

Technical Publications

Direction 2256472-100
Revision 1

EchoPAC version 6.2 **CONFORMANCE STATEMENT** **for DICOM V3.0**

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GE Vingmed Ultrasound

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

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

Section 5 (Ultrasound Multi-Frame Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of an Ultrasound Multi-Frame Information.

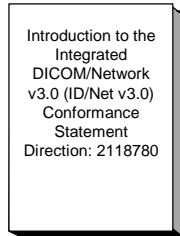
Section 6 (SC Object Implementation) , which specifies GEMS compliance to DICOM requirements for the implementation of a Secondary Capture Information Object.

Section 7 (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

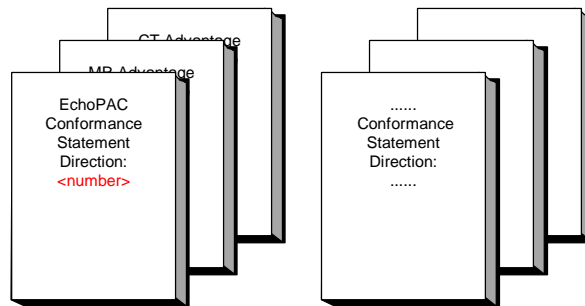
The Documentation Structure of the GEMS Conformance Statements and their relationship with the DICOM v3.0 Conformance Statements is shown in the Illustration below.

ID/Net v3.0



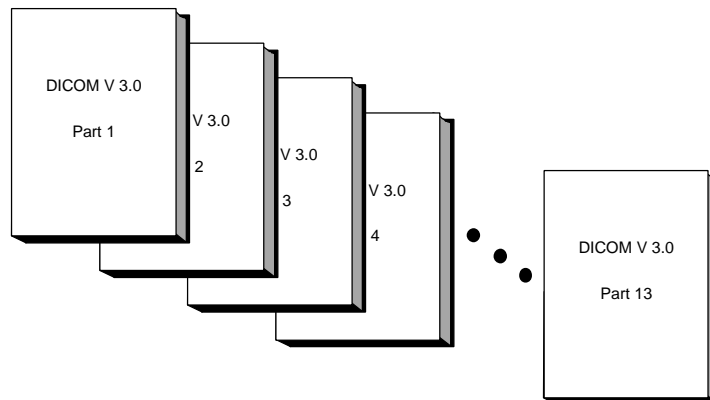
APPLICATION ENTITY SPECIFICATION (SERVICE CLASSES, INFORMATION OBJECTS, MESSAGE EXCHANGES, ETC.)

Product Implementation:



DICOM STANDARD

Standard Specification:



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

*EchoPAC version 6.2
Conformance Statement for DICOM v3.0*

Direction 2256472-100

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. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant **Networking** features for ECHOPAC 6.2 and later. 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.

EchoPAC is an Ultrasound Cardiac Workstation running on a commercial computer. DICOM image storage and import allows for the following DICOM functionality:

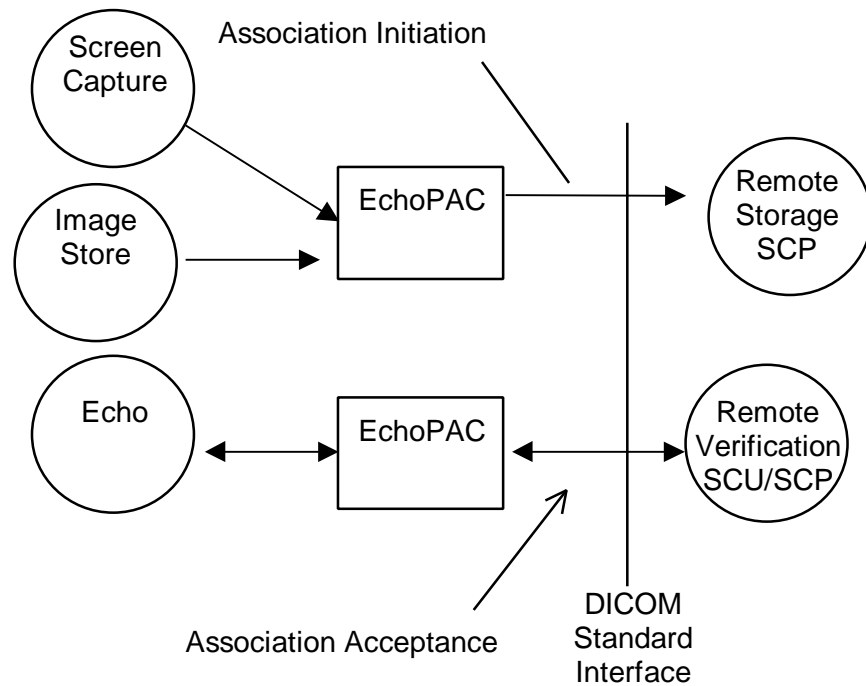
- Create DICOM images from raw data files
- Send the DICOM images to a server or saving the DICOM images to DICOM media format on a MO and MOD.
- Parse and import DICOM images to the local archive. Import is supported for DICOM images Ultrasound Multi-frame, Ultrasound and Secondary Captured images, the Secondary Captured images must contain an US modality image.

EchoPAC allows for selection of individual images or whole examinations to be saved into DICOM format. The images encoding can be controlled using the configuration setup menu. Through this interface, the selection of object definitions, color encoding scheme and compression is selectable. Storage target include for both media and Storage SCP.

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 :



There are three local real-world activities that occur in EchoPAC - **Image Store**, **Screen Capture** and **Echo**.

Image Store initiates a connection with the server, encodes one or more images and transmits the images to the server. Image Store is activated either pressing **Export** in Patient Home Screen, or pressing **DICOM** in the View Images. If an error occurs during transmission the storage is terminated and an error message is posted to the user.

Screen Capture initiates a connection with the server, encodes a DICOM image and transmits the images to the server. **Screen Capture** is activated pressing the Secondary Captured short-cut key. **Screen Capture** will only be activated if DICOM Storage SCP is selected as the target. If an error occurs during transmission the storage is terminated.

Echo initiates a connection with the DICOM server, posts an Echo message and closes the connection.

2.2.2 Functional Definition of AE's

Application Entity *EchoPAC* supports the following functions:

- Initiates a DICOM association to send images
- Encodes raw data images into DICOM images or load DICOM images from disk.
- Transmits DICOM images to the DICOM Storage SCP.

- Initiates a DICOM verification to assist in network diagnostics
- Responds to DICOM verification requests from other devices

2.2.3 Sequencing of Real-World Activities

Image Store:

- The *EchoPAC* initiates a DICOM association with the selected archive device AE when the operator requests an image be sent. The initial association negotiation list depends on the configuration setting. The association negotiation lists is described in 2.3.1.2.1.2.
- The images are then transferred to the Storage SCP(DICOM servers) using the C-STORE command. Multiple images are sent on the same DICOM Association according to the configuration of the connection in the Config Setup. For example, if the images are within one series and the reopening setting is series, study, patient or session, then all images are sent on the same connection. If the reopening setting is image, then the connection is reopened between sending every image.

Screen Capture:

- The *EchoPAC* initiates a DICOM association with the selected archive device AE when the operator requests an image be sent. The initial association list depends on the configuration setting. The association negotiation list is described in 2.3.1.2.1.2.
- The images are then transferred to the server using the C-STORE command.

Echo:

An **Echo** is initiated in the Config Screen using the "Echo" button.

- The AE uses the C-ECHO to verify the communication path to a remote AE

2.3 AE SPECIFICATIONS

1.1.1 *EchoPAC* AE Specification

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Ultrasound Multi-frame Image Storage(Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1

Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Verification SOP Class	1.2.840.10008.1.1

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCP** :

SOP Class Name	SOP Class UID
Verification SOP Class	1.2.840.10008.1.1

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

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

Application Context Name	1.2.840.10008.3.1.1.1
---------------------------------	------------------------------

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

The maximum length PDU for an association initiated by EchoPAC is configurable.

Maximum Length PDU	Configurable from 4096 to 30000
---------------------------	--

The SOP Class Extended Negotiation is not supported.

The user information Items sent by this product are :

- Maximum PDU Length
- Implementation UID
- Implementation Version Name

2.3.1.1.2 Number of Associations

The *EchoPAC* AE will initiate only one DICOM association at a time to perform an image store, or verify.

The *EchoPAC* AE can have a maximum of two DICOM associations open simultaneously, one to send an image and one to respond to an echo.

2.3.1.1.3 Asynchronous Nature

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

2.3.1.1.4 Implementation Identifying Information

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

EchoPAC Implementation UID	1.2.840.113619.6.71
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The Implementation Version Name for this DICOM v3.0 Implementation is:

EchoPAC Implementation Version Name	EchoPAC_6_2
--	--------------------

2.3.1.2 Association Initiation Policy

The *EchoPAC* AE attempts to establish a new association with a remote device due to three Real-World Activities:

- **Image Store** initiated by the operator for a specific image or group of images.
- **Screen Capture** initiated by the operator for a specific image or group of images.
- **Verification** which verifies application level communication between peer DICOM AE's for service purposes.

2.3.1.2.1 Real-World Activity A ('Image Store' Operation)

2.3.1.2.1.1 Associated Real-World Activity

Upon a request by the operator (manual or automatic), an image will be sent to a DICOM Storage SCP. If an error occurs during the transmission, the current association is released and a new association initiated. The maximum number of retries is configurable.

2.3.1.2.1.2 Proposed Presentation Context Tables

The proposed transfer syntaxes depend on the configuration settings for reopening the connection.

If the reopening setting is equal to **session, patient or study**, the most advanced negotiation scheme is used. Then the connection is negotiated to allow for transfer of image objects using of different transfer syntaxes without reopening the connection to the Storage SCP. This means that images encoded with different compression schemes may be transmitted without reopening the connection. Not all Storage SCP devices handles this association policy properly, and verification of image handling is necessary before using this setting.

If the **Reopen Transmission** is equal to **series**, the negotiation list contains only one instance of every SOP class UID, and the objects are negotiated using one compression setting. This means that images encoded using different SOP class UIDs (Secondary Captured, Ultrasound, Ultrasound MF) may be transmitted without reopening the Storage SCP connection, as long as the images are encoded using the same compression (uncompressed, RLE or JPEG) and the images are within one series. This association policy is normally supported by the Storage SCP devices.

If the reopening setting is equal to **image**, only one SOP class UID and one image compression scheme is negotiated. In this case the Storage SCP connection is reopened between sending every images. This association policy may be used if the communication with the Storage SCP device is problematic using **Reopen Transmission** equal to **series**.

2.3.1.2.1.2.1 Reopen Transmission: session, patient or study

The Proposed Presentation Context Table used when the **Reopen Transmission** is set to session, patient or study is:

Presentation Context Table 1 - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None

Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0	SCU	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0	SCU	None
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0	SCU	None
Ultrasound Multi-frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Ultrasound Multi-frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Ultrasound Multi-frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3	JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0	SCU	None
Verification SOP Class	1.2.840.10008.1.1	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None

2.3.1.2.1.2.2 Reopen Transmission: series

When **Reopen Transmission** is set to **series**, there are three presentation context lists, one for every setting of Compression:

Presentation Context Tables 2- Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Presentation Context Table: Compression set to None					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

		Implicit VR Little Endian	1.2.840.10008.1.2		
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to None 1S					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to RLE					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None

Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Presentation Context Table: Compression set to JPEG					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None

2.3.1.2.1.2.3 Reopening Transmission: image

When **Reopen Transmission** is set to image, only one of the Abstract syntaxes in the table is negotiated, and this Presentation Context Table depends on the Compression setting and the DICOM object to be transferred to the Storage SCP. The proposed Presentation Context Tables as a function of Compression and Storage service are:

Presentation Context Tables 5 - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Presentation Context Table: Compression set to None, Secondary Captured Image Storage					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2		
Presentation Context Table: Compression set to None 1S, Secondary Captured Image Storage					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to RLE, Secondary Captured Image Storage					

Presentation Context Tables 5 - Proposed					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Presentation Context Table: Compression set to JPEG, Secondary Captured Image Storage					
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Presentation Context Table: Compression set to None, Ultrasound Image Storage					
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		
Presentation Context Table: Compression set to None 1S, Ultrasound Image Storage					
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to JPEG, Ultrasound Image Storage					
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Presentation Context Table: Compression set to None, Ultrasound Multi-frame Image Storage					
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		
Presentation Context Table: Compression set to None 1S, Ultrasound Multi-frame Image Storage					
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to RLE, Ultrasound Multi-frame Image Storage					
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Presentation Context Table: Compression set to JPEG, Ultrasound Multi-frame Image Storage					

Presentation Context Tables 5 - Proposed					
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Presentation Context Table: Compression set to None, Ultrasound Image Storage (retired)					
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to None 1S, Ultrasound Multi-frame Image Storage					
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to RLE, Ultrasound Image Storage (retired)					
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Presentation Context Table: Compression set to JPEG, Ultrasound Image Storage (retired)					
Ultrasound Image Storage(retired)	1.2.840.10008.5.1.4.1.1.6	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None
Presentation Context Table: Compression: None, Ultrasound Multi-frame Image Storage(retired)					
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Explicit VR Little Endian Explicit VR Big Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression: None 1S, Ultrasound Multi-frame Image Storage(retired)					
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Presentation Context Table: Compression set to RLE, Ultrasound Multi-frame Image Storage(retired)					
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Run Length Encoding, RLE	1.2.840.10008.1.2.5	SCU	None
Presentation Context Table: Compression set to JPEG, Ultrasound Multi-frame Image Storage(retired)					

Presentation Context Tables 5 - Proposed					
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	JPEG BASELINE Lossy	1.2.840.10008.1.2.50	SCU	None

2.3.1.2.1.2.4 SOP Specific DICOM Conformance Statement for all Storage SOP Classes

Following are the status codes that are more specifically processed when receiving storage status messages from a **Storage** SCP equipment:

Service Status	Status Codes	Further Meaning	Application Behavior When receiving Status Codes	Related Fields Processed if received
Refused	A7xx	Out of resources	association is terminated; image not transferred	(0000,0902)
	0122	SOP Class not Supported	association is terminated; image not transferred	(0000,0902)
Error	Cxxx	Cannot Understand	association is terminated; image not transferred	(0000,0901) (0000,0902)
	A9xx	Data Set does not match SOP Class	association is terminated; image not transferred	(0000,0901) (0000,0902)
Warning	B000	Coercion of Data Elements	treated as a ' Successful ' response	(0000,0901) (0000,0902)
	B007	Data Set does not match SOP Class	treated as a ' Successful ' response	(0000,0901) (0000,0902)
	B006	Elements Discarded	treated as a ' Successful ' response	(0000,0901) (0000,0902)
Success	0000			None

The status codes are logged in the mergecom.log file if debugging is activated in the Config screen.

An association is open until a explicit reopen is select in the Config screen.

2.3.1.2.2 Real-World Activity A ('Screen Capture' Operation)

Screen Capture is initiated through the DICOM screen capture shortcut. This activity is like 'Image Store', but only one image is sent, and this image is a single frame image.

2.3.1.2.3 Real-World Activity - Verification Request

2.3.1.2.3.1 Associated Real-World Activity

An incoming Verification Request will cause EchoPAC to accept the association and respond with a Verification Response.

2.3.1.2.3.2 Accepted Presentation Context Table

Presentation Context Table - Accepted					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

2.3.1.2.3.3 Presentation Context Acceptance Criterion

No criterion.

2.3.1.2.3.4 Transfer Syntax Selection Policies

The selected transfer syntax is based on the proposed transfer syntax list. The priorities are first, Implicit VR Little Endian, then Explicit VR Little Endian and Explicit VR Big Endian.

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks (PS 3.8, PS 3.9)

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

2.4.2 OSI Stack

OSI stack not supported

2.4.2.1 International Standardized Profile (ISP)

ISP not supported.

2.4.2.2 API

Not applicable to this product.

2.4.2.3 Physical Media Support

This product support 10 Megabits pr second transmission.

2.4.3 TCP/IP Stack

The TCP/IP stack is inherited from a Mac OS Operating System.

2.4.3.1 API

Not applicable to this product.

2.4.4 Point-to-Point Stack

A 50-pin ACR-NEMA connection is not applicable to this product.

2.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

No private data elements are used.

2.6 CONFIGURATION

2.6.1 AE Title/Presentation Address Mapping

The Local AE title is configurable through the Config Setup screen.

2.6.2 Configurable Parameters

The following fields are configurable for this AE (local):

- Local AE Title
- Local IP Address
- Local Listening Port Number
- Raw data image size as a fraction of display size. (DICOM image information in a File on disc is not changed when save to Storage SCP).

Through the Mac TCP/IP configuration, the

- Local IP Address
- Local IP Netmask
- Local routing table information

can be set.

The following fields are configurable connection:

- Reopen Transmission setting: Image, Series, Study, Patient or Session .
- Remote AE Title
- Remote IP Address or computer name.
- Remote Listening TCP/IP Port Number.

- Timeout.
- PDU Length.
- IOD support: Ultrasound, Ultrasound MultiFrame, Secondary Captured
- Compression: None, RLE, JPEG (BASELINE lossy).
- Color encoding support, RGB(full), Palette (no RGB) or "Black & White".
- Verification support: OK/None
- Type 3 elements encoding: OK/None.
- Number of retries
- Retry interval.

2.7 SUPPORT OF EXTENDED CHARACTER SETS

EchoPAC 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 displayed or imported.

3. MEDIA STORAGE CONFORMANCE STATEMENT

3.1 INTRODUCTION

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

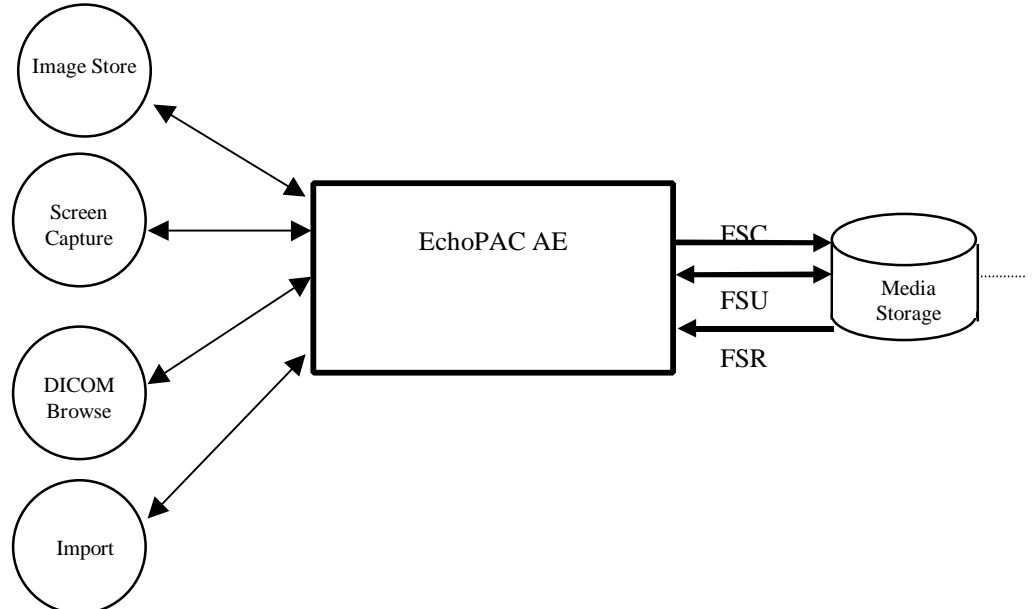
EchoPAC is able to export raw data files or screen captured object to DICOM media, browse DICOM media or import SOP instances from DICOM media.

3.2 IMPLEMENTATION MODEL

3.2.1 Application Data Flow Diagram

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

ILLUSTRATION 3-1
SPECIFIC AE APPLICATION MODEL



The EchoPAC device has a local storage that is capable of containing various SOP instances. These may have been obtained by network or by removable media using other application entities. These instances are external to this conformance claim and the origin of the SOP instances is outside the scope of this claim.

EchoPAC can initialize Media by acting as an FSC to create a new DICOM File-set on either 320 MB MOD, 640 MB MOD, 1.2 GB MOD ,2.4 GB MOD or Floppy. The SOP instances written to media must be one of the instances supported by EchoPAC. A pre-existing File-set will be updated with the information in DICOM files copied to media.

3.2.2 Functional Definition of AE's

EchoPAC can perform these functions:

- Create a new DICOM File-set on media
- Update DICOM File-set by adding new SOP instances to the File-set
- Display information and image previews from the existing File-set
- Copy SOP instances from the MOD onto local archive

3.2.3 Sequencing Requirements

None applicable

3.2.4 File Meta Information Options (See PS3.10)

The File Meta-Information for this implementation is :

File Meta-Information Version	1
EchoPAC Implementation UID	1.2.840.113619.6.71
Implementation Version Name	EchoPAC_6_2

3.3 AE SPECIFICATIONS

3.3.1 EchoPAC AE Specification

The EchoPAC 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-GEN-CD	Browse	FSR	Interchange
STD-US-ID-SF-CD	Import	FSR	Interchange
STD-US-ID-SF-FLOP, STD-US-ID-SF-MOD230, STD-US-ID-SF-MOD650, STD-US-ID-SF-MOD650, STD-US-ID-SF-MOD12, STD-US-ID-SF-MOD23,	Image Store	FSR/ FSC/ FSU	Interchange

	Browse	FSR	Interchange
	Import	FSR	Interchange

3.3.1.1 File Meta Information for the EchoPAC Application Entity

The Source Application Entity is set from the EchoPAC local AE title. The local AE is configurable.

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

Source Application Entity Title	EchoPAC
--	----------------

3.3.1.2 Real-World Activities for the EchoPAC Application Entity

3.3.1.2.1 Real-World Activity "Image Store"

"Image Store" saves a DICOM SOP instance to media and updates DICOM File Set. If the original image is a DICOM file, the DICOM SOP instance is copied from the local storage media, if not the image is loaded and displayed, and then encoded into a DICOM SOP Instance.

3.3.1.2.1.1 Media Storage Application Profile for the RWA "Image Store":

For the list of Application Profiles that invoke this AE for "Image Store" RWA, see the Table in Section 3.3.1 "EchoPAC AE Specification" where the table describing the profiles and real-world activities is defined.

3.3.1.2.1.1.1 Options :

Following are the SOP Classes supported by the RWA "Image Store":

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
DICOM Media Storage Directory	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	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG Baseline	1.2.840.10008.1.2.50

Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Explicit VR Little Endian Run Length Encoding, RLE JPEG Baseline	1.2.840.10008.1.2.1 1.2.840.10008.1.2.5 1.2.840.10008.1.2.50
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian Run Length Encoding, RLE JPEG Baseline	1.2.840.10008.1.2.1 1.2.840.10008.1.2.5 1.2.840.10008.1.2.50
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Explicit VR Little Endian Run Length Encoding, RLE JPEG Baseline	1.2.840.10008.1.2.1 1.2.840.10008.1.2.5 1.2.840.10008.1.2.50
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Run Length Encoding, RLE JPEG Baseline	1.2.840.10008.1.2.1 1.2.840.10008.1.2.5 1.2.840.10008.1.2.50

3.3.1.2.2 Real-World Activity "Screen Capture"

The " Screen Capture " RWA is a RGB screen capture. It encodes the Images into a DICOM image using the EchoPAC current Patient information. If the configuration is set to automatic storage of screen capture, the pre-selected DICOM media disk is the target, else the target disk is selected through a popup-menu. This menu shows all writeable disks mounted on EchoPAC.

3.3.1.2.2.1 Media Storage Application Profile for the RWA " Screen Capture ":

For the list of Application Profiles that invoke this AE for EchoPAC RWA, see the Table in Section 3.3.1, where the table describing the profiles and real-world activities is defined.

3.3.1.2.2.1.1 Options :

Following are the SOP Classes supported by the **Screen Capture**:

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
DICOM Media Storage Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.50

3.3.1.2.3 Real-World Activity "DICOM Browse"

DICOM Browse is activated pressing

- **DICOM Import.** The mounted disks are scanned for DICOMDIR located at the root directory. If one DICOMDIR is found the selection of DICOMDIR is automatic, if several DICOMDIR is found, the DICOMDIR is found using a menu selection.
- both keys <option> and **DICOM Import.** A file selection menu appears, and a selection of directory and file name is done. If the located file has name DICOMDIR, the DICOMDIR found is opened, if the located file is not DICOMDIR, all the DICOM files in the directory in question is scanned and a DICOMDIR is created in memory. This option is a way to located DICOMDIR outside the root level. It also allows browsing DICOM instances outside a DICOM File set or DICOM instances supported by a corrupted DICOMDIR.

The browse display then presents a list of patients, studies, series and images. At series level only records containing modality "US" is presented. On image level a preview image is presented, using the first frame in case of a multiframe DICOM object. On selecting a single image by a double-click using the mouse loads the image into memory and EchoPAC displays this DICOM file using the whole display area.

Selection of images to be imported is done from this display.

3.3.1.2.4 Media Storage Application Profile for the RWA "DICOM Browse ":

For the list of Application Profiles that invoke this AE for Import RWA, see the Table in Section 3.2.1 "EchoPAC AE Specification".

3.3.1.2.4.1.1 Options :

Following are the SOP Classes supported by the RWA DICOM Browse:

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
DICOM Media Storage Directory	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	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Explicit VR Little Endian	1.2.840.10008.1.2.1

		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.5 0

3.3.1.2.5 Real-World Activity " Import "

The " Import " RWA first extracts Patient data from the DICOM message. This information is presented for the user, The information is editable for the user before a confirmation is requested.

Then the patient archive is searched to check if the patient is already defined in the archive.

If the patient resides in the archive, a confirmation of is requested.

If the patient is not found in the archive, a confirmation of creating a new patient is requested.

If the confirmation of the patient data is denied the import is cancelled..

If the confirmation is positive, the DICOM files are not modified in any way, only copied in to a file, using the folder and file name standard within EchoPAC. Study and Series data are extracted and copied into the EchoPAC archive.

3.3.1.2.5.1 Media Storage Application Profile for the RWA " Import ":

For the list of Application Profiles that invoke this AE for Import RWA, see the Table in Section 3.2.1 "EchoPAC AE Specification".

3.3.1.2.5.1.1 Options :

Following are the SOP Classes supported by the Import RWA:

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
DICOM Media Storage Directory	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	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.50
Ultrasound Multi-frame Image Storage(retired)	1.2.840.10008.5.1.4.1.1.3	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.50
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.50
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.50
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian	1.2.840.10008.1.2.1
		Run Length Encoding, RLE	1.2.840.10008.1.2.5
		JPEG BASELINE Lossy	1.2.840.10008.1.2.50

3.4 AUGMENTED AND PRIVATE APPLICATION PROFILES

No augmented/private profile is implemented

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

Not Applicable

3.6 CONFIGURATION

The following parameters are configurable:

- Compression: None/JPEG BASELINE/RLE
- Source AE Title in the File Meta-Information set From EchoPAC's AE Title
- JPEG quality: 0-100, preferably 80-100.
- Auto store of Secondary Captured objects: OFF/Media
- Storage Volume for Secondary Capture: Disk name.
- Raw data image size as a fraction of display size. (DICOM image information in a File on disc is not changed when save to DICOM media).

3.7 SUPPORT OF EXTENDED CHARACTER SETS

The EchoPAC 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 read or imported.

4. ULTRASOUND (US) INFORMATION OBJECT IMPLEMENTATION

4.1 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:

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

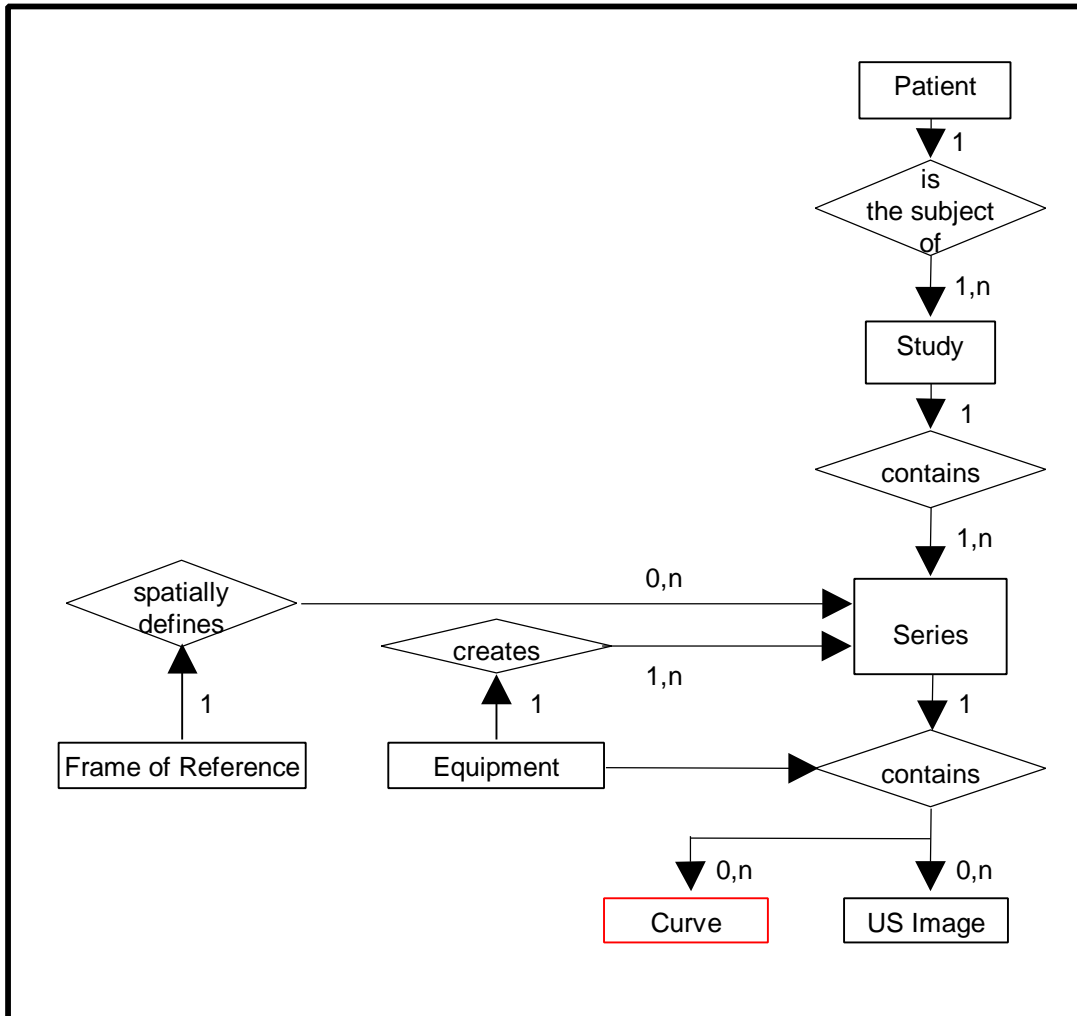
4.3 US ENTITY-RELATIONSHIP MODEL

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 EchoPAC Mapping of DICOM entities

TABLE 4.3-1
MAPPING OF DICOM ENTITIES TO ECHOPAC ENTITIES

DICOM	EchoPAC 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 data sets.

Table 4.4-1 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 4.4-1
US IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Frame of Reference	Frame of Reference	Not used
	US Frame of Reference	Not used
Equipment	General Equipment	4.5.4.1
Image	General Image	4.5.5.1
	Image Pixel	4.5.5.2
	Contrast/Bolus	4.5.5.3
	Palette Color Lookup Table	4.5.5.4
	US Region Calibration	4.5.7.1
	US Image	4.5.7.2
	Overlay Plane	Not used
	VOI LUT	4.5.5.5
	SOP Common	4.5.6.1
Curve	Not used	

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

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 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).

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	May be entered from User Interface. Only first and last names are used. The number of characters is limited to the number allowed by the New Patient screen, which is 31 in the last name and 31 in the first name. Middle name is not supported. A ^ is inserted as the delimiter between last and middle name. Import : Illegal characters removed, excess characters skipped. The user confirms and may edit the patient name on import of DICOM images.
Patient ID	(0010,0020)	2	May be entered from User Interface. Limited to the number of characters allowed by the New Patient screen. Import : Illegal characters replaced with SPACE, excess characters skipped. The user confirms and may edit the patient name on import of DICOM images.
Patient's Birth Date	(0010,0030)	2	May be entered from User Interface
Patient's Sex	(0010,0040)	2	May be entered from User Interface; limited to 'M' and 'F'. 'U' is not used on export. Import: Undefined will be set to Male
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

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	Generated using GEMS UID + EchoPAC implementation UID + DONGLE ID + boot time +study incremental number
Study Date	(0008,0020)	2	Is set to examination date
Study Time	(0008,0030)	2	Is set to examination time
Referring Physician's Name	(0008,0090)	2	May be entered from User Interface, New Patient screen
Study ID	(0020,0010)	2	Not used
Accession Number	(0008,0050)	2	May be entered from user interface, New Patient screen
Study Description	(0008,1030)	3	May be entered from user interface, Diagnosis
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

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
Admitting Diagnoses Description	(0008,1080)	3	May be entered from user interface in referral reason.
Patient's Age	(0010,1010)	3	Calculated from DOB entered from User Interface
Patient's Size	(0010,1020)	3	May be entered from User Interface. The unit is feet or meters depending on EchoPAC configuration setup

Attribute Name	Tag	Type	Attribute Description
Patient's Weight	(0010,1030)	3	May be entered from User Interface. The unit is lbs or kg depending on EchoPAC configuration setup
Occupation	(0010,2180)	3	Not used
Additional Patient's History	(0010,21B0)	3	Not used

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	Defined Term "US" used
Series Instance UID	(0020,000E)	1	Generated using GEMS UID + EchoPAC implementation UID + DONGLE ID + boot time +series incremental number
Series Number	(0020,0011)	2	Internal number which is incremented for each new exam within a study
Laterality	(0020,0060)	2C	Not used
Series Date	(0008,0021)	3	Is set to Examination date
Series Time	(0008,0031)	3	Is set to 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	May be entered from User Interface (limited to initials or 3-digit ID) Import: Only the 3 first characters are imported
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

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 a Series of Images.

TABLE 4.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Is set to "GE. Vingmed Ultrasound"
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	This field shall reflect EchoPAC software 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

4.5.4.1.1 General Equipment Attribute Descriptions

4.5.5 Common Image Entity Modules

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

4.5.5.1 General Image Module

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

TABLE 4.5-6
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	internal value which is incremented for each captured image, within a series (within a study),
Patient Orientation	(0020,0020)	2C	Not used
Image Date	(0008,0023)	2C	Set from Image date or image capture date
Image Time	(0008,0033)	2C	Set from Image time or image capture time

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	3	Value "ORIGINAL/PRIMARY" or "SECONDARY/DERIVED".
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	Set to 01 if images is JPEG BASELINE compressed

4.5.5.2 Image Pixel Module

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

TABLE 4.5-7
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Value of '1' if Photometric Interpretation element value has value 'MONOCHROME2' or 'PALETTE COLOR'. Value of '3' when Photometric Interpretation element value has value 'RGB' or 'YBR_FULL' or 'YBR_FULL_422'
Photometric Interpretation	(0028,0004)	1	Defined Values used: "MONOCHROME2" "PALETTE COLOR" "RGB" for uncompressed images "YBR_FULL" used for RLE compressed images "YBR_FULL_422" used for JPEG compressed images
Rows	(0028,0010)	1	Value depends on scanning mode and configuration setup
Columns	(0028,0011)	1	Value depends on scanning mode and configuration setup.

Attribute Name	Tag	Type	Attribute Description
Bits Allocated	(0028,0100)	1	Value always = 0008H
Bits Stored	(0028,0101)	1	Value always = 0008H
High Bit	(0028,0102)	1	Value always = 0007H
Pixel Representation	(0028,0103)	1	Defined Value '0' - unsigned integer
Pixel Data	(7FE0,0010)	1	
Planar Configuration	(0028,0006)	1C	Enumerated value 0000H Enumerated Value, color-by-pixel, if Photometric Interpretation element value has value 'RGB', 'YBR_FULL_422'. Enumerated value 0001H, color-by-plane if Photometric Interpretation element value has value 'YBR_FULL'.
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	Has the values(256,0 ,16) if Photometric Interpretation has value "PALETTE COLOR"
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Has the values(256,0 ,16) if Photometric Interpretation has value "PALETTE COLOR"
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Has the values(256,0 ,16) if Photometric Interpretation has value "PALETTE COLOR"
Red Palette Color Lookup Table Data	(0028,1201)	1C	Has 256 values if Photometric Interpretation has value "PALETTE COLOR"
Green Palette Color Lookup Table Data	(0028,1202)	1C	Has 256 values if Photometric Interpretation has value "PALETTE COLOR"
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Has 256 values if Photometric Interpretation has value "PALETTE COLOR"

4.5.5.3 Contrast/Bolus Module

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

**TABLE 4.5-8
CONTRAST/BOLUS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	May be entered from User Interface, Structured reporting mode If there is no value, this tag is not encoded into the message
Contrast/Bolus Agent Sequence	(0018,0012)	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
Contrast/Bolus Route	(0018,1040)	3	Not used
Contrast/Bolus Administration Route Sequence	(0018,0014)	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
>Additional Drug Sequence	(0018,002A)	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
Contrast/Bolus Volume	(0018,1041)	3	Not used
Contrast/Bolus Start Time	(0018,1042)	3	Not used
Contrast/Bolus Stop Time	(0018,1043)	3	Not used
Contrast/Bolus Total Dose	(0018,1044)	3	Not used
Contrast Flow Rate(s)	(0018,1046)	3	Not used
Contrast Flow Duration(s)	(0018,1047)	3	Not used
Contrast/Bolus Ingredient	(0018,1048)	3	Not used
Contrast/Bolus Ingredient Concentration	(0018,1049)	3	Not used

4.5.5.4 Palette Color Lookup Table Module

This section specifies the Attributes that describe the Lookup table data for images with Palette Color photometric interpretation.

**TABLE 4.5-9
PALETTE COLOR LOOKUP MODULE**

Attribute Name	Tag	Type	Attribute Description
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Has the values(256,0 ,16) if Photometric Interpretation has value "PALETTE COLOR"

Attribute Name	Tag	Type	Attribute Description
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Has the values(256,0 ,16) if Photometric Interpretation has value "PALETTE COLOR"
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Has the values(256,0 ,16) if Photometric Interpretation has value "PALETTE COLOR"
Palette Color Lookup Table UID	(0028,1199)	3	Not used
Red Palette Color Lookup Table Data	(0028,1201)	1C	Has 256 values if Photometric Interpretation has value "PALETTE COLOR"
Green Palette Color Lookup Table Data	(0028,1202)	1C	Has 256 values if Photometric Interpretation has value "PALETTE COLOR"
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Has 256 values if Photometric Interpretation has value "PALETTE COLOR"
Segmented Red Palette Color Lookup Table Data	(0028,1221)	1C	Not used
Segmented Green Palette Color Lookup Table Data	(0028,1222)	1C	Not used
Segmented Red Palette Color Lookup Table Data	(0028,1223)	1C	Not used

4.5.5.5 VOI LUT MODULE

This section specifies the Attributes which identify and describe the VOI LUT Module

**TABLE 4.5-10
VOI LUT MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	3	Not used
>LUT Descriptor	(0028,3002)	3	Not used
>LUT Explanation	(0028,3003)	3	Not used
>LUT Data	(0028,3006)	3	Not used
Window Center	(0028,1050)	3	Value set to 127 if Photometric Interpretation has value MONOCHROME2
Window Width	(0028,1051)	3	Value set to 256 if Photometric Interpretation has value MONOCHROME2
Window Center & Width Explanation	(0028,1055)	3	Not used

4.5.6 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

4.5.6.1 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 4.5-11
SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Set to "1.2.840.10008.5.1.4.1.1.3.1" "1.2.840.10008.5.1.4.1.1.3" "1.2.840.10008.5.1.4.1.1.6.1" "1.2.840.10008.5.1.4.1.1.6" "1.2.840.10008.5.1.4.1.1.7"
SOP Instance UID	(0008,0018)	1	generated from GEMS UID + dongle id+ boot time+thread id=1+image counter
Specific Character Set	(0008,0005)	1C	Set to "ISO_IR 100" if extended characters are used. Import: images using other extended character set than "ISO_IR 100" are rejected.
Instance Creation Date	(0008,0012)	3	Not used
Instance Creation Time	(0008,0013)	3	Not used
Instance Creator UID	(0008,0014)	3	Not used

4.5.7 US Modules

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

4.5.7.1 US Region Calibration Module

Specify how and if the US Region Calibration Module is used to describe multiple regions which have independent data regions, e.g. quad screen loops which may have different calibration information. The data presented in the various regions of a US image can represent a multiplicity of physical parameters, e.g., spatial distance, blood velocity, time, volume, etc., and these are often contained in the value of the pixel itself. It is therefore imperative that physical information be available for the various regions of a single region independent of each other.

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

**TABLE 4.5-12
US REGION CALIBRATION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Sequence of Ultrasound Regions	(0018,6011)	1	Object contains 0 or 1 regions
>Region Location Min x_0	(0018,6018)	1	Value is 0

Attribute Name	Tag	Type	Attribute Description
>Region Location Min y_0	(0018,601A)	1	Value is 0
>Region Location Max x_1	(0018,601C)	1	Value is image width-1.
>Region Location Max y_1	(0018,601E)	1	Value is image height-1
>Physical Units X Direction	(0018,6024)	1	Enumerated Values supported: 0003H cm 0004H seconds
>Physical Units Y Direction	(0018,6026)	1	Enumerated Values supported: 0003H cm 0004H seconds 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	Varies with scanning mode
>Reference Pixel y_0	(0018,6022)	3	Varies with scanning mode
>Ref. Pixel Physical Value X	(0018,6028)	3	Varies with scanning mode
>Ref. Pixel Physical Value Y	(0018,602A)	3	Varies with scanning 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 0006H Doppler Mode Trace
>Region Flags	(0018,6016)	1	Bit 0: 0 = Opaque Bit 1: 0 = Not Protected because there may be other regions within the image Bit 2 : 0 = Velocity
>Pixel Component Organization	(0018,6044)	1C	Pixel component calibration data does not exist for any region
>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
>Transducer Frequency	(0018,6030)	3	Not used
>Pulse Repetition Frequency	(0018,6032)	3	Not used

Attribute Name	Tag	Type	Attribute Description
>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

4.5.7.2 US Image Module

This section specifies the Attributes that describe ultrasound images.

TABLE 4.5-13
US IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples Per Pixel	(0028,0002)	1	Value of '1' if Photometric Interpretation element value has value 'MONOCHROME2' or 'PALETTE COLOR'. Value of '3' when Photometric Interpretation element value has value 'RGB' or 'YBR_FULL' or 'YBR_FULL_422'
Photometric Interpretation	(0028,0004)	1	Defined Values used: "MONOCHROME2" "PALETTE COLOR" "RGB" for uncompressed images "YBR_FULL" used for RLE compressed images "YBR_FULL_422" used for JPEG compressed images
Bits Allocated	(0028,0100)	1	Value always = 0008H
Bits Stored	(0028,0101)	1	Value always = 0008H
High Bit	(0028,0102)	1	Value always = 0007H
Planar Configuration	(0028,0006)	1	Enumerated value 0000H Enumerated Value, color-by-pixel, if Photometric Interpretation element value has value 'RGB', 'YBR_FULL_422'. Enumerated value 0001H, color-by-plane if Photometric Interpretation element value has value 'YBR_FULL'.
Pixel Representation	(0028,0103)	1	Always 0000H = unsigned integer.
Frame Increment Pointer	(0028,0009)	1C	Export: Set to Frame Time if the image is multiframe IOD, Not used if the image is a single frame IOD..
Image Type	(0008,0008)	2	Value "ORIGINAL/PRIMARY" or "SECONDARY/DERIVED".
Lossy Image Compression	(0028,2110)	1C	Set to 01 if image is compressed using JPEG BASELINE compression.
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

Attribute Name	Tag	Type	Attribute Description
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

Attribute Name	Tag	Type	Attribute Description
>>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	Set to heart rate as defined in EchoPAC
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

5. ULTRASOUND MULTIFRAME (US MF) INFORMATION OBJECT IMPLEMENTATION

5.1 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

5.2 US IOD IMPLEMENTATION

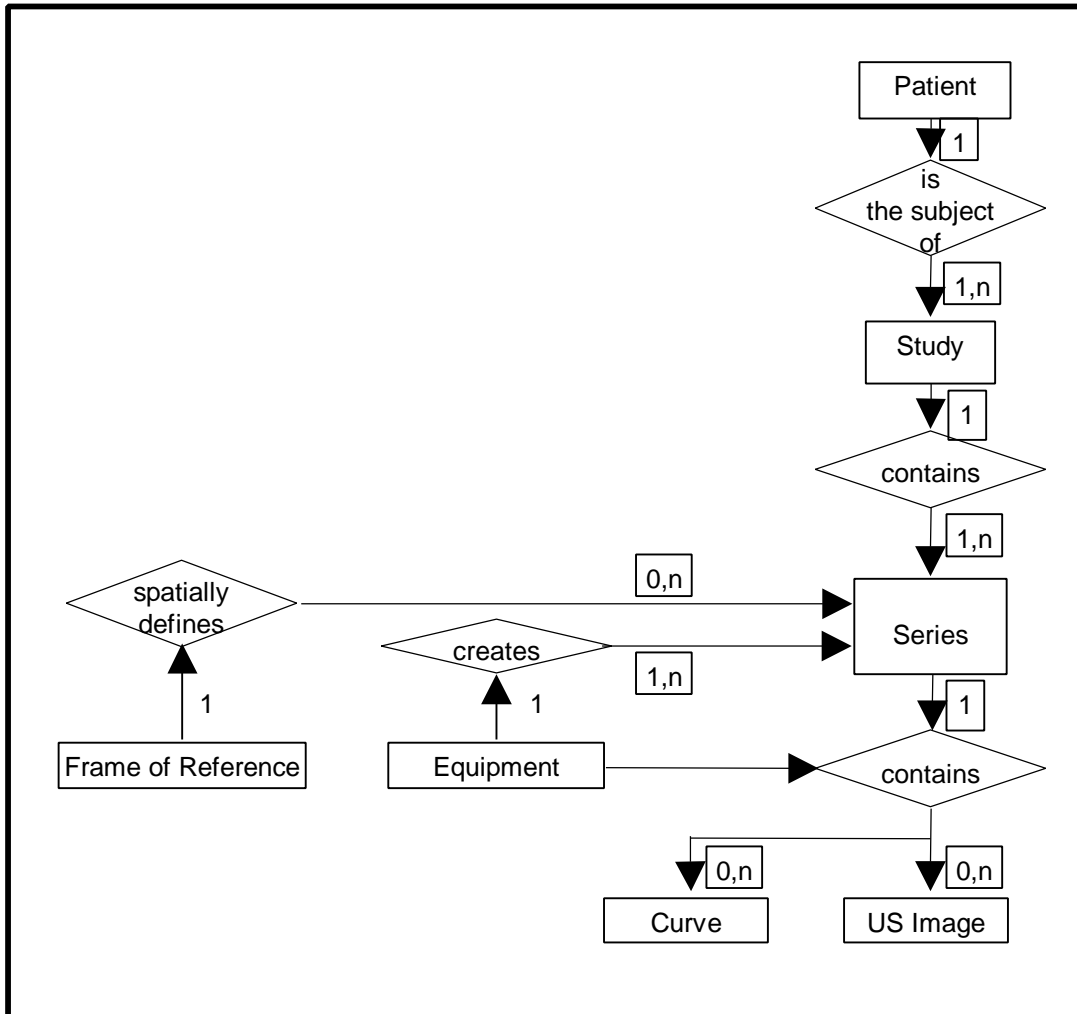
5.3 US ENTITY-RELATIONSHIP MODEL

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 5.3-1
US MULTIFRAME IMAGE ENTITY RELATIONSHIP DIAGRAM



5.3.1 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.

5.3.2 EchoPAC Mapping of DICOM entities

TABLE 5.3-1
MAPPING OF DICOM ENTITIES TO ECHOPAC ENTITIES

DICOM	EchoPAC Entity
Patient	Patient
Study	Exam
Series	Exam
Image	Image

Curve	Not used
-------	----------

5.4 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 4.4-1 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 US Multi-Frame Image IOD is described here. If supported the US Multi-Frame Image IOD should be described here or elsewhere, It is used in a different SOP Class however and may not be supported by all implementations.

TABLE 5.4-1
US MULTI-FRAME IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Frame of Reference	Frame of Reference	Not used
	US Frame of Reference	Not used
Equipment	General Equipment	4.5.4.1
Image	General Image	4.5.5.1
	Image Pixel	4.5.5.2
	Contrast/Bolus	4.5.5.3
	Cine	5.4.1.1
	Multi-frame	5.4.1.2
	Palette Color Lookup Table	4.5.5.4
	US Region Calibration	4.5.7.1
	US Image	4.5.7.2
	Overlay Plane	Not used
	VOI LUT	4.5.5.5
SOP Common	4.5.6.1	

Curve	Not used
-------	----------

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

5.4.1.1 Cine Module

TABLE 5.4-2
CINE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Time	(0018,1063)	1C	Is set to the interframe time
Frame Time Vector	(0018,1065)	1C	Import: Average value is set to interframe time
Start Trim	(0008,2142)	3	Not used
Stop Trim	(0008,2143)	3	Not used
Recommended Display Frame Rate	(0008,2144)	3	Not used
Cine Rate	(0018,0040)	3	Not used
Frame Delay	(0018,1066)	3	Not used
Effective Duration	(0018,0072)	3	Not used
Actual Frame Duration	(0018,1242)	3	Not used

5.4.1.2 Multi-frame Module

TABLE 5.4-3
MULTI-FRAME MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Is set to the interframe time
Frame Increment Pointer	(0028,0009)	1	Is set to Frame Time (0018,1063)

6. SC INFORMATION OBJECT IMPLEMENTATION

6.1 INTRODUCTION

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

6.2 - IOD Description

6.3 - IOD Entity-Relationship Model

6.4 - IOD Module Table

6.5 - IOD Module Definition

6.2 SC IOD IMPLEMENTATION

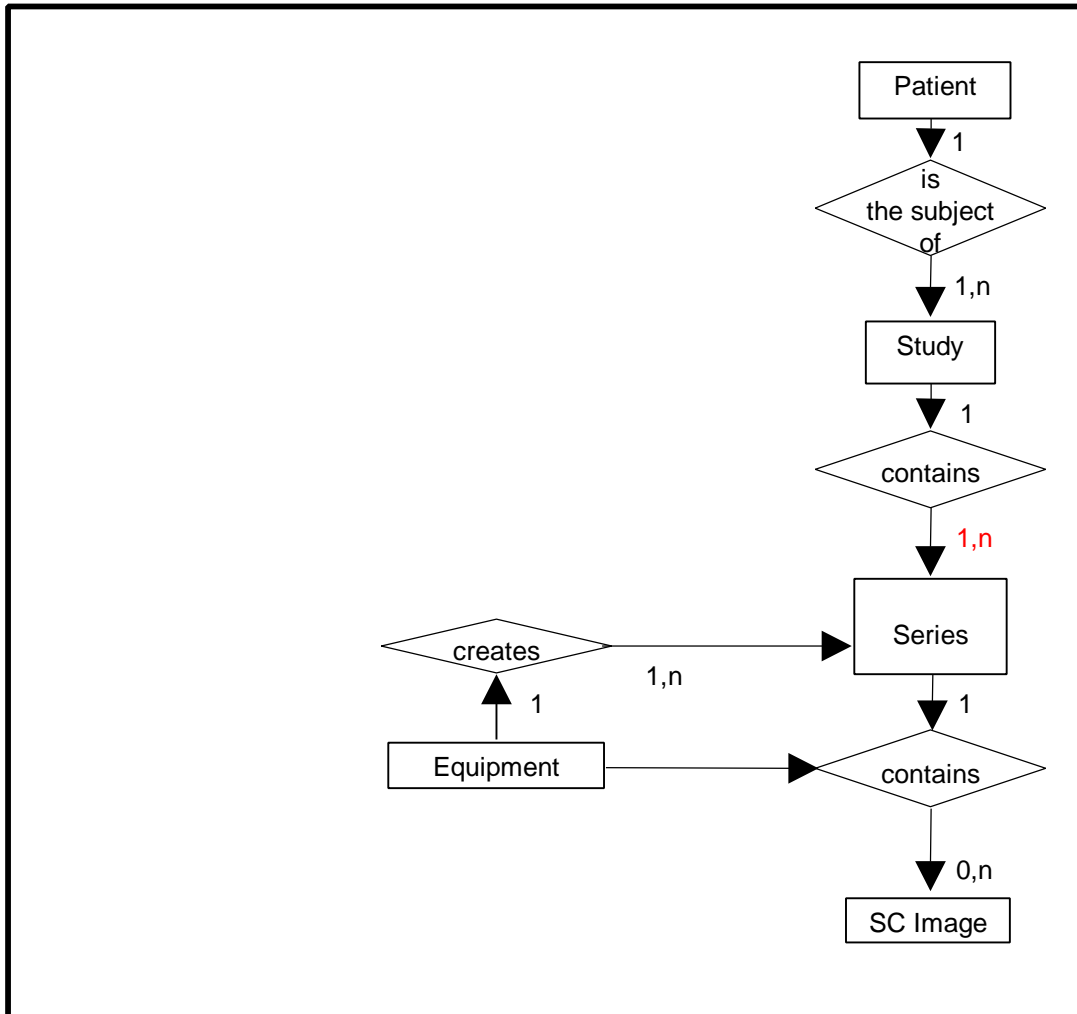
6.3 SC ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the SC Image interoperability schema is shown in Illustration 6.3-1. 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 6.3-1
SC IMAGE ENTITY RELATIONSHIP DIAGRAM**



6.3.1 ENTITY DESCRIPTIONS

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

6.3.2 EchoPAC Mapping of DICOM entities

**TABLE 6.3-1
MAPPING OF DICOM ENTITIES TO ECHOPAC ENTITIES**

DICOM	EchoPAC Entity
Patient	Patient
Study	Exam
Series	Exam
Image	Image

Frame	Not Applicable
-------	----------------

6.4 IOD MODULE TABLE

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

Table 6.4-1 identifies the defined modules within the entities which comprise the DICOM v3.0 SC IOD. Modules are identified by Module Name.

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

TABLE 6.4-1
SC IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	4.5.1.1
Study	General Study	4.5.2.1
	Patient Study	4.5.2.2
Series	General Series	4.5.3.1
Equipment	General Equipment	4.5.4.1
	SC Equipment	6.5.1.1
Image	General Image	4.5.5.1
	Image Pixel	4.5.5.2
	SC Image	6.5.1.2
	Overlay Plane	Not used
	Modality LUT	Not used
	VOI LUT	4.5.5.5
	SOP Common	4.5.6.1

6.5 INFORMATION MODULE DEFINITIONS

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

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from. It should be

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

6.5.1 SC Modules

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

6.5.1.1 SC Equipment Module

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

TABLE 6.5-2
SC IMAGE EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	Set to WSD (Workstation Derived)
Modality	(0008,0060)	3	Set to US
Secondary Capture Device ID	(0018,1010)	3	Defined Value "EchoPAC"
Secondary Capture Device Manufacturer	(0018,1016)	3	Implementation defined string "GE Vingmed Ultrasound"
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	3	Implementation defined string "EchoPAC"
Secondary Capture Device Software Version	(0018,1019)	3	Is set the EchoPAC software version
Video Image Format Acquired	(0018,1022)	3	Not used
Digital Image Format Acquired	(0018,1023)	3	Not used

6.5.1.2 SC Image Module

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

TABLE 6.5-3
SC IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Date of Secondary Capture	(0018,1012)	3	Image capture date
Time of Secondary Capture	(0018,1014)	3	Image capture time

7. BASIC DIRECTORY INFORMATION OBJECT IMPLEMENTATION

7.1 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:

7.2 - IOD Description

7.3 - IOD Entity-Relationship Model

7.4 - IOD Module Table

7.5 - IOD Module Definition

7.2 BASIC DIRECTORY IOD IMPLEMENTATION

7.3 BASIC DIRECTORY ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the Basic Directory interoperability schema is shown in Illustration 7.3-1. In this figure, the following diagrammatic convention is established to represent the information organization :

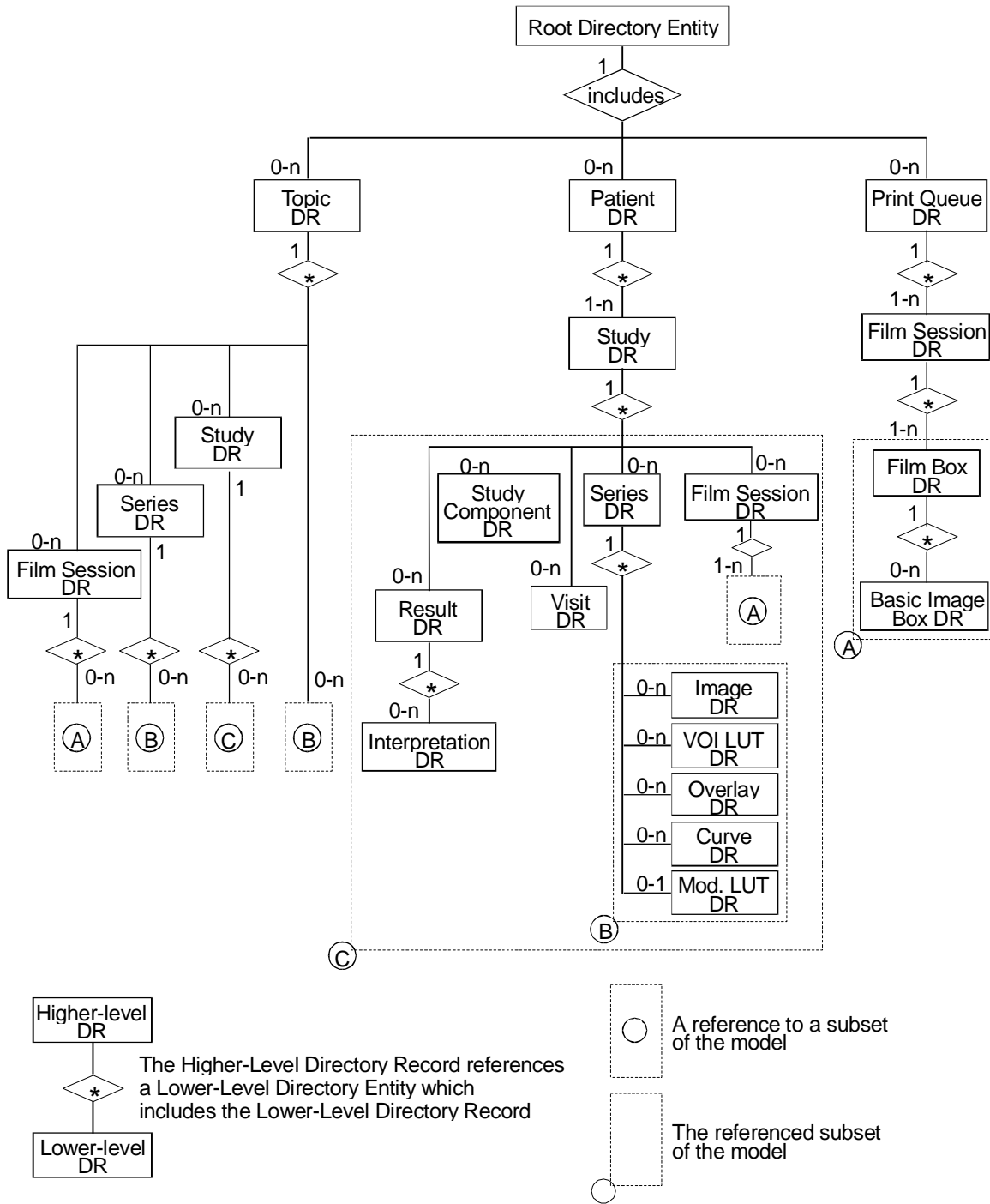
- each entity is represented by a rectangular box
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

7.3.1 EchoPAC Mapping of DICOM entities

TABLE 7.3-1
MAPPING OF DICOM ENTITIES TO ECHOPAC ENTITIES

DICOM	EchoPAC
Patient	Patient
Study	Exam
Series	Exam
Image	Image
etc.	...

ILLUSTRATION 7.3-1
BASIC DIRECTORY ENTITY RELATIONSHIP DIAGRAM



Edit this illustration to include only those entities supported by this implementation.

7.4 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 7.4-1 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 7.4-1
BASIC DIRECTORY IOD MODULES

Entity Name	Module Name	Reference
File Set Identification	File Set Identification	7.5.1.1
Directory Information	Directory Information	7.5.2.1

The Directory Information Module is created if it does not already exist on the storage media. If it already exists, the existing information is not changed regarding patient, study, series or image data.

An existing Directory Information Module may have been obtained from application entities using removable media. These instances are external to this conformance claim and the origin of the SOP instances is outside the scope of this claim.

7.5 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).

7.5.1 Common File Set identification Modules

7.5.1.1 File Set identification Module

TABLE 7.5-1
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

7.5.2 Common Directory Information Modules

7.5.2.1 Directory Information Module

TABLE 7.5-2
DIRECTORY INFORMATION MODULE

Attribute Name	Tag	Type	Attribute Description
Offset of the First Directory Record of the Root Directory Entity	(0004,1200)	1	Is set
Offset of the Last Directory Record of the Root Directory Entity	(0004,1202)	1	Is set
File-set Consistency Flag	(0004,1212)	1	FSC/FSU: Has the value 0000H: no known inconsistencies
Directory Record Sequence	(0004,1220)	2	Is created by FSC
>Offset of the Next Directory Record	(0004,1400)	1C	Is set
>Record In-use Flag	(0004,1410)	1C	FSC/FS: Is set to FFFFH FSR: A value of 0000H: imply skipping this record Import: A value of 0000H: the record is skipped
>Offset of Referenced Lower-Level Directory Entity	(0004,1420)	1C	Is set
>Directory Record Type	(0004,1430)	1C	The values support by FSC and FSU are PATIENT STUDY SERIES IMAGE
>Private Record UID	(0004,1432)	1C	Not used

Attribute Name	Tag	Type	Attribute Description
>Referenced File ID	(0004,1500)	1C	Is set if Directory Record Type is IMAGE Contains 1 to 3 elements: The first is Patient name (if not NULL) Exam date (if not NULL) <modality>+<incremental number> The elements are: - truncated to 8 characters - mapped to upper case characters - illegal characters are mapped to underscore _
>MRDR Directory Record Offset	(0004,1504)	1C	A MRDR is not created by an FSC or FSU.
>Referenced SOP Class UID in File	(0004,1510)	1C	Is set to the SOP class UID in File
>Referenced SOP Instance UID in File	(0004,1511)	1C	Is set to the SOP instance UID in File
>Referenced Transfer Syntax UID in File	(0004,1512)	1C	Is set to the Transfer Syntax UID in File
>Record Selection Keys			See 7.5.3.

7.5.3 Definition of Specific Directory Records

7.5.3.1 Patient Directory Record Definition

TABLE 7.5-3
PATIENT KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Is set if ISO IR 100 if extended characters are used in the message
Patient's Name	(0010,0010)	2	Is filled in by FSC and FSU, is a copy of the tag in the message stored to DICOMDIR. If this value is found then it is used by the FSR when importing images. If not, the first image file is used for input.
Patient ID	(0010,0020)	1	Is filled in by FSC and FSU(where it may be Type 2) , is a copy of the tag in the message stored to DICOMDIR.
Patient's Birth Date	(0010,0030)	3	FSC/FSU: Is a copy of the tag in the message stored to DICOMDIR.
Patient Comments	(0010,4000)	3	FSC/FSU Is a copy of the tag in the message stored to DICOMDIR
Patient's Sex	(0010,0040)	3	FSC/FSU: Is a copy of the tag in the message stored to DICOMDIR

7.5.3.2 Study Directory Record Definition

TABLE 7.5-4
STUDY KEYS

Key	Tag	Type	Attribute Description
-----	-----	------	-----------------------

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Is filled in by FSC or FSU as contained in the image message, if one of the tags contains extended characters
Study Date	(0008,0020)	1	Is filled in by FSC or FSU as contained in the image message
Study Time	(0008,0030)	1	Is filled in by FSC or FSU as contained in the image message. If not found, then a time of 00.00.00 is filled in
Study Description	(0008,1030)	2	Is filled in by FSC or FSU as contained in the image message. If not NULL value is set
Study Instance UID	(0020,000D)	1C	Is filled in by FSC or FSU as contained in the image message. If not update of DICOM is refused
Study ID	(0020,0010)	1	Is filled in by FSC or FSU as contained in the image message. If not it is created from Study Time.
Accession Number	(0008,0050)	2	Is filled in by FSC or FSU if it is contained in the image message. If not a NULL value is set. Used by FSR if found in the message.

7.5.3.3 Series Directory Record Definition

TABLE 7.5-5
SERIES KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Is filled in by FSC or FSU as contained in the image message, if one of the tags contains extended characters
Modality	(0008,0060)	1	Only "US" is created by FSC and FSU. FSR uses this value to check if this is a supported series. If value is not "US" then the series is not displayed or imported
Series Instance UID	(0020,000E)	1	As contained in the image message. If not update of DICOMDIR is refused
Series Number	(0020,0011)	1	Is filled in by FSC or FSU using the value found in the message if it is contained in the image message. If not found in the message, then an incremental value is used, incremented by 1 for each series within the study. Used by FSR if found in the message.
Icon Image Sequence	(0088,0200)	3	Not used.
Series Description	(0008,103E)	3	Is filled in by FSC or FSU as contained in the image message

Key	Tag	Type	Attribute Description
Series Date	(0008,0021)	3	Is filled in by FSC or FSU as contained in the image message
Series Time	(0008,0031)	3	Is filled in by FSC or FSU as contained in the image message
Series Description	(0008,103E)	3	Is filled in by FSC or FSU as contained in the image message

7.5.3.4 Image Directory Record Definition

TABLE 7.5-6
IMAGE KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Is filled in by FSC or FSU as contained in the image message, if one of the tags contains extended characters
Image Number	(0020,0013)	1	Is filled in by FSC or FSU using the value found in the message as contained in the image message. If not found in the message, then an incremental value is used, incremented by 1 for each image within the series. Used by FSR if found in the message
Icon Image Sequence	(0088,0200)	3	Not used
Image Date	(0008,0023)	3	Is filled in by FSC or FSU as contained in the image message
Image Time	(0008,0033)	3	Is filled in by FSC or FSU as contained in the image message
Image Type	(0008,0008)	3	Is filled in by FSC or FSU as contained in the image message
Rows	(0028,0010)	3	Is filled in by FSC or FSU as contained in the image message
Columns	(0028,0011)	3	Is filled in by FSC or FSU as contained in the image message
Number Of Frames	(0028,0008)	3	Is filled in by FSC or FSU as contained in the image message
Photometric Interpretation	(0028,0004)	3	Is filled in by FSC or FSU as contained in the image message
Referenced Transfer Syntax UID in File	(0004,1512)	3	Is filled in by FSC or FSU as contained in the image message
Referenced SOP Instance UID in File	(0004,1511)	3	Is filled in by FSC or FSU as contained in the image message
Referenced SOP Class in File	(0004,1510)	3	Is filled in by FSC or FSU as contained in the image message

7.5.3.5 Private Directory Record Definition

Not used

7.5.3.6 Multi-Referenced File Directory Record Definition

- Not used

7.6 PRIVATE DATA DICTIONARY

Not used