Direction Number: 2243476-100

Revision 1.0

DIASONICS GATEWAY
CONFORMANCE STATEMENT
for DICOM V3.0

1. Introduction

This document specifies the compliance to DICOM Standard v3.0 for the relevant network archive features on the Diasonics 2D GATEWAY ***fx*** (software version 7.0.3 and 7.1.0) and 2D GATEWAY (software version 6.3.0 and 6.4.0) products. In the following sections, we use the name GATEWAY to represent all these versions of the product.

GATEWAY is an ultrasound image scanning device. Its imaging archive module provides DICOM services, which support network storage and print management acting as a Service Class User (SCU).

2. Implementation Model

When on a network, GATEWAY implements two application entities that run as separate tasks and listen for requests from the user to send storage SOP class objects or print management SOP class objects to remote entities.

2.1. Application Data Flow Diagram

Figure 1 illustrates the two Application Entities (AE) present on the GATEWAY system and the relationships of those AE's use of DICOM to Real-World Activities.

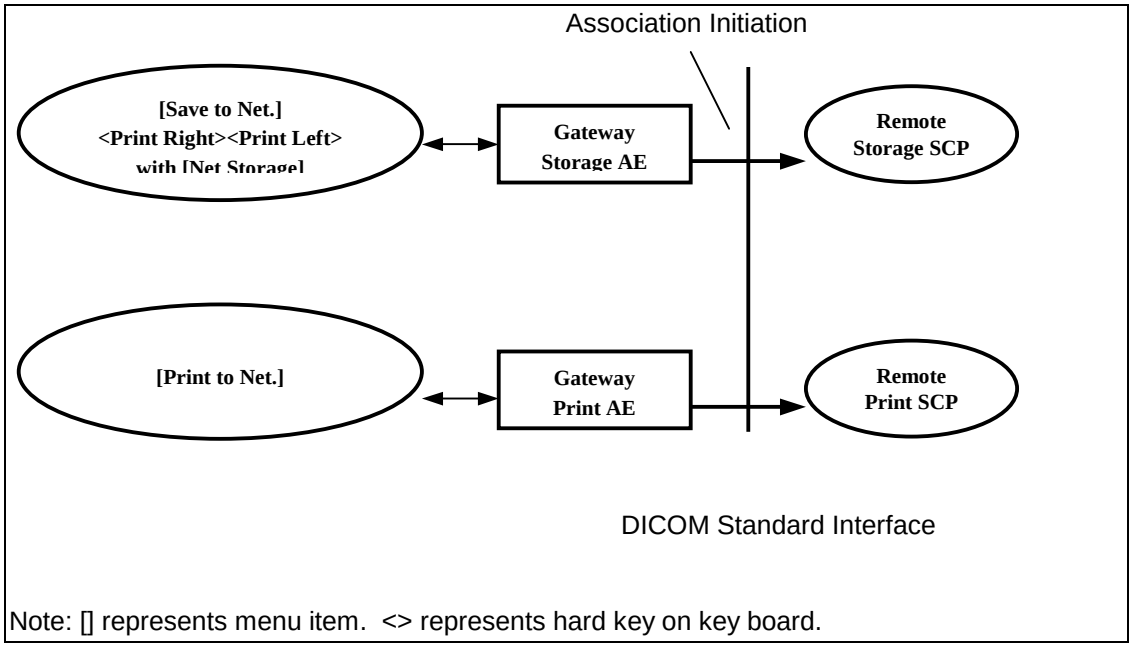

Figure 1. GATEWAY Implementation Model

There are two local real-work activities that occur on GATEWAY - network imaging storage and network imaging print.

The imaging storage activity can be initiated either by [Save to Net.] under the [Patient Review] menu or by the use of the dedicated keys <Print Right> and <Print Left> during scanning, when the image is frozen and [Net Storage] is configured. The imaging print activity can be initiated by [Print to Net.] under the [Patient Review] menu only.

When the user requests network imaging storage, either during scanning or in patient review, GATEWAY Storage AE initiates an association with the remote device. When the Remote Storage SCP accepts the association, GATEWAY 'pushes' the image to the Remote Storage SCP without user intervention. The user should wait for the completion message before continuing scanning or proceeding to other activities. The images, by default, are always saved on the local hard disk. It is the user's responsibility to delete the patient record and images in order to free disk space.

The imaging print activity works much the same way as imaging storage, but can only be initiated from the [Patient Review] menu.

2.2. Functional Definitions of AE's

The GATEWAY AEs are implemented as Service Class Users (SCU) that provide ultrasound imaging Storage and Print Management SOP Classes and also handle association related tasks for DICOM transmission.

2.3. Sequencing of Real-World Activities

For imaging storage, the sequencing is

- GATEWAY Storage AE initiates an ultrasound image storage service association with the selected remote archive device AE when user selects [Save to Net.] menu, or presses <Print Right> or <Print Left> when [Net Storage] is configured.
- GATEWAY Storage AE uses the C-STORE request to send images to the remote archive device.

For imaging print, the sequencing is

- GATEWAY Print AE initiates an image print service association with the selected remote print device AE when the user selects the [Print to Net.] menu item.
- GATEWAY Print AE uses the N-CREATE to request the print device AE to create a Basic Film Session SOP Instance.
- GATEWAY Print AE requests an N-CREATE operation to the print device AE to create a film box containing a certain number of image boxes.
- GATEWAY Print AE places the images themselves as part of an N-SET request to the image boxes.

- GATEWAY Print AE uses N-ACTION command to print an image on the film box. Requests to print are performed at the film box level and not the film session level.
- Once the print request has been sent, the film box and session are deleted by N-DELETE command.

3. AE Specifications

3.1. Storage AE Specification

The GATEWAY Storage AE provides Standard Conformance to the following DICOM v3.0 SOP Class as an SCU:

SOP Class Name	SOP Class UID
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6

3.1.1 Association Establishment Policies

3.1.1.1. General

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

Application Context Name	1.2.840.10008.3.1.1.1

The maximum length Protocol Data Unit (PDU) for an association initiated by the GATEWAY Storage AE is:

Maximum Length PDU	16384 bytes

The SOP Class Extended Negotiation is not supported.

3.1.1.2. Number of Associations

The GATEWAY Storage AE allows one association at any time.

3.1.1.3. Asynchronous Nature

Asynchronous mode is not supported. All operations are performed synchronously.

3.1.1.4. Implementation Identifying Information

The Implementation UID for this DICOM v3.0 Implementation is

Implementation UID	1.2.34.56

The Implementation Version Name for this DICOM v3.0 Implementation is

Implementation Version Name	Diasonics_DCM_1

3.1.2 Association Initiation Policy

3.1.2.1. Real-World Activity - Storage

3.1.2.1.1. Associated Real-World Activity

There are two different ways to initiate a DICOM association for network image storage:

- During scanning, use of the hard key <Print Left> or <Print Right> triggers a DICOM association, when GATEWAY is configured to [Net Storage] and the image is frozen.
- Under the patient image review menu, [Print to Net.] triggers a DICOM association.

3.1.2.1.2. Proposed Presentation Contexts

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiations
Name	UID	Name List	UID List		
Ultrasound Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.1.2.1. SOP Specific Conformance for Storage SOP Class

The following are the status codes that are more specifically processed when receiving messages from Storage SCP equipment:

Service Status	Status Codes	Further Meaning	Application Behavior When Receiving Status Codes	Related Fields Processed if Received
Refuse	A700	Out of resource	Current image may not be transferred, continue on next image.	(0000,0902)
	A800	SOP Class not supported	Current image may not be transferred, continue on next image.	(0000,0902)
Error	A900	Data Set does not match SOP Class	Current image may not be transferred, continue on next image.	(0000,0901) (0000,0902)
	C000	Cannot Understand	Current image may not be transferred, continue on next image.	(0000,0901) (0000,0902)
Warning	B000	Coercion of Data Elements	Current image may not be transferred, continue on next image.	(0000,0901) (0000,0902)
	B007	Data Set does not match SOP Class	Current image may not be transferred, continue on next image.	(0000,0901) (0000,0902)
	B006	Element Discarded	Current image may not be transferred, continue on next image.	(0000,0901) (0000,0902)
Success	0000			None

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes of the Ultrasound Information Object. Please refer to DICOM v3.0 Standard Part 3 (Information Object Definition) for a description of each entity and module within US IOD.

Table 1. Patient Module Attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Entered from [Begin Exam] menu, limited to 28 chars.
Patient ID	(0010,0020)	2	Entered from [Begin Exam] menu, limited to 12 chars.
Patient's Birth Date	(0010,0030)	2	Not specified, send 8 spaces.

Patient's Sex	(0010,0040)	2	Entered from [Begin Exam] menu, limited to 'M', 'F' and 'O'. 'O' when [Save to Net].

Table 2. General Study Module Attributes

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Generated using "1.2.840.15. + Patient ID. + Date" for v6.3.0 and v7.0.3; or "1.2.840.15. + Patient ID. + Date. + Time" for v7.1.0 and v6.4.0.
Study Date	(0008,0020)	2	Image capture date for v6.3.0 and v7.0.3; or [Begin Exam] date for v7.1.0 and v6.4.0. Format is yyyymmdd.
Study Time	(0008,0030)	2	Image capture time for v6.3.0 and v7.0.3; or [Begin Exam] time for v7.1.0 and v6.4.0. Format is hhmmssfrac.
Referring Physician's Name	(0008,0090)	2	Entered from [Begin Exam] menu, limited to 20 chars. Empty when [Save to Net].
Study ID	(0020,0010)	2	Generated using study date.
Accession Number	(0008,0050)	2	Internal value, fixed as "1" for v6.3.0 and v7.0.3; or entered from [Begin Exam] menu, up to 16 chars for v7.1.0 and v6.4.0. "1" when [Save to Net].
Study Description	(0008,1030)	3	Not support for v6.3.0 and v7.0.3; or entered from [Begin Exam] menu, up to 46 chars for v7.1.0 and v6.4.0. Empty when [Save to Net]

Table 3. General Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Defined Term "US".
Series Instance UID	(0020,000E)	1	Generated using "1.2.840.15. + Patient ID. + Date. + Icon. + Time + IP address".
Series Number	(0020,0011)	2	Internal encoded by icon string (image type).

Table 4. General Equipment Module Attributes

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	String "Diasonics".

Table 5. General Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Internal value which is incremented for each captured image within a study.
Image Type	(0008,0008)	3	ORIGINAL + PRIMARY + icon + imple#, where the imple# = "0000" for B-mode; "0002" for M-mode; "0004" for CW Doppler; "0008" for PD Doppler; "0010" for Color Doppler.

Table 6. Image Pixel Module Attributes

Attribute Name	Tag	Type	Attribute Description
Sample per Pixel	(0028,0002)	1	Value of "1" when monochrome; value of "3" when RGB.
Photometric Interpolation	(0028,0004)	1	Defined values: MONOCHROME2 and RGB.
Rows	(0028,0010)	1	Value always 480.
Columns	(0028,0011)	1	Up to 640.
Bits Allocated	(0028,0100)	1	Value always 8.
Bits Stored	(0028,0101)	1	Value always 8.
High Bit	(0028,0102)	1	Value always 7.
Pixel Representation	(0028,0103)	1	Defined value 0 - unsigned.
Pixel Data	(7FE0,0010)	1	Data stream of the pixel samples which comprise the Image.
Planar Configuration	(0028,0006)	1C	Defined value 0 - color by pixel.
Pixel Aspect Ratio	(0028,0034)	1C	Always 1/1.

Table 7. SOP Common Module Attributes

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	"1.2.840.10008.5.1.4.1.1.6"
SOP Instance UID	(0008,0018)	1	Generated using "1.2.840.15. + Patient ID. + Date. + Hours. + Minutes. + Seconds"

3.1.3 Association Acceptance Policy

The GATEWAY Storage AE does not accept associations.

3.2. Print AE Specification

The GATEWAY Print AE provides Standard Conformance to the following DICOM v3.0 Meta SOP Classes as an SCU:

Meta SOP Class Name	SOP Class UID
Basic Greyscale Print Management	1.2.840.10008.5.1.1.9
Basic Color Print Management	1.2.840.10008.5.1.1.18

This corresponds to conformance to the following SOP classes as an SCU:

SOP Class Name	SOP Class UID
Basic Film Session	1.2.840.10008.5.1.1.1
Basic Film Box	1.2.840.10008.5.1.1.2
Basic Greyscale Image Box	1.2.840.10008.5.1.1.4
Basic Color Image Box	1.2.840.10008.5.1.1.4.1

3.2.1 Association Establishment Policies

3.2.1.1. General

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

Application Context Name	1.2.840.10008.3.1.1.1

The maximum length Protocol Data Unit (PDU) for an association initiated by the GATEWAY Print AE is:

Maximum Length PDU	16384 bytes

The SOP Class Extended Negotiation is not supported.

3.2.1.2. Number of Associations

The GATEWAY Print AE allows one association at any time.

3.2.1.3. Asynchronous Nature

Asynchronous mode is not supported. All operations are performed synchronously.

3.2.1.4. Implementation Identifying Information

The Implementation UID for this DICOM v3.0 Implementation is

Implementation UID	1.2.34.57

The Implementation Version Name for this DICOM v3.0 Implementation is

Implementation Version Name	Diasonics_DCM_1

3.2.2 Association Initiation Policy

3.2.2.1. Real-World Activity - Print

3.2.2.1.1. Associated Real-World Activity

Under patient image review, the menu [Print to Net.] initiates a DICOM association with the SCP.

3.2.2.1.2. Proposed Presentation Contexts

Presentation Context Table - Proposed					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiations
Name	UID	Name List	UID List		
Basic Greyscale Print Management	1.2.840.10008.5.1.1.9	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management	1.2.840.10008.5.1.1.18	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.2.2.1.2.1. SOP Specific Conformance for Print SOP Class

The following are the status codes that are more specifically processed when receiving messages from Storage SCP equipment:

Service Status	Status Codes	Further Meaning	Application Behavior When Receiving Status Codes
Success	0000		
Warning	B602	No Image Box SOP Instance.	Current image may not be transferred, continue on next image.
Failure	C600	No Film Box SOP Instances.	Current image may not be transferred, continue on next image.
	C601 C602	Unable to create print job SOP Instance.	Current image may not be transferred, continue on next image.
	C603	Image size larger than image box size.	Current image may not be transferred, continue on next image.
	C604	Image position collision	Current image may not be transferred, continue on next image.

Standard conformance is provided to the DICOM Basic Greyscale Print Management Meta SOP Class and Basic Color Print Management Meta SOP Class as an SCU. All mandatory elements for film sessions, basic film boxes, and basic image boxes are provided. The valid range of these values is specified in the following tables:

Table 8. Basic Film Session Presentation Module Attributes

Attributes Name	Tag	USAGE	Possible Values
Number of Copies	(2000,0010)	U	1 to 10.
Print Priority	(2000,0020)	U	Always "HIGH"
Medium Type	(2000,0030)	U	PAPER, CLEAR FILM, BLUE FILM

Film Destination	(2000,0040)	U	MAGAZINE, PROCESSOR

Table 9. Basic Film Box Presentation Module Attributes

Attributes Name	Tag	USAGE	Possible Values
Image Display Format	(2010,0010)	U	STANDARD\1,1 STANDARD\1,2 STANDARD\2,1 STANDARD\2,2 STANDARD\2,3 STANDARD\2,4 STANDARD\3,2 STANDARD\3,3 STANDARD\3,4 STANDARD\3,5 STANDARD\4,2 STANDARD\4,3 STANDARD\4,4 STANDARD\4,5 STANDARD\4,6 STANDARD\5,3 STANDARD\5,4 STANDARD\6,4
Film Orientation	(2010,0040)	U	PORTRAIT, LANDSCAPE
Film Size ID	(2010,0050)	U	8INX10IN, 14INX17IN
Magnification Type	(2010,0060)	U	BILINEAR, CUBIC, NONE
Smoothing Type	(2010,0080)	U	Printer dependant, up to 16 chars
Board Density	(2010,0100)	U	BLACK, WHITE
Empty Image Density	(2010,0110)	U	BLACK, WHITE
Min Density	(2010,0120)	U	Integer number
Max Density	(2010,0130)	U	Integer number
Trim	(2010,0140)	U	YES, NO
Configuration Information	(2010,0150)	U	Printer dependant, up to 128 chars.

Table 10. Basic Image Box (Grayscale and Color) Presentation Module Attributes

Attributes Name	Tag	USAGE	Possible Values
Magnification Type	(2010,0060)	U	BILINEAR, CUBIC, NONE
Smoothing Type	(2010,0080)	U	Printer dependant, up to 16 chars.
Polarity	(2020,0020)	U	NORMAL, REVERSE
Requested Image Size	(2020,0030)	U	Printer dependant, up to 128 chars.

3.2.3 Association Acceptance Policy

The GATEWAY Print AE does not accept associations.

4. Communication Profiles

4.1. Supported Communication Stacks

The GATEWAY provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM standard.

4.2. OSI Stack

The OSI communication stack is not supported.

4.3. TCP/IP Stack

The TCP/IP stack is inherited from vxWorks operating system upon which the GATEWAY executes.

4.4. Point-to-Point Stack

The Point-to-Point interface is not supported.

5. Extensions/Specializations/Privatizations

Not applicable.

6. Configuration

6.1. AE Title/Presentation Address Mapping

The local AE Title used by <Print Left>, <Print Right> and [Save to Net.] is DIASONX for software version 7.0.3 and DIASONICS_STORE for software version

6.3.0. The AE Title used by [Print to Net.] is DIASONICS_PRINT for all software versions.

These AE Titles are also configurable for software version 7.1.0 and are configured by the GEMS Diasonics service engineer during the GATEWAY software installation.

6.2. Configurable Parameters

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

- local AE Title (if not set, the defaults are DIASONICS_STORE for storage, software version 6.3.0; DIASONX for storage, software version 7.0.3; and DIASONICS_PRINT for printing, all software versions)
- local IP address
- local listening port number (as SCU, not required)
- local IP Netmask

The following fields are configurable for every remote DICOM AE:

- remote AE Title
- remote IP address
- remote host name
- responding TCP/IP port number

All configuration changes must be performed by a GE Diasonics service engineer.

7. Support of Extended Character Sets

No extended character sets are supported.