GE Medical Systems

Technical Publications

DIRECTION 2358506–100

Revision 1

Innova 4100 Angiographic Imaging System
Conformance Statement for DICOM V3.0 sm

do not duplicate

ATTENTION

LES APPAREILS À RAYONS X SONT DANGEREUX À LA FOIS POUR LE PATIENT ET POUR LE MANIPULATEUR SI LES MESURES DE PROTECTION NE SONT PAS STRICTEMENT APPLIQUEES

Bien que cet appareil soit construit selon les normes de sécurité les plus sévères, la source de rayonnement X représente un danger lorsque le manipulateur est non qualifié ou non averti. Une exposition excessive au rayonnement X entraîne des dommages à l'organisme.

Par conséquent, toutes les précautions doivent être prises pour éviter que les personnes non autorisées ou non qualifiées utilisent cet appareil créant ainsi un danger pour les autres et pour elles–mêmes.

Avant chaque manipulation, les personnes qualifiées et autorisées à se servir de cet appareil doivent se renseigner sur les mesures de protection établies par la Commission Internationale de la Protection Radiologique, Annales 26 : Recommandations de la Commission Internationale sur la Protection Radiologique et les normes nationales en vigueur.

WARNING

X–RAY EQUIPMENT IS DANGEROUS TO BOTH PATIENT AND OPERATOR UNLESS MEASURES OF PROTECTION ARE STRICTLY OBSERVED

Though this equipment is built to the highest standards of electrical and mechanical safety, the useful x–ray beam becomes a source of danger in the hands of the unauthorized or unqualified operator. Excessive exposure to x–radiation causes damage to human tissue.

Therefore, adequate precautions must be taken to prevent unauthorized or unqualified persons from operating this equipment or exposing themselves or others to its radiation.

Before operation, persons qualified and authorized to operate this equipment should be familiar with the Recommendations of the International Commission on Radiological Protection, contained in Annals Number 26 of the ICRP, and with applicable national standards.

ATENCION

LOS APARATOS DE RAYOS X SON PELIGROSOS PARA EL PACIENTE Y EL MANIPULADOR CUANDO LAS NORMAS DE PROTECCION NO ESTAN OBSERVADAS

Aunque este aparato está construido según las normas de seguridad más estrictas, la radiación X constituye un peligro al ser manipulado por personas no autorizadas o incompetentes. Una exposición excesiva a la radiación X puede causar daños al organismo.

Por consiguiente, se deberán tomar todas las precauciones necesarias para evitar que las personas incompetentes o no autorizadas utilicen este aparato, lo que sería un peligro para los demás y para sí mismas.

Antes de efectuar las manipulaciones, las personas habilitadas y competentes en el uso de este aparato, deberán informarse sobre las normas de protección fijadas por la Comisión Internacional de la Protección Radiológica, Anales No 26: Recomendaciónes de la Comisión Internacional sobre la Protección Radiológica y normas nacionales.

ACHTUNG

RÖNTGENAPPARATE SIND EINE GEFAHR FÜR PATIENTEN SOWIE BEDIENUNGSPERSONAL, WENN DIE GELTENDEN SICHERHEITSVORKEHRUNGEN NICHT GENAU BEACHTET WERDEN

Dieser Apparat entspricht in seiner Bauweise strengsten elektrischen und mechanischen Sichereitsnormen, doch in den Händen unbefugter oder unqualifizierter Personen wird er zu einer Gefahrenquelle. Übermäßige Röntgenbestrahlung ist für den menschlichen Organismus schädlich.

Deswegen sind hinreichende Vorsichtsmaßnahmen erforderlich, um zu verhindern, daßunbefugte oder unqualifizierte Personen solche Geräte bedienen oder sich selbst und andere Personen deren Bestrahlung aussetzen können.

Vor Inbetriebnahme dieses Apparats sollte sich das qualifizierte und befugte Bedienungspersonal mit den geltenden Kriterien für den gefahrlosen Strahleneinsatz durch sorgfältiges Studium des Hefts Nr. 26 der Internationalen Kommission für Strahlenschutz (ICRP) vertraut machen: Empfehlungen der Internationalen Kommission für Strahlenschutz und anderer nationaler Normenbehörden.

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WARNING

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

If a customer's service provider requires a language other than English, it is the customer's responsibility to provide translation services.

This Service Manual is available in English only.

Failure to heed this warning may result in injury to the service provider, operator or patient from electric shock, mechanical or other hazards.

ATTENTION

NE PAS TENTER D'INTERVENIR SUR LES ÉQUIPEMENTS
TANT QUE LE MANUEL SERVICE N'A PAS ÉTÉ CONSULTÉ ET COMPRIS

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.

Le non-respect de cet avertissement peut entraîner chez le technicien, l'opérateur ou le patient des blessures dues à des dangers électriques, mécaniques ou autres.

ATENCION

NO SE DEBERÁ DAR SERVICIO TÉCNICO AL EQUIPO,
SIN HABER CONSULTADO Y COMPRENDIDO ESTE MANUAL DE SERVICIO.

Este Manual de Servicio sólo existe en inglés.

Si algún proveedor de servicios ajeno a GEMS solicita un idioma que no sea el inglés, es responsabilidad del cliente ofrecer un servicio de traducción.

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 eléctricas, mecánicas o de otra naturaleza.

WARNUNG

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

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.

Wird diese Warnung nicht beachtet, so kann es zu Verletzungen des Kundendiensttechnikers, des Bedieners oder des Patienten durch Stromschläge, mechanische oder sonstige Gefahren kommen.

ATENÇAO

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

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.

O não cumprimento deste aviso pode por em perigo a segurança do técnico, operador ou paciente devido a‘ choques elétricos, mecânicos ou outros.

AVVERTENZA

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

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.

Non tenere conto 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、翻訳作業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下さい。
・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が、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 GEMS 公司的维修员要求非英文本的维修手册时，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。

CHAPTER 1 – INTRODUCTION

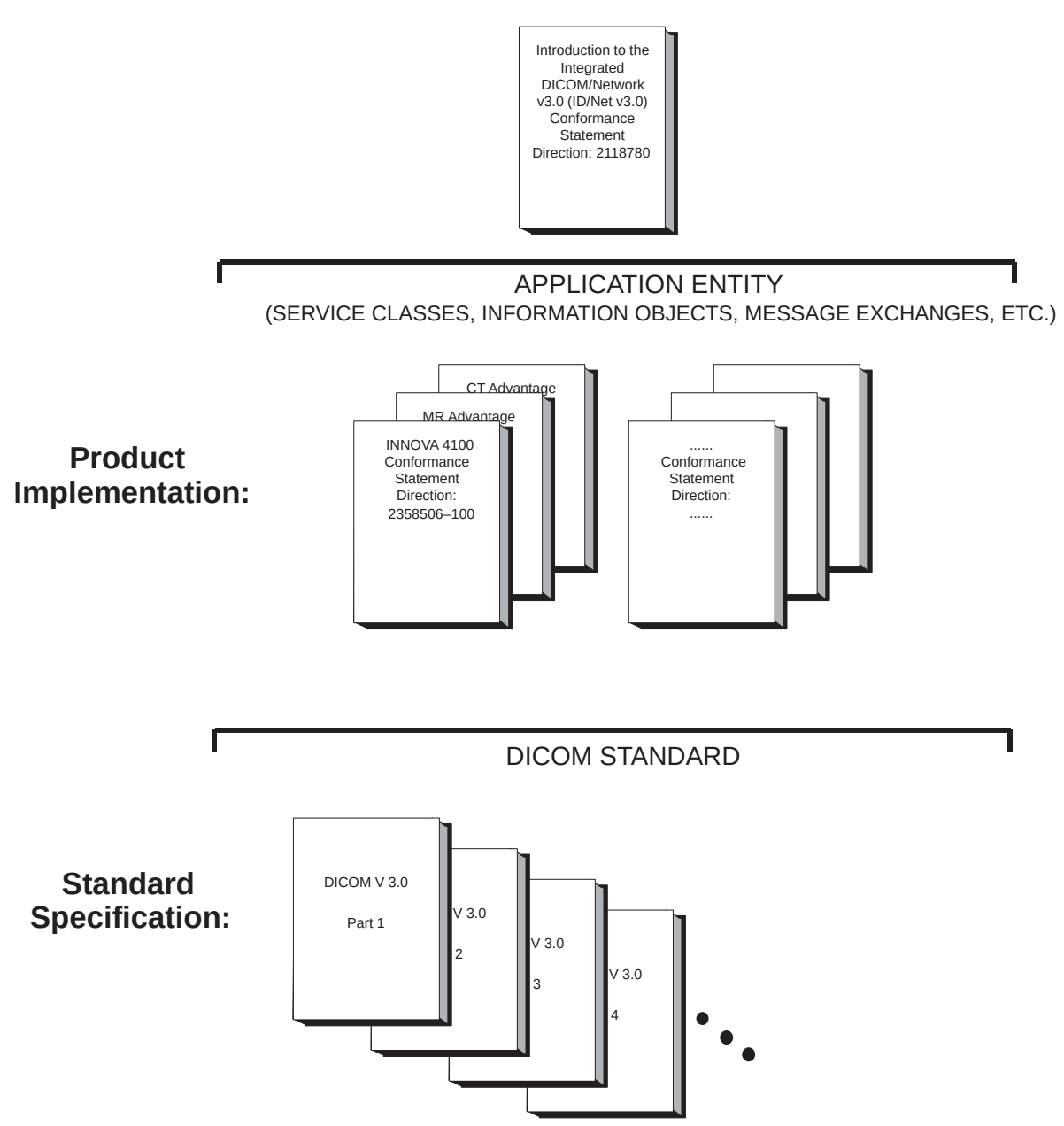
1 OVERVIEW

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.

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.



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

INNOVA 4100

Conformance Statement for DICOM v3.0

Direction **2358506–100**

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

Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0)

Conformance Statement

Direction: 2118780.

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

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

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

For 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 22209

USA

Phone: +1.703.841.3200

3 INTENDED AUDIENCE

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

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

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

4 SCOPE AND FIELD OF APPLICATION

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

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

Included in this DICOM Conformance Statement are the Module Definitions which define all data elements used by this GEMS implementation. If the user encounters unspecified private data elements while parsing a GEMS Data Set, the user is well advised to ignore those data elements (per the DICOM v3.0 standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a ”full fidelity storage device”, it should retain and re–transmit all of the private data elements which are sent by GEMS devices.

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.

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).

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*.

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 4100 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 4100 provides sophisticated image processing and storage functions. INNOVA 4100 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 4100 supports.

The INNOVA 4100 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 check the application level communication from the INNOVA DICOM Server to a remote DICOM Application Entity. To this aim the INNOVA 4100 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 4100. This is done by providing the Verification DICOM Service Class as a Service Class Provider.

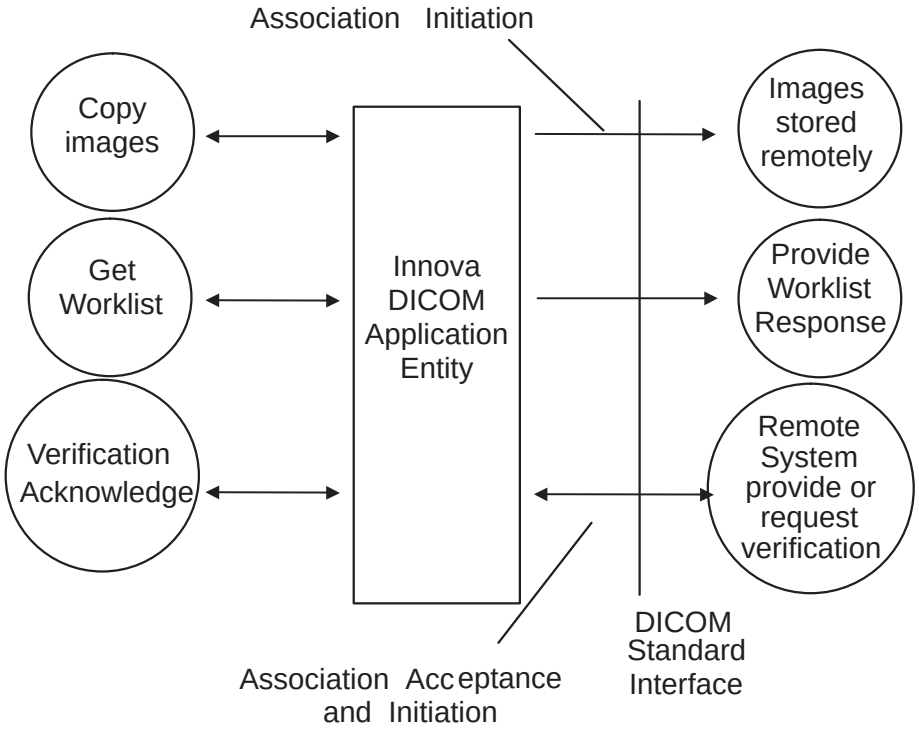
The details of the DICOM conformance related to other Information Objects and Information Models supported by this product are included in subsequent sections of this DICOM Conformance Statement.

2 IMPLEMENTATION MODEL

2-1 Application Data Flow Diagram

All DICOM functionality on the INNOVA 4100 product is provided by the DL DICOM Server AE.

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



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 three local Real World activities: Copy Images, Get Worklist 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.

Get Worklist activity consists of an operator request for the transfer of a list of procedure to be performed on the INNOVA 4100 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.

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. 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
3. Verification:
   - Initiate a DICOM Association
   - Send the C–ECHO request
   - Wait for the C–ECHO 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

3-1 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

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

3-1-1 Association Establishment Policies

3-1-1-1 General

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

Application Context Name	1.2.840.10008.3.1.1.1

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

The maximum length PDU for an association initiated by the 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

3-1-1-2 Asynchronous Nature

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

3-1-1-3 Implementation Identifying Information

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

INNOVA DL Implementation UID	1.2.840.113619.6.149

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

INNOVA DL Implementation Version Name	INNOVA 4100

3-1-2 Association Initiation Policy

3-1-2-1 Real–World Activity Copy Images

3-1-2-1-1 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.

3-1-2-1-2 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

3-1-2-1-2-1 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)
Warning	B000	Coercion of Data Elements	“Send” operation failed	None
	B007	Data Set does not match SOP Class	“Send” operation failed	None
	B006	Elements Discarded	“Send” operation failed	None
Success	0000		“Send” operation successful	None

3-1-2-2 Real–World Activity Verification Acknowledge

3-1-2-2-1 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

3-1-2-2-2 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

3-1-2-2-2-1 SOP Specific DICOM Conformance Statement for Verification SOP Class

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

3-1-2-3 Real–World Activity Get Worklist

3-1-2-3-1 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.

3-1-2-3-2 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

3-1-2-3-2-1 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	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

3-1-3 Association Acceptance Policy

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.

3-1-3-1 Real–World Activity Verification Acknowledge

3-1-3-1-1 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.

3-1-3-1-2 Accepted Presentation Context Table

Presentation Context Table – Accepted					
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		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

3-1-3-1-2-1 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.

4-3-1 API

Not applicable to this product.

4-3-2 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 4100, 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

5-1 Standard Extended /Specialized/Private SOPs

6 CONFIGURATION

GEMS Field Service Engineers configure the INNOVA 4100 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 4100 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
- Array size of the pixel data to be transferred (512x512, or any size up to 1024).

7 SUPPORT OF EXTENDED CHARACTER SETS

The INNOVA 4100 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.

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CHAPTER 3 – X–RAY ANGIOGRAPHY (XA) INFORMATION OBJECT IMPLEMENTATION

1 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. The contents of this section are:

2 IOD Description

3 IOD Entity–Relationship Model

4 IOD Module Table

5 IOD Module Definition

2 XA IOD IMPLEMENTATION

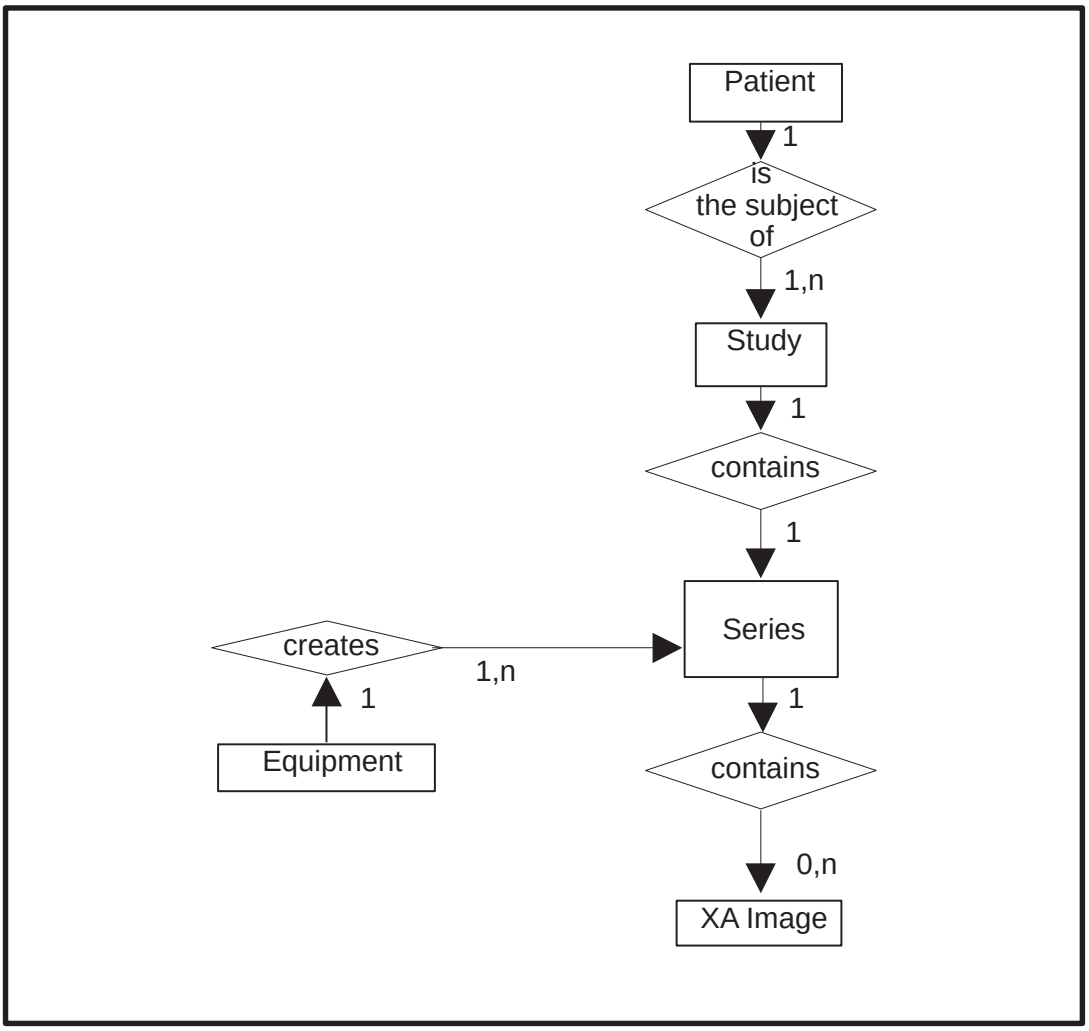
3 XA ENTITY–RELATIONSHIP MODEL

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 1 – XA IMAGE ENTITY RELATIONSHIP DIAGRAM



3-1 ENTITY DESCRIPTIONS

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

3-2 INNOVA 4100 Mapping of DICOM entities

Table 1 – Mapping of DICOM Entities to INNOVA 4100 Entities

DICOM	INNOVA 4100 Entity
Patient	Patient
Study	Exam
Series	Exam
Image	Sequence
Frame	Not Applicable

4 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 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 2 – XA IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	5–1–1
Study	General Study	5–2–1
	Patient Study	5–2–2
Series	General Series	5–3–1
Equipment	General Equipment	5–4–1
Image	General Image	5–5–1
	Image Pixel	5–5–2
	Contrast/Bolus	5–5–3
	Cine	5–5–4
	Multi–frame	5–5–5
	Frame Pointers	5–5–6
	Mask	5–5–7
	Display Shutter	5–5–8
	Device	5–5–9
	Therapy	5–5–10
	X–Ray Image	5–10–1

Entity Name	Module Name	Reference
	X–Ray Acquisition	5–10–2
	X–Ray Collimator	5–10–3
	X–Ray Table	5–10–4
	XA Positioner	5–10–5
	Overlay Plane	5–6–1
	Multi–frame Overlay	5–6–2
	Curve	5–7–1
	Modality LUT	5–8–2
	VOI LUT	5–8–1
	SOP Common	5–9–1
	SUB Lut module	5–10–6
	Gereral Frame	6

5 INFORMATION MODULE DEFINITIONS

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

5-1 Common Patient Entity Modules

5-1-1 Patient Module

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

Table 3 – 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".

5-2 Common Study Entity Modules

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

5-2-1 General Study Module

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

Table 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 re–entrance.
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).

Attribute Name	Tag	Type	Attribute Description
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).

5-2-2 Patient Study Module

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

Table 5 – 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).

5-3 Common Series Entity Modules

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

5-3-1 General Series Module

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

Table 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 re–entrance.
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).

5-4 Common Equipment Entity Modules

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

5-4-1 General Equipment Module

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

Table 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.

5-5 Common Image Entity Modules

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

5-5-1 General Image Module

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

Table 8 – GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	3	See 5–5–1–1–2.
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	Patient direction of the rows and columns of the image. Required if image does not require Image Orientation (0020,0037) and Image Position (0020,0032).
Instance Comments	(0020,4000)	3	From User Interface, restricted to 64 characters. (May not be sent).

5-5-1-1 General Image Attribute Descriptions

5-5-1-1-1 Patient Orientation

Always zero length.

5-5-1-1-2 Image Type

Always ORIGINAL/PRIMARY/SINGLE PLANE.

5-5-2 Image Pixel Module

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

Table 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 800, 1000 and 512.

Attribute Name	Tag	Type	Attribute Description
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 800, 1000 and 512.
Bits Allocated	(0028,0100)	1	8 or 16
Bits Stored	(0028,0101)	1	8 or 12
High Bit	(0028,0102)	1	7 or 11
Pixel Representation	(0028,0103)	1	0x0000
Pixel Data	(7FE0,0010)	1	Data stream of the pixel samples.

5-5-3 Contrast/Bolus Module

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

Table 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 miliseconds 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.

5-5-4 Cine Module

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

Table 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

5-5-5 Multi–Frame Module

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

Table 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	See 5–5–5–1 for further explanation.

5-5-5-1 Multi–Frame Attribute Descriptions

5-5-5-1-1 Number Of Frames And Frame Increment Pointer

Frame Increment Pointer (0028,0009) points to Frame Time (0018, 1063)

5-5-6 Frame Pointers Module

This section specifies the attributes of a Frame Pointer Module.

Table 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.

5-5-7 Mask Module

Table 14 – MASK MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Percent landscape	(0019,XX1E)	3	Percentage of mask applied during the last review.
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.

5-5-8 Display Shutter Module

Table 15 – DISPLAY SHUTTER MODULE

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.

5-5-9 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 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).
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).

Attribute Name	Tag	Type	Attribute Description
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 contaning 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).

5-5-10 Therapy Module

This module is not sent.

5-6 Common Overlay Modules

5-6-1 Overlay plane module

This module is not sent.

5-6-2 Multi–frame Overlay Module

This module is not sent.

5-7 Common Curve Modules

5-7-1 Curve module

This module is not sent.

5-8 Common Lookup Table Modules

5-8-1 VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

Table 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.

5-8-2 Modality LUT module

This module is not sent.

5-9 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

5-9-1 SOP Common Module

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

Table 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 re–entrance.
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

5-10 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.

5-10-1 X–Ray Image Module

Table 19 – X–Ray Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1	See5–5–5–1–1 for further explanation.
Image Type	(0008,0008)	3	See 5–5–1–1–2.
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	8 or 16
Bits Stored	(0028,0101)	1	8 or 12
High Bit	(0028,0102)	1	7 or 11
Pixel Representation	(0028,0103)	1	0x0000

5-10-2 X–Ray Acquisition Module

Table 20 – X–Ray Acquisition Module

Attribute Name	Tag	Type	Attribute Description
KVP	(0018,0060)	2	No value, Zero length.
Radiation Setting	(0018,1155)	1	GR

Attribute Name	Tag	Type	Attribute Description
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 Xray tube current expressed in mAs. Required if either Exposure Time (0018,1150) or Xray 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 160, 200, 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 truncature is (0018,1149). Possible values are 160.0, 200.0, 320.0, and 400.0 mm.
Detctor 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.

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 Xray 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. Defineed terms are YES and NO.

5-10-3 X–Ray Collimator

Table 21 – X–Ray Collimator Module

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.

Attribute Name	Tag	Type	Attribute Description
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.

5-10-4 X–Ray Table Module

Table 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

5-10-5 XA Positioner Module

Table 23 – 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 imulti–frame images, value of the first frame.

Attribute Name	Tag	Type	Attribute Description
Positioner Secondary Angle	(0018,1511)	2	For imulti–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.

5-10-6 SUB Lut module

Table 24 – 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.
Sub window width	(0019,XXA2)	3	window width applicable when the SUB lut module is applied

6 PRIVATE GENERAL FRAME MODULE

Table 25 – 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.
>dist_src_to_det	(0025,XX03)	3	Equivalent to (0018,1110) but for each frame of the multi–frame image.
>dist_src_to_pat	(0025,XX04)	3	Equivalent to (0018,1111) but for each frame of the multi–frame image.
>dist_src_to_skin	(0025,XX05)	3	SSD: source–to–Skin distance measured from the focal spot to the reference point where the PatientDoseLimit is defined.
>pos_pri_angle	(0025,XX06)	3	Equivalent to (0018,1510) but for each frame of the multi–frame image.
>pos_sec_angle	(0025,XX07)	3	Equivalent to (0018,1511) but for each frame of the multi–frame image.
>larm_angle	(0025,XX09)	3	Positioner angle for L arm in degrees (signed) for each frame of the multi–frame image.
>pivot_angle	(0025,XX10)	3	Positioner angle for Pivot arm in degrees (signed) for each frame of the multi–frame image.
>arc_angle	(0025,XX1A)	3	Positioner angle for C arm in degrees (signed) for each frame of the multi–frame image.
>table_vert_pos	(0025,XX1B)	3	Absolute Vertical position of the table with respect to the table referential for each frame of the multi–frame image. Down moving is positive.
>table_long_pos	(0025,XX1C)	3	Absolute longitudinal position of the table with respect to the table referential for each frame of the multi–frame image. Head moving is positive.
>table_lat_pos	(0025,XX1D)	3	Absolute lateral position of the table with respect to the table referential for each frame of the multi–frame image. Left moving is positive.
>pw_actual	(0025,XX21)	3	Equivalent to (0018,1150) but for each frame of the multi–frame image.
>tgt_entr_dose	(0025,XX27)	3	Exposure optimization conditions (nGy).
>cnr_cmd	(0025,XX28)	3	Exposure optimization conditions (%).
>contrast_cmd	(0025,XX29)	3	Exposure optimization conditions (LSB).

Attribute Name	Tag	Type	Attribute Description
>spect_flt_znb	(0025,XX2B)	3	Z number of the spectral filter.
>table rotation status	(0025,XX3B)	3	Indicates whether the table is rotated on the horizontal plane. Defined terms are YES and NO.

7 PRIVATE DATA DICTIONARY

Table 26 – Private Creator Identification (GEMS_DL_STUDY_01)

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

Table 27 – 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
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

Attribute Name	Tag	VR	VM
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

Table 28 – 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
Percent landscape	(0019,XX1E)	IS	1
adx acq mode	(0019,XX14)	IS	1
Table vertical position	(0019,XX21)	DS	1
Table 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

Table 29 – Private Creator Identification (GEMS_DL_FRAME_01)

Attribute Name	Tag	VR	VM
frame_sequence	(0025,XX0A)	SQ	1
>frame_id	(0025,XX02)	IS	1
>dist_src_to_det	(0025,XX03)	DS	1
>dist_src_to_pat	(0025,XX04)	DS	1
>dist_src_to_skin	(0025,XX05)	DS	1
>pos_pri_angle	(0025,XX06)	DS	1
>pos_sec_angle	(0025,XX07)	DS	1

Attribute Name	Tag	VR	VM
>larm_angle	(0025,XX09)	DS	1
>pivot_angle	(0025,XX10)	DS	1
>arc_angle	(0025,XX1A)	DS	1
>table_vert_pos	(0025,XX1B)	DS	1
>table_long_pos	(0025,XX1C)	DS	1
>table_lat_pos	(0025,XX1D)	DS	1
>pw_actual	(0025,XX21)	DS	1
>tgt_entr_dose	(0025,XX27)	DS	1
>cnr_cmd	(0025,XX28)	DS	1
>contrast_cmd	(0025,XX29)	DS	1
>spect_flt_znb	(0025,XX2B)	IS	1
>table rotation status	(0025,XX3B)	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. The contents of this section are:

2 IOD Description

3 IOD Entity–Relationship Model

4 IOD Module Table

5 IOD Module Definition

2 SC IOD IMPLEMENTATION

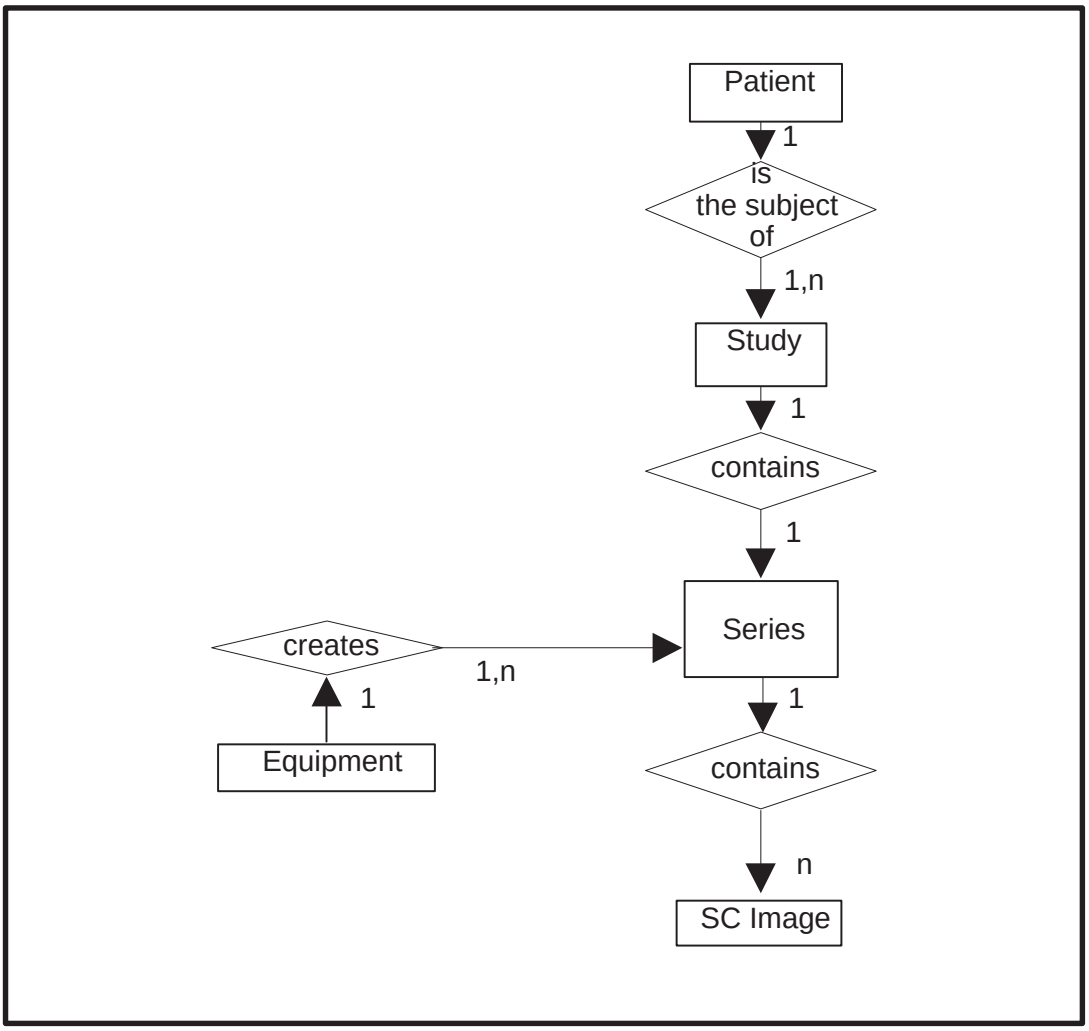
3 SC ENTITY–RELATIONSHIP MODEL

The Entity–Relationship diagram for the SC Image interoperability schema is shown in illustration 2 **.** In this figure, the following diagrammatic convention is established to represent the information organization :

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

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

Illustration 2 – SC IMAGE ENTITY RELATIONSHIP DIAGRAM



3-1 ENTITY DESCRIPTIONS

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

3-1-1 Patient Entity Description

3-1-2 Study Entity Description

3-1-3 Series Entity Description

3-1-4 Equipment Entity Description

3-1-5 SC Image Entity Description

3-1-6 Overlay Entity Description

3-1-7 VOI Lookup Table Entity Description

3-2 INNOVA 4100 Mapping of DICOM entities

Table 30 – Mapping of DICOM Entities to INNOVA 4100 Entities

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

4 IOD MODULE TABLE

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

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 31 – SC IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	5–1–1
Study	General Study	5–2–1
	Patient Study	5–2–2
Series	General Series	5–3–1
Equipment	General Equipment	5–4–1
	SC Equipment	5–9–1
Image	General Image	5–5–1
	Image Pixel	5–5–2
	SC Image	5–9–2
	Overlay Plane	5–6–1
	Modality LUT	5–7–2
	VOI LUT	5–7–1
	SOP Common	5–8–1
	XA Positioner	5–10–1

Entity Name	Module Name	Reference
	Photo QCA	5–10–2
	General Frame	6

5 INFORMATION MODULE DEFINITIONS

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

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

5-1 Common Patient Entity Modules

5-1-1 Patient Module

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

Table 32 – 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".

5-2 Common Study Entity Modules

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

5-2-1 General Study Module

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

Table 33 – 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 4100 System within GEMS” + “.a.b.c” encoded mac address of the DL host + “.x.y.z” unique id protected against reinstallation and re–entrance.
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).

5-2-2 Patient Study Module

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

Table 34 – 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).

5-3 Common Series Entity Modules

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

5-3-1 General Series Module

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

Table 35 – 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: "registred prefix for GEMS" + ".2. registred identification of Innova 4100 System within GEMS" + ".a.b.c" encoded mac address of the DL host + ".x.y.z" unique id protected against re-installation and re–entrance.
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

Attribute Name	Tag	Type	Attribute Description
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).

5-4 Common Equipment Entity Modules

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

5-4-1 General Equipment Module

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

Table 36 – 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 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.
Station name	(0018,1010)	3	AE Title of the system that generates the DICOM image

5-5 Common Image Entity Modules

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

5-5-1 General Image Module

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

Table 37 – GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	3	See 5–5–1–1–2.
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)

Attribute Name	Tag	Type	Attribute Description
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	
>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	See 5–5–1–1–1.
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

5-5-1-1 General Image Attribute Descriptions

5-5-1-1-1 Patient Orientation

Always zero length.

5-5-1-1-2 Image Type

Always DERIVED\SECONDARY

5-5-1-1-3 Derivation Description and Source Image Sequence

Derivation Description (0008,2111) not sent. Source Image Sequence is always sent.

5-5-1-1-4 Lossy Image Compression

Always 00.

5-5-2 Image Pixel Module

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

Table 38 – IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Rows	(0028,0010)	1	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 512, 608, 736, 864 and 1000.

Attribute Name	Tag	Type	Attribute Description
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 512, 608, 736, 864 and 1000.
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.

5-6 Common Overlay Modules

5-6-1 Overlay plane module

This module is not sent.

5-7 Common Lookup Table Modules

5-7-1 VOI LUT module

This section specifies the Attributes that describe the VOI LUT.

Table 39 – 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.

5-7-2 Modality LUT module

The Modality LUT module is not sent.

5-8 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

5-8-1 SOP Common Module

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

Table 40 – 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 4100 System within GEMS” + “.a.b.c” encoded mac address of the DL host + “.x.y.z” unique id protected against reinstallation and re–entrance.
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

5-9 SC Modules

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

5-9-1 SC Equipment Module

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

Table 41 – SC IMAGE EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	WSD
Secondary Capture Device Manufacturer	(0018,1016)	3	GE MEDICAL SYSTEMS (May not be sent).
Secondary Capture Device Manufacturer s Model Name	(0018,1018)	3	DL (May not be sent).

5-9-2 SC Image Module

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

Table 42 – 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

5-10 Other Modules

5-10-1 XA Positioner Module

Table 43 – XA Positioner 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.

5-10-2 Photo QCA Module

Table 44 – 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).

Attribute Name	Tag	Type	Attribute Description
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).
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).

6 PRIVATE GENERAL FRAME MODULE

Table 45 – Private General Frame Module Attributes

Attribute Name	Tag	Type	Attribute Description
>pos_pri_angle	(0025,XX06)	3	Equivalent to (0018,1510) but for each frame of the multi–frame image.
>pos_sec_angle	(0025,XX07)	3	Equivalent to (0018,1511) but for each frame of the multi–frame image.
>larm_angle	(0025,XX09)	3	Positioner angle for L arm in degrees (signed) for each frame of the multi–frame image.
>pivot_angle	(0025,XX10)	3	Positioner angle for Pivot arm in degrees (signed) for each frame of the multi–frame image.
>arc_angle	(0025,XX1A)	3	Positioner angle for C arm in degrees (signed) for each frame of the multi–frame image.

7 PRIVATE DATA DICTIONARY

Table 46 – Private Creator Identification (GEMS_DL_STUDY_01)

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

Table 47 – Private Creator Identification (GEMS_DL_IMG_01)

Attribute Name	Tag	VR	VM
src_frame_number	(0019,XX52)	IS	1

Table 48 – 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

Attribute Name	Tag	VR	VM
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

Table 49 – Private Creator Identification (GEMS_DL_FRAME_01)

Attribute Name	Tag	VR	VM
>pos_pri_angle	(0025,XX06)	DS	1
>pos_sec_angle	(0025,XX07)	DS	1
>larm_angle	(0025,XX09)	DS	1
>pivot_angle	(0025,XX10)	DS	1
>arc_angle	(0025,XX1A)	DS	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. The contents of this section are:

2 Information Model Description

3 Information Model Entity–Relationship Model

4 Information Model Module Table

5 Information Model Keys

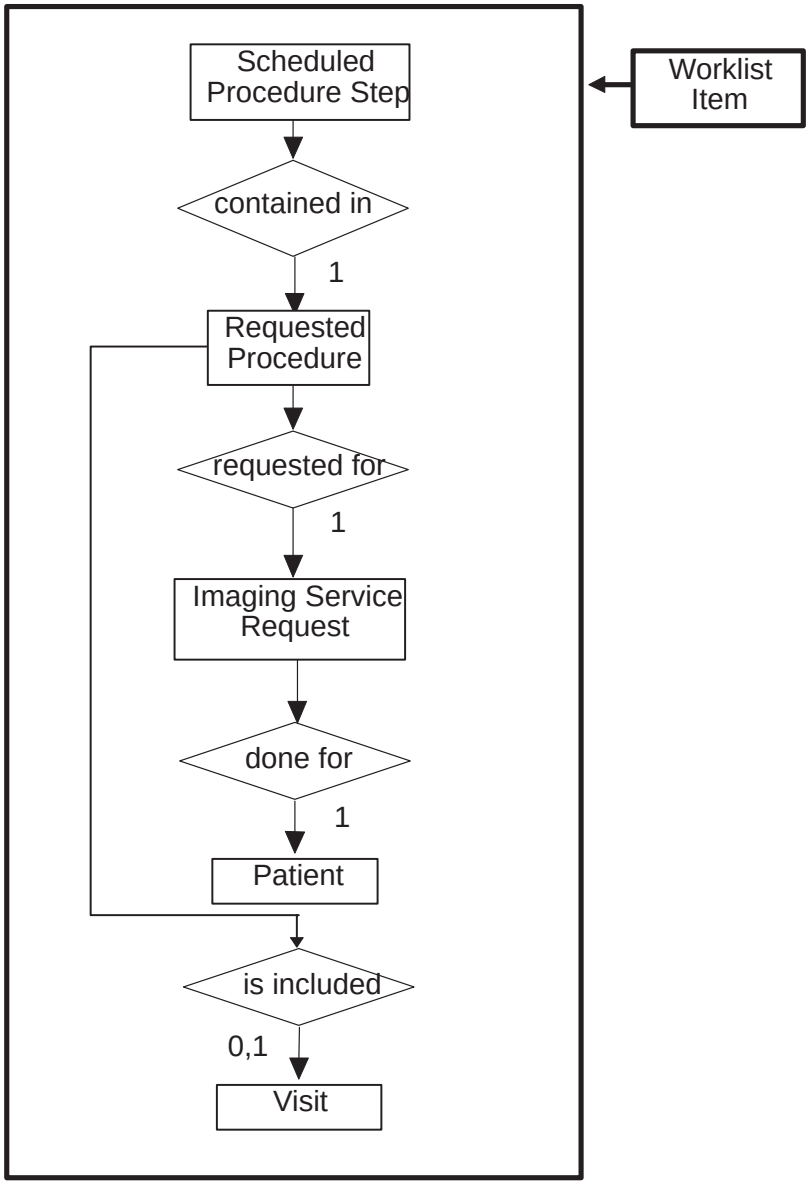
2 MODALITY WORKLIST INFORMATION MODEL DESCRIPTION

3 MODALITY WORKLIST INFORMATION MODEL ENTITY–RELATIONSHIP MODEL

The Entity–Relationship diagram for the Modality Worklist Information Model schema is shown in illustration 3. 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 3 – Modality Worklist Information Model E/R DIAGRAM



3-1 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.

3-1-1 Scheduled Procedure Step

3-1-2 Requested Procedure Entity Description

3-1-3 Imaging Service Request Entity Description

3-1-4 Visit Entity Description

3-1-5 Patient Entity Description

3-2 INNOVA 4100 Mapping of DICOM entities

Table 50 – Mapping of DICOM Entities to Innova 4100 Entities

DICOM	INNOVA 4100 Entity
Scheduled Procedure Step	
Requested Procedure	Exam
Imaging Service Request	Exam
Visit	
Patient	Patient

4 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 51 – MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Scheduled Procedure Step	SOP Common	5–2–1
	Scheduled Procedure Step	5–2–2
Requested Procedure	Requested Procedure	5–3–1
Imaging Service Request	Imaging Service Request	5–4–1
Visit	Visit Identification	5–5–1
	Visit Status	5–5–2
	Visit Relationship	5–5–3
	Visit Admission	5–5–4
Patient	Patient Relationship	5–6–1
	Patient Identification	5–6–2
	Patient Demographic	5–6–3
	Patient Medical	5–6–4

5 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).

5-1 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

5-2 Scheduled Procedure Step Entity

5-2-1 SOP Common Module

Table 52 – 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.

5-2-2 Scheduled Procedure Step Module

Table 53 – 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.

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

5-3 Requested Procedure Entity

5-3-1 Requested Procedure Module

Table 54 – 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	

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
>Referenced SOP Class UID	(0008,1150)	O	1C	No	
>Referenced SOP Instance UID	(0008,1155)	O	1C	No	

5-4 Imaging Service Request Entity

5-4-1 Imaging Service Request Module

Table 55 – 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*

5-5 Visit Entity

5-5-1 Visit Identification

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

5-5-2 Visit Status

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

5-5-3 Visit Relationship

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

5-5-4 Visit Admission

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

5-6 Patient Entity

5-6-1 Patient Relationship

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

5-6-2 Patient Identification

Table 56 – 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. Wild-cards are appened in the query at the end of the components (first name and last name). The first person name compo-nent 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.

5-6-3 Patient Demographic

Table 57 – Patient 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	

5-6-4 Patient Medical

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

6 PRIVATE DATA DICTIONARY

No private data dictionary is used by the worklist implementation

REVISION HISTORY

REV	DATE	REASON FOR CHANGE	PAGES
0	July 22, 2003	Initial release	64
1	October 23, 2003	Text and tables modified. Chapter 5 added.	74

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