GE Medical Systems

Technical Publications

Direction 5342650-100
Revision 3

Innova3DXR 1.2
DICOM CONFORMANCE STATEMENT

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GE Medical Systems

REVISION HISTORY

REV	DATE	REASON FOR CHANGE
1	June 2009	Initial release for InnovaDXR 1.1.7
2	July 2009	Updated with changes in the template
3	May 2010	Updated for Innova3DXR 1.2.8

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CONFORMANCE STATEMENT OVERVIEW

Innova3DXR 1.2 is a tool that is installed on the same hardware platform as the base application, **Advantage Workstation**. This base application is a Networked Medical Imaging Console dedicated to Examination Review and Diagnosis. The workstation uses DICOM services to import acquisition images for possible further analysis or processing, and to export images and radiotherapy data to other vendors.

Innova3DXR 1.2 does not have an intrinsic DICOM Network feature. It does not directly invoke the DICOM Server AE.

Table 0.1 provides an overview of the SOP Classes supported by Innova3DXR 1.2.

Table 0.1 – SUPPORTED SOP CLASSES

SOP Classes	Parsed Input	Generated Output
Transfer		
X-Ray Image Storage	Yes	No
CT Image Storage	No	Yes
GE Private 3D Model	No	Yes

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1. INTRODUCTION

1.1 OVERVIEW

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

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

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

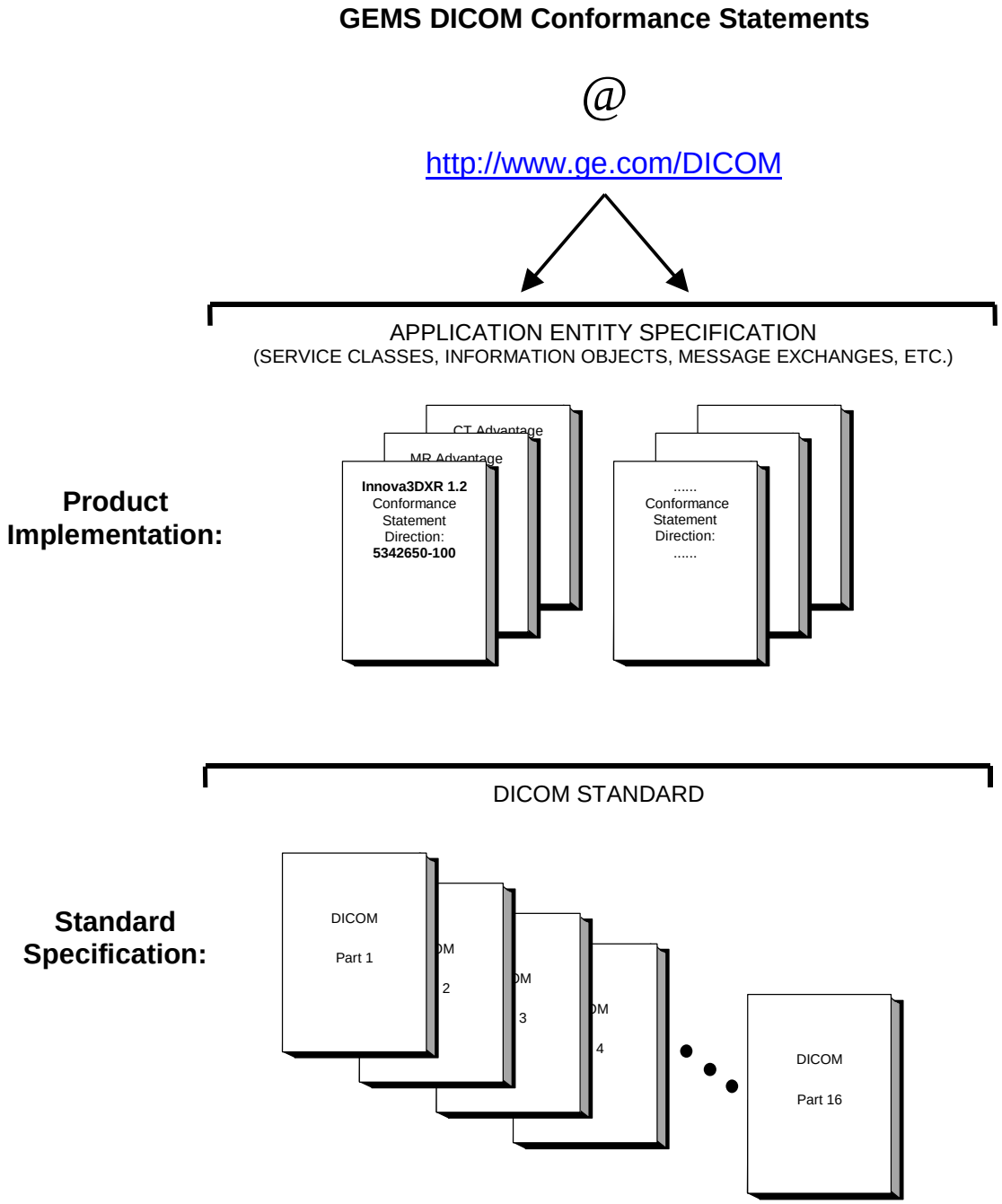
Section 3 (X-Ray Image Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a X-Ray Image Information Object.

Section 4 (3D Model GE private Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a 3D Model GE zprivate Information Object.

Section 5 (3D XACT Model Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a **3D XACT Model Object**.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEMS DICOM Conformance Statements is shown in the Illustration below.



This document specifies the DICOM implementation. It is entitled:

Innova3DXR 1.2
Conformance Statement for DICOM
Direction 5342650-100

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

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

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

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

1.3 INTENDED AUDIENCE

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

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document to provide an unambiguous specification for GEMS implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical data exchanged using DICOM. The GEMS Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEMS devices are capable of using different Information Object Definitions. For example, a GEMS CT Scanner may send images using the CT Information Object, 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 standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements, which are sent by GEMS devices.

1.5 IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM Standards, is intended to facilitate communication with GE imaging equipment. However,

by itself, it is not sufficient to ensure that inter-operation will be successful. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM 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 Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices, which have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) described 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. Failures to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

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

1.6 REFERENCES

NEMA PS3	Digital Imaging and Communications in Medicine (DICOM) Standard, available free at http://medical.nema.org/

1.7 DEFINITIONS

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class and Computed Radiography Image Storage SOP Class.

Application Entity (AE) – an end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title – the externally known name of an *Application Entity*, used to identify a DICOM application to other DICOM applications on the network.

Application Context – the specification of the type of communication used between *Application Entities*. Example: DICOM network protocol.

Association – a network communication channel set up between *Application Entities*.

Attribute – – a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD) – the specified set of *Attributes* that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The *Attributes* may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Joint Photographic Experts Group (JPEG) – a set of standardized image compression techniques, available for use by DICOM applications.

Media Application Profile – the specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

Module – a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation – first phase of *Association* establishment that allows *Application Entities* to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context – the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

Protocol Data Unit (PDU) – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Security Profile – a set of mechanisms, such as encryption, user authentication, or digital signatures, used by an *Application Entity* to ensure confidentiality, integrity, and/or availability of exchanged DICOM data

Service Class Provider (SCP) – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (Modality Worklist SCP).

Service Class User (SCU) – role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance – an information object; a specific occurrence of information exchanged in a *SOP Class*. Examples: a specific x-ray image.

Tag – a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the "group" and the "element". If the "group" number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax – the encoding used for exchange of DICOM information objects and messages. Examples: *JPEG* compressed (images), little-endian explicit value representation.

Unique Identifier (UID) – a globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR) – the format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
DICOM	Digital Imaging and Communications in Medicine
IOD	Information Object Definition
ISO	International Organization for Standards
LUT	Look-up Table
O	Optional (Key Attribute)
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
R	Required (Key Attribute)
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
VR	Value Representation
XA	X-ray Angiography

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the Innova3DXR 1.2 compliance to DICOM requirements for Networking features.

Innova3DXR 1.2 is a tool that is installed on the same hardware platform as the base application, **Advantage Workstation**. This base application is a Networked Medical Imaging Console dedicated to Examination Review and Diagnosis. The workstation uses DICOM services to import acquisition images for possible further analysis or processing, and to export images and radiotherapy data to other vendors.

Innova3DXR 1.2 does not have an intrinsic DICOM Network feature. It does not directly invoke the DICOM Server AE. For some detailed information on DICOM features of Advantage Windows, refer to the respective Conformance Statement - *Advantage Workstation where Innova3DXR 1.2 application is running*.

The application parses the following DICOM objects:

SOP Class Name	SOP Class UID
X-Ray Image Storage	1.2.840.10008.5.1.4.1.1.12.1

Innova3DXR 1.2 application parses 3D Innova sequences acquired using Innova 3D and Innova 3D CT protocols.

The application creates the following DICOM objects:

SOP Class Name	SOP Class UID
GE Private 3D Model	1.2.840.113619.4.26
CT Image Storage	1.2.840.10008.5.1.4.1.1.2

SOP Class “CT Image Storage” is used to create 3D XACT output, which is a CT Image Storage DICOM object extended with private elements as described in Section 5, 3D XACT MODEL information OBJECT IMPLEMENTATION.

2.2 IMPLEMENTATION MODEL

2.2.1 APPLICATION DATA FLOW DIAGRAM

Refer to the respective Conformance Statement - ***Advantage Workstation*** *where Innova3DXR 1.2 application is running.*

2.2.2 PRESENTATION CONTEXT TABLE

Refer to the respective Conformance Statement - ***Advantage Workstation*** *where Innova3DXR 1.2 application is running.*

2.2.3 REAL-WORLD ACTIVITIES

The user should select X-Ray image (XA) acquired with Innova 3D, 3DCT or 3D Sub protocol, then start application from AW application. Start the reconstruction algorithm by pressing 'Start'. After user request the 3D Model SOP Instance is created and saved into Advantage Windows database.

The **goal of this document** is to give a detailed description of:

- the 3D MODEL DICOM IOD

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.

2.2.4 SOP INSTANCE UID, SERIES INSTANCE UID

Implementation UID assigned to Innova3DXR 1.2 is: **1.2.840.113619.6.205**

An UID generated by a product has 2 parts : <root>.<suffix>.

For a GE product root is 1.2.840.113619 where

- 1 identifies ISO
- 2 identifies the ISO member body branch
- 840 identifies the country code
- 113619 identifies GEMS as a specific organization.

For a Series, Instances created in GE suffix is 2.Imp.id
where

- Imp identifies a specific implementation and is registered within GE
- id is an number or a substring (i.j or i.j.l...) defined by the implementation. In our implementation it means get UID from Advantage Windows (Conformance Statement - ***Advantage Workstation*** *Conformance Statement for DICOM.)*

So Innova3DXR 1.2 will generate UIDs for instances that looks like: **1.2.840.113619.2.205**

3. X-RAY ANGIOGRAPHY (XA) INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

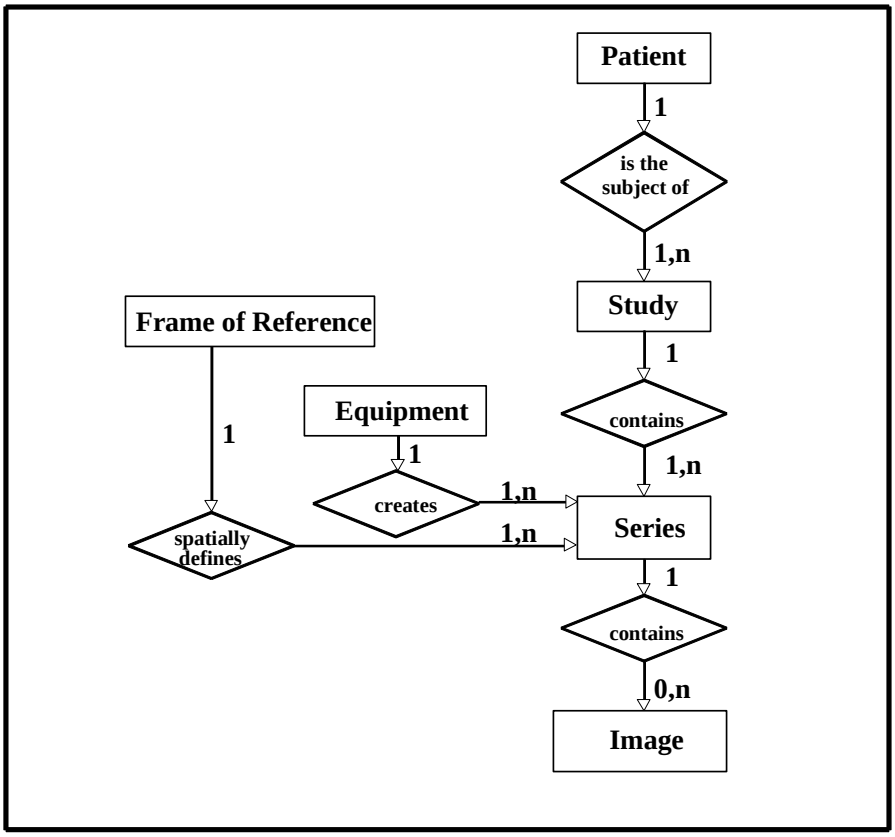
This section specifies the requirements for the DICOM X-Ray Image IOD when being used as input to Innova3DXR 1.2

3.2 X-RAY IMAGE IOD IMPLEMENTATION

This section defines how X-Ray Image attributes are used within the implementation, and whether these attributes are mandatory or optional for the correct operation of Innova3DXR 1.2

3.3 X-RAY IMAGE IOD ENTITY-RELATIONSHIP MODEL

ILLUSTRATION 3-1
X-RAY IMAGE ENTITY RELATIONSHIP DIAGRAM



The Entity-Relationship diagram for the X-Ray Image interoperability schema is shown in ILLUSTRATION 3-1. In this figure, the following diagrammatic convention is established to represent the information organization:

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

The relationships are fully defined with the maximum number of possible entities in the relationship shown. See DICOM Part 3 Section 5.1.2 for an explanation of the entity-relationship notation.

3.4 ENTITIES DESCRIPTION

Refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the X-Ray Image information object.

3.5 INNOVA3DXR 1.2 MAPPING OF DICOM ENTITIES

DICOM entities map to the Innova3DXR 1.2 entities in the following manner:

TABLE 3-1
INNOVA3DXR 1.2 MAPPING OF DICOM ENTITIES

DICOM	Innova3DXR 1.2
Patient Entity	Patient Entity (Advantage Workstation)
Study Entity	Exam Entity (Advantage Workstation)
Series Entity	Series Entity (Advantage Workstation)
Equipment Entity	Equipment Entity (Advantage Workstation)
Image Entity	Image Entity (Advantage Workstation)

3.6 IOD MODULE TABLE

The X-Ray Information Object Definitions comprise the modules of the following tables, plus Standard Extended and Private attributes. Which attributes will be described in the following section

TABLE 3-2
XA IMAGE IOD MODULES

Entity Name	Module Name	Usage	Comments	Reference
Patient	Patient	Mandatory	Required	3.7.2.1
Study	General Study	Mandatory	Required	3.7.3.1
	Patient Study	User Option	Used if present	3.7.3.2
Series	General Series	Mandatory	Required	3.7.4.1
Equipment	General Equipment	Mandatory	Required	3.7.5.1
Image	General Image	Mandatory	Required	3.7.6.1
	Image Pixel	Mandatory	Required	3.7.6.2
	Contrast/Bolus	C - Required if contrast media was used in this Image	Used if present	3.7.6.3
	Multi-frame	C - Required if pixel data is Multi-Frame Cine data	Required	3.7.6.4
	X-Ray Image	Mandatory	Required	3.7.6.5
	X-Ray Acquisition	Mandatory	Required	3.7.6.6
	X-Ray Collimator	User Option	Used if present	3.7.6.7
	X-Ray Table	C - Required if Image is created with table motion	Used if present	3.7.6.8
	XA Positioner	Mandatory	Required	3.7.6.9
	SOP Common	Mandatory	Required	3.7.6.10
	Cine	C - Required if pixel data is Multi-Frame Cine data	Used if present	3.7.6.11

3.7 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. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

3.7.1 COMMON INFORMATION MODULE DEFINITIONS

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

3.7.2 PATIENT ENTITY

3.7.2.1 PATIENT MODULE

TABLE 3-3
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Required with any value
Patient ID	(0010,0020)	2	Required with any value
Patient's Birth Date	(0010,0030)	2	Required with any value (including no value, zero length data element)
Patient's Sex	(0010,0040)	2	Required with any value (including no value, zero length data element)
Referenced Patient Sequence	(0008,1120)	3	Copied to derived instances without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied to derived instances without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied to derived instances without change

3.7.3 STUDY ENTITY

3.7.3.1 GENERAL STUDY MODULE

TABLE 3-4
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Required with any not null value
Study Date	(0008,0020)	2	Required with any value (including no value, zero length data element)
Study Time	(0008,0030)	2	Required with any value (including no value, zero length data element)
Referring Physician's Name	(0008,0090)	2	Required with any value (including no value, zero length data element)

Study ID	(0020,0010)	2	Required with any value (including no value, zero length data element)
Accession Number	(0008,0050)	2	Required with any value (including no value, zero length data element)
Study Description	(0008,1030)	3	Copied to derived instances without change
Procedure Code Sequence	(0008,1032)	3	Copied to derived instances without change
>Code Value	(0008,0100)	1C	Copied to derived instances without change
>Coding Scheme Designator	(0008,0102)	1C	Copied to derived instances without change
>Code Meaning	(0008,0104)	1C	Copied to derived instances without change
Name of Physician(s) Reading Study	(0008,1060)	3	Copied to derived instances without change
Referenced Study Sequence	(0008,1110)	3	Copied to derived instances without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied to derived instances without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied to derived instances without change

3.7.3.2 PATIENT STUDY MODULE

TABLE 3-5
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Copied to derived instances without change
Patient's Size	(0010,1020)	3	Copied to derived instances without change
Patient's Weight	(0010,1030)	3	Copied to derived instances without change

3.7.4 SERIES ENTITY

3.7.4.1 GENERAL SERIES MODULE

TABLE 3-6
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Required with any not null value
Series Instance UID	(0020,000E)	1	Required with any not null value
Series Number	(0020,0011)	2	Required with any value (including no value, zero length data element)
Performing Physician's Name	(0008,1050)	3	Copied to derived instances without change
Operators' Name	(0008,1070)	3	Copied to derived instances without change
Protocol Name	(0018,1030)	3	Copied to derived instances without change
Laterality	(0020,0060)	2C	Copied to derived instances without change
Request Attributes Sequence	(0040,0275)	3	Copied to derived instances without change
>Requested Procedure Description	(0032,1060)	3	Copied to derived instances without change
>Scheduled Procedure Step Description	(0040,0007)	3	Copied to derived instances without change
>Scheduled Protocol Code Sequence	(0040,0008)	3	Copied to derived instances without change
>>Code Value	(0008,0100)	1C	Copied to derived instances without change
>>Coding Scheme Designator	(0008,0102)	1C	Copied to derived instances without change

Attribute Name	Tag	Type	Attribute Description
>>Code Meaning	(0008,0104)	1C	Copied to derived instances without change
>Scheduled Procedure Step ID	(0040,0009)	1C	Copied to derived instances without change
>Requested Procedure ID	(0040,1001)	1C	Copied to derived instances without change

3.7.5 EQUIPMENT ENTITY

3.7.5.1 GENERAL EQUIPMENT MODULE

TABLE 3-7
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Required with any value (including no value, zero length data element)
Institution Name	(0008,0080)	3	Copied to derived instances without change
Institution Address	(0008,0081)	3	Copied to derived instances without change
Manufacturer Model Name	(0008,1090)	3	Copied to derived instances without change
Device Serial Number	(0018,1000)	3	Copied to derived instances without change
Software Versions	(0018,1020)	3	Copied to derived instances without change

3.7.6 IMAGE ENTITY

3.7.6.1 GENERAL IMAGE MODULE

TABLE 3-8
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	Required with any value (including no value, zero length data element)
Image Comments	(0020,4000)	3	Copied to derived instances without change
Acquisition Date	(0008,0022)	3	Copied to derived instances without change
Acquisition Time	(0008,0032)	3	Copied to derived instances without change

3.7.6.2 IMAGE PIXEL MODULE

TABLE 3-9
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Not used
Photometric Interpretation	(0028,0004)	1	Not used
Rows	(0028,0010)	1	Value shall be 500 to 1000
Columns	(0028,0011)	1	Value shall be 500 to 1000
Bits Allocated	(0028,0100)	1	Not used
Bits Stored	(0028,0101)	1	Value shall be 12
High Bit	(0028,0102)	1	Not used
Pixel Representation	(0028,0103)	1	Not used
Pixel Data	(7FE0,0010)	1	Required with any value

3.7.6.3 CONTRAST/BOLUS MODULE

TABLE 3-10
CONTRAST/BOLUS MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Contrast/Bolus Agent		(0018,0010)	LO	1	2	Copied to derived instances without change
Auto injection enabled	GEMS_DL_IMG_01	(0019,xxA4)	CS	1	3	Copied to derived instances without change
Injection phase	GEMS_DL_IMG_01	(0019,xxA5)	CS	1	3	Copied to derived instances without change
Injection delay	GEMS_DL_IMG_01	(0019,xxA6)	DS	1	3	Copied to derived instances without change
Reference injection frame number	GEMS_DL_IMG_01	(0019,xxA7)	IS	1	3	Copied to derived instances without change
Contrast/Bolus Start Time		(0018,1042)	TM	1	3	Copied to derived instances without change
Contrast/Bolus Stop Time		(0018,1043)	TM	1	3	Copied to derived instances without change

Contrast/Bolus Ingredient		(0018,1048)	CS	1	3	Copied to derived instances without change

3.7.6.4 MULTI-FRAME MODULE

TABLE 3-11
MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Value shall be higher than 0.9*((expected_number_of_frames)-2) Where expected_number_of_frames is stored in (0019,xxCA) The above check is only done if expected_number_of_frames is present.
Frame Increment Pointer	(0028,0009)	1	Not used

3.7.6.5 X-RAY IMAGE MODULE

TABLE 3-12
X-RAY IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Pixel Intensity Relationship	(0028,1040)	1	Value shall be “SQRT”

3.7.6.6 X-RAY ACQUISITION MODULE

TABLE 3-13
X-RAY ACQUISITION MODULE

Attribute Name	Tag	Type	Attribute Description
KVP	(0018,0060)	2	Not used
Radiation Setting	(0018,1155)	1	Not used
Imager Pixel Spacing	(0018,1164)	3	The first value shall be higher than 0
FOV Shape	(0018,1147)	3	Copied to derived instances without change
FOV Dimension	(0018,1149)	3	Copied to derived instances without change
Intensifier Size	(0018,1162)	3	Copied to derived instances without change
Grid	(0018,1166)	3	Value shall be one of the following "IN" "NONE" If the value does not match, the application assumes that the attribute is not present
Focal Spot	(0018,1190)	3	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present

3.7.6.7 X-RAY COLLIMATOR MODULE

TABLE 3-14
X-RAY COLLIMATOR MODULE

Attribute Name	Tag	Type	Attribute Description

Collimator Shape	(0018,1700)	1	Not used
Collimator Left Vertical Edge	(0018,1702)	1C	Value shall be between 1-1000 If the value does not match, the application assumes that the attribute is not present
Collimator Right Vertical Edge	(0018,1704)	1C	Value shall be between 1-1000 If the value does not match, the application assumes that the attribute is not present
Collimator Up Horizontal Edge	(0018,1706)	1C	Value shall be between 1-1000 If the value does not match, the application assumes that the attribute is not present
Collimator Low Horizontal Edge	(0018,1708)	1C	Value shall be between 1-1000 If the value does not match, the application assumes that the attribute is not present

3.7.6.8 X-RAY TABLE MODULE

TABLE 3-15
X-RAY TABLE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Table Motion	(0018,1134)	2	Required with any value (including no value, zero length data element)
Table Vertical Increment	(0018,1135)	2C	Copied to derived instances without change
Table Lateral Increment	(0018,1136)	2C	Copied to derived instances without change
Table Longitudinal Increment	(0018,1137)	2C	Copied to derived instances without change
Table Angle	(0018,1138)	3	Copied to derived instances without change

3.7.6.9 X-RAY POSITIONER MODULE

TABLE 3-16
X-RAY POSITIONER MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Positioner Primary Angle	(0018,1510)	2	Required with any value (including no value, zero length data element)
Positioner Secondary Angle	(0018,1511)	2	Required with any value (including no value, zero length data element)
Distance Source to Detector	(0018,1110)	3	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Distance Source to Patient	(0018,1111)	3	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Positioner Motion	(0018,1500)	3	Copied to derived instances without change
Positioner Primary Angle Increment	(0018,1520)	2C	Copied to derived instances without change
Positioner Secondary Angle Increment	(0018,1521)	2C	Copied to derived instances without change

3.7.6.10 SOP COMMON MODULE

TABLE 3-17
SOP COMMON MODULE ATTRIBUTES (INPUT)

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Required with any not null value.
SOP Instance UID	(0008,0018)	1	Required with any not null value.
Specific Character Set	(0008,0005)	3	Copied to derived instances without change

3.7.6.11 CINE MODULE

TABLE 3-18
CINE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Time Vector	(0018,1065)	1C	Copied to derived instances without change
Frame Delay	(0018,1066)	3	Copied to derived instances without change

3.7.7 PRIVATE DATA ATTRIBUTES

3.7.7.1 PRIVATE GROUP DLX_SERIE_01

Private Group DLX_SERIE_01 is modeled as part of the Image (X-Ray Acquisition, X-Ray Table, X-Ray Positioner) Information Entity.

TABLE 3-19
PRIVATE GROUP DLX_SERIE_01 (INPUT)

Attribute Name	Tag	VR	VM	Attribute Description and Use
Adx Acq Mode	(0019,xx14)	IS	1	Value shall be 140
Angle value 1	(0019,xx01)	DS	1	Copied to derived instances without change
Angle value 2	(0019,xx02)	DS	1	Copied to derived instances without change
Angle value 3	(0019,xx03)	DS	1	Copied to derived instances without change
IP Address	(0019,xx20)	LO	1	Copied to derived instances without change
Table Vertical Position	(0019,xx21)	DS	1	Copied to derived instances without change
Table Longitudinal Position	(0019,xx22)	DS	1	Copied to derived instances without change
Table Lateral Position	(0019,xx23)	DS	1	Copied to derived instances without change

3.7.7.2 PRIVATE GROUP GEMS_DL_IMG_01

Private Group GEMS_DL_IMG_01 is modeled as part of the Image (X-Ray Acquisition, X-Ray Positioner) Information Entity.

TABLE 3-20
PRIVATE GROUP GEMS_DL_IMG_01

Attribute Name	Tag	VR	VM	Attribute Description and Use
Patient Position Per Image	(0019,xxC7)	CS	1	Value shall be one of the following "HFS" "HFP" "HFDR" "HFDL" "FFS" "FFP" "FFDR" "FFDL" If the value does not match, the application assumes that the attribute is not present
FOV Dimension Double	(0019,xx0B)	DS	1-2	Value shall be higher than 0
Image Flip	(0019,xx95)	CS	2	Horizontal flip of the image at acquisition, followed by vertical flip Value shall be one of the following "NO\NO" "YES\NO" "NO\YES" "YES\YES" If the value does not match, the application assumes that the attribute is not present
EPT	(0019,xxA9)	DS	1-N	Value shall be higher or equal to 0 If the value does not match, the application assumes that the attribute is not present
kVp Actual Vector	(0019,xxAF)	DS	1-N	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
mAs Actual Vector	(0019,xxB0)	DS	1-N	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present

Preselected Pivot Rotation Speed	(0019,xxC5)	FL	1	Value shall be one of the following "10" "20" "40" If the value does not match, the application assumes that the attribute is not present
ABD Vector	(0019,xxB9)	FL	1-N	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
3D structure of interest	(0019,xxC8)	CS	1	Value shall be one of the following "VASCULAR" "OTHER" If the value does not match, the application assumes that the attribute is not present
3D Calibration Out of Date Flag	(0019,xxC9)	CS	1	Value shall be one of the following "YES" "NO" If the value does not match, the application assumes that the attribute is not present
Angle 1 Increment	(0019,xx97)	DS	1-N	Copied to derived instances without change
Angle 2 Increment	(0019,xx98)	DS	1-N	Copied to derived instances without change
Angle 3 Increment	(0019,xx99)	DS	1-N	Copied to derived instances without change
Auto Injection Enabled	(0019,xxA4)	CS	1	Copied to derived instances without change
Injection Phase	(0019,xxA5)	CS	1	Copied to derived instances without change
Injection Delay	(0019,xxA6)	DS	1	Copied to derived instances without change
Reference Injection Frame Number	(0019,xxA7)	IS	1	Copied to derived instances without change
Pw Actual Vector	(0019,xxC2)	DS	1-N	Copied to derived instances without change
Spectral Filter Thickness	(0019,xxC4)	IS	1	Value shall be one of the following "0" "100" "200" "300" "600" "900" If the value does not match, the application assumes that the attribute is not present
Acquisition Region Detail	(0019,xxC6)	CS	1	Copied to derived instances without change
3Dspin expected number of frames	(0019,xxCA)	IS	1	Copied to derived instances without change
Detection gain value	(0019,xxD4)	FL	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
mR mAs calibration value	(0019,xxD5)	FL	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
Table rotation angle vector	(0019,xxC3)	FL	1-N	Copied to derived instances without change
Table X Position to Isocenter vector	(0019,xxD7)	FL	1-N	Copied to derived instances without change
Table Y Position to Isocenter vector	(0019,xxD8)	FL	1-N	Copied to derived instances without change
Table Z Position to Isocenter vector	(0019,xxD9)	FL	1-N	Copied to derived instances without change
Table Head Tilt Angle vector	(0019,xxDA)	FL	1-N	Copied to derived instances without change
Table Cradle Tilt Angle vector	(0019,xxDB)	FL	1-N	Copied to derived instances without change

3.7.7.3 PRIVATE GROUP GEMS_XR3DCAL_01

TABLE 3-21
PRIVATE GROUP GEMS_XR3DCAL_01

Attribute Name	Tag	VR	VM	Attribute Description and Use
3Dcal image rows	(0021,xx01)	IS	1	Value shall be higher than 0
3Dcal image columns	(0021,xx02)	IS	1	Value shall be higher than 0
3Dcal acquisition date	(0021,xx04)	DA	1	Copied to derived instances without change
3Dcal acquisition time	(0021,xx05)	TM	1	Copied to derived instances without change
3Dcal Pivot angle vector	(0021,xx09)	FL	1-N	Not mandatory
3Dcal matrix sequence	(0021,xx0B)	SQ	1	Sequence shall exist
>3Dcal matrix elements	(0021,xx0C)	LO	1-N	Shall contains value
3Dcal 3D frame unit size	(0021,xx0E)	FL	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
3Dcal image frame origin row	(0021,xx10)	FL	1	Not mandatory
3Dcal image frame origin column	(0021,xx11)	FL	1	Not mandatory
3Dcal number of images	(0021,xx13)	IS	1	Value shall be higher than 0 If the value does not match, the application assumes that the attribute is not present
3Dcal image pixel spacing	(0021,xx15)	FL	2	Value shall be higher than 0
3Dcal centering mode	(0021,xx16)	CS	1	Value shall be "RECTIFICATION"

4. 3D MODEL GE PRIVATE INFORMATION OBJECT IMPLEMENTATION

4.1 INTRODUCTION

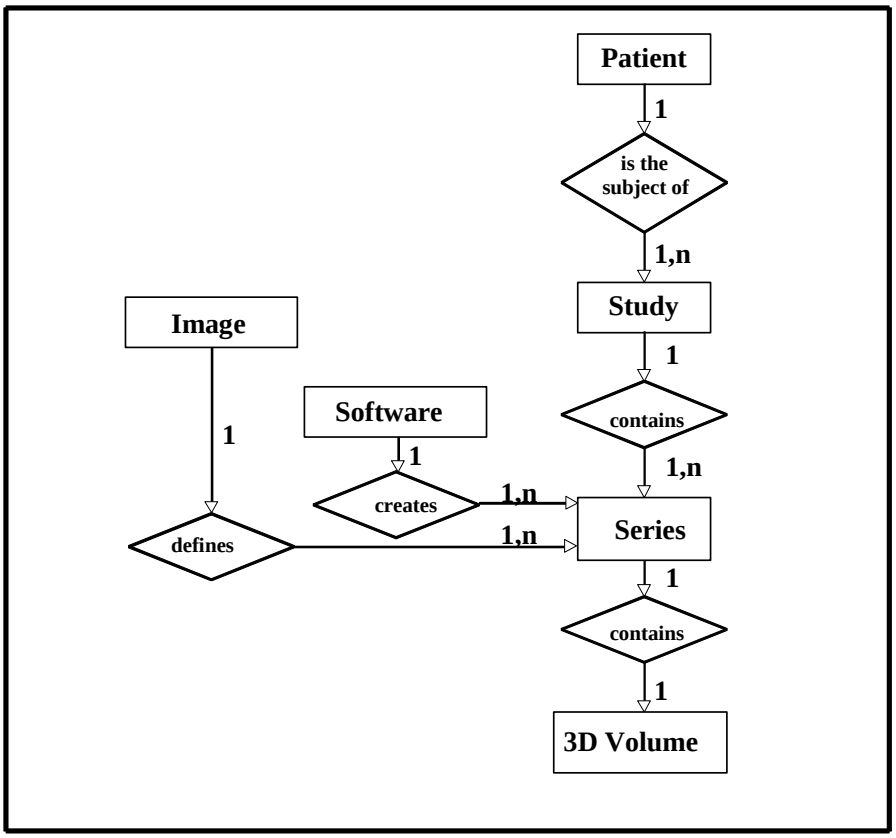
This section specifies the requirements for the GE Private 3D Model IOD as output of the Innova3DXR 1.2 product.

4.2 3D MODEL IOD IMPLEMENTATION

This section defines how 3D Model attributes are used within the implementation.

4.3 3D MODEL ENTITY-RELATIONSHIP MODEL

ILLUSTRATION 4-1
3D MODEL ENTITY RELATIONSHIP DIAGRAM



The Entity-Relationship diagram for the 3D Model interoperability schema is shown in ILLUSTRATION 4-1. In this figure, the following diagrammatic convention is established to represent the information organization:

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

The relationships are fully defined with the maximum number of possible entities in the relationship shown. See DICOM Part 3 Section 5.1.2 for an explanation of the entity-relationship notation.

4.4 ENTITIES DESCRIPTION

Refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the 3D Model Image information object.

4.5 INNOVA3DXR 1.2 MAPPING OF DICOM ENTITIES

DICOM entities map to the Innova3DXR 1.2 entities in the following manner:

TABLE 4-1
INNOVA3DXR 1.2 MAPPING OF DICOM ENTITIES

DICOM	Innova3DXR 1.2
Patient Entity	Patient Entity (Advantage Workstation)
Study Entity	Exam Entity (Advantage Workstation)
Series Entity	Series Entity (Advantage Workstation)
Equipment Entity	Equipment Entity (Advantage Workstation)
Image Entity	Private Image Entity (Advantage Workstation)

4.6 IOD MODULE TABLE

The 3D Model Information Object Definitions comprise the modules of the following tables, plus Standard Extended and Private attributes.

TABLE 4-2
XA IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Mandatory	4.7.2.1
Study	General Study	Mandatory	4.7.3.1
	Patient Study	User Option	4.7.3.2
Series	General Series	Mandatory	4.7.4.1
Equipment	General Equipment	Mandatory	4.7.5.1
Private Image	General Image	Mandatory	4.7.6.1
	Image Pixel	Mandatory	4.7.6.2
	VOI LUT	Mandatory	4.7.6.3
Private 3D Model	SOP Common	Mandatory	4.7.7.1
	Common Private Entity	Mandatory	4.7.7.2
	Volumic Data	Mandatory	4.7.7.3
	Reconstruction Parameters Sequence	Mandatory	4.7.7.4

4.7 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 3D Model 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. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

4.7.1 COMMON INFORMATION MODULE DEFINITIONS

Please refer to DICOM Part 3 (Information Object Definitions) for a description of each of the entities, modules, and attributes contained within the 3D Model Information Objects.

4.7.2 PATIENT ENTITY

4.7.2.1 PATIENT MODULE

TABLE 4-3
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	1	Copied from XA image without change.
Patient ID	(0010,0020)	1	Copied from XA image without change.
Patient's Birth Date	(0010,0030)	2	Copied from XA image without change.
Patient's Sex	(0010,0040)	2	Copied from XA image without change.
Referenced Patient Sequence	(0008,1120)	3	Sequence is copied from XA image without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied from XA image without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied from XA image without change

4.7.3 STUDY ENTITY

4.7.3.1 GENERAL STUDY MODULE

TABLE 4-4
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Copied from XA image without change
Study Date	(0008,0020)	2	Copied from XA image without change
Study Time	(0008,0030)	2	Copied from XA image without change
Referring Physician's Name	(0008,0090)	2	Copied from XA image without change
Study ID	(0020,0010)	2	Copied from XA image without change
Accession Number	(0008,0050)	2	Copied from XA image without change
Study Description	(0008,1030)	3	Copied from XA image without change
Procedure Code Sequence	(0008,1032)	3	Copied from XA image without change

>Code Value	(0008,0100)	1C	Copied from XA image without change
>Coding Scheme Designator	(0008,0102)	1C	Copied from XA image without change
>Code Meaning	(0008,0104)	1C	Copied from XA image without change
Name of Physician(s) Reading Study	(0008,1060)	3	Copied from XA image without change
Referenced Study Sequence	(0008,1110)	3	Copied from XA image without change
>Referenced SOP Class UID	(0008,1150)	1C	Copied from XA image without change
>Referenced SOP Instance UID	(0008,1155)	1C	Copied from XA image without change

4.7.3.2 PATIENT STUDY MODULE

TABLE 4-5
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Copied from XA image without change
Patient's Size	(0010,1020)	3	Copied from XA image without change
Patient's Weight	(0010,1030)	3	Copied from XA image without change

4.7.4 SERIES ENTITY

4.7.4.1 GENERAL SERIES MODULE

TABLE 4-6
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Value shall be XA
Series Instance UID	(0020,000E)	1	Unique UID generated
Series Date	(0008,0021)	1	Date of the creation of the object
Series Time	(0008,0031)	1	Time of the creation of the object
Series Description	(0008,103E)	1	Describe the series, and contains references for the source image to help identification in Advantage Windows Browser
Series Number	(0020,0011)	2	Copy of (0020,0013) from original image
Performing Physician's Name	(0008,1050)	3	Copied from XA image without change
Operators' Name	(0008,1070)	3	Copied from XA image without change
Protocol Name	(0018,1030)	3	Copied from XA image without change
Patient Position	(0018,5100)	2C	Copy of (0019,xxC7) from original image
Laterality	(0020,0060)	3	Copied from XA image without change
Request Attributes Sequence	(0040,0275)	3	Copied from XA image without change
>Requested Procedure Description	(0032,1060)	3	Copied from XA image without change
>Scheduled Procedure Step Description	(0040,0007)	3	Copied from XA image without change
>Scheduled Protocol Code Sequence	(0040,0008)	3	Copied from XA image without change
>>Code Value	(0008,0100)	1C	Copied from XA image without change
>>Coding Scheme Designator	(0008,0102)	1C	Copied from XA image without change

>>Code Meaning	(0008,0104)	1C	Copied from XA image without change
>Scheduled Procedure Step ID	(0040,0009)	1C	Copied from XA image without change
>Requested Procedure ID	(0040,1001)	1C	Copied from XA image without change

4.7.5 EQUIPMENT ENTITY

4.7.5.1 GENERAL EQUIPMENT MODULE

TABLE 4-7
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	1	Value shall be "GE MEDICAL SYSTEMS"
Institution Name	(0008,0080)	3	Copied from XA image without change
Institution Address	(0008,0081)	3	Copied from XA image without change
Station Name	(0008,1010)	3	Station Name of the Advantage Windows
Manufacturer's Model Name	(0008,1090)	3	Model Name of the Advantage Windows
Device Serial Number	(0018,1000)	3	Serial Number of the Advantage Windows
Software Version(s)	(0018,1020)	3	Version of the Innova3DXR 1.2 application
Date of Last Calibration	(0018,1200)	3	Copy of (0021,xx04) from original image
Time of Last Calibration	(0018,1201)	3	Copy of (0021,xx05) from original image

4.7.6 PRIVATE IMAGE ENTITY

4.7.6.1 GENERAL IMAGE MODULE

TABLE 4-8
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Date	(0008,0023)	1	Date of the creation of the object
Image Time	(0008,0033)	1	Time of the creation of the object
Source Image Sequence	(0008,2112)	1	Contains reference data for the source sequence
>Referenced SOP Class UID	(0008,1150)	1	Copy of (0008,0016) from original image
>Referenced SOP Instance UID	(0008,1155)	1	Copy of (0008,0018) from original image
Instance Number	(0020,0013)	2	Copied from XA image without change
Image Comments	(0020,4000)	3	Copied from XA image without change

4.7.6.2 IMAGE PIXEL MODULE

TABLE 4-9
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Value shall be 1
Photometric Interpretation	(0028,0004)	1	Value shall be "MONOCHROME2"
Rows	(0028,0010)	1	Value shall be 256 or 512 depends on user select
Columns	(0028,0011)	1	Value shall be 256 or 512 depends on user select
Bits Allocated	(0028,0100)	1	Value shall be 16
Bits Stored	(0028,0101)	1	Value shall be 12
High Bit	(0028,0102)	1	Value shall be 11
Pixel Representation	(0028,0103)	1	Value shall be 0
Pixel Data	(7FE0,0010)	1	Calculated MIP or Axial slice depending on original image

4.7.6.3 VOI LUT MODULE

TABLE 4-10
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Window Center	(0028,1050)	1	Value shall be 2048
Window Width	(0028,1051)	1	Value shall be 4096

4.7.7 PRIVATE 3D MODEL ENTITY

4.7.7.1 SOP COMMON MODULE

TABLE 4-11
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Value shall be "1.2.840.113619.4.26"
SOP Instance UID	(0008,0018)	1	Unique UID generated.
Specific Character Set	(0008,0005)	3	Copied from XA image without change

4.7.7.2 COMMON PRIVATE ENTITY MODULE

TABLE 4-12
COMMON PRIVATE ENTITY MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Private Entity Number	GEMS_ADWSoft_DPO1	(0039,xx80)	IS	1	3	Copy of (0020,0013) from original image
Private Entity Date	GEMS_ADWSoft_DPO1	(0039,xx85)	DA	1	1	Same as (0008,0023)
Private Entity Time	GEMS_ADWSoft_DPO1	(0039,xx90)	TM	1	1	Same as (0008,0033)
Private Entity Launch Command	GEMS_ADWSoft_DPO1	(0039,xx95)	LO	1	1	Value shall be "start_volan"
Private Entity Type	GEMS_ADWSoft_DPO1	(0039,xxAA)	CS	1	1	Value shall be "3DDPO"

4.7.7.3 VOLUMIC DATA MODULE

TABLE 4-13
VOLUMIC DATA MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Volume Color	GEMS_ADWSoft_3D1	(0047,xx49)	UL	3-N	1	Value shall be "255\255\255"
Volume Voxel Count	GEMS_ADWSoft_3D1	(0047,xx50)	UL	1	1	Calculated from user setting
Volume Segment Count	GEMS_ADWSoft_3D1	(0047,xx51)	UL	1-N	1	Calculated from user setting
Volume Slice Size	GEMS_ADWSoft_3D1	(0047,xx53)	US	1	1	Calculated from user setting
Volume Slice Count	GEMS_ADWSoft_3D1	(0047,xx54)	US	1	1	Calculated from user setting
Volume Voxel Ratio	GEMS_ADWSoft_3D1	(0047,xx57)	DS	1	1	Value shall be 1.0
Volume Voxel Size	GEMS_ADWSoft_3D1	(0047,xx58)	DS	1	1	Computed by reconstruction algorithm
Volume Z Position Size	GEMS_ADWSoft_3D1	(0047,xx59)	SS	1	1	Calculated from user setting
Volume Base Line	GEMS_ADWSoft_3D1	(0047,xx60)	DS	9	1	Value shall be "0.0\1.0\0.0\0.0\0.0\1.0\1.0\0.0\0.0"
Volume Center Point	GEMS_ADWSoft_3D1	(0047,xx61)	DS	3	1	Value shall be "0.0\0.0\0.0"
Volume Skew Base	GEMS_ADWSoft_3D1	(0047,xx63)	SL	1	1	Value shall be 0
Volume Upper Left High Corner RAS	GEMS_ADWSoft_3D1	(0047,xxC0)	DS	3	1	Computed from algorithm output
Volume Slice To RAS Rotation Matrix	GEMS_ADWSoft_3D1	(0047,xxC1)	DS	9	1	Computed from algorithm output
Volume Upper Left High Corner TLOC	GEMS_ADWSoft_3D1	(0047,xxC2)	DS	1	1	Computed from algorithm output
Volume Segment List	GEMS_ADWSoft_3D1	(0047,xxD1)	OB	1	1	Computed from algorithm output
Volume Density List	GEMS_ADWSoft_3D1	(0047,xxD3)	OB	1	1	Computed from algorithm output
Volume Z Position List	GEMS_ADWSoft_3D1	(0047,xxD4)	OB	1	1	Computed from algorithm output
Volume Original Index List	GEMS_ADWSoft_3D1	(0047,xxD5)	OB	1	1	Computed from algorithm output

Volume Name(s)	GEMS_ADWSoft_3D1	(0047,xxF4)	LO	1-N	1	Value shall be "vessels"
Min original density	GEMS_ADWSoft_3D1	(0047,xxF5)	DS	1-N	1	Computed by reconstruction algorithm
Max original density	GEMS_ADWSoft_3D1	(0047,xxF6)	DS	1-N	1	Computed by reconstruction algorithm
Min converted density	GEMS_ADWSoft_3D1	(0047,xxF7)	DS	1-N	1	Value shall be 0
Max converted density	GEMS_ADWSoft_3D1	(0047,xxF8)	DS	1-N	1	Value shall be 4095
Volume Threshold Value	GEMS_ADWSoft_3D1	(0047,xx55)	SL	1	1	Value shall be 1
Volume Registration Transform Rotation Matrix	GEMS_ADWSoft_3D1	(0047,xx64)	DS	9	1	Value shall be "0.0\0.0\0.0\0.0\0.0\0.0\0.0\0.0\0.0"
Volume Registration Transform Translation Vector	GEMS_ADWSoft_3D1	(0047,xx65)	DS	3	1	Value shall be "0.0\0.0\0.0"

4.7.7.4 RECONSTRUCTION PARAMETERS SEQUENCE MODULE

TABLE 4-14
RECONSTRUCTION PARAMETERS SEQUENCE MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Reconstruction Parameters Sequence	GEMS_ADWSoft_3D1	(0047,xx01)	SQ	1	1	Contains 1 item
>Pixel Spacing		(0028,0030)	DS	2	1	Copy from original image: tag (0018,1164)
>Volume Subtraction Mode	GEMS_3D_XA_01	(0031,xx04)	CS	1	1	Value shall be "NOSUB"
> Reconstruction Filtering Selection	GEMS_3D_XA_01	(0031,xx05)	CS	1	1	Calculated from user setting "0" – No filter "1" – Sharp "2" – Low Smooth "3" – Medium Smooth "4" – High Smooth
>Volume internal upscan method	GEMS_3D_XA_01	(0031,xx06)	CS	1	1	Calculated from user setting "0" – The volume is reconstructed on the same size as stored "1" – The volume is reconstructed smaller size and upscanned for storage.
>Acquisition DLX 2D Series Count	GEMS_ADWSoft_3D1	(0047,xx81)	IS	1	1	Value shall be "1"
>Transform Count	GEMS_ADWSoft_3D1	(0047,xx98)	US	1	1	Value shall be "1"
>Contrast/Bolus Agent		(0018,0010)	LO	1	2	Copy from original image: tag (0018,0010)
>Slice Thickness		(0018,0050)	DS	1	1	Computed from algorithm output

>Patient Position		(0018,5100)	CS	1	2	Copy from original image: tag (0019,xxC7)
>Manufacturer		(0008,0070)	LO	1	3	Copy from original image: tag (0008,0070)
>Manufacturer's Model Name		(0008,1090)	LO	1	3	Copy from original image: tag (0008,1090)
>Spacing Between Slices		(0018,0088)	DS	1	1	Computed from algorithm output
>Device Serial Number		(0018,1000)	LO	1	3	Copy from original image: tag (0018,1000)
>Software Version(s)		(0018,1020)	LO	1-N	3	Copy from original image: tag (0018,1020)
>Intensifier Size		(0018,1162)	DS	1	3	Copy from original image: tag (0018,1162)
>IP address	DLX_SERIE_01	(0019,xx20)	LO	1	3	Copy from original image: tag (0019,xx20)
>Frame of Reference UID		(0020,0052)	UI	1	3	Copy from original image: tag (0020,0052)
>Structure Of Interest	GEMS_3D_XA_01	(0031,xx01)	CS	1	3	Copy from original image: tag (0019,xxC8)
>Missing Frames Status	GEMS_3D_XA_01	(0031,xx02)	CS	1	1	Value shall be 1 or 0 Computed from original image information. If Number of frames is less, at least by two, then the expected number of frames it should be 1 else 0;
>Anatomy	GEMS_3D_XA_01	(0031,xx03)	CS	1	3	Copy from original image: tag (0019,xxC6)
>Acquisition DLX 2D Series Sequence	GEMS_ADWSoft_3D1	(0047,xx85)	SQ	1	1	Contains 1 item.
>>3Dspin expected number of frames	GEMS_DL_IMG_01	(0019,xxCA)	IS	1	3	Copy from original image: tag (0019,xxCA)
>>Table Motion		(0018,1134)	CS	1	2	Copy from original image: tag (0018,1134)
>>Number Of Injections	GEMS_ADWSoft_3D1	(0047,xx8A)	US	1	2	Empty
>>Positioner Motion		(0018,1500)	CS	1	2	Copy from original image: tag (0018,1500)
>>SOP instance UID		(0008,0018)	UI	1	1	Copy from original image: tag (0008,0018)
>>Acquisition Date		(0008,0022)	DA	1	3	Copy from original image: tag >(0008,0022)
>>Acquisition Time		(0008,0032)	TM	1	3	Copy from original image: tag (0008,0032)
>>Frame Time Vector		(0018,1065)	DS	1-N	3	Copy from original image: tag (0018,1065)

>>Frame Delay		(0018,1066)	DS	1	3	Copy from original image: tag (0018,1066)
>>Distance Source to Detector		(0018,1110)	DS	1	3	Copy from original image: tag (0018,1110)
>>Table Vertical Increment		(0018,1135)	DS	1-N	3	Copy from original image: tag (0018,1135)
>>Table Lateral Increment		(0018,1136)	DS	1-N	3	Copy from original image: tag (0018,1136)
>>Table Longitudinal Increment		(0018,1137)	DS	1-N	3	Copy from original image: tag (0018,1137)
>>Table Angle		(0018,1138)	DS	1	3	Copy from original image: tag (0018,1138)
>>Field of View Dimension(s)		(0018,1149)	IS	1-2	3	Copy from original image: tag (0018,1149)
>>Grid		(0018,1166)	CS	1	3	Copy from original image: tag (0018,1166)
>>Focal Spot		(0018,1190)	DS	1	3	Copy from original image: tag (0018,1190)
>>Positioner Primary Angle		(0018,1510)	DS	1	3	Copy from original image: tag (0018,1510)
>>Positioner Secondary Angle		(0018,1511)	DS	1	3	Copy from original image: tag (0018,1511)
>>Positioner Primary Angle Increment		(0018,1520)	DS	1-N	3	Copy from original image: tag (0018,1520)
>>Positioner Secondary Angle Increment		(0018,1521)	DS	1-N	3	Copy from original image: tag (0018,1521)
>>Angle value 1	DLX_SERIE_01	(0019,xx01)	DS	1	3	Copy from original image: tag (0019,xx01)
>>Angle value 2	DLX_SERIE_01	(0019,xx02)	DS	1	3	Copy from original image: tag (0019,xx02)
>>Angle value 3	DLX_SERIE_01	(0019,xx03)	DS	1	3	Copy from original image: tag (0019,xx03)
>>FOV dimension double	GEMS_DL_IMG_01	(0019,xx0B)	DS	1-2	1	Copy from original image: tag (0019,xx0B)
>>Table vertical position	DLX_SERIE_01	(0019,xx21)	DS	1	3	Copy from original image: tag (0019,xx21)
>>Table longitudinal position	DLX_SERIE_01	(0019,xx22)	DS	1	3	Copy from original image: tag (0019,xx22)
>>Table lateral position	DLX_SERIE_01	(0019,xx23)	DS	1	3	Copy from original image: tag (0019,xx23)
>>Angle 1 increment	GEMS_DL_IMG_01	(0019,xx97)	DS	1-N	3	Copy from original image: tag (0019,xx97)
>>Angle 2 increment	GEMS_DL_IMG_01	(0019,xx98)	DS	1-N	3	Copy from original image: tag (0019,xx98)
>>Angle 3 increment	GEMS_DL_IMG_01	(0019,xx99)	DS	1-N	3	Copy from original image: tag (0019,xx99)

>>Auto injection enabled	GEMS_DL_IMG_01	(0019,xxA4)	CS	1	3	Copy from original image: tag (0019,xxA4)
>>Injection phase	GEMS_DL_IMG_01	(0019,xxA5)	CS	1	3	Copy from original image: tag (0019,xxA5)
>>Injection delay	GEMS_DL_IMG_01	(0019,xxA6)	DS	1	3	Copy from original image: tag (0019,xxA6)
>>Reference injection frame number	GEMS_DL_IMG_01	(0019,xxA7)	IS	1	3	Copy from original image: tag (0019,xxA7)
>>kVp actual vector	GEMS_DL_IMG_01	(0019,xxAF)	DS	1-N	3	Copy from original image: tag (0019,xxAF)
>>mAs actual vector	GEMS_DL_IMG_01	(0019,xxB0)	DS	1-N	3	Copy from original image: tag (0019,xxB0)
>>pw actual vector	GEMS_DL_IMG_01	(0019,xxC2)	DS	1-N	3	Copy from original image: tag (0019,xxC2)
>>Table rotation angle vector	GEMS_DL_IMG_01	(0019,xxC3)	FL	1-N	3	Copy from original image: tag (0019,xxC3)
>>Spectral filter thickness	GEMS_DL_IMG_01	(0019,xxC4)	IS	1	3	Copy from original image: tag (0019,xxC4)
>>Preselected pivot rotation speed	GEMS_DL_IMG_01	(0019,xxC5)	FL	1	3	Copy from original image: tag (0019,xxC5)
>>Table X Position to Isocenter vector	GEMS_DL_IMG_01	(0019,xxD7)	FL	1-N	3	Copy from original image: tag (0019,xxD7)
>>Table Y Position to Isocenter vector	GEMS_DL_IMG_01	(0019,xxD8)	FL	1-N	3	Copy from original image: tag (0019,xxD8)
>>Table Z Position to Isocenter vector	GEMS_DL_IMG_01	(0019,xxD9)	FL	1-N	3	Copy from original image: tag (0019,xxD9)
>>Table Head Tilt Angle vector	GEMS_DL_IMG_01	(0019,xxDA)	FL	1-N	3	Copy from original image: tag (0019,xxDA)
>>Table Cradle Tilt Angle vector	GEMS_DL_IMG_01	(0019,xxDB)	FL	1-N	3	Copy from original image: tag (0019,xxDB)
>>Series Instance UID		(0020,000E)	UI	1	3	Copy from original image: tag (0020,000E)
>>Series Number		(0020,0011)	IS	1	3	Copy from original image: tag (0020,0011)
>>Instance Number		(0020,0013)	IS	1	3	Copy from original image: tag (0020,0013)
>>Rows		(0028,0010)	US	1	1	Copy from original image: tag (0028,0010)
>>Columns		(0028,0011)	US	1	1	Copy from original image: tag (0028,0011)
>>Bits Stored		(0028,0101)	US	1	1	Copy from original image: tag (0028,0101)
>>Frame Count	GEMS_ADWSoft_3D1	(0047,xx8B)	US	1	1	Copy from original image: tag (0028,0008)
>>Used Frames	GEMS_ADWSoft_3D1	(0047,xx96)	IS	1-N	1	List of all frame numbers

>XA 3D Reconstruction Algorithm Name	GEMS_ADWSoft_3D1	(0047,xx91)	LO	1	1	Output of the algorithm
>XA 3D Reconstruction Algorithm Version	GEMS_ADWSoft_3D1	(0047,xx92)	CS	1	1	Output of the algorithm
>DLX Calibration Date	GEMS_ADWSoft_3D1	(0047,xx93)	DA	1	3	Copy from original image: tag (0021,xx04)
>DLX Calibration Time	GEMS_ADWSoft_3D1	(0047,xx94)	TM	1	3	Copy from original image: tag (0021,xx05)
>DLX Calibration Status	GEMS_ADWSoft_3D1	(0047,xx95)	CS	1	1	Computed from original image information. If tag (0019,xxC9) private creator = GEMS_DL_IMG_01 in the original sequence is "NO" then "0" else "1"
>Transform Sequence	GEMS_ADWSoft_3D1	(0047,xx99)	SQ	1	1	Contains 1 item
>>Transform Rotation Matrix	GEMS_ADWSoft_3D1	(0047,xx9A)	DS	9	1	Value shall be "1.0\0.0\0.0\0.0\0.0\1.0\0.0\-1.0\0.0"
>>Transform Translation Vector	GEMS_ADWSoft_3D1	(0047,xx9B)	DS	3	1	Value shall be "0.0\0.0\0.0"
>>Transform Label	GEMS_ADWSoft_3D1	(0047,xx9C)	LO	1	1	Value shall be "3DPOS_REG"

5. 3D XACT MODEL INFORMATION OBJECT IMPLEMENTATION

5.1 INTRODUCTION

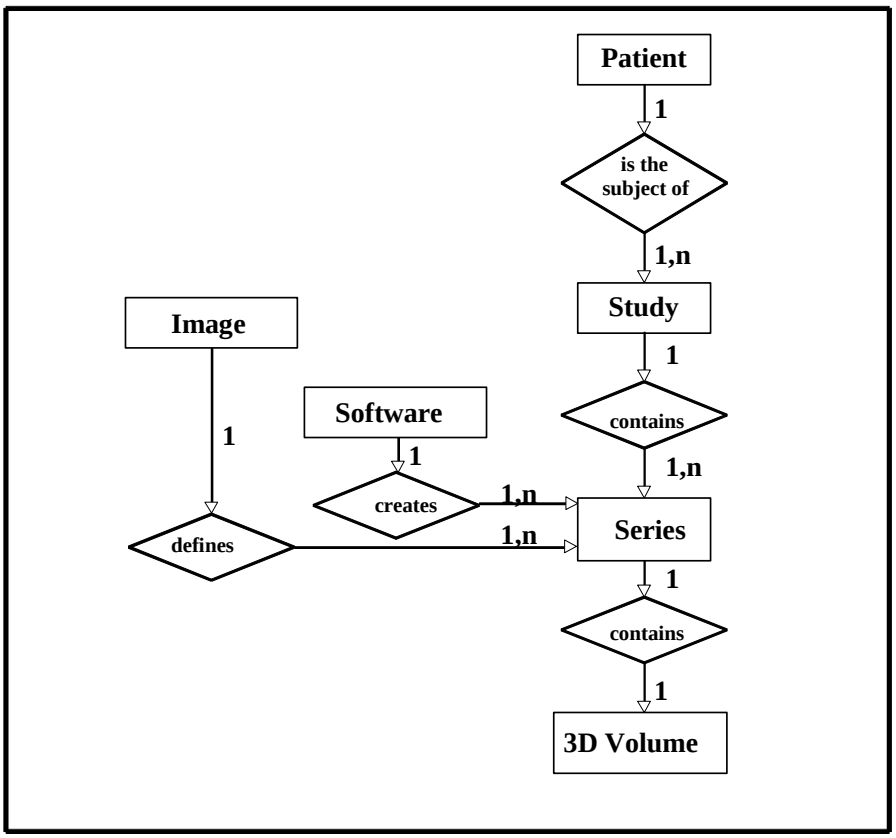
This section specifies the requirements for the DICOM 3D XACT Model IOD as output of the Innova3DXR 1.2 product. 3D XACT Model is an CT Image Storage extended with GE private elements.

5.2 3D XACT MODEL IOD IMPLEMENTATION

This section defines how 3D XACT Model attributes are used within the implementation.

5.3 3D XACT MODEL ENTITY-RELATIONSHIP MODEL

ILLUSTRATION 5-1
3D XACT MODEL ENTITY RELATIONSHIP DIAGRAM



The Entity-Relationship diagram for the 3D XACT Model interoperability schema is shown in ILLUSTRATION 4-1. In this figure, the following diagrammatic convention is established to represent the information organization:

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

The relationships are fully defined with the maximum number of possible entities in the relationship shown. See DICOM Part 3 Section 5.1.2 for an explanation of the entity-relationship notation.

5.4 ENTITIES DESCRIPTION

Refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the 3D XACT Model Image information object.

5.5 INNOVA3DXR 1.2 MAPPING OF DICOM ENTITIES

DICOM entities map to the Innova3DXR 1.2 entities in the following manner:

TABLE 5-1
INNOVA3DXR 1.2 MAPPING OF DICOM ENTITIES

DICOM	Innova3DXR 1.2
Patient Entity	Patient Entity (Advantage Workstation)
Study Entity	Exam Entity (Advantage Workstation)
Series Entity	Series Entity (Advantage Workstation)
Equipment Entity	Equipment Entity (Advantage Workstation)
Image Entity	Image Entity (Advantage Workstation)

5.6 IOD MODULE TABLE

The 3D XACT Model Information Object Definitions comprise the modules of the following tables, plus Standard Extended and Private attributes.

TABLE 5-2
XA IMAGE IOD MODULES

Entity Name	Module Name	Usage	Reference
Patient	Patient	Mandatory	5.6.2.1
Study	General Study	Mandatory	5.6.3.1
	Patient Study	User Option	5.6.3.2
Series	General Series	Mandatory	5.6.4.1
	Frame Of Reference	User Option	5.6.4.2
Equipment	General Equipment	Mandatory	5.6.5.1
Image	General Image	Mandatory	5.6.6.1
	Image Plane	Mandatory	5.6.6.2
	Image Pixel	Mandatory	5.6.6.3
	Contrast Bolus	Module is not present if no contrast injection in original image	5.6.6.4
	VOI lut	User Option	5.6.6.5
	SOP Common	Mandatory	5.6.6.6
	CT Image	Mandatory	5.6.6.7
	X-Ray 3D Angiographic Image Contributing Sources*	User Option	5.6.6.8
	X-Ray 3D Angiographic Acquisition*	User Option	5.6.6.9
	X-Ray 3D Reconstruction*	User Option	5.6.6.10

* These modules contain both Standard Extended and Private attributes.

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 3D XACT Model 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. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

5.6.1 COMMON INFORMATION MODULE DEFINITIONS

Please refer to DICOM Part 3 (Information Object Definitions) for a description of each of the entities, modules, and attributes contained within the 3D XACT Model Information Objects.

5.6.2 PATIENT ENTITY

5.6.2.1 PATIENT MODULE

TABLE 5-3
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Copied from XA image without change
Patient ID	(0010,0020)	2	Copied from XA image without change
Patient's Birth Date	(0010,0030)	2	Copied from XA image without change
Patient's Sex	(0010,0040)	2	Copied from XA image without change

5.6.3 STUDY ENTITY

5.6.3.1 GENERAL STUDY MODULE

TABLE 5-4
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008,0020)	2	Copied from XA image without change
Study Time	(0008,0030)	2	Copied from XA image without change
Accession Number	(0008,0050)	2	Copied from XA image without change
Referring Physician's Name	(0008,0090)	2	Copied from XA image without change
Study Description	(0008,1030)	3	Copied from XA image without change
Procedure Code Sequence	(0008,1032)	3	Copied from XA image without change
>Code Value	(0008,0100)	1C	Copied from XA image without change
>Coding Scheme Designator	(0008,0102)	1C	Copied from XA image without change
>Code Meaning	(0008,0104)	1C	Copied from XA image without change
Name of Physician(s) Reading Study	(0008,1060)	3	Copied from XA image without change
Study Instance UID	(0020,000D)	1	Copied from XA image without change
Study ID	(0020,0010)	2	Copied from XA image without change

5.6.3.2 PATIENT STUDY MODULE

TABLE 5-5
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Copied from XA image without change
Patient's Size	(0010,1020)	3	Copied from XA image without change
Patient's Weight	(0010,1030)	3	Copied from XA image without change

5.6.4 SERIES ENTITY

5.6.4.1 GENERAL SERIES MODULE

TABLE 5-6
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Series Date		(0008,0021)	DA	1	3	Date of the creation of the object
Series Time		(0008,0031)	TM	1	3	Time of the creation of the object
Modality		(0008,0060)	CS	1	1	"XA"
Source Modality	GEMS_3D_XA_01	(0031,xx07)	CS	1	1	"XA"
Series Description		(0008,103E)	LO	1	3	Describe the series, and contains references for the source image to help identification in Advantage Windows Browser
Performing Physician's Name		(0008,1050)	PN	1-N	3	Copied from XA image without change
Operators' Name		(0008,1070)	PN	1-N	3	Copied from XA image without change
Protocol Name		(0018,1030)	LO	1	3	"INNOVA 3D NOSUB" or "INNOVA 3D CT NOSUB"
Patient Position		(0018,5100)	CS	1	2C	Copy from original image: tag (0019,xxC7)
Series Instance UID		(0020,000E)	UI	1	1	Application generated unique ID
Series Number		(0020,0011)	IS	1	2	Copy from original image: tag (0020,0013)
Laterality		(0020,0060)	CS	1	2C	Copied from XA image without change
Smallest Pixel Value in Series		(0028,0108)	SS	1	3	Calculated by the application.
Largest Pixel Value in Series		(0028,0109)	SS	1	3	Calculated by the application.
Request Attributes Sequence		(0040,0275)	SQ	1	3	Copied from XA image without change
>Requested Procedure Description		(0032,1060)	LO	1	3	Copied from XA image without change
>Scheduled Procedure Step Description		(0040,0007)	LO	1	3	Copied from XA image without change

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Scheduled Protocol Code Sequence		(0040,0008)	SQ	1	3	Copied from XA image without change
>>Code Value		(0008,0100)	SH	1	1C	Copied from XA image without change
>>Coding Scheme Designator		(0008,0102)	SH	1	1C	Copied from XA image without change
>>Code Meaning		(0008,0104)	LO	1	1C	Copied from XA image without change
>Scheduled Procedure Step ID		(0040,0009)	SH	1	1C	Copied from XA image without change
>Requested Procedure ID		(0040,1001)	SH	1	1C	Copied from XA image without change
Related Series Sequence		(0008,1250)	SQ	1	3	Contains one item for each volume generated simultaneously with this volume.
>Study Instance UID		(0020,000D)	UI	1	1	Contains the Study UID of the additional volume, it's the same for all the volumes
>Series Instance UID		(0020,000E)	UI	1	1	For each item, it contains the Series UID of the additional volume
>Purpose of Reference Code Sequence		(0040,A170)	SQ	1-N	3	One item only
>>Code Value		(0008,0100)	SH	1	1C	"INNOVA-050" for a mask volume item "INNOVA-051" for a contrast volume item "INNOVA-052" for a subtracted volume item
>>Coding Scheme Designator		(0008,0102)	SH	1	1C	“99GEMS”
>>Code Meaning		(0008,0104)	LO	1	1C	Value can be: "3D Mask Series Simultaneously Reconstructed" "3D Contrast Series Simultaneously Reconstructed" "3D Subtracted Series Simultaneously Reconstructed"

5.6.4.2 FRAME OF REFERENCE MODULE

TABLE 5-7
FRAME OF REFERENCE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Application generated unique ID
Position Reference Indicator	(0020,1040)	2	""

5.6.5 EQUIPMENT ENTITY

5.6.5.1 GENERAL EQUIPMENT MODULE

TABLE 5-8
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	"GE MEDICAL SYSTEMS"
Institution Name	(0008,0080)	3	Copied from XA image without change
Institution Address	(0008,0081)	3	Copied from XA image without change
Station Name	(0008,1010)	3	Station Name of the Advantage Windows
Manufacturer's Model Name	(0008,1090)	3	Model Name of the Advantage Windows
Device Serial Number	(0018,1000)	3	Serial Number of the Advantage Windows
Software Version(s)	(0018,1020)	3	Version of the Innova3DXR 1.2 application
Date of Last Calibration	(0018,1200)	3	Copy from original image: tag (0021,xx04)
Time of Last Calibration	(0018,1201)	3	Copy from original image: tag (0021,xx05)

5.6.6 PRIVATE IMAGE ENTITY

5.6.6.1 GENERAL IMAGE MODULE

TABLE 5-9
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Content Date	(0008,0023)	2C	Date of the creation of the object
Content Time	(0008,0033)	2C	Date of the creation of the object
Source Image Sequence	(0008,2112)	3	Contains 1 item
>Referenced SOP Class UID	(0008,1150)	1C	Copy from original image: tag (0008,0016)
>Referenced SOP Instance UID	(0008,1155)	1C	Copy from original image: tag (0008,0018)
Instance Number	(0020,0013)	2	Zero-based number of current slice
Image Comments	(0020,4000)	3	"Slice " + <zero-based number of current slice>
Acquisition Date	(0008,0022)	3	Copied from XA image without change
Acquisition Time	(0008,0032)	3	Copied from XA image without change
Derivation Description	(0008,2111)	3	"3D Reconstruction from Rotational 2D Projection Xray Angiograpy"
Images in Acquisition	(0020,1002)	3	Computed from algorithm output
Burned In Annotations	(0028,0301)	3	"NO"
Lossy Image Compression	(0028,2110)	3	"00"
Image type	(0008,0008)	1	Refer to CT Image module, 5.6.6.7

5.6.6.2 IMAGE PLANE MODULE

TABLE 5-10
IMAGE PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Computed from algorithm output
Image Orientation (Patient)	(0020,0037)	1	Calculated by the application based on XA image tag (0019,xxC7), private creator "GEMS_DL_IMG_01"
Image Position (Patient)	(0020,0032)	1	Calculated by the application based on XA image tag (0019,xxC7), private creator "GEMS_DL_IMG_01"
Slice Thickness	(0018,0050)	2	Computed from algorithm output
Slice Location	(0020,1041)	3	Computed from algorithm output

5.6.6.3 IMAGE PIXEL MODULE

TABLE 5-11
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Rows	(0028,0010)	1	Computed from algorithm output
Columns	(0028,0011)	1	Computed from algorithm output
Pixel representation	(0028,0103)	1	"1"
Smallest Image Pixel Value	(0028,0106)	3	Computed from algorithm output
Largest Image Pixel Value	(0028,0107)	3	Computed from algorithm output
Pixel Data	(7FE0,0010)	1	Pixel data of the current slice
Samples per pixel	(0028,0002)	1	Refer to CT Image module, 5.6.6.7
Photometric interpretation	(0028,0004)	1	Refer to CT Image module, 5.6.6.7
Bits allocated	(0028,0100)	1	Refer to CT Image module, 5.6.6.7
Bits stored	(0028,0101)	1	Refer to CT Image module, 5.6.6.7
High bit	(0028,0102)	1	Refer to CT Image module, 5.6.6.7

5.6.6.4 CONTRAST BOLUS MODULE

TABLE 5-12
CONTRAST BOLUS MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Contrast/Bolus Agent		(0018,0010)	LO	1	2	If there was a contrast injection in original image, copied from XA image without change. Otherwise not present.
Auto injection enabled	GEMS_DL_IMG_01	(0019,xxA4)	CS	1	3	“YES” if there was a contrast injection in original image. Otherwise not present.

Injection phase	GEMS_DL_IMG_01	(0019,xxA5)	CS	1	3	Copied from XA image without change
Injection delay	GEMS_DL_IMG_01	(0019,xxA6)	DS	1	3	Copied from XA image without change
Reference injection frame number	GEMS_DL_IMG_01	(0019,xxA7)	IS	1	3	Copied from XA image without change
Contrast/Bolus Start Time		(0018,1042)	TM	1	3	Copied from XA image without change
Contrast/Bolus Stop Time		(0018,1043)	TM	1	3	Copied from XA image without change
Contrast/Bolus Ingredient		(0018,1048)	CS	1	3	Copied from XA image without change

5.6.6.5 VOI LUT MODULE

TABLE 5-13
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Window center	(0028,1050)	3	“350”
Window width	(0028,1051)	3	“2000”

5.6.6.6 SOP COMMON MODULE

TABLE 5-14
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Specific character	(0008,0005)	1C	Copied from XA image without change
SOP class UID	(0008,0016)	1	"1.2.840.10008.5.1.4.1.1.2"
SOP instance UID	(0008,0018)	1	Application generated unique ID

5.6.6.7 CT IMAGE MODULE

TABLE 5-15
CT IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image type	(0008,0008)	1	"DERIVED\SECONDARY\AXIAL\3DANGIO"
Samples per pixel	(0028,0002)	1	"1"
Photometric interpretation	(0028,0004)	1	"MONOCHROME2"
Bits allocated	(0028,0100)	1	"16"
Bits stored	(0028,0101)	1	"16"
High bit	(0028,0102)	1	"15"

Rescale Intercept	(0028,1052)	1	"-1000"
Rescale Slope	(0028,1053)	1	"1"
Rescale Type	(0028,1054)	3	"US"
KVP	(0018,0060)	2	""
Acquisition Number	(0020,0012)	2	Copy from original image: tag (0020,0013)

5.6.6.8 X-RAY 3D ANGIOGRAPHIC IMAGE CONTRIBUTING SOURCES MODULE

TABLE 5-16
X-RAY 3D ANGIOGRAPHIC IMAGE CONTRIBUTING SOURCES MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
Contributing Sources Sequence		(0018,9506)	SQ	1	3	Contains 1 item
>Contributing SOP Instances Reference Sequence		(0020,9529)	SQ	1	3	Copied if present in the original image
>>Study Instance UID		(0020,000D)	UI	1	3	Copied from XA image without change
>>Referenced Series Sequence		(0008,1115)	SQ	1	3	Copied from XA image without change
>>>Series Instance UID		(0020,000E)	UI	1	3	Copied from XA image without change
>>>Series Number		(0020,0011)	IS	1	3	Copied from XA image without change
>>>Referenced Instance Sequence		(0008,114A)	SQ	1	3	Copied from XA image without change
>>>>Referenced SOP Class UID		(0008,1150)	UI	1	3	Copied from XA image without change
>>>>Referenced SOP Instance UID		(0008,1155)	UI	1	3	Copied from XA image without change
>>>>Instance Number		(0020,0013)	IS	1	3	Copied from XA image without change
>Manufacturer		(0008,0070)	LO	1	3	Copy from original image: tag (0008,0070)
>Manufacturer's Model Name		(0008,1090)	LO	1	3	Copied if present in the original image: tag (0008,1090)
>Device Serial Number		(0018,1000)	LO	1	3	Copied if present in the original image: tag (0018,1000)
>Software Versions		(0018,1020)	LO	1-N	3	Copied if present in the original image: tag (0018,1020)

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Acquisition Datetime		(0008,002A)	DT	1	3	Copied if present in the original image Acquisition date (0008,0022) and time (0008,0032) in format "YYYYMMDDHHMMSS"
>Acquisition Date		(0008,0022)	DA	1	3	Copy from original image: tag (0008,0022)
>Acquisition Time		(0008,0032)	TM	1	3	Copy from original image: tag (0008,0032)
>Station Name		(0008,1010)	SH	1	3	Copied if present in the original image: tag (0008,1010)
>Operators' Name		(0008,1070)	PN	1-N	3	Copied if present in the original image: tag (0008,1070)
>Protocol Name		(0018,1030)	LO	1	3	Copied if present in the original image: tag (0018,1030)
>Acquisition Protocol Name		(0018,9423)	LO	1	3	Copied if present in the original image: tag (0019,xxB3)
>Rows		(0028,0010)	US	1	3	Copy from original image: tag (0028,0010)
>Columns		(0028,0011)	US	1	3	Copy from original image: tag (0028,0011)
>Bits Stored		(0028,0101)	US	1	3	Copy from original image: tag (0028,0101)
>Plane Identification		(0018,9457)	CS	1	3	Copied if present in the original image "MONOPLANE", "PLANE A" or "PLANE B"
>Imager Pixel Spacing		(0018,1164)	DS	2	3	Copied if present in the original image: tag (0018,1164)
>Ip address	DLX_SERIE_01	(0019,xx20)	LO	1	3	Copy from original image: tag (0019,xx20)

5.6.6.9 X-RAY 3D ANGIOGRAPHIC ACQUISITION MODULE

TABLE 5-17
X-RAY ANGIOGRAPHIC ACQUISITION MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
X-Ray 3D Acquisition Sequence		(0018,9507)	SQ	1	3	Contains 1 item
>Field of View Shape		(0018,1147)	CS	1	3	Copied if present in the original image

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>X-Ray Receptor Type		(0018,9420)	CS	1	3	Copied if present in the original image
>Frame Time Vector		(0018,1065)	DS	1-N	3	Copied from XA image without change
>Frame Delay		(0018,1066)	DS	1	3	Copied from XA image without change
>kVp actual vector	GEMS_DL_IMG_01	(0019,xxAF)	DS	1-N	3	Copied from XA image without change
>mAs actual vector	GEMS_DL_IMG_01	(0019,xxB0)	DS	1-N	3	Copied from XA image without change
>pw actual vector	GEMS_DL_IMG_01	(0019,xxC2)	DS	1-N	3	Copied from XA image without change
>Contrast/Bolus Agent		(0018,0010)	LO	1	3	Copied if present in the original image
>Auto injection enabled	GEMS_DL_IMG_01	(0019,xxA4)	CS	1	3	Copied from XA image without change
>Injection phase	GEMS_DL_IMG_01	(0019,xxA5)	CS	1	3	Copied from XA image without change
>Injection delay	GEMS_DL_IMG_01	(0019,xxA6)	DS	1	3	Copied from XA image without change
>Reference injection frame number	GEMS_DL_IMG_01	(0019,xxA7)	IS	1	3	Copied from XA image without change
>Filter Material		(0018,7050)	CS	1-N	3	Copied if present in the original image
>Filter Thickness Minimum		(0018,7052)	DS	1-N	3	Copied if present in the original image: tag (0019,xxC4)
>Filter Thickness Maximum		(0018,7054)	DS	1-N	3	Copied if present in the original image: tag (0019,xxC4)
>Table Motion		(0018,1134)	CS	1	3	Copied from XA image without change
>Positioner Motion		(0018,1500)	CS	1	3	Copied from XA image without change
>Positioner Primary Angle		(0018,1510)	DS	1	3	Copied from XA image without change
>Positioner Secondary Angle		(0018,1511)	DS	1	3	Copied from XA image without change
>Positioner Primary Angle Increment		(0018,1520)	DS	1-N	3	Copied from XA image without change
>Positioner Secondary Angle Increment		(0018,1521)	DS	1-N	3	Copied from XA image without change
>Angle value 1	DLX_SERIE_01	(0019,xx01)	DS	1	3	Copied from XA image without change
>Angle value 2	DLX_SERIE_01	(0019,xx02)	DS	1	3	Copied from XA image without change

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Angle value 3	DLX_SERIE_01	(0019,xx03)	DS	1	3	Copied from XA image without change
>Angle 1 increment	GEMS_DL_IMG_01	(0019,xx97)	DS	1-N	3	Copied from XA image without change
>Angle 2 increment	GEMS_DL_IMG_01	(0019,xx98)	DS	1-N	3	Copied from XA image without change
>Angle 3 increment	GEMS_DL_IMG_01	(0019,xx99)	DS	1-N	3	Copied from XA image without change
>Field of View Dimension(s) in Float		(0018,9461)	FL	1-2	3	Copied if present in the original image: tag (0019,xx0B)
>Field of View Dimension(s)		(0018,1149)	IS	1-2	3	Copy from original image: tag (0018,1149)
>Grid		(0018,1166)	CS	1	3	Copied if present in the original image: tag (0018,1166)
>KVP		(0018,0060)	DS	1	3	Copied if present in the original image: tag (0018,0060)
>X-Ray Tube Current in mA		(0018,9330)	FD	1	3	Copied if present in the original image: tag (0018,1151)
>Exposure Time in ms		(0018,9328)	FD	1	3	Copied if present in the original image: tag (0018,1150)
>Exposure in mAs		(0018,9332)	FD	1	3	Copied if present in the original image: tag (0018,1152)
>Intensifier Size		(0018,1162)	DS	1	3	Copy from original image: tag (0018,1162)
>Distance Source to Detector		(0018,1110)	DS	1	3	Copied if present in the original image: tag (0018,1110)
>Distance Source to Isocenter		(0018,9402)	FL	1	3	Copied if present in the original image: tag (0018,1111)
>Focal Spot		(0018,1190)	DS	1	3	Copied if present in the original image: tag (0018,1190)
>Filter Type		(0018,1160)	SH	1	3	Copied if present in the original image: tag (0018,1160)
>Table Angle		(0018,1138)	DS	1	3	Copy from original image: tag (0018,1138)
>Table vertical position	DLX_SERIE_01	(0019,xx21)	DS	1	3	Copy from original image: tag (0019,xx21)

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Table longitudinal position	DLX_SERIE_01	(0019,xx22)	DS	1	3	Copy from original image: tag (0019,xx22)
>Table lateral position	DLX_SERIE_01	(0019,xx23)	DS	1	3	Copy from original image: tag (0019,xx23)
>table rotation angle	GEMS_DL_IMG_01	(0019,xxEA)	FL	1	3	Copy from original image: tag (0019,xxEA)
>table cradle tilt angle	GEMS_DL_IMG_01	(0019,xxBC)	FL	1	3	Copy from original image: tag (0019,xxBC)
>Table X Position to Isocenter	GEMS_DL_IMG_01	(0019,xxEB)	FL	1	3	Copy from original image: tag (0019,xxEB)
>Table Y Position to Isocenter	GEMS_DL_IMG_01	(0019,xxEC)	FL	1	3	Copy from original image: tag (0019,xxEC)
>Table Z Position to Isocenter	GEMS_DL_IMG_01	(0019,xxED)	FL	1	3	Copy from original image: tag (0019,xxED)
>Preselected pivot rotation speed	GEMS_DL_IMG_01	(0019,xxC5)	FL	1	3	Copy from original image: tag (0019,xxC5)
>3Dspin expected number of frames	GEMS_DL_IMG_01	(0019,xxCA)	IS	1	3	Copy from original image: tag (0019,xxCA)
>Acquisition Positioner Calibration Date	GEMS_3D_XA_01	(0031,xx09)	DA	1	3	Copy from original image: tag (0021,xx04)
>Acquisition Positioner Calibration Time	GEMS_3D_XA_01	(0031,xx0A)	TM	1	3	Copy from original image: tag (0021,xx05)
>Positioner Calibration Out of Date Status	GEMS_3D_XA_01	(0031,xx0B)	CS	1	3	Derived from XA image tag (0019,xxC9), private creator "GEMS_DL_IMG_01". "0" or "1"

5.6.6.10 X-RAY 3D RECONSTRUCTION MODULE

TABLE 5-18
X-RAY 3D RECONSTRUCTION MODULE ATTRIBUTES

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
X-Ray 3D Reconstruction Sequence		(0018,9530)	SQ	1	3	Contains 1 item
>Reconstruction Description		(0018,9531)	LO	1	3	Reconstruction description based on user settings and input sequence parameters
>Application Name		(0018,9524)	LO	1	3	Name of the Innova3DXR 1.2 application
>Application Version		(0018,9525)	LO	1	3	Version of the Innova3DXR 1.2 application
>Application Manufacturer		(0018,9526)	LO	1	3	"GE MEDICAL SYSTEMS"
>Algorithm Type		(0018,9527)	CS	1	3	"FILTER_BACK_PROJ"
>Algorithm Description		(0018,9528)	LO	1	3	Output by the reconstruction algorithm

Attribute Name	Private Creator	Tag	VR	VM	Type	Attribute Description
>Algorithm Version	GEMS_3D_XA_01	(0031,xx08)	LO	1	3	Output by the reconstruction algorithm
>Acquisition Index		(0020,9518)	US	1-N	3	"1"
>Structure Of Interest	GEMS_3D_XA_01	(0031,xx01)	CS	1	3	Copy from original image: tag (0019,xxC8)
>Missing Frames Status	GEMS_3D_XA_01	(0031,xx02)	CS	1	3	"0" or "1"
>Anatomy	GEMS_3D_XA_01	(0031,xx03)	CS	1	3	Copy from original image: tag (0019,xxC6)
>Volume Subtraction Mode	GEMS_3D_XA_01	(0031,xx04)	CS	1	3	"NOSUB"
>Reconstruction Flitering Selection	GEMS_3D_XA_01	(0031,xx05)	CS	1	3	"0" "1" "2" "3" "4"
>Volume Internal Upscan Method	GEMS_3D_XA_01	(0031,xx06)	CS	1	3	"0" "1"
>3Dspin phase	GEMS_3D_XA_01	(0031,xx20)	CS	1	3	“MASK” or “CONTRAST”