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Technical
Publications

Direction 2277062-100
Revision 0

Vivid 3 version 1.0
CONFORMANCE STATEMENT
for DICOM V3.0

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TABLE OF CONTENTS

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 (Media Storage Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Media Storage features.

Section 3 (Ultrasound Information Object Implementation), which specifiesthe GEMS equipment compliance to DICOM requirements for the implementation of an Ultrasound Medicine Information Object.

Section 4 (Ultrasound Multi-Frame Information Object Implementation),which specifies the GEMS equipment compliance to DICOM requirements for the implementation of an Ultrasound Multi-Frame Information.

**Section 5 (Basic Directory Information Object Implementation**) , which specifies GEMS compliance to DICOM requirements for the implementation of a Basic Directory 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

Introduction to the
Integrated
DICOM/Network
v3.0 (ID/Net v3.0)
Conformance
Statement
Direction: 2118780
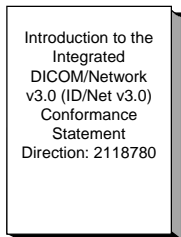
APPLICATION ENTITY SPECIFICATION
(SERVICE CLASSES, INFORMATION OBJECTS, MESSAGE EXCHANGES, ETC.)

**Product
Implementation:**

CT Advantage

MR Advantage

Vivid III
Conformance
Statement
Direction:
2277062-100

......
Conformance
Statement
Direction:
......
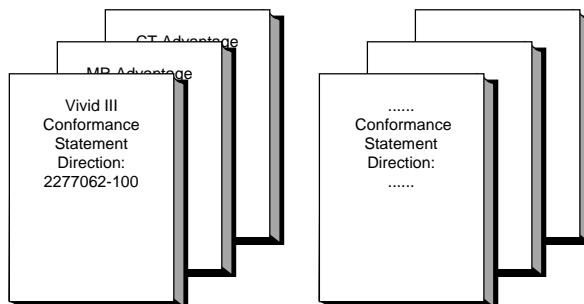
DICOM STANDARD

**Standard
Specification:**

DICOM V 3.0

Part 1

V 3.0

2

V 3.0

3

V 3.0

4

DICOM V 3.0

Part 14
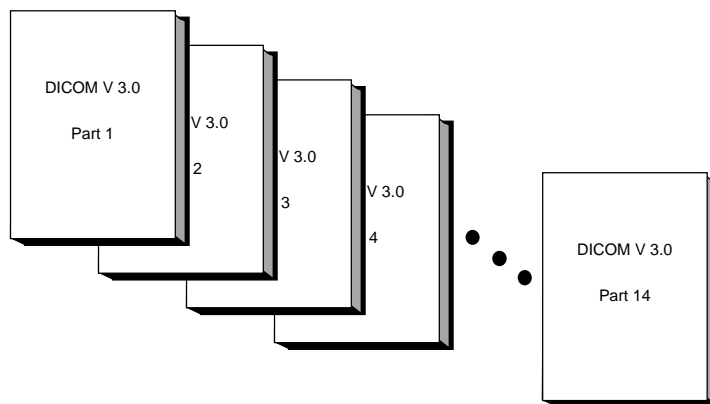
This document specifies the DICOM v3.0 implementation. It is entitled:

Vivid 3 version 1.0
Conformance Statement for DICOM v3.0

1–3

Direction **2277062-100**

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 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).

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. MEDIA STORAGE CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the conformance statement (CS) specifies the Vivid 3 compliance to DICOM Media Interchange. It details the DICOM Media Storage Application Profiles and roles which are supported by this product.

Vivid 3 is a sophisticated ultrasound scanning device with build in digital archiving system. User can choose any patient or group of patients from the archive and export all the patient's images to DICOM media.

Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

2.2 IMPLEMENTATION MODEL

2.2.1 Application Data Flow Diagram

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

ILLUSTRATION 2–1
SPECIFIC AE APPLICATION MODEL
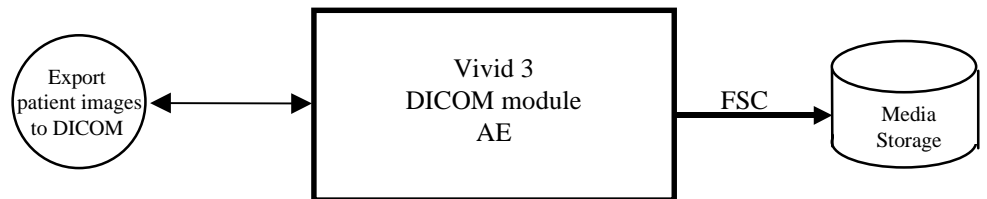
Vivid 3 archiving system let user to select one or more patients from patient list and to start "Export to DICOM" command. Then all images of the selected patients are "exported" to DICOM media as US Image Storage and US Multi-frame Image Storage SOP instances. Vivid 3 initialize Media by acting as an FSC to create a new DICOM File Set on 2.3 GB MOD.

2.2.2 Functional Definition of AE's

Vivid 3 create a new DICOM File Set on media and add new SOP instances to the File Set.

2.2.3 Sequencing Requirements

Non Applicable.

2.2.4 File Meta Information Options (See PS3.10)

The File Meta-Information for this implementation is :

File Meta-Information Version	1
Vivid 3 Implementation UID	1.2.840.113619.6.85
Implementation Version Name	Vivid3_1_0

2.3 AE SPECIFICATIONS

2.3.1 Vivid 3 AE Specification

The Vivid 3 Application Entity provides standard conformance to DICOM Interchange Option of the Media Storage Service Class. The application Profiles and roles are listed below.

Supported Application Profile	Real World Activity	Role	Description
STD-US-ID-SF-MOD23 STD-US-ID-MF-MOD23	Export to DICOM	FSC	Interchange

2.3.1.1 File Meta Information for the Vivid 3 Application Entity

Following are the values set in the File Meta Information for this AE Title :

Source Application Entity Title	Vivid 3

2.3.1.2 Real-World Activities for the Vivid 3 Application Entity

2.3.1.2.1 Real-World Activity "Export to DICOM"

"Export to DICOM" saves US Image Storage and US MF Image Storage SOP instances to media and updates DICOM File Set. All images of a current selected patient are

processed: each raw image is loaded and displayed, and then encoded into a DICOM SOP Instance.

2.3.1.2.1.1 Media Storage Application Profile for the RWA "Export to DICOM":

For the list of Application Profiles that invoke this AE for the "Export to DICOM" RWA, see the Table in Section 2.3.1 "Vivid3 AE Specification" where the table describing the profiles and real-world activities is defined.

2.3.1.2.1.1.1 Options :

Following are the SOP Classes supported by the RWA "Export to DICOM" :

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Media Storage Directory Storage	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	JPEG Baseline	1.2.840.10008.1.2.50
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	JPEG Baseline	1.2.840.10008.1.2.50

2.4 AUGMENTED AND PRIVATE APPLICATION PROFILES

No augmented/private profile is implemented.

2.5 EXTENSIONS, SPECIALIZATIONS, PRIVATIZATIONS OF SOP CLASSES AND TRANSFER SYNTAXES

Not Applicable.

2.6 CONFIGURATION

No configuration is available.

2.7 SUPPORT OF EXTENDED CHARACTER SETS

No extended character sets supported.

3. ULTRASOUND (US) INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

This section specifies the use of the DICOM US Image IOD to represent the information included in US 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 US IOD IMPLEMENTATION

3.3 US ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the US 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
US IMAGE ENTITY RELATIONSHIP DIAGRAM
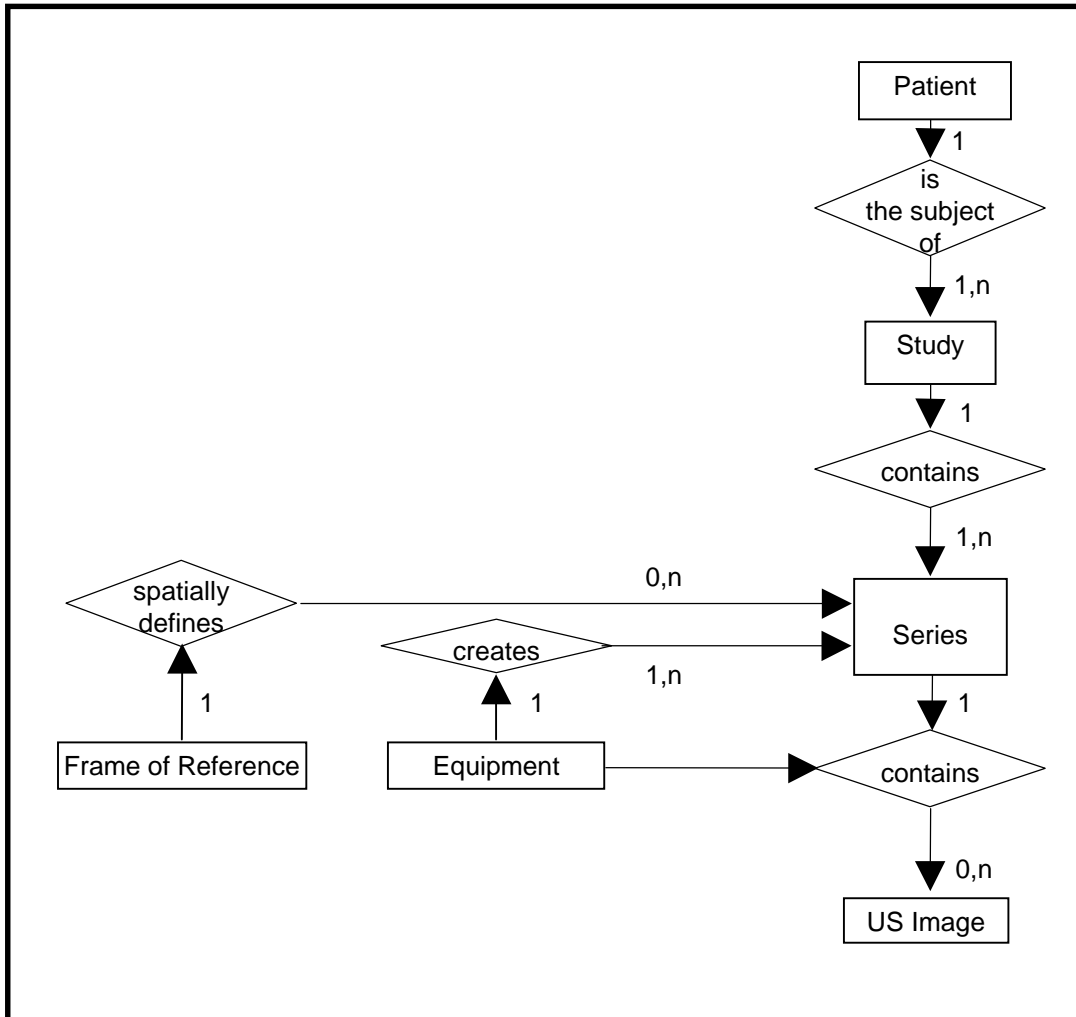
3.3.1 ENTITY DESCRIPTIONS

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

3.3.2 Vivid 3 Mapping of DICOM entities

TABLE 3.3-1
MAPPING OF DICOM ENTITIES TO VIVID 3 ENTITIES

DICOM	Vivid 3 Entity
Patient	Patient
Study	Exam
Series	Exam
Image	Image
Curve	Not used

3.4 IOD MODULE TABLE

Within an entity of the DICOM v3.0 US 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 US IOD. Modules are identified by Module Name.

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

Only the single frame US Image IOD is described here.

TABLE 3.4-1
US IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	3.5.1.1
Study	General Study	3.5.2.1
	Patient Study	Not used
Series	General Series	3.5.3.1
Frame of Reference	Frame of Reference	Not used
	US Frame of Reference	Not used
Equipment	General Equipment	3.5.5.1
Image	General Image	3.5.6.1
	Image Pixel	3.5.6.2
	Contrast/Bolus	Not used
	Palette Color Lookup Table	Not used
	US Region Calibration	3.5.11.2
	US Image	3.5.11.3
	Overlay Plane	Not used
	VOI LUT	Not used
	SOP Common	3.5.10.1
Curve		Not used

The Image and Curve IEs are mutually exclusive. Each SOP Instance using this IOD shall contain exactly one of these IODs. Curve entities are not created by this implementation.

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 US Information Object.

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

3.5.1   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	Entered from UI, New Patient screen. Only first and last names are used. Middle name is not supported. Number of characters for Last name and First name is limited to 64.
Patient ID	(0010,0020)	2	Entered from UI, New Patient screen. Number of characters for Patient ID is limited to 64.
Patient's Birth Date	(0010,0030)	2	Entered from UI, New Patient screen.
Patient's Sex	(0010,0040)	2	Entered from UI, New Patient screen. Supported values are "M" and "F"
Referenced Patient Sequence	(0008,1120)	3	Not used
>Referenced SOP Class UID	(0008,1150)	1C	Not used
>Referenced SOP Instance UID	(0008,1155)	1C	Not used
Patient's Birth Time	(0010,0032)	3	Not used
Other Patient IDs	(0010,1000)	3	Not used
Other Patient Names	(0010,1001)	3	Not used
Ethnic Group	(0010,2160)	3	Not used
Patient Comments	(0010,4000)	3	Not 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	1.2.840.113619.2.85+System Serial Number+ .2.+examination unique ID received from archiving module
Study Date	(0008,0020)	2	Examination date
Study Time	(0008,0030)	2	Examination time
Referring Physician's Name	(0008,0090)	2	Set to 0 length
Study ID	(0020,0010)	2	Set to 0 length
Accession Number	(0008,0050)	2	Set to 0 length
Study Description	(0008,1030)	3	"Vivid3 Echo Study"
Physician(s) of Record	(0008,1048)	3	Not used
Name of Physician(s) Reading Study	(0008,1060)	3	Not used
Referenced Study Sequence	(0008,1110)	3	Not used
>Referenced SOP Class UID	(0008,1150)	1C	Not used
>Referenced SOP Instance UID	(0008,1155)	1C	Not used

3.5.2.2 Patient Study Module

Not 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 3.5-3
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Defined Terms "US" used
Series Instance UID	(0020,000E)	1	1.2.840.113619.2.85+ System Serial Number+.3.+examination unique ID received from archiving module
Series Number	(0020,0011)	2	Set to 0 length
Laterality	(0020,0060)	2C	Not used
Series Date	(0008,0021)	3	Examination date
Series Time	(0008,0031)	3	Examination time
Performing Physicians' Name	(0008,1050)	3	Not used
Protocol Name	(0018,1030)	3	Not used
Series Description	(0008,103E)	3	Not used
Operators' Name	(0008,1070)	3	Not used
Referenced Study Component Sequence	(0008,1111)	3	Not used
>Referenced SOP Class UID	(0008,1150)	1C	Not used
>Referenced SOP Instance UID	(0008,1155)	1C	Not used
Body Part Examined	(0018,0015)	3	Not used
Patient Position	(0018,5100)	2C	Not used
Smallest Pixel Value in Series	(0028,0108)	3	Not used
Largest Pixel Value in Series	(0028,0109)	3	Not used

3.5.4 Common Frame Of Reference Entity Modules

Not used.

3.5.5 Common Equipment Entity Modules

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

3.5.5.1 General Equipment Module

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

TABLE 3.5-4
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Is set to "GEMS"
Institution Name	(0008,0080)	3	Not used
Institution Address	(0008,0081)	3	Not used
Station Name	(0008,1010)	3	Not used
Institutional Department Name	(0008,1040)	3	Not used
Manufacturer's Model Name	(0008,1090)	3	Not used
Device Serial Number	(0018,1000)	3	Not used
Software Versions	(0018,1020)	3	Current Vivid 3 s/w version
Spatial Resolution	(0018,1050)	3	Not used
Date of Last Calibration	(0018,1200)	3	Not used
Time of Last Calibration	(0018,1201)	3	Not used
Pixel Padding Value	(0028,0120)	3	Not used

3.5.6 Common Image Entity Modules

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

3.5.6.1 General Image Module

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

TABLE 3.5-5
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Image date-time stamp
Patient Orientation	(0020,0020)	2C	Not used
Image Date	(0008,0023)	2C	Is set to image date
Image Time	(0008,0033)	2C	Is set to image time
Image Type	(0008,0008)	3	"ORIGINAL/SECONDARY"
Acquisition Number	(0020,0012)	3	Not used
Acquisition Date	(0008,0022)	3	Not used
Acquisition Time	(0008,0032)	3	Not used
Referenced Image Sequence	(0008,1140)	3	Not used
>Referenced SOP Class UID	(0008,1150)	1C	Not used
>Referenced SOP Instance UID	(0008,1155)	1C	Not used
Derivation Description	(0008,2111)	3	Not used
Source Image Sequence	(0008,2112)	3	Not used
>Referenced SOP Class UID	(0008,1150)	1C	Not used
>Referenced SOP Instance UID	(0008,1155)	1C	Not used
Images in Acquisition	(0020,1002)	3	Not used
Image Comments	(0020,4000)	3	Not used
Lossy Image Compression	(0028,2110)	3	Lossy compression is used.
Lossy Image Compression Ratio	(0028,2112)	3	Not used

3.5.6.2 Image Pixel Module

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

TABLE 3.5-6
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Is set to 3
Photometric Interpretation	(0028,0004)	1	Is set to YBR_FULL_422
Rows	(0028,0010)	1	Image height
Columns	(0028,0011)	1	Image width
Bits Allocated	(0028,0100)	1	Always 0008H
Bits Stored	(0028,0101)	1	Always 0008H
High Bit	(0028,0102)	1	Always 0007H
Pixel Representation	(0028,0103)	1	Is set to '0' = unsigned int
Pixel Data	(7FE0,0010)	1	
Planar Configuration	(0028,0006)	1C	Is set to 0000H = color-by-pixel
Pixel Aspect Ratio	(0028,0034)	1C	Not used
Smallest Image Pixel Value	(0028,0106)	3	Not used
Largest Image Pixel Value	(0028,0107)	3	Not used
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Not used
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Not used
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Not used
Red Palette Color Lookup Table Data	(0028,1201)	1C	Not used
Green Palette Color Lookup Table Data	(0028,1202)	1C	Not used
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Not used

3.5.6.3 Contrast/Bolus Module

Not used

3.5.6.4 Palette Color Lookup Table Module

Not used.

3.5.7 Common Overlay Modules

3.5.7.1 Overlay plane module

Not Used.

3.5.8 Common Curve Modules

Not used.

3.5.9 Common Lookup Table Modules

Not used.

3.5.10 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

3.5.10.1 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 3.5-7
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	"1.2.840.10008.5.1.4.1.1.6.1" for single frame "1.2.840.10008.5.1.4.1.1.3.1" for multi-frame
SOP Instance UID	(0008,0018)	1	1.2.840.113619.2.85+ System Serial Number+Image date stamp + image time stamp
Specific Character Set	(0008,0005)	1C	Not used
Instance Creation Date	(0008,0012)	3	Not used
Instance Creation Time	(0008,0013)	3	Not used
Instance Creator UID	(0008,0014)	3	Not used

3.5.11 US Modules

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

3.5.11.1 US Frame of Reference Module

Not used.

3.5.11.2 US Region Calibration Module

US Region Calibration Module is used to describe scan windows of Ultrasound image. It could be 2D window and/or M-mode window and/or Doppler window in one image. Calibration attributes allow to perform distance measurements on 2D and M-mode windows, time measurements on Doppler and M-mode windows and frequency measurements on Doppler.

This section contains IOD Attributes that describe an ultrasound region calibration.

TABLE 3.5-8
US REGION CALIBRATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Sequence of Ultrasound Regions	(0018,6011)	1	Object contains ultrasound regions
>Region Location Min x_0	(0018,6018)	1	ULS region TopLeft.x
>Region Location Min y_0	(0018,601A)	1	ULS region TopLeft.y
>Region Location Max x_1	(0018,601C)	1	ULS region RightBottom.x
>Region Location Max y_1	(0018,601E)	1	ULS region RightBottom.y
>Physical Units X Direction	(0018,6024)	1	Values supported: 0003H cm 0004H seconds
>Physical Units Y Direction	(0018,6026)	1	Values supported: 0003H cm 0004H seconds 0005H Hertz 0007H cm/sec
>Physical Delta X	(0018,602C)	1	Varies with scanning mode
>Physical Delta Y	(0018,602E)	1	Varies with scanning mode
>Reference Pixel x_0	(0018,6020)	3	Used to define baseline position in Doppler mode
>Reference Pixel y_0	(0018,6022)	3	Used to define baseline position in Doppler mode
>Ref. Pixel Physical Value X	(0018,6028)	3	Used to define baseline position in Doppler mode
>Ref. Pixel Physical Value Y	(0018,602A)	3	Used to define baseline position in Doppler mode

>Region Spatial Format	(0018,6012)	1	Enumerated Values supported: 0001H 2D 0002H M-Mode 0003H Spectral
>Region Data Type	(0018,6014)	1	Enumerated Values supported: 0001H Tissue 0003H PW Spectral Doppler 0004H CW Spectral Doppler
>Region Flags	(0018,6016)	1	Bit 0 = OPAQUE Bit 1 = PROTECT Bit 2 Depends on doppler scale type
>Pixel Component Organization	(0018,6044)	1C	Not used
>Pixel Component Mask	(0018,6046)	1C	Not used
>Pixel Component Range Start	(0018,6048)	1C	Not used
>Pixel Component Range Stop	(0018,604A)	1C	Not used
>Pixel Component Physical Units	(0018,604C)	1C	Not used
>Pixel Component Data Type	(0018,604E)	1C	Not used
>Number of Table Break Points	(0018,6050)	1C	Not used
>Table of X Break Points	(0018,6052)	1C	Not used
>Table of Y Break Points	(0018,6054)	1C	Not used
>Number of Table Entries	(0018,6056)	1C	Not used
>Table of Pixel Values	(0018,6058)	1C	Not used
>Table of Parameter Values	(0018,605A)	1C	Not used
>Tranducer Frequency	(0018,6030)	3	Not used
>Pulse Repetition Frequency	(0018,6032)	3	Not used
>Doppler Correction Angle	(0018,6034)	3	Not used
>Steering Angle	(0018,6036)	3	Not used
>Doppler Sample Volume X Position	(0018,6038)	3	Not used
>Doppler Sample Volume Y Position	(0018,603A)	3	Not used
>TM-Line Position x_0	(0018,603C)	3	Not used
>TM-Line Position y_0	(0018,603E)	3	Not used
>TM-Line Position x_1	(0018,6040)	3	Not used
>TM-Line Position y_1	(0018,6042)	3	Not used

3.5.11.3 US Image Module

This section specifies the Attributes that describe ultrasound images.

TABLE 3.5-9
US IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples Per Pixel	(0028,0002)	1	Is set to 3
Photometric Interpretation	(0028,0004)	1	Defined Value used is YBR_FULL_422
Bits Allocated	(0028,0100)	1	Always 0008H
Bits Stored	(0028,0101)	1	Always 0008H
High Bit	(0028,0102)	1	Always 0007H
Planar Configuration	(0028,0006)	1	Values used is 0000H = color-by-pixel
Pixel Representation	(0028,0103)	1	Always 0000H = unsigned integer.
Frame Increment Pointer	(0028,0009)	1C	Presumably absent in single frame IOD.
Image Type	(0008,0008)	2	Set to "ORIGINAL/SECONDARY"
Lossy Image Compression	(0028,2110)	1C	Lossy compression is used.
Number of Stages	(0008,2124)	2C	Not used
Number of Views in Stage	(0008,212A)	2C	Not used
Ultrasound Color Data Present	(0028,0014)	3	Not used
Referenced Overlay Sequence	(0008,1130)	3	Not used
>Referenced SOP Class UID	(0008,1150)	1C	Not used
>Referenced SOP Instance UID	(0008,1155)	1C	Not used
Referenced Curve Sequence	(0008,1145)	3	Not used
>Referenced SOP Class UID	(0008,1150)	1C	Not used
>Referenced SOP Instance UID	(0008,1155)	1C	Not used
Stage Name	(0008,2120)	3	Not used
Stage Number	(0008,2122)	3	Not used
View Number	(0008,2128)	3	Not used
Number of Event Timers	(0008,2129)	3	Not used
Event Elapsed Time(s)	(0008,2130)	3	Not used
Event Timer Name(s)	(0008,2132)	3	Not used
Anatomic Region Sequence	(0008,2218)	3	Not used
>Code Value	(0008,0100)	1C	Not used
>Coding Scheme Designator	(0008,0102)	1C	Not used
>Code Meaning	(0008,0104)	3	Not used
>Anatomic Region Modifier Sequence	(0008,2220)	3	Not used
>>Code Value	(0008,0100)	1C	Not used
>>Coding Scheme Designator	(0008,0102)	1C	Not used
>>Code Meaning	(0008,0104)	3	Not used
Primary Anatomic Structure Sequence	(0008,2228)	3	Not used

>Code Value	(0008,0100)	1C	Not used
>Coding Scheme Designator	(0008,0102)	1C	Not used
>Code Meaning	(0008,0104)	3	Not used
>Primary Anatomic Structure Modifier Sequence	(0008,2230)	3	Not used
>>Code Value	(0008,0100)	1C	Not used
>>Coding Scheme Designator	(0008,0102)	1C	Not used
>>Code Meaning	(0008,0104)	3	Not used
Transducer Position Sequence	(0008,2240)	3	Not used
>Code Value	(0008,0100)	1C	Not used
>Coding Scheme Designator	(0008,0102)	1C	Not used
>Code Meaning	(0008,0104)	3	Not used
> Transducer Position Modifier Sequence	(0008,2242)	3	Not used
>>Code Value	(0008,0100)	1C	Not used
>>Coding Scheme Designator	(0008,0102)	1C	Not used
>>Code Meaning	(0008,0104)	3	Not used
Transducer Orientation Sequence	(0008,2244)	3	Not used
>Code Value	(0008,0100)	1C	Not used
>Coding Scheme Designator	(0008,0102)	1C	Not used
>Code Meaning	(0008,0104)	3	Not used
> Transducer Orientation Modifier Sequence	(0008,2246)	3	Not used
>>Code Value	(0008,0100)	1C	Not used
>>Coding Scheme Designator	(0008,0102)	1C	Not used
>>Code Meaning	(0008,0104)	3	Not used
Trigger Time	(0018,1060)	3	Not used
Nominal Interval	(0018,1062)	3	Not used
Beat Rejection Flag	(0018,1080)	3	Not used
Low R-R Value	(0018,1081)	3	Not used
High R-R Value	(0018,1082)	3	Not used
Heart Rate	(0018,1088)	3	Not used
Output Power	(0018,5000)	3	Not used
Transducer Data	(0018,5010)	3	Not used
Transducer Type	(0018,6031)	3	Not used
Focus Depth	(0018,5012)	3	Not used
Preprocessing Function	(0018,5020)	3	Not used
Mechanical Index	(0018,5022)	3	Not used
Bone Thermal Index,	(0018,5024)	3	Not used
Cranial Thermal Index	(0018,5026)	3	Not used

Soft Tissue Thermal Index	(0018,5027)	3	Not used
Soft Tissue-focus Thermal Index	(0018,5028)	3	Not used
Soft Tissue-surface Thermal Index	(0018,5029)	3	Not used
Depth of Scan Field	(0018,5050)	3	Not used
Image Transformation Matrix	(0018,5210)	3	Not used
Image Translation Vector	(0018,5212)	3	Not used
Overlay Subtype	(60xx,0045)	3	Not used

4. ULTRASOUND MULTIFRAME (US MF) INFORMATION OBJECT IMPLEMENTATION

4.1 INTRODUCTION

This section specifies the use of the DICOM US Multi-frame Image IOD to represent the information included in US images 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 US IOD IMPLEMENTATION

4.3 US ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the US Image 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
US IMAGE ENTITY RELATIONSHIP DIAGRAM
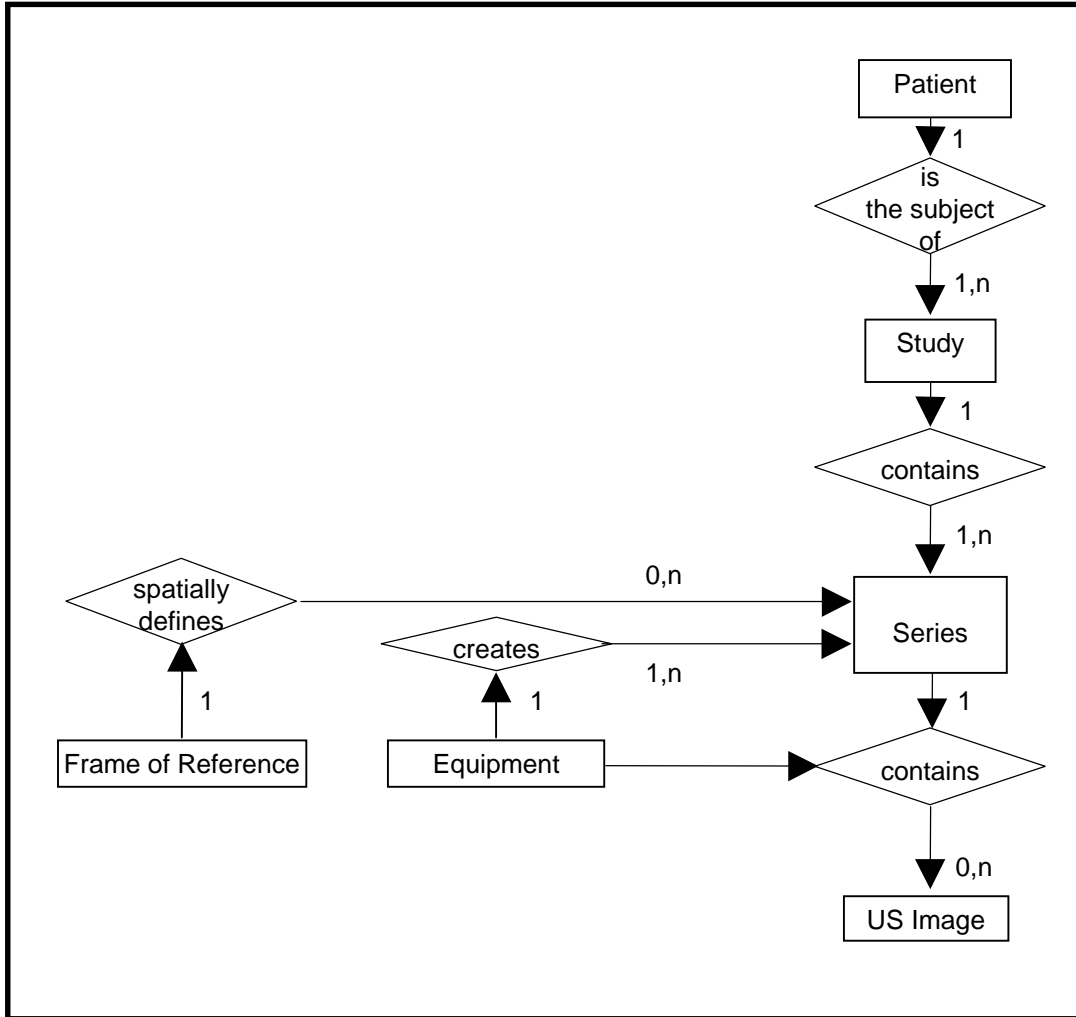
4.3.1 ENTITY DESCRIPTIONS

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

4.3.2 Vivid 3 Mapping of DICOM entities

TABLE 4.3-1
MAPPING OF DICOM ENTITIES TO VIVID 3 ENTITIES

DICOM	Vivid 3 Entity
Patient	Patient
Study	Exam
Series	Exam
Image	Image

Curve	Not used

4.4 IOD MODULE TABLE

Within an entity of the DICOM v3.0 US 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 DICOM v3.0 US IOD. Modules are identified by Module Name.

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

Only the Multi-frame US Image IOD is described here. Only modules, that are different from Single-frame US Image IOD are given in detail here.

TABLE 4.4-1
US IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	3.5.1.1
Study	General Study	3.5.2.1
	Patient Study	Not used
Series	General Series	3.5.3.1
Frame of Reference	Frame of Reference	Not used
	US Frame of Reference	Not used
Equipment	General Equipment	3.5.5.1
Image	General Image	3.5.6.1
	Image Pixel	3.5.6.2
	Contrast/Bolus	Not used
	Cine	4.5.1.1
	Multi-frame	4.5.1.2
	Palette Color Lookup Table	Not used
	US Region Calibration	3.5.11.2
	US Image	3.5.11.3
	Overlay Plane	Not used
	VOI LUT	Not used
	SOP Common	3.5.10.1

Curve		Not used

The Image and Curve IEs are mutually exclusive. Each SOP Instance using this IOD shall contain exactly one of these IODs. Curve entities are not created by this implementation.

4.5 INFORMATION MODULE DEFINITIONS

4.5.1 Common Image Entity Modules

4.5.1.1 Cine Module

TABLE 4.5-1
CINE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Time	(0018,1063)	1C	Is set to interframe time
Frame Time Vector	(0018,1065)	1C	Not used
Start Trim	(0008,2142)	3	Is set to 1 - first frame
Stop Trim	(0008,2143)	3	Is set to last frame number

4.5.1.2 Cine Module

TABLE 4.5-2
MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number Of Frames	(0028,0008)	1	Is set to number of frames in CINE
Frame Increment Pointer	(0028,0009)	1	Is set to Frame Time (0018,1063)

5. BASIC DIRECTORY INFORMATION OBJECT IMPLEMENTATION

5.1 INTRODUCTION

This section specifies the use of the DICOM Basic Directory IOD to represent the information included in directories produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

5.2 - IOD Description

5.3 - IOD Entity-Relationship Model

5.4 - IOD Module Table

5.5 - IOD Module Definition

5.2 BASIC DIRECTORY IOD IMPLEMENTATION

5.3 BASIC DIRECTORY ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the Basic Directory interoperability schema is shown in Illustration 5.3-1**.** 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.

5.3.1 Vivid 3 Mapping of DICOM entities

TABLE 5.3-1
MAPPING OF DICOM ENTITIES TO VIVID 3 ENTITIES

DICOM	Vivid 3 Entity
Patient	Patient
Study	Exam
Series	Exam
Image	Image

ILLUSTRATION 5.3-1
BASIC DIRECTORY ENTITY RELATIONSHIP DIAGRAM

```
                    ┌─────────────────────┐
                    │ Root Directory Entity│
                    └─────────────────────┘
                             1
                          <includes>
                            0-n
                      ┌──────────┐
                      │ Patient  │
                      │   DR     │
                      └──────────┘
                            1
                          < * >
                           1-n
                      ┌──────────┐
                      │  Study   │
                      │   DR     │
                      └──────────┘
                            1
                          < * >
                           0-n
                      ┌──────────┐
                      │  Series  │
                      │   DR     │
                      └──────────┘
                            1
                          < * >
                           0-n
                      ┌──────────┐
                      │  Image   │
                      │   DR     │
                      └──────────┘
```

```
┌──────────────┐
│ Higher-level │
│      DR      │          The Higher-Level Directory Record references
└──────────────┘          a Lower-Level Directory Entity which
     < * >                includes the Lower-Level Directory Record
┌──────────────┐
│ Lower-level  │
│      DR      │
└──────────────┘
```
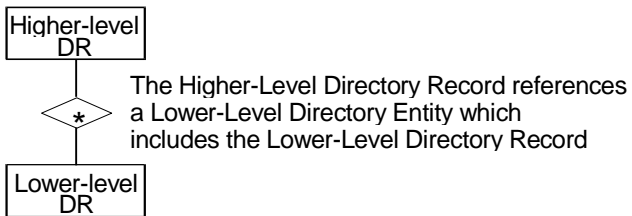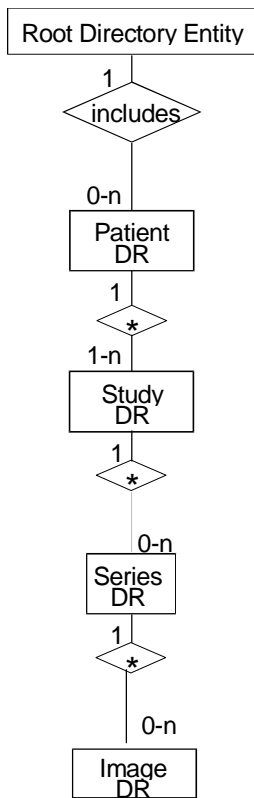
5.4 IOD MODULE TABLE

Within an entity of the Basic Directory 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 5.4-1 identifies the defined modules within the entities which comprise the Basic Directory IOD. Modules are identified by Module Name.

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

TABLE 5.4-1
BASIC DIRECTORY IOD MODULES

Entity Name	Module Name	Reference
File Set Identification	File Set Identification	5.5.1.1
Directory Information	Directory Information	5.5.2.1

5.5 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 Basic Directory Information Object.

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

5.5.1 Common File Set identification Modules

5.5.1.1 File Set identification Module

TABLE 5.5-1
FILE-SET IDENTIFICATION MODULE

Attribute Name	Tag	Type	Attribute Description
File-set ID	(0004,1130)	2	Has NULL value
File-set Descriptor File ID	(0004,1141)	3	Not used
Specific Character Set of File-set Descriptor File	(0004,1142)	1C	Not used

5.5.2 Common Directory Information Modules

5.5.2.1 Directory Information Module

TABLE 5.5-2
DIRECTORY INFORMATION MODULE

Attribute Name	Tag	Type	Attribute Description
Offset of the First Directory Record of the Root Directory Entity	(0004,1200)	1	
Offset of the Last Directory Record of the Root Directory Entity	(0004,1202)	1	
File-set Consistency Flag	(0004,1212)	1	Is set to 0000H: no known inconsistencies
Directory Record Sequence	(0004,1220)	2	Is created by FSC
>Offset of the Next Directory Record	(0004,1400)	1C	
>Record In-use Flag	(0004,1410)	1C	Is set to FFFFH
>Offset of Referenced Lower-Level Directory Entity	(0004,1420)	1C	
>Directory Record Type	(0004,1430)	1C	The values supported are: PATIENT STUDY SERIES IMAGE
>Private Record UID	(0004,1432)	1C	Not used
>Referenced File ID	(0004,1500)	1C	Is set if Directory Record Type is IMAGE Contains 3 elements: Exam year _Exam month Exam day Unique 8 characters string
>MRDR Directory Record Offset	(0004,1504)	1C	A MRDR is not created by FSC
>Referenced SOP Class UID in File	(0004,1510)	1C	
>Referenced SOP Instance UID in File	(0004,1511)	1C	
>Referenced Transfer Syntax UID in File	(0004,1512)	1C	

>Record Selection Keys			

5.5.3 Definition of Specific Directory Records

5.5.3.1 Patient Directory Record Definition

TABLE 5.5-3
PATIENT KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Not used
Patient's Name	(0010,0010)	2	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Patient ID	(0010,0020)	1	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Patient's Birth Date	(0010,0030)	3	
Patient's Sex	(0010,0040)	3	

5.5.3.2 Study Directory Record Definition

TABLE 5.5-4
STUDY KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Not used
Study Date	(0008,0020)	1	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Study Time	(0008,0030)	1	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Study Description	(0008,1030)	2	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Study Instance UID	(0020,000D)	1C	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Study ID	(0020,0010)	1	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR. Always exists in the system.
Accession Number	(0008,0050)	2	Set to 0 length

5.5.3.3 Series Directory Record Definition

TABLE 5.5-5
SERIES KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Not used
Modality	(0008,0060)	1	Only "US" is created by FSC.
Series Instance UID	(0020,000E)	1	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR

Series Number	(0020,0011)	1	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR. Always exists in the system.
Icon Image Sequence	(0088,0200)	3	Not used
Series Date	(0088,0021)	3	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Series Time	(0088,0031)	3	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR

5.5.3.4 Image Directory Record Definition

TABLE 5.5-6
IMAGE KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Not used
Image Number	(0020,0013)	1	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR. Always exists in the system.
Icon Image Sequence	(0088,0200)	3	Not used
Image Date	(0008,0023)	3	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Image Time	(0008,0033)	3	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR
Image Type	(0008,0008)	3	Is filled in by FSC, is a copy of the tag in the file stored to DICOMDIR

5.5.3.5 Private Directory Record Definition

Not used

5.5.3.6 Multi-Referenced File Directory Record Definition

Not used

5.6 PRIVATE DATA DICTIONARY

Not used.