GE Healthcare

# Innova 2100-IQ, 3100/3100-IQ, 4100/4100-IQ Cardiovascular Imaging System Conformance Statement for DICOM V3.0

Operating Documentation

**WARNING**
- THIS SERVICE MANUAL IS AVAILABLE IN ENGLISH ONLY.

- IF A CUSTOMER'S SERVICE PROVIDER REQUIRES A LANGUAGE OTHER THAN ENGLISH, IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE TRANSLATION SERVICES.

- DO NOT ATTEMPT TO SERVICE THE EQUIPMENT UNLESS THIS SERVICE MANUAL HAS BEEN CONSULTED AND IS UNDERSTOOD.

- FAILURE TO HEED THIS WARNING MAY RESULT IN INJURY TO THE SERVICE PROVIDER, OPERATOR OR PATIENT FROM ELECTRIC SHOCK, MECHANICAL OR OTHER HAZARDS.

**ATTENTION**
- CE MANUEL DE SERVICE N'EST DISPONIBLE QU'EN ANGLAIS.

- SI LE TECHNICIEN DU CLIENT A BESOIN DE CE MANUEL DANS UNE AUTRE LANGUE QUE L'ANGLAIS, C'EST AU CLIENT QU'IL INCOMBE DE LE FAIRE TRADUIRE.

- NE PAS TENTER D'INTERVENIR SUR LES EQUIPEMENTS TANT QUE LE MANUEL SERVICE N'A PAS ETE CONSULTE ET COMPRIS

- LE NON-RESPECT DE CET AVERTISSEMENT PEUT ENTRAINER CHEZ LE TECHNICIEN, L'OPERATEUR OU LE PATIENT DES BLESSURES DUES A DES DANGERS ELECTRIQUES, MECANIQUES OU AUTRES.

**ATENCION**
- ESTE MANUAL DE SERVICIO SOLO EXISTE EN INGLES.

- SI ALGUN PROVEEDOR DE SERVICIOS AJENO A GEMS SOLICITA UN IDIOMA QUE NO SEA EL INGLES, ES RESPONSABILIDAD DEL CLIENTE OFRECER UN SERVICIO DE TRADUCCION

- NO SE DEBERA DAR SERVICIO TECNICO AL EQUIPO, SIN HABER CONSULTADO Y COMPRENDIDO ESTE MANUAL DE SERVICIO

- LA NO OBSERVANCIA DEL PRESENTE AVISO PUEDE DAR LUGAR A QUE EL PROVEEDOR DE SERVICIOS, EL OPERADOR O EL PACIENTE SUFRAN LESIONES PROVOCADAS POR CAUSAS ELECTRICAS, MECANICAS O DE OTRA NATURALEZA.

**WARNUNG**
- DIESE SERVICEANLEITUNG EXISTIERT NUR IN ENGLISCHER SPRACHE.

- FALLS EIN FREMDER KUNDENDIENST EINE ANDERE SPRACHE BENÖTIGT, IST ES AUFGABE DES KUNDEN FÜR EINE ENTSPRECHENDE ÜBERSETZUNG ZU SORGEN.

- VERSUCHEN SIE NICHT DIESE ANLAGE ZU WARTEN, OHNE DIESE SERVICEANLEITUNG GELESEN UND VERSTANDEN ZU HABEN.

- WIRD DIESE WARNUNG NICHT BEACHTET, SO KANN ES ZU VERLETZUNGEN DES KUNDENDIENSTTECHNIKERS, DES BEDIENERS ODER DES PATIENTEN DURCH STROMSCHLÄGE, MECHANISCHE ODER SONSTIGE GEFAHREN KOMMEN.

**ATENÇÃO**

- ESTE MANUAL DE ASSISTÊNCIA TÉCNICA SÓ SE ENCONTRA DISPONÍVEL EM INGLÊS.

- SE QUALQUER OUTRO SERVIÇO DE ASSISTÊNCIA TÉCNICA, QUE NÃO A GEMS, SOLICITAR ESTES MANUAIS NOUTRO IDIOMA, É DA RESPONSABILIDADE DO CLIENTE FORNECER OS SERVIÇOS DE TRADUÇÃO.

- NÃO TENTE REPARAR O EQUIPAMENTO SEM TER CONSULTADO E COMPREENDIDO ESTE MANUAL DE ASSISTÉNCIA TÉCNICA

- O NÃO CUMPRIMENTO DESTE AVISO PODE POR EM PERIGO A SEGURANÇA DO TÉCNICO, OPERADOR OU PACIENTE DEVIDO A CHOQUES ELÉTRICOS, MECÂNICOS OU OUTROS.

**AVVERTENZA**

- IL PRESENTE MANUALE DI MANUTENZIONE È DISPONIBILE SOLTANTO IN INGLESE.

- SE UN ADDETTO ALLA MANUTENZIONE ESTERNO ALLA GEMS RICHIEDE IL MANUALE IN UNA LINGUA DIVERSA, IL CLIENTE È TENUTO A PROVVEDERE DIRETTAMENTE ALLA TRADUZIONE.

- SI PROCEDA ALLA MANUTENZIONE DELL'APPARECCHIATURA SOLO DOPO AVER CONSULTATO IL PRESENTE MANUALE ED AVERNE COMPRESO IL CONTENUTO

- IL NON RISPETTO DELLA PRESENTE AVVERTENZA POTREBBE FAR COMPIERE OPERAZIONI DA CUI DERIVINO LESIONI ALL'ADDETTO ALLA MANUTENZIONE, ALL'UTILIZZATORE ED AL PAZIENTE PER FOLGORAZIONE ELETTRICA, PER URTI MECCANICI OD ALTRI RISCHI.

**警告**

- このサービスマニュアルには英語版しかありません。
- GEMS以外でサービスを担当される業者が英語以外の言語を要求される場合 翻訳業者はその業者の責任で行うものとさせていただきます。
- このサービスマニュアルを熟読し理解せずに、装置のサービスを行わないで丁
- この警告に従わない場合、サービスを担当される方、操作員あるいは患者さん 感電や機械的又はその他の危険により負傷する可能性があります。

**注意**

- 本维修手册仅存有英文本。
- 非**GE Healthcare**公司的维修员要求非英文本的手册时，客户需自行负责翻译。
- 未详细阅读和完全了解本手册之前，不得进行维修。
- 忽略本注意事项会对维修员、操作员或病人造成触电，机械伤害或其他伤害。

# Revision History

| Part / Rev | Date | Reason for change | Pages |
|---|---|---|---|
| 2358506-1-100 rev 1 | April 26, 2005 | • Initial release of direction 2358506-1-100. This direction integrates the Innova 2100-IQ system. The previous release of this manual was 2358506-100 rev 03.<br>• SPR EURge24546 fix has been integrated. | 86 |
| 5173574-1-100 rev 1 | March 16, 2006 | • Initial release of direction 5173574-1-100. The previous release of this manual was 2358506-1-100 rev 01.<br>• Section Storage Commitment has been modified. | 86 |
| 5173574-2-100 rev 1 | May 31, 2006 | • Initial release of direction 5173574-2-100. The previous release of this manual was 5173574-1-100 rev 1.<br>• SPR EURge50736 fix has been integrated. | 75 |
| 5173574-2-100 rev 2 | Nov 07, 2006 | • Initial release of direction 5173574-2-100. The previous release of this manual was 5173574-2-100 rev 1.<br>• MPPS has been integrated | |

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# Chapter 1 - Introduction

## 1   Introduction

### 1.1   Overview

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

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

- Chapter 2 (Network Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Networking features.

- Chapter 3 (X–Ray Angiography Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a X–Ray Angiography Information Object.

- Chapter 4 (Secondary capture Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a Secondary capture Information Object.

- Chapter 5 (Modality Worklist Information Model), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of the Modality Worklist service.

- Chapter 6 (Storage Commitment Information Model Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of the Storage Commitment service.

- Chapter 7 (Modality Performed Procedure Step), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a Modality      Performed Procedure Step Service.

### 1.2   Overall Dicom Conformance Statement Document Structure

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

**Illustration 1-1:**
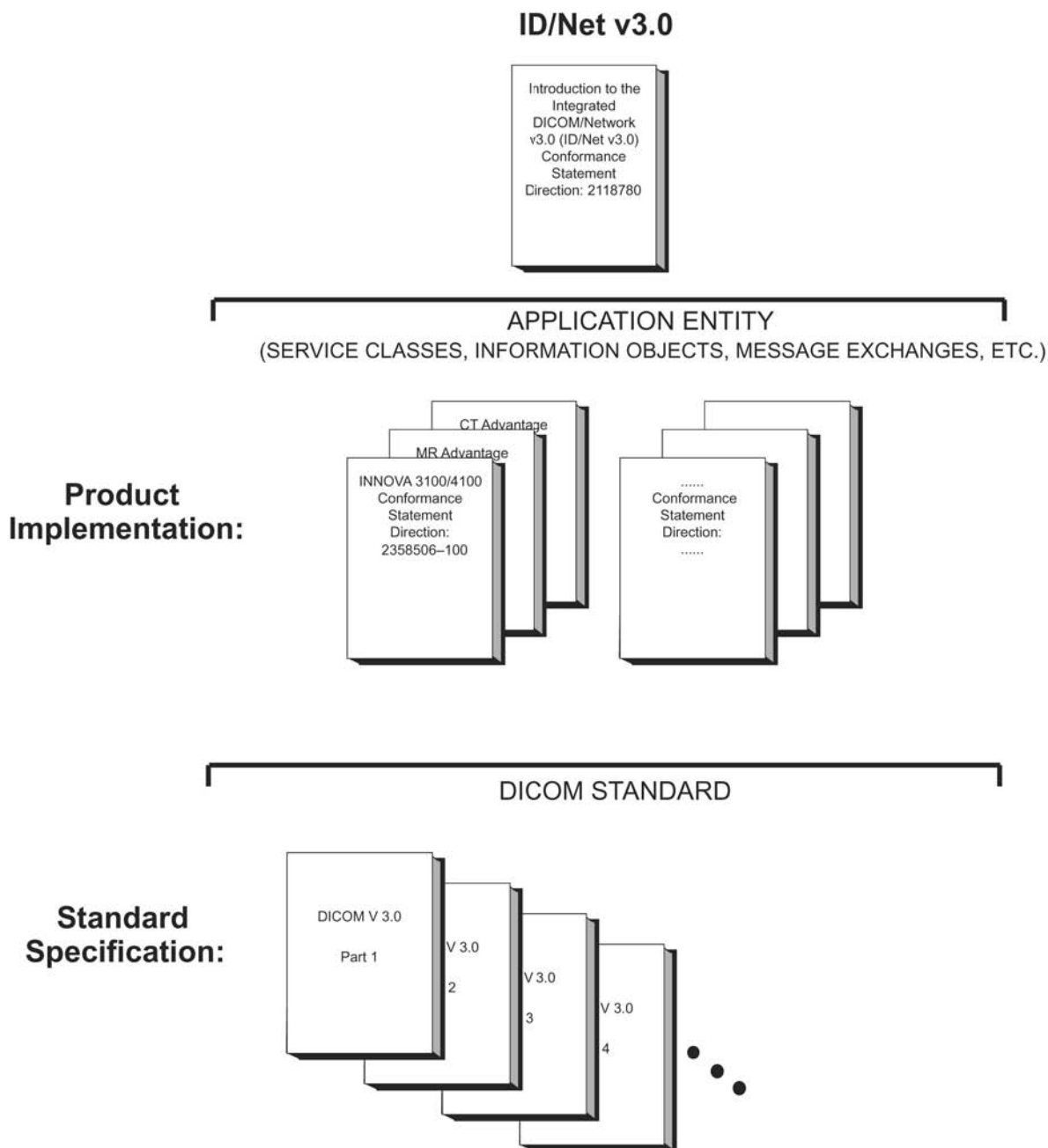


This document specifies the DICOM v3.0 implementation. It is entitled:

1    INNOVA 2100-IQ, 3100/3100-IQ, 4100/4100-IQ
2    Conformance Statement for DICOM v3.0
3    Direction Number

This DICOM Conformance Statement documents the DICOM v3.0 Conformance Statement and Technical Specification required to interoperate with the GEMS network interface.

Introductory information, which is applicable to all GEMS Conformance Statements, is described in the document:

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

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

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

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

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

DICOM Secretariat, NEMA, Suite 1847, Rosslyn, VA 22209USA Phone: +1.703.841.3200

## 1.3    Intended Audience

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM v3.0 Standards and with the terminology and concepts which are used in those Standards.

If readers are unfamiliar with DICOM v3.0 terminology they should first refer to the document listed below, then read the DICOM v3.0 Standard itself, prior to reading this DICOM Conformance Statement document.

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

## 1.4    Scope and Field Application

It is the intent of this document, in conjunction with the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*, to provide an unambiguous specification for GEMS implementations. This specification, called a Conformance Statement, includes a DICOM v3.0 Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical data exchanged using DICOM v3.0. The GEMS Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEMS devices are capable of using different Information Object Definitions. For example, a GEMS CT Scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this DICOM Conformance Statement are the Module Definitions which define all data elements used by this GEMS implementation. If the user encounters unspecified private data elements while parsing a GEMS Data Set, the user is well advised to ignore those data elements (per the DICOM

v3.0 standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re–transmit all of the private data elements which are sent by GEMS devices.

## 1.5   Important Remarks

The use of these DICOM Conformance Statements, in conjunction with the DICOM v3.0 Standards, is intended to facilitate communication with GE imaging equipment. However, by itself, it is not sufficient to ensure that inter–operation will be successful. The user (or user's agent) needs to proceed with caution and address at least four issues:

Integration – The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non–GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE systems is the user's responsibility and should not be underestimated. The user is strongly advised to ensure that such an integration analysis is correctly performed.

Validation – Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the user should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications. Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non–GE device, as well as when images acquired on non–GE equipment is processed/displayed on a GE console or workstation.

Future Evolution – GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM v3.0 Standard. DICOM v3.0 will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM v3.0 as specified in each 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 DICOM Conformance Statements. The user should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

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

## 1.6    References

A list of references which is applicable to all GEMS Conformance Statements is included in the Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780.

The information object implementation refers to DICOM PS 3.3 (Information Object Definition).

## 1.7    Definitions

A set of definitions which is applicable to all GEMS Conformance Statements is included in the Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780.

## 1.8    Symbols and Abbreviations

A list of symbols and abbreviations which is applicable to all GEMS Conformance Statements is included in the Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780.

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# Chapter 2 Network Conformance Statement

## 1   Introduction

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant Networking features on GE INNOVA product. Note that the format of this section strictly follows the format defined in DICOM Standard PS

3.2 (Conformance). Please refer to that part of the standard while reading this section.

The INNOVA System provides sophisticated image processing and storage functions. INNOVA System will provide support for DICOM 3.0 to achieve interoperability across equipment produced by different vendors.

This section details the roles and the DICOM Service Classes the INNOVA System supports.

The INNOVA System DICOM implementation allows:

- The user to copy INNOVA images acquired through the system to a remote DICOM Application Entity, using the Standard Storage DICOM Service as a Service Class User
- The user to request storage commitment for INNOVA images that were previously sent trough the system to a remote DICOM application entity, using the Storage Commitment Service as a Service Class User
- The user to check the application level communication from the INNOVA DICOM Server to a remote DICOM Application Entity. To this aim the INNOVA System uses the Verification DICOM Service Class as a Service Class User
- The user to get from the Radiology Information System (RIS) the list of procedure to be performed. This is done using the Basic Worklist Management DICOM Service as a Service Class User.
- A remote Application Entity to check the application level communication with the INNOVA System. This is done by providing the Verification DICOM Service Class as a Service Class Provider.
- To inform RIS that a specific Procedure Step has been started (using N-CREATE messages) and later that this Procedure Step has been completed or discontinued (using N-SET messages). This is done by using the Modality Performed Procedure Step service as a Service Class User.

The details of the DICOM conformance related to other Information Objects and Information Models supported by this product are included in subsequent sections of this DICOM Conformance Statement.

## 2   Implementation Module

### 2.1   Application Data Flow Diagram

All DICOM functionality on the INNOVA product is provided by the DL DICOM Server AE.

The Basic and Specific Application models for this device are shown in the following Illustration :

**Illustration 2-1:**
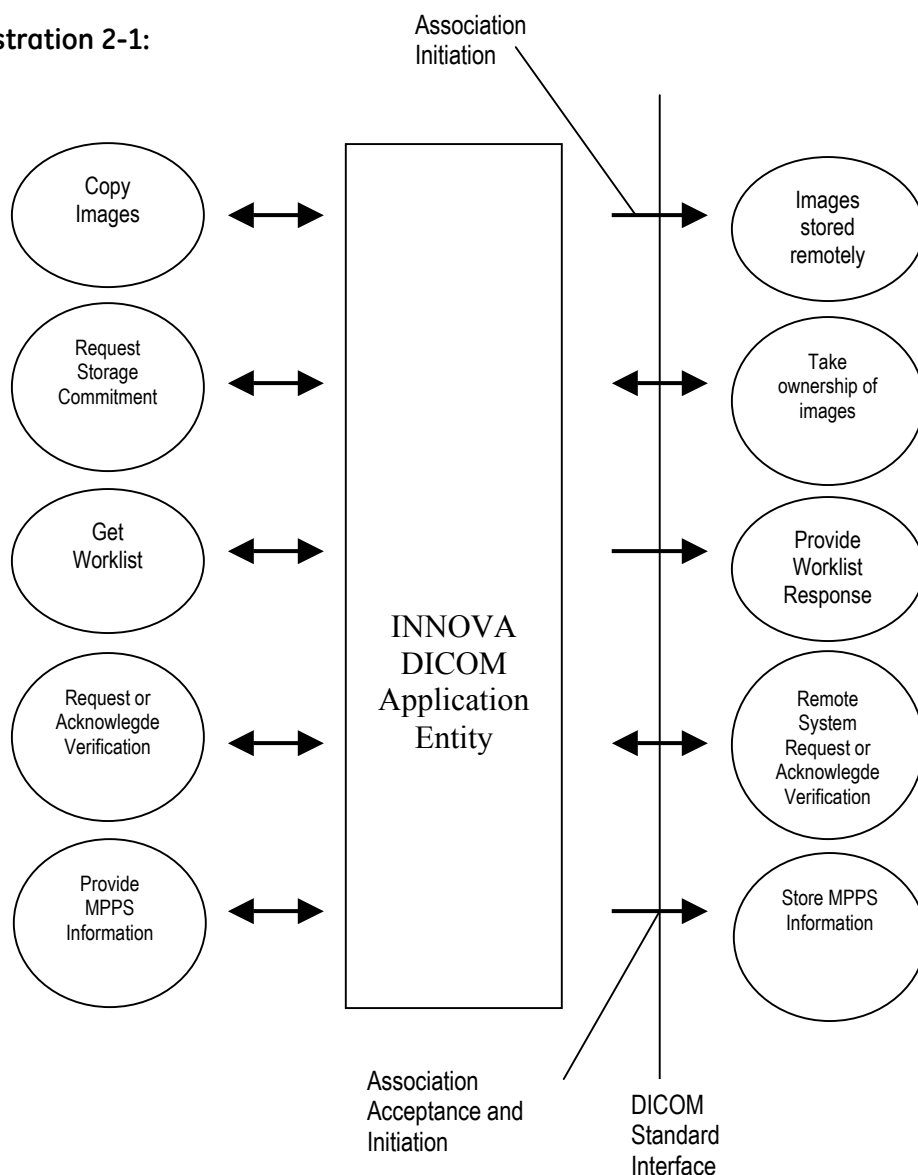


The INNOVA DICOM Application Entity is an application which handles DICOM protocol communication. INNOVA DICOM AE is automatically brought up when the INNOVA system is powered on.

All remote DICOM AE must be manually configured on the INNOVA, usually at the software installation time, by a GE Field Engineer.

There are five local Real World activities: Copy Images, Request Storage Commitment for a set of images, Get Worklist, Provide MPPS Information and Verification which can cause the INNOVA DICOM AE to initiate a DICOM association.

Copy Image consists of an operator selecting one or several images through the User Interface known as "Browser" and "Viewer". Selection of Remote System and visualization of the transfer status is done in a specific screen. The remote system can be any DICOM stage SCP supporting XA modality.

Request storage commitment consists of an automatic request performed by the system after each successful image transfer. The remote system can be a DICOM Storage Commitment SCP.

Get Worklist activity consists of an operator request for the transfer of a list of procedure to be performed on the INNOVA acquisition system from a remote HIS/RIS system. The Remote system can be any DICOM modality worklist SCP.

Query keys can be entered for the following items:

> Patient Name
> Patient ID
> Accession number
> Procedure ID

The system can be configured to query for its own modality (XA) or AE Title.

A date or a date range for the query can also be specified.

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

Provide MPPS Information entity consists of automatic MPPS transactions generated by the system during the start and termination of the exam.

## 2.2   Functional Definition of AE's

The INNOVA DICOM Application Entity supports the following three SCU functions

1. Copy images:

   > Access to patient demographics and pixel Data in the local database
   > Build a DICOM Dataset
   > Initiate a DICOM Association to send the image(s).

2. Request Storage Commitment:

   > Initiate a DICOM Association to send the request
   > Send the N–ACTION request
   > Wait for the N–ACTION–RSP response
   > Wait for a configurable delay the N–EVENT–REPORT request
   > Send the N–EVENT–REPORT response
   > Close the association.
   > Optionally the system will accept a configurable number of DICOM associations from the Storage Commitment SCP to receive storage commitment responses.

3. 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 to the local database to add new patient / exam demographic data
   > Close the association

4. Verification:

Initiate a DICOM Association
Send the C–ECHO request
Wait for the C–ECHO response
Close the Association

5.  Provide MPPS Information

*   At the start of an exam, build a MPPS N-CREATE DICOM message

*   Initiate a DICOM association to send the N-CREATE request

*   Wait for the response

*   Close the Association

*   At the termination of the exam, build a MPPS N-SET DICOM message mentioning the exam termination status as 'COMPLETED' or 'DISCONTINUED'

*   Initiate a DICOM association to send the N-SET request

*   Wait for the response

*   Close the Association

The INNOVA DICOM Application Entity also serves a default SCP function, the Verification Service Class, independently from others SCU functions.

## 2.3    Sequencing of Real–World Activities

Not Applicable.

# 3  AE Specifications

Innova Dicom AE Specification:

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

| SOP Class Name | SOP Class UID |
|---|---|
| Secondary Capture Image Storage | 1.2.840.10008.5.1.4.1.1.7 |
| X–Ray Angiographic Image Storage | 1.2.840.10008.5.1.4.1.1.12.1 |
| Modality Worklist Information Model – FIND | 1.2.840.10008.5.1.4.31 |
| Verification SOP Class | 1.2.840.10008.1.1 |
| Storage Commitment Push Model | 1.2.840.10008.1.20.1 |
| Modality  Performed Procedure Step | 1.2.840.10008.3.1.2.3.3 |

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

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

## 3.1    Association Establishment Policies

### 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 INNOVA DICOM Application Entity is:

| Maximum Length PDU | 1024 Kbytes |
|---|---|

The SOP Class Extended Negotiation is not supported.

The maximum number of Presentation Context Items that will be proposed is 5

The user information Items sent by this product are :

Maximum PDU Length

Implementation UID
Implementation Version Name

## Number of Associations

The INNOVA DICOM AE will support a configurable number of simultaneous associations initiated by remote nodes with the Storage Commitment Push Model presentation context.

## Asynchronous Nature

Asynchronous mode is not supported. All operations will be performed synchronously.

## Implementation Identifying Information for Innova 3100/3100-IQ, 4100/4100-IQ systems

The Implementation UID for this DICOM v3.0 Implementation is:

| INNOVA DL Implementation UID | 1.2.840.113619.6.167 |
|---|---|

The Implementation Version Name for this DICOM v3.0 Implementation is:

| INNOVA DL Implementation Version Name | INNOVA_3100_4100 |
|---|---|

## Implementation Identifying Information for Innova 2100-IQ system

The Implementation UID for this DICOM v3.0 Implementation is:

| INNOVA DL Implementation UID | 1.2.840.113619.6.200 |
|---|---|

The Implementation Version Name for this DICOM v3.0 Implementation is:

| INNOVA DL Implementation Version Name | INNOVA_2100 |
|---|---|

# 3.2   Association Initiation Policy

## 3.2.1 Real–World Activity Copy Images

### 3.2.1.1     Associated Real–World Activity

The operator must select a destination in the User Interface towards which the images will be transferred.

Then one of the two following scenarios is possible:

1.  The operator selects data to be sent to the destination though the User Interface. Once these selections are done, the user clicks on the "Network" button to initiate a "Copy images" operation. The INNOVA DICOM AE will then initiate a DICOM association with the selected destination and transfer the selected images on this association.

2.  If system is configured for autoarchive, the INNOVA DICOM AE will automatically initiate a DICOM association with the selected destination to transfer any new image created on the system.

### 3.2.1.2    Proposed Presentation Context Table

| Presentation Context Table – Proposed | | | | | |
|---|---|---|---|---|---|
| Abstract Syntax | | Transfer Syntax | | Role | Extended Negotiation |
| Name | UID | Name List | UID List | | |
| 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 |
| X–Ray Angiographic 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 |
| X–Ray Angiographic 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 |

SOP Specific DICOM Conformance Statement for all Storage SOP Classes:

This implementation can perform multiple C–STORE operation over a single association.

Upon receiving a C–STORE confirmation containing a Successful status, this implementation will perform the next C–STORE operation. The association will be maintained if possible.

Upon receiving a C–STORE confirmation containing a Refused status, this implementation will terminate the association. No new assocation will be opened to send remaining images.

Upon receiving a C–STORE confirmation containing a status other than Successful or Refused, this implementation will consider the current request to be a failure but will continue to attempt to send any remaining images in the request over a different association.

Establishing an association supports an "Association Timer". This timer starts when the association request is sent and stops when the Association response is received. The time out value is 10 seconds.

If the above time outs expires, the association is closed and the operation in progress is considered to be failed.

Following are the status codes that are more specifically processed when receiving messages from a Storage SCP equipment:

| Service Status | Status Codes | Further Meaning | Application Behavior When receiving Status Codes | Related Fields Processed if received |
|---|---|---|---|---|

| Refused | A7xx | Out of resources | "Send" operation failed. Root cause indicated in error log. | (0000,0902) |
|---|---|---|---|---|
| | 0122 | SOP Class not Supported | "Send" operation failed. Root cause indicated in error log. | (0000,0902) |
| Error | Cxxx | Cannot Understand | "Send" operation failed | (0000,0901) (0000,0902) |
| | A9xx | Data Set does not match SOP Class | "Send" operation failed | (0000,0901) (0000,0902) |

| Service Status | Status Codes | Further Meaning | Application Behavior When receiving Status Codes | Related Fields Processed if received |
|---|---|---|---|---|
| Warning | B000 | Coercion of Data Elements | "Send" operation successful | None |
| | B007 | Data Set does not match SOP Class | "Send" operation successful | None |
| | B006 | Elements Discarded | "Send" operation successful | None |
| Success | 0000 | Success | "Send" operation successful | None |

### 3.2.2 Real–World Activity Verification Acknowledge

### 3.2.2.1 Associated Real–World Activity

The operator must select a destination in the User Interface and press the "Verification" button. These operations will cause:

the INNOVA DICOM Application Entity to initiate a DICOM association
the INNOVA DICOM Application Entity to emit a C–ECHO command to check if the remote AE is available

### 3.2.2.2 Proposed Presentation Context Table

| Presentation Context Table - Proposed | | | | | |
|---|---|---|---|---|---|
| Abstract Syntax | | Transfer Syntax | | Role | Extended Negotiation |
| Name | UID | Name List | UID List | | |
| Verification | 1.2.840.10008.1.1 | Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU | None |

*SOP Specific DICOM Conformance Statement for Verification SOP Class:*

The INNOVA DICOM AE provides standard conformance to the DICOM Verification SOP class.

### 3.2.3 Real–World Activity Get Worklist

### 3.2.3.1 Associated Real–World Activity

The worklist transfer can be initiated either automatically when the DL application starts, or manually by either clicking the "Refresh" button in the Patient Browser interface or the "Refresh now" button in the "Define Worklist Settings" screen.

These operation will cause:

> the INNOVA Application Entity to initiate a DICOM association
> the INNOVA DL application to build the C–FIND request
> the INNOVA Application Entity to emit the C–FIND request
> the INNOVA Application Entity to receive the C–FIND Reponse(s)
> the INNOVA Application Entity to close the association
> the possibility for the user to add a new item to the local database

While the query is in progress, it is possible to cancel it by pressing a button on the patient browser. This will cause a C–FIND cancel to be sent.

### 3.2.3.2    Proposed Presentation Context Table

| Presentation Context Table - Proposed | | | | | |
|---|---|---|---|---|---|
| Abstract Syntax | | Transfer Syntax | | Role | Extended Negotiation |
| Name | UID | Name List | UID List | | |
| 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 |

*SOP Specific DICOM Conformance Statement for the Modality Worklist Information Model – FIND SOP Class:*

Following are the status codes that are more specifically processed when receiving messages from a Modality Worklist SCP equipment :

| Service Status | Status Codes | Further Meaning | Application Behavior When receiving Status Codes | Related Fields Processed if received |
|---|---|---|---|---|
| Refused | A700 | Out of resources | A message is displayed; with text "Last query failed" (more detailed information is logged in the error log). | (0000,0902) |
| | 0122 | SOP Class not Supported | A message is displayed; with text "Last query failed" (more detailed information is logged in the error log). | (0000,0902) |
| Failed | A900 | Identifier does not match SOP class | Class A message is displayed; with text "Last query failed" (more detailed information is logged in the error log). | (0000,0901) (0000,0902) |
| | Cxxx | Unable to process | A message is displayed; with text "Last query failed" (more detailed information is logged in the error log). | (0000,0901) (0000,0902) |
| Cancel | FE00 | Matching terminated due to cancel | A message is displayed; with text "Canceled" | None |
| Success | 0000 | Matching is complete – No final identifier is supplied | Worklist matches are displayed. | None |

| Pending | FF00 | Matches are continuing – Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys. | None | None |
|---|---|---|---|---|
| | FF01 | Matches are continuing – Warning that one or more Optional Keys were not supported for existence for this Identifier | None | None |

### 3.2.4 Real–World Activity Request Storage Commitment

### 3.2.4.1 Associated Real–World Activity

The operator may configure the image storage destination host to have an associated Storage Commitment SCP AE (this can be the same AE as the Storage SCP). If there is an associated Storage Commitment SCP specified, after each successful image transfer the system will automatically.

1    Wait for a configurable delay time (this allows re–routing of images from Storage SCP to the Storage Commitment SCP, if needed),
2    Initiate a DICOM association to the Storage Commitment SCP to send the storage commitment request.

### 3.2.4.2    Proposed Presentation Context Table

| Presentation Context Table - Proposed | | | | | |
|---|---|---|---|---|---|
| Abstract Syntax | | Transfer Syntax | | Role | Extended Negotiation |
| Name | UID | Name List | UID List | | |
| Storage Commitment Push Model | 1.2.840.10008.20.1 | Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU | None |
| Storage Commitment Push Model | 1.2.840.10008.20.1 | Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCU | None |

SOP Specific DICOM Conformance Statement for the Storage Commitment Push Model SOP Class SCU :

The Storage Commitment will be requested for all SOP Instances for which the image transfer wassuccessful. The request may include one or more SOP Instances, depending on the number of images that were transferred.

The AE uses DICOM network storage services to transfer SOP Instances which are to be committed.

It does not support the optional Storage Media File–Set ID and UID Attributes in the Storage Commitment N–ACTION for transfer of SOP Instances by media for Storage Commitment.

The AE may request Storage Commitment for Instances of any of the Composite SOP Classes it supports as an SCU (see Section 3.2.3.2 )

The Storage Commitment Information Object is described in Chapter 6, Section 1, Storage commitment push model information object definition .

The AE will generate a new transaction UID at each new N–Action request. Any time after the N–Action request was sent, AE will accept storage commitment responses sent by the remote SCP for the SOP instances referenced in the request.

The association opened to send the storage commitment request will be kept open by the AE for a configurable delay. This enables the remote SCP to send the storage commitment response on the same association as the request was received. The association is closed when this timeout expires and there is no active transaction performed by the system linked to this association.

If an N–EVENT–REPORT request is received on this association, the AE will process it, and send an N–EVENT–REPORT response on the same association. The association will not be closed by the AE even if the N–EVENT–REPORT conveys failure. If the N–ACTION response conveys failure status, the association is closed by the AE. If a Storage Commitment N–EVENT–REPORT is received on the Association initiated by the Storage Commitment SCP Application Entity, it will be processed as described for Association initiated by the Storage Commitment SCP (see Chapter 3.3.2.3). Following are the status codes that are more specifically processed when receiving messages from a Storage Commitment SCP AE:

| N-ACTION response Status Codes | | | | |
|---|---|---|---|---|
| Service Status | Status Codes | Further Meaning | Application Behavior When Receiving Status Codes | Related Fields Processed if Received |
| Sucess | 0000H | sucessful request | Waiting for storage commitment response | None |
| Failed | 0213H | Resourse limitation | Automatic retry of storage commitment request for a configurable number of times with a configurable delay between retries | None |
| Failed | Other than above | Failure reason other than resourse limitation | Display error status in network queue | None |

### 3.2.5 Real-World Activity Provide MPPS Information

#### 3.2.5.1 Associated Real–World Activity

The MPPS information transfer can be initiated automatically when the exam is started and terminated in Innova.

These operation will cause:

1. At the start of an exam, build a MPPS N-CREATE DICOM message
2. Initiate a DICOM association to send the N-CREATE request
3. Wait for the response
4. Close the Association
5. At the termination of the exam, build a MPPS N-SET DICOM message mentioning the state as 'COMPLETED' or 'DISCONTINUED'
6. Initiate a DICOM association to send the N-SET request
7. Wait for the response
8. Close the Association

### 3.2.5.2 Proposed Presentation Context Table

| Presentation Context Table – Proposed | | | | | | |
|---|---|---|---|---|---|---|
| Abstract Syntax | | Transfer Syntax | | Role | Extended Negotiation | |
| Name | UID | Name List | UID List | | | |
| Modality Performed Procedure Step | 1.2.840.10008.3.1.2.3.3 | Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU | None | |

*SOP Specific DICOM Conformance Statement for the Modality Performed Procedure Step Model SOP Class:*

Following are the status codes that are more specifically processed when receiving messages from a remote MPPS SCP equipment:

| Service Status | Status Codes | Further Meaning | Application Behavior When receiving Status Codes | Related Fields Processed if received |
|---|---|---|---|---|
| Refused | A7xx | Out of resources | "MPPS" operation failed. Root cause indicated in error log. | (0000,0902) |
| | 0122 | SOP Class not Supported | "MPPS" operation failed. Root cause indicated in error log. | (0000,0902) |
| Error | Cxxx | Cannot Understand | "MPPS" operation failed | (0000,0901) (0000,0902) |
| | A9xx | Data Set does not match SOP Class | "MPPS" operation failed | (0000,0901) (0000,0902) |

## 3.3   Association Acceptance Policy

### 3.3.1 Introduction

The INNOVA DICOM AE places no limitation on who may connect to it.

Any remote AE can open an association to the INNOVA DICOM AE for the purpose of application level communication verification.

### 3.3.2 Real–World Activity Verification Acknowledge

### Associated Real–World Activity

The INNOVA DICOM AE is always listening to associations. No operator action is required to respond to a Verification request from any DICOM node.

### Accepted Presentation Context Table

| Presentation Context Table – Proposed | | | | | |
|---|---|---|---|---|---|
| Abstract Syntax | | Transfer Syntax | | Role | Extended Negotiation |
| Name | UID | Name List | UID List | | |
| Verification SOP Class | 1.2.840.10008.1.1 | Implicit VR Little Endian | 1.2.840.10008.1.2 | SCP | None |
| | | Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCP | None |
| | | Explicit VR Big Endian | 1.2.840.10008.1.2.1.2 | SCP | None |

*SOP Specific Conformance Statement for Verification SOP Class:*

INNOVA DICOM Application provides standard conformance to the DICOM Verification Service Class

# 4    Communication Profiles

## 4.1    Supported Communication Stacks (PS 3.8, PS 3.9)

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

## 4.2    OSI Stack

OSI stack not supported

## 4.3    TCP/IP Stack

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

### API

Not applicable to this product.

### Physical Media Support

DICOM is indifferent to the Physical medium over which TCP/IP executes (e.g. Ethernet V2.0,IEEE 802.3, ATM, FDDI)

**NOTE**:      For more information about the Physical Media available on INNOVA System, please refer to the Product Data Sheet.

## 4.4    Point–to–Point Stack

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

# 5    Extensions / Specializations / Privatizations

None

# 6    Configuration

GEMS Field Service Engineers configure the INNOVA System. The DICOM configuration items below are configurable or re–configurable by a Field Service Engineer.

## 6.1 AE Title/Presentation Address Mapping

The INNOVA System DICOM SERVER AE allows for the configuration of the mapping of remote AE titles to IP addresses and ports. The IP address of a remote AE may be in a different sub net (using routing). GEMS Field Service Engineers perform this configuration.

## 6.2    Configurable Parameters

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

> Local AE Title
> Local IP Address
> Local IP Netmask

**NOTE:** The local listening port number is not configurable for this product, and is equal to 4002.

The following fields are configurable for the DICOM AE used as worklist SCP:

> Remote AE Title
> Remote IP Address
> Listening TCP/IP Port Number

**NOTE:** A GE Field Engineer must perform all the above configurations.

The following fields are configurable for every remote DICOM AE used as storage SCP:

> Remote AE Title
> Remote IP Address
> Listening TCP/IP Port Number
> Is archive or not
> If archive:
> Remote Storage Commitment SCP AE Title
> Remote Storage Commitment SCP IP Address
> Remote Storage Commitment SCP Listening TCP/IP Port Number
> Array size of the pixel data to be transferred (512x512, or any size up to 1024x1024).

The following fields are configurable:

> Number of automatic retries and the delay between retries of storage commitment requests
> Maximum number of associations accepted for storage commitment responses
> Delay between image transfer and storage commitment request
> Delay of releasing the association after sending the storage commitment request

# 7  Support of Extented Character Sets

The INNOVA System will support only the ISO_IR 100 (ISO 8859–1:1987 Latin alphabet N 1. supplementary set) as extended character sets. Any incoming worklist entry that is encoded using another extended character set will display as if it were IS0_IR 100, and any SOP Instances created for these entries will reference ISO_IR 100.

# Chapter 3 X-Ray Angiography (XA) Information Object Implementation

## 2  Introduction

This section specifies the use of the DICOM XA Image IOD to represent the information included in X–Ray Angiography images produced by this implementation. Corresponding attributes are conveyed using the module construct.

## 3  XA Entity Relationship Model

The Entity–Relationship diagram for the XA Image interoperability schema is shown in illustration 1 . In this figure, the following diagrammatic convention is established to represent the information organization :

    each entity is represented by a rectangular box
    each relationship is represented by a diamond shaped box.
    the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. In other words, the relationship between Series and Image can have up to n Images per Series, between Patient and Study can have up to n Studies per Patient, but the Study to Series has 1 Series for each Study.

**Illustration 3-1: XA Image Entity Relationship Diagram**
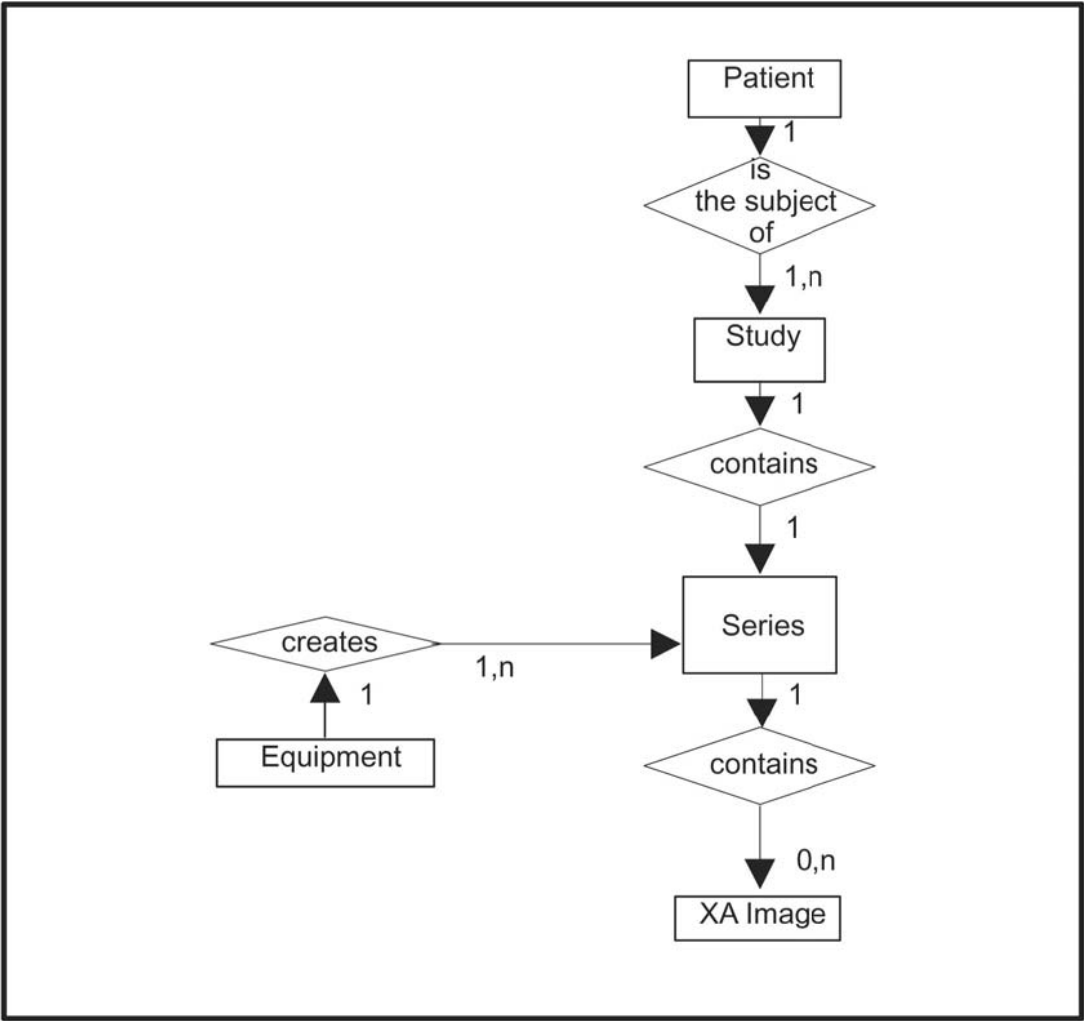
## 2.1  Entity Descriptions

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

## 2.2  Innova Mapping of DICOM Entities

Table 3-1: Mapping of DICOM Entities to Innova Entities

| DICOM | INNOVA Entity |
|---|---|
| Patient | Patient |
| Study | Exam |
| Series | Exam |
| Image | Sequence |
| Frame | Not Applicable |

# 4  IOD Module Table and Information Module Definitions

## 2.1  IOD Module Table

Within an entity of the DICOM v3.0 XA IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 3-2 identifies the defined modules within the entities which comprise the DICOM v3.0 XA IOD. Modules are identified by Module Name.

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

**Table 3-2: XA Image IOD Modules**

| Entity Name | Module Name | Reference |
|---|---|---|
| Patient | Patient | Section 3.2.1.2 |
| Study | General Study | Section 3.2.2.2 |
| | Patient Study | Section 3.2.2.3 |
| Series | General Series | Section 3.2.3.2 |
| Equipment | General Equipment | Section 3.2.4.2 |
| Image | General Image | Section 3.2.5.2 |
| | Image Pixel | Section 3.2.5.3 |
| | Contrast/Bolus | Section 3.2.5.4 |
| | Cine | Section 3.2.5.5 |
| | Multi–frame | Section 3.2.5.6 |
| | Frame Pointers | Section 3.2.5.7 |
| | Mask | Section 3.2.5.8 |
| | Display Shutter | Section 3.2.5.9 |
| | Device | Section 3.2.5.10 |
| | Therapy | Section 3.2.5.11 |
| | X-Ray Image | Table 3-19 |
| | X-Ray Acquisition | Table 3-20 |
| | X-Ray Collimator | Table 3-21 |
| | X-Ray Table | Table 3-22 |
| | X-Ray 3D Calibration | Table 3-23 |
| | X-Ray Filtration | Table 3-24 |
| | XA Positioner | Table 3-25 |
| | Overlay Plane | Section 3.2.5.12 |
| | Multi–frame Overlay | Section 3.2.5.12 |
| | Curve | Section 3.2.5.13 |

| | Modality LUT | Section 3.2.5.14 |
|---|---|---|
| | VOI LUT | Table 3-17 |

### Table 3-2: XA Image IOD Modules (cont'd)

| Entity Name | Module Name | Reference |
|---|---|---|
| | SOP Common | Section 3.2.5.15 |
| | SUB LUT | Table 3-26 |
| | Gereral Frame | Section 3.2.5.17 |

# 3.2 Information Module Definitions

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

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

## 3.2.1   Common Patient Entity Modules

### Introduction

This section describes the modules of Common Patient Entity.

### Patient Module

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

#### Table 3-3: Patient Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Patient's Name | (0010,0010) | 2 | From user interface or worklist. When from user interface, value contains only last_name(restricted to 32 chars)^first_name(restricted to 31 chars). When from worklist, equals first component group. |
| Patient ID | (0010,0020) | 2 | From worklist or user interface. Restricted to 64 chars. |
| Patient's Birth Date | (0010,0030) | 2 | From user interface or worklist. Restricted to 8 chars. YYYYMMDD. |
| Patient's Sex | (0010,0040) | 2 | From user interface or worklist. "M", "F" or "O". |

### 3.2.2 Common Study Entity Modules

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

### Introduction

This section describes the modules of Common Study Entity

### General Study Module

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

#### Table 3-4: General Study Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Study Instance UID | (0020,000D) | 1 | Restricted to 64 characters, internally generated as follows: "registered prefix for GEMS" + ".2. Registered prefix within GEMS" + ".a.b.c" encoded mac address of the DL host +".x.y.z" unique id protected against reinstallation and reentrance. |
| Study Date | (0008,0020) | 2 | YYYYMMDD, restricted to 8 characters. |
| Study Time | (0008,0030) | 2 | HHMMSS.XXX, restricted to 10 characters. |
| Referring Physician's Name | (0008,0090) | 2 | From User Interface or worklist, restricted to 64 characters. |
| Study ID | (0020,0010) | 2 | From User Interface or worklist, restricted to 64 characters. |
| Accession Number | (0008,0050) | 2 | From User Interface or worklist, restricted to 64 characters. |
| Study Description | (0008,1030) | 3 | From User Interface or worklist, restricted to 64 characters. (May not be sent). |
| Name of Physician(s) Reading Study | (0008,1060) | 3 | From User Interface, restricted to 64 characters. Value contains only one component. (May not be sent). |
| study_number | (0015,XX8F) | 3 | Internally generated, starting at 1. (May not be sent). |

### Patient Study Module

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

#### Table 3-5: Patient Study Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Patient's Age | (0010,1010) | 3 | Either from User Interface or Calculated from Patient's Birth Date (0010,0030). Three digits followed by one letter: In Years (Y), Months (M), Weeks (W) or Days (D). (May not be sent). |
| Patient's Size | (0010,1020) | 3 | From User Interface or worklist, restricted to 16 characters. (May not be sent). |
| Patient's Weight | (0010,1030) | 3 | From User Interface or worklist, restricted to 16 characters. (May not be sent). |

### 3.2.3 Common Series Entity Modules

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

### Introduction

This section describes the modules of Common Series Entity.

### General Series Module

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

### Table 3-6: General Series Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Modality | (0008,0060) | 1 | XA |
| Series Instance UID | (0020,000E) | 1 | Restricted to 64 characters, internally generated as follows: "registered prefix for GEMS" + ".2. Registered prefix within GEMS" + ".a.b.c" encoded mac address of the DL host +".x.y.z" unique id protected against reinstallation and reentrance. |
| Series Number | (0020,0011) | 2 | Internally generated, starting at 1. |
| Series Date | (0008,0021) | 3 | YYYYMMDD, restricted to 8 characters. |
| Series Time | (0008,0031) | 3 | HHMMSS.XXX, restricted to 10 characters. |
| Performing Physicians' Name | (0008,1050) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| Protocol Name | (0018,1030) | 3 | From User Interface, user defined description of the acquisition protocol. |
| Series Description | (0008,103E) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| Operators' Name | (0008,1070) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| Request attribute sequence | (0040,0275) | 3 | Sequence that contains attributes from the Imaging Service Request. In this implementation, this sequence contains only two items. |
| >Request procedure id | (0040,1001) | 1C | Identifier that identifies the Requested Procedure in the Imaging Service Request. Required if Sequence Item is present. |
| >Scheduled Procedure Step ID | (0040,0009) | 1C | Field always contains the value "Unknown" in the image header. |

### 3.2.4 Common Equipment Entity Modules

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

### Introduction

This section describes the modules of Common Equipment Entity.

## General Equipment Module

This section specifies the attributes which identify and describe the piece of equipment which produced a series of images.

### Table 3-7: General Equipment Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Manufacturer | (0008,0070) | 2 | GE MEDICAL SYSTEMS |
| Institution Name | (0008,0080) | 3 | From "Service User Interface", configured at the installation of the system. Restricted to 64 characters. |
| Institution Address | (0008,0081) | 3 | From "Service User Interface", configured at the installation of the system. Restricted to 1024 characters. |
| Station name | (0008,1010) | 3 | AE Title of the system that created the DICOM image. |
| Manufacturer's Model Name | (0008,1090) | 3 | DL |
| Device Serial Number | (0018,1000) | 3 | From internal configuration of the machine. |
| Software Versions | (0018,1020) | 3 | DL application version. |

## 3.2.5 Common Image Entity Modules

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

## 4.1.0.0   Introduction

This section describes the modules of Common Image Entity.

## General Image Module

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

### Table 3-8: General Image Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Image Type | (0008,0008) | | Always ORIGINAL/PRIMARY/SINGLE PLANE |
| Acquisition Date | (0008,0022) | 3 | YYYYMMDD, restricted to 8 characters, date the sequence was acquired. |
| Image Date | (0008,0023) | 2C | Same as acquisition date (0008,0022) |
| Acquisition Time | (0008,0032) | 3 | HHMMSS.XXX, restricted to 10 characters. |
| Image Time | (0008,0033) | 2C | Same as acquisition time (0008,0032) |
| Image number | (0020,0013) | 2 | Internally generated, starting at 1. |
| Patient Orientation | (0020,0020) | 2C | Always zero length |
| Instance Comments | (0020,4000) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |

## Image Pixel Module

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

### Table 3-9: Image Pixel Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Samples per Pixel | (0028,0002) | 1 | 1 |
| Photometric Interpretation | (0028,0004) | 1 | MONOCHROME1 or MONOCHROME2 |
| Rows | (0028,0010) | 1 | Depends on the size of the FOV (imaged region of the X–ray detector), and the re– sampling applied during the DICOM conversion. Possible values are 608, 750, 800, 1000 and 512. |
| Columns | (0028,0011) | 1 | Depends on the size of the FOV (imaged region of the X–ray detector), and the re– sampling applied during the DICOM conversion. Possible values are 608, 750, 800, 1000 and 512. |
| Bits Allocated | (0028,0100) | 1 | 8or16 |
| Bits Stored | (0028,0101) | 1 | 8or12 |
| High Bit | (0028,0102) | 1 | 7or11 |
| Pixel Representation | (0028,0103) | 1 | 0x0000 |
| Pixel Data | (7FE0,0010) | 1 | Data stream of the pixel samples. |

## Contrast/Bolus Module

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

### Table 3-10: Contrast/Bolus Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Auto injection enabled | (0019,xxA4) | 3 | YES/NO |
| Injection phase | (0019,xxA5) | 3 | PRE/POST |
| Injection delay | (0019,xxA6) | 3 | Number of milliseconds between the injection and the reference frame. Always positive. |
| Reference injection frame number | (0019,xxA7) | 3 | Frame number of the reference frame related to the auto– injection delay. |
| Contrast/Bolus Agent | (0018,0010) | 2 | No value, zero length. |

## Cine Module

The table in this section specifies the Attributes of a Multi–frame Cine Image.

### Table 3-11: Cine Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Start Trim | (0008,2142) | 3 | 1 |

| Stop Trim | (0008,2143) | 3 | Last frame of the multi–frame image. |
|---|---|---|---|
| Recommended Display Frame Rate | (0008,2144) | 3 | Number of frames per second (truncated to integer). |
| Cine Rate | (0018,0040) | 3 | Number of frames per second (truncated to integer). |
| Frame Time | (0018,1063) | 1C | Nominal time (in msec) between frames. |
| Frame Delay | (0018,1066) | 3 | 0.0 |
| Frame time vector | (0018,1065) | 1C | An array which contains the real time increments (in msec) between frames for a Multi-frame image. Required if Frame Increment Pointer (0028,0009) points to Frame Time Vector. |

## Multi–Frame Module

This section specifies the Attributes of a Multi–frame pixel data Image.

### Table 3-12: Multi–Frame Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Number of Frames | (0028,0008) | 1 | Internally generated by acquisition system. Maximum: 460. |
| Frame Increment Pointer | (0028,0009) | 1 | Frame Increment Pointer (0028,0009) points to Frame Time (0018,1063) |

## Frame Pointers Module

This section specifies the attributes of a Frame Pointer Module.

### Table 3-13: Frame Pointers Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Representative Frame Number | (0028,6010) | 3 | Calculated as "number of frames (0028,0008)" divided by 2. |

## Mask Module Table 3-14: Mask Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Recommended viewing mode | (0028,1090) | 2 | SUB or NAT |
| Mask substraction sequence | (0028,6100) | 1 | Defines a sequence which describe mask subtraction operations for a Multi–frame Image. |
| >Mask operation | (0028,6101) | 1 | AVG_SUB or NONE |
| >Applicable frame range | (0028,6102) | 3 | Frames of the mask operation applied during the last review. |
| >Mask frame numbers | (0028,6110) | 1C | Frames selected as Mask during the last review. Required if Mask Operation (0028,6101) is AVG_SUB. |
| >Mask subpixel shift | (0028,6114) | 3 | Pixel shift applied during the last review. |

## Display Shutter Module Table 3-15: Display Shutter Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Shutter Shape | (0018,1600) | 1 | RECTANGULAR |
| Shutter Left Vertical Edge | (0018,1602) | 1C | Internally generated by acquisition system. |
| Shutter Right Vertical Edge | (0018,1604) | 1C | Internally generated by acquisition system. |
| Shutter Upper Horizontal Edge | (0018,1606) | 1C | Internally generated by acquisition system. |
| Shutter Lower Horizontal Edge | (0018,1608) | 1C | Internally generated by acquisition system. |

## Device Module

The table in this section describes the Attributes of devices (e.g., catheters, markers, baskets) which are associated with a study and/or image.

### Table 3-16: Device Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Calibration frame | (0019,XX81) | 3 | frame on which the calibration was performed (May not be sent). |
| Calibration object | (0019,XX82) | 3 | Sphere, catheter or segment (only one) (May not be sent). |
| Calibration object size mm | (0019,XX83) | 3 | Size (diameter, distance...) in mm (May not be sent). |
| Calibration factor | (0019,XX84) | 3 | Calib factor in mm/pix (May not be sent). |
| Calibration date | (0019,XX85) | 3 | Date of the calibration of the image (May not be sent). |
| Calibration time | (0019,XX86) | 3 | Time of the calibration of the image (May not be sent). |

### Table 3-16: Device Module Attributes (cont'd)

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Calibration accuracy | (0019,XX87) | 3 | In % with respect to the calibration factor (May not be sent). |
| Calibration extended | (0019,XX88) | 3 | YES/NO (May not be sent). |
| Calibration image original | (0019,XX89) | 3 | If calib extended, the image number of the original calibration (May not be sent). |
| Calibration frame original | (0019,XX8A) | 3 | If extended calibration, the frame number of the original calibration (May not be sent). |
| Calibration nb points uif | (0019,XX8B) | 3 | 0,1 or 2 (May not be sent). |
| Calibration points row | (0019,XX8C) | 3 | Location of the points that define the calibration object, given as row (May not be sent). |
| Calibration points column | (0019,XX8D) | 3 | Location of the points that define the calibration object, given as column (May not be sent). |
| Calibration mag ratio | (0019,XX8E) | 3 | Ratio between the SID over the distance from source to the center of the calibration object (> 1.0) (May not be sent). |
| Calibration sw version | (0019,XX8F) | 3 | String containing algorithm generation, algorithm version and algorithm release. A new release does not change the algorithm, only change code structure (I/O, code optimization...) (May not be sent) |

| Extend calib sw version | (0019,XX90) | 3 | String containing algorithm generation, algorithm version and algorithm release. A new release does not change the algorithm, only change code structure (I/O, code optimization…) (May not be sent). |
|---|---|---|---|
| Calibration return code | (0019,XX91) | 3 | Code returned by the calibration algorithm (May not be sent). |

## Therapy Module

This module is not sent.

## Common Overlay Modules

Overlay Plane Module
This module is not sent

Multi–Frame Overlay Module This module is not sent.

## Curve Module

This module is not sent.

## Common Lookup Table Modules VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

### Table 3-17: VOI LUT Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Window center | (0028,1050) | 3 | Value of the window center optimized at the image acquisition. |
| Window width | (0028,1051) | 3 | Value of the window width optimized at the image acquisition. |

## Modality LUT Module

This module is not sent.

## SOP Common Module

The SOP Common Module is mandatory for all DICOM IODs.

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

## Table 3-18: SOP Common Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| SOP Instance UID | (0008,0018) | 1 | Restricted to 64 characters, internally generated as follows: "registered prefix for GEMS" + ".2. Registered prefix within GEMS" + ".a.b.c" encoded mac address of the DL host +".x.y.z" unique id protected against reinstallation and reentrance. |
| SOP Class UID | (0008,0016) | 1 | 1.2.840.10008.5.1.4.1.1.12.1 |
| Specific Character Set | (0008,0005) | 1C | ISO_IR 100 |

## X–Ray Modules

This Section describes Modules used in one or more X–Ray IODs. These Modules contain Attributes that are specific to X–Ray images.

### X–Ray Image Module

## Table 3-19: X–Ray Image Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Frame Increment Pointer | (0028,0009) | 1 | Frame Increment Pointer (0028,0009) points to Frame Time (0018, 1063) |
| Image Type | (0008,0008) | 3 | Always ORIGINAL/PRIMARY/SINGLE PLANE. |
| Pixel Intensity Relationship | (0028,1040) | 1 | DRM or SQRT |
| Samples per Pixel | (0028,0002) | 1 | 1 |
| Photometric Interpretation | (0028,0004) | 1 | MONOCHROME1 or MONOCHROME2 |
| Bits Allocated | (0028,0100) | 1 | 8or16 |
| Bits Stored | (0028,0101) | 1 | 8or12 |
| High Bit | (0028,0102) | 1 | 7or11 |

## Table 3-19: X–Ray Image Module Attributes (cont'd)

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Pixel Representation | (0028,0103) | 1 | 0x0000 |
| Calibration image | (0050,0004) | 3 | Indicates whether a reference object (phantom) of known size is present in the image and was used for calibration. Defined terms are: YES and NO |

**X–Ray Acquisition Module**

**Table 3-20: X–Ray Acquisition Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| KVP | (0018,0060) | 2 | No value, Zero length. |
| Radiation Setting | (0018,1155) | 1 | GR |
| Exposure Time | (0018,1150) | 2C | No value, Zero length. |
| X–Ray Tube Current | (0018,1151) | 2C | No value, Zero length. |
| Exposure | (0018,1152) | 2C | The product of exposure time and X-Ray tube current expressed in mAs. Required if either Exposure Time (0018,1150) or X-Ray tube current (0018,1151) are not present. |
| Radiation Mode | (0018,115A) | 3 | PULSED |
| Intensifier Size | (0018,1162) | 3 | 409.6 |
| Field of View Shape | (0018,1147) | 3 | RECTANGLE |
| Field of View Dimension(s) | (0018,1149) | 3 | From user selection in the User Interface of the acquisition system. Possible values are 120, 150, 160, 170, 200, 300, 320 and 400 mm. |
| Image Pixel Spacing | (0018,1164) | 3 | Is the ratio between the field of view dimension and the number of rows and columns. |
| Field of View Origin | (0018,7030) | 3 | Depends on the size of the FOV (imaged region of the X–ray detector). |
| fov_dim_double | (0019,XX0B) | 3 | Value in floating point resolution, whose truncated counterpart is (0018,1149). Possible values are 121.6, 147.2, 160.0, 172.8, 200.0 300.0, 320.0 and 400.0 mm. |
| Detector rot angle | (0019,XX92) | 3 | |
| usr_spa_flt_strgth | (0019,XX17) | 3 | The strength of the spatial filters selected by the user during the image Review. Values from 1 to 10. |
| usr_zoom_factor | (0019,XX18) | 3 | 1 |
| lbd_cm_pc_dtort | (0019,XX24) | 3 | "0.0". Coefficient of the pincushion distortion model of the Image Intensifier, in cm–1. This model allows to correct the position of a point of the image as function of the distance to the center of the image. |
| slope_lv_regress | (0019,XX25) | 3 | "0.85". Slope coefficient (unitless) of the linear regression correction of the Left Ventricular volume. This linear regression corrects the Left Ventricular volume calculated by the Dodge's method from the contour of the left ventricle traced by an expert. |
| int_lv_regress | (0019,XX26) | 3 | "4.72". Intercept coefficient (in cm3) of the linear regression correction of the Left Ventricular volume. This linear regression corrects the Left Ventricular volume calculated by the Dodge's method from the contour of the left ventricle traced by an expert. |
| def_spa_flt_family | (0019,XX31) | 3 | The family of the spatial filters applied during the image acquisition. |

## Table 3-20: X–Ray Acquisition Module Attributes (cont'd)

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| def_spa_flt_strgth | (0019,XX32) | 3 | The strength of the spatial filters applied during the image acquisition. Values from 1 to 9. |
| def_bright_contr | (0019,XX4E) | 3 | The brightness/contrast applied during the image acquisition. Brightness from 0.0 to 100.0, Contrast from −100.0 to 100.0 |
| user_bright_contr | (0019,XX4F) | 3 | The brightness/contrast modified by the user during the image review. Brightness from 0.0 to 100.0, Contrast from −100.0 to 100.0 |
| Average pulse width | (0018,1154) | 3 | Average width of X-Ray pulse in msec. |
| adx acq mode | (0019,XX14) | 3 | 0.1: Vascular, 2 to 7: Cardiac 8 to 13: DSA stepping 14 to 16 and 26: Bolus chasing 20 to 25: HSS acquisition. |
| current spatial filter strength | (0019,XXAB) | 3 | The strength of the spatial filters selected by the user in DL during the image Review. Values from 1 to 9. |
| EPT | (0019,XXA9) | 3 | Exposure optimization conditions (cm). |
| can downscan 512 | (0019,XXAA) | 3 | Indicates the possibility to downscan the pixel data to 512x512 for exchange purposes (YES/NO). |
| sensor feedback | (0019,XX9A) | 3 | Internally generated. |
| Image sweep | (0019,XX95) | 3 | Horizontal and vertical image sweep performed by the acquisition system before sending the DICOM image. Defined terms are YES and NO. |
| Grid | (0018,1166) | 3 | Identify the grid. Defined Terms are IN (a grid is positioned) and NONE (no grid is used). |
| Focal spot | (0018, 1190) | 3 | Nominal focal spot size in mm used to acquire this image. |
| IP address | (0019,XX20) | 3 | IP address of the machine that sends the serie. |
| Preselected pivot rotation speed | (0019,XXC5) | 3 | |
| Detection gain value | (0019,XXD4) | 3 | Value in nGy/counts computed at start of acquisition. |
| mR mAs calibration value | (0019,XXD5) | 3 | The value of the mR/mAs calibration. |
| DRM LUT file name | (0019,XXDC) | 3 | Name of the file where the DRM lookup table can be found. |
| DRM Strength | (0019,XXDD) | 3 | DRM Strength. |

## X–Ray Collimator Module

### Table 3-21: X–Ray Collimator Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Collimator Shape | (0018,1700) | 1 | RECTANGULAR |
| Collimator Left Vertical Edge | (0018,1702) | 1C | Internally generated by the acquisition system. |
| Collimator Right Vertical Edge | (0018,1704) | 1C | Internally generated by the acquisition system. |
| Collimator Upper Horizontal Edge | (0018,1706) | 1C | Internally generated by the acquisition system. |
| Collimator Lower Horizontal Edge | (0018,1708) | 1C | Internally generated by the acquisition system. |

## X–Ray Table Module

**Table 3-22: X–Ray Table Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Table Motion | (0018,1134) | 2 | Will be DYNAMIC if table moves in at least one direction. |
| Table Vertical Increment | (0018,1135) | 2C | Value will be filled in if Table Motion is DYNAMIC. For STATIC, will be sent as no value, zero length. |
| Table Longitudinal Increment | (0018,1137) | 2C | Value will be filled in if Table Motion is DYNAMIC. For STATIC, will be sent as no value, zero length. |
| Table Lateral Increment | (0018,1136) | 2C | Value will be filled in if Table Motion is DYNAMIC. For STATIC, will be sent as no value, zero length. |
| Table vertical position | (0019,XX21) | 3 | Absolute vertical position of the table with respect to the table referential. Down moving is positive. |
| Table longitudinal position | (0019,XX22) | 3 | Absolute longitudinal position of the table with respect to the table referential. Head moving is positive. |
| Table lateral position | (0019,XX23) | 3 | Absolute lateral position of the table with respect to the table referential. Left moving is positive. |
| Table Angle | (0018,1138) | 3 | 0.0 |

**X–Ray 3D Calibration Module**

**Table 3-23: X–Ray 3D Calibration Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| 3Dcal image rows | (0021,XX01) | 3 | Number of rows of the image of the calibration phantom (helix) that has been used to determine the projection matrices. |
| 3Dcal image columns | (0021,XX02) | 3 | Number of columns of the image of the calibration phantom (helix) that has been used to determine the projection matrices. |
| 3Dcal field of view | (0021,XX03) | 3 | Field of View in mm applied to the acquisition of the calibration phantom (helix). NOTE: the size of the image of the calibration phantom may be bigger than the Field of View region. |
| 3Dcal acquisition date | (0021,XX04) | 3 | Date of the acquisition of the calibration phantom. |
| 3Dcal acquisition time | (0021,XX05) | 3 | Time of the acquisition of the calibration phantom. |
| 3Dcal calibration processing date | (0021,XX06) | 3 | Date of the processing of the calibration that has determined the projection matrices. |
| 3Dcal calibration processing time | (0021,XX07) | 3 | Time of the processing of the calibration that has determined the projection matrices. |
| 3Dcal L arm angle | (0021,XX08) | 3 | Mechanical angle of the L-arm corresponding to the first image of the acquisition of the calibration phantom. |
| 3Dcal Pivot angle vector | (0021,XX09) | 3 | Vector of the mechanical angles of the Pivot corresponding to all the images of the acquisition of the calibration phantom. The number of values of this attribute must be equal to the attribute (0021,xx13) "3Dcal number of images". |

| | | | |
|---|---|---|---|
| 3Dcal C arm angle | (0021,XX0A) | 3 | Mechanical angle of the C-arm corresponding to the first image of the acquisition of the calibration phantom. |

**Table 3-23: X–Ray 3D Calibration Module Attributes (cont'd)**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| 3Dcal matrix sequence | (0021,XX0B) | 3 | Sequence containing the elements of the calibration matrices. The number of items of this sequence must be equal to the attribute (0021,xx13) "3Dcal number of images". |
| >3Dcal matrix elements | (0021,XX0C) | 3 | Elements of the projection matrices. Each element is a real number represented by a maximum of 5 digits in its integer part, then a comma, then 15 digits in its fractional part. |
| 3Dcal algorithm version | (0021,XX0D) | 3 | Version of the calibration algorithm. |
| 3Dcal 3D frame unit size | (0021,XX0E) | 3 | Size in mm of the unity used to describe the 3D frame dimensions. |
| 3Dcal calibration mode | (0021,XX0F) | 3 | Internal code used to classify the different modes of calibration. |
| 3Dcal image frame origin row | (0021,XX10) | 3 | Vertical coordinate of the origin of the image frame used for the calculation of the projection matrices, given as row of the calibration image (starts at 0). |
| 3Dcal image frame origin column | (0021,XX11) | 3 | Horizontal coordinate of the origin of the image frame used for the calculation of the projection matrices, given as column of the calibration image (starts at 0). |
| 3Dcal positioner pivot rotation speed | (0021,XX12) | 3 | Speed of the pivot rotation, in degrees per second, as specified by the operator before the acquisition of the calibration phantom. **NOTE:** This speed may be slightly different from the actual speed of the gantry due to mechanical constraints like accelerate. |
| 3Dcal number of images | (0021,XX13) | 3 | Number of projections acquired during the acquisition of the calibration phantom. |
| 3Dcal Instance UID | (0021,XX14) | 3 | SOP Instance UID of the DICOM image corresponding to the acquisition of the calibration phantom. |
| 3Dcal image pixel spacing | (0021,XX15) | 3 | Distance between the center of each pixel of the image of the calibration phantom, specified by a pair -row spacing value (delimiter) column spacing value in mm. |
| 3Dcal centering mode | (0021,XX16) | 3 | Type of algorithm that centers the projection matrices: defined values are: "ISOCENTER", "HELIX", "RECTIFIED", "OTHER". |

## X–Ray Filtration Module

### Table 3-24: X–Ray Filtration Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Contour filter type | (0018,1160) | 3 | Type of filter(s) inserted into the X-Ray beam (e.g. wedges). Defined Terms: STRIP WEDGE BUTTERFLY MULTIPLE NONE |

## XA Positioner Module
### Table 3-25: XA Positioner Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Distance Source to Detector | (0018,1110) | 3 | Internally generated by the acquisition system. |
| Distance Source to Patient | (0018,1111) | 3 | Internally generated by the acquisition system. |
| Estimated Radiographic Magnification Factor | (0018,1114) | 3 | Calculated from (0018,1110) and (0018,1111) |
| Positioner Motion | (0018,1500) | 2C | Will be DYNAMIC if Pivot or C_ARM moves. If no motion, or if L only moves, will be sent as STATIC. |
| Positioner Primary Angle | (0018,1510) | 2 | For multi–frame images, value of the first frame. |
| Positioner Secondary Angle | (0018,1511) | 2 | For multi–frame images, value of the first frame. |
| Positioner Primary Angle Increment | (0018,1520) | 2C | Value of the RAO/LAO increments relative to the first frame. If positioner motions is STATIC, will be sent zero length. |
| Positioner Secondary Angle Increment | (0018,1521) | 2C | Value of the CRA/CAU increments relative to the first frame. If positioner motions is STATIC, will be sent zero length. |
| Angle value 1 | (0019,XX01) | 3 | Positioner angle for L arm (in degrees). Left moving is positive. |
| Angle value 2 | (0019,XX02) | 3 | Positioner angle for Pivot arm (in degrees). Left moving is positive. |
| Angle value 3 | (0019,XX03) | 3 | Positioner angle for C arm (in degrees). Head moving is positive. |
| Angle 1 increment | (0019,XX97) | 3 | Incremental change in L arm with respect to the angle of the first frame. Present only if positioner motion is DYNAMIC. |
| Angle 2 increment | (0019,XX98) | 3 | Incremental change in Pivot arm with respect to the angle of the first frame. Present only if positioner motion is DYNAMIC. |
| Angle 3 increment | (0019,XX99) | 3 | Incremental change in C arm with respect to the angle of the first frame. Present only if positioner motion is DYNAMIC. |

## SUB LUT Module

### Table 3-26: SUB LUT Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Applicable review mode | (0019,XX9D) | 3 | Review mode in which the SUB LUT module is applicable. Defined terms re NONE, NAT, SUB and BOTH |
| Log LUT control points | (0019,XX9E) | 3 | Control points of the log LUT. |
| Exp LUT SUB control points | (0019,XX9F) | 3 | Control points of the exp LUT for SUB review. |
| Exp LUT NOSUB control points | (0019,XXAD) | 3 | Control points of the exp LUT for NOSUB review. |
| ABD value | (0019,XXA0) | 3 | Average gray level value of the histogram. |
| Sub window center | (0019,XXA1) | 3 | window center applicable when the SUB LUT module is applied. |

### Table 3-26: SUB LUT Module Attributes (cont'd)

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Sub window width | (0019,XXA2) | 3 | window width applicable when the SUB LUT module is applied. |
| SUB operator LUTs names | (0019,xxAE) | 3 | Three LUT files' name (2 ExpLUTs, 1 LogLUT) in the database for the Viewer to be able to configure the IP SUB operator with the LUTs used for acquisition. Names are given in following order : SUB exp LUT\NOSUB exp LUT\ log LUT |

## 4.1.0.1  Private General Frame Module Table 3-27: Private General Frame Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| frame_sequence | (0025,XX0A) | 3 | Sequence with as many items as number of frames in the image, containing data of related to the acquisition of each frame. |
| >frame_id | (0025,XX02) | 3 | Frame identification inside the frame sequence, starting at 1. |

# 5  Private Data Dictionary

## Table 3-28: Private Creator Identification (GEMS_DL_STUDY_01)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| study_number | (0015,XX8F) | IS | 1 |

## Table 3-29: Private Creator Identification (GEMS_DL_SERIES)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| Number of images | (0015,XX87) | IS | 1 |

## Table 3-30: Private Creator Identification (GEMS_DL_IMG_01)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| Calibration frame | (0019,XX81) | US | 1 |
| Calibration object | (0019,XX82) | CS | 1 |
| Calibration object size mm | (0019,XX83) | DS | 1 |
| Calibration factor | (0019,XX84) | FL | 1 |
| Calibration date | (0019,XX85) | PA | 1 |
| Calibration time | (0019,XX86) | TM | 1 |
| Calibration accuracy | (0019,XX87) | US | 1 |
| Calibration extended | (0019,XX88) | CS | 1 |
| Calibration image original | (0019,XX89) | US | 1 |
| Calibration frame original | (0019,XX8A) | US | 1 |
| Calibration nb points uif | (0019,XX8B) | US | 1 |
| Calibration points row | (0019,XX8C) | US | 1–N |
| Calibration points column | (0019,XX8D) | US | 1–N |
| Calibration mag ratio | (0019,XX8E) | FL | 1 |
| Calibration sw version | (0019,XX8F) | LO | 1 |
| Extend calib sw version | (0019,XX90) | LO | 1 |
| Calibration return code | (0019,XX91) | IS | 1 |
| detector_rot_angle | (0019,XX92) | DS | 1 |
| def_bright_contr | (0019,XX4E) | DS | 2 |
| user_bright_contr | (0019,XX4F) | DS | 2 |
| applicable review mode | (0019,XX9D) | CS | 1 |
| log LUT control points | (0019,XX9E) | DS | 1–N |

| exp LUT SUB control points | (0019,XX9F) | DS | 1–N |
|---|---|---|---|
| exp LUT NOSUB control points | (0019,XXAD) | DS | 1–N |
| ABD value | (0019,XXA0) | DS | 1 |
| Sub window center | (0019,XXA1) | DS | 1 |
| Sub window width | (0019,XXA2) | DS | 1 |

### Table 3-30: Private Creator Identification (GEMS_DL_IMG_01) (cont'd)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| Auto injection enabled | (0019,XXA4) | CS | 1 |
| injection phase | (0019,XXA5) | CS | 1 |
| injection delay | (0019,XXA6) | DS | 1 |
| reference injection frame number | (0019,XXA7) | IS | 1 |
| fov dimension double | (0019,XX0B) | DS | 1–2 |
| default spatial filter family | (0019,XX31) | IS | 1 |
| default spatial filter strength | (0019,XX32) | IS | 1 |
| current spatial filter strength | (0019,XXAB) | IS | 1 |
| EPT | (0019,XXA9) | DS | 1–N |
| can downscan 512 | (0019,XXAA) | CS | 1 |
| sensor feedback | (0019,XX9A) | DS | 1–N |
| Image sweep | (0019,XX95) | CS | 2 |
| Angle 1 increment | (0019,XX97) | DS | 1–N |
| Angle 2 increment | (0019,XX98) | DS | 1–N |
| Angle 3 increment | (0019,XX99) | DS | 1–N |
| Image detector rotation angle | (0019,XX92) | DS | 1 |
| Image flip | (0019,XX95) | CS | 2 |
| Patient position per image | (0019,XXC7) | CS | 1 |
| Spatial change | (0019,XX93) | CS | 1 |
| Detector origin | (0019,XX4B) | IS | 2 |
| Preselected pivot rotation speed | (0019,XXC5) | FL | 1 |
| Detection gain value | (0019,XXD4) | FL | 1 |
| mR mAs calibration value | (0019,XXD5) | FL | 1 |
| DRM LUT file name | (0019,XXDC) | LO | 1 |
| DRM Strength | (0019,XXDD) | DS | 1-N |
| SUB operator LUTs names | (0019,XXAE) | LO | 1-N |
| Default spatial filter family | (0019,XXC4) | IS | 1 |
| 3D structure of interest | (0019,XXC8) | CS | 1 |
| 3D calibration out of date flag | (0019,XXC9) | CS | 1 |
| 3Dspin expected number of frames | (0019,XXCA) | IS | 1 |

**Table 3-31: Private Creator Identification (DLX_SERIE_01)**

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| usr_spa_flt_strgth | (0019,XX17) | IS | 1 |
| usr_zoom_factor | (0019,XX18) | IS | 1 |
| lbd_cm_pc_dtort | (0019,XX24) | DS | 1 |
| slope_lv_regress | (0019,XX25) | DS | 1 |
| int_lv_regress | (0019,XX26) | DS | 1 |

## Table 3-31: Private Creator Identification (DLX_SERIE_01) (cont'd)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| Percent landscape | (0019,XX1E) | IS | 1 |
| adx acq mode | (0019,XX14) | IS | 1 |
| Table vertical position Table | (0019,XX21) | DS | 1 |
| longitudinal position | (0019,XX22) | DS | 1 |
| Table lateral position | (0019,XX23) | DS | 1 |
| Angle value 1 | (0019,XX01) | DS | 1 |
| Angle value 2 | (0019,XX02) | DS | 1 |
| Angle value 3 | (0019,XX03) | DS | 1 |
| IP address | (0019,XX20) | LO | 1 |
| X zoom | (0019,XX19) | IS | 1 |
| Y zoom | (0019,XX1A) | IS | 1 |

## Table 3-32: Private Creator Identification (GEMS_DL_FRAME_01)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| frame_sequence | (0025,XX0A) | SQ | 1 |
| >frame_id | (0025,XX02) | IS | 1 |

## Table 3-33: Private Creator Identification (GEMS_XR3DCAL_01)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| 3Dcal image rows | (0021,XX01) | IS | 1 |
| 3Dcal image columns | (0021,XX02) | IS | 1 |
| 3Dcal field of view | (0021,XX03) | FL | 1 |
| 3Dcal acquisition date | (0021,XX04) | DA | 1 |
| 3Dcal acquisition time | (0021,XX05) | TM | 1 |
| 3Dcal calibration processing date | (0021,XX06) | DA | 1 |
| 3Dcal calibration processing time | (0021,XX07) | TM | 1 |
| 3Dcal L arm angle | (0021,XX08) | FL | 1 |
| 3Dcal Pivot angle vector | (0021,XX09) | FL | 1-N |
| 3Dcal C arm angle | (0021,XX0A) | FL | 1 |
| 3Dcal matrix sequence | (0021,XX0B) | SQ | 1 |
| >3Dcal matrix elements | (0021,XX0C) | LO | 1-N |
| 3Dcal algorithm version | (0021,XX0D) | LO | 1 |
| 3Dcal 3D frame unit size | (0021,XX0E) | FL | 1 |
| 3Dcal calibration mode | (0021,XX0F) | LO | 1 |
| 3Dcal image frame origin row | (0021,XX10) | FL | 1 |
| 3Dcal image frame origin column | (0021,XX11) | FL | 1 |

| 3Dcal positioner pivot rotation speed | (0021,XX12) | IS | 1 |
| 3Dcal number of images | (0021,XX13) | IS | 1 |

**Table 3-33: Private Creator Identification (GEMS_XR3DCAL_01) (cont'd)**

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| 3Dcal Instance UID | (0021,XX14) | UI | 1 |
| 3Dcal image pixel spacing | (0021,XX15) | FL | 2 |
| 3Dcal centering mode | (0021,XX16) | CS | 1 |

# Chapter 4 - SC Information Object Implementation

## 1  Introduction

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

## 2  SC Entity Relationship Model

The Entity–Relationship diagram for the SC Image interoperability schema is shown in Illustration 4-1 . In this figure, the following diagrammatic convention is established to represent the information organization :

 Each entity is represented by a rectangular box
 Each relationship is represented by a diamond shaped box.
 The fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. In other words, the relationship between Series and Image can have up to n Images per Series, between Patient and Study can have up to n Studies per Patient, but the Study to Series has 1 Series for each Study.

**Illustration 4-1: SC Image Entity Relationship Diagram**
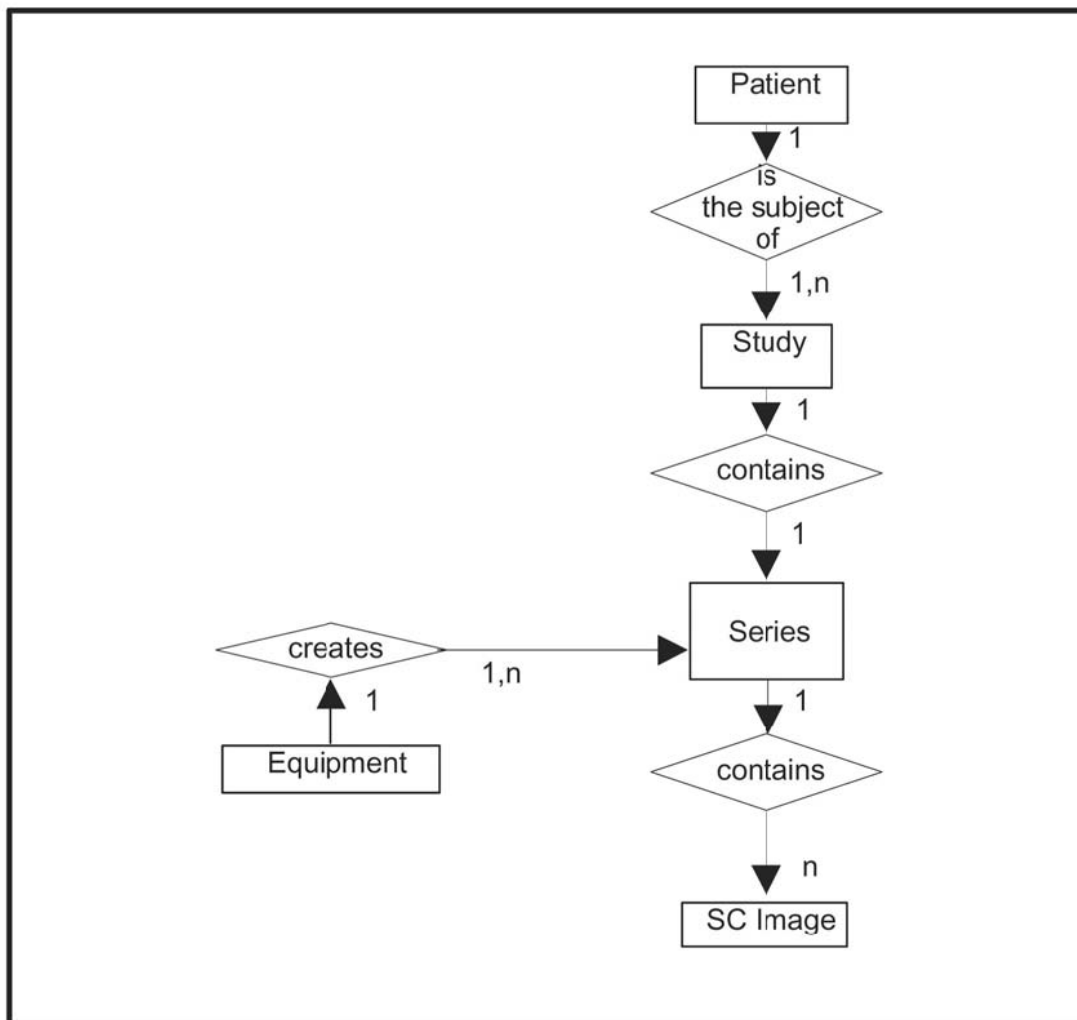
## 2.1 Entity Descriptions

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

## 2.2 Innova Mapping of DICOM Entities

**Table 4-1: Mapping of DICOM Entities to INNOVA Entities**

| DICOM | <Name of the product> Entity |
|---|---|
| Patient | Patient |
| Study | Exam |
| Series | Exam |
| Image | Photo |
| Frame | Not Applicable |

# 3  IOD Module Table and Information Module Definitions

## 3.1  IOD Module Table

Within an entity of the DICOM v3.0 SC IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets. The table in this section identifies the defined modules within the entities which comprise the DICOM v3.0 SC IOD. Modules are identified by Module Name.See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes.

### Table 4-2: SC Image IOD Modules

| Entity Name | Module Name | Reference |
|---|---|---|
| Patient | Patient | Section 3.2.1.2 |
| Study | General Study | Section 3.2.2.2 |
| | Patient Study | Section 3.2.2.3 |
| Series | General Series | Section 3.2.3.2 |
| Equipment | General Equipment | Section 3.2.4.2 |
| | SC Equipment | Table 4-12 |
| Image | General Image | Section 3.2.5.2 |
| | Image Pixel | Section 3.2.5.3 |
| | SC Image | Table 4-13 |
| | Overlay Plane | Section 3.2.5.4 |
| | Modality LUT | Section 3.2.5.5 |
| | VOI LUT | Table 4-10 |
| | SOP Common | Section 3.2.5.6 |
| | XA Positioner | Section 3.2.5.8 |
| | Photo QCA | Section 3.2.5.9 |

## 3.2 Information Module Definitions

Please refer to DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the SC Information Object. The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

### 3.2.1 Common Patient Entity Modules

## Introduction

This section describes the modules of Common Patient Entity

## Patient Module

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

### Table 4-3: Patient Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Patient's Name | (0010,0010) | 2 | From user interface or worklist. When from user interface, value contains only last_name(restricted to 32 chars)^first_name(restricted to 31 chars). When from worklist, equals first component group. |
| Patient ID | (0010,0020) | 2 | From worklist or user interface. Restricted to 64 chars. |
| Patient's Birth Date | (0010,0030) | 2 | From user interface or worklist. Restricted to 64 chars. YYYYMMDD. |
| Patient's Sex | (0010,0040) | 2 | From user interface or worklist. "M", "F" or "O" |

## 3.2.2 Common Study Entity Modules

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

## Introduction

This section describes the modules of Common Study Entity.

## General Study Module

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

### Table 4-4: General Study Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Study Instance UID | (0020,000D) | 1 | Restricted to 64 characters, internally generated as follows: "registred prefix for GEMS" + ".2. registred identification of Innova System within GEMS" + ".a.b.c" encoded mac address of the DL host + ".x.y.z" unique id protected against reinstallation and reentrance. |
| Study Date | (0008,0020) | 2 | YYYYMMDD, restricted to 8 characters. |
| Study Time | (0008,0030) | 2 | HHMMSS.XXX, restricted to 10 characters. |
| Referring Physician's Name | (0008,0090) | 2 | From User Interface, restricted to 64 characters. |
| Study ID | (0020,0010) | 2 | From User Interface, restricted to 64 characters. |
| Accession Number | (0008,0050) | 2 | From User Interface, restricted to 64 characters |

| | | | |
|---|---|---|---|
| Study Description | (0008,1030) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| Name of Physician(s) Reading Study | (0008,1060) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| study_number | (0015,XX8F) | 3 | Internally generated, starting at 1. (May not be sent). |

## Patient Study Module

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

### Table 4-5: Patient Study Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Patient's Age | (0010,1010) | 3 | Either from User Interface or Calculated from Patient's Birth Date (0010,0030). Three digits followed by one letter: In Years (Y), Months (M), Weeks (W) or Days (D). (May not be sent). |
| Patient's Size | (0010,1020) | 3 | From User Interface or worklist, restricted to 16 characters. (May not be sent). |
| Patient's Weight | (0010,1030) | 3 | From User Interface or worklist, restricted to 16 characters. (May not be sent). |

## 3.2.3 Common Series Entity Modules

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

## Introduction

This section describes the modules of Common Series Entity.

## General Series Module

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

### Table 4-6: General Series Study Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Modality | (0008,0060) | 1 | XA |
| Series Instance UID | (0020,000E) | 1 | Restricted to 64 characters, internally generated as follows: "registred prefix for GEMS" + ".2. registred identification of Innova System within GEMS" + ".a.b.c" encoded mac address of the DL host + ".x.y.z" unique id protected against reinstallation and reentrance. |
| Series Number | (0020,0011) | 2 | Internally generated, starting at 1. Series Date (0008,0021) 3 YYYYMMDD, restricted to 8 characters. |

| | | | |
|---|---|---|---|
| Series Time | (0008,0031) | 3 | HHMMSS.XXX, restricted to 10 characters. |
| Performing Physicians' Name | (0008,1050) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| Protocol Name | (0018,1030) | 3 | From User Interface |
| Series Description | (0008,103E) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| Operators' Name | (0008,1070) | 3 | From User Interface, restricted to 64 characters. (May not be sent). |
| request attribute sequence | (0040,0275) | 3 | Sequence that contains attributes from the Imaging Service Request. In this implementation, this sequence contains only two items. |

**Table 4-6: General Series Study Module Attributes (cont'd)**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| >request procedure id | (0040,1001) | 1C | Identifier that identifies the Requested Procedure in the Imaging Service Request. Required if Sequence Item is present. |
| >Scheduled Procedure Step ID | (0040,0009) | 1C | Field always contains the value "Unknown" in the image header. |

## 3.2.4 Common Equipment Entity Modules

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

### Introduction

This section describes the modules of Common Equipment Entity

### General Equipment Module

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

**Table 4-7: General Equipment Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Manufacturer | (0008,0070) | 2 | GE MEDICAL SYSTEMS |
| Institution Name | (0008,0080) | 3 | From "Service User Interface", configured at the installation of the system. Restricted to 64 characters. |
| Institution Address | (0008,0081) | 3 | From "Service User Interface", configured at the installation of the system. Restricted to 1024 characters. |
| Manufacturer's Model | (0008,1090) | 3 | DL |
| Name Device | (0018,1000) | 3 | Serial Number From internal configuration of the machine. |
| Software Versions | (0018,1020) | 3 | DL application version. |
| Station name | (0018,1010) | 3 | AE Title of the system that generates the DICOM image. |

## 3.2.5 Common Image Entity Modules

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

### Introduction

This section describes the modules of Common Image Entity.

### General Image Module

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

**Table 4-8: General Image Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Image Type | (0008,0008) | 3 | Always DERIVED\SECONDARY |
| Acquisition Date | (0008,0022) | 3 | YYYYMMDD, restricted to 8 characters, date the sequence was acquired. |
| Content Date | (0008,0023) | 2C | Same as acquisition date (0008,0022) |
| Acquisition Time | (0008,0032) | 3 | HHMMSS.XXX, restricted to 10 characters. |
| Content Time | (0008,0033) | 2C | Same as acquisition time (0008,0032) |
| Source Image Sequence | (0008,2112) | 3 | Derivation Description (0008,2111) not sent. Source Image Sequence is always sent. |
| >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 | UID of the image from which the photo was derived |
| >Referenced Frame Number | (0008,1160) | 1C | Frame number from which the photo was derived |
| Image number | (0020,0013) | 2 | Internally generated, starting at 1. |
| Patient Orientation | (0020,0020) | 2C | Always zero length. |
| Burned In Annotation | (0028,0301) | 3 | NO: Indicates that the image does not contain any burned in annotation to identify the patient and date the image was acquired. |
| Image comments | (0020,4000) | 3 | User defined comments |

### Image Pixel Module

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

**Table 4-9: Image Pixel Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Samples per Pixel | (0028,0002) | 1 | 1 |
| Photometric Interpretation | (0028,0004) | 1 | MONOCHROME1 or MONOCHROME2 |
| Rows | (0028,0010) | 1 | 1024 |
| Columns | (0028,0011) | 1 | 1024 |

| Bits Allocated | (0028,0100) | 1 | 8 |
|---|---|---|---|
| Bits Stored | (0028,0101) | 1 | 8 |
| High Bit | (0028,0102) | 1 | 7 |
| Pixel Representation | (0028,0103) | 1 | 0000H (unsigned integer) |
| Pixel Data | (7FE0,0010) | 1 | Data stream of the pixel samples. |

## Overlay Plane Module

This module is not sent

## Common Lookup Table Modules VOI LUT Module

This section specifies the Attributes that describe the VOI LUT.

### Table 4-10: VOI LUT Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Window center | (0028,1050) | 3 | Value of the window center optimized at the image acquisition. |
| Window width | (0028,1051) | 3 | Value of the window width optimized at the image acquisition. |

## Modality LUT Module

The Modality LUT module is not sent.

## SOP Common Module

The SOP Common Module is mandatory for all DICOM IODs.

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

### Table 4-11: SOP Common Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| SOP Instance UID | (0008,0018) | 1 | Restricted to 64 characters, internally generated as follows: "registred prefix for GEMS" + ".2. registred identification of Innova System within GEMS" + ".a.b.c" encoded mac address of the DL host + ".x.y.z" unique id protected against reinstallation and reentrance. |
| SOP Class UID | (0008,0016) | 1 | 1.2.840.10008.5.1.4.1.1.12.1 |
| Specific Character Set | (0008,0005) | 1C | ISO_IR 100 |

## SC Modules

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

## SC Equipment Module

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

### Table 4-12: SC Image Equipment Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Conversion type | (0008,0064) | 1 | Describes the kind of image conversion. Defined terms are: DV=Digitized Video, DI=Digital Interface, DF=Digitized Film, WSD=Workstation |
| SC manufacturer | (0018,1016) | 3 | Manufacturer of the Secondary Capture Device |
| SC manufacturer model name | (0018,0018) | 3 | Manufacturer's model number of the Secondary Capture Device |

## SC Image Module

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

### Table 4-13: SC Image Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Date of Secondary Capture | (0018,1012) | 3 | Date the SC image was captured |
| Time of Secondary Capture | (0018,1014) | 3 | Time the SC image was captured |

## XA Positioner Module Table 4-14: XA Positioner Equipment Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Positioner Primary Angle | (0018,1510) | 2 | LAO/RAO angle for the SC image. |
| Positioner Secondary Angle | (0018,1511) | 2 | CRA/CAU angle for the SC image. |

## Photo QCA Module Table 4-15: Photo QCA Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Analysis Views | (0009,XX00) | 1 | Enumerated type containing one of the following values: PRE, POST and PRE_POST. |
| Segment | (0009,XX10) | 2 | ACC segment name. Defined terms: Proximal RCARCA OstiumMid RCADistal RCARight PDARight LV–BRLMCALMCA OstiumProximal LADMid LADDistal LAD1st Diagonal2nd Diagonal1st Septal-Proximal CircumflexMid Circumflex1st Marginal2nd Marginal3rd MarginalDistal CircumflexL |

| Pre Catheter Name | (0009,XX11) | 2C | User description of pre–procedure catheter. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |
|---|---|---|---|
| Pre Catheter Size | (0009,XX12) | 1C | Size of pre–procedure catheter in millimeters. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |
| Pre Reference Diameter | (0009,XX13) | 1C | Pre–procedure Reference Diameter, in millimeters. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |
| Pre Minimum Lumen Diameter | (0009,XX14) | 1C | Pre–procedure Minimum Lumen Diameter, in millimeters. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |
| Pre Average Diameter | (0009,XX15) | 2C | Pre–procedure Average Diameter, in millimeters. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |
| Pre Stenosis Length | (0009,XX16) | 2C | Pre–procedure Stenosis Length, in millimeters. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |
| Pre Stenosis % | (0009,XX17) | 2C | Pre–procedure Stenosis as a percentage. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |

## Table 4-15: Photo QCA Module Attributes (cont'd)

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Pre Geometric Area Reduction % | (0009,XX18) | 2C | Pre–procedure Geometric Area Reduction as a percentage. Required if Analysis Type (0009,XX00) is "PRE" or "PRE_POST". (May not be sent). |
| Post Catheter Name | (0009,XX21) | 2C | User description of post–procedure catheter. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent). |
| Post Catheter Size | (0009,XX22) | 1C | Size of post–procedure catheter in millimeters. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent). |
| Post Reference Diameter | (0009,XX23) | 1C | Post–procedure Reference Diameter, in millimeters. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent). |
| Post Minimum Lumen Diameter | (0009,XX24) | 1C | Post–procedure Minimum Lumen Diameter, in millimeters. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent). |
| Post Average Diameter | (0009,XX25) | 2C | Post–procedure Average Diameter, in millimeters. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent). |
| Post Stenosis Length | (0009,XX26) | 2C | Post–procedure Stenosis Length, in millimeters. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent). |
| Post Stenosis % | (0009,XX27) | 2C | Post–procedure Stenosis as a percentage. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent) . |
| Post Geometric Area Reduction % | (0009,XX28) | 2C | Post–procedure Geometric Area Reduction as a percentage. Required if Analysis Type (0009,XX00) is "POST" or "PRE_POST". (May not be sent). |

# 4 Private Data Dictionary

## Table 4-16: Private Creator Identification (GEMS_DL_STUDY_01)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| study_number | (0015,XX8F) | IS | 1 |

## Table 4-17: Private Creator Identification (GEMS_DL_IMG_01)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| src_frame_number | (0019,XX52) | IS | 1 |
| Image detector rotation angle | (0019,XX92) | DS | 1 |
| Image flip | (0019,XX95) | CS | 2 |

## Table 4-18: Private Creator Identification (QCA_Results)

| Attribute Name | Tag | VR | VM |
|---|---|---|---|
| Analysis Views | (0009,XX00) | CS | 1 |
| Segment | (0009,XX10) | LO | 1 |
| Pre Catheter Name 2C | (0009,XX11) | LO | 1 |
| Pre Catheter Size | (0009,XX12) | DS | 1 |
| Pre Reference Diameter | (0009,XX13) | DS | 1 |
| Pre Minimum Lumen Diameter | (0009,XX14) | DS | 1 |
| Pre Average Diameter | (0009,XX15) | DS | 1 |
| Pre Stenosis Length | (0009,XX16) | DS | 1 |
| Pre Stenosis % | (0009,XX17) | IS | 1 |
| Pre Geometric Area Reduction % | (0009,XX18) | IS | 1 |
| Post Catheter Name | (0009,XX21) | LO | 1 |
| Post Catheter Size | (0009,XX22) | DS | 1 |
| Post Reference Diameter | (0009,XX23) | DS | 1 |
| Post Minimum Lumen Diameter | (0009,XX24) | DS | 1 |
| Post Average Diameter | (0009,XX25) | DS | 1 |
| Post Stenosis Length | (0009,XX26) | DS | 1 |
| Post Stenosis % | (0009,XX27) | IS | 1 |
| Post Geometric Area Reduction % | (0009,XX28) | IS | 1 |

# Chapter 5 Modality Worklist Information Model Definition

## 1   Introduction

This section specifies the use of the DICOM Modality Worklist Information Model used to organize data and against which a Modality Worklist Query will be performed.

## 2   Modality Worklist Information Model Entity Relationship Model

The Entity–Relationship diagram for the Modality Worklist Information Model schema is shown in Illustration 5-1 . It represents the information that composes a Worklist Item. In this figure, the following diagrammatic convention is established to represent the information organization :

Each entity is represented by a rectangular box.
Each relationship is represented by a diamond shaped box..
The fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

**Illustration 5-1: Modality Worklist Information Model E/R DIAGRAM**
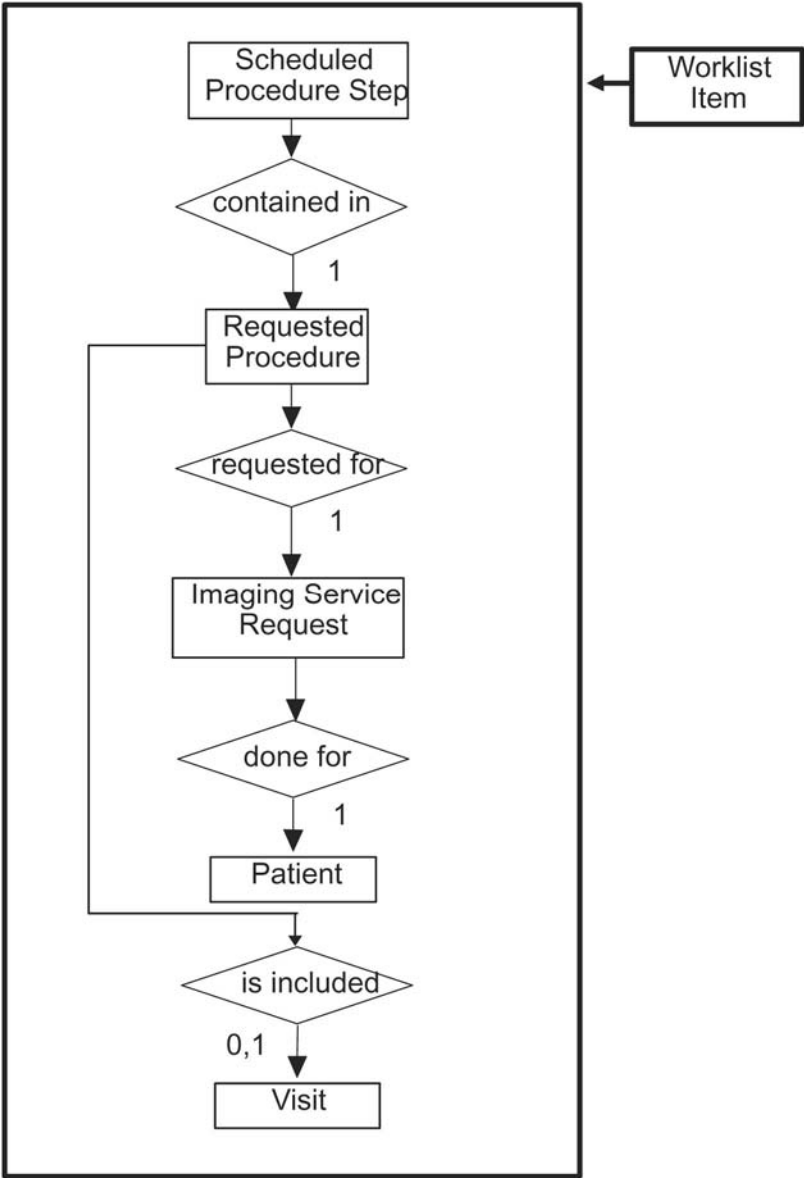
## 2.1  Entity Descriptions

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) and PS 3.4 (Service Class Specifications) for a description of each of the Entities contained within the Modality Worklist Information Model.

## 2.2  Innova Mapping of DICOM Entities

Table 5-1: Mapping of DICOM Entities to INNOVA Entities

| DICOM | INNOVA Entity |
|---|---|
| Scheduled Procedure Step | |
| Requested Procedure | Exam |
| Imaging Service Request | Exam |
| Visit | |
| Patient | Patient |

# 3   Information Model

## 3.1    Information Model Module Table

Within an entity of the DICOM v3.0 Modality Worklist Information Model, 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.

The table in this section identifies the defined modules within the entities which comprise the DICOM v3.0 Modality Worklist Information Model. Modules are identified by Module Name.

See DICOM v3.0 PS 3.3 and PS 3.4 for a complete definition of the entities, modules, and attributes.

### Table 5-2: Modality Worklist Information Model Modules

| Entity Name | Module Name | Reference |
|---|---|---|
| Scheduled Procedure Step | SOP Common | Section 3.2.2.2 |
| | Scheduled Procedure Step | Section 3.2.2.3 |
| Requested Procedure | Requested Procedure | Section 3.2.3.2 |
| Imaging Service Request | Imaging Service Request | Section 3.2.4.2 |
| Visit | Visit Identification | Section 3.2.5.2 |
| | Visit Status | Section 3.2.5.3 |
| | Visit Relationship | Section 3.2.5.4 |
| | Visit Admission | Section 3.2.5.5 |
| Patient | Patient Relationship | Section 3.2.6.2 |
| | Patient Identification | Section 3.2.6.3 |
| | Patient Demographic | Section 3.2.6.4 |
| | Patient Medical | Section 3.2.6.5 |

## 3.2 Information Model Keys

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) and PS 3.4 (Service Class Specifications) for a description of each of the Entities contained within the Modality Worklist Information Model. The following Module descriptions are included to specify what data elements are supported and what type of matching can be applied. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard PS 3.4 (Service Class Specifications).

## 3.2.1 Supported Matching

Following are the types of matching that can be request by the implementation :

Single Value matching
Universal Matching
Wild Card Matching
Range of date, Range of Time

## 3.2.2 Scheduled Procedure Step Entity

### Introduction

This section describes the modules of Scheduled Procedure Step Entity.

### SOP Common Module Table 5-3: SOP Common Module Attributes

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|---|---|---|---|---|---|
| Specific Character Set | (0008,0005) | O | 1C | No | Matching on this tag is not supported. ISO IR_100 is always assumed. |

### Scheduled Procedure Step Module Table 5-4: Scheduled Procedure Step Module Attributes

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|---|---|---|---|---|---|
| Scheduled Procedure Step Sequence | (0040,0100) | R | 1 | No | |
| >Scheduled Station AE Title | (0040,0001) | R | 1 | No | Matching is supported. The matching value is the AE– Title of the Innova system. |
| >Scheduled Procedure Step Start Date | (0040,0002) | R | 1 | No | Matching value can be configured for date or date range. |
| >Scheduled Procedure Step Start Time | (0040,0003) | R | 1 | No | Requested, zero length. |
| >Modality | (0008,0060) | R | 1 | No | This is requested either as zero length or as XA, user configurable. |
| >Scheduled Performing Physician's Name | (0040,0006) | R | 2 | Yes | Requested, zero length. After user confirmation, the first value can be mapped into Performing Physician (0008, 1050) |

| | | | | | |
|---|---|---|---|---|---|
| >Scheduled Procedure Step Description | (0040,0005) | O | 1C | No | After user confirmation, can be mapped into Study description (0008, 1030) |
| >Scheduled Action Item Code Sequence | (0040,0008) | O | 1C | No | |
| >>Code Value | (0008,0100) | O | 1C | No | |
| >>Coding Scheme Designator | (0008,0102) | O | 1C | No | |

**Table 5-4: Scheduled Procedure Step Module Attributes (cont'd)**

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|---|---|---|---|---|---|
| >>Code Meaning | (0008,0104) | O | 3 | No | |
| >Scheduled Procedure Step ID | (0040,0009) | O | 1 | No | |

### 3.2.3 Requested Procedure Entity

### Introduction

This section describes the modules of Requested Procedure Entity.

Requested Procedure Module Table 5-5: Requested Procedure Module Attributes

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|---|---|---|---|---|---|
| Requested Procedure ID | (0040,1001) | O | 1 | Yes | This information can be mapped into Study ID (0020,0010) after user confirmation. |
| Requested Procedure Description | (0032,1060) | O | 1C | No | |
| Requested Procedure Code Sequence | (0032,1064) | O | 1C | No | |
| >Code Value | (0008,0100) | O | 1C | No | |
| >Coding Scheme Designator | (0008,0102) | O | 1C | No | |
| >Code Meaning | (0008,0104) | O | 3 | No | |
| Study Instance UID | (0020,000D) | O | 1 | Yes | If one SPS is selected, or if multiple SPSs with the same Study Instance UID are selected, the value is mapped in the images. Else, a Study Instance UID is generated by the implementatoin. |
| Referenced Study Sequence | (0008,1110) | O | 2 | No | |
| >Referenced SOP Class UID | (0008,1150) | O | 1C | No | |

| >Referenced SOP Instance UID | (0008,1155) | O | 1C | No | |
|---|---|---|---|---|---|

## 3.2.4 Imaging Service Request Entity

### Introduction

This section describes the modules of Imaging Service Request Entity.

Imaging Service Request Module Table 5-6: Imaging Service Request Module Attributes

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|---|---|---|---|---|---|
| Accession Number | (0008,0050) | O | 2 | Yes | Matching is supported, user entered value is sent. |
| Referring Physician's Name | (0008,0090) | O | 2 | Yes | Requested, zero length. The first person name component group is mapped in the image. No truncation is performed. Values may be trucnated for display only. |

## 3.2.5 Visit Entity

### Introduction

This section describes the modules of Visit Entity.

**Visit Identification Module**

No attribute from this module is requested in the modality worklist query.

**Visit Status Module**

No attribute from this module is requested in the modality worklist query.

**Visit Relationship Module**

No attribute from this module is requested in the modality worklist query.

**Visit Admission Module**

No attribute from this module is requested in the modality worklist query.

## 3.2.6 Patient Entity

### Introduction

This section describes the modules of Patient Entity.

### Patient Relationship Module

No attribute from this module is requested in the modality worklist query.

### Patient Identification Module Table 5-7: Patient Identification Module Attributes

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|---|---|---|---|---|---|
| Patient's Name | (0010,0010) | R | 1 | Yes | Matching is supported, user entered value is sent. Wildcards are appened in the query at the end of the components (first name and last name). The first person name component group returned is mapped in the image. No truncation is performed. Values may be trucnated for display only |
| Patient ID | (0010,0020) | R | 1 | Yes | Matching is supported, user entered value is sent. |

### Patient Demographic Module Table 5-8: PPatient Demographic Module Attributes

| Attribute Name | Tag | Expected Matching Key Type | Expected Returned Key Type | Mapped into the Image | Note |
|---|---|---|---|---|---|
| Patients Birth Date | (0010,0030) | O | 2 | Yes | |
| Patient's Sex | (0010,0040) | O | 2 | Yes | |
| Patient's Weight | (0010,1030) | O | 2 | Yes | |
| Patient's Size | (0010,1020) | O | 3 | Yes | |

### Patient Medical Module

No attribute from this module is requested in the modality worklist query.

# 4  Private Data Dictionary

No private data dictionary is used by the worklist implementation.

# Chapter 6 - Storage Commitment Push Model Implementation

## 1  Storage commitment push model information object definition

## 2  Introduction

The Storage Commitment Information Object is used both for N–ACTION Storage Commitment Requests by the SCU and N–EVENT–REPORT Storage Commitment Notifications by the SCP

### 2.1  Storage Commitment Module for N-Action

The INNOVA uses the DIMSE service element N–ACTION to send the Storage Commitment request.

The INNOVA supports the following data elements in the part of data set of the N–ACTION request:

**Table 6-1: Storage Commitment Module for N-Action-RQ**

| Attribute Name | Tag | AE Use |
|---|---|---|
| Transaction UID | (0008,1195) | Restricted to 64 characters, internally generated as follows:"registered prefix for GEMS" + ".2" Registered prefix of Innova System within GEMS + ".a.b.c" encoded mac address of the DL host +".x.y.z" unique id protected against reinstallation and re–entrance |
| Storage Media File–Set ID | (0088,0130) | Not used |
| Storage Media File–Set UID | (0088,0140) | Not used |
| Referenced SOP Sequence | (0008,1199) | |
| >Referenced SOP Class UID | (0008,1150) | |
| >Referenced SOP Instance UID | (0008,1155) | |
| >Storage Media File–Set ID | (0088,0130) | Not used |
| >Storage Media File–Set UID | (0088,0140) | Not used |

## 2.2  Storage Commitment Module for N-Event-Report

The INNOVA uses the DIMSE service element N–EVENT–REPORT to receive a Storage Commitment response.

The INNOVA supports the following data elements in the part of data set in a received N–EVENT–REPORT request:

### Table 6-2: Storage Commitment Module for N-Event-Report-RQ

| Attribute Name | Tag | AE Use |
|---|---|---|
| Transaction UID | (0008,1195) | Not used |
| Retrieve AE Title | (0008,0054) | Not used |
| Storage Media File–Set ID | (0088,0130) | Not used |
| Storage Media File–Set UID | (0088,0140) | Not used |
| Referenced SOP Sequence | (0008,1199) | The AE considers the SOP Instances referenced by this sequence as successfully archived. |
| >Referenced SOP Class UID | (0008,1150) | |
| >Referenced SOP Instance UID | (0008,1155) | |
| >Retrieve AE Title | (0008,0054) | Not used |
| >Storage Media File–Set ID | (0088,0130) | Not used |
| >Storage Media File–Set UID | (0088,0140) | Not used |
| Failed SOP Sequence | (0008,1198) | The AE considers the SOP Instances referenced by this sequence as not archived; the application will display an error status in the network queue. |
| >Referenced SOP Class UID | (0008,1150) | |
| >Referenced SOP Instance UID | (0008,1155) | |
| >Failure Reason | (0008,1197) | The failure reason is logged in the application error log. |

# Chapter 7    Modality Performed Procedure Step Implementation

## 1 Introduction

This Section of the DICOM Conformance Statement specifies the supported Modality Performed Procedure Step SOP classes, the optional attributes, and service elements supported, the valid range of values for mandatory and optional attributes, and the status code behavior.

## 2 Modality Performed Procedure Step information object definition

Modality Performed Procedure Step IOD Modules:

| Module Name | Module Description | Reference |
|---|---|---|
| SOP Common | Contains SOP common information | Section 7.2.1 |
| Performed Procedure Step Relationship | References the related SOPs and IEs. | Section 7.2.2 |
| Performed Procedure Step Information | Includes identifying and status information as well as place and time | Section 7.2.3 |
| Image Acquisition Result | Identifies Series and Images related to this PPS and specific image acquisition conditions | Section 7.2.4 |
| Radiation DOSE Module | Contains radiation dose information related to this PPS | Section 7.2.5 |

*All other optional modules are ignored.

DIMSE Service Group :

| DIMSE Service Element | Usage |
|---|---|
| N-CREATE | M |
| N-SET | M |

**SOP Common**

| Attribute Name | Tag | N-CREATE | N-SET |
|---|---|---|---|
| Specific Character Set | (0008,0005) | X | - |

## Performed Procedure Step Relationship

| Attribute Name | Tag | N-CREATE | N-SET |
|---|---|---|---|
| Scheduled Step Attributes Seq | (0040,0270) | X | - |
| >Study Instance UID | (0020,000D) | X | - |
| >Referenced Study Seq | (0008,1110) | X | - |
| >>Referenced SOP Class UID | (0008,1150) | X | - |
| >>Referenced SOP Instance UID | (0008,1155) | X | - |
| >Accession Number | (0008,0050) | X | - |
| >RP ID | (0040,1001) | X | - |
| >RP Desc | (0032,1060) | X | - |
| >SPS ID | (0040,0009) | X | - |
| >SPS Desc | (0040,0007) | X | - |
| >Scheduled Action Item Code Seq | (0040,0008) | X | - |
| >>Code Value | (0008,0100) | X | - |
| >>Coding Scheme Designator | (0008,0102) | X | - |
| >>Coding Scheme Version | (0008,0103) | X | - |
| >>Code Meaning | (0008,0104) | X | - |
| Pat's name | (0010,0010) | X | - |
| Pat's ID | (0010,0020) | X | - |
| Pat's birth date | (0010,0032) | X | - |
| Pat's sex | (0010,0040) | X | - |
| Referenced Pat's seq | (0008,1120) | X | - |
| >Referenced SOP Class UID | (0008,1150) | X | - |
| >Referenced Instance UID | (0008,1155) | X | - |

**Performed Procedure Step Information**

| Attribute Name | Tag | N-CREATE | N-SET |
|---|---|---|---|
| PPS Id | (0040,0253) | X | - |
| Performed Station AE Title | (0040,0241) | X | - |
| Performed Station Name | (0040,0242) | X | - |
| Performed Location | (0040,0243) | X | - |
| PPS Start Date | (0040,0244) | X | - |
| PPS Start Time | (0040,0245) | X | - |
| PPS Status | (0040,0252) | X | X |
| PPS Desc | (0040,0254) | X | X |
| PP type Desc | (0040,0255) | X | X |
| Proc Code Sequence | (0008,1032) | X | X |
| >>Code Value | (0008,0100) | X | X |
| >>Coding Scheme Designator | (0008,0102) | X | X |
| >>Coding Scheme Version | (0008,0103) | X | X |
| >>Code Meaning | (0008,0104) | X | X |
| PPS End Date | (0040,0250) | X | X |
| PPS End Time | (0040,0251) | X | X |
| PPS Discontinuation Reason Code Seq | (0040,0281) | - | X |
| >>Code Value | (0008,0100) | - | X |
| >>Coding Scheme Designator | (0008,0102) | - | X |
| >>Coding Scheme Version | (0008,0103) | - | - |
| >>Code Meaning | (0008,0104) | - | X |

## Image Acquisition Result

| Attribute Name | Tag | N-CREATE | N-SET |
|---|---|---|---|
| Modality | (0008,0060) | X | - |
| Study Id | (0020,0010) | X | - |
| Performed Action Item Code Seq | (0040,0260) | X | X |
| >>Code Value | (0008,0100) | X | X |
| >>Coding Scheme Designator | (0008,0102) | X | X |
| >>Code Meaning | (0008,0104) | X | X |
| Performed Series Seq | (0040,0340) | X | X |
| >Performing Physc name | (0008,1050) | X | X |
| >Protocol Name | (0018,1030) | X | X |
| >Operator's name | (0008,1070) | X | X |
| >Series's instance UID | (0020,000E) | X | X |
| >series desc | (0008,103E) | X | X |
| >retrieve AE title | (0008,0054) | X | X |
| >referenced image seq | (0008,1140) | X | X |
| >>Referenced SOP Class UID | (0008,1150) | X | X |
| >>Referenced SOP Instance UID | (0008,1155) | X | X |
| >referenced standalone sop instance seq | (0040,0220) | X | X |
| >>Referenced SOP Class UID | (0008,1150) | X | X |
| >>Referenced SOP Instance UID | (0008,1155) | X | X |

**Radiation DOSE Module**

| Attribute Name | Tag | N-CREATE | N-SET |
|---|---|---|---|
| Total Time of Fluoroscopy | (0040,0300) | X | X |
| Total Number of Exposures | (0040,0301) | X | X |
| Distance Source to Detector | (0018,1110) | X | X |
| Distance Source to Distance | (0040,0306) | X | X |
| Entrance Dose | (0040,0302) | X | X |
| Entrance Dose in mGy | (0040,8302) | X | X |
| Exposed Area | (0040,0303) | X | X |
| Image Area Dose Product | (0018,115E) | X | X |
| Comments on Radiation Dose | (0040,0310) | X | X |

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