

Siemens Medical Systems, Inc.
Ultrasound Group

SONOLINE Elegra Product Platform: DICOM Conformance Statement

Revision: 04
Software 4.3 Release

The information provided herein is proprietary work produced by Siemens Medical Systems, Inc., Ultrasound Group. Any reproduction, disclosure, or use of this material in whole or in part not authorized in writing is prohibited and is in violation of the rights of Siemens Medical Systems, Inc.

Siemens Medical Systems, Inc. Ultrasound Group

1. Introduction	4
1.1 DICOM AND THE SONOLINE ELEGRA PLATFORM PRODUCTS	4
2. Implementation Model	5
2.1 APPLICATION DATA FLOW DIAGRAM	5
2.1.1 Store to Disk	5
2.1.2 Copy To	6
2.1.3 Print 1 and Print 2	6
2.1.4 Print To.....	6
2.1.5 Worklist.....	6
2.2 AE FUNCTIONAL DEFINITION	9
2.2.1 Store real-world activities	9
2.2.2 Print real-world activities	9
2.2.3 Worklist real-world activity.....	9
2.3 SEQUENCING OF REAL-WORLD ACTIVITIES	9
3. AE Specifications	10
3.1 ELEGRA AE SPECIFICATION	10
3.1.1 Association Establishment Policies	10
3.1.1.1 General.....	10
3.1.1.2 Number of Associations	10
3.1.1.3 Asynchronous Nature	11
3.1.1.4 Implementation Identifying Information.....	11
3.1.2 Association Initiation by Real-World Activities	11
3.1.2.1 Real World Activity – Store	11
3.1.2.1.1 Associated Real World Activities	12
3.1.2.1.2 Proposed Presentation Context	12
3.1.2.1.1.1 SOP Specific Conformance to Storage Service SOP Classes.....	13
3.1.2.1.1.2 Error Handling	15
3.1.2.2 Real World Activity - Print.....	17
3.1.2.2.1 Associated Real World Activities	17
3.1.2.2.2 Proposed Presentation Context to a Grayscale Print Server	17
3.1.2.2.2.1 SOP Specific Conformance to Basic Grayscale Print Management Meta SOP Class	18
3.1.2.2.3 Proposed Presentation Context to a Color Print Server.....	22
3.1.2.2.3.1 SOP Specific Conformance to Basic Color Print Management Meta SOP Class	22
3.1.2.2.4 Error Handling	23
3.1.2.3 Real World Activity - Worklist.....	24
3.1.2.3.1 Proposed Presentation Context	24
3.1.2.3.1.1 SOP Specific Conformance to Modality Worklist Service SOP Classes	24
3.1.2.3.1.2 Error Handling	27
4. Communication Profiles	28
4.1 TCP/IP STACK SUPPORTED	28
4.1.1 Physical Media Supported.....	28
5. Extensions/Specializations/Privatizations	28
5.1 STANDARD EXTENDED/SPECIALIZED/PRIVATE SYNTAXES	28
5.2 PRIVATE TRANSFER SYNTAXS	28
6. Configuration	29

Siemens Medical Systems, Inc.
Ultrasound Group

6.1 BASIC SYSTEM CONFIGURATION	29
6.1.1 <i>Organization Name</i>	29
6.1.2 <i>Department Name</i>	29
6.1.3 <i>System Location</i>	29
6.2 DICOM NETWORK CONFIGURATION	29
6.2.1 <i>Local</i>	30
6.2.2 <i>Remote</i>	30
6.3 DICOM STORE CONFIGURATION	30
6.4 DICOM WORKLIST CONFIGURATION.....	30
6.5 DICOM PRINT CONFIGURATION	31
6.6 EXAM TYPES CONFIGURATION	33
6.7 EXTERNAL EQUIPMENT CONFIGURATION	33
7. Support of Extended Character Sets	33
8. References	33
9. Glossary	33

Siemens Medical Systems, Inc. Ultrasound Group

1. Introduction

This document describes the conformance to the ACR-NEMA DICOM 3.0 Standard by the SONOLINE® Elegra ultrasound system from Siemens Medical Systems, Inc. Ultrasound Group. It shall establish the conformance specifications for this system only, and does not apply to other products offered by Siemens Medical Systems, or its affiliates.

The SONOLINE Elegra system is a device that generates ultrasound images and other data that can be sent using DICOM standard protocols and definitions to centralized network archive servers, printers, and workstations.

1.1 DICOM and the SONOLINE Elegra platform products

The DICOM standard provides a well-defined set of structures and protocols that allow inter-operability to take advantage of distributed services offered by a wide variety of medical imaging devices.

When configured with the DICOM option, the SONOLINE Elegra system provides support for essential services related to ultrasound scanning and connectivity to DICOM compliant devices. SONOLINE Elegra system products will not support all features supported by the DICOM standard. This document clearly states the DICOM services and data classes that are supported by the applications included with the SONOLINE Elegra. The intent of this document is to allow users and other vendors who also support the DICOM standard to exchange information within the specific context of those elements of the DICOM standard that SONOLINE Elegra system supports.

This document is written with respect to the adopted portions of the DICOM standard, Revision 3.0. The outline of the following sections of this document follows the outline specified in the DICOM Standard NEMA publication PS3.2.¹

¹ Second part of the DICOM standard: NEMA Standards Publication PS 3.2-1998, Digital Imaging and Communications in Medicine (DICOM), Part 2: Conformance

2. Implementation Model

SONOLINE Elegra system users can store images and other data directly on the Elegra system hard disk, a DICOM archive server or workstation on a network, as well as sending images to a DICOM printer or print server on a network. The user can also query a DICOM Worklist server for a list of scheduled patient procedures. In the following sections, SONOLINE Elegra system real world activities are indicated by “Real World Activity” name while “ELEGRA AE” indicates the invoked Application Entity. Similarly, the activities associated with service providers are indicated as “Real World Service Activity”.

2.1 Application Data Flow Diagram

The diagram shown in Figure 2.1 represents the SONOLINE Elegra system’s Application Entity (AE) which is shown in the box. Relationships between user invoked activities (in the circles at the left of the AE) and the associated real-world activities provided by DICOM service providers (in the circles on the right side of the diagram) are shown.

The user selects “**New Patient**” at the start of each new patient examination. Selecting either “**End Exam**” or “**New Patient**” ends the previous exam. An End Exam message is presented to the Elegra AE and the associations to all DICOM open devices are closed.

2.1.1 Store to Disk

To invoke the DICOM Store, the user selects “Store to Disk” (a SONOLINE Elegra system real world activity) during a patient exam. This causes the image currently displayed on the Ultrasound screen to be captured and sent to a DICOM device on the network. The destination device (attached to the “Store to Disk” key) is selected through System Presets by choosing from list of available DICOM devices on the network. Image types are identified on the SONOLINE Elegra system to assure that the appropriate image attributes are sent to the server. In order to assure the selected server is on line and able to perform the desired service a network PING (Packet Internet Groper) function is invoked.

Captured images can be transmitted to the selected STORE destination immediately after capture or all images for an exam can be held and transmitted at the end of exam. This can be configured on a per device basis through the User Presets.

Siemens Medical Systems, Inc.
Ultrasound Group

2.1.2 Copy To

The user can also select “Copy To”, another SONOLINE Elegra Real World Activity, to copy one or more selected exams or individual images from the Elegra’s hard disk to a pre-configured DICOM server. “Copy To” is available through the Manage Records function.

2.1.3 Print 1 and Print 2

The user may either select the desired network grayscale or color printer server using the User Presets function. In Presets, a desired printer is assigned to either the “PRINT 1” or “PRINT 2” hard key. The Presets function is also used to define the configuration of the DICOM Print Service Provider. In order to assure the selected print server is on line and able to perform the desired service a ping function is invoked. Image format on the hardcopy is determined from the format described in the Presets function.

To invoke the Print Real World Activity, the user selects the “PRINT 1” or “PRINT 2” hard key real world activity during the review of the exam which subsequently causes the system to send the displayed image to a network grayscale or color printer. Print images are sent immediately after the hard key is pressed.

2.1.4 Print To

After an image exam is complete, the user has the ability to Print images stored on the hard drive using the Manage Records function. Invoking the “Print To” Real World activity invokes the DICOM Print activity for selected exams or individual images. “Print To” is available through the Manage Records function.

Image types are identified on the Elegra system to assure that the appropriate image attributes are sent to the server, invoking real world activities on the Elegra system to cause grayscale images or image sequences, or color images or image sequences to be printed.

2.1.5 Worklist

Patient registration can be automated by using the Worklist Real World Activity. Selecting the “Worklist” button (located at the bottom of the Patient Data screen) causes the Elegra to query the active DICOM Worklist server for a list of scheduled patient procedures. The Worklist displays Ultrasound procedures scheduled for today or tomorrow. The search starts with exams scheduled for today. If no matching exams are found the search is expanded to include today and tomorrow. The user can narrow the search by entering search criteria in key fields in the Patient Data screen, before pressing the Worklist button. Key fields are:

Siemens Medical Systems, Inc.
Ultrasound Group

1. Patient Name (last and first only) - wild card
2. Patient ID - single value only
3. Accession number- single value only

The search attempts to find all matching patients using the information from the above fields. Patient name fields that are partially filled or empty are treated as though an implicit wild card was appended to the end of the field. Patient ID and Accession number is exact match only. If only one matching patient is found in the query, the patient data fields are immediately populated using the returned information. If no matches are found, a message is presented to the user indicating so. If more than one matching patient is found, a pick list of patient procedures is presented for the user to select from. Each of the fields in the list can be sorted, in ascending or descending order. The list contains:

1. Patient Name
2. Patient ID
3. Accession number
4. Scheduled Exam Date & Time

The user has the option to select a patient procedure, or cancel the operation. Selecting a patient from the list causes all demographic information for that patient to be loaded into the patient data fields. The list is limited to 75 entries. If more than 75 matching records are found in query, the user is prompted to limit the search by entering additional search criteria.

SONOLINE Elegra Local Processes

Remote Processes

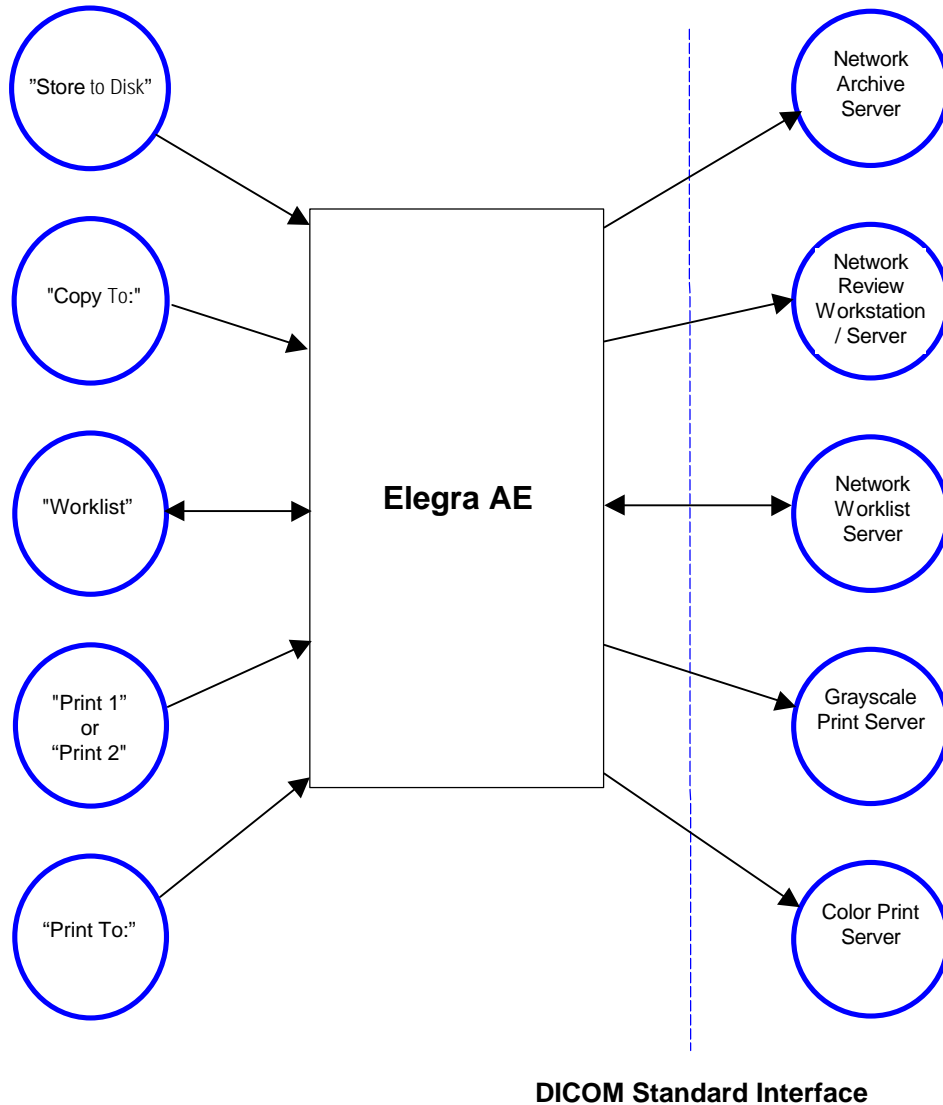


Figure 2.1 - Implementation Model

There are three local real-world activities that occur in the Elegra - Image Store, Image Print and Worklist Query. All DICOM activities are handled in a queued manner by a single Application Entity (Elegra AE) running on the ultrasound system. A single user-configurable AE title is used for all DICOM Store, Print, and Worklist operations.

Siemens Medical Systems, Inc. Ultrasound Group

Image store and print operations are initiated by the user via console keys; “Store to Disk”, “Print 1” and “Print 2”. All images are first spooled to the system hard disk and then sent to their destination device. Destination devices are configured through the Elegra’s System Presets. Image Store and Print operations can also be initiated via the “Manage Patient Records” menu, utilizing the “Copy to:” or “Print To:” function. If the system is removed from the network (i.e. a portable exam), image store and print requests remain queued and are executed when the network connection is restored.

The user initiates a Worklist query, by selecting the “Worklist” button. The user can enter any combination of Patient Name, ID and Accession Number, to be used as search criteria in the Worklist query.

2.2 AE Functional Definition

2.2.1 Store real-world activities

The Elegra application entity performs all of the functions to transmit ultrasound image and associated data to network servers and/or workstations. The Elegra AE supports the Ultrasound Image Storage SOP class in the role of an SCU. The AE initiates separate associations to the store servers, verifying their on-line status when the user selects “Store to Disk” or “Copy To”.

2.2.2 Print real-world activities

The Elegra AE provides all aspects of the Print Management SCU. The AE initiates separate associations to the print servers, verifying their on-line status when the user selects “Print 1”, “Print 2” or “Print To”. The Elegra AE accommodates both grayscale and color print servers.

2.2.3 Worklist real-world activity

The Elegra AE supports the DICOM Basic Worklist Management Service as an SCU. The AE initiated an association to the active Worklist server when a Worklist query is selected (via the “Worklist” button). The association is closed upon the completion of each query. A maximum of 75 matching results is accepted, at which point, the ELEGRA AE issues a C-FIND-CANCEL request.

2.3 Sequencing of real-world activities

In order for any of the remote processes to be able to provide the Real World Activity (RWA) SCP services which the SONOLINE Elegra system, an SCU, has requested, the appropriate associations must have been previously opened. This initiation occurs with the “Store to Disk” and “Copy To:” for image store operations, “Print 1”, “Print 2” and “Print To:” for image printing operations and “Worklist” for Worklist query operations. There are no other sequencing requirements.

Siemens Medical Systems, Inc.
Ultrasound Group

3. AE Specifications

The following specifications apply to the AE as depicted in Figure 2.1.

3.1 Elegra AE Specification

The Elegra AE provides conformance to the following DICOM Service SOP Classes as an SCU:

Table 3.1-1 Supported SOP Classes

Service SOP Class Name	SOP Class UID
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1
Printer SOP Class	1.2.840.10008.5.1.1.16
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31

3.1.1 Association Establishment Policies

3.1.1.1 General

The SONOLINE Elegra system uses TCP/IP. The Maximum Length PDU negotiation is included in all association establishment requests. The maximum length PDU offered for an association initiated by Elegra is:

- Maximum PDU Offered: 16k

The following DICOM Application Context Name UID is proposed and recognized:

- Application Context Name: "1.2.840.10008.3.1.1.1"

3.1.1.2 Number of Associations

The maximum number of simultaneous associations for the Elegra AE is 5 associations, one for each of the following Real-World Activities:

- Store to Disk

Siemens Medical Systems, Inc.
Ultrasound Group

- Print 1
- Print 2
- Copy To: or Print To:
- Worklist

3.1.1.3 Asynchronous Nature

All associations use the default synchronous mode of operation. Asynchronous Operations Window negotiations are not supported on the Elegra.

3.1.1.4 Implementation Identifying Information

- Implementation Class UID: "1.3.12.2.1107.5.5.1" (See below).
- Implementation Version Name: "SMSUG-vQ4.3" (where vQ4.3 is the Software release version).

Siemens has provided registration for all Siemens Medical Systems Groups. This unique Class UID is defined as: "1.3.12.2.1107.5.5.product"

Where the interpretation is:

1. = International Standards Organization (ISO)

3. = International branch of ISO

12.2.1107.5. = Assigned to Siemens-UB MED

5. = Ultrasound Modality (SMS-UG)

Product = 1 = First SMS-UG product to support DICOM (e.g. SONOLINE ELEGRA)

3.1.2 Association Initiation by Real-World Activities

3.1.2.1 Real World Activity – Store

The user selects "New Patient" at the start of each new patient examination. When images are transferred to a DICOM Store SCP, the system establishes an association between the Elegra AE and the identified DICOM device (i.e. Network Archive Server, Review Workstation Server)

The Elegra system can be configured to send images individually, as they are acquired during the exam (In Progress Review), or to send all images at the end of the exam. If the system is configured to send images during the exam, an association is opened when the first Store to Disk operation occurs. The association remains open for the entire exam and is closed when the user selects either "End Exam" or "New Patient".

Siemens Medical Systems, Inc.
Ultrasound Group

If the system is configured to send images at the End of Exam, an association is opened and all images acquired during the exam are transferred when the user selects either “End of Exam” or “New Patient”. After all images are transferred, the association is closed.

3.1.2.1.1 Associated Real World Activities

An association is established when the user initiates a “Copy To” operation from the Manage Records screen. Individual images or entire exams can be transferred to the selected DICOM Store device. The association is opened when the first image of each exam is transferred and closed when the last image transfer is complete.

An association is also opened after a network outage and images are queued to be stored or when the system is powered-on and images are queued to be stored. After all images have been stored, the association is closed.

3.1.2.1.2 Proposed Presentation Context

The following Presentation Context(s) is presented to the SCP in an A-Associate request for DIMSE C-STORE storage services. The storage services utilize C-STORE services, whose parameters are defined in PS 3.7 (Table 9.1-1).

The following Presentation Context applies to both “Store to Disk” and “Copy To:” Real World Activities.

Table 3.1.2.1.1-1 Store Presentation Context Table

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Ultrasound Image Storage	1.2.840. 10008.5.1.4 .1.1.6	DICOM Implicit VR Little Endian	1.2.840. 10008.1.2	SCU	None

The SONOLINE Elegra system always acts as an SCU and is the client in a client-server model. For simplicity, since all DICOM providers must support ***implicit VR Little Endian as the default syntax (see PS 3.5 page 36 of the DICOM standard)***, the Implicit VR Little Endian syntax is the only format supported. Compression syntaxes are not supported at this time.

Siemens Medical Systems, Inc.
Ultrasound Group

3.1.2.1.1.1 SOP Specific Conformance to Storage Service SOP Classes

The Store RWA provides standard extended conformance as an SCU for the following standard Storage Service Class SOP:

Table 3.1.2.1.1.1-1 Supported SOP Classes

Service SOP Class Name	SOP Class UID	Conformance Level
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6	Standard Extended

This is accomplished through the use of the DIMSE C-STORE Service to whom the SCU issues a service request with an SOP instance, which meets the requirements of the desired ultrasound IOD.

The following table denotes the attributes included in the Ultrasound Image Object as implemented on the Elegra. Attributes not listed are not used.

Table 3.1.2.1.1.1-2 US Image IOD Attributes used

Module	Attribute	Tag	Notes
Patient	Patient's Name	(0010,0010)	Elegra Patient Data Screen – Last Name, First & MI fields. Default is “Unknown”.
	Patient ID	(0010,0020)	Elegra Patient Data Screen – ID field. Default is today’s date & time (i.e. 9804241022 = Apr 24, 1998 – 10:22am).
	Patient's Birth Date	(0010,0030)	Elegra Patient Data Screen – DOB field. Default is a zero length attribute.
	Patient's Sex	(0010,0040)	Elegra Patient Data Screen – Gender field. M = male F = female. Default is a zero length attribute.
General Study	Study Instance UID	(0020,000D)	
	Study Date	(0008,0020)	Date the exam started.
	Study Time	(0008,0030)	Time the exam started.
	Referring Physician's Name	(0008,0090)	Elegra Patient Data Screen – Physician field.
	Study ID	(0020,0010)	Set to “1”.

Siemens Medical Systems, Inc.
Ultrasound Group

	Accession Number	(0008,0050)	Elegra Patient Data Screen – Accession # field.
	Study Description	(0008,1030)	Elegra Patient Data Screen – Exam Type field (e.g. Liver, Abdomen, etc.). Default is “Unknown”.
Patient Study	Admitting Diagnoses Description	(0008,1080)	Elegra Patient Data Screen – Indications field.
	Patient’s Size	(0010,1020)	Patient height in meters. Default is zero length attribute.
	Patient’s Weight	(0010,1030)	Patient weight in kg. Default is zero length attribute.
General Series	Modality	(0008,0060)	Set to “US”.
	Series Instance UID	(0020,000E)	
	Series Number	(0020,0011)	Set to 1.
	Operator Name	(0008,1070)	Elegra Patient Data Screen – Sonographer Initials (maximum of 3 character).
	Series Description	(0008,103E)	Elegra Patient Data Screen - Exam Type field.
General Equipment	Manufacturer	(0008,0070)	Set to “SIEMENS Ultrasound”
	Institution Name	(0008,0080)	Elegra System Presets – Organization Name field.
	Manufacturers Model Name	(0008,1090)	Set to “Elegra”.
	Station Name	(0008,1010)	Elegra System Presets – System Location field.
General Image	Image Number	(0020,0013)	Image number is series (1 – n)
	Patient Orientation	(0020,0020)	Zero length attribute.
	Image Date	(0008,0023)	Date the image was captured.
	Image Time	(0008,0033)	Time the image was captured.
	Acquisition Number	(0020,0012)	Set to 1.
Image Pixel	Samples per Pixel	(0028,0002)	Monochrome2 = 1, RGB = 3.
	Rows	(0028,0010)	Set to 666.
	Columns	(0028,0011)	Set to 888.
	Bits Allocated	(0028,0100)	Set to 8.
	Bits Stored	(0028,0101)	Set to 8.
	High Bit	(0028,0102)	Set to 7.
	Pixel Data	(7FE0,0010)	
02/18/99	Page 14 of 34		

Siemens Medical Systems, Inc.
Ultrasound Group

	Planar Configuration	(0028,0006)	Color-by-pixel. Only sent if Samples per Pixel is greater than 1.
US Image	Photometric Interpretation	(0028,0004)	RGB – for color images Monochrome2 – for grayscale.
	Pixel Representation	(0028,0103)	0000H = unsigned integer.
	Image Type	(0008,0008)	The Defined Terms for Value 3 are the current Application type (e.g. ABDOMIN, OB, etc).
VOI LUT	Window Center	(0028,1050)	Set to 128.
	Window Width	(0028,1051)	Set to 256.
SOP Common	SOP Class UID	(0008,0016)	Always US Image – 1.2.840.10008.5.1.4.1.1.6
	SOP Instance UID	(0008,0018)	
	Specific Character Set	(0008,0005)	“ISO-IR 100” is sent if system is configured for French or German language, otherwise the attribute is not sent.
	Pixel Spacing	(0028,0030)	See Notes 1 & 2.
	Rescale Intercept	(0028,1052)	Set to 0. (See Note 1)
	Rescale Slope	(0028,1053)	Set to 1. (See Note 1)

Note 1: These attributes are not part of the US Image IOD, and are Standard Extended SOP Class attributes. These attributes are optional (type 3), and their support is not required by SCPs receiving Elegra Images.

Note 2: Pixel Spacing information is only sent for single, full screen, 2d image types (2d image types are: b-mode, b-mode with color, b-mode with power).

3.1.2.1.2 Error Handling

The following table indicates the possible response status codes, which a SCP may return following the SCU's C-STORE-RSP command. Only those status responses that indicate some form of error condition are presented to the user. A successful C-STORE operation will allow the AE to continue to the next action desired by the user.

Siemens Medical Systems, Inc.
Ultrasound Group

Table 3.1.2.1.1.2-1 C-STORE Status Responses

Service Status	Further Meaning	Protocol Codes	Related Fields
Refused	Out of resources.	A7xx	None
Error	Data set does not match SOP Class.	A9xx	None
	Cannot understand.	Cxxx	
Warning	Coercion of data Elements.	B000	None
	Data set does not match SOP Class.	B007	
	Elements discarded.	B006	
Success		0000	None

If the C-STORE operation is not successful, the image(s) are spooled on the Elegra hard drive. Transfer attempts continue at periodic intervals until either a successful completion of the C-STORE operation occurs, or the image(s) are removed from the transfer-waiting list.

All image storage on the Elegra system hard drive is temporary in nature. The oldest transferred exams are automatically deleted to make room for new exams, on a need to basis. If an attempt is made to store images on a full SONOLINE Elegra system hard drive, the system will attempt to delete the oldest transferred exam data. If no deleteable data exists, a "DISK FULL" message is displayed on the SONOLINE Elegra system display. The user must then have to explicitly delete exams not transferred in order to temporarily store additional images.

Siemens Medical Systems, Inc.
Ultrasound Group

3.1.2.2 Real World Activity - Print

The user selects “New Patient” at the start of each new patient examination. When the “Print 1” or “Print 2” key is pressed, an association with the assigned DICOM Printer/Print Server is initiated. The Print keys can be assigned to separate printers, or to the same DICOM print device, with separate configurations (i.e. one key for printing grayscale images and one for printing color images).

A separate association is established by this AE when the first image of a film sheet is transferred. The film sheet is printed and the association is closed when the sheet is full. The association is also closed and the pending film sheet printed when the exam is ended by either “End Exam” or “New Patient”.

3.1.2.2.1 Associated Real World Activities

An association is established when the user initiates a “Print To” operation from the Manage Records screen. Individual images or entire exams can be transferred to the selected DICOM Print device. The association is opened when the first image of each selected exam is transferred and closed when the last image transfer is complete.

An association is opened after a network outage, if images are queued to be printed, or when the system is powered-on and images are queued to be printed.

3.1.2.2.2 Proposed Presentation Context to a Grayscale Print Server

Table 3.1.2.2.2-1 Grayscale Print Presentation Context Table

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Basic Grayscale Print Management Meta SOP Class	1.2.840. 10008.5.1. 1.9	DICOM Implicit VR Little Endian	1.2.840. 10008.1.2	SCU	None

Siemens Medical Systems, Inc.
Ultrasound Group

3.1.2.2.2.1 SOP Specific Conformance to Basic Grayscale Print Management Meta SOP Class

The Print AE provides standard conformance of the grayscale Meta SOP classes as an SCU. Specifically, with respect to the Basic Grayscale Print Management Meta SOP Class this means conformance to the underlying SOP classes:

SOP Class Name	SOP Class UID	Conformance Level
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	Standard
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	Standard
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4	Standard
Printer SOP Class	1.2.840.10008.5.1.1.16	Standard

All mandatory elements of these classes are supported.

3.1.2.2.2.1.1 SOP Specific Conformance to Basic Film Session SOP Class

DICOM specified usage - M = Mandatory; U = User Option

Table 3.1.2.2.2.1.1-1 Supported DIMSE Services for Basic Film Session SOP Class.

Name	Usage	Description
N-Create	M	Creates the Film Session.
N-Set	U	Not used.
N-Delete	U	Not used.
N-Action	U	Not used.

Table 3.1.2.2.2.1.1-2 Supported Basic Film Session SOP Class Elements

Attribute Name	Attribute Tag	Usage	Range	Description
Number of Copies	(2000,0010)	U	1 to 99	Number of requested film copies.
Print Priority	(2000,0020)	U	HIGH, MED, LOW	set at configuration
Medium Type	(2000,0030)	U	PAPER CLEAR FILM BLUE FILM CURRENT TRANSPARENCY	Media used for hardcopy; may be further limited by print vendor/server

Siemens Medical Systems, Inc.
Ultrasound Group

			NONE	
Film Destination	(2000,0040)	U	MAGAZINE PROCESSOR CURRENT	May be further limited by print vendor, and/or print server

3.1.2.2.1.2 SOP Specific Conformance to Basic Film Box SOP Class

Table 3.1.2.2.1.2-1 Supported DIMSE Services for Basic Film Box SOP Class.

Name	Usage	Description
N-Create	M	Creates the Film Box.
N-Set	U	Not used.
N-Delete	U	Deletes the Film Box. Issued after each film is printed.
N-Action	M	PRINT. Sent after each Film Box is filled, and at the end of the exam to force a print of partially filled Film Box.

Table 3.1.2.2.1.2-2 Optional Attributes set for the Basic Film Box SOP Class

Attribute Name	Attribute Tag	Usage	Range	Description
Film Orientation	(2010,0040)	U	PORTRAIT LANDSCAPE	Range may be limited by print server/printer.
Film Size ID	(2010,0050)	U	8INX10IN 14INX17IN 20CMX25CM 35CMX43CM	Range may be limited by print server/printer.
Magnification Type	(2010,0060)	U	REPLICATE BILINEAR CUBIC NONE	Used.
Min Density	(2010,0120)	U	0-99999	Used - printer specific
Max Density	(2010,0130)	U	0-99999	Used - printer specific
Configuration Information	(2010,0150)	U	Limited by Print server/printer.	Used.
Smoothing Type	(2010,0080)	U	Values depend on Printer	Used.
Border Density	(2010,0100)	U	BLACK WHITE i	where i represents the desired image density in hundredths of OD

Siemens Medical Systems, Inc.
Ultrasound Group

Empty Image Density	(2010,0110)	U	BLACK WHITE i	where i represents the desired image density in hundredths of OD
Trim	(2010,0140)	U	YES NO	Used.

3.1.2.2.1.3 SOP Specific Conformance to Basic Grayscale Image Box SOP Class

Table 3.1.2.2.1.3-1 Supported DIMSE Services for the Basic Grayscale Image Box SOP

Name	Usage	Description
N-Set	M	The SCP for each potential image of the film box creates an image box instance. Only those instances, which actually contain images, will be updated with the N-SET message.

Table 3.1.2.2.1.3-2 Optional Attributes set for the Basic Grayscale Image Box SOP Class

Name	Attribute	Range	Description
Polarity	(2020,0020)	NORMAL REVERSE	Intensity mapping between display and print
Magnification Type	(2010,0060)	REPLICATE, BILINEAR, CUBIC, NONE	Used. Note that Magnification Type is always set to the same value as FILM BOX
Smoothing Type	(2010,0080)	Values depend on Printer	Used. Note that Smoothing Type is always set to the same value as FILM BOX

Siemens Medical Systems, Inc.
Ultrasound Group

3.1.2.2.2.1.4 SOP Specific Conformance: Printer SOP Class

Table 3.1.2.2.2.1.4-1 Supported DIMSE Services for the Printer SOP Class

Name	Usage	Description
N-Event-Report	M	Ignored and not handled.
N-Get	U	May be issued by this device at any time to get printer status.

Table 3.1.2.2.2.1.4-2 Supported Printer SOP Class Elements

Name	Usage	Range	Description
Printer Status	U	NORMAL WARNING FAILURE	Only WARNING is reported to the user.
Printer Status Information	U	Vendor specific	Reported to user if printer status = WARNING.
Printer Name	U		Used (not reported to user)
Manufacturer	U		Used (not reported to user)
Model Name	U		Used (not reported to user)
Device Serial Number	U		Used (not reported to user)
Software Versions	U		Used (not reported to user)
Date Last Calibration	U		Used (not reported to user)
Last Calibration	U		Used (not reported to user)

Siemens Medical Systems, Inc.
Ultrasound Group

3.1.2.2.3 Proposed Presentation Context to a Color Print Server

Table 3.1.2.2.3-1 Color Print Server Presentation Context Table

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.2.3.1 SOP Specific Conformance to Basic Color Print Management Meta SOP Class

The Print AE provides standard conformance to the color printing Meta SOP classes as an SCU. Specifically, with respect to the Basic Color Print Management Meta SOP Class this means conformance to the underlying SOP classes:

SOP Class Name	SOP Class UID	Conformance Level
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	Standard
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	Standard
Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1	Standard
Printer SOP Class	1.2.840.10008.5.1.1.16	Standard

3.1.2.2.3.1.1 SOP Specific Conformance to Basic Color Image Box SOP Class

The Basic Color Image Box SOP Class makes identical use of the *Basic Film Session SOP Class*, *Basic Film Box SOP Class* and *Printer SOP Class* elements, which have been previously described, for grayscale image printing. Therefore these will not be described again in this section on color printing. However, it should be noted that certain of the attributes, such as Medium Type which is defined in the Basic Film Session SOP Class, are highly likely to require printer/print server specific media.

Table 3.1.2.2.3.1.1-1 Supported DIMSE Services for the Basic Color Image Box SOP Class

Name	Usage	Description
N-Set	M	The SCP for each potential image of the film box creates an image box instance. Only those instances, which actually contain images, will be updated with the N-SET message.

Siemens Medical Systems, Inc.
Ultrasound Group

Table 3.1.2.2.3.1.1-2 Optional attributes set for the Basic Color Image Box SOP Class

Name	Attribute	Range	Description
Planar Configuration	(0028,0006)	Color-by-plane	Red plane, Green plane, Blue plane.
Polarity	(2020,0020)	REVERSE NORMAL	Used
Magnification Type	(2010,0060)	REPLICATE BILINEAR CUBIC NONE	Used.
Smoothing Type	(2010,0080)	Values depend on Printer	Used.

The Printer SOP Class behavior is identical to that used for grayscale printing.

3.1.2.2.4 Error Handling

Table 3.1.2.2.4-1 Supported Error Codes for Printer Classes

Service Status	Further Meaning	Protocol Codes	
Success	Film accepted for Printing	0000	
Warning	All	B60x	
Failure	Printing not successful	C60x	

Siemens Medical Systems, Inc.
Ultrasound Group

3.1.2.3 Real World Activity - Worklist

A separate Network association is established by the AE for each Worklist query operation, with only one active query at a time. The association is closed at completion of the query.

3.1.2.3.1 Proposed Presentation Context

Table 3.1.2.3.1-1 Worklist Presentation Context Table

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist Information Model – FIND	1.2.840.1000 8.5.1.4.31	Implicit VR Little Endian	1.2.840. 10008.1.2	SCU	None

The SONOLINE Elegra system will always act as an SCU and be the client in a client-server model. For simplicity, since all DICOM providers must support ***implicit VR Little Endian as the default syntax (see PS 3.5 page 36 of the DICOM standard)***, the Implicit VR Little Endian syntax is the only format supported.

3.1.2.3.1.1 SOP Specific Conformance to Modality Worklist Service SOP Classes

The Worklist AE provides conformance to the following DICOM Service SOP Classes as an SCU all at a standard extended level of conformance:

Table 3.1.2.3.1.1-1 Supported SOP Classes

Service SOP Class Name	SOP Class UID	Conformance Level
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Standard Extended

**Siemens Medical Systems, Inc.
Ultrasound Group**

The following table provides the list of attributes requested in the Modality Worklist Query, plus the attributes, which are, conveyed in US images as the result of these queries.

3.1.2.3.1.1-2 Modality Worklist Information Model Attributes

Module	Attribute name	Tag	Match Type	Return Type	Mapped to image	Comments
SOP Common	Specific Character Set	(0008,0005)	--	1C	No	The Elegra ignores this attribute.
Scheduled Procedure Step	Scheduled Procedure Step Sequence	(0040,0100)	SQ	1	No	
	>Scheduled Station AE Title	(0040,0001)	UV	1	No	
	>Scheduled Procedure Step Start Date	(0040,0002)	SV	1	No	
	>Scheduled Procedure Step Start Time	(0040,0003)	UV	1	No	
	>Modality	(0008,0060)	SV	1	No	Always "US"
	>Scheduled Performing Physician	(0040,0006)	UV	2	No	
	>Scheduled Procedure Step Description	(0040,0007)	UV	1C	Yes	Used for Exam Type - returned in image as Study Description, if Study Description is not returned.
	>Scheduled Procedure Step ID	(0040,0009)	UV	1	No	
Requested Procedure	Requested Procedure ID	(0040,1001)	UV	1	No	
	Requested Procedure Description	(0032,1060)	UV	1C	Yes	Used for Exam Type - returned in image as Study Description if Study Description and Scheduled Procedure Step Description are not returned.
	Study Instance UID	(0020,000D)	UV	1	Yes	
Imaging Service Request	Accession Number	(0008,0050)	SV	2	Yes	
	Referring Physician Name	(0008,0090)	UV	2	Yes	

Siemens Medical Systems, Inc.
Ultrasound Group

Patient Identification	Patient's Name	(0010,0010)	WC	1	Yes	
	Patient ID	(0010,0020)	SV	1	Yes	
Patient Demographic	Patient's birth date	(0010,0030)	UV	2	Yes	
	Patient's Sex	(0010,0040)	UV	2	Yes	
	Patient's Size	(0010,1020)	UV	3	Yes	
	Patient's Weight	(0010,1030)	UV	2	Yes	
	Study Description	(0008,1030)	UV	3	Yes	Used for Exam Type. (See Note 1)
	Admitting Diagnosis Description	(0008,1080)	UV	3	Yes	See Note 1.

Note 1: These attributes are not part of the Modality Worklist Information Model, and are Standard Extended SOP Class attributes. These attributes are optional, and their support is not required by SCPs receiving Elegra Worklist queries.

Matching Key Types	
SV	Single Value matching
WC	Wild Card matching
SQ	Sequence matching
UV	Universal matching
DR	Date Range matching

Siemens Medical Systems, Inc.
Ultrasound Group

3.1.2.3.2 Error Handling

The following table indicates the possible response status codes, which a SCP may return following the SCU's C-FIND command. Only those status responses that indicate some form of error condition are presented to the user. Related fields are not used.

Table 3.1.2.1.1.2-1 C-Find Status Responses

Service Status	Further Meaning	Protocol Codes	Related Fields
Refused	Out of resources	A700	None
Failed	Identifier does not match SOP Class	A900	None
	Unable to process	Cxxx	None
Cancel	Matching terminated due to Cancel request	FE00	None
Success	Matching is complete - No final Identifier is supplied.	0000	None
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	FF00	None
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence for this Identifier.	FF01	None

4. Communication Profiles

All SONOLINE Elegra system application entities utilize the DICOM 3.0 TCP/IP communication support as defined in PS3.8 (Part 8) of the DICOM 3.0 Standard.

4.1 TCP/IP Stack Supported

Each process inherits its TCP/IP stack from the SONOLINE Elegra's operating system TCP/IP stack. Port number 5000 is used for DICOM communication with the Elegra.

4.1.1 Physical Media Supported

Standard representations of IEEE 802.3 (10Base2 ("thinwire"), Fiber Optic (both SMA and ST style connectors) and 10BaseT ("twisted pair") is supported and the system interfaces and transceivers configured to meet customer site-specific requirements.

5. Extensions/Specializations/Privatizations

5.1 Standard extended/specialized/private Syntaxes

No extensions specialized or private syntaxes are used in the SONOLINE Elegra system DICOM implementation.

5.2 PRIVATE TRANSFER SYNTAXS

No private transfer syntaxes are used.

6. Configuration

SONOLINE Elegra Networking and DICOM parameters can be configured through the Elegra System Presets Menu screens. The following configuration is supported:

- Basic system
- Network (local and remote)
- DICOM Store
- DICOM Print
- DICOM Worklist
- Exam Types
- External Equipment

6.1 Basic system configuration

The following system parameters can be configured via the Elegra System Presets Basic Menu screens. These parameters are mapped to DICOM image attributes:

- Organization Name
- Department Name
- System Location

6.1.1 Organization Name

The user can enter the organization (i.e. hospital, clinic, etc.) as a text string in the Organization Name field of the System Presets - Basic menu. The Organization Name field is transferred to DICOM devices as Institution Name - DICOM data element (0008, 0080).

6.1.2 Department Name

The user can enter the department name (i.e. ultrasound lab, OB/Gyn, etc.) as a text string in the Department Name field of the System Presets - Basic menu. The Department Name field is transferred to DICOM devices as Institutional Department Name - DICOM data element (0008, 1040).

6.1.3 System Location

The user can enter the location where the ultrasound exam(s) are being performed in the System Location field of the System Presets - Basic menu. The System Location field will be transferred to DICOM devices as Station Name - DICOM data element (0008, 1010).

6.2 DICOM Network configuration

DICOM and networking parameters can be configured for both the local Elegra device and remote DICOM service class providers through the System Presets

Siemens Medical Systems, Inc.
Ultrasound Group

DICOM Network Menu.

6.2.1 Local

The SONOLINE Elegra local network parameters are configurable. The following network parameters can be configured for Elegra device:

- Hostname (i.e. Elegra)
- IP address
- Network IP mask
- DICOM Application Entity Title (default = SMSUG_STORE)
- Network Time-out (DICOM Association Response timer - in seconds). One timer value is used for all DICOM network transfers.

6.2.2 Remote

Multiple DICOM service class providers can be configured through the system presets. The following network parameters can be configured for each remote device:

- Host name
- IP address
- Router/Gateway hostname
- Router/Gateway IP address

6.3 DICOM Store configuration

Remote DICOM Storage service class providers are configured through the DICOM - Store page of the System Presets menu. The following parameters can be configured:

- AET - Application Entity Title
- Port number
- Implementation Class UID
- Image types accepted (RGB and Monochrome, or Monochrome only)
- Transfer at End Exam (check boxes) - allows the user to select whether images are transferred to the destination store device as they are acquired (i.e. In Progress Review), or are transferred when the patient exam ends, either by the "End Exam" key or "New Patient" button.

6.4 DICOM Worklist configuration

Remote DICOM Worklist service class providers are configured through the DICOM - Worklist page of the System Presets. The following parameters can be configured for each Worklist server:

- AET - Application Entity Title
- Port number
- ICUID - Implementation Class UID
- Active pushbutton – makes the current selected device the active Worklist



Siemens Medical Systems, Inc.
Ultrasound Group

server.

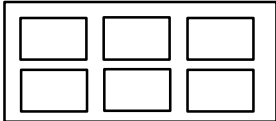
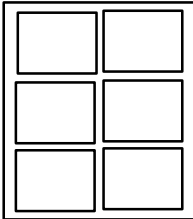
6.5 DICOM Print Configuration

For each DICOM Print server, the following data is configurable by the user using the System Presets DICOM Print User Interface. The user can change each element at any time during the operation of the Elegra. The effect of changing parameters of the DICOM Print server will be seen at the next film sheet. The current film sheet is not affected by changing these parameters.

Table 6.5-1 User configurable Printer parameters

Parameter	Description
Printer Type:	Color or Black and White - depends on printer
Film Size	Select the size of the film - 8x10 inches, 11x17 inches, 20x25 cm, and 35x43 cm
Film Orientation	Select from Portrait:  or Landscape: 

Siemens Medical Systems, Inc.
Ultrasound Group

Display Format	<p>You must supply the number of rows and columns of images on the printed sheet. For example, a 6 on 1 print with Landscape mode should have 3 columns and 2 rows:</p>  <p>A 6 on 1 with Portrait mode would have 2 columns and 3 rows:</p> 
Print Priority	HIGH, MEDIUM or LOW
Medium Type	PAPER, CLEAR FILM, BLUE FILM, TRANSPARENCY or CURRENT (to use the currently loaded media)
Film Destination	MAGAZINE, PROCESSOR or CURRENT
Max. Density	Used to define the Black value - printer specific
Min. Density	Used to define the White value - printer specific
Smoothing Type	Printer specific value
Border Density	BLACK, WHITE or i border around film
Empty Image Density	BLACK,WHITE, or i empty image segments on film
Trim	Yes/No to having a border around each image
Polarity	Normal/reverse. Normal means black is printed as black. Reverse means the grayscale is inverted so that black comes out as white and white as black.
Configuration Information:	Printer Specific values

Siemens Medical Systems, Inc.
Ultrasound Group

6.6 Exam Types Configuration

User configurable Exam Types are supported (as free form text) through the System Presets Exam Types screen. These user defined Exam types are available for selection in the Patient Data screen, during patient registration. Exam types are mapped to the DICOM Study Description (0008,1030) and Series Description (0008,103E) image attributes.

6.7 External Equipment Configuration

The Elegra user can configure "Hard Key" to "Output Device" mapping through the System Presets - External Equipment menu. Images are acquired and sent to the assigned device when the user presses the associated key. The following key assignments are supported:

- **Store to Disk** – This key can be assigned to any configured DICOM Store device, or the DEFF MO Disk.
- **Print 1** – This key can be assigned to any configured DICOM Printer, or OEM printer device.
- **Print 2** – This key can be assigned to any configured DICOM Printer, or OEM printer device.

7. Support of Extended Character Sets

The "ISO-IR 100" Extended character set is supported by the Elegra.

8. References

Specifications of the DICOM 3.0 standard may be obtained from ACR-NEMA for customers who require detailed information.

9. Glossary

ACR-NEMA = American College of Radiology - National Electrical Manufacturer's Association

AE = Application Entity

Conformance Statement = A formal statement associated with a specific implementation of the DICOM Standard. It specifies the Service Classes, Information Objects, Communications Protocols and Media Storage Application Profiles supported by the implementation

DICOM 3.0 = Digital Imaging and Communications in Medicine, Version 3.0.

DIMSE = DICOM Message Service Element

DIMSE C-Store = DICOM Message Service Element, Composite Sore

Ethernet = Network methodology devised in 1976 by DIX (DEC/Intel/Xerox) which

Siemens Medical Systems, Inc.
Ultrasound Group

is the most common in practice today.

IOD = Information Object Definition

PACS = Picture Archiving and Communications Systems

PDU = Protocol Data Unit

RWA = Real-World Activity

SCP = Service Class Provider

SCU = Service Class User

SOP = Service-Object Pairs

UID = Unique identifier