

**EchoNous Bladder
EchoNous Vein
Uscan**

DICOM Conformance Statement

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EchoNous, Inc.
8310 154th Ave NE, Suite 200
Redmond, WA 98052 USA
Tel: + 1.844.854.0800
echonous.com

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1. CONFORMANCE STATEMENT OVERVIEW

This DICOM conformance statement specifies the behaviour and functionality of the Uscan, release 5.1.0. This software specifies the following capabilities:

- Send ultrasound images via the DICOM Storage Server Class
- Send multi-frame ultrasound images via the DICOM Storage Server Class (SigViewer only)

TABLE 1 SUPPORTED SOP CLASSES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Ultrasound Image Storage	Yes	No
Ultrasound Multi-frame Image Storage	Yes	No

2. INTRODUCTION

2.1 Revision History

Document Revision	Software Version	Description of changes
A	3.5.0	Initial release of DICOM support for Uscan
B	4.0.2	Implementation Version Name updated to match new software release. No change to DICOM support.
C	4.1.1	Implementation Version Name updated to match new software release. No change to DICOM support.
D	4.1.2	Implementation Version Name updated to match new software release. No change to DICOM support.
E	4.2.1	Implementation Version Name updated to match new software release. No change to DICOM support.
F	4.3.0	Implementation Version Name updated to match new software release. No change to DICOM support.
G	4.4.0	Implementation Version Name updated to match new software release. No change to DICOM support.
H	4.4.1	Implementation Version Name updated to match new software release. No change to DICOM support.
J	4.5.0	Implementation Version Name updated to match new software release. No change to DICOM support.

K	4.5.1	Implementation Version Name updated to match new software release. No change to DICOM support.
L	5.1.0	Implementation Version Name updated to match new software release. No change to DICOM support

2.2 Audience

This document is written for the people that need to understand how Uscan will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader may understand how this product implements DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features.

2.3 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between Uscan and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability. The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

- The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between the product and other DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.

2.4 Terms and Definitions

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax: the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

Application Entity (AE): an end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title: the externally known name of an Application Entity, used to identify a DICOM application to other DICOM applications on the network.

Application Context: the specification of the type of communication used between Application Entities. Example: DICOM network protocol.

Association: a network communication channel set up between Application Entities.

Attribute: - a unit of information in an object definition; a data element identified by a tag. The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD): the specified set of Attributes that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The Attributes may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Joint Photographic Experts Group (JPEG): a set of standardized image compression techniques, available for use by DICOM applications.

Module: a set of Attributes within an Information Object Definition that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation: first phase of Association establishment that allows Application Entities to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context: the set of DICOM network services used over an Association, as negotiated between Application Entities; includes Abstract Syntaxes and Transfer Syntaxes.

Service Class Provider (SCP): role of an Application Entity that provides a DICOM network service; typically, a server that performs operations requested by another Application Entity (Service Class User). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

Service Class User (SCU): role of an Application Entity that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class: the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance: an information object; a specific occurrence of information exchanged in a SOP Class. Examples: a specific x-ray image.

Tag: a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the "group" and the "element". If the "group" number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax: the encoding used for exchange of DICOM information objects and messages. Examples: JPEG compressed (images), little endian explicit value representation.

Unique Identifier (UID): a globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR): the format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit

identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

2.5 Basics of DICOM Communication

This section describes terminology used in this Conformance Statement for the non-specialist. The key terms used in the Conformance Statement are highlighted in italics below. This section is not a substitute for training about DICOM, and it makes many simplifications about the meanings of DICOM terms.

Two Application Entities (devices) that want to communicate with each other over a network using DICOM protocol must first agree on several things during an initial network "handshake". One of the two devices must initiate an Association (a connection to the other device), and ask if specific services, information, and encoding can be supported by the other device (Negotiation).

DICOM specifies a number of network services and types of information objects, each of which is called an Abstract Syntax for the Negotiation. DICOM also specifies a variety of methods for encoding data, denoted Transfer Syntaxes. The Negotiation allows the initiating Application Entity to propose combinations of Abstract Syntax and Transfer Syntax to be used on the Association; these combinations are called Presentation Contexts. The receiving Application Entity accepts the Presentation Contexts it supports.

For each Presentation Context, the Association Negotiation also allows the devices to agree on Roles - which one is the Service Class User (SCU - client) and which is the Service Class Provider (SCP - server). Normally the device initiating the connection is the SCU, i.e., the client system calls the server, but not always.

The Association Negotiation finally enables exchange of maximum network packet (PDU) size, security information, and network service options (called Extended Negotiation information).

The Application Entities, having negotiated the Association parameters, may now commence exchanging data. Common data exchanges include queries for worklists and lists of stored images, transfer of image objects and analyses (structured reports), and sending images to film printers. Each exchangeable unit of data is formatted by the sender in accordance with the appropriate Information Object Definition, and sent using the negotiated Transfer Syntax. There is a Default Transfer Syntax that all systems must accept, but it may not be the most efficient for some use cases. Each transfer is explicitly acknowledged by the receiver with a Response Status indicating success, failure, or that query or retrieve operations are still in process.

Two Application Entities may also communicate with each other by exchanging media (such as a CD-R). Since there is no Association Negotiation possible, they both use a Media Application Profile that specifies "pre-negotiated" exchange media format, Abstract Syntax, and Transfer Syntax.

2.6 Abbreviations

AE: Application Entity

CSE: Customer Service Engineer

DICOM: Digital Imaging and Communications in Medicine

DNS: Domain Name System

IE: Information Entity

IOD: Information Object Definition

IPv4: Internet Protocol version 4

JPEG: Joint Photographic Experts Group

O: Optional (Key Attribute)

R: Required (Key Attribute)

SCP: Service Class Provider

SCU: Service Class User

SOP: Service-Object Pair

US: Ultrasound

2.7 References

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>

3. NETWORKING

3.1 Implementation Model

3.1.1 Application Data Flow

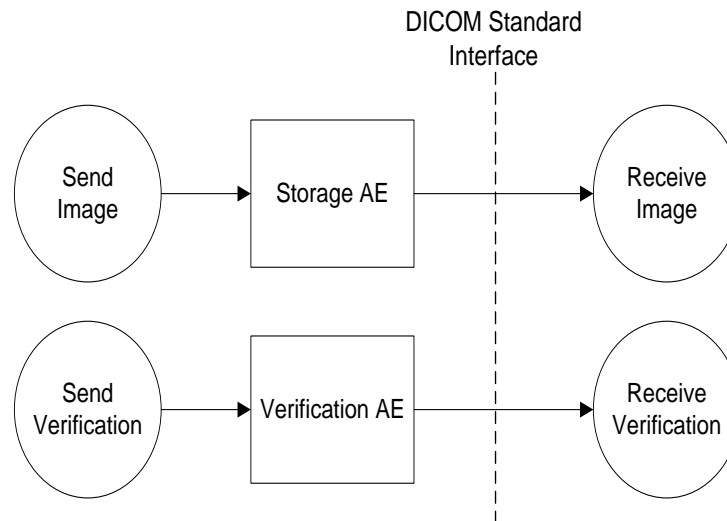


FIGURE 1 APPLICATION DATA FLOW DIAGRAM

3.1.2 Functional Definition of Storage Application Entity

The Verification AE supports the following function:

- Initiation of DICOM verification to assist in network diagnostics

The Storage AE supports the following functions:

- Initiation of DICOM association to send images
- Transmission of DICOM images to a DICOM Storage SCP

3.2 Application Entity Specifications

3.2.1 Storage Application Entity

3.2.1.1 SOP Classes

This Application Entity provides Standard Conformance to the following SOP Classes:

TABLE 2 SUPPORTED SOP CLASSES

SOP Class Name	SOP Class UID	SCU	SCP
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	No
Verification SOP Class	1.2.840.10008.1.1	Yes	No

3.2.1.2 Association Policies

General

The DICOM standard Application Context Name is always proposed.

TABLE 3 APPLICATION CONTEXT NAME

Application Context Name	1.2.840.10008.3.1.1.1
--------------------------	-----------------------

Number of Associations

The Storage AE will only propose a single association.

Asynchronous Nature

Asynchronous operation is not supported

Implementation Identifying Information

TABLE 4 IDENTIFYING INFORMATION

Implementation Class UID	1.2.36.81578378.1.1.1
Implementation Version Name	5_1_0_31091A

The Implementation Version Name may change with new releases of the application software

3.2.1.3 Association Initiation Policy

An attempt to establish a new association will be made due to two Real-World Activities

- Image Save initiated by the operator to transmit images to a Peer AE
- Verification initiated by the operator which verifies communication between a Peer AE for diagnostic purposes.

Verification Activity – Proposed Presentation Contexts

Table 5 shows the proposed presentation contexts for the Verification Activity.

TABLE 5 PROPOSED VERIFICATION PRESENTATION CONTEXTS

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		

Storage Activity – Proposed Presentation Contexts

Table 6 shows the proposed presentation contexts for the Storage Activity. Ultrasound Multi-frame Image Storage is only proposed in SigViewer.

TABLE 6 PROPOSED STORAGE PRESENTATION CONTEXTS

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Lossy Compression Disabled					
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		
		RLE Lossless	1.2.840.10008.1.2.5		
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70		
		PEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80		

Ultrasound Multi- frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		
		RLE Lossless	1.2.840.10008.1.2.5		
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70		
		PEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80		

Lossy Compression Enabled					
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		
		RLE Lossless	1.2.840.10008.1.2.5		
		JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50		
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70		
		PEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80		
		JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81		
Ultrasound Multi-frame	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

Image Storage	Explicit VR Big Endian	1.2.840.10008.1.2.2		
	Implicit VR Little Endian	1.2.840.10008.1.2		
	RLE Lossless	1.2.840.10008.1.2.5		
	JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50		
	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70		
	PEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80		
	JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81		

SOP Specific DICOM Conformance Statement for all Storage SOP Classes

All status codes with status Refused or Error are treated as failures and terminate the association and operation. All status codes with status Warning or Success are treated as successes.

3.3 Network Interfaces

3.3.1 Physical Network Interfaces

TCP/IP over IP4 is supported

3.4 Configuration

3.4.1 AE Title/Presentation Address Mapping

The Local AE title is configurable through the DICOM Configuration screen of Uscan Settings.

3.4.2 Configurable Parameters

- Local AE Title
- Peer Hostname or IP Address
- Peer Port number
- Peer AE Title
- Enable/disable Lossy Compression

4. ANNEXES

4.1 Created SOP Instances

Abbreviations used for attributes:

- **VNAP:** Value Not Always Present
- **ANAP:** Attribute Not Always Present
- **ALWAYS:** Always Present
- **EMPTY:** Attribute is sent without a value

Abbreviations used for the source of data values

- **USER:** The attribute value is from User input
- **AUTO:** The attribute value is generated automatically

4.1.1 US or Multi-frame US Image Storage SOP Class

The Ultrasound or Ultrasound Multi-Frame Image Storage Class uses the Common Composite Image IOD Modules shown in Table 7.

TABLE 7 US (MULTI-FRAME) IMAGE IOD MODULES

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8	ALWAYS
Study	General Study	Table 9	ALWAYS
Series	General Series	Table 10	ALWAYS
Equipment	General Equipment	Table 11	ALWAYS
Image	General Image	Table 12	ALWAYS
	Image Pixel	Table 13	ALWAYS
	Cine	Table 14	Only if Multi-frame
	Multi-frame	Table 15	Only if Multi-frame
	US Image	Table 16	ALWAYS
	SOP Common	Table 17	ALWAYS

4.1.2 Patient Module of Created SOP Instances

Table 8 specifies the attributes used from the Patient Module.

TABLE 8 PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Patient's Name	(0010,0010)		ALWAYS	USER
Patient ID	(0010,0020)	EMR-ID	ALWAYS	USER
Patient's Birth Date	(0010,0030)		ALWAYS	USER
Patient's Sex	(0010,0040)		ALWAYS	USER

4.1.3 General Study Module

Table 9 specifies the attributes used from the General Study Module.

TABLE 9 GENERAL STUDY ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	Generated for each exam	ALWAYS	AUTO
Study Date	(0008,0020)	Exam creation date	ALWAYS	AUTO
Study Time	(0008,0030)	Exam creation time	ALWAYS	AUTO
Referring Physician's Name	(0008,0090)		EMPTY	AUTO
Study ID	(0020,0010)		EMPTY	AUTO
Accession Number	(0008,0050)		EMPTY	AUTO

4.1.4 General Series Module

Table 10 specifies the attributes used from the General Series Module.

TABLE 10 GENERAL SERIES ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Modality	(0008,0060)	US	ALWAYS	AUTO
Series Instance UID	(0020,000E)	Generated for each exam	ALWAYS	AUTO
Series Number	(0020,0011)		EMPTY	AUTO
Series Date	(0008,0021)	Exam creation date	ALWAYS	AUTO
Series Time	(0008,0031)	Exam creation time	ALWAYS	AUTO
Operators' Name	(0008,1070)	Name of the user performing the scan	ANAP	USER

4.1.5 General Equipment Module

Table 11 specifies the attributes used from the General Equipment Module.

TABLE 11 GENERAL EQUIPMENT MODULE

Attribute Name	Tag	Value	Presence of Value	Source
Manufacturer	(0008,0070)	Signostics	ALWAYS	AUTO
Device Serial Number	(0018,1000)	Set by manufacturer	ALWAYS	AUTO

4.1.6 General Image Module

Table 12 specifies the attributes used from the General Image Module.

TABLE 12 GENERAL IMAGE ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Instance Number	(0020,0013)	Generated for each image	ALWAYS	AUTO
Content Date	(0008,0023)	Image creation date	ALWAYS	AUTO
Content Time	(0008,0033)	Image creation time	ALWAYS	AUTO

Image Type	(0008,0008)	Derived, primary, specific ultrasound modality	ALWAYS	AUTO
Image Comments	(0020,4000)	Image name	ALWAYS	USER
Lossy Image Compression	(0028,2110)	Set to 1 when “Use Lossy Compression” selected and negotiated by server.	ANAP	AUTO
Lossy Image Creation Ratio	(0028,2112)	Generated by device when lossy compression enabled and selected by server.	ANAP	AUTO

4.1.7 Image Pixel Module

Table 13 specifies the attributes used from the Image Pixel Module.

TABLE 13 IMAGE PIXEL ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Samples per pixel	(0028,0002)	3	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	RGB	ALWAYS	AUTO
Rows	(0028,0010)		ALWAYS	AUTO
Columns	(0028,0011)		ALWAYS	AUTO
Bits Allocated	(0028,0100)	8 bits per pixel	ALWAYS	AUTO
Bits Stored	(0028,0101)	8 bits per pixel	ALWAYS	AUTO
High Bit	(0028,0102)	High bit is 7	ALWAYS	AUTO
Pixel Representation	(0028,0103)	0000H	ALWAYS	AUTO
Pixel Data	(7FE0,0010)		ALWAYS	AUTO
Planar Configuration	(0028,0006)	0 – colour by pixel	ALWAYS	AUTO

4.1.8 Cine Module

Table 14 specifies the attributes used from the Cine Module.

TABLE 14 CINE MODULE ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Frame Time	(0018,1063)	Set by device for multi-frame images	ANAP	AUTO

4.1.9 Multi-frame Module

Table 15 specifies the attributes used from the Multi-frame Module.

TABLE 15 MULTI-FRAME ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Number of Frames	(0028,0008)	Set by device for multi-frame images	ANAP	AUTO
Frame Increment Pointer	(0028,0009)	Points to frame time for multi-frame images	ANAP	AUTO

4.1.10 US Image Module

Table 16 specifies the attributes used from the US Image Module.

TABLE 16 US IMAGE ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Samples per pixel	(0028,0002)	3	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	RGB	ALWAYS	AUTO
Bits Allocated	(0028,0100)	8 bits per pixel	ALWAYS	AUTO
Bits Stored	(0028,0101)	8 bits per pixel	ALWAYS	AUTO
High Bit	(0028,0102)	High bit is 7	ALWAYS	AUTO
Pixel Representation	(0028,0103)	0000H	ALWAYS	AUTO

Pixel Data	(7FE0,0010)		ALWAYS	AUTO
Planar Configuration	(0028,0006)	0 – colour by pixel	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	Set to 1 when “Use Lossy Compression” selected and negotiated by server.	ANAP	AUTO

4.1.11 SOP Common Module

Table 17 specifies the attributes used from the SOP Common Module

TABLE 17 SOP COMMON ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.6.1 for US Image 1.2.840.10008.5.1.4.1.1.3.1 for US Multiframe Image	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	Generated by device	ALWAYS	AUTO