IMAGE IOD MODULE TABLE

Within an entity of the DICOM v3.0 XRAY Angio Image 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 5–2 identifies the defined modules within the entities which comprise the DICOM v3.0 XRAY Angio Image Information object Definition. Modules are identified by Module Name.

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

Table 4.2
SC Image Information Object Definition (IOD) Module Table

IE	Module Name	Reference
Patient	Patient	4–4–1–1
Study	General Study	4–4–2–1
	Patient Study	4–4–2–2
Series	General Series	4–4–3–1
Equipment	SC Equipment	4–4–4–1
Image	General Image	4–4–5–1
	Image Pixel	4–4–5–2
	Overlay Plane	4–4–5–3
	SOP Common	4–4–5–4

4–4 MODULE LIBRARY

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

Modules contain also **type 3 Private elements**.

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

4–4–1 Patient Entity Module

4–4–1–1 Patient Module

Attribute Name	Element Tag	TP	Notes
Patient's Name	0010, 0010	2	From user interface, restricted to 48 char.
Patient ID	0010, 0020	2	From user interface, restricted to 64 char.
Patient's Birth Date	0010, 0030	2	From user interface, no value if wrong format
Patient's Sex	0010, 0040	2	From user interface, "M", "F" or "O"
Patient DOB	0011, xx01	3	Patient Date of birth in free form.

4–4–2 Study Entity Module

4–4–2–1 General Study

Attribute Name	Element Tag	TP	Notes
Study Instance UID	0020, 000D	1	Restricted to 64 char.
Study Date	0008, 0020	2	YYYYMMDD, restricted to 8 char.
Study Time	0008, 0030	2	HHMMSS.XXX, restricted to 10 char.
Referring Physicians' Name	0008, 0090	2	From user interface, restricted to 48 char.
Study ID	0020, 0010	2	From user interface, restricted to 64 char.
Accession number	0008, 0050	2	May have a value if comming from worklist already filled, restricted to 16 char.
Study Description	0008, 1030	3	From user interface, restricted to 16 char.

4–4–2–2 Patient Study

Attribute Name	Element Tag	TP	Notes
Patient's Size	0010, 1020	3	From user interface.
Patient's Weight	0010, 1030	3	From user interface, restricted to 16 char.
Additional Patient's History	0010, 21B0	3	From user interface, restricted to 252 char.
Patient address	0010, 1040	3	From user interface, restricted to 252 char.
Patient telephone	0010, 2154	3	From user interface, restricted to 32 char.

4–4–3 Series Entity Module

4–4–3–1 General Series

Attribute Name	Element Tag	TP	Notes
Modality	0008, 0060	1	value : XA
Series Instance UID	0020, 000E	1	Restricted to 64 char. Study instance UID + '.1'
Series Number	0020, 0011	2	value : 1
Series Date	0008, 0021	3	YYYYMMDD, restricted to 8 char.
Series Time	0008, 0031	3	HHMMSS.XXX, restricted to 10 char.
Performing Physician's Name	0008, 1050	3	From user interface, restricted to 48 char.

Series Description	0008, 103E	3	From user interface, restricted to 16 char.
Operators' Name	0008, 1070	3	From user interface, restricted to 48 char.
Patient position	0018, 5100	2C	No value, Zero length

4–4–4 Equipment Entity Module

4–4–4–1 SC Equipment Module

Attribute Name	Element Tag	TP	Notes
Conversion Type	0008, 0064	1	WSD
Modality	0008, 0060	3	XA
Manufacturer	0008, 0070	3	GE MEDICAL SYSTEMS
Institution name	0008, 0080	3	Generated by DLXINSTAL during acquisition
Secondary Capture Device Manufacturer	0018, 1016	3	GE MEDICAL SYSTEMS
Secondary Capture Device Manufacturer's Model Name	0018, 1018	3	DLX

4–4–5 Image Entity Module

4–4–5–1 General Image

Attribute Name	Element Tag	TP	Notes
Image Number	0020,0013	2	Image number in the serie
Image Date	0008,0023	2C	YYYYMMDD, restricted to 8 char.
Image Time	0008,0033	2C	HHMMSS.XXX, restricted to 10 char.
Image Type	0008,0008	3	DERIVED\SECONDARY\ either SINGLE PLANE, BIPLANE A or BIPLANE B
Patient Orientation	0020,0020	2C	No value, Zero length
Referenced Image Sequence	0008, 1140	3	Used to reference the associated plane Secondary Capture in case of Biplane Acquisition
>Referenced SOP Class UID	0008, 1150	1C	1.2.840.10008.5.1.4.1.1.7
>Referenced SOP Instance UID	0008, 1155	1C	Restricted to 64 char. Photo_UID + '.2' if frontal plane photo, Photo_UID + '.1' if lateral plane photo
Source Image Sequence	0008, 2112	3	used to reference the original acquisition
>Referenced SOP Class UID	0008, 1150	1C	1.2.840.10008.5.1.4.1.1.12.1
>Referenced SOP Instance UID	0008, 1155	1C	Restricted to 64 char. Series_UID + '.1' if frontal plane photo, Series_UID + '.2' if lateral plane photo
Image comments	0020,4000	3	From user interface, restricted to 16 char.

4–4–5–2 Image Pixel

Attribute Name	Element Tag	TP	Notes
Samples per Pixel	0028, 0002	1	1
Photometric Interpretation	0028, 0004	1	MONOCHROME1 if reverse video, or MONOCHROME2 otherwise
Rows	0028, 0010	1	512 or 1024
Columns	0028, 0011	1	512 or 1024
Bits Allocated	0028, 0100	1	16
Bits Stored	0028, 0101	1	8
High Bit	0028, 0102	1	7
Pixel Representation	0028, 0103	1	0
Pixel Data	7FE0, 0010	1	

4–4–5–3 Overlay Plane Module

Attribute Name	Element Tag	TP	Notes
Rows	60nn, 0010	1	512 or 1024
Columns	60nn, 0011	1	512 or 1024
Overlay type	60nn, 0040	1	G
Origin	60nn, 0050	2	1,1
Bits Allocated	60nn, 0100	1	1
Bit Position	60nn, 0102	1	8..15
Gray Palette color lookup table descriptor	60nn, xx01	3	'**1,1,8**',to describe a lookup table of **1** entry, with the ovl value mapped on the **1rst** entry of the lookup table, and with lookup table data coded on **8** bits (0.255). For complete description, refer to Palette color lookup table descriptor of Image pixel module (tag 0028,1101)
Gray Palette color lookup table data	60nn, xx02	3	**0** for black overlay **255** for white overlay For complete description, refer to Palette color lookup table data of Image pixel module (tag 0028,1201)

4–4–5–4 SOP Common

Attribute Name	Element Tag	TP	Notes
SOP Class UID	0008, 0016	1	1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	0008, 0018	1	Restricted to 64 char. Series_UID + '.1' if frontal plane photo, Series_UID + '.2' if lateral plane photo
Specific Character Set	0008, 0005	1C	ISO–IR–100

4–5 PRIVATE DATA DICTIONARY FOR SECONDARY CAPTURE

Attribute Name	Data Elemenr Tag	VR	VM
Private Creator PATIENT_01	**0011,00xx**	**LO**	**1**
Patient DOB	0011, xx01	LT	1
Private Creator LKUP_01	**60nn,00xx**	**LO**	**1**
Gray Palette color lookup table descriptor	60nn, xx01	US	3
Gray Palette color lookup table data	60nn, xx02	US	1

Attribute name	Data Element Tag	Value
Private Creator PATIENT_01	0011,00xx	DLX_PATNT_01
Private Creator LKUP_01	60nn,00xx	DLX_LKUP_01