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GE Medical Systems

Technical Publications

Direction 2259903-100
Revision 1

Advantage 3D XR 2.0 CONFORMANCE STATEMENT for DICOM V3.0

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REVISION HISTORY

REV	DATE	REASON FOR CHANGE
1	November 1999	First release (M3). Document derives from Advantage 3D XR 1.0 Dicom Conformance Statement, rev 2.

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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

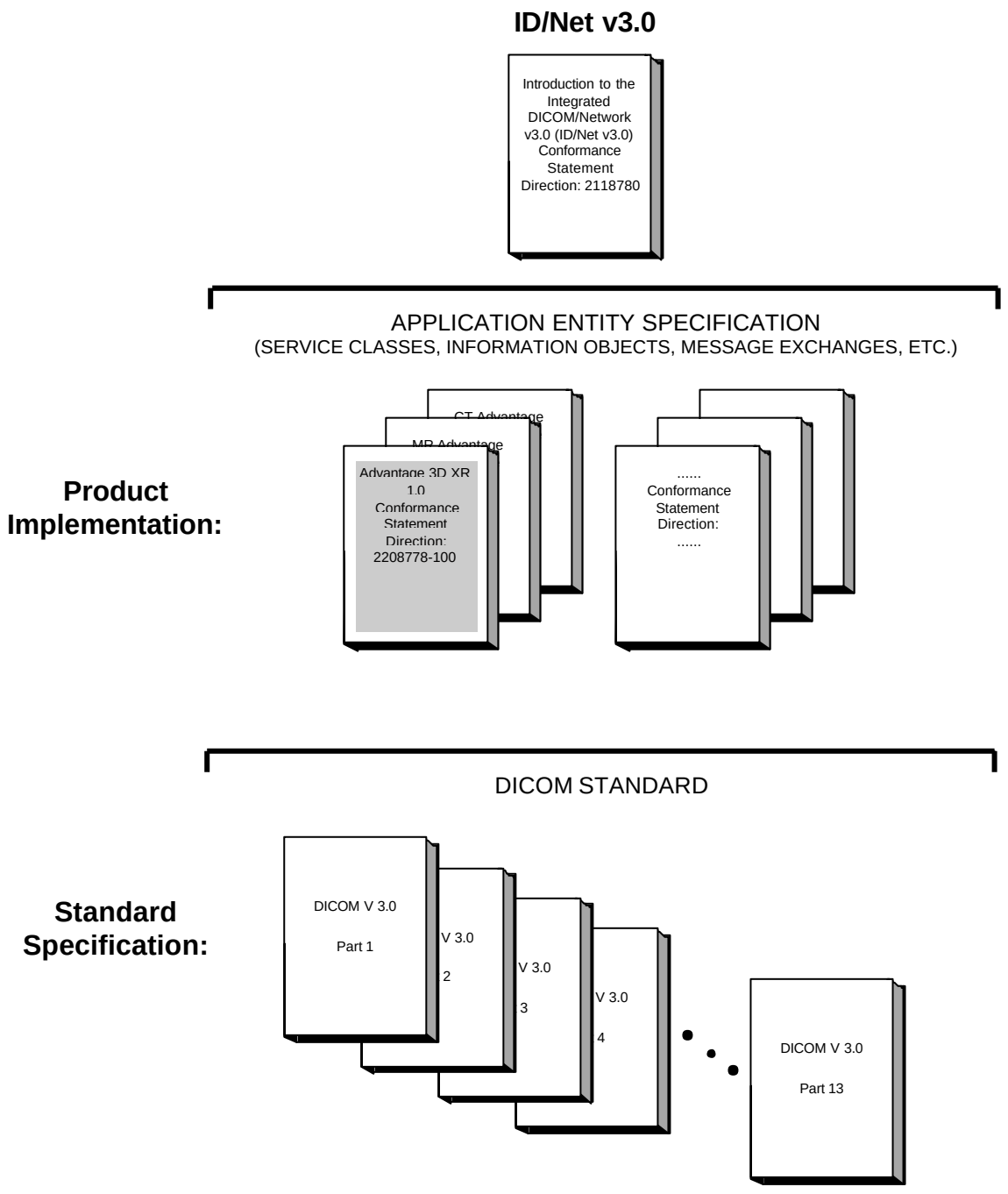
Section 2 (Network Conformance Statement), which specifies the Advantage 3D XR 1.0 compliance to the DICOM requirements for the implementation of Networking features.

Section 3 (X-Ray Angiography Information Object Implementation), which specifies the Advantage 3D XR 1.0 compliance to DICOM requirements for the implementation of a X-ray Angiography Information Object.

Section 4 (3D Model Information Object Implementation), which specifies the Advantage 3D XR 1.0 compliance to DICOM requirements for the implementation of a 3D Model Information Object (GEMS private DICOM Information Object).

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

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



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

Advantage 3D XR 2.0
Conformance Statement for DICOM v3.0
*Direction **2259903-100***

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 v3.0, copies of the Standard may be obtained by written request or phone by contacting:

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

1.3 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

1.4 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.

1.5 IMPORTANT REMARKS

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

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

- **Validation** - Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications.

  Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM v3.0 Standard. DICOM v3.0 will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM v3.0 as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM v3.0. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) reflected on by these DICOM Conformance Statements**. The **user** should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

- **To be informed of the evolution of the implementation described in this document, the User is advised to regularly check the GE Internet Server,**

accessible via anonymous ftp (GE Internet Server Address: ftp.med.ge.com, 192.88.230.11).

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

1.6 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) and DICOM supplement 4 (X-ray Angiography Objects).

1.7 DEFINITIONS

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

1.8 SYMBOLS AND ABBREVIATIONS

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

2. CONFORMANCE STATEMENT EXTENSION

2.1 INTRODUCTION

This conformance statement extension describes additional functionality of feature Advantage 3D XR above and beyond the DICOM Conformance with Standard Storage SOP Classes provided by product Advantage Workstation 3.1 described in :

Advantage Workstation 3.1 DICOM Conformance Statement
Direction 2201403-100

This additional functionality is only available if the stored images meet the additional requirements described here. Since conformance with this additional functionality is beyond the scope of the DICOM Standard to define, the Standard SOP Classes are used, rather than defining Private SOP Classes, to promote interoperability. The DICOM Standard only specifies the requirements to store an image, not how the image should be used in an application.

If images are supplied by an Storage SCU without this additional information, then the additional functionality described herein will not be available. The Storage SCU may however, still be fully conformant to the DICOM Standard, and failure to interoperate with this application cannot be construed as non-conformance to the Standard.

Advantage 3D XR 2.0 is a X-ray Angiography application which is installed on the same hardware platform as the base application, Advantage Workstation 3.1. It provides high quality vessel 3D reconstructions from digital subtracted spin acquisitions of cerebral arteries.

It is applicable to images acquired with the LCN+, LCV+ and LCA+ 3D Spin protocol, which are X-Ray multiframe images. Any such sequence transferred from DLX (see DLX DICOM V3.0 Conformance Statement, direction 2142506-100), to the Advantage Workstation 3.1 is automatically processed. It can provide either:

- 3D models, which are private DICOM information objects. Such model is stored into the Advantage Workstation database. It can be loaded and displayed by other GEMS applications (such as Voxtool), filmed and exported to other Advantage Workstations. Any transfer syntax supported by Advantage Workstation 3.1 is also supported by Advantage 3D XR. The detailed description of the DICOM XA IOD required to reconstruct a 3 dimensional model is given in Section 3. The detailed description of the private IOD that contains the 3D volume is given in Section 4.
- A calibration result, which is a private DICOM information object. Such result is stored into the

Advantage Workstation database for further use by Advantage 3D XR application to produce 3D models. A calibration result is completely unvisible to the user of Advantage Workstation. It can not be displayed, filmed or networked in any way, thus it is not described in this document.

Any 3D model generated by Advantage 3D XR application is conform to the definition of a GEMS private DICOM information object. Please refer to the following document for a full description of this private object.

Voxtool 2.0 DICOM Conformance Statement
Direction 2198583-100

2.2 APPLICATION SPECIFICATIONS

2.2.1 Networking Specifications

The Advantage Workstation 3.1 Application, using the DICOM SERVER Application Entity specified in the Advantage Workstation 3.1 DICOM Conformance Statement, provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCP**:

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

In addition to the above SOP Classes, the DICOM SERVER Application Entity also provides Standard Conformance to the SOP Classes described in Section 2.2 of the Advantage Workstation 3.1 DICOM Conformance Statement.

The Advantage Workstation 3.1 Application, using the DICOM SERVER Application Entity specified in the Advantage Workstation 3.1 DICOM Conformance Statement, provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCU**:

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

In addition to the above SOP Classes, the DICOM SERVER Application Entity also provides Standard Conformance to the SOP Classes described in Section 2.3 of the Advantage Workstation 3.1 DICOM Conformance Statement.

2.2.2 Media Interchange Specifications

The Advantage Workstation 3.1 Application, using CDR/CDROM DICOM Media Server Application Entity specified in the Advantage Workstation 3.1 DICOM Conformance Statement, provides Standard Conformance to the following DICOM V3.0 Application Profiles as an **FSC**:

Media Storage Application Profile	SOP Class Name	SOP Class UID

STD-GEN-CD	GE Private 3D Model Image Storage	1.2.840.113619.4.26

In addition to the above Media Storage Application Profile and SOP Classes, the using CDR/CDROM DICOM Media Server AE also provides Standard Conformance to the SOP Classes described in Section 3.2 of the Advantage Workstation 3.1 DICOM Conformance Statement.

The Advantage Workstation 3.1 Application, using CDR/CDROM DICOM Media Server Application Entity specified in the Advantage Workstation 3.1 DICOM Conformance Statement, provides Standard Conformance to the following DICOM V3.0 Application Profiles as an **FSR**:

Media Storage Application Profile	SOP Class Name	SOP Class UID
STD-GEN-CD	X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1

In addition to the above Media Storage Application Profile and SOP Classes, the CDR/CDROM DICOM Media Server Application Entity also provides Standard Conformance to the SOP Classes described in Section 3.3 of the Advantage Workstation 3.1 DICOM Conformance Statement.

2.2.3 Implementation Identifying Information

The Implementation UID for this Application is:

Advantage 3D XR Implementation UID	1.2.840.113619.6.56

2.3 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

2.3.1 Standard Extended /Private SOPs

2.3.1.1 Standard Extended X-Ray Angiographic Image SOP Class

Refer to Section 3 for a description of the Standard Extended X-Ray Angiographic Image SOP class supported by Advantage 3D XR application.

2.3.1.2 Private 3D Model SOP Class

Refer to section 4 for a description of the Private 3D Model SOP class generated by Advantage 3D XR application.

2.4 SUPPORT OF EXTENDED CHARACTER SETS

The Advantage 3D XR Application will support only the ISO_IR 100 (ISO 8859-1:1987 Latin alphabet N 1. supplementary set) as extended character sets. Any incoming SOP instance that is encoded using another extended character set will not be supported by the Application.

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

3.1 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:

3.2 - IOD Description

3.3 - IOD Entity-Relationship Model

3.4 - IOD Module Table

3.5 - IOD Module Definition

3.2 XA IOD IMPLEMENTATION

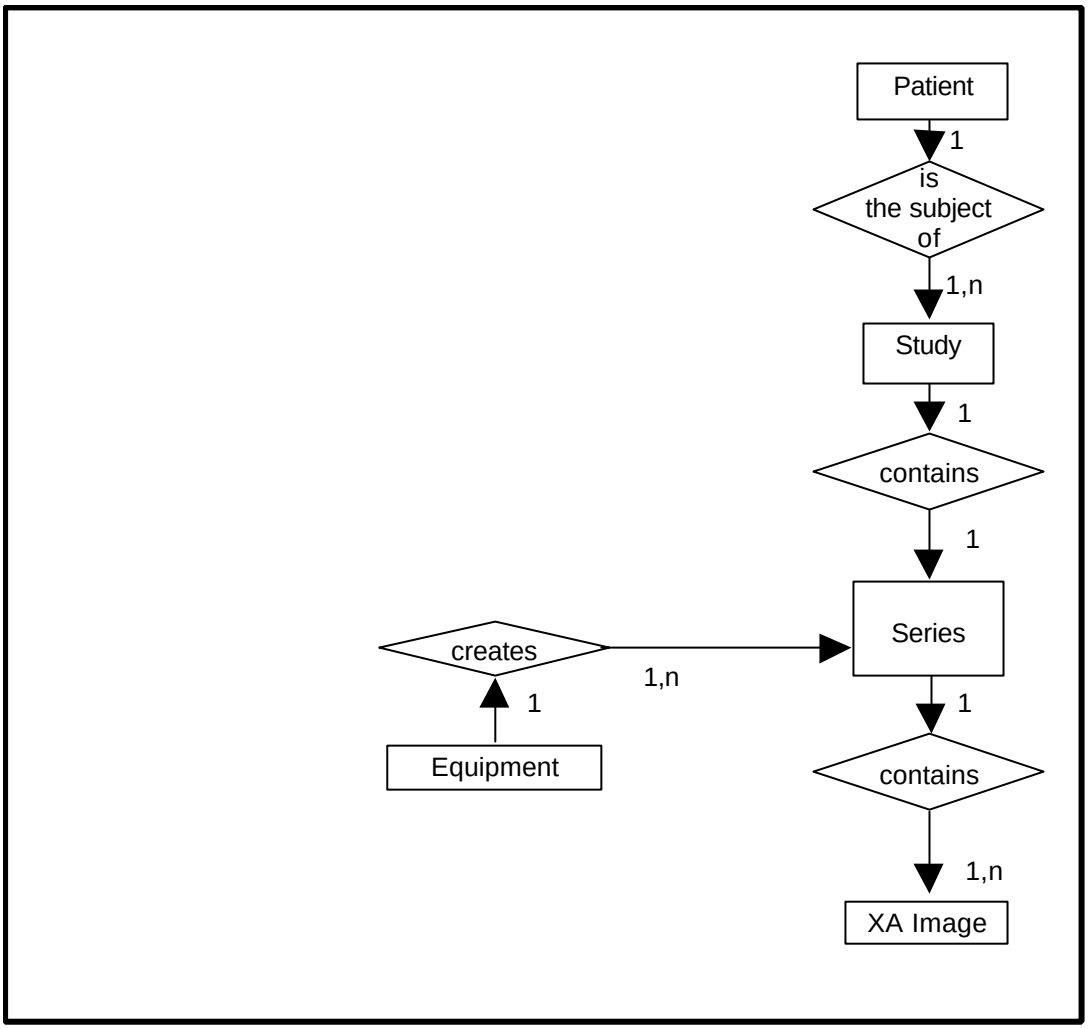
3.3 XA ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the XA Image interoperability schema is shown in Illustration 3.3-1**.** 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. In other words, the relationship between Series and Image can have up to n Images per Series, but the Patient to Study relationship has 1 Study for each Patient (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).

ILLUSTRATION 3.3-1
XA IMAGE ENTITY RELATIONSHIP DIAGRAM



3.3.1 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.

3.3.2 Advantage 3D XR Mapping of DICOM entities

TABLE 3.3-1
MAPPING OF DICOM ENTITIES TO ADVANTAGE 3D XR ENTITIES

DICOM	Advantage 3D XR Entity
Patient	Patient (DLX)
Study	Exam (DLX)
Series	Exam (DLX)
Image	Series (DLX)
Frame	Image (DLX)

3.4 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 3.4-1 identifies the defined modules within the entities which comprise the DICOM v3.0 XA IOD. Modules are identified by Module Name.

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

TABLE 3.4-1
XA IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	3.5.1.1
Study	General Study	3.5.2.1
	Patient Study	3.5.2.2
Series	General Series	3.5.3.1
Equipment	General Equipment	3.5.4.1
Image	General Image	3.5.5.1
	Image Pixel	3.5.5.2
	Contrast/Bolus	3.5.5.3
	Cine	3.5.5.4
	Multi-frame	3.5.5.5
	Mask	3.5.5.6
	X-Ray Image	3.5.7.1
	X-Ray Acquisition	3.5.7.2
	X-Ray Table	3.5.7.3
	XA Positioner	3.5.7.4
	SOP Common	3.5.6.1

3.5 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).

Advantage 3D XR is an application which computes a 3D reconstructed image from an original XA DICOM Object found on the database of Advantage Workstation. Since the reconstruction

algorithm needs to know many elements that characterize the acquisition, several optional tags are required when the image is to be processed with Advantage 3D XR.

Today, only DLX images are supported by Advantage 3D XR application.

Only the attributes used or required by Advantage 3D XR application are described. Attribute description is either Used, Required or the value (or values) supported by the application.

3.5.1 Common Patient Entity Modules

3.5.1.1 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 3.5-1
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Used
Patient ID	(0010,0020)	2	Used
Patient's Birth Date	(0010,0030)	2	Used
Patient's Sex	(0010,0040)	2	Used
Patient's Birth Time	(0010,0032)	3	Used

3.5.2 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.

3.5.2.1 General Study Module

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

TABLE 3.5-2
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Required
Study Date	(0008,0020)	2	Used
Study Time	(0008,0030)	2	Used
Referring Physician's Name	(0008,0090)	2	Used
Study ID	(0020,0010)	2	Used
Accession Number	(0008,0050)	2	Used
Study Description	(0008,1030)	3	Used

3.5.2.2 Patient Study Module

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

TABLE 3.5-3
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Age	(0010,1010)	3	Used
Patient's Weight	(0010,1030)	3	Used

3.5.3 Common Series Entity Modules

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

3.5.3.1 General Series Module

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

TABLE 3.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	XA
Series Instance UID	(0020,000E)	1	Required
Series Number	(0020,0011)	2	Required, to allow differenciation of elements in the display queue
Laterality	(0020,0060)	2C	Used
Series Date	(0008,0021)	3	Required, for associating appropriate calibration data
Series Time	(0008,0031)	3	Required, for associating appropriate calibration data
Performing Physicians' Name	(0008,1050)	3	Used
Series Description	(0008,103E)	3	Used

3.5.4 Common Equipment Entity Modules

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

3.5.4.1 General Equipment Module

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

TABLE 3.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	GE MEDICAL SYSTEMS
Institution Name	(0008,0080)	3	Used
Manufacturer's Model Name	(0008,1090)	3	DLX
Device Serial Number	(0018,1000)	3	Required, for management of several acquisition systems
DLX_IP_address	(0019,xx20)	3	Used, for sending back positioner angles

3.5.4.1.1 General Equipment Attribute Descriptions

3.5.5 Common Image Entity Modules

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

3.5.5.1 General Image Module

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

TABLE 3.5-6
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Required, to allow differenciation of elements in the display queue
Image Date	(0008,0023)	2C	Required, for associating appropriate calibration data
Image Time	(0008,0033)	2C	Required, for associating appropriate calibration data

3.5.5.1.1 General Image Attribute Descriptions

3.5.5.2 Image Pixel Module

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

TABLE 3.5-7
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Rows	(0028,0010)	1	512
Columns	(0028,0011)	1	512
Bits Allocated	(0028,0100)	1	16
Bits Stored	(0028,0101)	1	10
High Bit	(0028,0102)	1	9
Pixel Data	(7FE0,0010)	1	Required, for 3D reconstruction

3.5.5.3 Contrast/Bolus Module

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

TABLE 3.5-8
CONTRAST/BOLUS MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	Used
Contrast/Bolus Route	(0018,1040)	3	Used
Contrast/Bolus Volume	(0018,1041)	3	Used
Contrast/Bolus Start Time	(0018,1042)	3	Used
Contrast/Bolus Stop Time	(0018,1043)	3	Used
Contrast/Bolus Total Dose	(0018,1044)	3	Used
Contrast Flow Rate(s)	(0018,1046)	3	Used
Contrast Flow Duration(s)	(0018,1047)	3	Used

3.5.5.4 Cine Module

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

TABLE 3.5-9
CINE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Time Vector	(0018,1065)	1C	Used
Frame Delay	(0018,1066)	3	Used

3.5.5.5 Multi-Frame Module

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

TABLE 3.5-10
MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Required
Frame Increment Pointer	(0028,0009)	1	Used

3.5.5.5.1 Multi-Frame Attribute Descriptions

3.5.5.6 Mask Module

The table in this section specifies the Attributes that describe mask operations for a Multi-frame image.

TABLE 3.5-11
MASK MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Mask Subtraction Sequence	(0028,6100)	1	Required: mask subtraction needed before reconstruction
>Mask Operation	(0028,6101)	1	AVG_SUB
>Applicable Frame Range	(0028,6102)	3	Required
>Mask Frame Numbers	(0028,6110)	1C	Required

3.5.6 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

3.5.6.1 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 3.5-12
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Required
SOP Instance UID	(0008,0018)	1	Required
Specific Character Set	(0008,0005)	1C	absent or ISO_IR 100

3.5.7 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.

3.5.7.1 X-Ray Image Module

TABLE 3.5-13
X-RAY IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1C	00181065H
Image Type	(0008,0008)	1	ORIGINAL\PRIMARY\SINGLE_PLANE
Bits Allocated	(0028,0100)	1	16
Bits Stored	(0028,0101)	1	10
High Bit	(0028,0102)	1	9

3.5.7.2 X-Ray Acquisition Module

TABLE 3.5-14
X-RAY ACQUISITION MODULE

Attribute Name	Tag	Type	Attribute Description
Intensifier Size	(0018,1162)	3	Used
Field of View Dimension(s)	(0018,1149)	3	Required, for associating appropriate calibration data
Adx_procedure_name	(0019,xx07)	3	Used
Adx_exam_name	(0019,xx08)	3	Used
Adx_injector_delay	(0019,xx10)	3	Used
Adx_acquisition_mode	(0019,xx14)	3	Required, to ensure that 3D acquisition protocol was used: should be either 28, 29, 30 or 31
Adx_record_view	(0019,xx0A)	3	Used
Adx_dose	(0019,xx1C)	3	Used

3.5.7.3 X-Ray Table Module

TABLE 3.5-15
X-RAY TABLE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Table Motion	(0018,1134)	2	Used
Table Vertical Increment	(0018,1135)	2C	Used
Table Longitudinal Increment	(0018,1137)	2C	Used
Table Lateral Increment	(0018,1136)	2C	Used
Table Angle	(0018,1138)	3	Used

3.5.7.4 XA Positioner Module

TABLE 3.5-16
XA POSITIONER MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Distance Source to Detector	(0018,1110)	3	Required: between 1190 and 1210
Positioner Motion	(0018,1500)	2C	DYNAMIC
Positioner Primary Angle	(0018,1510)	2	Required, for associating appropriate calibration data
Positioner Secondary Angle	(0018,1511)	2	Required, for associating appropriate calibration data
Positioner Primary Angle Increment	(0018,1520)	2C	Required, for associating appropriate calibration data
Positioner Secondary Angle Increment	(0018,1521)	2C	Required, for associating appropriate calibration data
Angle_value_1	(0019,xx01)	3	Used
Angle_value_2	(0019,xx02)	3	Used
Angle_value_3	(0019,xx03)	3	Used
Angle_label_1	(0019,xx04)	3	Used
Angle_label_2	(0019,xx05)	3	Used
Angle_label_3	(0019,xx06)	3	Used

3.6 PRIVATE DATA DICTIONARY

The Type of a Private Attribute is determined by the module of the IOD in which it is used, and hence is not listed in this dictionary. Any Private Attribute contained within an IOD should be described in the preceding sections in the appropriate module.

TABLE 3.6-1
PRIVATE CREATOR IDENTIFICATION (DLX_SERIE_01)

Attribute Name	Tag	VR	VM
Angle_value_1	(0019,xx01)	DS	1
Angle_value_2	(0019,xx02)	DS	1
Angle_value_3	(0019,xx03)	DS	1
Angle_label_1	(0019,xx04)	CS	1
Angle_label_2	(0019,xx05)	CS	1
Angle_label_3	(0019,xx06)	CS	1
Adx_procedure_name	(0019,xx07)	ST	1
Adx_exam_name	(0019,xx08)	ST	1
Adx_record_view	(0019,xx0A)	IS	1
Adx_injector_delay	(0019,xx10)	DS	1
Adx_acquisition_mode	(0019,xx14)	IS	1
Adx_camera_rotation_enable	(0019,xx15)	CS	1
Adx_reverse_sweep	(0019,xx16)	CS	1
Adx_focus	(0019,xx1B)	DS	1
Adx_dose	(0019,xx1C)	CS	1
DLX_IP_address	(0019,xx20)	SH	1

4. 3D MODEL INFORMATION OBJECT IMPLEMENTATION

4.1 INTRODUCTION

This section specifies the use of the GEMS private DICOM 3D Model IOD to represent the information included in 3-dimensional volumes produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

4.2- IOD Description

4.3- IOD Entity-Relationship Model

4.4- IOD Module Table

4.5- IOD Module Definition

4.2 3D MODEL IOD IMPLEMENTATION

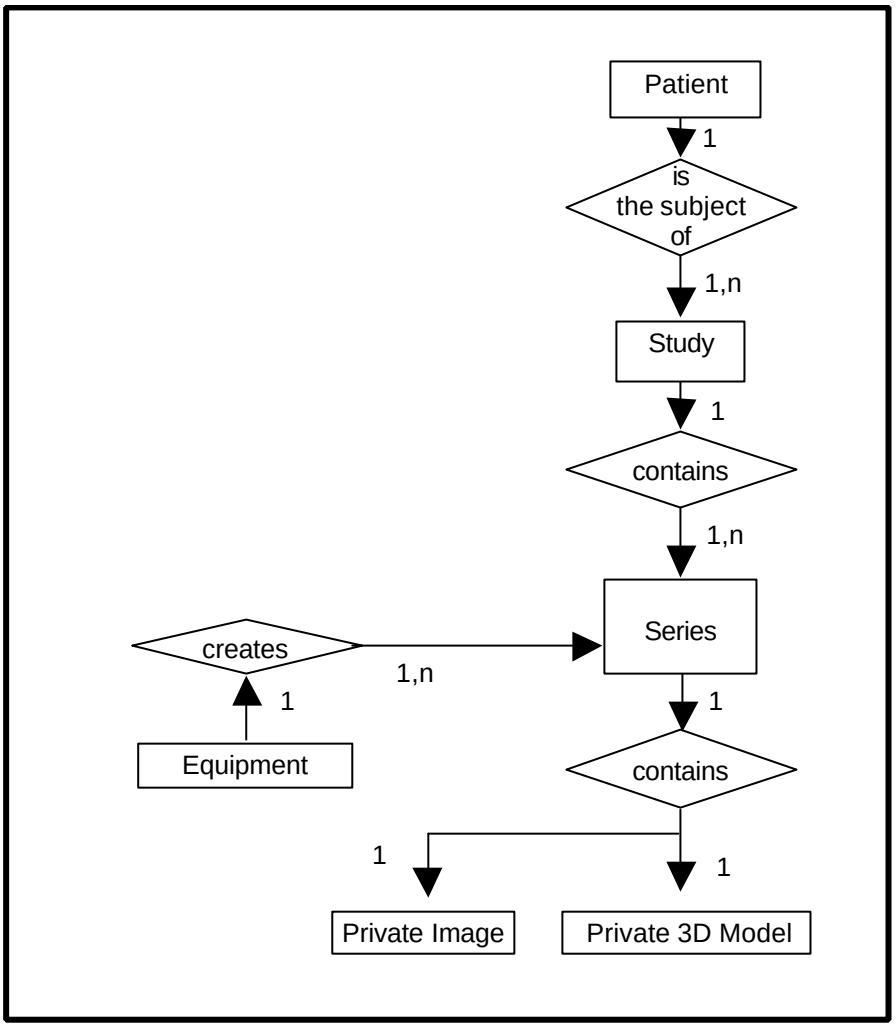
4.3 3D MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the 3D Model interoperability schema is shown in Illustration 4.3-1**.** 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. In other words, the relationship between Series and Image can have up to n Images per Series, but the Patient to Study relationship has 1 Study for each Patient (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).

ILLUSTRATION 4.3-1
3D MODEL ENTITY RELATIONSHIP DIAGRAM



4.3.1 ENTITY DESCRIPTIONS

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of the entities contained within the 3D Model Information Object (except GEMS private 3D Model and Image entities).

4.3.1.1 Private Image Entity Description

The Private Image Information Entity defines the attributes that describe the pixel data of an image that represents a view of the 3-dimensional volume generated by the application. Unlike DICOM Image Information Entity, this Private Image Information Entity does not convey modality specific characteristics : this information is already contained in the 3D Model Entity Description.

4.3.1.2 3D Model Entity Description

The 3D Model Information Entity (GEMS private) describes the 3-dimensional volume reconstructed by this application. This Information Entity also contains a description of the parameters used to achieve such reconstruction. Most of these data are

described by **DICOM v3.0 attributes**, but some of them are described by GEMS **private attributes**. A list of all private attributes defined here can be found at the end of this section.

4.3.2 Advantage 3D XR 1.0 Mapping of DICOM entities

TABLE 4.3-1
MAPPING OF DICOM ENTITIES TO ADVANTAGE 3D XR 1.0 ENTITIES

DICOM	Advantage 3D XR Entity (3D model)
Patient	Patient
Study	Exam
Series	Series
Image	Private Image

4.4 IOD MODULE TABLE

Within an entity of the GEMS private 3D Model 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 4.3-1 identifies the defined modules within the entities which comprise the 3D Model IOD. Modules are identified by Module Name.

See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes (except GEMS private ones). Note that some attributes of the 3D Model entity are GEMSE **private attributes**.

The attributes description can take one of the following values :

- Generated : this attribute is generated by the application,
- Generated : XXX : this attribute is generated by the application, its value is XXX,
- Duplicated : this attribute is a copy of the original, if present in the XA images used to generate the 3-dimensional volume. Otherwise, this attribute is saved but is empty.
- Empty : this attribute is saved but is empty,
- Not Saved : this attribute is not saved.

TABLE 4.4-2
3D MODEL IOD MODULES

Entity Name	Module Name	Reference	Usage
Patient	Patient	4.5.1.1	M
Study	General Study	4.5.2.1	M
	Patient Study	4.5.2.2	U
Series	General Series	4.5.3.1	M
Equipment	General Equipment	4.5.4.1	M
Private Image	Image Pixel	4.5.6.2	M
Private 3D Model	Common Private Entity	4.5.5.1	M
	Reconstruction Parameters	4.5.5.2	M
	> XA Reconstruction Parameters	4.5.5.3	C - required if modality XA
	XA VOI LUT	4.5.5.4	U (optional, XA modality only)
	Volumic Data	4.5.5.4	M
	SOP Common	4.5.7.1	M

4.5 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 3D Model Information Object (except GEMS private 3D Model related module).

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). **Type 3 attributes that are not mentioned are not saved** by the application.

4.5.1 Common Patient Entity Modules

4.5.1.1 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 4.5-1
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Duplicated
Patient ID	(0010,0020)	2	Duplicated
Patient's Birth Date	(0010,0030)	2	Duplicated
Patient's Sex	(0010,0040)	2	Duplicated

4.5.2 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.

4.5.2.1 General Study Module

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

TABLE 4.5-2
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Duplicated
Study Date	(0008,0020)	2	Duplicated
Study Time	(0008,0030)	2	Duplicated
Referring Physician's Name	(0008,0090)	2	Duplicated
Study ID	(0020,0010)	2	Duplicated
Accession Number	(0008,0050)	2	Duplicated
Study Description	(0008,1030)	3	Duplicated

4.5.2.2 Patient Study Module

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

TABLE 4.5-3
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description

Patient's Age	(0010,1010)	3	Duplicated
Patient's Weight	(0010,1030)	3	Duplicated

4.5.3 Common Series Entity Modules

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

4.5.3.1 General Series Module

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

TABLE 4.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Duplicated (can only be XA)
Series Instance UID	(0020,000E)	1	Generated: provided by Advantage Workstation
Series Number	(0020,0011)	2	Generated: duplicated from XA image number, tag (0020,0013)
Laterality	(0020,0060)	2C	Duplicated
Series Description	(0008,103E)	3	Generated: either Empty or “Coils/Clips”
Patient Position	(0018,5100)	2C	Generated: HFS

4.5.4 Common Equipment Entity Modules

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

4.5.4.1 General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced the 3D Model.

TABLE 4.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Generated: GE MEDICAL SYSTEMS
Institution Name	(0008,0080)	3	Duplicated
Station Name	(0008,1010)	3	Generated: hostname of the Advantage Workstation
Manufacturer's Model Name	(0008,1090)	3	Generated: provided by Advantage Workstation
Device Serial Number	(0018,1000)	3	Generated: provided by Advantage Workstation
Software Versions	(0018,1020)	3	Generated: Advantage 3D XR version

4.5.5 3D Model Entity Modules

The following Modules specify all the attributes which describe a 3-dimensional volume reconstructed by the application.

4.5.5.1 Common Private Entity Module

This section specifies the attributes that are common to all GEMSE Private DICOM Entities.

TABLE 4.5-6
COMMON PRIVATE ENTITY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Private Entity Number	(0039,xx80)	1	Generated: 1
Private Entity Date	(0039,xx85)	1	Generated: 3D model creation date
Private Entity Time	(0039,xx90)	1	Generated: 3D model creation time
Private Entity Launch Command	(0039,xx95)	2	Generated: « start_vxtl »
Private Entity Type	(0039,xxAA)	1	Generated: « 3DDPO »

4.5.5.1.1 Common Private Entity Attribute Descriptions

4.5.5.1.1.1 Private Entity Number

Identifies the private entity instance.

4.5.5.1.1.2 Private Entity Date

Defines the creation date of this private entity.

4.5.5.1.1.3 Private Entity Time

Defines the creation time of this private entity.

4.5.5.1.1.4 Private Entity Launch Command

Defines the command that should be called to launch the application corresponding to the Private Entity (Voxtool 2.0, in our case).

4.5.5.1.1.5 Private Entity Type

Defines the type of this private entity. Here we use the string « 3DDPO » to indicate that this private entity corresponds to a 3-dimensional volume.

4.5.5.2 Reconstruction Parameters Module

This section specifies the Attributes which describe the parameters that where used to achieve the 3-dimensional reconstruction.

Note that these attributes are **encapsulated in a private Sequence** item : we use standard attributes to code the reconstruction parameters. In DICOM Standard, these attributes are related to the Image Entity, whereas here they are related to the 3D Model Private Entity. The encapsulation avoids possible semantical confusions.

Next table gives the reconstruction parameters that do not depend on the type of the original images used to build the 3-dimensional volume. These attributes are saved for all 3D Models. The description of GEMS private attribute is given at the end of this section.

TABLE 4.5-7
RECONSTRUCTION PARAMETERS MODULE ATTRIBUTES
(FOR ALL ORIGINAL IMAGE TYPES)

Attribute Name	Tag	Type	Attribute Description
Reconstruction Parameters Sequence	(0047, xx01)	1	Generated
> Contrast/Bolus Agent	(0018,0010)	3	Duplicated
> Slice thickness	(0018, 0050)	2	Generated: 0.0 (Not revelant for XA modality)
> Spacing between Slices	(0018, 0088)	3	Generated: 0.0 (Not revelant for XA modality)
> Contrast/Bolus Route	(0018,1040)	3	Not saved
> Patient Position	(0018, 5100)	2C	Not saved (required for CT and MR only)
> Pixel Spacing	(0028, 0030)	1	Generated: 0.0\0.0 (Not relevant for XA modality)
> Pixel Padding Value	(0028, 0120)	3	Not saved
> Largest Image Value	(0028, 0107)	3	Not saved

4.5.5.3 XA Reconstruction Parameters Module

Next table gives the reconstruction parameters that are saved only when the 3-dimensional volume has been reconstructed from X-Ray Series. Hence, all these attributes are conditional type. Remember that they are all **encapsulated** in the Reconstruction Parameters Sequence attribute. The description of GEMS private attribute is given at the end of this section.

Note: This module is intended to be part of the reconstruction parameters sequence, associated to the Private 3D Model Information entity.

TABLE 4.5-8
XA RECONSTRUCTION PARAMETERS ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008, 0070)	3	Duplicated: can only be GE MEDICAL SYSTEMS
Manufacturer Model Name	(0008, 1090)	3	Duplicated: can only be DLX
Software Versions	(0018,1020)	3	Duplicated

Intensifier Size	(0018, 1162)	3	Duplicated
Series count	(0047,xx81)	1	Generated: 1
Device serial number	(0008,1000)	3	Duplicated
DLX IP address	(0019,xx20)	3	Duplicated
Acquisition DLX 2D Series Sequence	(0047, xx85)	1C	Generated
> Series Date	(0008, 0021)	3	Generated: duplicated from XA image date, tag (0008,0023)
> Series Time	(0008, 0031)	3	Generated: duplicated from XA image time, tag (0008,0033)
> Contrast Flow Rates	(0018, 1046)	3	Not saved
> Injections Duration	(0018, 1047)	3	Not saved
> Frame Delay	(0018, 1066)	3	Not saved
> Frame Time Vector	(0018, 1065)	3	Not saved
> Sid	(0018, 1110)	3	Duplicated
> Table Heigth	(0018, 1130)	3	Duplicated
> Table Traverse	(0018, 1131)	3	Duplicated
> Table Motion	(0018, 1134)	2	Duplicated
> Table Vertical Increment	(0018, 1135)	3	Not saved
> Table Lateral Increment	(0018, 1136)	3	Not saved
> Table Longitudinal Increment	(0018, 1137)	3	Not saved
> Table Angle	(0018, 1138)	3	Duplicated
> Fov	(0018, 1149)	3	Duplicated
> Positioner Motion	(0018, 1500)	2C	Duplicated
> Positioner Primary Angle	(0018,1510)	3	Duplicated
> Positioner Secondary Angle	(0018,1511)	3	Duplicated
> Positioner Primary Angle Increment	(0018,1520)	3	Duplicated
> Positioner Secondary Angle Increment	(0018,1521)	3	Duplicated
> DLX Series Number	(0020, 0011)	3	Generated: duplicated from XA image number, tag (0020,0013)
>Series instance UID	(0020, 000E)	3	Duplicated
> Rows	(0028, 0010)	3	Duplicated
> Columns	(0028, 0011)	3	Duplicated
> Bits Stored	(0028, 0101)	3	Duplicated
> Angle Value 1	(0019, xx01)	3	Duplicated
> Angle Value 2	(0019, xx02)	3	Duplicated
> Angle Value 3	(0019, xx03)	3	Duplicated
> Angle Label 1	(0019, xx04)	3	Duplicated
> Angle Label 2	(0019, xx05)	3	Duplicated
> Angle Label 3	(0019, xx06)	3	Duplicated
> Adx Exam Name	(0019, xx08)	3	Duplicated
> Adx Record View	(0019, xx0A)	3	Duplicated
> Adx Injector Delay	(0019, xx10)	3	Duplicated

> Adx Dose	(0019, xx1C)	3	Duplicated
> KPV List	(0047, xx70)	3	Not saved
>X-Ray Tube Current List	(0047, xx71)	3	Not saved
> Exposure Time List	(0019, xx72)	3	Duplicated
> Number Of Injections	(0047, xx8A)	2	Empty
> Frame Count	(0047, xx8B)	3	Generated
> Contrast Agent Volume List	(0047, xx89)	3	Not saved
> Used Frames	(0047, xx96)	3	Not saved
XA 3D Reconstruction Algorithm Name	(0047, xx91)	3	Generated: “Advantage 3D X-ray reconstruction”
XA 3D Reconstruction Algorithm Version	(0047, xx92)	3	Generated: Reconstruction algorithm version
3D Calibration Date	(0047, xx93)	3	Generated: acquisition date of the calibration data used to reconstruct the 3D model
3D Calibration Time	(0047, xx94)	3	Generated: acquisition date of the calibration data used to reconstruct the 3D model
3D Calibration Status	(0047, xx95)	3	Generated: “0” or “1”
Transform Count	(0047, xx98)	1	Generated: “1”
Transform Sequence	(0047, xx99)	1C	Generated
> Transform Rotation Matrix	(0047, xx9A)	1C	Generated
> Transform Translation Vector	(0047, xx9B)	1C	Generated
> Transform Label	(0047, xx9C)	1C	Generated: “3DPOS_REG”

4.5.5.3.1 Reconstruction Parameters Attribute Descriptions

A complete description of used GEMS private attributes can be found in the following documents:

- DLX related private attributes (group number 0019): see **Advantx DLX DICOM V3.0 Conformance Statement** (direction 2142506-100),
- 3D model private attributes (group number 0047): see **Voxtool 2.0 DICOM V3.0 Conformance Statement** (direction 2198583-100)

4.5.5.3.1.1 Reconstruction Parameters Sequence

This GEMSE private Sequence contains only one Sequence Item. This item is used to encapsulate the reconstruction parameters attributes to avoid possible confusions with the Image Entity.

4.5.5.3.1.2 Series count

This is the number of XA series that were used to reconstruct the 3D model.

4.5.5.3.1.3 Acquisition DLX 2D Series Sequence

Each Item contained in this Sequence Data Element describes a Series acquired by the DLX device. These Series were used to build the 3-dimensional volume. One or more Frames are acquired within each Series.

4.5.5.3.1.4 Frame Count

Defines the number of Frames of the current series that were used to produce the 3D reconstruction.

4.5.5.3.1.5 KPV List

Defines the value of KPV used to acquire each Frame of the Acquisition Series. Since this value may change whitin the same Acquisition Series, this attribute is described by a multi-valued string. We use a private attribute instead of the KPV data element (0018, 0060) in order to allow a Value Multiplicity greater than one.

4.5.5.3.1.6 X-ray Tube Current List

Defines the value of X-ray tube current used to acquire each Frame of the Acquisition Series. Since this value may change whitin the same Acquisition Series, this attribute is described by a multi-valued string. We use a private attribute instead of the X-ray Tube Current attribute (0018, 1151) in order to allow a Value Multiplicity greater than one.

4.5.5.3.1.7 Exposure Time List

Defines the value of exposure time used to acquire each Frame of the Acquisition Series. Since this value may change whitin the same Acquisition Series, this attribute is described by a multi-valued string. We use a private attribute instead of the Exposure Time attribute (0018, 1152) in order to allow a Value Multiplicity greater than one.

4.5.5.3.2 Number of injections

Defines the number of contrast agent injections performed during the current Series.

4.5.5.3.3 Contrast Agent Volume List

Defines the volume of contrast agent corresponding to each injection. We use a private attribute instead of the Contrast/Bolus Volume Data Element (0018, 1041) in order to allow a Value Multiplicity greater than one.

4.5.5.3.4 Used frames

Identifies the Frames of the current Series that were used to achieve the 3-dimensional reconstruction. this attribute is described by a multi-valued integer string. Each item of this string codes the index

of one of these frames (first frame of the Series is represented by « 1 »).

4.5.5.3.5 Reconstruction Algorithm Name

Defines the algorithm used to reconstruct the 3-dimensional volume from all the acquired Series. This attribute is described by a mono-valued string whose value is user-defined.

4.5.5.3.6 Reconstruction Algorithm Version

Identifies the version of the algorithm used to reconstruct the 3-dimensional volume from all the acquired Series.

4.5.5.3.7 3D Calibration Date

Date of the calibration of the acquisition system that was used to reconstruct the 3-dimensional volume.

4.5.5.3.8 3D Calibration Time

Time of the calibration of the acquisition system that was used to reconstruct the 3-dimensional volume.

4.5.5.3.9 3D Calibration Status

Defines the validity of the calibration used in the reconstruction. This attribute is described by a string. The two possible values are “0” and “1”.

4.5.5.3.10 Transform Count

Some geometrical transforms can be related to the 3-dimensional reconstruction from the aquired DLX Series. The Transform Count attribute defines the number of geometrical transforms.

4.5.5.3.11 Transform Sequence

Each Item of this Sequence attribute describes a geometrical transform. The geometrical parameters that define such a transform are a rotation matrix and a translation vector. These geometrical parameters are related to the slice-relative referential.

4.5.5.3.12 Transform Rotation Matrix

Defines the rotation matrix that corresponds to the current transform.

4.5.5.3.13 Transform Translation Vector

Defines the translation vector that corresponds to the current transform.

4.5.5.3.14 Transform Label

Identifies the current transform. The value of this label is user-defined.

4.5.5.4 XA VOI LUT Module

This section specifies the linear LUT used to translate between voxel values generated by the algorithm and display levels.

TABLE 4.5-8
XA RECONSTRUCTION PARAMETERS ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Min original density	(0047, xxF5)	3	Generated
Max original density	(0047, xxF6)	3	Generated
Min converted density	(0047, xxF7)	3	Generated
Max converted density	(0047, xxF8)	3	Generated

4.5.5.4.1 Min original density

Mininum voxel density, as generated by the reconstruction algorithm.

4.5.5.4.2 Max original density

Maximum voxel density, as generated by the reconstruction algorithm.

4.5.5.4.3 Min converted density

Mininum voxel density, as used for display.

4.5.5.4.4 Max converted density

Maximum voxel density, as used for display.

4.5.5.5 Volumic Data Module

This section specifies the Attributes which describe the 3-dimensional volumic data. Most of them are GEMS private.

TABLE 4.5-9
VOLUMIC DATA MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Volume Color	(0047, xx49)	3	Not saved
Volume Voxel Count	(0047, xx50)	1	Generated
Volume Segment Count	(0047, xx51)	1	Generated
Volume Slice Size	(0047, xx53)	1	Generated
Volume Slice Count	(0047, xx54)	1	Generated
Volume Threshold Value	(0047, xx55)	2C	Generated
Volume Voxel Ratio	(0047, xx57)	1	Generated
Volume Voxel Size	(0047, xx58)	1	Generated

Volume Z Position Size	(0047, xx59)	1	Generated
Volume Base Line	(0047, xx60)	1	Generated
Volume Center Point	(0047, xx61)	1	Generated
Volume Skew Base	(0047, xx63)	1	Generated
Volume Registration Transform Rotation Matrix	(0047, xx64)	3	Generated: null matrix
Volume Registration Transform Translation Vector	(0047, xx65)	3	Generated: null vector
Volume Upper Left High Corner RAS	(0047, xxC0)	1	Generated
Volume Slice to RAS Rotation Matrix	(0047, xxC1)	1	Generated
Volume Upper Left High Corner TLOC	(0047, xxC2)	1	Generated
Volume Volume Segment List	(0047, xxD1)	1	Generated
Volume Gradient List	(0047, xxD2)	1	Generated
Volume Density List	(0047, xxD3)	1	Generated
Volume Z Position List	(0047, xxD4)	1	Generated
Volume Original Index List	(0047, xxD5)	1	Generated
Volume label	(0047, xxF4)	3	Generated: either “vessels” or “vessels and coils \\vessels \\coils”

4.5.5.5.1 Volumic Data Attribute Descriptions

4.5.5.5.1.1 Voxel Count

Defines the number of volumic elements (« voxels ») used to describe the three-dimensional reconstruction.

4.5.5.5.1.2 Segment Count

The voxels are grouped into sets called « segments ». This attribute defines the number of segments used to describe the three-dimensional reconstruction.

4.5.5.5.1.3 Slice Count

The 3-dimensional volume can be seen as a superposition of voxel slices. This attribute defines the number of slices used to describe the three-dimensional reconstruction.

4.5.5.5.1.4 Threshold Value

Defines the value of the threshold applied to the volumic data. If no threshold is applied, set this attribute to zero.

4.5.5.5.1.5 Ratio

Defines the ratio between slice spacing and voxel size.

4.5.5.5.1.6 Voxel size

Defines the size of a voxel (cubic element).

4.5.5.5.1.7 Z Position size

Defines the z location of the original slices.

4.5.5.5.1.8 Base Line

3x3 matrix that defines the slices orientation.

4.5.5.5.1.9 Center Point

Defines the coordinates of the volume center point.

4.5.5.5.1.10 Registration Transform Rotation Matrix

3x3 matrix that defines the rotation matrix associated to the transform from the slice-relative refernetial to another arbitrary referential. Set to null matrix if no transformation is defined.

4.5.5.5.1.11 Registration Transform Translation Vector

3x1 vector that defines the translation vector associated to the transform from the slice-relative refernetial to another arbitrary referential. Set to null vector if no transformation is defined.

4.5.5.5.1.12 Upper Left High Corner RAS

3x1 vector that defines the coordinates of the Upper Left High Corner (i.e. first voxel of the first slice) in the RAS refernetial.

4.5.5.5.1.13 Slice To RAS Rotation Matrix

3x3 matrix that defines the rotation matrix associated to the transform from the RAS referential to slice-relative referential.

4.5.5.5.1.14 Upper Left High Corner TLOC

4.5.5.5.1.15 Segment List

Describes the list of segments used to describe the three-dimensional reconstruction.

4.5.5.5.1.16 Gradient List

Describes the gradients for each voxel of the Segment List.

4.5.5.5.1.17 Density List

Defines the value of each voxel of the Segment List.

4.5.5.5.1.18 Z Position List

Defines the Z location of original slices.

4.5.5.5.1.19 Original Index List

Defines the rank index list of original slices.

4.5.5.5.1.20 Volume label

Defines the string label associated to the volume.

4.5.5.6 Wireframe Module

This section specifies the attributes which describe the 3-dimensional wireframes (if any) attached to 3-dimensional volume. All of them are GEMS private.

TABLE 4.5-10
WIREFRAME MODULE ATTRIBUTES
THIS MODULE IS NOT SAVED BY ADVANTAGE 3D XR APPLICATION

4.5.6 Common Image Entity Modules

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

4.5.6.1 General Image Module

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

TABLE 4.5-11
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Duplicated

4.5.6.2 Image Pixel Module

This section specifies the Attributes that describe the pixel data of the image. This image represents a view of the 3dimensional volume.

TABLE 4.5-12
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Generated: “1”
Photometric Interpretation	(0028,0004)	1	Generated: « MONOCHROME2 »
Rows	(0028,0010)	1	Generated: “64”
Columns	(0028,0011)	1	Generated: “64”
Bits Allocated	(0028,0100)	1	Generated: “16”
Bits Stored	(0028,0101)	1	Generated: “10”
High Bit	(0028,0102)	1	Generated: “9”
Pixel Representation	(0028,0103)	1	Generated: “0”

Pixel Data	(7FE0,0010)	1	Generated

4.5.7 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

4.5.7.1 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 4.5-13
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Generated: « 1.2.840.113619.4.26 »
SOP Instance UID	(0008,0018)	1	Generated: provided by Advantage Workstation
Specific Character Set	(0008,0005)	1C	Duplicated if present in original XA, absent otherwise

4.6 PRIVATE DATA DICTIONARY

The Type of a Private Attribute is determined by the module of the IOD in which it is used, and hence is not listed in this dictionary. Private Attributes contained within these list are described in the preceding sections in the appropriate module.

TABLE 5.6-1
3D MODEL IOD PRIVATE ATTRIBUTES

Attribute Name	Tag	VR	VM
Private Creator « SERIE_01 »	(0019, 00xx)	LO	1
Angle Value 1	(0019, xx01)	DS	1
Angle Value 2	(0019, xx02)	DS	1
Angle Value 3	(0019, xx03)	DS	1
Angle Label 1	(0019, xx04)	CS	1
Angle Label 2	(0019, xx05)	CS	1
Angle Label 3	(0019, xx06)	CS	1
DLX Exam Name	(0019, xx08)	ST	1
Adx Record View	(0019, xx0A)	IS	1
Adx Injector Delay	(0019, xx10)	DS	1
Adx Dose	(0019, xx1C)	CS	1
DLX IP address	(0019, xx20)	SH	1
Private Creator « GEMS_ADWSoft_DPO »	(0039, 00xx)	LO	1
Private Entity Number	(0039,xx80)	IS	1
Private Entity Date	(0039,xx85)	DA	1
Private Entity Time	(0039,xx90)	TM	1
Private Entity Launch Command	(0039,xx95)	LO	1
Private Entity Type	(0039,xxAA)	CS	1
Private Creator « GEMS_ADWSoft_3D1 »	(0047, 00xx)	LO	1
Reconstruction Parameters Sequence	(0047, xx01)	SQ	1
Volume Voxel Count	(0047, xx50)	UL	1
Volume Segment Count	(0047, xx51)	UL	1-N
Volume Slice Size	(0047, xx53)	US	1
Volume Slice Count	(0047, xx54)	US	1
Volume Threshold Value	(0047, xx55)	SL	1
Volume Voxel Ratio	(0047, xx57)	DS	1
Volume Voxel Size	(0047, xx58)	DS	1
Volume Z Position Size	(0047, xx59)	US	1
Volume Base Line	(0047, xx60)	DS	9
Volume Center Point	(0047, xx61)	DS	3
Volume Skew Base	(0047, xx63)	SL	1
Volume Registration Transform Rotation Matrix	(0047, xx64)	DS	9

Volume Registration Transform Translation Vector	(0047, xx65)	DS	3
KPV List	(0047, xx70)	DS	1-N
X-Ray Tube Current List	(0047, xx71)	IS	1-N
Exposure List	(0047, xx72)	IS	1-N
Acquisition DLX 2D Series Sequence	(0047, xx85)	SQ	1
Contrast Agent Volume List	(0047, xx89)	DS	1-N
Number Of Injections	(0047, xx8A)	US	1
Frame Count	(0047, xx8B)	US	1
Used Frames	(0047, xx96)	IS	1-N
XA 3D Reconstruction Algorithm Name	(0047, xx91)	LO	1
XA 3D Reconstruction Algorithm Version	(0047, xx92)	CS	1
DLX Calibration Date	(0047, xx93)	DA	1
DLX Calibration Time	(0047, xx94)	TM	1
DLX Calibration Status	(0047, xx95)	CS	1
Transform Count	(0047, xx98)	US	1
Transform Sequence	(0047, xx99)	SQ	1
Transform Rotation Matrix	(0047, xx9A)	DS	9
Transform Translation Vector	(0047, xx9B)	DS	3
Transform Label	(0047, xx9C)	LO	1
Location System	(0047, xxB2)	US	1
Volume Upper Left High Corner RAS	(0047, xxC0)	DS	3
Volume Slice To RAS Rotation Matrix	(0047, xxC1)	DS	9
Volume Upper Left High Corner TLOC	(0047, xxC2)	DS	1
Volume Segment List	(0047, xxD1)	OB	1
Volume Gradient List	(0047, xxD2)	OB	1
Volume Density List	(0047, xxD3)	OB	1
Volume Z Position List	(0047, xxD4)	OB	1
Volume Original Index List	(0047, xxD5)	OB	1
Volume label	(0047, xxF4)	CS	1-N
Min original density	(0047, xxF5)	DS	1-N
Max original density	(0047, xxF6)	DS	1-N
Min converted density	(0047, xxF7)	DS	1-N
Min converted density	(0047, xxF8)	DS	1-N