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SonoSite

iViz® DICOM Conformance Statement

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CONTENTS

CHAPTER 1

Introduction

About this document

This document describes the SonoSite iViz ® Ultrasound System's conformance to the ACR-NEMA DICOM (Digital Imaging and Communications in Medicine) standard and satisfies the DICOM requirement for a vendor conformance specification.

The iViz system is an ultrasound imaging device. The DICOM options of the iViz system provide a means to query the Information System for scheduled procedures using Modality Worklist, send procedure status messages to RIS via MPPS, send images to printers, storage servers and removable USB media, and request Storage Commitment for images stored to PACS.

Throughout this document DICOM storage servers will be referred to as archivers. For a device to be classified as an archiver it must be capable of receiving DICOM store commands. Archivers are primarily comprised of PACS.

This document is written with respect to ACR-NEMA DICOM version number 3.0 - 2007.

Changes in this version

Revision	Description of Change
A	Initial release

Conformance Statement Overview

The iViz Ultrasound System implements the necessary DICOM services to download work lists from an information system, save acquired images to a network storage, and store DICOM files onto removable media.

Table 1-1 provides an overview of the network services supported by the iViz Ultrasound System.

Table 1-1: Networking Services

Networking SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Ultrasound Image Storage	Yes	No
Ultrasound Multi-frame Image Storage	Yes	No
Secondary Capture Image Storage	Yes	No
Workflow Management		
Modality Worklist	Yes	No

Table 1-1: Networking Services

Networking SOP Classes	User of Service (SCU)	Provider of Service (SCP)
General		
Verification	Yes	No

Table 1-2 provides an overview of the media storage services supported by the iViz Ultrasound System.

Table 1-2: Media Storage Services

SOP Classes	Role
Media Storage Directory Storage	FSC
Ultrasound Image Storage	FSC
Ultrasound Multi-frame Image Storage	FSC
Basic Text SR Storage	FSC

DICOM Background

The DICOM information exchange specification provides a definitive structure of commands and information that allow for the inter-communication of medical imaging devices. Developed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA), the DICOM standard strives to promote communication of image information through the use of a standardized set of command classes and information semantics.

The DICOM standard defines classes of information that are common to many modalities of medical imaging. However, to meet the specific needs of information content for such a diverse range of information, the DICOM specification defines structures for a multitude of medical data. To alleviate the need for applications to implement every aspect of the DICOM specification, a list of conformance tables for every modality was created to define the minimum set of information necessary for data exchanges. A requirement of the DICOM specification is to maintain a compliance document that outlines a subset of DICOM services and data classes that are supported by a device. The purpose of this document is to define a subset of DICOM for the exchange of information with the SonoSite iViz via its DICOM feature.

Definitions

AE	Application Entity
ANSI	American National Standards Institute
CDA	Clinical Document Architecture
CW	Continuous Wave
DICOM	Digital Imaging and Communications in Medicine

DIMSE	DICOM Message Service Element
FSC	File Set Creator
HIS	Hospital Information System
IE	Information Entity
IOD	Information Object Definition
kHz	Kilohertz
LUT	Look Up Table
MPPS	Modality Performed Procedure Step
PACS	Picture Archive and Communication System
PW	Pulsed Wave
PDU	Protocol Data Unit
PPS	Performed Procedure Step
RGB	Red, Green, Blue
RIS	Radiology Information System
SC	Secondary Capture
SCU	Service Class User (Client)
SCP	Service Class Provider (Server)
SOP	Service Object Pair
SPS	Scheduled Procedure Step
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
US	Ultrasound
USB	Universal Serial Bus
UTC	Coordinated Universal Time
VOI	Value Of Interest
VR	Value Representation

Reference Documents

ACR-NEMA DICOM Standard Version 3.0 – 2007

CHAPTER 2

Implementation Model

The iViz DICOM feature incorporates the DICOM 3.0 standard for networked image image storage, and Modality Worklist functions. Scheduled Procedures are queried from the HIS/RIS Worklist SCP and presented to the operator for selection.

The behavior of how images are sent depends on which Transfer Images setting is selected during DICOM setup of locations. Two selections are offered, "Manual" or "End of exam" (batch transfer mode).

For batch transfer mode, iViz allows up to four archivers and one Worklist server to be selected at any given time. The devices are selected using DICOM Setup mode with all selected archive devices being placed into a destination list.

A maximum of 100 Scheduled Procedures Steps may be queried from the selected Modality Worklist SCP. The Worklist is persisted to non-volatile memory so that it can be accessed during portable exams. Both manual and automatic queries are supported. Automatic queries are user configurable and are performed in the background at periodic intervals.

During an exam all saved images are written to internal storage. For batch transfer mode, when the exam completes, all images associated with it are marked as Archive Pending for transfer to each device in the current destination list. If a network connection is present then transfer begins immediately.

Performed Procedures are Archived to devices in the destination list sequentially, starting with the first selected archiver and ending with the last selected archiver. Exam images are sent to each destination device in batch transfer mode; an association is opened, all exam images are transferred in acquisition order, and the association is closed. Once an exam is successfully transferred to a device then all images in the exam are marked as Archived to that destination. Archiving then continues with the next device in the destination list. Once all devices in the destination list have successfully received each exam image then the Exam Archive is complete.

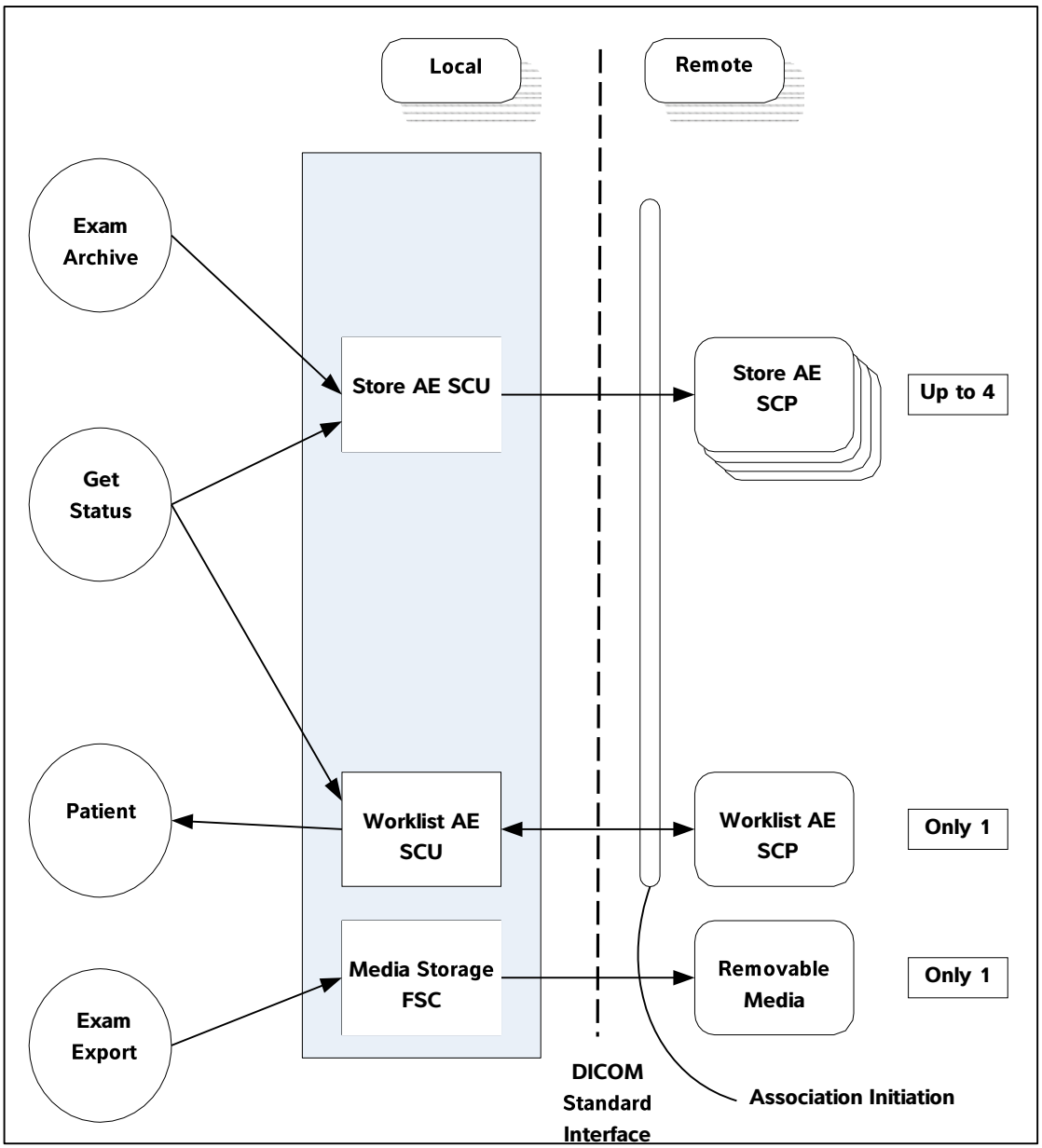
If an archiver is configured to receive Basic Text Structured Reports, those documents are transferred at the end of each exam.

One or more completed exams may be selected from the iViz studies list to have their images saved as DICOM files to the selected USB medium.

Application Data Flow Diagram

The diagram in Figure 2-1 represents the relationship between the ultrasound system's real-world activities (circles on the left), the local AE's built into iViz (boxes in the center), and the remote AE's built into the devices iViz communicates with using DICOM (boxes on the right).

Figure 2-1 Implementation Model



The following are the conditions that invoke real-world activities associated with AE's.

Exam Archive

- For batch transfer mode, End Exam with one or more images saved on internal storage. Exam end occurs when the "End Study" button is clicked on the screen, or when New study button is clicked on the "iViz studies" UI or Patient Search UI.
- User manually selects the studies from the "iViz studies" UI and shares them with the "Local PACS".

Get Status

- Operator Verify command in DICOM Setup mode.

Patient

- User enters Patient Setup screen, enters search criteria, and presses the Search key. The Worklist screen is entered and a list of matching Scheduled Procedures Steps are returned and displayed.

Exam Export

- User selects one or more completed exams from the iViz studies list and the images and reports for those exams are written to the selected removable media.

Functional Definition of AE's

Store

This AE handles sending ultrasound images to an archiver using the DICOM store SCU services.

Steps taken to Get Archiver Status:

A-ASSOCIATE
C-ECHO command
A-RELEASE

Steps taken to Send Exam to Archiver, batch transfer mode:

A-ASSOCIATE
for each exam image or report
{
    C-STORE Image SOP Instance
}
A-RELEASE

Steps taken to Send Exam to Archiver, in progress transfer mode:

A-ASSOCIATE

for each image or clip acquired that has not been transferred yet

{

C-STORE Image SOP Instance

}

A-RELEASE

Worklist

This AE handles querying a Worklist SCP for a list of scheduled procedures using the DICOM Modality Worklist SCU services.

Steps taken to Get Worklist Status:

A-ASSOCIATE

C-ECHO command

A-RELEASE

Steps taken to Query a Worklist SCP:

A-ASSOCIATE

SEND C-FIND Request command

{

RECEIVE C-FIND Response

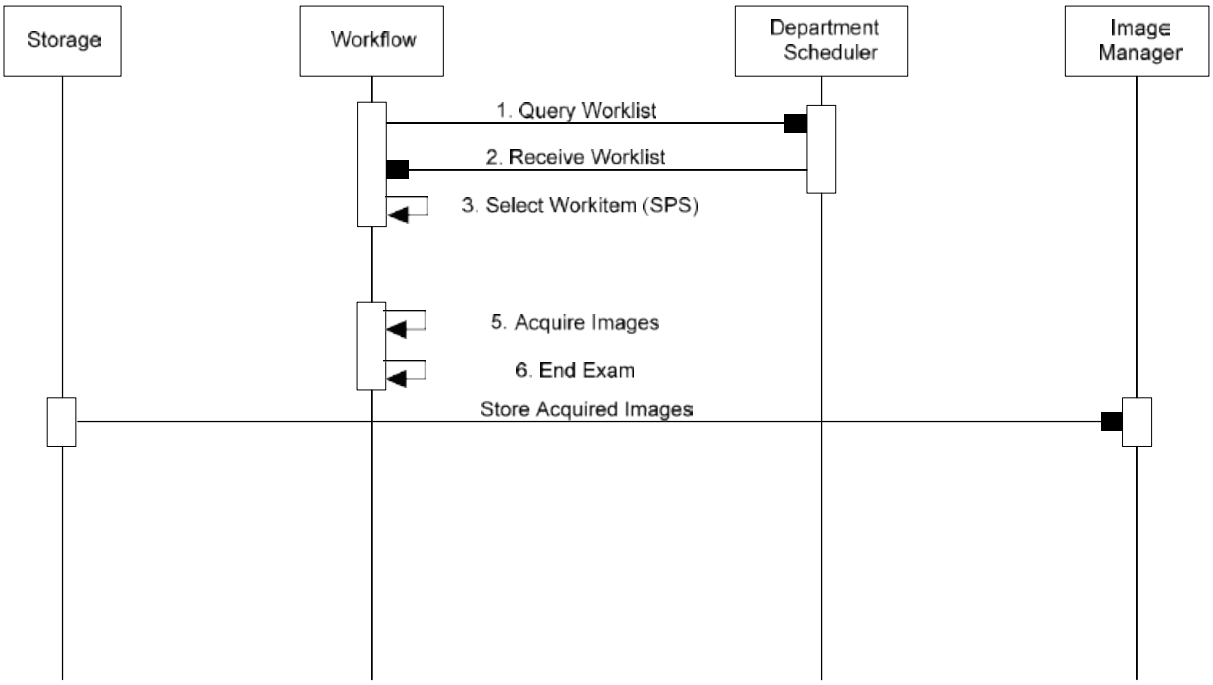
} While C-FIND status == pending AND response <= 100

A-RELEASE

Sequencing of Real-World Activities

All real world activities that initiate communication to remote AE's operate asynchronously with respect to each other and Workflow activities.

Figure 2-2 Sequencing Constraints - "End of Exam" Configuration



Under normal scheduled workflow conditions the sequencing constraints illustrated apply:

1. Worklist Query in initiated.
2. List of Scheduled Procedure Steps (SPS) are returned.
3. Images and Clips are acquired.
4. Exam is ended.
5. SOP instances acquired during the exam are stored to the Image Manager.

CHAPTER 3

AE Specifications

Store AE Specification

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

Table 3-1: Store AE SOP Class Support

SOP Class Name	SOP Class UID	Conformance Level
Verification	1.2.840.10008.1.1	Standard
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Standard
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Standard
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Standard
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11	Standard

Association Establishment Policies

The Store AE will initiate an association to a device in response to the following real-world activities; Archive Exam or Image Acquisition, Review Archive, and Get Status.

General

Maximum PDU size offered to SCP: 32,768 bytes

This is the maximum PDU size the Store AE can receive and is the value offered for the maximum PDU size in the Association Request command. Once the Association is open, if the Store AE receives a PDU that is larger than this value then the Association will be aborted.

Minimum PDU size accepted from SCP: 1,024 bytes

This is the minimum PDU size the Store AE can be configured to send. If the Store AE receives a maximum PDU size in the Association Accept response that is smaller than this value then the Association will be aborted immediately.

Maximum PDU size sent by SCU: 32,768 bytes

This is the maximum PDU size the Store AE can be configured to send. The maximum PDU size sent on any Store AE Association will be the smaller of the configured value and the maximum PDU size received in the Association Accept response.

Number of Associations

Number of simultaneous associations for the Store AE: 1

Asynchronous Nature

The Store AE will not use asynchronous operations.

Implementation Identifying Information

Implementation Class UID: "1.2.276.0.7230010.3.0.3.6.1"

Implementation Version name: "OFFIS_DCMTK_361"

Association Initiation by Real-World Activity

The Store AE will open associations to the storage devices listed in the current destination list in response to the following real-world activities: Archive Exam, Review Archive, and Get Status.

Association Initiation by: Archive Exam

The Archive Exam real-world activity will cause the Store AE to open associations to each storage device listed in the current destination list.

Association Initiation by: Review Archive

The Archive command real-world activity while in Review mode will cause the Store AE to open associations to each storage device listed in the current destination list.

Association Initiation by: Get Status

The Get Status real-world activity will cause the Store AE to open associations to each archiver listed in the current destination list.

Proposed Presentation Contexts to an Archiver

Table 3-2: Store AE Proposed Presentation Contexts to an Archiver

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	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 Explicit VR Little Endian JPEG Baseline (Process 1)	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50	SCU	None

Table 3-2: Store AE Proposed Presentation Contexts to an Archiver

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian Explicit VR Little Endian JPEG Baseline (Process 1)	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

Verification SOP Class

The Store AE provides standard conformance to the Verification SOP Class as an SCU. The remote SCP must support Verification in the same association as the Store Command (C-Store).

Ultrasound Image Storage SOP Class

The Ultrasound Image Storage SOP Class uses the Common Composite Image IOD Modules as shown in Table 3-3.

Table 3-3: US Image IOD Modules

IE	Module	Reference	Usage
Patient	Patient	3.1.4.1	M
	Clinical Trial Subject	Not Used	U
Study	General Study	3.1.4.2	M
	Patient Study	3.1.4.3	U
	Clinical Trial Study	Not Used	U
Series	General Series	3.1.4.4	M
	Clinical Trial Series	Not Used	U
Frame Of Reference	Frame Of Reference	Not Used	U

Table 3-3: US Image IOD Modules

IE	Module	Reference	Usage
	Synchronization	Not Used	U
Equipment	General Equipment	3.1.4.5	M
Image	General Image	3.1.4.7	M
	Image Pixel	0	M
	Contrast/Bolus	Not Used	C
	Palette Color Lookup Table	Not Used	C
	US Region Calibration	3.1.4.10	U
	US Image	3.1.4.11	M
	Overlay Plane	Not Used	U
	VOI LUT	Not Used	U
	SOP Common	3.1.4.12	M

Ultrasound Multi-Frame Image Storage SOP Class

The Ultrasound Image Storage SOP Class uses the Common Composite Image IOD Modules as shown in Table 3-4.

Table 3-4: US Multi-Frame Image IOD Modules

IE	Module	Reference	Usage
Patient	Patient	3.1.4.1	M
	Clinical Trial Subject	Not Used	U
Study	General Study	3.1.4.2	M
	Patient Study	3.1.4.3	U
	Clinical Trial Study	Not Used	U
Series	General Series	3.1.4.4	M
	Clinical Trial Series	Not Used	U
Frame Of Reference	Frame Of Reference	Not Used	U
	Synchronization	Not Used	U
Equipment	General Equipment	3.1.4.5	M
Image	General Image	3.1.4.7	M
	Image Pixel	0	M
	Contrast/Bolus	Not Used	C
	Cine	3.1.4.8	M

Table 3-4: US Multi-Frame Image IOD Modules

IE	Module	Reference	Usage
	Multi-Frame	3.1.4.9	M
	Frame Pointers	Not Used	U
	Palette Color Lookup Table	Not Used	C
	US Region Calibration	3.1.4.10	U
	US Image	3.1.4.11	M
	VOI LUT	Not Used	U
	SOP Common	3.1.4.12	M

Secondary Capture Image Storage SOP Class

The Secondary Capture Image Storage SOP Class uses the Common Composite Image IOD Modules as shown in Table 3-5.

Table 3-5: SC Image IOD Modules

IE	Module	Reference	Usage
Patient	Patient	3.1.4.1	M
	Clinical Trial Subject	Not Used	U
Study	General Study	3.1.4.2	M
	Patient Study	3.1.4.3	U
	Clinical Trial Study	Not Used	U
Series	General Series	3.1.4.4	M
	Clinical Trial Series	Not Used	U
Equipment	General Equipment	3.1.4.5	U
	SC Equipment	3.1.4.6	M
Image	General Image	3.1.4.7	M
	Image Pixel	0	M
	SC Image	Not Used	M
	Overlay Plane	Not Used	U
	Modality LUT	Not Used	U
	VOI LUT	Not Used	U
	SOP Common	3.1.4.12	M

Basic Text SR Storage SOP Class

The Basic Text SR Storage SOP Class uses the IOD Modules as shown in Table 3-6.

Table 3-6: Basic Text SR IOD Modules

IE	Module	Reference	Usage
Patient	Patient	3.1.4.1	M
	Clinical Trial Subject	Not Used	U
Study	General Study	3.1.4.2	M
	Patient Study	3.1.4.3	U
	Clinical Trial Study	Not Used	U
Series	SR Document Series	3.2.4.16	M
	Clinical Trial Series	Not Used	U
Equipment	General Equipment	3.1.4.5	M
Document	SR Document General	3.2.4.17	M
	SR Document Content	3.2.4.18	M
	SOP Common	3.2.4.12	M

Common Composite Image IOD Modules

The section defines the Modules that are common to the Secondary Capture Store SOP Classes.

Patient Module

Table 3-7 specifies the attributes used from the Patient Module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-7: Patient Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Name*	(0010,0010)	2	From Worklist or manually entered on Patient Info screen (Last, First and Middle fields). All 5 Person Name Components are preserved when name comes from Worklist.
Patient ID*	(0010,0020)	2	From Worklist or manually entered on Patient Info screen (ID field)
Patient's Birth Date*	(0010,0030)	2	From Worklist or manually entered on Patient Info screen (Date of birth fields)
Patient's Sex*	(0010,0040)	2	From Worklist or manually entered on Patient Info screen (Gender pick list)
* This attribute cannot be modified by the user when coming from DICOM Worklist.			

General Study Module

Table 3-8 specifies the attributes used from the General Study Module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-8: General Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	From Worklist or automatically generated
Study Date	(0008,0020)	2	Procedure start date
Study Time	(0008,0030)	2	Procedure start time
Referring Physician's Name	(0008,0090)	2	From Worklist or manually entered on Patient Setup screen (Referring Dr. field)
Study ID	(0020,0010)	2	From Worklist (mapped from Requested Procedure ID attribute) or manually entered for unscheduled procedures. If no value is provided via worklist or manual entry, then a value will be automatically generated.
Accession Number[2]	(0008,0050)	2	From Worklist or manually entered on Patient Setup screen (Accession field)
Study Description	(0008,1030)	3	From Worklist[1] or selected manually on Patient Setup screen (Procedure Type pick list)
Referenced Study Sequence	(0008,1110)	3	From Worklist. Not sent if procedure was unscheduled.
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Procedure Code Sequence	(0008,1032)	3	Mapped from Worklist Requested Procedure Code Sequence, if performed. Not sent if procedure was unscheduled.
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

[1]Mapped from Scheduled Procedure Step Description (0040,0007) if it exists. Otherwise, Study Description is set to value of Requested Procedure Description (0032,1060) if it exists. If Requested Procedure Description (0032,1060) is also empty, Study Description is set to Requested Procedure Code Sequence (0032,1064) Code Meaning (0008,0104).

[2] This attribute cannot be modified by the user when coming from DICOM Worklist.

Patient Study Module

Table 3-9 specifies the attributes used from the Patient Study Module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-9: Patient Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Size	(0010,1020)	3	Only sent for Cardiac Exam types.
Patient's Weight	(0010,1030)	3	Only sent for Cardiac Exam types.

General Series Module

Table 3-10 specifies the attributes used from the General Series Module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-10: General Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	"US"
Series Instance UID	(0020,000E)	1	Automatically generated
Series Number	(0020,0011)	2	"1"
Laterality	(0020,0060)	2C	Zero Length
Series Date	(0008,0021)	3	Procedure start date
Series Time	(0008,0031)	3	Procedure start time
Protocol Name	(0018,1030)	3	Zero length
Series Description	(0008,103E)	3	Same as Performed Procedure Step Description
Operator's Name	(0008,1070)	3	Not Used
Request Attributes Sequence	(0040,0275)	3	Only sent if the procedure originated from a Worklist Scheduled Procedure Step
>Requested Procedure ID	(0040,1001)	1C	From Worklist
>Scheduled Procedure Step ID	(0040,0009)	1C	From Worklist
>Scheduled Procedure Step Description	(0040,0007)	3	From Worklist
>Scheduled Protocol Code Sequence	(0040,0008)	3	From Worklist
>>Code Value	(0008,0100)	1C	
>>Coding Scheme Designator	(0008,0102)	1C	

Table 3-10: General Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
>>Code Meaning	(0008,0104)	1C	
Performed Procedure Step ID	(0040,0253)	3	From Worklist (mapped from Scheduled Procedure Step ID) or Generated by iViz
Performed Procedure Step Start Date	(0040,0244)	3	Procedure start date
Performed Procedure Step Start Time	(0040,0245)	3	Procedure start time
Performed Procedure Step Description	(0040,0254)	3	Mapped from Worklist SPS description, if performed, or selected manually on Patient Setup screen (Procedure Type pick list)
Performed Protocol Code Sequence	(0040,0260)	3	Mapped From Worklist Scheduled Protocol Code sequence, if performed. Otherwise sent as zero length sequence.
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	1C	

General Equipment Module

Table 3-11 specifies the attributes used from the General Equipment Module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-11: General Equipment Module Attributes

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	"SonoSite, Inc."
Institution Name	(0008,0080)	3	Not Used
Station Name	(0008,1010)	3	Host Name
Institutional Department Name	(0008,1040)	3	Not Used
Manufacturer's Model Name	(0008,1090)	3	Model name (maps to product line)
Software Versions	(0018,1020)	3	Not Used

SC Equipment Module

Table 3-12 describes the attributes used from the SC Equipment Module. These attributes are used by the Secondary Capture Image Storage SOP Class. Attributes not listed are not used.

Table 3-12: SC Equipment Module Attributes

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	"WSD"
Modality	(0008,0060)	3	"US"

General Image Module

Table 3-13 specifies the attributes used from the General Image Module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-13: General Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	2	A number that identifies this image
Content Date	(0008,0023)	2C	Image acquisition date
Content Time	(0008,0033)	2C	Image acquisition time
Derivation Description	(0008,2111)	3	Not Used
Lossy Image Compression	(0028,2110)	3	01=Lossy Compressed - JPEG Lossy Compressed images.
Lossy Image Compression Ratio	(0028,2112)	3	The approximate compression ratio is sent for JPEG Lossy Compressed images.

Image Pixel Module

Table 3-14 specifies the attributes used from the Image Pixel Module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-14: Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	MONOCHROME2=1, RGB=3, YBR_FULL_422 = 3
Photometric Interpretation	(0028,0004)	1	Configurable in DICOM Setup mode. Valid settings defined by archiver type and Transfer Syntax being used. MONOCHROME2, RGB or YBR_FULL_422
Rows	(0028,0010)	1	480
Columns	(0028,0011)	1	640
Bits Allocated	(0028,0100)	1	8
Bits Stored	(0028,0101)	1	8

Table 3-14: Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
High Bit	(0028,0102)	1	7
Pixel Representation	(0028,0103)	1	0
Pixel Data	(7FE0,0010)	1	Used – Basic Offset Table is set to zero length for encapsulated multi-frame images.
Planar Configuration	(0028,0006)	1C	0=Color-by-pixel - Only sent for RGB and YBR_FULL_422 images

CINE Module

Table 3-15 specifies the attributes used from the Cine module. The Ultrasound Multi-Frame Image IOD uses these attributes. Attributes not listed are not used.

Table 3-15: CINE Module Attributes

Attribute Name	Tag	Type	Attribute Description
Frame Time	(0018,1063)	1C	Nominal time (in msec) per individual frame.

Multi-frame Module

Table 3-16 specifies the attributes used from the Cine module. The Ultrasound Multi-Frame Image IOD uses these attributes.

Table 3-16: Multi-frame Module Attributes

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Number of frames in a Multi-frame Image.
Frame Increment Pointer	(0028,0009)	1	Always set to 00181063H (Frame Time).

US Region Calibration Module

Table 3-17 specifies the attributes used from the US Region Calibration Module. These attributes are used by Ultrasound, Ultrasound Multi-frame Image Storage SOP instances created by the iViz system. Attributes not listed are not used.

Table 3-17: US Region Calibration Attributes

Attribute Name	Tag	Type	Attribute Description
Sequence of Ultrasound Regions	(0018,6011)	1	Used
>Region Location Min x_0	(0018,6018)	1	Automatically generated
>Region Location Min y_0	(0018,601A)	1	Automatically generated

Table 3-17: US Region Calibration Attributes

Attribute Name	Tag	Type	Attribute Description
>Region Location Max x_1	(0018,601C)	1	Automatically generated
>Region Location Max y_1	(0018,601E)	1	Automatically generated
>Physical Units X Direction	(0018,6024)	1	
>Physical Units Y Direction	(0018,6026)	1	Automatically generated
>Physical Delta X	(0018,602C)	1	Automatically generated
>Physical Delta Y	(0018,602E)	1	Automatically generated
>Region Spatial Format	(0018,6012)	1	Automatically generated
>Region Data Type	(0018,6014)	1	Automatically generated
>Region Flags	(0018,6016)	1	Automatically generated

US Image Module

Table 3-18 specifies the attributes used from the US Image Module. These attributes are used by Ultrasound, Ultrasound Multi-frame Image Storage SOP instances created by the iViz system. Attributes not listed are not sent.

Table 3-18: US Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Samples Per Pixel	(0028,0002)	1	YBR_FULL_422 = 3
Photometric Interpretation	(0028,0004)	1	YBR_FULL_422
Bits Allocated	(0028,0100)	1	8
Bits Stored	(0028,0101)	1	8
High Bit	(0028,0102)	1	7
Planar Configuration	(0028,0006)	1C	0=Color-by-pixel
Pixel Representation	(0028,0103)	1	0
Image Type	(0008,0008)	2	YBR_FULL_422 = "DERIVED\PRIMARY\<ExamType>\nnnn" Possible values for <ExamType>: ▸ ABDOMINAL ▸ OBSTETRICAL ▸ CARDIAC ▸ LUNG nnnn=bit map designating the image mode: 0001 = 2D Imaging 0002 = M-Mode 0010 = Color Doppler

Table 3-18: US Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Lossy Image Compression	(0028,2110)	1C	01=Lossy Compressed - JPEG Lossy Compressed images.
Ultrasound Color Data Present	(0028,0014)	3	00=Color data not present in image 01=Color data is present in image
Heart Rate	(0018,1088)	3	
Transducer Data	(0018,5010)	3	

SOP Common Module

Table 3-19 specifies the attributes used from the SOP Common module. These attributes are used by the Ultrasound, Ultrasound Multi-frame, and Secondary Capture Image Storage SOP Classes. Attributes not listed are not used.

Table 3-19: SOP Common Module Attributes

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	Automatically generated
SOP Instance UID	(0008,0018)	1	Automatically generated
Specific Character Set	(0008,0005)	1C	ISO_IR 192
Instance Number	(0020,0013)	3	A number that identifies this image

SR Document Series Module

Table 3-20 specifies the attributes used from the SR Document Series Module. These attributes are used by the SR Document Storage SOP Class. Attributes not listed are not used.

Table 3-20: SR Document Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	"US"
Series Instance UID	(0020,000E)	1	
Series Number	(020,0011)	1	
Referenced Performed Procedure Step Sequence	(0008,1111)	2	

SR Document General Module

Table 3-21 specifies the attributes used from the SR Document General Module. These attributes are used by the SR Storage SOP Class. Attributes not listed are not used.

Table 3-21: SR Document General Module Attributes

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	1	
Completion Flag	(0040,A491)	1	
Verification Flag	(0040,A493)	1	
Content Date	(0008,0023)	1	
Content Time	(0008,0033)	1	
Performed Procedure Code Sequence	(0040,A372)	2	

SR Document Content Module

Table 3-22 specifies the attributes used from the SR Document Content Module. These attributes are used by the SR Storage SOP Class. Attributes not listed are not used.

Table 3-22: SR Document Content Module Attributes

Attribute Name	Tag	Type	Attribute Description
Value Type	(0040,A040)	1	
Concept Name Code Sequence	(0040,A043)	1C	
Text Value	(0040,A160)	1C	
Observation Date Time	(0040,A032)	1C	
Content Sequence	(0040,A730)	1C	
>Relationship Type	(0040,A010)	1	
>Referenced Content Item Identifier	(0040,DB73)	1C	

Store AE Behavior to C Store Status

Table 3-23 describes the behavior for C-Store response status returned from the Storage SCP. All image SOP classes supported by the Store AE exhibit the same behavior.

Table 3-23: Store AE Behavior to C-Store Status

Service Status	Further Meaning	Status Codes	Store AE Behavior
Success		0000	Continue without user notification
Refused	Out of Resources	A7xx	Association terminated.
Error	Data Set does not match SOP Class	A9xx	Association terminated.
	Cannot understand	Cxxx	Association terminated.

Table 3-23: Store AE Behavior to C-Store Status

Service Status	Further Meaning	Status Codes	Store AE Behavior
Warning	Coercion of data elements	B000	Ignored - Message logged.
	Data set does not match SOP class	B007	Ignored - Message logged.
	Elements discarded	B006	Ignored - Message logged.

Modality Worklist AE Specification

The Modality Worklist AE provides conformance to the following DICOM V3.0 SOP Classes as an SCU:

Table 3-24: Modality Worklist AE SOP Class Support

SOP Class Name	SOP Class UID	Conformance Level
Verification	1.2.840.10008.1.1	Standard
Modality Worklist Information Model -FIND	1.2.840.10008.5.1.4.31	Standard

Association Establishment Practices

The Modality Worklist AE will initiate an association to a device in response to the following real-world activities:

- The user initiates a manual Update Worklist (Broad Query).
- The user initiates a specific Worklist Query (Patient Based Query).
- The system initiates an Automatic Worklist Query (Broad Query).

In all cases a C-FIND command is issued to the Modality Worklist server. After the requested data is returned, the association is closed.

General

Maximum PDU size offered to SCP: 32,768 bytes

This is the maximum PDU size the Modality Worklist AE can receive and is the value offered for the maximum PDU size in the Association Request command. Once the Association is open, if the Modality Worklist AE receives a PDU that is larger than this value then the Association will be aborted.

Minimum PDU size accepted from SCP: 1,024 bytes

This is the minimum PDU size the Modality Worklist AE can be configured to send. If the Modality Worklist AE receives a maximum PDU size in the Association Accept response that is smaller than this value then the Association will be aborted immediately.

Maximum PDU size sent by SCU: 32,768 bytes

This is the maximum PDU size the Modality Worklist AE can be configured to send. The maximum PDU size sent on any Modality Worklist AE Association will be the smaller of the configured value and the maximum PDU size received in the Association Accept response.

Number of Associations

Number of simultaneous associations for the Modality Worklist AE: 1

Asynchronous Nature

The Modality Worklist AE will not use asynchronous operations.

Implementation Identifying Information

Implementation Class UID: "1.2.276.0.7230010.3.0.3.6.1"

Implementation Version name: "OFFIS_DCMTK_361"

Association Initiation by Real-World Activity

The Modality Worklist AE will open associations to the configured Worklist SCP in response to the following real-world activities: Update Worklist, Query Worklist, Automatic Worklist Query, and Get Status.

Association Initiation by: Update Worklist

The Update Worklist real-world activity initiated in Worklist screen will cause the Modality Worklist AE to open an association with the Worklist SCP, configured in the current Location.

Association Initiation by: Worklist Query

The Query Worklist command real-world activity initiated in Patient Setup screen will cause the Modality Worklist AE to open an association with the Worklist SCP, configured in the current Location.

Association Initiation by: Automatic Worklist Query

The Automatic Worklist Query real-world activity initiated by the system at periodic intervals will cause the Modality Worklist AE to open an association with the Worklist SCP, configured in the current Location.

Association Initiation by: Get Status

The Get Status real-world activity will cause the Modality Worklist AE to open an association to the Modality Worklist SCP configured in the current Location.

Proposed Presentation Contexts to a Worklist Server

Table 3-25: Modality Worklist AE Proposed Presentation Contexts to a Worklist Server

Presentation Context Table					
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	SCU	None
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Modality Worklist Information Model – FIND SOP Class

The Modality Worklist AE provides standard conformance to the Modality Worklist Information Model – FIND SOP Class as an SCU.

Verification SOP Class

The Modality Worklist AE provides standard conformance to the Verification SOP Class as an SCU.

Modality Worklist Attributes

Broad Worklist Query Matching Key Attributes

Table 3-26 specifies the Matching Key attributes used by Automatic Worklist C-FIND requests and manual Update Worklist C-FIND requests for Broad queries initiated by the user from the Worklist screen.

Table 3-26: Broad Worklist Query Matching Key Attributes

Attribute Name	Tag	Type	Notes
Modality	(0008,0060)	R	Selectable from list provided by User Interface
Scheduled Station AE-Title	(0040,0001)	R	Configurable – Sent as either : ▸ iViz's AE Title ▸ Universal Matching
Scheduled Procedure Step Start Date	(0040,0002)	R	Configurable – Sent as either: ▸ Today's date ▸ Yesterday, Today and All date range ▸ Universal Matching

Patient Based Query Matching Key Attributes

Table 3-27 specifies the Matching Key attributes used for Worklist C-FIND requests for Patient Based queries initiated by the user from the Patient Setup screen.

Table 3-27: Patient Based Query Matching Key Attributes

Attribute Name	Tag	Type	Notes
Modality	(0008,0060)	R	Selectable from list provided by User Interface
Scheduled Station AE-Title	(0040,0001)	R	Configurable – Sent as either : ▸ iViz's AE Title ▸ Universal Matching
Scheduled Procedure Step Start Date	(0040,0002)	R	Configurable – Sent as either: ▸ Today's date ▸ Yesterday, Today and All date range ▸ Universal Matching
Patient's Name	(0010,0010)	R	Entered on Patient Setup screen. A wild card is appended to Last, First and Middle name component.
Patient ID	(0010,0020)	R	Entered on Patient Setup screen. Single value matching only.
Accession Number	(0008,0050)	O	Entered on Patient Setup screen.
Requested Procedure ID	(0040,1001)	O	Entered on Patient Setup screen.

Return Key Attributes

Table 3-28 specifies the Return Key attributes that are included in all Worklist C-FIND requests.

Table 3-28: Return Key Attributes

Attribute Name	Tag	Type	Notes
Study Instance UID	(0020,000D)	1	
Accession Number*	(0008,0050)	2	Displayed on Patient Setup screen
Referring Physician's Name	(0008,0090)	2	Displayed on Patient Setup screen
Patient's Name*	(0010,0010)	1	Displayed on Patient Setup screen. All 5 name components are preserved but only Last, First and Middle name components are displayed.
Patient ID*	(0010,0020)	1	Displayed on Patient Setup screen
Patients Birth Date	(0010,0030)	2	Displayed on Patient Setup screen
Patient's Sex	(0010,0040)	2	Displayed on Patient Setup screen
Admitting Diagnoses Description	(0008,1080)	3	Not Used

Table 3-28: Return Key Attributes

Attribute Name	Tag	Type	Notes
Last Menstrual Date	(0010,21D0)	2	Displayed on Patient Setup screen with OB/GYN exam type only.
Scheduled Procedure Step Sequence	(0040,0100)	1	
>Modality	(0008,0060)	1	
>Scheduled Station AE Title	(0040,0001)	1	
>Scheduled Procedure Step Start Date	(0040,0002)	1	
>Scheduled Procedure Step Start Time	(0040,0003)	1	
>Scheduled Procedure Step Description*	(0040,0007)	1C	
>Scheduled Protocol Code Sequence	(0040,0008)	1C	
>>Code Value	(0008,0100)	1C	
>>Coding Scheme Designator	(0008,0102)	1C	
>>Code Meaning	(0008,0104)	3	
>Scheduled Procedure Step ID	(0040,0009)	1	
Requested Procedure ID*	(0040,1001)	1	Displayed on Patient Setup screen.
Requested Procedure Description*	(0032,1060)	1C	
Requested Procedure Code Sequence	(0032,1064)	1C	
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning*	(0008,0104)	3	
Referenced Study Sequence	(0008,1110)	2	
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	

* This attribute from Worklist may be truncated when displayed in the iViz User Interface. However, the value contained in the attribute is preserved in full fidelity.

Worklist AE Behavior to C-FIND Status

Table 3-29 specifies the response status codes, which an SCP may return following the SCU's C-FIND request, along with the Worklist AE's associated behavior. Only those status responses that indicate some form of error condition are presented to the user. Related fields are not used.

Table 3-29: Worklist AE Behavior to C-FIND Status

Service Status	Further Meaning	Status Codes	Worklist AE Behavior
Refused	Out of resources	A700	The association is terminated. The user is notified of the failure.
Failed	Identifier does not match SOP Class	A900	The association is terminated. The user is notified of the failure.
	Unable to process	Cxxx	The association is terminated. The user is notified of the failure.
Cancel	Matching terminated due to Cancel request	FE00	The association is terminated. The user is notified that the query was incomplete.
Success	Matching is complete - No final Identifier is supplied.	0000	The Modality Worklist AE will continue operation without user notification.
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	FF00	The Modality Worklist AE will continue operation without user notification.
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence for this Identifier.	FF01	The Modality Worklist AE will continue operation without user notification.

Media Export AE-Specification

Introduction

This section of the conformance statement specifies the iViz compliance to DICOM Media Storage. It details the roles supported by this product.

iViz is able to export DICOM images to removable USB media stick memory. Any reference to USB in this document refers to "Micro USB media stick memory".

Implementation Model

The Media Export AE saves single, multi-frame US images and DICOM Basic Text SR reports to a USB storage device. It is associated with the local real-world activity "Export to USB". "Export to USB" is performed upon user request for selected patient series.

Application Data Flow

Figure 3-1 Media Export Data Flow

Functional Definition of the AE

iViz can perform the following functions:

- Create a new DICOM file-set on the USB medium
- Add to an existing DICOM file-set previously created by the iViz system

Sequencing of Real-World Activities

Not applicable.

File Meta Information Options (see PS 3.10)

The implementation information written to the File Meta Header in each file is:

Implementation Class UID: "1.2.276.0.7230010.3.0.3.6.1"

Implementation Version name: "OFFIS_DCMTK_361"

AE Specifications

File Meta Information for the Application Entity

The Source Application Entity Title included in the file header is configurable. The default value set in the File Meta Information for this AE is: "DICOM Media".

Real-World Activities

Real-World Activity – "Export to USB"

"Export to USB" saves the selected DICOM SOP instances to the USB medium and creates a DICOM File Set. If a DICOM File Set created by the iViz exists on the medium, any new files selected for export will be added to the existing files. The Media Export AE acts as a File Set Creator when requested to export SOP instances from the internal storage to a USB medium. If there is insufficient space on the medium, the user will be prompted with an informative message.

Limitations: The user cannot review or manipulate DICOM files written to the USB medium on the system.

Media Storage Application Profile for the real-world activity "Export to USB"

Not applicable [FUTURE]

Options

This Application Entity supports the SOP Classes and Transfer Syntaxes listed below in Table 3-30:

Table 3-30: SOP Classes and Transfer Syntaxes for Media Export

Abstract Syntax		Transfer Syntax	
Name	**UID**	**Name List**	**UID List**
Media Storage Directory Storage	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian JPEG Baseline (Process 1)	1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian JPEG Baseline (Process 1)	1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11	Explicit VR Little Endian	1.2.840.10008.1.2.1

Common Composite Image IOD Modules on page 16 describes image module usage by iViz.

Augmented and Private Application Profiles

Not applicable.

Media Configuration

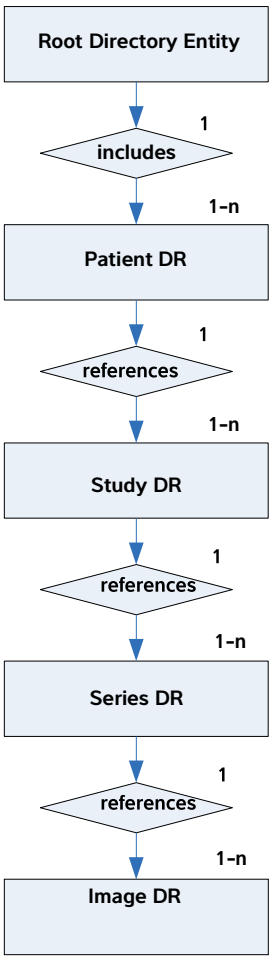
The Application Entity Titles configurable for Media Services are listed below:

- Application Entity: "Media Export"
- Default AE Title: "DICOM Media"

Media Storage SOP Class

The following diagram illustrates the relationship between directory entities in the Basic Directory module produced by iViz. It is based on the basic DICOM entity relationship model.

Figure 3-2 iViz Directory Entity Relationship Diagram



The Media Storage SOP Class uses the Basic Directory IOD Modules as shown in Table 3-31.

Table 3-31: Basic Directory IOD Modules

Module	Reference	Usage
File-set Identification	3.1.4.1	M
Directory Information	3.1.7.2	U

Information Module Definitions

File-Set Identification Module

Table 3-32 specifies the attributes used from the File-set Identification Module.

Table 3-32: File-Set Identification Module

Attribute Name	Tag	Type	Attribute Description
File-set ID	(0004,1130)	2	"SONO_EXPORT"
File-set Descriptor ID	(0004,1141)	3	Not Used
Specific Character Set of File- set Descriptor File	(0004,1142)	1C	Not Used

Directory Information Module

Table 3-33 specifies the attributes used from the Directory Information Module.

Table 3-33: Directory Information Module

Attribute Name	Tag	Type	Attribute Description
Offset of the First Directory Record of the Root Directory Entity	(0004,1200)	1	See PS 3.3
Offset of the Last Directory Record of the Root Directory Entity	(0004,1202)	1	See PS 3.3
File-set Consistency Flag	(0004,1212)	1	See PS 3.3
Directory Record Sequence	(0004,1220)	2	See PS 3.3
>Offset of the Next Directory Record	(0004,1400)	1C	See PS 3.3
>Record In-use Flag	(0004,1410)	1C	iViz sets all created records to 0xFFFF
>Offset of Referenced Lower-Level Directory Entity	(0004,1420)	1C	See PS 3.3
>Directory Record Type	(0004,1430)	1C	iViz Supported Values: PATIENT, STUDY, SERIES, IMAGE
>Referenced File ID	(0004,1500)	1C	See PS 3.3
>Referenced SOP Class UID in File	(0004,1510)	1C	See PS 3.3
>Referenced SOP Instance UID in File	(0004,1511)	1C	See PS 3.3
>Referenced Transfer Syntax in UID in File	(0004,1512)	1C	See PS 3.3

Patient Keys

Table 3-34 specifies the additional keys used for directory records of type PATIENT.

Table 3-34: Patient Keys

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Reference 3.2.4.1
Patient ID	(0010,0020)	1	Reference 3.2.4.1

Study Keys

Table 3-35 specifies the additional keys used for directory records of type STUDY.

Table 3-35: Study Keys

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008,0020)	1	Reference 3.2.4.2
Study Time	(0008,0030)	1	Reference 3.2.4.2
Study Description	(0008,1030)	2	Reference 3.2.4.2
Study Instance UID	(0020,000D)	1C	Reference 3.2.4.2
Study ID	(0020,0010)	1	Reference 3.2.4.2
Accession Number	(0008,0050)	2	Reference 3.2.4.2

Series Keys

Table 3-36 specifies the additional keys used for directory records of type SERIES.

Table 3-36: Series Keys

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Reference 3.2.4.4
Series Instance UID	(0020,000E)	1	Reference 3.2.4.4
Series Number	(0020,0011)	1	Reference 3.2.4.4

Image Keys

Table 3-37 specifies the additional keys used for directory records of type IMAGE.

Table 3-37: Image Keys

Attribute Name	Tag	Type	Attribute Description
Instance Number	(0020,0013)	1	Reference 3.2.4.7

CHAPTER 4

Communication Profiles

TCP/IP Stack

The TCP/IP protocol is used.

CHAPTER 5

Extensions/Specializations/Privatizations

Private Transfer Syntaxes

None

CHAPTER 6

Configuration

AE Title/Presentation Address Mapping

The iViz AE Title and iViz networking parameters are configurable in DICOM Setup Mode. Port number 104 is the default used for DICOM communication with the iViz.

Configurable Parameters

iViz Configurable Parameters per Network Location

The iViz system can be configured to operate in multiple network locations. The iViz local device settings and remote device settings (e.g. Archivers/Worklist) can be configured for each location. These parameters are intended to be configured by a network/DICOM administrator.

Configurable iViz Networking and DICOM parameters:

- DHCP (default = disabled)
- Hostname (Name field)
- DICOM AE Title
- IP Address (disabled if DHCP is selected)
- Subnet Mask (disabled if DHCP is selected)
- Default Gateway (disabled if DHCP is selected)
- Transfer Images (End of exam, During the exam)
- Port (default = 104)
- Wireless properties (see iViz User Guide for detailed configuration information)

Configurable Parameters per Remote Device Instance

Every archiver, and Modality Worklist device that iViz is setup to communicate with has a set of parameters that are configurable in Setup mode. These parameters are intended to be configured by a network/DICOM administrator.

Configurable parameters for each device instance:

- DICOM AE Title
- Hostname (Name field)
- IP Address
- Port Number

Configurable parameters for each Archiver device instance:

- SOP Class — Ultrasound /Secondary Capture
- SOP Class — Ultrasound Multi-frame (enable/disable)

Configurable parameters for the Worklist SCP device instance:

- Automatic Query Enable — On/Off
- Automatic Query Interval — Selection = 30 minutes, 1, 2, 4 , 8, 12, 24 hours
- Automatic Query Start Time — Selection = 0:00 to 23:00 hours

▸ Modality	Selectable in user interface
▸ Scheduled Station AE Title	This iViz system only or universal matching (used for Broad & Patient Based Queries)
▸ SPS Date	Today; "Yesterday, Today & All"; or universal matching (used for Broad & Patient Based Queries)

CHAPTER 7

Support of Extended Character Sets

The iViz system supports the ISO 8859 Latin 1 (ISO-IR 100) character set family.

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