

Acuson
A Siemens Company

Sequoia™ Ultrasound System
DICOM Conformance Statement
(Sequoia 6.0 Release)

1. Document History

Rev	Date	Author	Comments
1	8/10/98	JB Wang	Created
2	8/11/98	JB Wang	Incorporated comments from Paul Spadafora
3	8/19/98	JB Wang	Correct Implementation UID/Name errors
4	1/18/99	A Goldner	Updated for Sequoia 4.1 functionality
5	6/29/99	Paul Spadafora	Minor updates for Sequoia 4.0
6	7/1/99	JB Wang	Updated Sequoia version numbers
7	2/16/2000	JB Wang	Updated for Sequoia 5.x
8	6/01/2001	Lin Barron	Updated for Sequoia 6.0

2. Introduction

This document is a DICOM 3.0 Conformance Statement for the Acuson Sequoia Ultrasound System release 6.0. The DICOM conformance for other medical devices manufactured by Acuson is not included in this document.

The following DICOM 3.0 functions are supported in Sequoia 6.0:

1. Verifying DICOM 3.0 connectivity using Verification service class SCU.
2. Exporting images using DICOM 3.0 Storage service class SCU.
3. Committing the safekeeping of stored images using DICOM 3.0 Storage Commitment service class SCU.
4. Printing images using DICOM 3.0 Print management service class SCU.
5. Querying patient and study scheduling information using DICOM 3.0 Modality Worklist service class SCU.
6. Updating the status of a particular procedure step of study using DICOM 3.0 Modality Performed Procedure Step service class SCU.
7. Notifying images sent through the DICOM 3.0 Storage Commitment Push SOP Class.
8. 90mm (3.5") 128MB, 230MB, and 540MB DICOM magneto-optical disk media.

2.1. Source of Information

- Digital Imaging and Communication in Medicine (DICOM), NEMA Standard Publication No. PS 3.1~3.13, NEMA, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209, phone: (703)-841-3200.
- World Wide Web: <http://www.nema.org/medical/dicom.htm>

2.2. Acronyms and Abbreviations

ACR	American College of Radiology
AE	Application Entity
ANSI	American National Standards Institute
DICOM	Digital Imaging and Communication in Medicine
DIMSE-C	DICOM Message Service Element-Composite
DIMSE-N	DICOM Message Service Element-Normalized
FSC	File-set Creator
FSR	File-set Reader
FSU	File-set Updator

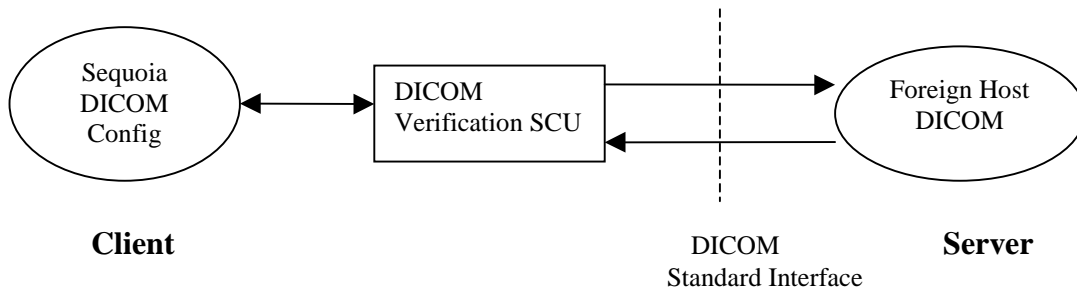
HIS/RIS	Hospital Information System/Radiology Information System
IOD	Information Object Definition
ISO	International Standards Organization
MOD	Magneto-Optical Disk
NEMA	National Electrical Manufacturers Association
OSI	Open Systems Interconnections
PDU	Protocol Data Unit
SCP	Service Class Provider (server)
SR	Structured Report
SCU	Service Class User (client)
TCP/IP	Transmission Control Protocol/Internet Protocol
SOP	Service Object Pair
UID	Unique Identification

3. Implementation Model

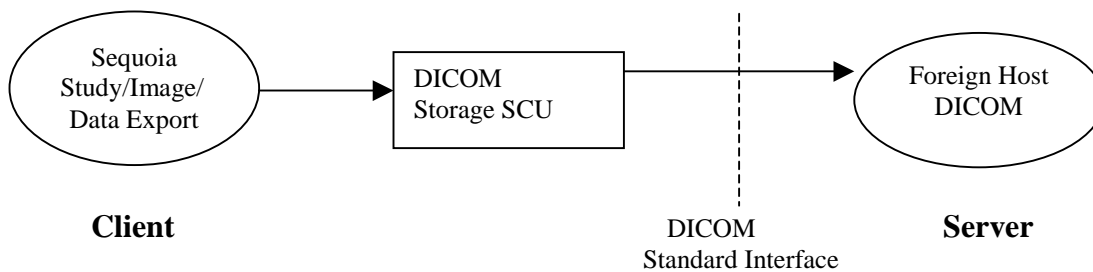
Each DICOM function is an Application Entity (AE).

3.1. Application Data Flow Diagram

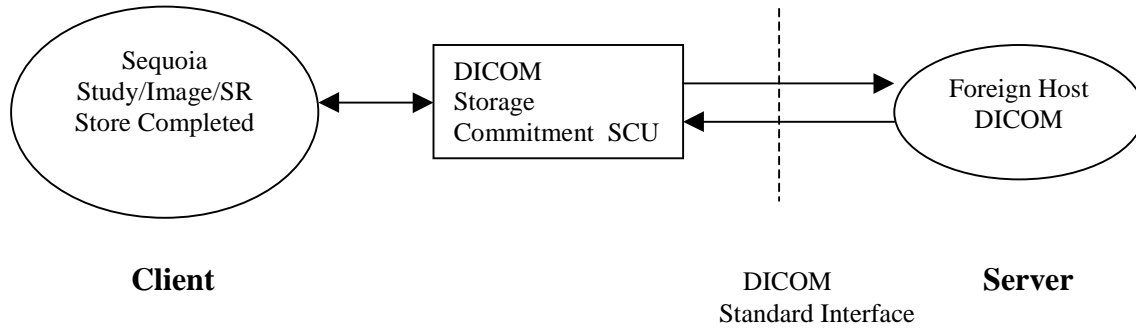
3.1.1 Verification AE



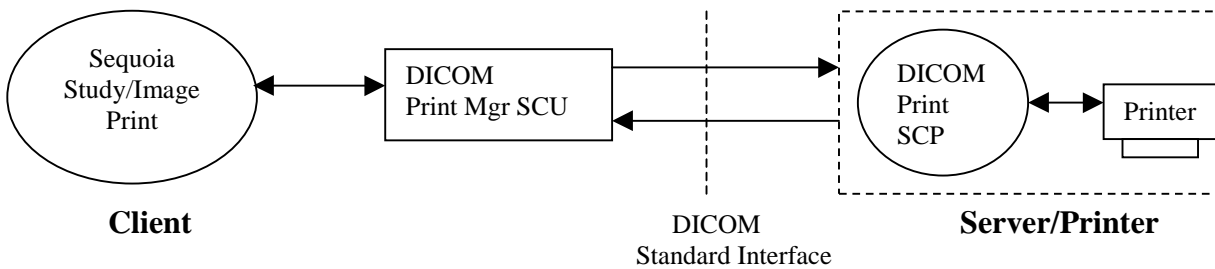
3.1.2 Image and Structured Report Export AE



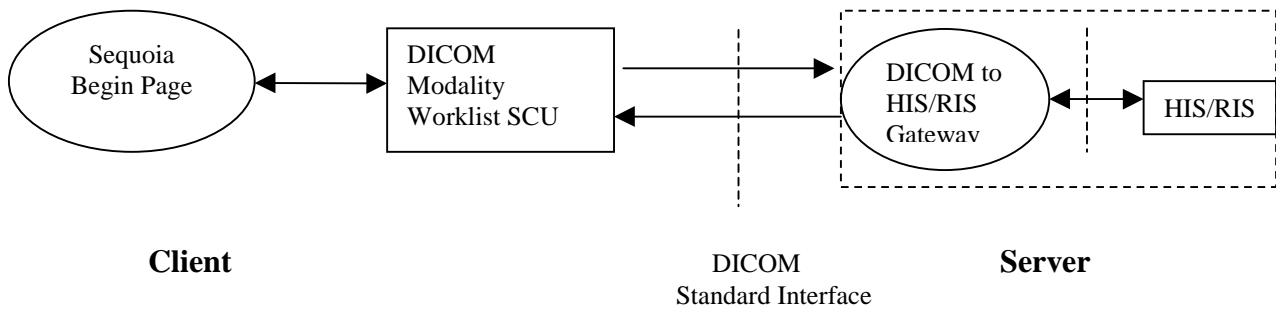
3.1.3 Storage Commitment AE



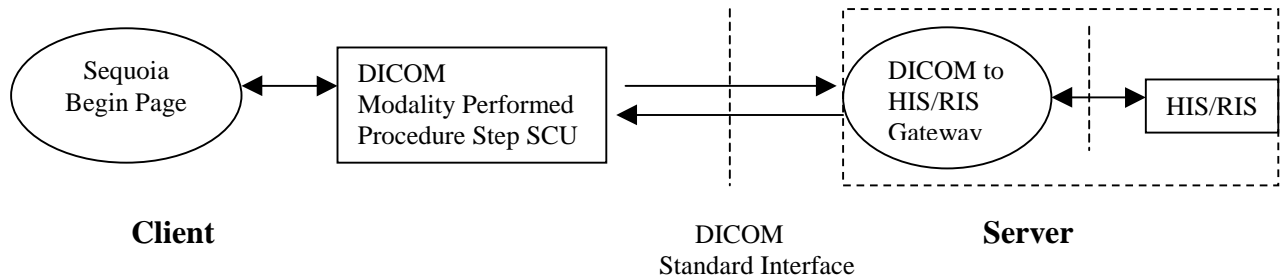
3.1.4 DICOM Print AE



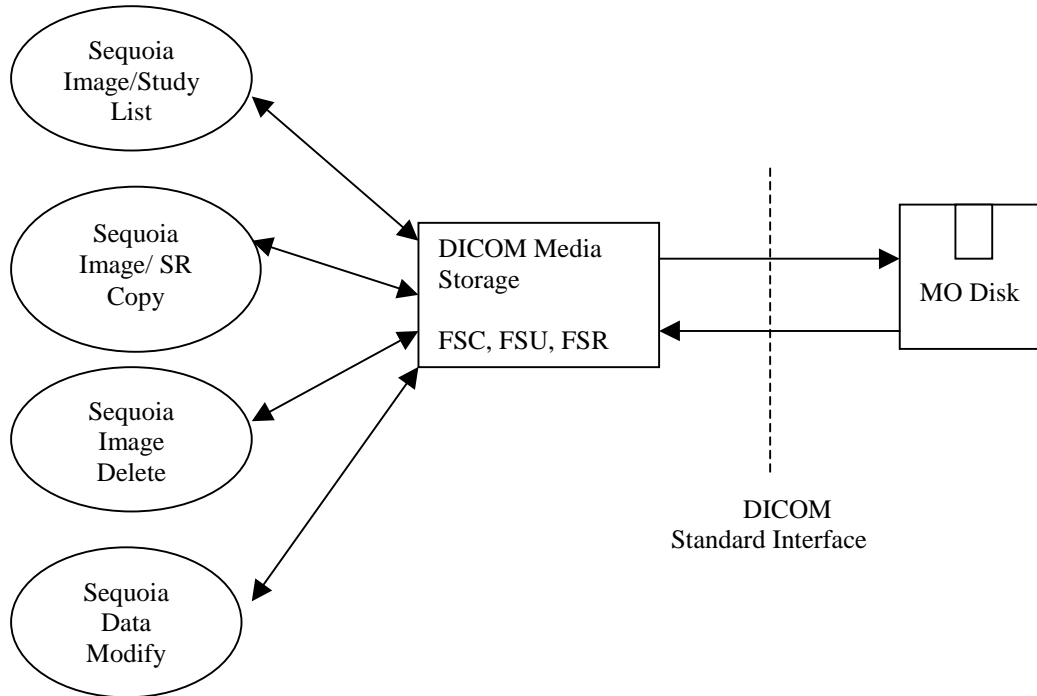
3.1.5 Modality Worklist AE



3.1.6 Modality Performed Procedure Step AE



3.1.7 DICOM MO Disk Media Interchange AE



3.2. Functional Definitions of AE

3.2.1. Verification AE

The Verification AE is part of the DICOM configuration tool. It issues a DICOM Verification request to the remote DICOM device, receives a response (if any) and reports the result.

The result can be either of the following.

1. Success
2. Rejected
3. Time-out

In the Verification step the Calling AE Title (Sequoia system) and Called AE Title are identical to those AE titles configured for Image Export, Print, Modality Worklist, Modality Performed Procedure Step AE's.

3.2.2 Image Export AE

The Image Export AE is a DICOM Storage service class SCU to export Sequoia single frame and multi-frame Ultrasound images to a host which supports the Storage service class SCP role. It also exports a Structured Reporting object to a host which supports storing this object.

The user can manually bulk store completed studies by selecting one or more in the Study Util UI and export them. The destination is selected from a pop-up selection of pre-configured devices at run-time.

Additionally, there are automated background image export methods available. The system can be set to store either “in-progress” or “on study close” where:

- The system automatically exports an image as soon as it is captured and saved to the local disk while the study is currently open and in-progress.
- The system automatically exports all the images belonging to the current study as it closes.
- The system automatically exports one or more studies in the background, acquired while in a portable non-networked mode, once it is powered up on the network.

The “in-progress” method distributes the network load over time and can provide image review at the review station in near real-time (provided the server supports this capability). The “on study close” method lets the user store studies more accurately in the server. It is a common practice in Ultrasound to delete some images or modify demographic data before the study is closed.

If a Storage SCP accepts the Sequoia proposed SR object in the Association Negotiation, the Structured Report object is exported with the Study Instance UID.

In the event of a network failure during background export, the Store SCU maintains a queue of failed C-STORE requests. These are periodically retried subsequent to the end of the study. The queue is also retried upon power cycling the Sequoia.

To use background export, the user pre-configures the destinations and mode of copy with the Sequoia Aegis Setup function. Images can be stored to two destinations.

3.2.3 Structured Reporting

The Sequoia system conforms to a Private Structured Reporting (SR) SOP class as an SCU. It always creates a Structured Reporting object with each study and will export the SR object in a C-STORE if successfully negotiated. The SR object contains patient information and any measurements or calculations entered into one of the three Sequoia calculations package worksheets for OB, Cardiac, or Vascular studies.

The Acuson implementation of Structured Reporting predated the adoption of DICOM Supplement 23 and substantially differs from that final version. Data contained in the Sequoia SR object cannot be extracted to populate other Structured Reporting implementations in non-Acuson devices. Acuson uses a Private Structured Reporting SOP Class UID 1.2.840.10008.5.1.4.1.1.88.3.

If a Storage SCP accepts the Sequoia proposed SR object in the Association Negotiation, the Structured Report object is exported with the Study Instance UID. Additionally, Sequoia will include the Structured Reporting SOP instance UID in the Storage Commitment N-Action request and will process the N-Event-Report for the SR SOP instance.

A Structured Reporting object is also exported to a DICOM MO for each Study Instance.

3.2.4 Image Print AE

The Image Print AE uses the DICOM 3.0 Print management service class SCU to print Sequoia single frame Ultrasound images to a network DICOM printer.

The user can manually use the Study Util UI to select completed studies for printing. The printers and print formats are determined by the selections made in Aegis Setup under “Define Printers.” It is possible to select one B&W and one color printer to route gray scale images and color Doppler images to separate printers.

Additionally, there are two automated background printing methods available. The system can be setup to either print a study “in-progress” or “on study close” where:

- The system automatically prints a sheet of film as soon as enough static images have been captured to fully populate a film format while the study is in-progress.
- The system automatically prints all the images and films belonging to the study as soon as the study is closed

Since it can take 30 seconds to several minutes to print a film, the “in-progress” setting will print most of the films before the study is closed. However, for ultrasound users who delete images throughout the study, the “on study close” method will give more correct study printouts.

The user can use the “Print Now” button, located on the Sequoia Begin page, to force print a partially formatted film before it is fully populated with images and automatic printing occurs.

3.2.5 DICOM Modality Worklist AE

The Sequoia Modality Worklist AE uses the DICOM 3.0 Modality Worklist service class SCU to query a Radiology/Cardiology/Hospital Information System, often via a DICOM-to-HL7 gateway, to obtain patient demographic and scheduled study information.

The DICOM Modality Worklist AE is embedded in the Sequoia Begin page (or patient demographic page) application. The user can type in some filters, such as part of the last name or accession number, or do a wild card query. The returned elements populate the Begin page, so that the operator does not need to type in patient name, birth date, ID, etc.

Sequoia can serve to itself as a virtual RIS if the scheduled study list is down loaded and saved before the system is disconnected from the network and operates in a portable mode.

3.2.6 DICOM Modality Performed Procedure Step AE

The Sequoia DICOM Modality Performed Procedure Step (MPPS) uses the DICOM 3.0 MPPS service class SCU to send event transactions for the start of a study (i.e. the first image is captured) and for the end of a study. The MPPS SCU is embedded in the Sequoia Begin (or patient demographic) page application and supports the N-Create and N-Set DIMSE Service

Elements. A different MPPS AE can be configured separately from a Modality Worklist AE on the Sequoia system.

This information can be used by the Hospital Information System to manage its list of scheduled patients that is requested by a DICOM Modality Worklist AE.

When a study is started on Sequoia, it uses the N-Create DIMSE to construct an MPPS-SOP with the MPPS server SCP. There is no further interaction with the MPPS SCP until the study ends. When the study is closed, the Sequoia system uses the N-Set DIMSE to set the values contained in the MPPS-SOP.

The Sequoia N-Set value for the “Performed Procedure Step Status” (0004,0252) is set to either “COMPLETED” or “DISCONTINUED”. Additionally, the contents of the “Performed Series Sequence” (0040,0340) are updated so that all mandatory attributes are supplied to the SCP.

3.2.7 DICOM Storage Commitment AE

DICOM Storage Commitment AE is embedded in the successful completion of a study store to a DICOM Store SCP. It is dynamically negotiated when all images have been successfully stored to a server. If the host supports C-store of a Structured Report object, Sequoia includes an SR SOP instance UID in the Storage Commitment N-Action request and will process the N-Event-Report for the SR SOP instance.

This AE uses DICOM Storage Commitment Push Model to inform the server when all stores for a study have been completed. The Storage Commitment SCU uses the N-ACTION primitive to make a request to the SCP for safekeeping of a set of SOP instances (eg: Ultrasound images).

The Sequoia Storage Commitment SCU also performs a role reversal and becomes the SCP for the N-EVENT-REPORT primitives received from the original SCP (now an SCU).

3.2.8 DICOM MOD Media Interchange AE

The DICOM MOD Media Interchange AE performs the following DICOM roles:

- File-set creator (FSC): it creates a DICOM MOD medium when the user copies studies/images to MO. A DICOM 3.0 conforming DICOMDIR file is created together with the directory structures and image files.
 - Supported MO disk formats are 128MB, 230MB, and 540MB
 - The Sequoia disk drive may be either a 230MB drive or a 640MB drive.
 - Sequoia creates a partitioned MOD if formatted on the system.
- File-set updator (FSU): it modifies the DICOMDIR file and image files when the user copies or deletes studies/images.
- File-set reader (FSR): it reads the DICOMDIR and makes a listing. The DICOMDIR file is read and parsed by the system Study Util user interface to generate the study listing. Sequoia does not read and display images from an MOD.

Studies/images can be manually copied to MOD from the system local hard drive via the Sequoia Study Util user interface. The SR object is copied to and from the MOD and hard disk.

Studies/images can be manually copied to the system local hard drive from MOD via the Sequoia Study Util user interface. This is the only method to review previously stored studies from an MOD. A study can be displayed and reviewed once it has been copied to the hard drive.

Limitations:

- Only Acuson Aspen and Sequoia studies can be copied to and from MOD. An MOD can contain a mix of Aspen and Sequoia studies.
- Only Acuson Aspen and Sequoia created studies can be reviewed on Sequoia.
- The Aspen release version must be 3.0 or greater.
- The Sequoia release version must be 1.0 or greater.

The level of compatibility of Sequoia 6.0 DICOM MOD with a non-Acuson DICOM 3.0 reader must be assessed by the maker of the reader.

3.3. Sequencing of Real World Activities

See the previous section.

4. Network Transfer Specifications

4.1. Supported SOP Classes

This implementation provides standard conformance to the following DICOM 3.0 SOP classes.

TABLE 1. Verification SOP Class

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

TABLE 2. Storage SOP Classes

SOP Class Name	SOP Class UID	Role
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6 (retired)	SCU
	1.2.840.10008.5.1.4.1.1.6.1	
Multi-frame Ultrasound Image	1.2.840.10008.5.1.4.1.1.3 (retired)	SCU
	1.2.840.10008.5.1.4.1.1.3.1	
Secondary Capture	1.2.840.10008.5.1.4.1.1.7	SCU

TABLE 3. Structured Report SOP Class (Private)

SOP Class Name	SOP Class UID	Role
Structured Report	1.2.840.10008.5.1.4.1.1.88.3 (private)	SCU

TABLE 4. Print Management SOP Class

SOP Class Name	SOP Class UID	Role
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	SCU
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	SCU

TABLE 5. Storage Commitment SOP Class

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

TABLE 6. Modality Worklist Management SOP Class

SOP Class Name	SOP Class UID	Role
Modality Worklist Information Model-FIND	1.2.840.10008.5.1.4.31	SCU

TABLE 7. Modality Performed Procedure Step SOP Class

SOP Class Name	SOP Class UID	Role
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	SCU

4.2. Association Establishment Policies

4.2.1. General

The default PDU size is 32768 8-bit bytes unless a lower maximum is specified by the receiver during association negotiation, in which case the value negotiated will be used. Note that the peer must negotiate at least a maximum of 128 bytes.

4.2.2. Number of Associations

Multiple associations can be opened for the same or different types of transactions. The maximum number of simultaneous associations is 10.

It is possible to configure the Sequoia to allow only serial associations with a Store SCP that does not support overlapping associations.

4.2.3. Asynchronous Nature

This implementation does not support Asynchronous operation.

4.2.4. Implementation Identifying Information

This implementation will be identified by

- Implementation Class UID = 1.2.840.113680.15.1
- Implementation Version Name = DS<version>

4.2.5. Calling and Called AE Titles

The SCU Calling AE Title is pre-configured at the installation time to be:

- SEQUOIA_serial#

This is modifiable in the Sequoia configuration if necessary.

The “Called AE Title” is used by a SCP. This Sequoia release does not contain a SCP, (except in its role reversal in the Storage Commitment SOP Class).

4.3. Association Initiation Policy

This implementation will initiate the association in the following manner.

- The Verification SCU opens one association.
It is closed at the end of the transaction.
- The Storage SCU will open a variable number of associations in background storage modes. There is one association in bulk storage mode per one or more studies.
- The Storage Commitment SCU and the subsequent SCP opens one association each in background storage modes. There is one association in bulk storage mode.
- The Print SCU opens one association per film session.

4.3.1. Proposed Presentation Context

TABLE 7. Proposed Presentation Contexts for Sending Data/Request

Presentation Context (SCU)					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP	UID	Name List	UID List		
Tables 1~4	Tables 1~4	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Image	Table 2	RLE Lossless Image	1.2.840.10008.1.2.5	SCU	None
Multi-frame Ultrasound	Table 2	JPEG Baseline	1.2.840.10008.1.2.4.50	SCU	None

4.3.2. SOP Specific Conformance of SCU

4.3.2.1. Storage SOP Classes: Presentation Contexts

The Image Export AE is implemented in such a way that it negotiates with the peer AE the 5 possible presentation contexts as listed in Table 8 during the association.

It selects the SOP Class UID according to the scheme in Table 9. It composes one presentation context for exporting single frame images and one for multi-frame ones based on the selected SOP Class UID and Table 8.

TABLE 8. Storage SCU SOP Class UID Selection Scheme

Image Type	Selection Order: SOP Class UID
Single Frame Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1 (new) 1.2.840.10008.5.1.4.1.1.6 (retired) 1.2.840.10008.5.1.4.1.1.7 (Secondary Capture)
Multi-frame Ultrasound Image	1.2.840.10008.5.1.4.1.1.3.1 (new) 1.2.840.10008.5.1.4.1.1.3 (retired)

TABLE 9. Storage SCU Presentation Context Selection Scheme

Image Type	Selection Order: SOP Class UID
1.2.840.10008.5.1.4.1.1.6.1	1.2.840.10008.1.2.5 (RLE) 1.2.840.10008.1.2 (Implicit VR Little Endian)
1.2.840.10008.5.1.4.1.1.6	1.2.840.10008.1.2.5 (RLE) 1.2.840.10008.1.2 (Implicit VR Little Endian)
1.2.840.10008.5.1.4.1.1.3.1	1.2.840.10008.1.2.4.50 (JPEG Baseline) 1.2.840.10008.1.2 (Implicit VR Little Endian)
1.2.840.10008.5.1.4.1.1.3	1.2.840.10008.1.2.4.50 (JPEG Baseline) 1.2.840.10008.1.2 (Implicit VR Little Endian)
1.2.840.10008.5.1.4.1.1.7	1.2.840.10008.1.2 (Implicit VR Little Endian)

Sequoia sends SOP class UID and transfer syntax UID pairs to negotiate for the supported presentation contexts, i.e.,

- SOP class UID 1 and Transfer Syntax UID 1
- SOP class UID 1 and Transfer Syntax UID 2
- SOP class UID 2 and Transfer Syntax UID 1
- ...

This may pose problems to servers that can only recognize the following method of grouping:

- SOP class UID 1 and Transfer Syntax UID 1, Transfer Syntax UID 2
- SOP class UID 2 and Transfer Syntax UID 1, ...

4.3.2.2. Storage SOP Classes: Photometric Interpretation

Photometric Interpretation, i.e., color mode of the pixel image data, is not a negotiable parameter in DICOM 3.0.

This implementation exports color images in RGB mode and grayscale images in Monochrome 2 if the peer AE only accepts uncompressed Implicit VR Little Endian transfer syntax. It is also possible to manually configure the ultrasound system to export color images as Monochrome 2.

If the peer AE accepts either RLE or JPEG compression transfer syntax, images are exported in a YBR color mode (see Table 10).

TABLE 10. Photometric Interpretation of Exported Images

Ultrasound Image SOP Class UID	Transfer Syntax and UID	Image Content	User Config	Photometric Interpretation
Single-frame: 1.2.840.10008.5.1.4.1.1.6.1 1.2.840.10008.5.1.4.1.1.6 1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian 1.2.840.10008.1.2	B/W	n/a	MONOCHROME2
Multi-frame: 1.2.840.10008.5.1.4.1.1.3.1 1.2.840.10008.5.1.4.1.1.3		Color	B/W	MONOCHROME2
			RGB	RGB
Single-frame: 1.2.840.10008.5.1.4.1.1.6.1	RLE Lossless Image Compression 1.2.840.10008.1.2.5	B/W or Color	B/W or RGB	YBR_FULL
Multi-frame: 1.2.840.10008.5.1.4.1.1.3.1	JPEG Baseline Compression 1.2.840.10008.1.2.4.50	B/W or Color	B/W or RGB	YBR_FULL_422

4.3.2.3. Storage SOP Classes: DICOM IOD Specification

This implementation uses DICOM 3.0 Part 3 and Supplement 5 as the DICOM Image IOD specification. All Type 1 and 2 elements specified in the DICOM 3.0 standard are encoded and exported. Some Type 3, 1C and 2C elements are also exported.

Private elements are also exported if the Storage SCP has been configured in the Sequoia system to accept private elements (0009,xxxx) and (7FDF,xxxx).

4.3.2.4. Print SOP Class

The Sequoia DICOM configuration tool has several pre-defined printer templates which can be used to reduce the possibility of an unsupported printer configuration. Additionally, the tool allows the user to customize some printer parameters as listed in Table 11. The actual allowable values for a printer should be determined by reading its DICOM 3.0 Conformance Statement.

Sequoia will automatically negotiate for grayscale printing if the printer does not support color printing (Photometric Interpretation). None of the other print parameters are negotiable as per the DICOM 3.0 standard. For example, if a Display Format is customized, but the printer does not support it, images will not be printed.

Once printers are installed, the user can re-select the routing of color and grayscale images. The user can also change image display formats, film size, and film media between studies by using the “Define Printers” setup.

TABLE 11. User Configurable Print Parameters

(Default Template values are in **BOLD**. There is variability in customizing many of these parameters, depending on which printer template is selected in the network printer configuration and what parameter options a printer model supports.)

Parameter	Tag	Editable Values
Number of Copies	2000,0010	1 or more
Print Priority	2000,0020	LOW MED HIGH
Film Medium Type	2000,0030	PAPER BLUE FILM CLEAR FILM
Min Density	2010,0120	0 or higher
Max Density	2010,0130	350 or lower
Display Format	2010,0010	STANDARD\1,1 STANDARD\1,2 STANDARD\2,2 STANDARD\2,3 STANDARD\3,2 STANDARD\3,5 STANDARD\4,6 STANDARD\4,5 STANDARD\5,6
Film Orientation	2010,0040	PORTRAIT LANDSCAPE
Film Size ID	2010,0050	8INX10IN 14INX17IN 10INX12IN 10INX14IN 11INX14IN 14INX14IN 24CMX24CM 24CMX30CM
Photometric Interpretation	0028,0004	RGB (Color) MONOCHROME2 (B/W)
Border Density	2010,0100	BLACK
Empty Image Density	2010,0110	BLACK
Trim	2010,0140	ON or off

TABLE 12. Other Supported Print SOP Class Parameters

Parameter	Tag
Referenced Film Session Sequence	2010,0500
>Referenced SOP Class UID	0008,1150
>Referenced SOP Instance UID	0008,1155
Basic Grayscale Image Sequence	2020,0110
Basic Color Image Sequence	2020,0111
Image Position	2020,0010
Polarity	2020,0020
Samples per Pixel	0028,0002
Rows	0028,0010
Columns	0028,0011
Pixel Aspect Ratio	0028,0034
Bits allocated	0028,0100
Bits Stored	0028,0101
High Bit	0028,0102
Pixel Representation	0028,0103

4.4. Storage Commitment

TABLE 13. N-ACTION Request

Description/Module	Tag	Value Description
Transaction UID	(0008,1195)	Valid UID
Referenced SOP Sequence	(0008,1199)	
>Referenced SOP Class UID	(0008,1150)	Class UID of each object stored
>Referenced SOP Instance UID	(0008, 1155)	UID for each Primary Image

4.5. Modality Worklist SOP Class Filtering and Requested Elements

TABLE 14. Filtering Query Elements

Description/Module	Tag	Value Range
Scheduled Procedure Step Sequence	(0040, 0100)	
>Scheduled Procedure Step Start Date ^a	(0040, 0002)	Today Tomorrow 3 days 1 week All
>Scheduled Procedure Step Start Time	(0040, 0003)	0-235900
>Modality ^b	(0008, 0060)	US null
>Scheduled station AE title ^b	(0040, 0001)	This system only null
Accession Number	(0008, 0050)	
Patient's Name	(0010, 0010)	
Patient's ID	(0010, 0020)	

a. The date/range internally is in DICOM format, e.g., 19980510.

b. Modality and Scheduled Station AE Title filtering is configurable.

TABLE 15. Request to Return Elements

Description/Module	Tag
Scheduled Procedure Step	
Study Instance UID	(0020,000d)
Scheduled Procedure Step Sequence	(0040, 0100)
>Modality	(0008, 0060)
>Scheduled Station AE title	(0040, 0001)
>Scheduled Procedure Step Start Date	(0040, 0002)
>Scheduled Procedure Step Start Time	(0040, 0003)
>Scheduled Performing Physician's Name	(0040, 0006)
>Scheduled Procedure Step Description ^a	(0040, 0007)
>Scheduled Procedure Step ID	(0040, 0009)
>Comments on the Scheduled Procedure Step	(0040, 0400)
Requested Procedure	
Requested Procedure ID	(0040, 1001)
Reason for Requested Procedure	(0040, 1002)
Requested Procedure Description	(0032, 1060)
Image Service Request	
Accession Number	(0008, 0050)
Referring Physician's Name	(0008, 0090)
Patient Identification	
Patient's Name	(0010, 0010)
Patient's ID	(0010, 0020)
Patient Other ID	(0010, 1000)

TABLE 15. Request to Return Elements (cont'd)

Description/Module	Tag
Patient Comments	(0010, 4000)
Patient Demographic	
Patient's Birth Date	(0010, 0030)
Patient Sex	(0010, 0040)
Patient Size	(0010, 1020)
Patient Weight	(0010, 1030)
Patient Last Menstrual Date	(0010,21d0)

a. Scheduled Procedure Step Description (0040, 0007) is “Study Type” in the Sequoia Begin (patient demographic) page. The Sequoia system has a pre-defined list of study types. A site can customize this list so that the Sequoia and HIS/RIS lists match.

4.6. Modality Performed Procedure Step

TABLE 16. N-CREATE Service Request (Study Start with first image capture)

Description/Module	Tag	Value Description
Scheduled Procedure Step		
Scheduled Step Attribute Sequence	(0040,0270)	
>Study Instance UID	(0020, 000D)	a
>Referenced Study Sequence	(0008, 1110)	null
>Accession Number	(0008, 0050)	a
>Requested Procedure ID	(0040, 1001)	a
>Requested Procedure Description	(0040, 0001)	a
>Scheduled Procedure Step ID	(0040, 0009)	a
>Scheduled Procedure Description	(0040, 0007)	a
>Scheduled Action Item Code Sequence	(0040, 0008)	null
Patient's Name	(0010, 0010)	
Patient's ID	(0010, 0020)	
Patient's Birth Date	(0010, 0030)	
Patient Sex	(0010, 0040)	
Referenced Patient Sequence	(0008,1120)	null
Performed Procedure Step Information		
Performed Procedure Step ID	(0040,0253)	
Performed Station AE Title	(0040,0241)	
Performed Station Name	(0040,0242)	
Performed Location	(0040,0243)	null
Performed Procedure Step Start Date	(0040,0244)	
Performed Procedure Step Start Time	(0040,0245)	
Performed Procedure Step Status	(0040,0252)	"INPROGRESS"
Performed Procedure Step Description	(0040,0254)	null
Performed Procedure Type Description	(0040,0255)	null
Procedure Code Sequence	(0008,1032)	null
Performed Procedure Step End Date	(0040,0250)	null
Performed Procedure Step End Time	(0040,0251)	null
Image Acquisition Results		
Modality	(0008,0060)	
Study ID	(0020,0010)	
Performed Action Item Code Sequence	(0040,0260)	null
Performed Series Sequence	(0040,0340)	null

a. Uses relevant attributes from the Modality Worklist when available.

TABLE 17. N-Set Service Request (Study End)

Description/Module	Tag	Value Description
Performed Procedure Step Information		
Performed Procedure Step Status	(0040,0254)	“COMPLETED” or “DISCONTINUED”
Performed Procedure Step End Date	(0040,0250)	
Performed Procedure Step End Time	(0040,0251)	
Image Acquisition Results		
Performed Series Sequence	(0040,0340)	
>Performing Physician’s Name	(0008,1050)	null
>Protocol Name	(0018,1030)	“NONE”
>Operator’s Name	(0008,1070)	
>Series Instance UID	(0020,000E)	
>Series Description	(0008,103E)	
>Retrieve AE Title	(0008,0054)	null
>Referenced Image Sequence	(0008,1140)	One for each clip/image
>>Referenced SOP Class UID	(0008,1150)	
>>Referenced SOP Instance UID	(0008,1155)	
>Referenced Stand-alone SOP Sequence	(0040,0220)	One for each SR Object
>>Referenced SOP Class UID	(0008,1150)	
>>Referenced SOP Instance UID	(0008,1155)	

4.7. Association Acceptance Policy

This implementation, in a role reversal, accepts an association request from the Storage Commitment SCP. It does not support other association requests.

4.8. Communication Profile

This implementation supports TCP/IP Protocol stack. OSI stack is not supported.

A DICOM 50-pin physical connection is not supported.

This implementation is indifferent to the underlying physical medium. It only requires TCP/IP in the Transport and Network layers.

5. Removable Media Interchange Specifications

This implementation supports two 3.5” DICOM MOD removable media. It conforms to DICOM 3.0 Part 10, 11 and 12.

5.1. Supported SOP Classes

This implementation provides standard conformance to the following DICOM 3.0 SOP classes:

TABLE 18. Media Storage SOP Classes

SOP Class Name	SOP Class UID	Role
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	FSC
Multi-frame Ultrasound Image	1.2.840.10008.5.1.4.1.1.3.1	FSU
DICOM Media Storage Directory	1.2.840.10008.1.3.10	FSR

5.1.1. Proposed Media Interchange Transfer Syntaxes

TABLE 19. Proposed Transfer Syntaxes for Media Interchange

Presentation Context (SCU)			
Abstract Syntax		Transfer Syntax	
SOP	UID	Name List	UID List
Ultrasound Image	Table18	RLE Lossless Image Compression	1.2.840.10008.1.2.5
Multi-frame Ultrasound	Table18	JPEG Baseline Compression	1.2.840.10008.1.2.4.50
Ultrasound Image & Multi-frame Image	Table18	Explicit VR Little Endian	1.2.840.10008.1.2.1
Structured Report	Table 3	Explicit VR Little Endian	1.2.840.10008.1.2.1

5.1.2. Physical Storage Media and Format

The physical storage media supported are 90mm (3.5”) 128MB, 230MB, and 540MB preformatted magneto-optical disks. The Sequoia disk driver uses a PC (DOS) file system format.

Some Sequoia systems may have 640MB disk drive hardware. If a preformatted 640MB disk is inserted in one of these drives, it will be recognized. Studies can be written to and read from this disk. However, the sector size of 640MB disks is currently not DICOM compliant and is also incompatible with 230MB drives. Disk incompatibilities between Sequoia systems with smaller 230MB drives in a multi-system ultrasound department can occur. Smaller disk drives will not mount the 640MB MOD. A 640MB disk will not be recognized on Aspen or Cypress systems as well.

6. Data Identification Information

Patient and image data originated from an Sequoia system can be identified by the Study Instance UID, Series Instance UID and SOP Instance UID, i.e., DICOM elements (0020, 000D), (0020, 000E) and (0008, 0018) in the IOD.

- Sequoia UID root is 1.2.840.113680.1.103
where:
1.2.840.113680 is the ANSI registered Acuson UID root.
- The Study Instance UID is composed using the following convention:
1.2.840.113680.1.103.n.s.t
where
n = serial number of the Sequoia machine
s = the UNIX epoch based time since a base time in seconds
t = microsecond within the second of current UNIX epoch-base time
- The Series Instance UID is composed of the Study Instance UID and the series number:
1.2.840.113680.1.103.n.s.t.r
where
r = 1 for full-screen static and dynamic and quarter-size static images
r = 2 for quarter-screen dynamic image
- The SOP Instance UID is composed of the Series Instance UID and the image number:
1.2.840.113680.1.103.n.s.t.r.f
where
f = image number

7. Extensions, Specializations and Privatizations

7.1. Private DICOM and Acuson Elements

There are many DICOM Private and Acuson Private tags used in Acuson proprietary files internal to Acuson software for image acquisition and image review on the Sequoia system and in the private Structured Report SOP object.

These can be exported to servers as part of the Store SCU AE configuration on the Sequoia system. They are also exported to removable MOD with DICOM FSC, FSR, and FSU:

- ACQ_SET file: acquisition protocol and acquired image set information.
DICOM Private Elements, primarily (0009,xxxx)
- DSP_SET file: image set selected for display.
- CLIPS/IMAGES: Acuson image data
Acuson private elements (7FDF, xxxx) in “Explicit VR Big Endian” file format
- CALC_SR: Acuson measurements, calculations and findings for Cardiac, OB, and Vascular reports.
Various Acuson private, LOINC, and SNOMED elements
(The SR object is always stored if successfully negotiated in the Association negotiation.)

8. Configuration

The Sequoia Service User Interface database maintains configuration parameters for remote and local DICOM Application Entities. The parameters include:

- AE identification, i.e., a descriptive name
- Calling AE Title, IP address, and TCP port number (for Sequoia DICOM SCU)
- Called AE Title (for a remote SCP)
- TCP port number (for a remote SCP)
- IP address or host name (for a remote host where the remote SCP resides)
- DICOM print parameters for a DICOM print SCP entry
- Printer templates
- Some specialized information

This configuration database can be copied to other Sequoia machines on the network via a MO disk.

The local DICOM applications read information from this database. The DICOM Network configuration tool is the only application that can modify this database.

9. Support of Extended Character Sets

The following character set is supported:

ISO-IR 100 Latin Alphabet No. 1