



# **Technical Publications**

**Direction 2199312-100**  
**Revision 0**

## **Advantage Straight 1.0.2 CONFORMANCE STATEMENT for DICOM V3.0**

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***GE Medical Systems***

**REVISION HISTORY**

<b>REV</b>	<b>DATE</b>	<b>REASON FOR CHANGE</b>
0	22-June-1998	Initial Release

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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

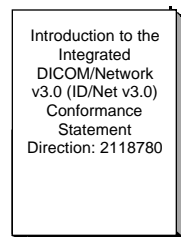
**Section 2 (Network Conformance Statement)**, which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Networking features.

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

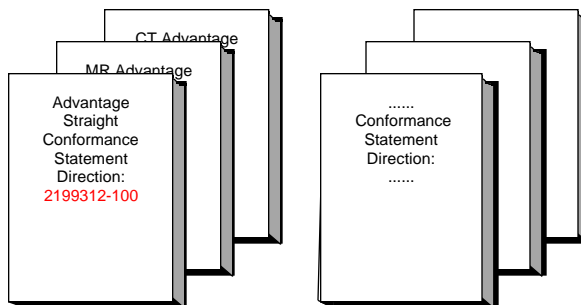
#### ID/Net v3.0




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#### APPLICATION ENTITY SPECIFICATION (SERVICE CLASSES, INFORMATION OBJECTS, MESSAGE EXCHANGES, ETC.)

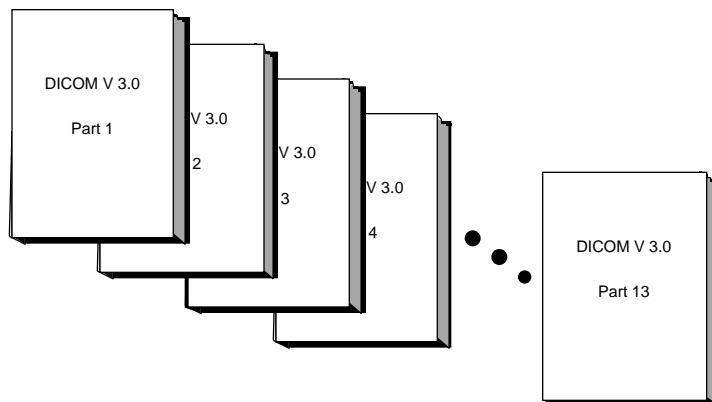
**Product Implementation:**




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#### DICOM STANDARD

**Standard Specification:**





*Advantage Straight*

*Conformance Statement for DICOM v3.0*

*Direction 2199312-100*

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 the convenience of software developers, there is "collector" Direction available. By ordering the collector, the Introduction described above and all of the currently published GEMS Product Conformance Statements will be received. The collector Direction is:

*ID/Net v3.0 Conformance Statements*

*Direction: 2117016*

For more information regarding DICOM v3.0, copies of the Standard may be obtained by written request or phone by contacting:

NEMA Publication

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

*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

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. NETWORK CONFORMANCE STATEMENT EXTENSION

### 2.1 INTRODUCTION

This conformance statement extension describes additional functionality of feature Advantage Straight, 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 consistent with the DICOM Standard, and failure to interoperate with this application cannot be construed as non-conformance to the Standard.

Advantage Straight is a X-Ray angiography application which is installed on the same hardware platform as the base application, Advantage Workstation 3.1. The scope of this new application is to correct geometrical distortions introduced by the Image Intensifier, in order to **deliver distortion-free digital images**. Although current digital images bear some geometrical distortion, they are acceptable for most diagnostic or therapeutic uses. However, distortion-free images become a necessity when performing digital angiography procedures in stereotactic conditions before treatment of arterio-venous malformations (AVM's).

Original X-Ray multi-frames images transferred from DLX (see DLX DICOM V3.0 Conformance Statement, direction 2142506-100) to the Advantage Workstation 3.1 are processed and provide corrected X-Ray multi-frames image. Computed images are stored into the Advantage Workstation 3.1 database and can be displayed, filmed and exported to other vendors using Advantage Workstation 3.1. Any transfer syntax supported by Advantage Workstation 3.1 is also supported by Advantage Straight.

### 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 SCU as well 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.

**2.2.2 Media Interchange Specifications**

The Advantage Workstation 3.1 Application, using the 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** as well as an **FSC**:

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:

<b>Advantage Straight Implementation UID</b>	<b>1.2.840.113619.6.61</b>
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**2.3 SUPPORT OF EXTENDED CHARACTER SETS**

The Advantage Straight 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**

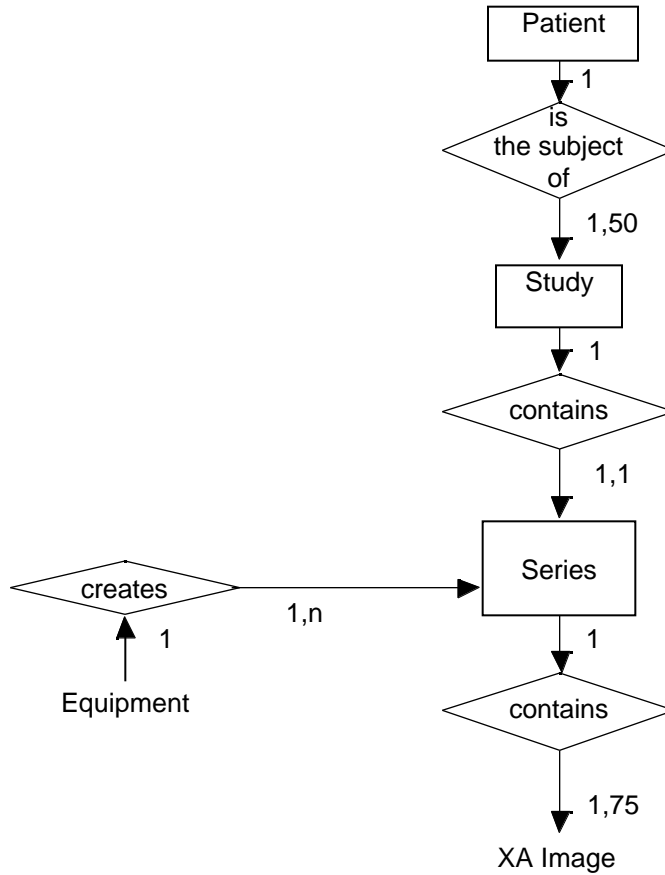
#### **3.3 XA ENTITY-RELATIONSHIP MODEL**

The Entity-Relationship diagram for the XA Image interoperability scheme 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 75 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.



**3.3.1.1 Patient Entity Description**

**3.3.1.2 Study Entity Description**

**3.3.1.3 Series Entity Description**

**3.3.1.4 Equipment Entity Description**

**3.3.1.5 XA Image Entity Description**

**3.3.1.6 Overlay Entity Description**

**3.3.1.7 VOI Lookup Table Entity Description**

**3.3.1.8 Modality Lookup Table Entity Description**

**3.3.1.9 Curve Entity Description**

**3.3.2 Advantage Straight Mapping of DICOM entities**

**TABLE 3.3-1  
MAPPING OF DICOM ENTITIES TO ADVANTAGE STRAIGHT ENTITIES**

<b>DICOM</b>	<b>Advantage Straight Entity</b>
Patient	Patient Entity (Advantage Workstation)
Study	Exam Entity (Advantage Workstation)
Series	Exam Entity (Advantage Workstation)
Image	Series Entity (Advantage Workstation)
Frame	Image Entity (Advantage Workstation)

**3.4 IOD MODULE TABLE**

Within an entity of the DICOM v3.0 XA IOD, attributes are grouped into related sets 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
	Frame Pointers	3.5.5.6
	Mask	3.5.5.7
	Display Shutter	3.5.5.8
	Device	3.5.5.9
	Therapy	3.5.5.10
General	SOP Common	3.5.6.1
X-Ray	X-Ray Image	3.5.7.1
	X-Ray Acquisition	3.5.7.2
	X-Ray table	3.5.7.3
	X-Ray Positioner	3.5.7.4
	Overlay Plane	3.5.7.5
	Multi-frame Overlay	3.5.7.6
	Curve	3.5.7.7
	Modality LUT	3.5.7.8
	VOI LUT	3.5.7.9

### 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).

**Important Note :**

Advantage Straight is an X-Ray angiography application which computes new XA DICOM Object from an original XA DICOM Object found on Advantage Workstation 3.1. In order to explain how the new XA DICOM Object is created, **for each module two tables are displayed** : first one to describe the original XA DICOM Object, second one to describe the created XA DICOM Object. For any attributes with type different from 1 & 2 and not detailed in this part, the created

added to the created image. This behavior comes from the purpose of the application which creates images identical to original images but which are distortion free.

**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 (INPUT)**

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Required with any non null string (for safety reason)
Patient ID	(0010,0020)	2	Required with any value (including no value, zero length data element)
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)

**TABLE 3.5-2  
PATIENT MODULE ATTRIBUTES (OUTPUT)**

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

**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 3.5-3**  
**GENERAL STUDY MODULE ATTRIBUTES(INPUT)**

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Required with 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)

**TABLE 3.5-4**  
**GENERAL STUDY MODULE ATTRIBUTES(OUTPUT)**

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

**3.5.2.2 Patient Study Module**

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

No information is required from patient Study Module.

**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 3.5-5  
GENERAL SERIES MODULE ATTRIBUTES (INPUT)**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	XA
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)

**TABLE 3.5-6  
GENERAL SERIES MODULE ATTRIBUTES (OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Duplicated from original object.
Series Instance UID	(0020,000E)	1	1.2.840.113619.2.61 + specific signature. See 3.5.6.1.1.1 for further information.
Series Number	(0020,0011)	2	Original object series number + 1000

**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 3.5-7  
GENERAL EQUIPMENT MODULE ATTRIBUTES (INPUT)**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	see 3.5.4.1.1.1
Manufacturer's Model Name	(0008,1090)	3	see 3.5.4.1.1.2

**TABLE 3.5-8  
GENERAL EQUIPMENT MODULE ATTRIBUTES (OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Duplicated from original object.
Manufacturer's Model Name	(0008,1090)	3	Duplicated from original object.

**3.5.4.1.1 General Equipment Attribute Descriptions**

**3.5.4.1.1.1 Manufacturer**

Only Images acquired on GE equipment can be corrected by the application. Since it is safety critical, Manufacturer attribute (0008,0070) must contains GE MEDICAL SYSTEMS value.

**3.5.4.1.1.2 Manufacturer Model Name**

Only Images acquired on GE DLX equipment can be corrected by the application. Since it is safety critical, Manufacturer Model Name attribute (0008,1090) must contain DLX value.

**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 3.5-9  
GENERAL IMAGE MODULE ATTRIBUTES (INPUT)**

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Required with not null value. See 3.5.5.1.1.1 for further information.
Image Date	(0008,0023)	2C	Required with not null value. See 3.5.5.1.1.2 for further information.
Image Time	(0008,0033)	2C	Required with not null value. See 3.5.5.1.1.2 for further information.
Image Type	(0008,0008)	3	See X-Ray Module.
Referenced Image Sequence	(0008,1140)	3	See X-Ray Module.
>Referenced SOP Class UID	(0008,1150)	1C	See X-Ray Module.
>Referenced SOP Instance UID	(0008,1155)	1C	See X-Ray Module.

**TABLE 3.5-10  
GENERAL IMAGE MODULE ATTRIBUTES (OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Duplicated from original object.
Image Date	(0008,0023)	2C	Duplicated from original object.
Image Time	(0008,0033)	2C	Duplicated from original object.
Image Type	(0008,0008)	3	See X-Ray Module.
Referenced Image Sequence	(0008,1140)	3	See X-Ray Module.
>Referenced SOP Class UID	(0008,1150)	1C	See X-Ray Module.
>Referenced SOP Instance UID	(0008,1155)	1C	See X-Ray Module.
Source Image Sequence	(0008,2112)	3	See X-Ray Module.
>Referenced SOP Class UID	(0008,1150)	1C	See X-Ray Module.
>Referenced SOP Instance UID	(0008,1155)	1C	See X-Ray Module.
Derivation description	(0008,2111)	3	See X-Ray Module.

**3.5.5.1.1 General Image Attribute Descriptions**

**3.5.5.1.1.1 Image Number**

This field is required with different values for images of the same study because it is used to reference images in the application.

**3.5.5.1.1.2 Image Date and Time**

These fields are required with dates and time of acquisition because elapsed time between patient series and grid series is safety critical.

**3.5.5.2 Image Pixel Module**

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

**TABLE 3.5-11**  
**IMAGE PIXEL MODULE ATTRIBUTES (INPUT)**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	See X-Ray Module.
Photometric Interpretation	(0028,0004)	1	See X-Ray Module.
Rows	(0028,0010)	1	512 or 1024.
Columns	(0028,0011)	1	512 or 1024.
Bits Allocated	(0028,0100)	1	See X-Ray Module.
Bits Stored	(0028,0101)	1	See X-Ray Module.
High Bit	(0028,0102)	1	See X-Ray Module.
Pixel Representation	(0028,0103)	1	See X-Ray Module.
Pixel Data	(7FE0,0010)	1	Required with any value

**TABLE 3.5-12**  
**IMAGE PIXEL MODULE ATTRIBUTES (OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	See X-Ray Module.
Photometric Interpretation	(0028,0004)	1	See X-Ray Module.
Rows	(0028,0010)	1	Duplicated from original object.
Columns	(0028,0011)	1	Duplicated from original object.
Bits Allocated	(0028,0100)	1	See X-Ray Module.
Bits Stored	(0028,0101)	1	See X-Ray Module.
High Bit	(0028,0102)	1	See X-Ray Module.
Pixel Representation	(0028,0103)	1	See X-Ray Module.
Pixel Data	(7FE0,0010)	1	

**3.5.5.3 Contrast/Bolus module**

If present in original object, then duplicated in created object, else not added in created object.

**3.5.5.4 Cine Module**

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

**TABLE 3.5-13**  
**CINE MODULE ATTRIBUTES (INPUT)**

Attribute Name	Tag	Type	Attribute Description
Frame Time Vector	(0018,1065)	1C	Required with not null value in case of multi-frame cine data

**TABLE 3.5-14**  
**CINE MODULE ATTRIBUTES (OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Frame Time Vector	(0018,1065)	1C	See 3.5.5.4.1.1 for further information.

### 3.5.5.4.1 Cine Attribute Descriptions

#### 3.5.5.4.1.1 Frame Time Vector

Attribute Frame Time Vector (0018,1065) is duplicated from original object in case of a patient image, and set to 0 in case of a grid image.

### 3.5.5.5 Multi-Frame Module

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

**TABLE 3.5-15**  
**MULTI-FRAME MODULE ATTRIBUTES (INPUT)**

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Required with not null value in case of multi-frame cine data. See 3.5.5.5.1.1 for further explanation
Frame Increment Pointer	(0028,0009)	1	See X-Ray Module.

**TABLE 3.5-16**  
**MULTI-FRAME MODULE ATTRIBUTES (OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	See 3.5.5.5.1.1 for further explanation
Frame Increment Pointer	(0028,0009)	1	See X-Ray Module.

### 3.5.5.5.1 Multi-Frame Attribute Descriptions

#### 3.5.5.5.1.1 Number Of Frames

Attribute Number of Frames (0028,0008) original image expected value depends on attributes Rows (0028,0010), Columns (0028,0011) and Bits Stored (0028,0101):

- if Rows and Columns are equal to 1024 and Bits Stored is equal to 10, then Number of Frames should be from 1 to 70,
- if Rows and Columns are equal to 1024 and Bits Stored is equal to 8, then Number of Frames should be from 1 to 120,
- if Rows and Columns are equal to 512, then Number of Frames should be



Created patient images Number of Frames value is duplicated from original object. Created grid images contain 1 (corresponding to the frame used to compute distortion field).

**3.5.5.6 Frame Pointers Module**

If present in original object, then duplicated in created object, else not added in created object.

**3.5.5.7 Mask Module**

If present in original object and if created object is a multi-frame object, then duplicated in created object.

**3.5.5.8 Display Shutter Module**

If present in original object, then duplicated in created object, else not added in created object.

**3.5.5.9 Device module**

If present in original object, then duplicated in created object, else not added in created object.

**3.5.5.10 Therapy module**

If present in original object, then duplicated in created object, else not added in created object.

**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 3.5-17**  
**SOP COMMON MODULE ATTRIBUTES (INPUT)**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	1.2.840.10008.5.1.4.1.1.12.1
SOP Instance UID	(0008,0018)	1	
Specific Character Set	(0008,0005)	1C	ISO_IR 100 = Latin Alphabet No. 1 or no element (default Dicom characters set)

**TABLE 3.5-18**  
**SOP COMMON MODULE ATTRIBUTES (OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Duplicated from original object.
SOP Instance UID	(0008,0018)	1	See 3.5.6.1.1.1 for further information
Specific Character Set	(0008,0005)	1C	Duplicated from original object.

**3.5.6.1.1 SOP Common Attributes Descriptions**

**3.5.6.1.1.1 SOP Instance UID**

The SOP instance UID = 1.2.840.113619.2.61.H.P.E.C where :  
 H = hostid of the AW3.1 station,  
 P = pid of Advantage Straight process,  
 E = elapse time (in milisecond) since Advantage Straight process start  
 C = number given by Advantage Straight process (counter).

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 3.5-19  
X-RAY IMAGE MODULE ATTRIBUTES (INPUT)

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1C	See 3.5.7.1.1.1 for further information.
Image Type	(0008,0008)	1	ORIGINAL\PRIMARY\SINGLE PLANE or ORIGINAL\PRIMARY\BIPLANE A or ORIGINAL\PRIMARY\BIPLANE B
Pixel Intensity Relationship	(0028,1040)	1	LIN See 0
Samples per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Bits Allocated	(0028,0100)	1	8 or 16.
Bits Stored	(0028,0101)	1	8 or 10
Pixel Representation	(0028, 0103)	1	0
High Bit	(0028,0102)	1	7 or 9
Referenced Image Sequence	(0008,1140)	1C	See 3.5.7.1.1.4 for further information.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Referenced Image Sequence (0008, 1140) is present.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced Image Sequence (0008, 1140) is present.

TABLE 3.5-20  
X-RAY IMAGE MODULE ATTRIBUTES (OUTPUT)

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1C	See 3.5.7.1.1.1 for further information.
Image Type	(0008,0008)	1	See 3.5.7.1.1.2 for further information.
Pixel Intensity Relationship	(0028,1040)	1	Duplicated from original object.
Samples per Pixel	(0028,0002)	1	Duplicated from original object.
Photometric Interpretation	(0028,0004)	1	Duplicated from original object.
Bits Allocated	(0028,0100)	1	Duplicated from original object.
Bits Stored	(0028,0101)	1	Duplicated from original object.
Pixel Representation	(0028, 0103)	1	Duplicated from original object.
High Bit	(0028,0102)	1	Duplicated from original object.
Referenced Image Sequence	(0008,1140)	1C	See 3.5.7.1.1.4 for further information.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Referenced Image Sequence (0008, 1140) is present.

>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced Image Sequence (0008, 1140) is present.
Source Image Sequence	(0008,2112)	3	See 3.5.7.1.1.5 for further information.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Referenced Image Sequence (0008, 2112) is present.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced Image Sequence (0008, 2112) is present.
Derivation description	(0008,2111)	3	See 3.5.7.1.1.6 for further information.

**3.5.7.1.1 X-Ray Image Attribute Descriptions**

**3.5.7.1.1.1 Frame Increment Pointer**

For input and output objects, Frame Increment Pointer must be equal to (0018,1065) in case of multi-frames images and is not required in case of single frame.

**3.5.7.1.1.2 Image Type**

Given an original image with attribute Image Type (0008,0008) equal to:

ORIGINAL\PRIMARY\[PLANE TYPE]

with PLANE TYPE in (SINGLE PLANE, BIPLANE A, BIPLANE B),

the Attribute Image Type (0008,0008) of the created image will be :

DERIVED\SECONDARY\[NEW PLANE TYPE]\DISTORTION FREE

with NEW PLANE TYPE corresponding to the status of the new image. If only one plane of a biplane image is corrected or/and imported in the database, plane type of the corrected image is SINGLE PLANE.

**3.5.7.1.1.3 Pixel Intensity Relationship**

Pixel Intensity Relationship linearity is an hypothesis to the algorithms used in Advantage Straight.

**3.5.7.1.1.4 Referenced Image Sequence**

If Image Type Value 3 is BIPLANE A or BIPLANE B: required in original images and computed in created images in order to relate each plane to the corresponding plane. The sequence contains only one pair of Image SOP class/Instance. If only one plane image is corrected, then it is related to the original other plane image.

**3.5.7.1.1.5 Source Image Sequence**

A sequence which provides reference to original images using pairs of Image SOP class/Instance.

1. **Created patient image:** contains one pair for original patient image and one pair for original grid image
2. **Created grid image:** contains only one pair for original grid image

**3.5.7.1.1.6 Derivation Description**

Contains in this order: a short description of the processing, the release number of Advantage Straight application, the release number of distortion field computation program, the release number of distortion correction program and the number of the frame used to compute the distortion field. Elements are separated by “\” symbol.

**3.5.7.2 X-Ray Acquisition Module**

**TABLE 3.5-21  
X-RAY ACQUISITION MODULE ATTRIBUTES(INPUT)**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Radiation Setting	(0018,1155)	1	GR (application not validated with radiology images)
Field of View Shape	(0018,1147)	3	ROUND (application not validated with rectangle field of view shape)
Adx_acq_mode	(0019,xx14)	1	1
Adx_camera_rotation_enable	(0019,xx15)	1	0, 1
Adx_reverse_sweep	(0019,xx16)	3	from 0 to 15
Adx_focus	(0019,xx1B)	3	from 0.0 to 1.5
Adx_dose	(0019,xx1C)	3	0, 1, 2, 3
Field of View Dimension(s)	(0018,1149)	3	From 10 to 40 (algorithms validated in this range)

**TABLE 3.5-22**  
**X-RAY ACQUISITION MODULE ATTRIBUTES(OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Radiation Setting	(0018,1155)	1	Duplicated from original object.
Field of View Shape	(0018,1147)	3	Duplicated from original object.
Adx_acq_mode	(0019,xx14)	3	Duplicated from original object.
Adx_camera_rotation_enable	(0019,xx15)	3	Duplicated from original object.
Adx_reverse_sweep	(0019,xx16)	3	Duplicated from original object.
Adx_focus	(0019,xx1B)	3	Duplicated from original object.
Adx_dose	(0019,xx1C)	3	Duplicated from original object.
Field of View Dimension(s)	(0018,1149)	3	Duplicated from original object.

**3.5.7.3 X-Ray Table Module**

**TABLE 3.5-23**  
**X-RAY TABLE MODULE ATTRIBUTES(INPUT)**

Attribute Name	Tag	Type	Attribute Description
Table Motion	(0018,1134)	2	Not required. If present, must be STATIC.

**TABLE 3.5-24**  
**X-RAY TABLE MODULE ATTRIBUTES(OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Table Motion	(0018,1134)	2	Duplicated from original object.

**3.5.7.4 X-Ray Positioner Module**

**TABLE 3.5-25**  
**X-RAY POSITIONER MODULE ATTRIBUTES(INPUT)**

Attribute Name	Tag	Type	Attribute Description
Distance Source To Detector	(0018,1110)	3	Required with any not null value (due to specificity of the application)
Positioner Motion	(0018,1500)	2C	STATIC (required in case of multi-frames data)
Positioner Primary Angle	(0018,1510)	2	Required with any not null value
Positioner Secondary Angle	(0018,1511)	2	Required with any not null value
Angle Value Label 1	(0019,xx04)	3	See 3.5.7.4.1.1 for further information
Angle Value Label 2	(0019,xx05)	3	Required with any not null value
Angle Value Label 3	(0019,xx06)	3	Required with any not null value
Angle Value 1	(0019,xx01)	3	See 3.5.7.4.1.1 for further information
Angle Value 2	(0019,xx02)	3	Required with any not null value
Angle Value 3	(0019,xx03)	3	Required with any not null value

**TABLE 3.5-26**  
**X-RAY POSITIONER MODULE ATTRIBUTES(OUTPUT)**

Attribute Name	Tag	Type	Attribute Description
Distance Source To Detector	(0018,1110)	3	Duplicated from original object.
Positioner Motion	(0018,1500)	2C	Duplicated from original object.
Positioner Primary Angle	(0018,1510)	2	Duplicated from original object.

Angle Value Label 1	(0019,xx04)	3	Duplicated from original object.
Angle Value Label 2	(0019,xx05)	3	Duplicated from original object.
Angle Value Label 3	(0019,xx06)	3	Duplicated from original object.
Angle Value 1	(0019,xx01)	3	Duplicated from original object.
Angle Value 2	(0019,xx02)	3	Duplicated from original object.
Angle Value 3	(0019,xx03)	3	Duplicated from original object.

**3.5.7.4.1 X-Ray Positioner Attributes Descriptions**

**3.5.7.4.1.1 Angle Value Label 1 and Angle Value 1**

Angle value 1 has no meaning for lateral biplane images (BIPLANE A images). There is so no specific requirement on Angle Value Label 1 and Angle Value 1 attributes for this type of images. These are required with no null value for single plane and biplane images.

**3.5.7.5 Overlay Plane Module**

If present, duplicated in created object.

**3.5.7.6 Multi-frame Overlay Module**

If present, duplicated in created object.

**3.5.7.7 Curve Module**

If present, duplicated in created object.

**3.5.7.8 Modality LUT Module**

If present, duplicated in created object.

**3.5.7.9 VOI LUT Module**

If present, duplicated in created object.

