GE Medical Systems

# Technical Publications

**Direction 2406266–100**

Revision 0

## Advantx DLX
## Dicom V3.0 (ID/NET V3.0) (ID/NET V3.0)
## Dicom Conformance Statement

# This document applies to DLX Release M25.XX

**do not duplicate**

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# REVISION HISTORY

| REV | DATE | REASON FOR CHANGE |
|-----|------|-------------------|
| 0 | March 2004 | Initial release. (M25.XX DLX Software Release) (Clarity 3 Vascular Program) |

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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**, *DLX3 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.

**Section 5**, *Basic Worklist Management 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.

**Section 6**, *Modality Performed Procedure Step Implementation*, defines the technical specification 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.

1−1        **OVERALL CONFORMANCE STATEMENT DOCUMENT STRUCTURE**

The Documentation Structure of the ID/Net v3.0 Conformance Statements and their relationship with the DICOM v3.0 Conformance Statements is shown in Illustration 1−1.

ILLUSTRATION 1–1
**DOCUMENTATION STRUCTURE**

**ID/NET V3.0**

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

APPLICATION ENTITY SPECIFICATION

(services classes, Information objects, message
exchange, etc.)

**PRODUCT
IMPLEMENTATION:**

CT9800
DICOM v3.0
(1.0)
6G5

MR Advantage
Conformance

ADVANTX
DLX3
Conformance
Statement for
DICOM v3.0
(ID/Net v3.0)
Direction:
........

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DICOM STANDARD

**STANDARD
SPECIFICATION:**

DICOM v3.0
Part 1

M v3.0
t 2

M v3.0
t 3

M v3.0
t 4

DICOM v3.0
Part 5

M v3.0
t 6

M v3.0
t 7

M v3.0
t 8

1–2

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

*ADVANTX DLX*
*Conformance Statement for DICOM v3.0 (ID/Net v3.0)*
*Direction ........# 2142506–100*

This Conformance Statement documents the DICOM v3.0 Conformance Statement and Technical Specification required to interoperate with the GEMS ID/Net v3.0 network interface. Introductory information, which is applicable to all GEMS ID/Net v3.0 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' ID/Net v3.0 Conformance Statements.

The ID/Net v3.0 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 ID/Net v3.0 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
2101 L Street, N.W., Suite 300
Washington, DC  20037  USA
Phone: (202) 457–8474

**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 ID/Net v3.0 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 ID/Net v3.0 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 ID/Net v3.0 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 kept informed of the evolution of the implementation described in this document, the User should register on the GE Internet Server, accessible via anonymous ftp, by entering his e−mail address (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 ID/Net v3.0 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 ID/Net v3.0 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 ID/Net v3.0 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 Advantx DLX 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. It uses DICOM services to export images 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 Illustration 2–1.

ILLUSTRATION 2–1
**SPECIFIC AE APPLICATION MODEL**
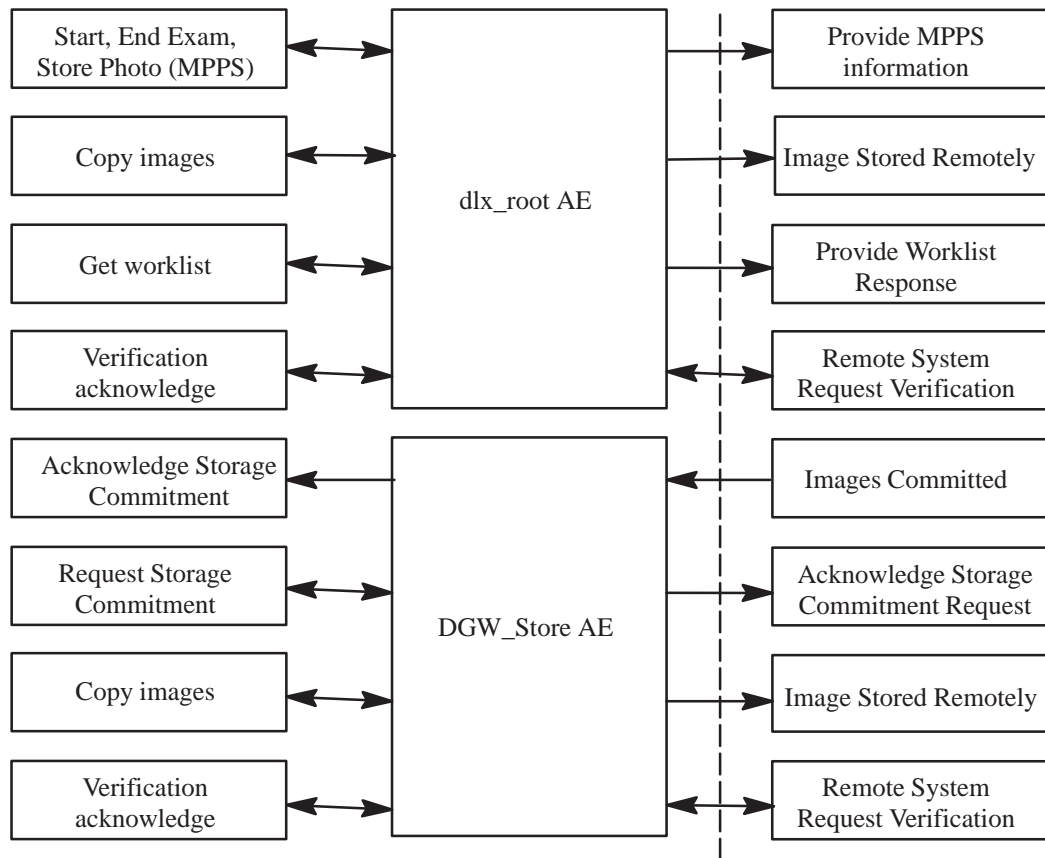


**DICOM INTERFACE STANDARD**

The DICOM High–Speed Interface–STORE Application Entity (DGW_Store AE) and dlx_root Application Entity (AE) are applications that handle protocol communication. Both applications are automatically started when the Digital Angiographic system (DLX) is powered on. A GE field engineer must manually configure – usually at the software installation time – all remote DICOM AEs on the DLX.

1. Real world activities that can cause the dlx_root AE to initiate a DICOM association:

- *Verification* consists of an operator request for the verification of the availability of a remote station.

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

- *Get Worklist (GW)* consists of an operator request for the transfer of a list of Patient/Exam entries from a predefined remote HIS/RIS system. The remote workstation can be any DICOM compliant HIS/RIS system supporting XA modality. Query strings may be entered for the following items:

  - Patient Name

  - Patient ID

  - Accession Number

  - Procedure ID

  - Date range.

**Note:**     However it is optional for a WL SCP to support query for Accession Number and Procedure ID, DLX supports filtering on these fields even if WL SCP doesn't.

If Modality Performed Procedure Step (MPPS) is enabled:

- *Start new* or *resume old exam* will create an MPPS and will initiate the transfer of an N–Create MPPS message to a configured MPPS server.

- *Close exam* will close the current MPPS and will initiate the transfer of an N–Set Completed MPPS message to a configured MPPS server.

- *Store photo offline* (post processing) will create an MPPS, update and close it and will initiate the transfer of both N–Create and N–Set Complete messages to a configured MPPS server.

The remote server can be any DICOM compliant MPPS SCP.

2. Real world activities that can cause the DGW_Store AE to initiate a DICOM association:

- *Verification* that consists of an operator request for the verification of the availability of a remote station.

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

- *Request Storage Commit (ReqSC)*, that is used to request Transfer of Ownership for the Images that have been transferred earlier by the CI real world activity. There is no User interface for the invoking of the ReqSC activity. In fact, this activity immediately follows a successful CI activity.

**2−1−2**          **Functional definitions of AE's**

The DICOM High–Speed Interface–STORE Application Entity supports the following functions:

1. Verification (Storage SCP)

- Initiation of a DICOM association request to test the availability of a remote server (Verification)
- Close the association

2. Copy Images:

- Access to patient demographics and Pixel Data in the local database.
- Build a DICOM format data set.
- Initiate a DICOM association to send the image(s).

3. Storage Commitment

- Initiation of a DICOM association in order to request Storage Commitment of the sent image(s)
- Request Storage Commitment for sent image(s).
- Accept DICOM Association for receiving Storage Commitment response.
- Receive Storage Commitment response.

The DGW_storage Application Entity also serves a default SCP function, the verification (Echo) Service Class request, independently from the other SCU functions.

The dlx_root Application Entity supports the following three SCU functions (one at a time):

1. Verification (WL and MPPS SCP)

- Initiate a DICOM association.
- Close the association.

2. Get Worklist:

- Build a DICOM formatted basic worklist management data request.
- Initiate a DICOM association to send the request.
- Wait for worklist response(s).
- Access the local database to add new patient/exam demographic data.
- Close the open Association.

3. Send MPPS:

- Build a DICOM formatted MPPS message.
- Initiate a DICOM association.
- Send MPPS message.
- Close connection.

4. Copy Images:

- Access to patient demographics and Pixel data in the local database.
- Buid a DICOM format data set.

- Initiate a DICOM association to send the images(s).

The dlx_root Application Entity also serves a default SCP function, the verification (Echo) Service Class request, independently from the other SCU functions.

**2−1−3      Sequencing of Real−World Activities**

The Copy Image activity must be successful in sending an image to the remote station before the Request Storage Commit activity can be triggered.

**2−2      AE SPECIFICATION**

**2−2−1      AE Specification**

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

| SOP Class Name | SOP Class UID |
|---|---|
| Verification | 1.2.840.10008.1.1 |
| Modality Worklist | 1.2.840.10008.5.1.4.31 |
| Modality Performed Procedure Step | 1.2.840.10008.3.1.2.3.3 |
| 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 |

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

| SOP Class Name | SOP Class UID |
|---|---|
| Verification Service Class | 1.2.840.10008.1.1 |

The **DICOM High–Speed Interface–STORE** Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCU**:

| SOP Class Name | SOP Class UID |
|---|---|
| Verification | 1.2.840.10008.1.1 |
| 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 |
| Storage Commitment Push Model SOP Class | 1.2.840.10008.1.20.1 |

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

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

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Class 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 both 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 applications will initiate only one DICOM association to perform image storage, Worklist or MPPS transfers and will not support multiple associations open simultaneously.

The verification SCP association can be open simultaneously to another SCU association.

**2−2−1−1−3        Asynchronous Nature**

Asynchronous mode is supported. All Image store and Request Storage Commit operations will be performed synchronously, with the exception that a single C–Echo response or a single N–Event (Storage Commitment) 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 High–Speed Interface Implementation UID | 1.2.840.113619.91 |
|---|---|
| AdvantX DLX Implementation UID | 1.2.840.113619.90 |

**2−2−1−2        Association Initiation Policy**

DICOM High–Speed Interface–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).

After each successful transfer of an image, the DGW–STORE AE attempts to initiate a new association to send a Storage Commitment Request for that particular image. This association corresponds to the second Real–World Activity: Request Storage Commit (ReqSC).

dlx_root AE attempts to initiate a new association for each Real–World Activity: Get Worklist (GW), all type of MPPS transfers.

#### 2−2−1−2−1 Real−Word Activity "Copy Image"

Both AE sends user selected XA and SC IODs to a previously selected remote AE one at a time.

#### 2−2−1−2−1−1 Associated Real−Word Activity

The operator selects a destination by selecting a Host from the 'Host list' of the Host Selection window (by default the last selected host is active). Automatic archive host destination(s) are set at installation time by the Field Service Engineer.

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

This operation will cause for both AEs:

- to initiate a DICOM association, select the appropriate Abstract and Transfer syntax from those accepted by the remote AE.
- to emit C–STORE command to send the image.
- 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 Little Endian | 1.2.840.10008.1.2.1 | 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 Little Endian | 1.2.840.10008.1.2.1 | 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.

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.

**Note:**  Several hosts can be selected at the same time in the DLX User Interface. This ensures multi–destination storage, each user selected XA and SC IOD being sent to each selected host (one remote AE at a time i.e. an item is queued to host1, then queued again to host2, ..., queued to hostN).

**2−2−1−2−2**  **Real−Word Activity "Request Storage Commit" (OPTIONAL)**

The DGW–STORE AE sends one Storage Commitment Request for the XA and SC, which have been transferred earlier by way of "Copy Image" activity. This request is sent for each XA/SC to the previously selected remote AE one at a time.

**2−2−1−2−2−1**  **Associated Real−Word Activity**

The operator selects a destination by selecting a Host from the 'Host list' of the Host Selection window (by default the last selected host is active). Automatic archive host destination(s) are set at installation time by the Field Service Engineer.

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

Upon successful transfer of the selected Image(s), the Request Storage Commit activity is automatically triggered.

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 N–Action command to request Storage commitment for the sent image.

- Close the Association upon receiving N–Action confirmation.

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

| Presentation Context Table – Proposed | | | | | |
|---|---|---|---|---|---|
| Abstract Syntax | | Transfer Syntax | | Role | Expanded |
| Name | UID | Name List | UID List | | Negotiation |
| Storage Commitment Push Model | 1.2.840.10008.1.20.1 | Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU | None |

**2−2−1−2−2−2−1**     **SOP Specific Conformance Statement for Storage Commitment Push Model SOP Class**

This implementation performs a single N–Action operation over an association.

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

Upon receiving a N–Action confirmation containing a Success Status, this implementation will treat it as only the Storage Commitment request was successful. The implementation expects to receive the actual response of the Storage Commitment request via another Real World Activity: Acknowledge Storage Commit (ASC).

Each N–Action 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 N–Action operation supports an " Operation Inactivity Timer ". This timer starts once a N–Action request has been issued and stops once a N–Action 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.

**2−2−1−2−3**     **Real−Word Activity "Get Worklist" (OPTIONAL)**

**2−2−1−2−3−1**     **Associated Real−Word Activity**

The Worklist option has to be enabled by the system installation procedure.

The operator selects a destination host through a service menu.

The worklist transfer can be initiated from the Patient Viewer Dialogue by pressing the "Worklist" soft key.

This operation will cause:

- the dlx_root AE to initiate a DICOM association.
- the dlx_root AE to emit a C–ECHO request to check if the remote AE is available. Finally the association is closed.
- the DLX to build a Basic Worklist C–FIND Request.
- the dlx_root AE to initiate a DICOM association, select the appropriate Abstract and Transfer Syntax from those accepted by the remote AE.
- the dlx_root AE to emit the C–FIND Request.
- the dlx_root AE to receive C–FIND (Worklist) Response(s).
- the DLX to add new entry items to the local database if they are not existing yet.
- the dlx_root AE to close the association.

**2−2−1−2−3−2**     **Proposed Presentation Contexts**

| Presentation Context Table – Proposed | | | | | |
|---|---|---|---|---|---|
| **Abstract Syntax** | | **Transfer Syntax** | | **Role** | **Expanded** |
| **Name** | **UID** | **Name List** | **UID List** | | **Negotiation** |
| Modality Worklist Information Model – FIND | 1.2.840.10008.5.1.4.31 | Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU | None |

**2−2−1−2−3−2−1   SOP Specific Conformance Statement for Storage Commitment Push Model SOP Class**

This implementation performs a single C–FIND operation over one association.

If the AE does not receive a C–ECHO confirmation, this implementation will terminate the association. The Worklist request is considered as failed.

Upon receiving a C–ECHO confirmation containing an Error, Refused or Warning status, this implementation will consider the result OK. This is because the only purpose of the C–ECHO is to check that the remote AE responds.

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

The C–ECHO operation supports an "Operation Inactivity Timer". This timer starts when the C–ECHO request is sent and it stops when the C–ECHO response is received. This timer is also set to 30 seconds.

Upon receiving a C–FIND response containing an error status this implementation will terminate the association issuing a close request. The current C–FIND is considered as failed.

Each C–FIND operation supports an "Operation Inactivity Timer". This timer starts when the C–FIND request is sent and it stops when the C–FIND final response received. This timer is set to 60 seconds.

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

Badly formatted C–FIND response(s) from the SCP will result in the initiatiation of a C–FIND cancel request. In the dlx_root AE, the C–FIND cancel operation is not implemented as an additional operator choice.

On completion of operation the dlx_root AE places the status (flag) of the final Worklist update operation on DLX into the Abort flag of the close association request. That way the Worklist provider can get a final success feed back of the complete HIS/RIS data transfer operation. This flag setting doesn't change the basic DICOM association management functionality.

**2−2−1−2−4      Real−Word Activity "MPPS" (OPTIONAL)**

**2−2−1−2−4−1   Associated Real−Word Activity**

The MPPS option has to be enabled by the system installation procedure.

The operator selects a destination host through a service menu

The MPPS transfer is initiated automatically any time when the user starts an exam, stops it, or produces a store photo event after the end of the examen.

This operation will cause:

- the dlx_root AE to initiate a DICOM association.
- the dlx_root AE to emit a C–ECHO request to check if the remote AE is available. Finally the association is closed.
- the dlx_root AE to initiate a DICOM association, select the appropriate Abstract and Transfer Syntax from those accepted by the remote AE.
- the dlx_root AE to emit a N–Create_Request or and N–Set Request depending on the state of the MPPS to send.
- the dlx_root AE to receive a success or failure response from MPPS SCP.

- the dlx_root AE to remove the successfully sent MPPS message from the queue.
- the dlx_root AE to close the association.

**2−2−1−2−4−2    Proposed Presentation Contexts**

<table>
<tr><th colspan="6">Presentation Context Table – Proposed</th></tr>
<tr><th colspan="2">Abstract Syntax</th><th colspan="2">Transfer Syntax</th><th>Role</th><th>Expanded</th></tr>
<tr><th>Name</th><th>UID</th><th>Name List</th><th>UID List</th><th></th><th>Negotiation</th></tr>
<tr><td>Modality Performed Procedure Step</td><td>1.2.840.10008.3.1.2.3.3</td><td>Implicit VR Little Endian</td><td>1.2.840.10008.1.2</td><td>SCU</td><td>None</td></tr>
</table>

**2−2−1−2−4−2−1    SOP Specific Conformance Statement for Storage Commitment Push Model SOP Class**

This implementation performs a single N–Create or N–Set 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 N–Create or N–Set will be attempted. Upon receiving a C–ECHO confirmation containing an Error, Refused or Warning status, this implementation will consider the result as OK. This is because the only purpose of the C–ECHO is to check that the remote AE responds, whatever is the C–ECHO status.

Upon receiving an N–Create or N–Set confirmation containing an Error or a Refused status, this implementation will terminate the association, except if the error code is 0111H which conveys a "Duplicate SOP Instance" error message. For this implementation the duplication of SOP instance means that the MPPS were already created by this application but for some reason (e.g. network failure) the success of creation was not registered, no other checks are performed to find any other possible root cause of this error message. In the case of all the other errors the current N–Create or N–Set is considered as failed.

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

Each N–Create or N–Set 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 120 seconds.

Each N–Create or N–Set operation supports an " Operation Inactivity Timer ". This timer starts once a N–Create or N–Set request has been issued and stops once corresponding confirmation has been received. This Timer is set to 5 minutes.

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

If once an operation failed, no further attempts are made until user intervention.

**2−2−1−2−5    Real−Word Activity "Verification" (OPTIONAL)**

**2−2−1−2−5−1    Associated Real−Word Activity**

The operator selects a destination by selecting an host in the TRANSFER menu (by default the last selected host is active).

Then the operator activates one of the "host verification", "worklist verification" or "MPPS Host Verification" keys depending on the tested SCP (storage SCP, WL SCP or MPPS SCP).

These operations will cause:

- the DICOM application to initiate a DICOM association.
- the DICOM application to emit a C–ECHO command to check if the remote AE is available.

**2−2−1−2−5−2    Proposed Presentation Contexts**

<table>
<tr><td colspan="6" align="center"><strong>Presentation Context Table – Proposed</strong></td></tr>
<tr><td colspan="2" align="center"><strong>Abstract Syntax</strong></td><td colspan="2" align="center"><strong>Transfer Syntax</strong></td><td align="center"><strong>Role</strong></td><td align="center"><strong>Expanded</strong></td></tr>
<tr><td align="center"><strong>Name</strong></td><td align="center"><strong>UID</strong></td><td align="center"><strong>Name List</strong></td><td align="center"><strong>UID List</strong></td><td></td><td align="center"><strong>Negotiation</strong></td></tr>
<tr><td>Verification</td><td>1.2.840.10008.1.1</td><td>Implicit VR Little Endian</td><td>1.2.840.10008.1.2</td><td>SCU</td><td>None</td></tr>
</table>

**2−2−1−3        Association Acceptance Policy**

The dlx_root AE provides only DICOM Verification Service Class.

The DGW–STORE AE provides the DICOM Verification Service Class and the Storage Commitment Push Model service Class in the SCP Role.

**2−2−1−3−1      Real−Word Activity "Verification acknowledge"**

Both DICOM application 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−Word 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 the correct TCP/IP port (default: 4006)

**Note:**        The Port number where the DGW–STORE AE is listening at is configure–able at installation time.

**2−2−1−3−1−2    Accepted Presentation Context**

<table>
<tr><td colspan="6" align="center"><strong>Presentation Context Table – Proposed</strong></td></tr>
<tr><td colspan="2" align="center"><strong>Abstract Syntax</strong></td><td colspan="2" align="center"><strong>Transfer Syntax</strong></td><td align="center"><strong>Role</strong></td><td align="center"><strong>Expanded</strong></td></tr>
<tr><td align="center"><strong>Name</strong></td><td align="center"><strong>UID</strong></td><td align="center"><strong>Name List</strong></td><td align="center"><strong>UID List</strong></td><td></td><td align="center"><strong>Negotiation</strong></td></tr>
<tr><td>Verification</td><td>1.2.840.10008.1.1</td><td>Implicit VR Little Endian</td><td>1.2.840.10008.1.2</td><td>SCP</td><td>None</td></tr>
</table>

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

Both DICOM application provides standard conformance to the DICOM Verification Service Class.

**2−2−1−3−1−2−2  SOP Specific Conformance Statement for Storage Commitment Push Model SOP Class**

This implementation accepts a single N–Event operation over an association.

Upon receiving a N–Event Request (Storage Commitment Response) for a particular image, this implementation will send a corresponding N–Event Response to the remote.

The Success status contained in the N–Event Request will be used to mark the Image in the DLX database as Archived.

The Failed status contained in the N–Event Request will not update the Image status in the DLX database.

The implementation will then wait for the release of the Association, initiated by the remote.

## 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

Ethernet v2.0, IEEE 802.3.

The DICOM High–Speed Interface supports an Asynchronous 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. DICOM High–Speed Interface supports either Switched Virtual Channel and Permanent Virtual Channel.

### 2−3−3  Point − to − pint 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 AdvantX DLX  and DICOM High–Speed Interface 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. This must be configured by a GEMS Field Service Engineer during installation.

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

**2−5−2**      **Configurable Parameters**

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

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

The following fields are configurable for every remote DICOM AE:

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

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

**2−6**      **SUPPORT OF EXTENDED CHARACTER SET**

This implementation supports the following extended character set:

ISO–IR–100

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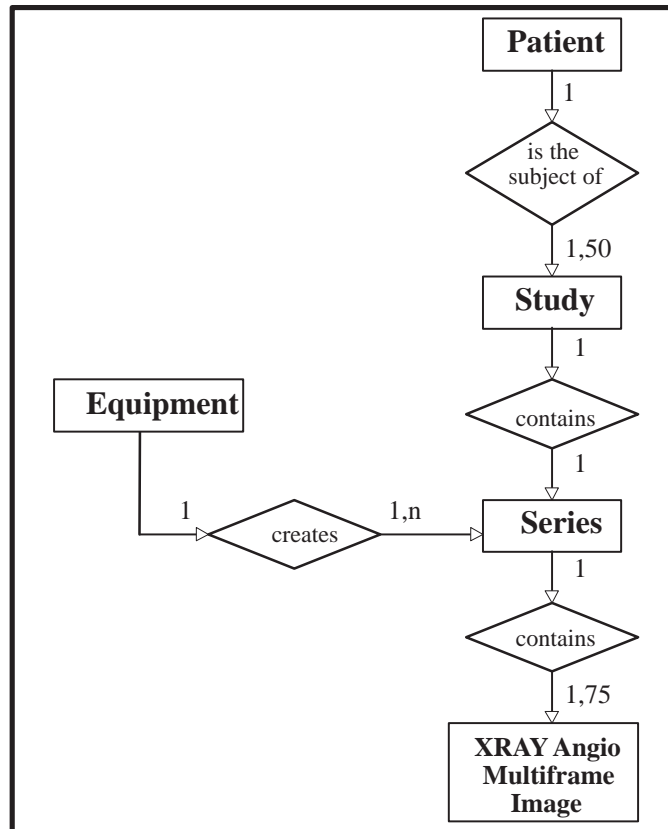
The Entity–Relationship diagram for the XRAY Angiographic Image interoperability schema is shown in Illustration 3–1. In this figure, the following diagrammatic convention is established to represent the information organisation:

- 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 3–1 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 3–1
**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 |
| | XA Positioner | 3–4–5–12 |
| | X–Ray Table | 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. |
| Referenced Study Component Sequence | 0008,1111 | 3 | Sent only if MPPS is turned on and sequence items are available |
| >Referenced SOP Class UID | 0008,1150 | 1C | 1.2.840.10008.3.1.2.3.3 |
| >Referenced SOP Instance UID | 0008,1155 | 1C | Associated MPPS UID sent |
| Protocol Name | 0018,1030 | 3 | Sent only if MPPS is turned on, WL SCP supported SPS description is sent back |
| Performed Procedure Step ID | 0040,0253 | 3 | Sent only if MPPS is turned on |

| Attribute Name | Element Tag | TP | Notes |
|---|---|---|---|
| Performed Procedure Step Start Date | 0040,0244 | 3 | Sent only if MPPS is turned on |
| Performed Procedure Step Start Time | 0040,0245 | 3 | Sent only if MPPS is turned on |
| Performed Procedure Step Description | 0040,0254 | 3 | Sent only if MPPS is turned on, WL SCP supported SPS description is sent back |
| Requested Attributes Sequence | 0040,0275 | 3 | Sent only if MPPS is turned on and sequence items are available |
| >Requested Procedure ID | 0040,1001 | 1C | Sent only if MPPS is turned on, WL SCP supported value sent back |
| >Scheduled Procedure Step ID | 0040,0009 | 1C | Sent only if MPPS is turned on, WL SCP supported value sent back |
| >Scheduled Procedure Step Description | 0040,0007 | 3 | Sent only if MPPS is turned on, WL SCP supported value sent back |

**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 |
| Institution Address | 0008, 0081 | 3 | |
| Manufacturer Model Name | 0008, 1090 | 3 | DLX |
| Device Serial Number | 0018, 1000 | 3 | Identifier entered in DLXINSTAL |
| 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<br>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 :<br>0 : not defined<br>1, 4, 6 : Left of the patient is on the left side of the frame<br>2, 3, 5 : Right of the patient is on the left side of the frame |
| Station name | 0008, 1010 | 3 | User defined name identifying the SW entity (AE–Title) of the functionality that are providing the digital images. |

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 MONO-CHROME2 otherwise |
| Rows | 0028, 0010 | 1 | 512 or 1024 |
| Columns | 0028, 0011 | 1 | 512 or 1024 |
| Bits Allocated | 0028, 0100 | 1 | 8 or 16 |
| Bits Stored | 0028, 0101 | 1 | 8 or 10 |
| High Bit | 0028, 0102 | 1 | 7 or 9 |
| Pixel Representation | 0028, 0103 | 1 | 0 |
| Window Center | 0028, 1050 | 1C | Value is 128 for 8 bit XA multi–frame images. Value is 512 for 10 bit XA multi–frame images |
| Window Width | 0028, 1051 | 1C | Value is 256 for 8 bit XA multi–frame images. Value is 1024 for 10 bit XA multi–frame images |
| 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 annotation 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 RECTANGULAR/CIRCULAR 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 |

**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 EDR. In EDR mode, it should be possible to modify the edge enhancement filters and WW/WL. Spatial measurement should also be possible. |
| Samples per Pixel | 0028,0002 | 1 | 1 |
| Photometric interpretation | 0028,0004 | 1 | MONOCHROME1 if reverse video, MONOCHROME2 otherwise |
| Bits allocated | 0028, 0100 | 1 | 8 or 16 |
| Bits stored | 0028, 0101 | 1 | 8 or 10 |
| High Bit | 0028, 0102 | 1 | 7 or 9 |
| 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 |
| Acq_Record View | 0019, 000A | 3 | 1 Frontal, 2 Lateral 3 Biplane |
| Adx_injector_delay | 0019, xx10 | 3 | delay in start of injection in 1/10th of seconds |

| Attribute Name | Element Tag | TP | Notes |
|---|---|---|---|
| Adx_auto_inject | 0019, xx11 | 3 | 1 if autoinjection, 0 if not |
| Adx_acq_mode | 0019, xx14 | 3 | 0,1 for vascular<br>2..7 for cardiac<br>8..13 for DSA stepping<br>14..19, 26 for Bolus Chasing<br>20..25 for HSS acquisition |
| Adx_camera_rotation _enable | 0019, xx15 | 3 | 0 —> disable<br>1 —> enable<br>Value sent by acquisition system Advantx–E<br>0 if generated by acquisition system Advantx1 |
| Adx_reverse_sweep | 0019, xx16 | 3 | Value      Meaning<br><br>0   No reverse sweep on frontal and lateral<br>1   No reverse sweep on lateral,<br>     only vertical reverse sweep on frontal,<br>2   No reverse sweep on lateral,<br>     only horizontal reverse sweep on frontal,<br>3   No reverse sweep on lateral,<br>     vertical and horizontal reverse sweep on frontal,<br>4   Only vertical reverse sweep on lateral,<br>     no reverse sweep on frontal,<br>5   Only vertical reverse sweep on lateral,<br>     only vertical reverse sweep on frontal,<br>6   Only vertical reverse sweep on lateral,<br>     only horizontal reverse sweep on frontal,<br>7   Only vertical reverse sweep on lateral,<br>     vertical and horizontal reverse sweep on frontal,<br>8   Only horizontal reverse sweep on lateral,<br>     no reverse sweep on frontal,<br>9   Only horizontal reverse sweep on lateral,<br>     only vertical reverse sweep on frontal,<br>10 Only horizontal reverse sweep on lateral,<br>     only horizontal reverse sweep on frontal,<br>11 Only horizontal reverse sweep on lateral,<br>     vertical and horizontal reverse sweep on frontal,<br>12 Vertical and horizontal reverse sweep on lateral,<br>     no reverse sweep on frontal,<br>13 Vertical and horizontal reverse sweep on lateral,<br>     only vertical reverse sweep on frontal,<br>14 Vertical and horizontal reverse sweep on lateral,<br>     only horizontal reverse sweep on frontal,<br>15 Vertical and horizontal reverse sweep on lateral,<br>     vertical and horizontal reverse sweep on frontal.<br>Values sent by acquisition system Advantx–E<br>0 if generated by acquisition system Advantx1 |
| Adx_focus | 0019, xx1B | 3 | focus on frontal plane |

| Attribute Name | Element Tag | TP | Notes |
|---|---|---|---|
| Adx_dose | 0019, xx1C | 3 | 0, 1, 2, 3 for dose A, B, C, D |
| Adx_exposure_duration | 0019, xx1F | 3 | in ms. |
| IP address | 0019, xx20 | 3 | IP Address of the machine that sends the serie |

### 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 XA Positioner

| Attribute Name | Element Tag | TP | Notes |
|---|---|---|---|
| Distance Source to Patient | 0018, 1111 | 3 | Value sent by acquisition system Advantx–E<br>0 if generated by acquisition system Advantx1 |
| Distance Source to detector | 0018, 1110 | 3 | Value sent by acquisition system Advantx–E<br>0 if generated by acquisition system Advantx1 |
| 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 |

### 3−4−5−13    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 |
| Table Vertical position | 0019, xx21 | 3 | Vertical position of table in mm with respect to GEMS defined origin. |
| Table Longitudinal position | 0019, xx22 | 3 | Longitudinal position of table in mm with respect to GEMS defined origin. |
| Table Lateral position | 0019, xx23 | 3 | Vertical position of table in mm with respect to GEMS defined origin. |

### 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 Series_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 |
| IP address | 0019, xx20 | SH | 1 |
| Table vertical position | 0019, xx21 | DS | 1 |
| Table longitudinal position | 0019, xx22 | DS | 1 |
| Table lateral position | 0019, xx23 | 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 SERIE_01 | 0019,00xx | DLX_SERIE_01 |
| Private Creator ANNOT_01 | 70nn,00xx | DLX_ANNOT_01 |

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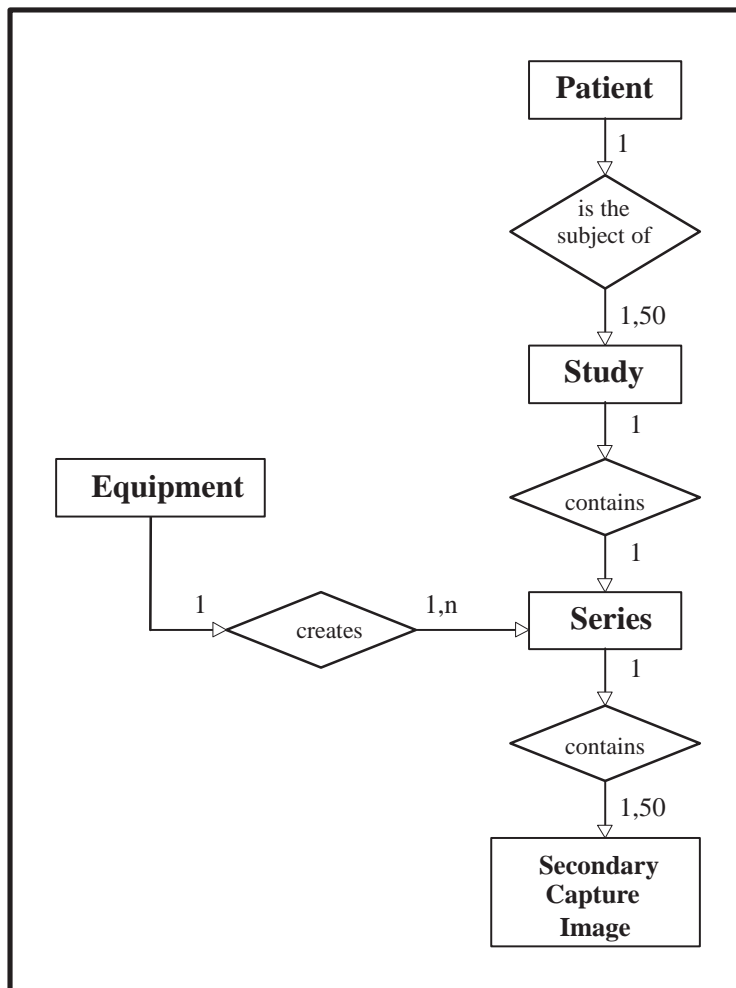
The Entity–Relationship diagram for the SC Image interoperability schema is shown in Illustration 4–1. The following diagrammatic convention is established to represent the information organisation:

- 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        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 |
| 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 4–1 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 4–1
**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. |
| Series Number | 0020, 0011 | 2 | value : 1 if the SC is a normal photo<br>value : > 1 if the SC belongs to a processed sequence |
| 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 |
| Institution Address | 0008, 0081 | 3 | |
| 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 |
| >Referenced Frame Number | 0008,1160 | 3 | Provides the number of frame of the originating Sequence from which the SC was generated. |
| 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. If SC belongs to a processed seqeunce "_xxx" is added, where 'xxx' contains the frame number. |
| Station name | 0008, 1010 | 3 | User defined name identifying the SW entity (AE–Title) of the functioality that are providing the digital images. |

**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 MONO-CHROME2 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 |
| Window Center | 0028, 1050 | 1C | Value is 128 for SC images. |
| Window Width | 0028, 1051 | 1C | Value is 256 for SC images. |
| 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.<br>Series_UID + '.1' if frontal plane photo,<br>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 |

| Attribute name | Data Element Tag | Value |
|---|---|---|
| Private Creator PATIENT_01 | 0011,00xx | DLX_PATNT_01 |

# SECTION 5 − BASIC WORKLIST MANAGEMENT IMPLEMENTATION (OPTIONAL)

**5−0**        **INTRODUCTION**

This section specifies the use of the Basic Worklist Management Information Objects to transfer the Worklist from the Information System to the Application Entity where the task is performed.

**5−1**        **WORKLIST INFORMATION MODEL IMPLEMENTATION**

This section defines the implementation of the Basic Worklist Information Object. It refers to the DICOM V3.0 Standard, Basic Worklist Management – Supplement 10 (August 11, 1995) to Part 3 (Information Object definition).

Note:        Result of query – in compliance with the DICOM standard– depends on whether the WL SCP supports or not the optinal query fields (Access number, Procedure ID). If WL SCP doesn't support these fields, there turned worklist will not be filtered by these parameters.

**5−2**        **WORKLIST INFORMATION MODEL ENTITY − RELATIONSHIP DIAGRAM**

ILLUSTRATION 5–1
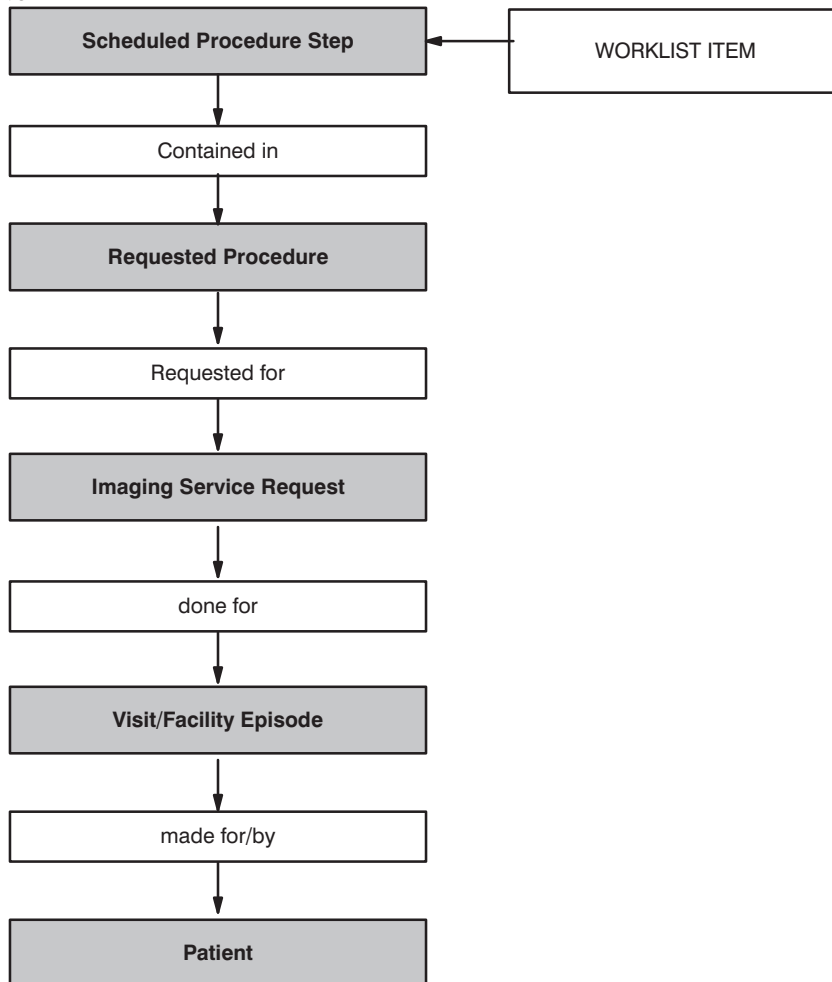
The Entity–Relationship diagram for the Basic Worklist Management interoperability schema is shown in Illustration 5–1. In this figure, the following diagrammatic convention is established to represent the information organization:

- each entity is represented by the gray rectangular box.

- each relationship is represented by the white rectangular box.

- the fact that a relationship exists between the two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

**5−2−1    Entities Description**

Refer to DICOM Standard Supplement 10 (August 11, 1995) to Part 3 (Information Object Definitions) for a description of the entities contained within this Information object.

**5−3    BASIC WORKLIST INFORMATION MODULE TABLE**

Within an entity of the DICOM v3.0 Basic Worklist 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 data sets.

Table 5–1 identifies the defined modules within the entities which comprise the DICOM v3.0 Basic Worklist Management Information Object. Modules are identified by Module Name.

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

TABLE 5–1
**BASIC WORKLIST MANAGEMENT INFORMATION MODULE TABLE**

| IE | Module Name | Reference |
|---|---|---|
| Patient | Patient Identification Module | 5–4–1–1 |
| | Patient Demographic Module | 5–4–1–2 |
| | Patient Medical Module | 5–4–1–3 |
| Visit/Facility Episode | Visit Identification Module | 5–4–2–1 |
| | Visit Status Module | 5–4–2–2 |
| | Visit Relationship Module | 5–4–2–3 |
| Imaging Service Request | Imaging Service Request Module | 5–4–3–1 |
| Requested Procedure | Requested Procedure Module | 5–4–4–1 |
| Scheduled Procedure Step | Scheduled Procedure Step Module | 5–4–5–1 |
| | SOP Common Module | 5–4–5–2 |

5−4 **INFORMATION MODULE DEFINITIONS**

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

Modules do not contain any **type 3 Private Elements**.

5−4−1 **Patient Entity Module**

5−4−1−1 **Patient Identification Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Patient's Name | 0010, 0010 | R | 1 | Yes | User entered value expanded by "*" mark at the end is sent Truncated to 20. A "^" character is added to separate last name and first name in database |
| Patient ID | 0010, 0020 | R | 1 | Yes | User entered value is sent Truncated to 18 characters. |
| Other Patient IDs | 0010, 1000 | O | 3 | No | Zero length sent. |

5−4−1−2 **Patient Demographic Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Patient's Address | 0010, 1040 | O | 3 | Yes | Truncated to 252 characters. Each line is truncated to 30 characters. Add "‖" after each line, then concatenate them in database. |
| Patients Telephone Numbers | 0010, 2154 | O | 3 | Yes | Truncated to 32 characters. |
| Patient's Birth Date | 0010, 0030 | O | 2 | Yes | Truncated to 24 characters. |
| Patient's Sex | 0010, 0040 | O | 2 | Yes | '0' if "M", '1' otherwise. |
| Patient's Size | 0010, 1020 | O | 3 | Yes | Truncated to 16 characters. Multiplied by 100. (Unit = cm) |
| Patient's Weight | 0010, 1030 | O | 2 | Yes | Truncated to 16 characters. |
| Ethnic Group | 0010, 2160 | O | 3 | No | Zero length sent |
| Patient Comments | 0010, 4000 | O | 3 | No | Zero length sent |

**5−4−1−3        Patient Medical Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Additional Patient History | 0010, 21B0 | O | 3 | Yes | Truncated to 252 characters. |
| Medical Alerts | 0010, 2000 | O | 2 | No | Zero length sent |
| Pregnancy Status | 0010, 21C0 | O | 2 | No | Zero length sent |

**5−4−2        Visit/Facility Episode Entity Module**

**5−4−2−1        Visit Identification Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Institution Name | 0008, 0080 | O | 3 | Yes | Truncated to 48 characters. |
| Admission ID | 0038, 0010 | O | 2 | No | |

**5−4−2−2        Visit Status Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Current Patient Location | 0038, 0300 | O | 2 | No | Zero length sent |

**5−4−2−3        Visit Relationship Module**

This Module is not sent as the necessary information  is not available.

**5−4−3** **Imaging Service Request Entity Module**

**5−4−3−1** **Imaging Service Request Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Referring Physician's Name | 0008, 0090 | O | 2 | Yes | Truncated to 48 characters. |
| Accession Number | 0008, 0050 | O | 1 | Yes | User entered value is sent Truncated to 16 characters. '\' and control characters are replaced by space character. |
| Requesting Physician | 0032, 1032 | O | 2 | No | Zero length sent. |
| Requesting Service | 0032, 1033 | O | 3 | No | Zero length sent. |
| Imaging Service Request Comments | 0040, 2400 | O | 1C | No | Zero length sent. |

**5−4−4** **Requested Procedure Entity Module**

**5−4−4−1** **Requested Procedure Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Requested Procedure ID | 0040, 1001 | O | 1 | Yes | User entered value is sent Truncated to 64 characters. "0" if empty. |
| Study Instance UID | 0020, 000D | O | 1 | Yes | Truncated to 62 characters. Affected by database if empty. |
| Requested Procedure Description | 0032, 1060 | O | 1C | Yes | Truncated to 16 characters. |
| Requested Procedure Code Sequence | 0032, 1064 | O | 1C | No | Explicit length of sequence sent. |
| >Code Value | 0008, 0100 | O | 1C | No | Zero length sent. |
| >Code Scheme Designator | 0008, 0102 | O | 1C | No | Zero length sent. |
| >Code Meaning | 0008, 0104 | O | 3 | No | Zero length sent. |
| Names of Intended Recipients of Results | 0040, 1010 | O | 3 | No | Zero length sent. |
| Requested Procedure Comments | 0040, 1400 | O | 3 | No | Zero length sent. |

**5−4−5**          **Scheduled Procedure Step Entity Module**

**5−4−5−1**          **Scheduled Procedure Step Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Scheduled Procedure Step Sequence | 0040, 0100 | R | 1 | No | |
| >Scheduled Station AE title | 0040, 0001 | R | 1 | No | Zero length sent |
| >Scheduled Station Name | 0040, 0010 | O | 2 | No | Zero length sent |
| >Scheduled Procedure Step Start Date | 0040, 0002 | R | 1 | No | User entered value is sent |
| >Scheduled Procedure Step Start Time | 0040, 0003 | R | 1 | No | Zero length sent |
| >Scheduled Performing Physician's Name | 0040, 0006 | R | 2 | Yes | Truncated to 20 characters |
| >Scheduled Procedure Step ID | 0040, 0009 | O | 1 | No | |
| >Modality | 0008, 0060 | R | 1 | No | Modality value = "XA" (*) |
| >Scheduled Procedure Step Description | 0040, 0007 | O | 1C | No | Zero length sent |
| >Scheduled Action Item Code Sequence | 0040, 0008 | O | 1C | No | Explicit length of sequence sent. |
| >>Code Value | 0008, 0100 | O | 1C | No | Zero length sent. |
| >>Code Scheme Designator | 0008, 0102 | O | 1C | No | Zero length sent. |
| >>Code Meaning | 0008, 0104 | O | 3 | No | Zero length sent. |
| >Scheduled Procedure Step Location | 0040, 0011 | O | 2 | No | Zero length sent. |

(*) This means that matching is requested upon the provided value.

**5−4−5−2**          **SOP Common Module**

| Attribute Name | Element Tag | Expected matching key type | Expected Returned key type | Mapped into the image | Notes |
|---|---|---|---|---|---|
| Specific Character Set Start Date | 0008, 0005 | O | 1C | Yes | "ISO_IR 100" value is sent |

**Note:** Incoming worklist files MUST NOT contain study UID with a length over 62 characters.

# SECTION 6 − MODALITY PERFORMED PROCEDURE STEP IMPLEMENTATION (OPTIONAL)

**6−0**        **INTRODUCTION**

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

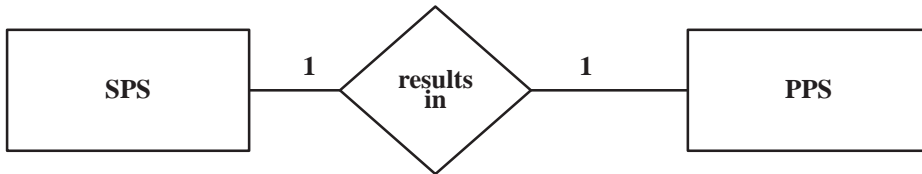**6−1**        **MPPS IOD IMPLEMENTATION**

This section defines the implementation of MPPS information object. It refers to the DICOM V3.0 Standard, (1999) to Part 4, Annex F7 (MODALITY PERFORMED PROCEDURE STEP SOP CLASS).
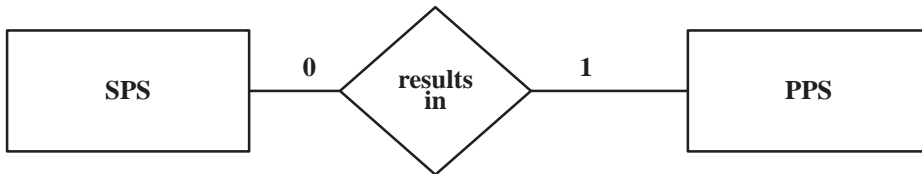
**6−2**        **MPPS IOD ENTITY – RELATIONSHIP DIAGRAM**

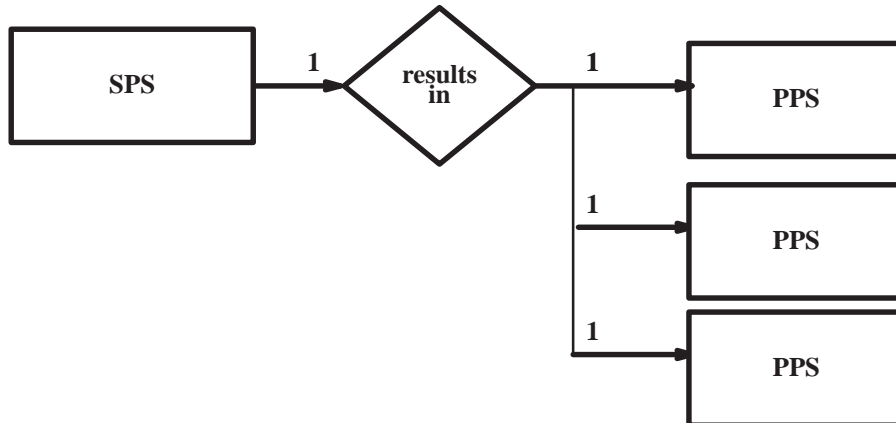The dlx_root AE implements the following 3 cases:

ILLUSTRATION 6–1

The Entity–Relationship diagram for the MPPS IOD schema is shown in Illustration 6–1. 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 exist between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are defined with the number of possible entities in the relationship shown, except that in Append case the number of resulted MPPS are not restricted. (However there are certain circumstances – e.g. in the case of a network problem, or SCP failure – when the number of MPPS is limited to 256.

**6−2−1 Entities Description**

Refer to DICOM Standard (1999) to Part 4, Annex F7 (MODALITY PERFORMED PROCEDURE STEP SOP CLASS) for a description of the entities contained within this Information object.

**6−3 MPPS IOD MODULE TABLE**

Within an entity of the DICOM v3.0 Modality Performed Procedure Step 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 6–1 identifies the defined modules within the entities that comprise the DICOM v3. Modality Performed Procedure Step 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 6–1
**MODALITY PERFORMED PROCEDURE STEP INFORMATION MODULE TABLE**

| Module Name | Reference |
|---|---|
| SOP Common | 6–4–1 |
| Performed Procedure Step Relationship | 6–4–2 |
| Performed Procedure Step Information | 6–4–3 |
| Image Acquisition Results | 6–4–4 |
| Radiation Dose | 6–4–5 |
| Billing and material management codes | 6–4–6 |
| Private Radiation Dose | 6–4–7 |

**6−4 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 MPPS Information Object.

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

**6−4−1        SOP Common**

| Attribute Name | Tag Value | Req. Type N–CREATE (SCU/SCP) | Req. Type N–SET (SCU/SCP) | Notes |
|---|---|---|---|---|
| Specific Character Set | (0008,0005) | 1C/1C (Required if an extended or replacement character set is used) | Not allowed | "ISO_IR 100" value is sent in any case |

**6−4−2        Performed Procedure Step Relationship**

| Attribute Name | Tag Value | Req. Type N–CREATE (SCU/SCP) | Req. Type N–SET (SCU/SCP) | Notes |
|---|---|---|---|---|
| Scheduled Step Attribute Sequence | (0040,0270) | 1/1 | Not allowed | Contains only one sequence |
| >Study Instance UID | (0020,000D) | 1/1 | Not allowed | * |
| >Referenced Study Sequence | (0008,1110) | 2/2 | Not allowed | Contains one element or zero length in unscheduled case or if WL SCP doesn't support |
| >>Referenced SOP Class UID | (0008,1150) | 1C/1 (Required if Sequence Item is present) | Not allowed | See above |
| >>Referenced SOP Instance UID | (0008,1155) | 1C/1 (Required if Sequence Item is present) | Not allowed | See above |
| >Accession Number | (0008,0050) | 2/2 | Not allowed | * |
| >Requested Procedure ID | (0040,1001) | 2/2 | Not allowed | ** |
| >Requested Procedure description | (0032,1060) | 2/2 | Not allowed | ** |
| >Scheduled Procedure Step ID | (0040,0009) | 2/2 | Not allowed | * |
| >Scheduled Procedure Step Description | (0040,0007) | 2/2 | Not allowed | * |
| >Scheduled Action Item Code Sequence | (0040,0008) | 2/2 | Not allowed | * |
| >>Code Value | (0008,0100) | 1C/1 (Required if Sequence Item is present) | Not allowed | * |
| >>Coding Scheme Designator | (0008,0102) | 1C/1 (Required if Sequence Item is present) | Not allowed | * |

| Attribute Name | Tag Value | Req. Type N–CREATE (SCU/SCP) | Req. Type N–SET (SCU/SCP) | Notes |
|---|---|---|---|---|
| >> Code Meaning | (0008,0104) | 3/3 | Not allowed | * |
| Patient Name | (0010,0010) | 2/2 | Not allowed | Restricted to 48 char |
| Patient ID | (0010,0020) | 2/2 | Not allowed | ** |
| Patient's Birth Date | (0010,0030) | 2/2 | Not allowed | ** |
| Patient's Sex | (0010,0040) | 2/2 | Not allowed | ** |

* filled only if worklist SCP supported the values, zero length sent if type 2 and has no value

** WL supported value is sent back, data can be modified on DLX console

**6−4−3        Performed Procedure Step Information**

| Attribute Name | Tag Value | Req. Type N–CREATE (SCU/SCP) | Req. Type N–SET (SCU/SCP) | Notes |
|---|---|---|---|---|
| Performed Procedure Step ID | (0040,0253) | 1/1 | Not allowed | Uniquely generated ID |
| Performed Station AE Title | (0040,0241) | 1/1 | Not allowed | Configured AE title retrieved |
| Performed Station Name | (0040,0242) | 2/2 | Not allowed | 0 length data sent |
| Performed Location | (0040,0243) | 2/2 | Not allowed | 0 length data sent |
| Performed Procedure Step Start date | (0040,0244) | 1/1 | Not allowed | System date of MPPS N–Create is sent |
| Performed Procedure Step Start time | (0040,0245) | 1/1 | Not allowed | System time of MPPS N–Create is sent |
| Performed Procedure Step Status | (0040,0252) | 1/1 | 3/1 | IN PROGRES, COMPLETED or DISCONTINUED is sent |
| Performed Procedure Step Description | (0040,0254) | 2/2 | 3/1 | Scheduled Procedure Step Description (0040,0007) is copied to here if recived from WL |
| Performed Procedure Type Description | (0040,0255) | 2/2 | 3/2 | 0 length data sent |
| Procedure Code Sequence | (0008,1032) | 2/2 | 3/2 | 0 length sent |
| Performed Procedure Step End Date | (0040,0250) | 2/2 | 3/1 | System date of MPPS N–Set – when (0040,0252) with COMPLETED – is sent |
| Performed Procedure Step End Time | (0040,0251) | 2/2 | 3/1 | System time of MPPS N–Set – when (0040,0252) with COMPLETED – is sent |

**6−4−4**      **Image Acquisition Results**

| Attribute Name | Tag Value | Req. Type N–CREATE (SCU/SCP) | Req. Type N–SET (SCU/SCP) | Notes |
|---|---|---|---|---|
| Modality | (0008,0060) | 1/1 | Not allowed | "XA" |
| Study ID | (0020,0010) | 2/2 | Not allowed | Requested Procedure ID (0040,1001) |
| Performed Action Item Code Sequence | (0040,0260) | 2/2 | 3/2 | Scheduled Action Item Code Sequence is mapped |
| >Code Value | (0008,0100) | 1C/1 (Required if Sequence Item is present) | Not allowed | See above |
| >Coding Scheme Designator | (0008,0102) | 1C/1 (Required if Sequence Item is present) | Not allowed | See above |
| >Code Meaning | (0008,0104) | 3/3 | Not allowed | See above |
| Performed Series Sequence | (0040,0340) | 2/2 | 3/1 | Sequence contains 1 element |
| >Performing Physician's Name | (0008,1050) | 2C/2 (Required if Sequence Item is present) | 2C/2 (Required if Sequence Item is present) | The contents of the Physician field of Exam Information Window shall be sent |
| >Protocol Name | (0018,1030) | 1C/1 (Required if Sequence Item is present) | 1C/1 (Required if Sequence Item is present) | Scheduled Procedure Step Description (0040,0007) is copied to here |
| >Operator's Name | (0008,1070) | 2C/2 (Required if Sequence Item is present) | 2C/2 (Required if Sequence Item is present) | The same as (0008,1050) |
| >Series Instance UID | (0020,000E) | 1C/1 (Required if Sequence Item is present) | 1C/1 (Required if Sequence Item is present) | Study Instance UID+".1" is sent |
| >Series Description | (0008,103E) | 2C/2 (Required if Sequence Item is present) | 2C/2 (Required if Sequence Item is present) | Scheduled Procedure Step Description (0040,0007) is copied to here |
| >Retrieve AE Title | (0008,0054) | 2C/2 (Required if Sequence Item is present) | 2C/2 (Required if Sequence Item is present) | 0 length sent |
| >Referenced Image Sequence | (0008,1140) | 2C/2 (Required if Sequence Item is present) | 2C/2 (Required if Sequence Item is present) | Sequence shall contain as many items as many images were generated from Start Exam or Resume Exam. If none were generated this will have 0 length |

| Attribute Name | Tag Value | Req. Type N–CREATE (SCU/SCP) | Req. Type N–SET (SCU/SCP) | Notes |
|---|---|---|---|---|
| >>Referenced SOP Class UID | (0008,1150) | 1C/1 (Required if Sequence Item is present) | 1C/1 (Required if Sequence Item is present) | 1.2.840.10008.5.1.4.1.1.12.1 or 1.2.840.10008.5.1.4.1.1.7 (run or photo) |
| >>Referenced SOP Instance UID | (0008,1155) | 1C/1 (Required if Sequence Item is present) | 1C/1 (Required if Sequence Item is present) | (0008,0018) tag of DICOM image sent |
| >Referenced Standalone SOP Instance Sequence | (0040,0220) | 2C/2 (Required if Sequence Item is present) | 2C/2 (Required if Sequence Item is present) | 0 length sent |

**6−4−5        Radiation Dose**

This Module is not sent, as the necessary information is not available.

**6−4−6        Billing and material management codes**

This Module is not sent, as the necessary information is not available.

**6−4−7        Private Radiation Dose**

| Attribute Name | Tag Value | Req. Type N–CREATE (SCU/SCP) | Req. Type N–SET (SCU/SCP) | Notes (VR) |
|---|---|---|---|---|
| Private Creator Dose_01 | (0027,00xx) | 3 | 3 | GEMS_DLX_DOSE_01 |
| Private Radiation Dose Sequence | (0027,xx01) | 3 | 3 | * (SQ) |
| >Run Number | (0027,xx02) | Not present | 3 | 1..N (IS) |
| >Run Time | (0027,xx03) | Not present | 3 | HHMMSS (TM) |
| >Number of Frames | (0027,xx04) | Not present | 3 | (IS) |
| >Frames per Second | (0027,xx05) | Not present | 3 | (DS) |
| >Plane | (0027,xx06) | Not present | 3 | FR, LT, BI (CS) |
| >KV | (0027,xx07) | Not present | 3 | (DS) |
| >MA | (0027,xx08) | Not present | 3 | (DS) |
| >Mas | (0027,xx09) | Not present | 3 | (DS) |
| >Ms | (0027,xx10) | Not present | 3 | (DS) |
| >Angulation | (0027,xx11) | Not present | 3 | (DS) |
| >Rotation | (0027,xx12) | Not present | 3 | (DS) |
| >Focal Distance | (0027,xx13) | Not present | 3 | (DS) |
| >Image Intensifier Mode | (0027,xx14) | Not present | 3 | (DS) |

* Sequence contains as many elements as many images were created during exam (N), in N–Create zero length sent.

**GE Medical Systems**