Philips Medical Systems

Conformance Statement

EnVisor DICOM

EnVisor System Version: A.0

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0. Introduction

0.1 Purpose of this Document

The Digital Imaging and Communications in Medicine (DICOM) standard was originally developed by a joint committee of the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) to "facilitate the open exchange of information between digital imaging computers". It specifies how medical images and related clinical information are passed between medical devices.

The DICOM Conformance Statement (DCS) is a required document for any device claiming conformance to DICOM. Since the DICOM standard specifies the structure and content of this document (PS3.2 - 2001) a DCS describes the DICOM capabilities and key features of a particular product in a standardized, defined manner.

This DCS defines the DICOM capabilities and key features of Philips Medical Systems' EnVisor ultrasound imaging system.

For a hospital's Information Technology (IT) department, matching DICOM Conformance Statements between vendor product offerings is a key element to determine interconnectivity between vendors' devices.

0.2 Overview of DICOM Product Offering

The services supported by EnVisor's DICOM subsystem are derived from the following customer needs:

Name	Customer Need	Options package
Optioning	Ability to purchase some features and not others.	N/A
Archival	Archival of digital images to: 1. Removable media or 2. Across the network	1. DICOM Media 2. DICOM Basic
Printing of medical images	Printing to a DICOM compatible printer	DICOM Basic
Verification	Ability to verify the existence of and communicate with a DICOM server on the network.	DICOM Basic

The base EnVisor system will be sold with no DICOM services enabled. Customers requiring functionality beyond that provided by the base system purchase DICOM services as options on top of the base system.

Philips Medical Systems offers customers two DICOM options:

1. DICOM Media — Capability to read/write studies from/to a floppy, CD, or MOD.
2. DICOM Basic — Capability to store studies across a network and print a hardcopy to a DICOM printer.

While the DICOM Conformance Statement is not intended to be a complete EnVisor product specification, some areas of this document will reference system operation where it is necessary to add a context for the discussion or to help explain a capability.

0.3 Sources for this Document

- American College of Radiology-National Electrical Manufacturers Association (ACR-NEMA) Digital Imaging and Communications in Medicine (DICOM) V3.0. 2001

0.4 Acronyms, Abbreviations and Glossary of Terms

The following acronyms and abbreviations are used in this document.

• ACR	American College of Radiology, initiated the DICOM standardization effort in the early 80's.
• AE	Application Entity
• AVI	Audio Video Interleave
• BMP	Bitmap
• DICOM	Digital Imaging and Communications In Medicine
• DIMSE	DICOM Message Service Element
• EnVisor	Philips Medical Systems' EnVisor ultrasound system
• FSC	File-set creator
• FSR	File-set reader
• FSU	File-set updater
• HTML	Hypertext Markup Language
• IOD	Information Object Definition
• MOD	Magneto-Optical Device
• MRN	Medical Record Number
• MPPS	Modality Perform Procedure Step
• NEMA	National Electrical Manufacturers Association
• PACS	Picture Archiving and Communications System
• PDU	Protocol Data Unit
• SCP	Service Class Provider
• SCU	Service Class User
• SOP	Service Object Pair
• TCP/IP	Transmission Control Protocol/Internet Protocol
• UID	Unique Identifier
• US	Ultrasound
• VR	Value Representation
• 3D/PanView	Philips Medical System's EnVisor Fetal-3D and Panoramic View options

1. Implementation Model

This section describes the functional relationship between the device and the DICOM services:

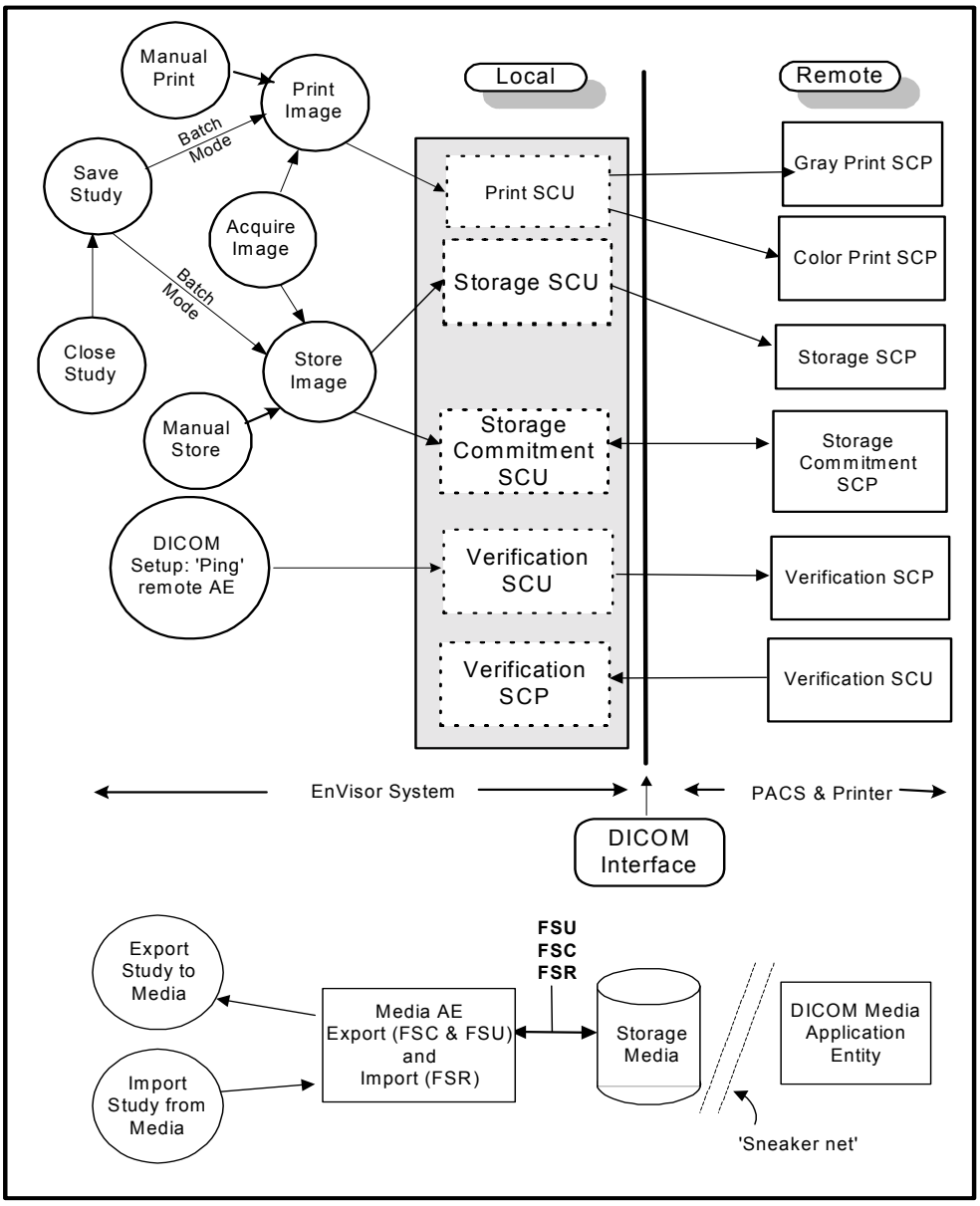
Customer Need	Provided in Options Package	Functionality	DICOM Service Classes Required
Optioning	Bundled	Ability to install/remove optional features	
Archive to Media	Bundled	Saving BMP's, AVI's, and HTML docs to media	
		Formatting removable media (floppy, MOD)	
	DICOM Media	Saving DICOM studies to removable media.	Media Storage Service Class – File Set Creator
			Media Storage Service Class – File Set Updater
Retrieval from Media	DICOM Media	Reading DICOM studies from removable media	Media Storage Service Class – File Set Reader
Archive to Network	DICOM Basic	Network export of DICOM studies.	Storage SCU
		Transfer ownership of acquired images to an image management system.	Storage Commitment SCU
Print	Bundled	Print images to PC based printers, non-DICOM film printers.	
	DICOM Basic	Print studies to a DICOM printer – both color and B&W.	Print Management SCU
Setup	DICOM Basic	Verification that a network device is a DICOM server.	Verification SCU
		Response to requests from the network to verify that EnVisor is a DICOM device.	Verification SCP

Customer Need	Provided in Options Package	Functionality	DICOM Service Classes Required
		Set the AE title for EnVisor; Specify which network server is the storage SCP, storage commit SCP; List servers, add servers etc	

1.1 Application Data Flow Diagram

The diagram in Figure 1.1-1 represents the relationship between EnVisor's Application Entity and it's use of DICOM to real-world activities.

Figure 1.1-1



The left side of the diagram represents the EnVisor ultrasound system being described in this DICOM Conformance Statement. The right side represents equipment that EnVisor is meant to exchange information with, and the vertical line in between is the DICOM standard interface.

The rectangular box represents the one and only Application Entity that is used in the implementation of all EnVisor's DICOM services. Since an AE must have a unique AE Title across a hospitals network (HIS), the user can configure the AE's title through setup.

The circles represent real-world activities such as saving a study and acquiring an image.

The diagram shows that EnVisor supports storing images to a remote PACS, as well as transferring ownership of the images to an image manager so that the study can automatically be deleted from EnVisor's hard-drive. Images can be sent to the Storage SCP as soon as they are acquired, this is called send-as-you-go mode; they can be batched up and sent all at once each time the study is saved; or a study can be selected, by the user, from a list of studies on EnVisor's local hard-drive, and manually exported.

EnVisor also supports printing studies to a grayscale or color DICOM printer. As with storing studies to a remote PACS, images can be printed as soon as they are acquired (but only when there are enough to fill a page); they can be batched for printing all at once when the study is saved, or the study can be selected manually for printing.

If color images are sent to a grayscale printer, they will be monochromized. If both a color and grayscale printer is configured, color images will be routed to the color printer and grayscale images will be routed to the grayscale printer.

The user can disconnect the network cable and use EnVisor in walk-about or portable mode. When reconnected to the network, EnVisor will perform any queued jobs including storage, printing and Storage Commitment.

1.2 Functional Definition of EnVisor AE

EnVisor is implemented as a single AE. The DICOM AE Title and Port number are configurable by the user through the 'Setup' screens. The default AE Title that EnVisor will use is the host name of the computer. Since AE Titles must be unique across a hospitals' network and computer names must also be unique, some institutions institute a policy where the AE Title is derived from the computer name. EnVisor supports this by allowing the user to specify a fixed string for a prefix and suffix. The AE title is then generated from the prefix, the computers name and the suffix.

The default port number is 104 but as with the AE Title, the port number can be configured by the user.

There are seven functions that the EnVisor AE performs. These are:

1. Storage of DICOM studies to a PACS,
2. Issuing of storage commitment requests to an image manager,
3. Verification of the existence of a DICOM server on the hospital's network,
4. Printing DICOM studies to a B&W or color printer,
5. Responding to a verification request from a remote DICOM server,
6. Saving a DICOM study to removable media,
7. Reading a DICOM study from removable media.

These seven functions, which are performed by the EnVisor AE, are described, in general terms, in the following sub-sections.

1.2.1 Storage of DICOM studies to a PACS

EnVisor acts as a Service Class User of Ultrasound Image Store SOP Class using DIMSE C-STORE commands to transmit images to the storage server. It provides a set of DICOM configuration settings used to set up the network interface and storage options. The configurable options include specification of the DICOM storage server (host-name, port number and AE title). These options can be accessed through the DICOM Setup screen.

Just before the first image is sent from the system, the storage AE establishes an association with the storage SCP and maintains the open association as long as images for store are in the queue to that SCP. If the queue empties, the storage AE will close the association. This process will repeat for subsequent images. Therefore, images sent

quickly one after the other would share the same association. This reduces overhead and improves performance. Therefore

- In Batch Mode, where all the images are sent to the storage SCP when the user closes (and saves) the study, all the images will be sent on the same association.

- In send-as-you-go mode, where the images are sent one-at-a-time as the user acquires them, most likely each image would be sent on a separate association.

1.2.2 Issuing of storage commitment requests to an image manager

If the user has configured, through DICOM setup, a storage commitment server, then after the last image of the study is successfully stored to the storage SCP, EnVisor will generate an N-Action to request Storage Commitment by the Storage Commitment SCU.

This command contains a list of image transaction UIDs. EnVisor then closes the association and waits for a reply from the STORAGE COMMITMENT server. Some time later, the Storage Commitment SCP will open an association with EnVisor's AE using reverse-role negotiation and will send an N-Event Report with a list of the image transaction UIDs that were successfully committed and, if applicable, a list of those that were not.

For backward compatibility with older PACS, EnVisor allows the user to configure the system to not reject an association requested by a Storage Commitment SCP, which does not employ role-reversal.

1.2.3 Verification of the existence of DICOM server on the hospitals network

When the user configures one of the SCP servers (for example the Storage SCP or B&W printer SCP), he/she can optionally 'ping' the SCP to verify it is a DICOM server, it is on-line and it is enabled to communicate with this EnVisor system.

When the user requests a 'DICOM Ping', the verification SCU AE will initiate an association with the remote server and send a C-Echo request to the server.

1.2.4 Printing DICOM studies to a B&W or color printer

EnVisor serves as a print SCU and sends images to a remote DICOM print device. The operator can configure up to two print SCPs: one B&W and one COLOR. If only a B&W print SCP is configured, then color images will be monochromized. If both B&W and color print SCP's are defined then EnVisor uses an "intelli-print" process to send color images to the color SCP and grayscale images to the B&W SCP.

As images are acquired, they are held until a full page of images is ready for printing. When a full page of images is ready for printing, EnVisor will open an association with the printer, send the images and then close the association. When the study is closed (or Saved), any partially filled page is printed. This ensures that a printed page cannot have images from multiple studies.

1.2.5 Responding to a verification request from a remote DICOM server

The ultrasound system employs a Verification SCP to reply to verification requests sent by remote devices. This will allow the remote devices to ensure the availability of each ultrasound system on the network, within the constraints of the network topology, and timeout values.

EnVisor will respond to a C-Echo ping request even if the requesting server is not an AE that it knows about and even if a customer has not purchased any DICOM options.

1.2.6 Saving a DICOM study to removable media

EnVisor is a DICOM file set creator (FSC) and updater (FSU). Studies can be saved (exported) to EnVisor's removable media (MOD, or CD-R), for long-term storage. Also, if a customer chooses not to purchase DICOM Basic, then DICOM media can be used as a 'sneaker-net' to get DICOM studies off EnVisor and onto the PACS

1.2.7 Reading a DICOM study from removable media

EnVisor is a DICOM file set reader (FSR). Studies that have been saved to removable media may also be loaded into another EnVisor system or even into the same EnVisor system (as long as the original study has already been deleted).

The system guarantees that studies created on the system, or on another EnVisor system, can be read back into the system from removable media. EnVisor often will be able to read studies generated by other manufacturer's systems, and even studies generated by other modalities, however this is not guaranteed and not documented.

1.3 Sequencing of Real-World Activities

For printing and storing using the Print Gray Image, Print Color Image, and Store Image commands, the user must have previously completed the Patient ID screen (which creates a study).

2. Application Entity Specifications

EnVisor is implemented as a single AE.

2.1 EnVisor AE Specification

2.1.1 Association establishment policies

2.1.1.1 General

The following Application Context Name will be proposed and recognized by *EnVisor*:

- DICOM 3.0 Application Context `1.2.840.10008.3.1.1.1`

EnVisor contains no limitations for maximum PDU size. The PDU size is configurable.

2.1.1.2 Number of associations

EnVisor **establishes** one association per destination at a time. The total number of associations possible at one time is four: 1 B&W printer, 1 color printer, 1 storage server, and 1 storage commitment server.

EnVisor accepts simultaneous associations for Storage Commitment and Verification. If multiple servers issue a storage commitment or verification request at the same time, EnVisor will accept all the associations. The maximum number of simultaneous associations **accepted** by *EnVisor* is limited only by resource constraints.

2.1.1.3 Asynchronous nature

EnVisor allows a single outstanding operation on any association. Therefore, *EnVisor* does not support asynchronous operations window negotiation, other than Storage Commitment reverse-role negotiation for N-Event Reports.

2.1.1.4 Implementation Identifying Information

Element	Implementation Value
Implementation Class UID	1.2.840.113543.6.6.3.0
Implementation Version Name	EnVisor_A.0

Table 1: Implementation Identifying Information

Note: The Class UID and Version Name above will be used initially but is subject to change with subsequent versions.

2.1.2 Association initiation by real-world activity

2.1.2.1 Storage of DICOM studies to a PACS

The EnVisor provides standard conformance to the following DICOM V3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID	Role
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCU

Table 2: SOP Classes Supported by Network Storage AE

2.1.2.1.1 Associated real-world activity

The real world activities that will trigger EnVisor to initiate an association with the Storage Server is dependent on the mode of operation:

1. **In Manual mode**

   An association is initiated when the user selects a study from the list of studies on EnVisor's local hard-drive and requests that the selected study be exported to the PACS.

2. **In Send-as-You-Go mode**

   An association is initiated when the first image is acquired. It is kept open while images remain to be stored. If no images have been stored within its time-out window, EnVisor will close the association. A new association will be initiated when the next image is acquired. The association will be closed when the study is closed.

3. **In Batch mode**

   An association is initiated whenever the user saves the study. The images that have been acquired since the previous 'save' are stored to the PACS.

Store Association Negotiation - Association Status (After Each Image)

User Action	DICOM Activity – Store Batch Mode	DICOM Activity – Store Send as You Go Mode
First image acquired from system	None	Association Negotiation (but will reuse current Association if queue to that Store SCP is non-empty) + C-Store until queue to that SCP is empty when Association Release Request is sent.

Store Association Negotiation - Association Status (Save Study in Batch Store Mode)

User Action	DICOM Activity - Store
Save Study	Association Negotiation then C-Store until all images sent, then Association Release Request is sent.

Table 3 describes the behavior of the Network Storage AE in response to various error conditions and C-STORE-RSP status indicators. After all images in the study have been processed, the association is closed.

Establishing the association

Condition (After C-Store)	**Status Codes** (C-Store-RSP)	**Response**
Could not establish the association within 30-second time window (Connect Timeout) due to NO RESPONSE from the Storage Server	Not Applicable	The association attempt is aborted, and after 5-minutes a new association is attempted. EnVisor will make three attempts to open an association with the configured Storage SCP before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the 'Read Timeout' input control on the 'DICOM Setup screen and the number of retries is mapped to 'Maximum Retries' on the DICOM Setup screen.
Refused	A7xx	If the Storage SCP server refuses the association, then the association attempt is aborted. EnVisor will wait 5-minutes and then reattempt the association. EnVisor will make three attempts to establish the association before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. As an example, the association would be refused if the storage server employs a high security mechanism whereby it only accepts association requests from DICOM Servers that it knows about and the EnVisor's AE Title was not in the PACS database. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the ''Retry Interval' input control on the DICOM Setup screen and the retry is mapped to 'Maximum Retries' on the DICOM Setup Screen.

During image transfer

Condition (After C-Store)	**Status Codes** (C-Store-RSP)	**Response**
After association has been accepted, there is no response to a request within 5-minute time window (Read Timeout).	Not Applicable	If the association is lost during active image transfer to the Storage SCP server, EnVisor will keep a record of which images have been successfully stored to the Storage SCP (PACS) and which are still waiting for storage. After 5 minutes, EnVisor will initiate a new association and attempt to store the remaining images. If during transfer, the association is again lost, EnVisor will wait another 5 minutes and try again. EnVisor will make

Condition (After C-Store)	**Status Codes** (C-Store-RSP)	**Response**
		three attempts to send all the images before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later time. The failure is logged to the DICOM log file as an error. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the ‘’Retry Interval’ input control on the DICOM Setup screen and the retry is mapped to ‘Maximum Retries’ on the DICOM Setup Screen.
Error	A9xx, Cxxx, 0122, Other	If the Storage SCP rejects an image, then EnVisor will keep a record of the image that failed and will continue with the remaining images. The failure is logged to the DICOM log file as an error. Once all the images have been attempted, EnVisor will close the association and wait for 5-minutes. The job, as viewable by the user from the job manager, will be in the ‘retry’ status. After it’s ‘retry interval’ has expired, EnVisor will move the job to ‘in progress’, establish another association and try storing the images that failed in the earlier association. Successfully stored images are not re-exported, only those that earlier failed. EnVisor will make three attempts to complete the transferal of all the images. If, after three attempts, some images are still not successfully stored to the PACS, EnVisor will notify the user (through an icon on the list of studies) and the job will be placed into the ‘error’ state. The user can, at some later date, select the study for manual export. EnVisor will give the user the option of storing all the images or just those that did not make it in the earlier job. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the ‘’Retry Interval’ input control on the DICOM Setup screen and the number of retries is mapped to ‘Maximum Retries’ on the DICOM Setup Screen.
Warning	D000, B000, B006, B007 0111	If the Storage SCP issues a warning on a particular image (perhaps it had to use coercion, EnVisor logs the warning to the DICOM log file as an informational event and continues on as if the image was successfully stored to the PACS (see row below).
Success	0000	When an image is successfully stored to the Storage SCP (PACS), EnVisor will keep a record of the successful storage. If all the images in the job are successfully stored, EnVisor will notify the user (through an icon on the list of studies), and the job will be removed from the job manager. The successful storage will be recorded in the DICOM log file as a service level event.

Table 3: Responses to Image Storage Error Conditions

Note that in “Send As You Go” mode, one association is established for one study, and closed when all images of the study currently existing in the EnVisor system are stored. If more images of the same study are presented to the EnVisor system, additional associations will be initiated to transfer the remaining images using the same Study and Series Instance UIDs.

2.1.2.1.2 Proposed presentation context

Each time the Network Storage AE initiates an association in response to the store request, it requests services summarized in Table 4.

Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Ultrasound Multi-frame Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.3.1	RLE Loss-less (Proposed first)	1.2.840.10008.1.2.5	SCU	None
		DICOM Implicit VR Little Endian (Proposed only if RLE is declined)	1.2.840.10008.1.2		
Ultrasound Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.6.1	RLE Loss-less (Proposed first)	1.2.840.10008.1.2.5	SCU	None
		DICOM Implicit VR Little Endian (Proposed only if RLE is declined)	1.2.840.10008.1.2		

Table 4: Transfer Syntaxes

If Run Length Encoding (RLE) loss-less is not accepted by the PACS, then EnVisor will request 'Implicit VR, Little Endian' (an uncompressed format). All PACS are mandated, by the standard, to support 'Implicit VR, Little Endian'. EnVisor will uncompress the image pixel data and save the uncompressed DICOM file to the PACS.

The values of certain image attributes used in the transfer of each image depend on a number of factors, including the transfer syntax accepted by the Storage SCP and the type of the image. Table 5 describes the relationships among these parameters.

Negotiated Transfer Syntax	**Image Type**	**Resultant Attribute Values**	
		Photometric Interpretation	Samples per Pixel and Bits per Sample
RLE Loss-less	2D B&W Image[1]	PALETTE_COLOR	1 8-bit sample / pixel
	2D Color Image[2]	PALETTE_COLOR	1 16-bit sample / pixel

[1] 2D B&W Image refers to any 8-bit sample mode. Images employing 8-bit sample modes include "Colorized" images, which map a sample to a color instead of a grayscale value. Also, 3D and PanView images are 8-bit (B&W).

Negotiated Transfer Syntax	Image Type	Resultant Attribute Values	
		Photometric Interpretation	Samples per Pixel and Bits per Sample
Implicit VR Little Endian.	2D B&W Image	PALETTE_COLOR	1 8-bit sample / pixel
	2D Color Image	PALETTE_COLOR	1 16-bit sample / pixel
	B&W Still/Loop from EnVisor 3D or PanView optional features	RGB	3 8-bit samples / pixel

Table 5: Image Attributes based upon Transfer Syntax and Image Type

2.1.2.1.2.1 SOP specific conformance statement for ultrasound image storage SOP class

The EnVisor AE uses the Ultrasound Image IOD Modules for both Ultrasound Image (1.2.840.10008.5.1.4.1.1.3.1) and Ultrasound Multi-frame Image (1.2.840.10008.5.1.4.1.1.6.1) IODs as follows:

2.1.2.1.2.1.1 Ultrasound image & ultrasound multi-frame image storage modules used

For each SOP class, DICOM defines what modules must be supported. A module simply defines a set of DICOM tags that must be present in the DICOM Part10 file.

Per the DICOM standard (PS3.3-2001 A.1.3), modules may be mandatory, optional or conditionally mandatory:

- **Mandatory** modules shall be supported per the definitions, semantics and requirements defined in PS3.3-2001, Annex C.
- **User Option** Modules may or may not be supported. If an optional Module is supported, the Level 1 (and Level 2) Attribute Types specified in the Modules shall be supported.
- **Conditional** Modules are Mandatory Modules if specific conditions are met. If the specified conditions are not met, this Module shall not be supported; that is, no information defined in that Module shall be sent.

The following table defines the modules that are supported by EnVisor for ultrasound images when they are sent to a Storage SCP (PACS).

	US Image (Still)		US Multi-frame Image (Loop)	
Module	**DICOM Standard**	**Supported in EnVisor**	**DICOM Standard**	**Supported in EnVisor**

[2] Color Image refers to all 16-bit sample modes. Images employing 16-bit sample modes include images produced in Color Flow mode.

	US Image (Still)		US Multi-frame Image (Loop)	
Module	**DICOM Standard**	**Supported in EnVisor**	**DICOM Standard**	**Supported in EnVisor**
Patient	Mandatory	✓	Mandatory	✓
General Study	Mandatory	✓	Mandatory	✓
Patient Study	User Option	✓	User Option	✓
General Series	Mandatory	✓	Mandatory	✓
Frame of Reference	User Option		User Option	
Synchronization	User Option		User Option	
General Equipment	Mandatory	✓	Mandatory	✓
General Image	Mandatory	✓	Mandatory	✓
Image Pixel	Mandatory	✓	Mandatory	✓
Palette Color Lookup Table	Conditional	✓	Conditional	✓
Contrast/Bolus	Conditional		Conditional	
Cine	Unused		Mandatory	✓
Multi-Frame	Unused		Mandatory	✓
Ultrasound Image	Mandatory	✓	Mandatory	✓
Overlay Plane	Unused		User Option	
Curve Identification	Mandatory	Not used since Curve & Curve Id is mutually exclusive with Image Pixel	Mandatory	Not used since Curve & Curve Id is mutually exclusive with Image Pixel
Curve	Mandatory		Mandatory	
Audio	User Option		User Option	
VOI LUT	User Option		User Option	
SOP Common	Mandatory	✓	Mandatory	✓

For each module that must be present in an ultrasound image that is going to be sent to a storage SCP, a subsequent sub-section defines the tags in that module that are supported by EnVisor.

Note: *Unused type "3" tags are **not** listed.*

2.1.2.1.2.1.2 Patient module

The Patient Module (PS3.3-2001, Table C.7.1.1) defines attributes that provide information about the Patient who is the subject of a diagnostic Study. This module is mandatory for storage of ultrasound single-frame or multi-frame images.

					Generated by		
Attribute Name	**Tag**	**Type**	**VR**	**Description**	**User**	**System**	**Value**
Patient's Name	0010, 0010	2	PN	Patient's full name.	✓		Entered by user from the Patient ID screen.
Patient ID	0010, 0020	2	LO	Primary hospital identification number or code for the patient.	✓		Entered by user from the Patient ID screen. This maps to the MRN field of the Patient ID screen and can be up to a maximum of 18 characters. If the user does not enter a value, the system will automatically generate one.
Patient's Birth Date	0010, 0030	2	DA	Birth date of the patient.	✓		Entered by user from the Patient ID screen. If the user does not enter a value, the system fills includes this tag as the empty string.
Patient's Sex	0010, 0040	2	CS	Sex of the named patient. Enumerated Values: M = male F = female O = other	✓		Selected from a drop-down list, by the user, from the Patient ID screen. If the user selects 'Unknown', this attribute is the empty string.
Other Patient Ids	0010, 1000	3	LO	Other identification numbers or codes used to identify the patient.	✓		Entered by user from the Patient ID screen. This maps to the Alternate ID Number of the Patient ID screen . If the user does not enter a value, the system fills includes this tag as the empty string.

2.1.2.1.2.1.3 General study module

The General Study Module (PS3.3-2001, Table C.7.2.1) defines Attributes that provide information about the Study that was performed. This module is mandatory for storage of ultrasound single-frame or multi-frame images.

					Generated by		
Atribute Name	**Tag**	**Type**	**VR**	**Description**	**User**	**System**	**Value**
Study Instance UID	0020, 000D	1	UI	A unique identifier for the Study.		✓	A system generated Unique Identifier of the form: 1.2.840.113543.6.6.3.0.nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn (64 characters) The first part is for EnVisor. The right-most digits (nnnnnn) are unique

							based on timestamp and machine characteristics.
Study Date	0008, 0020	2	DA	Date the Study started. The format is yyyymmdd		✓	The system computes this value as the date the study was created. Every image (with the same Study Instance UID) will have the same Study date.
Study Time	0008, 0030	2	TM	Time the Study started. The format is hhmmss		✓	The system computes this value as the time the study was created. Every image (with the same Study Instance UID) will have the same Study time.
Referring Physician Name	0008, 0090	2	PN	Physician(s) who are responsible for overall patient care at time of Study	✓		Entered by user from the Patient ID screen. If the user does not enter a value, the system fills includes this tag as the empty string.
Study ID	0020, 0010	2	SH	User or equipment generated Study identifier.		✓	A system generated Study identifier that is unique only within the EnVisor system that generated the study. The Study Identifier starts at 1 and is incremented by one for each new study created on that system. Study Identifiers will not be unique across multiple EnVisor systems.
Accession Number	0008, 0050	2	SH	A RIS generated number, which identifies the order for the Study.	✓		Entered by user from the Patient ID screen. If the user enters a value for this field, then it must be unique. If the user does not enter a value, the system includes this tag as the empty string.
Study Description	0008, 1030	3	LO	Institution-generated description or classification of the Study (component) performed.		✓	Constant string. In English systems the string is "Ultrasound Study". In non-English EnVisor systems, *this field will be **translated** to the semantically equivalent string in the language of the locality.*

2.1.2.1.2.1.4 Patient study module

The Patient Study Module (PS3.3-2001, Table C.7.2.2) defines Attributes that provide information about the Patient at the time the Study was performed. This module is optional for storage of ultrasound single-frame or multi-frame images.

					Generated by		
Attribute Name	**Tag**	**Type**	**VR**	**Description**	**User**	**System**	**Value**
Patient's Size	0010, 1020	3	DS	Length or size of the Patient, in meters.	✓		Entered by user from the Patient ID screen. If the user does not enter a value, the system fills includes this tag as the empty string.
Patient's Weight	0010, 1030	3	DS	Weight of the Patient, in kilograms.	✓		Entered by user from the Patient ID screen. If the user does not enter a value, the system fills includes this tag as the empty string.
Additional Patient's History	0010, 21B0	3	LT	Additional information about the Patient's	✓		Entered by user from the Patient ID screen. If the user does not enter a

				medical history.			value, the system fills includes this tag as the empty string.

2.1.2.1.2.1.5 General series module

The General Series Module (PS3.3-2001, Sec C.7.3.1, Table C.7-5) defines Attributes that identify and describe general information about a Series within a Study. . This module is mandatory for storage of ultrasound single-frame or multi-frame images. . Each EnVisor Study has exactly one Series.

					Generated by		
Attribute Name	**Tag**	**Type**	**VR**	**Description**	**User**	**System**	**Value**
Modality	0008, 0060	1	CS	Type of equipment that originally acquired the data used to create the images in this Series.		✓	Always “US” for ultrasound
Series Instance UID	0020, 000E	1	UI	Unique identifier of the Series.		✓	A machine-generated unique identifier for this series In the format: 1.2.840.113543.6.6.3.0.nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn (64 characters) The first part is for EnVisor. The right-most digits (nnnnnn) are unique based on timestamp and machine characteristics.
Series Number	0020, 0011	2	IS	Number of the series		✓	Always “0”. EnVisor studies have exactly one series.
Performing Physician’s Name	0008, 1050	3	PN	Name of the physicians administering the Series.	✓		Entered by user from the Patient ID screen. This maps to the ‘Performed by’ field of the Patient ID screen. If the user does not enter a value, the system fills includes this tag as the empty string.
Operator’s Name	0008, 1070	3	PN	Name of the operator (or technician) using the system.		✓	Entered by the system as the same text as ‘Performing Physician’s Name’, (tag 0008,1050).
Patient Position	0018, 5100	2C	CS	Required for CT and MR images. See C.7.3.1.1.2 of the DICOM standard for Defined Terms and further explanation.			Not used. Not required for Ultrasound (US).
Requested Procedure ID	0040, 1001	1C	SH	Identifier which identifies the Requested Procedure in the Imaging Service Request. Required if Sequence Item is present.			Not used. EnVisor_A.0 does not support MPPS.

Attribute Name	Tag	Type	VR	Description	Generated by User	Generated by System	Value
Scheduled Procedure Step ID	0040, 0009	1C	SH	Identifier which identifies the Scheduled Procedure Step. Required if Sequence Item is present.			Not used. EnVisor_A.0 does not support MPPS

2.1.2.1.2.1.6 General equipment module

The General Equipment Module (PS3.3-2001, Sec C.7.5.1, Table C.7-8) defines attributes that identify and describe the piece of equipment that produced a Series of Images. This module is mandatory for storage of ultrasound single-frame or multi-frame images.

Attribute Name	Tag	Type	VR	Description	Generated by User	Generated by System	Value
Manufacturer	0008, 0070	2	LO	Manufacturer of the equipment that produced the digital images.		✓	Constant string. In English systems the string is "Philips Medical Systems". In non-English EnVisor systems, *this field will be **translated** to the semantically equivalent string in the language of the locality.*

2.1.2.1.2.1.7 General image module

The General Image Module (PS3.3-2001, Sec C.7.6.1, Table C.7-9) defines Attributes that describe an image within a particular series. This module is optional for storage of ultrasound single-frame or multi-frame images. All attributes are system generated.

Attribute Name	Tag	Type	VR	Description	Value
Instance Number	0020, 0013	2	IS	A number that identifies this image. Note: This Attribute was named Image Number in earlier versions of this Standard.	The system computes this value as a unique number for each image in a study. The value accends as each image is acquired but the value does not start at "1" for each study. Gaps may be present if images were deleted before DICOM store was requested.
Patient Orientation	0020, 0020	2C	CS	Patient direction of the rows and columns of the image.	The system computes this value as Zero length for 2D images, not used in 3D/PanView images.
Content Date	0008, 0023	2C	DA	The date the image pixel data creation started. Required if image is part of a series in which the images are temporally related. Note: This Attribute was formerly known as Image Date.	The system computes this value as the date that the image was acquired. The format is yyyymmdd.
Content Time	0008, 0033	2C	TM	The time the image pixel data creation started. Required if image is part of a series in which the images are temporally related.	The system computes this value as the time that the image was acquired. The format is hhmmss

Attribute Name	Tag	Type	VR	Description	Value
Image Type	0008, 0008	2	CS	Image identification characteristics.	The system computes this value as the multi-value attribute ORIGINAL/PRIMARY/cccccc/nnnn ORIGINAL/PRIMARY denotes original source data based on primary examination. The third field is based on the user selected entry in the drop down list 'Additional Data Type' on the Patient Id screen. It is mapped to the most appropriate value from the DICOM standard (Ex: "ABDOMINAL"). Note: The third field is **not** present in stills and loops from 3D/PanView. The fourth field is always blank.
Acquisition Date	0008, 0022	3	DA	The date the acquisition of data that resulted in this image started	The system uses the same value as the Content Date, tag 0008,0033.
Acquisition Time	0008, 0032	3	TM	The time the acquisition of data that resulted in this image started	The system uses the same value as the Content Date, tag 0008,0033.
Acquisition Datetime	0008, 002A	3	DT	The date and time that the acquisition of data that resulted in this image started.	The system generates this as a combination of Acquisition Date and Acquisition Time. The format is yyyymmddhhmmss
Derivation Description	0008, 2111	3	CS	A text description of how this image was derived.	The system generates this as "ORIGINAL" in 3D/PanView images, not used in 2D images
Lossy Compression	0028,2110	3	DS	Specifies whether an Image has undergone lossy compression. Enumerated Values: 00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression.	Always 00 - EnVisor images are never lossy compressed.

2.1.2.1.2.1.8 Image pixel module

The Image Pixel Module (PS3.3-2001, Sec C.7.6.3, Table C.7-11) defines Attributes that describe the pixel data of an image. This module is mandatory for storage of ultrasound single-frame or multi-frame images. All attributes are system generated.

Attribute Name	Tag	Type	VR	Description	Value
Samples per Pixel	0028, 0002	1	US	Number of samples (planes) in this image.	2D B/W and Color stills/loops: 1 3D B/W stills/loops: 3
Photometric Interpretation	0028, 0004	1	CS	Specifies the intended interpretation of the pixel data.	2D B/W images are Palette Color (8-bit) 2D Color images are Pallette Color (16-bit) 3D and PanView stills and loop images are 8-bit RGB. Colorization is supported (as with regular EnVisor 8-bit images)
Rows	0028, 0010	1	US	Number of rows in the image.	2D B/W & Color stills/loops: 564 2D B/W & Color stills/loops from stress: 245 3D/PanView B/W stills/loops: 528
Columns	0028, 0011	1	US	Number of columns in the image	2D B/W & Color stills/loops: 800 2D B/W & Color stills/loops from stress: 720 3D/PanView B/W stills/loops: 720
Bits Allocated	0028, 0100	1	US	Number of bits allocated for each pixel sample.	2D, 3D, and PanView B/W: 8 bits 2D Color: 16 bits
Bits Stored	0028, 0101	1	US	Number of bits stored for each pixel sample.	2D, 3D, and PanView B/W: 8 bits 2D Color: 16 bits
High Bit	0028, 0102	1	US	Most significant bit for pixel sample data.	2D, 3D, and PanView B/W: 7 bits 2D Color: 15 bits
Pixel Representation	0028, 0103	1	US	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values: 0000H = unsigned integer. 0001H = 2's complement	000H (Unsigned integers)
Pixel Data	7FE0, 0010	1	OB	A data stream of the pixel samples which comprise the Image.	The pixel data of the DICOM image.
Planar Configuration	0026, 0006	1C	US		Always zero for 3D/PanView (RGB) images, otherwise this tag is ommitted
Pixel Aspect Ratio	0028, 0034	1C	IS	Ratio of the vertical size and horizontal size of the pixels in the image specified by a pair of integer	Always 1/1.

Attribute Name	Tag	Type	VR	Description	Value
				values where the first value is the vertical pixel size, and the second value is the horizontal pixel size.	
Red Palette Color Lookup Table Descriptor	0028, 1101	1C	US	Specifies the format of the Red Palette Color Lookup Table Data	Used only for 2D: 256, 0, 16 ***This tag and other tags related to Palette Color are not present in 3D/PanView since these files are RGB.***
Green Palette Color Lookup Table Descriptor	0028, 1102	1C	US	Specifies the format of the Green Palette Color Lookup Table Data	Used only for 2D B/W and Color stills/loops: 256, 0, 16
Blue Palette Color Lookup Table Descriptor	0028, 1103	1C	US	Specifies the format of the Blue Palette Color Lookup Table Data	Used only for 2D B/W and Color stills/loops: 256, 0, 16
Red Palette Color Lookup Table Data	0028, 1201	1C	OW	Red Palette Color Lookup Table Data.	Used only for 2D B/W and Color stills/loops.
Green Palette Color Lookup Table Data	0028, 1202	1C	OW	Green Palette Color Lookup Table Data.	Used only for 2D B/W and Color stills/loops.
Blue Palette Color Lookup Table Data	0028, 1203	1C	OW	Blue Palette Color Lookup Table Data.	Used only for 2D B/W and Color stills/loops.

2.1.2.1.2.1.9 Palette color lookup table module

The Palette Color Lookup Module (PS3.3-2001, Sec C.7.9, Table C.7-22) defines Attributes that describe the Lookup table data for images with Palette Color photometric interpretation. This module is present for EnVisor 2D B/W and Color stills/loops but is not present in (RGB) files created by EnVisor's 3D/Panview application. All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
Red Palette Color Lookup Table Descriptor	0028, 1101	1C	US	Used only for 2D: 256, 0, 16 ***This tag and other tags related to Palette Color are not present in 3D/PanView since these files are RGB.***
Green Palette Color Lookup Table Descriptor	0028, 1102	1C	US	Used only for 2D: 256, 0, 16
Blue Palette Color Lookup Table Descriptor	0028, 1103	1C	US	Used only for 2D: 256, 0, 16
Red Palette Color Lookup Table Data	0028, 1201	1C	OW	Used only for 2D.
Green Palette Color Lookup Table Data	0028, 1202	1C	OW	Used only for 2D.
Blue Palette Color Lookup Table Data	0028, 1203	1C	OW	Used only for 2D.
Segmented Red Palette Color Lookup Table Data	0028, 1221	1C	OW	Not used

Attribute Name	Tag	Type	VR	Value
Segmented Green Palette Color Lookup Table Data	0028, 1222	1C	OW	Not used
Segmented Blue Palette Color Lookup Table Data	0028, 1223	1C	OW	Not used

2.1.2.1.2.1.10 Cine module

The Cine Module (PS3.3-2001, Sec C.7.6.5, Table C.7-13) defines Attributes of a Multi-frame Cine image. This module is mandatory for Multi-frame images but is not used for Single-frame images. All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
Recommended Display Frame Rate	0008, 2144	3	IS	Used for Multiframe
Cine Rate	0018, 0040	3	IS	Used for Multiframe
Effective Duration	0018, 0072	3	DS	Used for Multiframe
Frame Time Vector	0018, 1065	1C	DS	An array which contains the real time increments (in msec) between frames for a Multi-frame image. Required since Frame Increment Pointer (0028,0009) points to Frame Time Vector

2.1.2.1.2.1.11 Multi-frame module

The Multi-Frame Module (PS3.3-2001, Sec C.7.6.6, Table C.7-14) defines Attributes of a Multi-frame pixel data image. This module is mandatory for Multi-frame images but is not used for Single-frame images. All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
Number of Frames	0028, 0008	1	IS	Used
Frame Increment Pointer	0028, 0009	1	AT	frame_time_vector

2.1.2.1.2.1.12 US region calibration module

The US Region Calibration Module (PS3.3-2001, Sec C.8.5.5.1, Table C.8-17) defines Attributes that describe an ultrasound region calibration. This module is optional for ultrasound. All attributes are system generated.

Atribute Name	Tag	Type	VR	Value
Sequence of Ultrasound Regions	0018, 6011	1	SQ	Used
Region Spatial Format	0018, 6012	1	US	Used
Region Data Type	0018, 6014	1	US	Used
Region Flags	0018, 6016	1	UL	Used
Region Location Min X0	0018, 6018	1	UL	Used
Region Location Min Y0	0018, 601A	1	UL	Used
Region Location Max X1	0018, 601C	1	UL	Used
Region Location Max Y1	0018, 601E	1	UL	Used
Reference Pixel X	0018, 6020	1	SL	Used

Atribute Name	Tag	Type	VR	Value
Reference Pixel Y	0018, 6022	1	SL	Used
Physical Units X Direction	0018, 6024	1	US	Used
Physical Units Y Direction	0018, 6026	1	US	Used
Ref Pixel Physical Value X	0018, 6028	1	FD	Used
Ref Pixel Physical Value Y	0018, 602A	1	FD	Used
Physical Delta X	0018, 602C	1	FD	Used
Physical Delta Y	0018, 602E	1	FD	Used

2.1.2.1.2.1.13 US image module

The US Image Module (PS3.3-2001, Sec C.8.5.6, Table C.8-18) defines attributes that describe ultrasound images. This module is mandatory for storage of ultrasound single-frame or multi-frame images. All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
Samples per Pixel	0028, 0002	1	US	#Samples=1 for B/W and Color
Photometric Interpretation	0028, 0004	1	CS	2D B/W images are Palette Color 8 2D Color images are Palette Color 16 3D and PanView stills and loop images are only 8-bit RGB. Only colorization is supported (as with regular EnVisor 8-bit images)
Bits Allocated	0028, 0100	1	US	2D, 3D, and PanView B/W: 8 bits 2D Color: 16 bits
Bits Stored	0028, 0101	1	US	2D, 3D, and PanView B/W: 8 bits 2D Color: 16 bits
High Bit	0028, 0102	1	US	2D, 3D, and PanView B/W: 7 bits 2D Color: 15 bits
Pixel Representation	0028, 0103	1	US	Always zero
Image Type	0008, 0008	2	CS	This denotes *original* source data based on *primary* examination. This multi-value attribute is ORIGINAL/PRIMARY/cccccc/nnnn The third field is filled with the most appropriate value from the DICOM standard for image type (Ex: “ABDOMINAL”) but the third field is **not** present in stills and loops from 3D/PanView. The fourth field is always blank.
Lossy Image Compression	0028, 2110	1C	N	Always “00”. EnVisor images are **not** lossy compressed.
Ultrasound Color Data Present	0028, 0014	3	US	“1” for B/W and Color 2D and 3D/PanView stills/loops.
Number of Stages	0008, 2124	2C	N	Number of stages in a protocol. *For stress Multiframe images only, or else this tag is not used.*
Number of Views in Stage	0008, 212A	2C	N	Number of views in a stage. *For stress Multiframe images only*

Attribute Name	Tag	Type	VR	Value
Stage Name	0008, 212A	3	IS	Used in protocols *For stress Multiframe images only*
Stage Number	0008, 2122	3	IS	Which stage in a protocol. *For stress Multiframe images only*
View Number	0008, 2128	3	IS	Number of event timers used during acquisition *For stress Multiframe images only.* 1, 2, or 3 Null if timers not used
Heart Rate	0018, 1088	3	IS	Beats per minute. *For stress Multiframe images only*

2.1.2.1.2.1.14 SOP common module

The SOP Common Module (PS3.3-2001, Sec C.12.1, Table C.12-1) defines the Attributes that are required for proper functioning and identification of associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD. This module is mandatory for storage of ultrasound single-frame or multi-frame images. All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
SOP Class UID	0008, 0016	1	UI	1.2.840.10008.5.1.4.1.1.3.1 (Single Frame) or 1.2.840.10008.5.1.4.1.1.6.1 (Multi-Frame)
SOP Instance UID	0008, 0018	1	UI	A system generated SOP Instance UID of the format 1.2.840.113543.6.6.3.0.nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn (64 characters) The first part is for EnVisor. The right-most digits (nnnnnn) are unique based on timestamp and machine characteristics.

2.1.2.2 Issuing of storage commitment requests to an image manager

EnVisor provides Standard Conformance to the following DICOM V3.0 **Storage Commitment** SOP Class as an SCU.

SOP Class Name	SOP Class UID	Role
Storage Commitment Push Model	1.2.840.10008.1.20.1	SCU

Table 6: SOP Class Supported by Storage Commitment AE

EnVisor sends images to the storage server for permanent storage. The request for storage commitment may then be transmitted from EnVisor together with a list of references to one or more SOP instances. This action is invoked through the DIMSE N-ACTION primitive.

2.1.2.2.1 Associated real-world activity

The user does not explicitly initiate a storage commitment; rather EnVisor transfers studies/images to the storage server upon request. When the user configures a storage commit server with the storage server, EnVisor initiates storage commit request after images are sent to the storage server. The storage SCP and commit SCP can be different AE's.

Storage Commitment Association Behavior (By Save Study or Send As You Go)

User Action	DICOM Activity – Storage Commitment Device Association	Association Status
Save Study (Or Image acquisition in Send As You Go)	Each Save Study operation will initiate an association with the SC server, and send an N-Action Request, containing a list of all images that need to be committed. Then Association Release Request. In Send As You Go mode, each image acquisition initiates the same DICOM activity as Save Study.	Association closed.
Reverse Role Negotiation	The system will remain available as long as it is connected to the network to receive Storage Commitment responses from the SC server. The SCP will send an N-Event Report with status. Then the association is released.	Association closed.

2.1.2.2.2 Proposed presentation contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 7: Storage Commitment - Presentation Context

2.1.2.2.2.1 SOP specific conformance statement for storage commitment SOP class

EnVisor provides standard conformance to the DICOM Storage Commitment Service Class.

EnVisor supports the following elements for this SOP class as an SCU. The Transaction UID Attribute (0008,1195) value generated by EnVisor uniquely identifies each Storage Commitment Request.

Action Type Name	Action Type ID	Attribute Name	Tag
Request Storage Commitment	1	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		>Referenced SOP Class UID	(0008,1150)
		>Referenced SOP Instance UID	(0008,1155)

Table 8 – Storage Commitment Request – Attributes

Subsequently, EnVisor expects N-EVENT-REPORTS from the storage commit server although EnVisor does not assume that the event will arrive at any particular time. EnVisor does not wait but will process the event whenever it arrives.

EnVisor might be either powered down or disconnected from the network and used in portable mode, it is possible for the N-EVENT-REPORT to arrive from the Storage Commitment SCP while EnVisor cannot receive it. If an outstanding N-EVENT-REPORT does not arrive within 96 hours, then EnVisor will reissue the same Storage Commitment request. When the event arrives, EnVisor returns an N-EVENT-REPORT response primitive with one of the following status codes.

Service Status	Further Meaning	Protocol Codes	Related Fields	Description
Success	Success	0000		N-EVENT-REPORT message understood.
Error	Failed	0110		N-EVENT-REPORT message was not processed successfully.

Table 9 - Storage Commitment Status Codes

2.1.2.3 Verification of the existence of DICOM server on the hospitals network

EnVisor provides standard conformance to the DICOM V3.0 SOP Class as shown in Table 10.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU

Table 10: SOP Class Supported by Verification AE

2.1.2.3.1 Associated real-world activity

The user can verify the existence of a DICOM server on the hospitals network, through a button in the 'DICOM Setup' screen. When the user presses this button, EnVisor will initiate the association.

2.1.2.3.2 Proposed presentation contexts

Only one association is established for each verification attempt. When the association is opened, the presentation contexts noted in Table 11 are proposed.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Verification SOP Class	1.2.840.10008.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

Table 11: Proposed Presentation Contexts

2.1.2.3.2.1 SOP specific conformance statement for the verification SOP class

The C-ECHO request primitive is sent to the Verification SCP. The Verification SCP with a status indicator of success returns the C-ECHO response primitive. The absence of a C-ECHO response within a specific timeout period is an indication that the server cannot be located through the Verification service.

2.1.2.4 Printing DICOM studies to a B&W or color printer

EnVisor provides standard conformance to the following DICOM V3.0 SOP Class as an SCU.

SOP Class Name	SOP Class UID	Role
Basic Film Session	1.2.840.10008.5.1.1.1	SCU
Basic Film Box	1.2.840.10008.5.1.1.2	SCU
Basic Grayscale Image Box	1.2.840.10008.5.1.1.4	SCU
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	SCU
Referenced Grayscale Print Management Meta	1.2.840.10008.5.1.1.9.1	SCU
Basic Color Image Box	1.2.840.10008.5.1.1.4.1	SCU
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	SCU
Referenced Color Print Management Meta	1.2.840.10008.5.1.1.18.1	SCU
Basic Annotation Box	1.2.840.10008.5.1.1.15	SCU
Printer	1.2.840.10008.5.1.1.16	SCU
Print Job	1.2.840.10008.5.1.1.14	SCU
Presentation LUT	1.2.840.10008.5.1.1.23	SCU

Table 12: SOP Classes Supported by Print AE

2.1.2.4.1 Associated real world activity

EnVisor issues Print Management requests to an SCP supporting the DICOM V3.0 Print services, in order to produce hard copy representations of DICOM images, based on user requests.

Print Association Negotiation - Association Status (After Each Image)

User Action	DICOM Activity - Print Batch Mode	DICOM Activity – Print Send As You Go Mode
First image acquired	None.	If a full page is ready to print: Association

from system		

Print Association Negotiation - Association Status (Save Study in Batch Print Mode)

User Action	DICOM Activity – Print
Save Study	Association Negotiation + N_Create Film Session and N_Create Film Box, N_GET Status then N_Sets for each image and N_Action for each page, then Association Release Request

2.1.2.4.2 Proposed presentation contexts

Print AE supports the following Presentation Contexts for **Print**.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Basic Film Session	1.2.840.10008.5.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Film Box	1.2.840.10008.5.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Grayscale Image Box	1.2.840.10008.5.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Image Box	1.2.840.10008.5.1.1.4.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Annotation Box	1.2.840.10008.5.1.1.15	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Printer	1.2.840.10008.5.1.1.16	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 13: Print Presentation Contexts

EnVisor provides standard conformance to the DICOM Print Service Classes by supporting a number of distinct Service classes described below.

2.1.2.4.2.1 SOP specific conformance to basic film session SOP class

EnVisor requests the following DIMSE-N commands for the Basic Film Session SOP Class: N-CREATE

Attribute Name	**Tag**	**Usage**	**Attribute Description**	
			Options	**Default**
Number of Copies	(2000,0010)	U	[1 to 99]	1
Print Priority	(2000,0020)	U	LOW MED HIGH	MED
Medium Type	(2000,0030)	U	PAPER CLEAR FILM BLUE FILM	PAPER
Film Destination	(2000,0040)	U	PROCESSOR MAGAZINE BIN_i	PROCESSOR
Film Session Label	(2000,0050)	U	Not Set	Not Set
Memory Allocation	(2000,0060)	U	Not set	Not set

Table 14 Basic Film Session Attributes

2.1.2.4.2.2 SOP specific conformance to basic film box SOP class

EnVisor requests the following DIMSE-N commands for the Basic Film Box SOP Class:

N-CREATE

Attribute Name	**Tag**	**Usage**	**Attribute Description**	
			Options	**Default**
Image Display Format	(2010,0010)	M	STANDARD*cols,rows* *Cols:1..99, Rows:1..99*	STANDARD\2,3
Film Orientation	(2010,0040)	U	PORTRAIT LANDSCAPE	PORTRAIT
Film Size ID	(2010,0050)	U	8INX10IN, 8_5INX11IN, 10INX12IN, 10INX14IN, 11INX14IN, 11INX17IN, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM, A3, A4, …	8INX10IN
Magnification Type	(2010,0060)	U	NONE, CUBIC, BILINEAR, REPLICATE	CUBIC
Border Density	(2010,0100)	U	BLACK, WHITE Or a density number: 0-399	BLACK
Empty Image Density	(2010,0110)	U	BLACK, WHITE Or a density number: 0-399	BLACK
Trim	(2010,0140)	U	YES, NO	YES
Min Density	(2010,0120)	U	0-399	[Empty]
Max Density	(2010,0130)	U	0-399	[Empty]
Configuration Information	(2010,0150)	U	[Text string] Vendor specific information	Not apply if this field is empty or missing
Annotation display format ID	(2010,0030)	U	[Text string]	[Empty] Not apply if this field is empty or missing
Smoothing Type	(2010,0080)	U		
Referenced Film Session Sequence	(2010,0500)	M	Always set	
>Referenced SOP Class UID	(0008,1150)	M	Always set	
>Referenced SOP Instance UID	(0008,1155)	M	Always set	

Table 15 Basic Film Box Attributes

N-ACTION

EnVisor provides all possible printer settings. For a specific printer, the user must check the manufacturer's documentation to determine the subset of available settings that the printer actually supports. For example, if the user configures the B&W printer to use a film-size of 14Inx17IN but the maximum film size supported by the printer is 8_5INX11IN, then the printer may reject the images.

2.1.2.4.2.3 SOP specific conformance to basic grayscale image box SOP class

Print AE issues the following DIMSE-N commands for the Basic Grayscale Image Box SOP Class:

N-SET

Attribute Name	**Tag**	**Usage**	**Attribute Description**	
			Options	**Default**
Image Position	(2020,0010)	M	Always set	
Polarity	(2020,0020)	U	NORMAL REVERSE	NORMAL
Magnification Type	(2010,0060)	U	NONE, CUBIC, BILINEAR, REPLICATE	CUBIC
Smoothing Type	(2010,0080)	U	NORMAL, ENHANCED, … Note: This parameter is valid and applied only if Magnification Type is CUBIC	NORMAL
Basic Grayscale Image Sequence	(2020,0110)	M	Always set (but only for B&W Images.)	
>Samples Per Pixel	(0028,0002)	M	Always set (1)	
>Photometric Interpretation	(0028,0004)	M	Always set (but MUST be Monochrome2)	
>Rows	(0028,0010)	M	Always set	
>Columns	(0028,0011)	M	Always set	
>Pixel Aspect Ratio	(0028,0034)	M	Always set	
>Bits Allocated	(0028,0100)	M	Always set (8)	
>Bits Stored	(0028,0101)	M	Always set (8)	
>High Bit	(0028,0102)	M	Always set (7)	
>Pixel Representation	(0028,0103)	M	Always set (0)	
> Window Center	(0028,1050)	U	[String value] Apply only when photometric interpretation is MONOCHROME2	[Empty] Not applied if either window center or window width is empty or missing
> Window Width	(0028,1051)	U	[String value] Apply only when photometric interpretation is MONOCHROME2	[Empty] Not applied if either window center or window width is empty or missing

Attribute Name	Tag	Usage	Attribute Description	
			Options	Default
>Pixel Data	(7FE0,0010)	M	Always set	

Table 16 Basic Grayscale Image Box Attributes

2.1.2.4.2.4 SOP Specific conformance to basic color image box SOP class

Print AE issues the following DIMSE-N commands for the Basic Color Image Box SOP Class:

N-SET.

Attribute Name	Tag	Usage	Attribute Description	
			Options	Default
Image Position	(2020,0010)	M	Always set	
Polarity	(2020,0020)	U	NORMAL REVERSE	NORMAL
Magnification Type	(2010,0060)	U	NONE, CUBIC, BILINEAR, REPLICATE	CUBIC
Smoothing Type	(2010,0080)	U	NORMAL, ENHANCED, … Note: This parameter is valid and applied only if Magnification Type is CUBIC	NORMAL
Basic Color Image Sequence	(2020,0111)	M	Always set (but only for Color Images)	
>Samples Per Pixel	(0028,0002)	M	Always set (3)	
>Photometric Interpretation	(0028,0004)	M	Always set (but MUST always be RGB)	
>Planar Configuration	(0028,0006)	M	Always set (0)	
>Rows	(0028,0010)	M	Always set	
>Columns	(0028,0011)	M	Always set	
>Pixel Aspect Ratio	(0028,0034)	M	Always set	
>Bits Allocated	(0028,0100)	M	Always set (8)	
>Bits Stored	(0028,0101)	M	Always set (8)	
>High Bit	(0028,0102)	M	Always set (7)	
>Pixel Representation	(0028,0103)	M	Always set (0)	
>Pixel Data	(7FE0,0010)	M	Always set	

Table 17 Basic Color Image Box Attributes

2.1.2.4.2.5 SOP specific conformance to basic annotation box SOP class

The Basic Annotation Box is not used in EnVisor.

2.1.2.4.2.6 SOP specific conformance to printer SOP class

EnVisor issues the following DIMSE-N commands for the Printer SOP Class:

N-GET.

Attribute Name	Tag	Usage SCU/SCP
Printer Status	(2110,0010)	U/M
Printer Status Info	(2110,0020)	U/M
Printer Name	(2110,0030)	U/U
Manufacturer	(0008,0070)	U/U
Manufacturer's Model Name	(0008,1090)	U/U
Device Serial Number	(0018,1000)	U/U
Software Version	(0018,1020)	U/U

Table 18 Printer Attributes

Note: These printer commands are issued for internal use only. The printer status is never reported back to the user.

2.1.2.4.2.7 SOP specific conformance to basic grayscale print management Meta SOP class

The Meta SOP class is requested at negotiation, but is then ignored. EnVisor uses the individual SOP classes defined by the DICOM specification.

2.1.2.4.2.8 SOP specific conformance to basic color print management Meta SOP class

The Meta SOP class is requested at negotiation, but is then ignored. EnVisor uses the individual SOP classes defined by the DICOM specification.

2.1.3 Association acceptance policy

2.1.3.1 Responding to a verification request from a remote DICOM server

EnVisor provides standard conformance to the DICOM V3.0 SOP Class as shown in the Table 19.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCP

Table 19: SOP Class Supported by Verification AE

2.1.3.1.1 Associated real-world activity

EnVisor will respond to *external Verification* requests.

2.1.3.1.2 Accepted presentation contexts

Only one association is established for each verification attempt. When the association is opened, the presentation contexts noted in Table 20 are accepted.

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

Table 20: Accepted Presentation Contexts

3. EnVisor as a Media Storage Application

The implementation model, application data flow diagram, functional definition of the EnVisor AE, sequencing of real world activities are the same as in section 2.

3.1 File Meta Information for the EnVisor AE

Element	**Implementation Value**
Implementation Class UID	1.2.840.113543.6.6.3.0
Implementation Version Name	EnVisor_A.0

Table 21: Implementation Identifying Information

3.1.1 Real-world activities

3.1.1.1 Saving a DICOM study to removable media

The EnVisor AE conforms to the Application Profile for Ultrasound Media Storage applications. For all SOP Classes described in the Application Profile, this AE performs in the role of File Set Creator (FSC) and File Set Updater (FSU). The particular physical media available is 3.5” floppy diskette, 3.5” MOD, or CD-R. For previously imported studies, EnVisor will export the IODs using the transfer syntax and tags that were used when EnVisor originally imported the study.

Supported Application Profile	Real-World Activity	Roles	Service Class Option
STD-US-SC-SF&MF	Export Study	FSC and FSU	Interchange
STD-US-ID-SF&MF	Export Study	FSC and FSU	Interchange

Table 22: Export Study to DICOM Media

The Export DICOM Objects Application Entity acts as FSC and FSU using the Interchange Option.

The user choosing the Export operation from a menu initiates exporting studies. See the system user manuals for a description of the specific user interface capabilities. ***The user has no control*** over the photometric interpretation and transfer syntax used to create DICOM files since all Media Exports are performed in their EnVisor-internal formats. The EnVisor internal format for 2D stills/loops is (*8-bit or 16-bit)* ***Palette Color with RLE compression*** and internal format for EnVisor 3D/PanView stills/loops is ***8-bit RGB.***

Note: EnVisor creates special 3D and PanView internal files called 'dataset' files which are never exported to a PACS but may be optionally exported to media.

These DICOM files are not exported in network storage since they are only of use to EnVisor's 3D/PanView application. These files may be optionally exported to media with the rest of the study for archival purposes: the study could later be imported into an EnVisor system and the user would be able to click on the dataset file to enter into the 3D/PanView application. For example, the user could manipulate the 3D object and then acquire a still from a different angle and save that new still into the study.

A 3D 'dataset' file is a MONOCHROME2 multi-frame image with many private tags for use by the 3D application to reconstruct a 3D image.

A PanView 'dataset file is a MONOCHROME2 single frame image with private tags for use by the PanView application.

3.1.1.2 Reading a DICOM study from removable media

When requested to read the media directory, the Import DICOM Objects Application Entity acts as FSR using the Interchange Option,

The user choosing the Import operation from a menu initiates importing images. See the system user manuals for a description of the specific user interface capabilities.

3.1.1.2.1 Import DICOM object specifications

The EnVisor AE conforms to the Application Profile for Ultrasound Media Storage applications. For all SOP Classes described in the Application Profile, this AE performs in the role of File Set Reader (FSR). The particular physical media available is 3.5" floppy diskette, 3.5" MOD, or CD-R. Image Display and Spatial Calibration of Single and Multi-Frame image objects on any media in the Ultrasound Application Profile is therefore supported.

Supported Application Profile	Real-World Activity	Roles	Service Class Option
STD-US-SC-SF&MF-FLOP	Import Studies	FSR	Interchange

STD-US-SC-SF&MF-MOD128	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD230	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD540	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD650	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD12	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD23	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-CDR	Import Studies	FSR	Interchange

Table 23: DICOM Objects Application Profiles

EnVisor's DICOM Study Import feature is designed for importing studies that *were originally exported from **EnVisor.*** However, the system will allow the user to import ultrasound studies created by another manufacturers system.

3.1.1.2.2 Media storage application profiles

The supported Application Profiles are listed in Table 23 DICOM Objects Application Profiles.

3.1.1.2.3 SOP specific conformance for "DICOM Directory" SOP class

Type 1, 1C, 2, and 2C data elements present in the Basic Directory Object are supported as required in DICOM 3.0, Parts 3 and 10. They are used for properly navigating through the directory data structures, recognizing and conforming to the character set being used, and the Import Study user interface to aid in the selection of objects to import. Data elements that elicit behavior that is specific to the Application Entity are described in the sections below. If Type 2 data elements are null or if Type 3 data elements are absent, the data elements are ignored by the system and the corresponding display fields in the user interface screen(s) are left blank.

3.1.1.2.4 File-set identification module

Contents of the File-Set Identification Module are not displayed or otherwise used in this version of EnVisor.

3.1.1.2.5 Directory information module

All data elements are used as described in DIOCM 3.0 Part 3 for Basic Directory Object Definitions. As stated in the Ultrasound Application Profile, "The (DICOMDIR) Directory shall include Directory Records of PATIENT, STUDY, SERIES, and IMAGE corresponding to the information object files in the File-set". Given this requirement, EnVisor uses these directory records to identify the study to import. If there are DICOM image files on the import media that do not appear in the DICOMDIR Directory Information Module (either because references to these files were omitted or because the Directory Information Module, optional in DICOM but required in the Ultrasound Application Profile, does not exist), these files are not recognized by the system.

EnVisor ignores directory Record Types other than those above.

EnVisor also ignores the "File-Set consistency Flag" (0004, 1212).

3.1.1.2.5.1 Patient directory record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008, 0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7

			for details.
Patient Name	(0010, 0010)	2	Displayed to help the user identify the patient folder in which to place the studies for this patient.
Patient ID	(0010, 0020)	1	Displayed to help the user identify the patient folder in which to place the studies for this patient.

Table 24: Specific Usage of Patient Directory Record Information

3.1.1.2.5.2 Study directory record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008, 0005)	1C	The Default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details.
Study Date	(0008, 0020)	1	Used in displaying list of studies to user
Study Time	(0008, 0030)	1	Used in displaying list of studies to user
Accession Number	(0008, 0050)	2	Stored in the system database
Study Description	(0008, 1030)	2	Generated
Study Instance UID	(0020, 000D)	1C	Stored in the system database
Study ID	(0020, 0010)	1	Stored in the system database

Table 25: Specific Usage of Study Directory Record Information

3.1.1.2.5.3 Series directory record

Attribute Name	Tag	Type	Usage
Specific Character Set	0008, 0005	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details.
Modality	(0008, 0060)	1	Only US is supported. Other modalities are ignored.
Series Description	(0008, 103E)	3	Stored
Series Instance UID	(0020, 0011)	1	Stored

Table 26: Specific Usage of Series Directory Record Information

3.1.1.2.5.4 Image directory record

Attribute Name	Tag	Type	Usage
Specific Character Set	0008, 0005	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details.
Referenced File ID	(0004, 1500)	1C	Used
Referenced SOP Class UID in File	(0004, 1510)	1C	Used
Referenced SOP UID in File	(0004, 1511)	1C	Used
Referenced Transfer Syntax UID in File	(00004, 1512)	1C	Used
Image Date	(0008, 0023)	3	Used for ordering the thumbnail display. On

			Export, comes from the image.
Image Time	(0008, 0033)	3	Used for ordering the thumbnail display. On Export, comes from the image.

Table 27: Specific Usage of Image Directory Record Information

4. Communications Profiles

EnVisor provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

5. Extensions/Specializations/Privatizations

5.1 2D

There are no extensions, specializations or privatizations in EnVisor's 2D application.

5.2 3D Stills and Loops, and PanView

3D and PanView image files contain the following private tags for use by EnVisor's 3D/PanView application:

Attribute Name	Tag	Type	VR	Description	Value
Private Creator	7777, 0010		LO	3D/PanView component type	"Philips EnVisor"
	7777, 1001		DA	Date 3D/PanView internal 'dataset ' file was acquired	
	7777, 1002		CS	Type of 3D or PanView	3D Still: "3D STILL" 3D Loop: "3D MOVIE" PanView still: "PANVIEW STILL"
	7777, 1003		LO	Internal 3D/PanView software version number	"1.0"
	7777, 1014		LT	Private string	

6. Configuration

EnVisor obtains configuration information from the following sources:

- Mapping from Application Entity Title to Presentation Address is provided by the database, which is controlled by the DICOM setup screen.

7. Support for Extended Character Sets

EnVisor supports the following character sets:

- ISO-IR 6 (default) — Basic G0 Set
- ISO-IR 100 — Latin Alphabet No. 1