

EchoNous KOSMOS

DICOM Conformance Statement

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1. CONFORMANCE STATEMENT OVERVIEW

This DICOM conformance statement specifies the behavior and functionality of the KOSMOS, release 1.0. This software specifies the following capabilities:

- Send ultrasound images via the DICOM Storage Service Class
- Send ultrasound clips via the DICOM Storage Service Class
- Export multi-frame ultrasound images/clips via the DICOM Storage Service Class
- Send PDF report via the DICOM Storage Service Class.
- Query Modality worklist

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
Encapsulated PDF Storage	Yes	No
Modality Worklist	Yes	No

2. INTRODUCTION

2.1 Revision History

Document Revision	Software Version	Description of changes
B	1.0	Modality Worklist
A	1.0	Initial release of DICOM support for KOSMOS

2.2 Audience

This document is written for the people that need to understand, how KOSMOS 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 KOSMOS 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

MWL: Modality Worklist

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

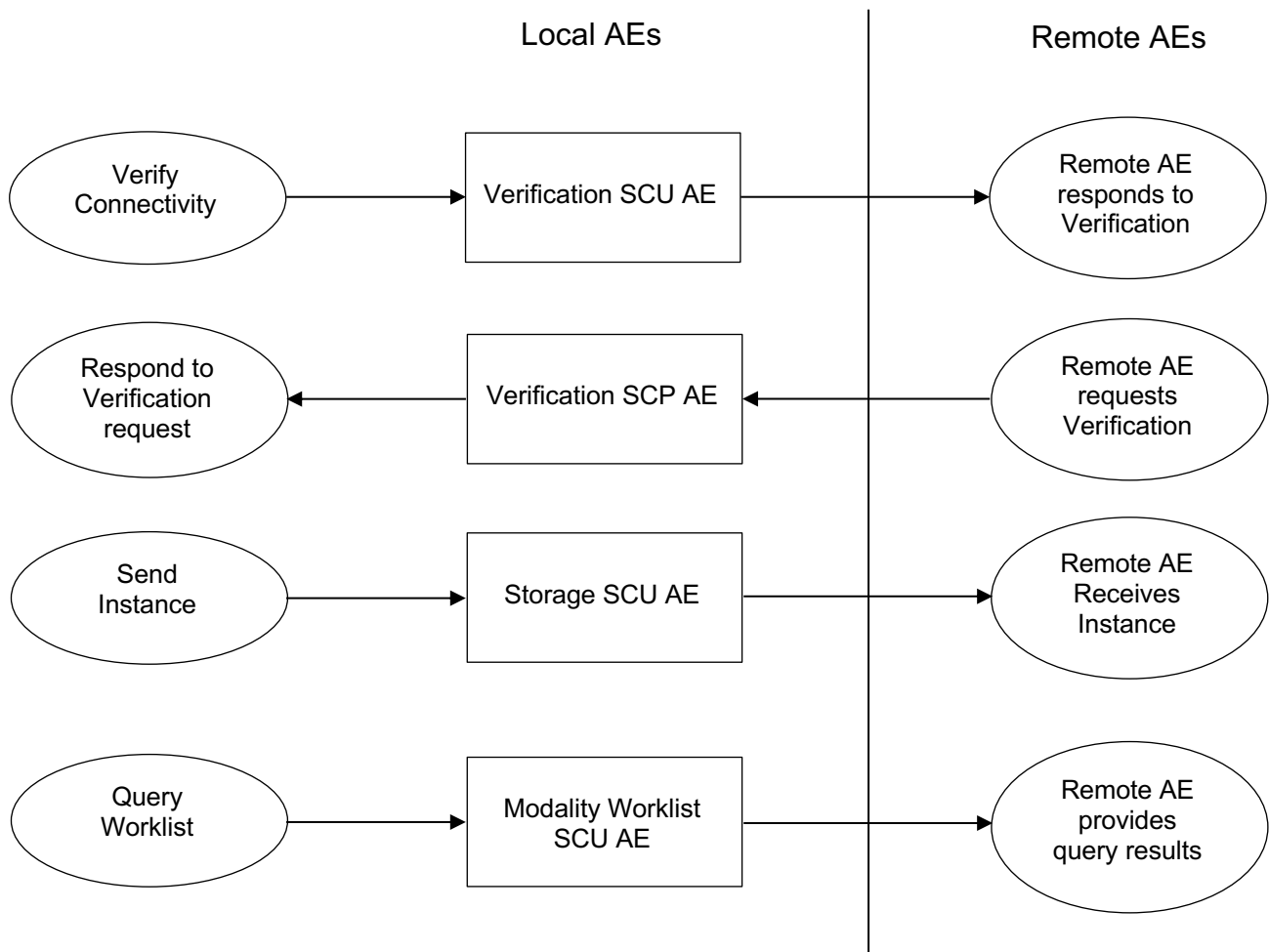


FIGURE 1 APPLICATION DATA FLOW DIAGRAM

3.1.2 Functional Definition of Application Entity

3.1.2.1 Functional Definition of Verification SCU AE

The verification SCU AE issues a C-ECHO to verify a DICOM connection to a remote AE.

3.1.2.2 Functional Definition of Verification SCP AE

The verification SCP AE responds successfully to C-ECHO requests from known AE Titles.

3.1.2.3 Functional Definition of Storage SCU AE

The existence of a send-job queue entry with associated network destination will activate the Storage SCU AE. An association request is sent to the destination AE and upon successful negotiation of a Presentation Context the image transfer is started. If the image transfer fails, the Storage SCU AE will retry this send-job automatically.

3.1.2.4 Functional Definition of Modality Worklist Query SCU AE

When the operator initiates a query request from the system, the Modality Worklist Query SCU AE issues a C-Find request containing the parameters and values specified by the user.

The available value matching parameters are:

- Patient First Name
- Patient Last Name
- MRN
- Accession Number
- Requested Procedure ID
- Scheduled Procedure Step Start Date
- Modality
- Scheduled Station AE Title

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

Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	No
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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	1.2.276.0.7230010.3.0.3.6.5
Implementation Version Name	OFFIS_DCMTK_365

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 archiving initiated by the operator to transmit images to a Peer AE
- Verification initiated by the operator which verifies DICOM communication between a Peer AE.

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.

TABLE 6 PROPOSED STORAGE PRESENTATION CONTEXTS

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
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		
		JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50		
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	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		

		JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50		
		MPEG-4 AVC/H.264 High Profile / Level 4.1	1.2.840.10008.1.2.4.102		

3.2.1.4 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. The **Behaviour** of Storage SCU AE that corresponds to the status codes in a C-STORE response is summarized in the table below:

TABLE 7 STORAGE C-STORE RESPONSE STATUS HANDLING BEHAVIOR

Status	Further Meaning	Status Code	Behaviour
Success	Success	0000	The SCP has successfully stored the SOP Instance. If all SOP Instances in a send job have status success, then the job is removed from the job queue.
Failure	Refused: Out of resource	A7xx A9xx	The job is marked as failed after the configured retry attempts. The job failed status will be notified to user.
	Error: Data Set does not match SOP Class		

The **Behaviour** of Storage SCU AE during communication failure is summarized in the TABLE-8

TABLE 8 STORAGE C-STORE COMMUNICATION FAILURE BEHAVIOR

Exception	Behaviour
Timeout	The association is aborted, and the send job is marked as failed. The job failed status will be notified to user.
Association aborted by the SCP or network layers	The send job is marked as failed. The job failed status will be notified to user.

If the image transfer fails, the Storage SCU AE retries the failed job based on the number of retries configured.

3.2.2 Workflow Application Entity

3.2.2.1 SOP Classes

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

TABLE 9 SUPPORTED SOP CLASSES

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No

3.2.2.2 Association Policies

General

The DICOM standard Application Context Name is always proposed.

TABLE 10 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 11 IDENTIFYING INFORMATION

Implementation Class UID	1.2.276.0.7230010.3.0.3.6.5
Implementation Version Name	OFFIS_DCMTK_365

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

3.2.2.3 Association Initiation Policy

An attempt to establish a new association will be made due to:

- Modality worklist query initiated by the operator to request scheduled patient from the Modality worklist server.

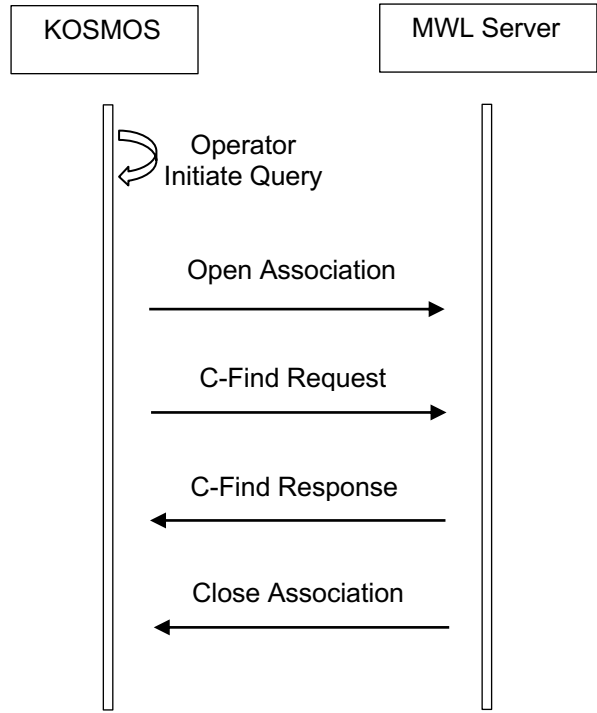


Figure 2 Application Data Flow Diagram

Worklist Query Activity – Proposed Presentation Contexts

Table 12 shows the proposed presentation contexts for the Modality Worklist Query Activity.

TABLE 12 PROPOSED MODALITY WORKLIST QUERY PRESENTATION CONTEXTS

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
			1.2.840.10008.1.2.2		
		Explicit VR Big Endian	1.2.840.10008.1.2		
		Implicit VR Little Endian			

3.2.2.4 SOP Specific DICOM Conformance Statement Modality

The Modality worklist SCU AE queries with attributes summarized in the table below. The attributes that provides value matching is specified in the Value Matching column.

TABLE 13 MODALITY WORKLIST QUERY KEYS

Attribute Name	Tag	Value Matching
Accession Number	(0008,0050)	Single Value
Institution Name	(0008,0080)	
Referring Physician Name	(0008,0090)	
Admitting Diagnoses Description	(0008,1080)	
Reference Study Sequence	(0080,1110)	
>Referenced SOP Class UID	(0008,1150)	
>Referenced SOP Instance UID	(0008,1155)	
Patient Name	(0010,0010)	Single Value / Wildcard
Patient ID	(0010,0020)	Single Value
Patient Birth Date	(0010,0030)	
Patient Sex	(0010,0040)	
Patient Size	(0010,1020)	
Patient Weight	(0010,1030)	
Medical Alert	(0010,2000)	
Allergies	(0010,2110)	
Ethnic Group	(0010,2160)	
Additional Patient History	(0010,21b0)	
Pregnancy Status	(0010,21c0)	
Patient Comments	(0010,4000)	
Study Instance UID	(0020,000d)	
Requesting Physician	(0032,1032)	
Requested Procedure Description	(0032,1060)	
Requested Procedure Code Sequence	(0032,1064)	

>Code Value	(0008,0100)	
>Coding Scheme Designator	(0008,0102)	
>Coding Scheme Version	(0008,0103)	
>Code Meaning	(0008,0104)	
Current Patient Location	(0038,0300)	
Scheduled Procedure Step Sequence	(0040,0100)	
>Modality	(0008,0060)	Single Value
>Scheduled Station AE Title	(0040,0001)	Single Value
>Scheduled Procedure Step Start Date	(0040,0002)	Date range
>Scheduled Procedure Step Start Time	(0040,0003)	
>Scheduled Performing Physician Name	(0040,0006)	
>Scheduled Procedure Step Description	(0040,0007)	
>Scheduled Protocol Code Sequence	(0040,0008)	
>>Code Value	(0008,0100)	
>>Coding Scheme Designator	(0008,0102)	
>>Coding Scheme Version	(0008,0103)	
>>Code Meaning	(0008,0104)	
>Scheduled Procedure Step ID	(0040,0009)	
>Scheduled Station Name	(0040,0010)	
Requested Procedure ID	(0040,1001)	Single Value
Reason for the Requested Procedure	(0040,1002)	
Names of the Intended Recipients of Results	(0040,1010)	
Requested Procedure Comments	(0040,14000)	

The **Behaviour** of Modality worklist SCU AE that corresponds to the status codes in a C-FIND response is summarized in the table below:

TABLE 14 MODALITY WORKLIST C-FIND RESPONSE STATUS HANDLING BEHAVIOR

Status	Further Meaning	Status Code	Behaviour
Success	Success	0000	The application displays the returned items to the user.
Failure	Refused: Out of resource	A700	The application notifies the user the query has failed.
	Error: Data Set does not match SOP Class	A900	
	Refused: SOP Class not supported	0122	
	Failed: Unable to process	Cxxx	
Pending	Matches are continuing	FF00	The application displays the returned item to the user and wait for next C-FIND response.
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence for this Identifier.	FF01	
Cancel	Matching terminated due to Cancel request	FE00	The application displays the returned items to the user up until the response that has cancel status

3.3 Network Interfaces

3.3.1 Wireless Network Interfaces

TCP/IP over IP4 is supported over WiFi 802.11ad, 802.11ac Wave 2, 802.11a/b/g, 802.11n

3.4 Configuration

3.4.1 AE Title/Presentation Address Mapping

The Local AE title and Remote AE title is configurable through the individual profile in the DICOM settings of Modality Worklist and PACS.

3.4.2 Configurable Parameters

- Local AE Title
- Server Hostname or IP Address
- Server AE Title

- Server Port number

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 specified in the table below.

TABLE 15 US (MULTI-FRAME) IMAGE IOD MODULES

IE	Module	Reference	Presence of Module
Patient	Patient	Table 16	ALWAYS
Study	General Study	Table 18	ALWAYS
Series	General Series	Table 19	ANAP
Equipment	General Equipment	Table 20	ALWAYS
Image	General Image	Table 21	ALWAYS
	Image Pixel	Table 22	ALWAYS
	Cine	Table 23	Only if Multi-frame
	Multi-frame	Table 24	Only if Multi-frame
	US Image	Table 25	ALWAYS
	SOP Common	Table 26	ALWAYS

4.1.2 Patient Module

TABLE 16 PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Patient's Name	(0010,0010)	From MWL/User Enter	ALWAYS	MWL/USER
Patient ID	(0010,0020)	From MWL/System Generated/User Enter	ALWAYS	MWL/USER
Patient's Birth Date	(0010,0030)	From MWL/User Enter	ALWAYS	MWL/USER
Patient's Sex	(0010,0040)	From MWL/User Enter	ALWAYS	MWL/USER

4.1.3 Patient Study Module

TABLE 17 PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Patient Size	(0010,1020)	From MWL/User Enter	VNAP	MWL/USER
Patient's Weight	(0010,1030)	From MWL/User Enter	VNAP	MWL/USER
Medical Alerts	(0010,2000)	From MWL	ANAP	MWL
Allergies	(0010,2110)	From MWL	ANAP	MWL
Pregnancy Status	(0010,21C0)	From MWL	ANAP	MWL

4.1.4 General Study Module

TABLE 18 GENERAL STUDY ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	From MWL/System Generated	ALWAYS	MWL/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)	From MWL/User Enter	VNAP	MWL/USER
Study ID	(0020,0010)	System Generated	ALWAYS	AUTO
Accession Number	(0008,0050)	From MWL/User Enter	VNAP	MWL/USER
Study Description	(0008,1030)	User Enter	VNAP	USER
Physician(s) of Record	(0008,1048)	User Enter	VNAP	USER

4.1.5 General Series Module

TABLE 19 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	ANAP	AUTO
Series Number	(0020,0011)	System Generated	ALWAYS	AUTO
Performing Physicians' Name	(0008,1050)	User Enter	VNAP	USER
Operators' Name	(0008,1070)	Same as performing physicians' name	VNAP	USER
Request Attribute Sequence	(0040,0275)		ANAP	MWL
>Requested Procedure Description	(0032,1060)	From MWL	ANAP	MWL
>Scheduled Procedure Step Description	(0040,0007)	From MWL	ANAP	MWL
>Scheduled Protocol Code Sequence	(0040,0008)	From MWL	ANAP	MWL

>Scheduled Procedure Step ID	(0040,0009)	From MWL	ANAP	MWL
>Requested Procedure ID	(0040,1001)	From MWL	ANAP	MWL

4.1.6 General Equipment Module

TABLE 20 GENERAL EQUIPMENT MODULE

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

4.1.7 General Image Module

TABLE 21 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	ANAP	AUTO
Content Time	(0008,0033)	Image creation time	ANAP	AUTO
Image Type	(0008,0008)	Derived, primary, specific ultrasound modality	ALWAYS	AUTO
Image Comments	(0020,4000)	Image name	ANAP	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

4.1.8 Image Pixel Module

TABLE 22 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)	720	ALWAYS	AUTO
Columns	(0028,0011)	1280	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 – color by pixel	ALWAYS	AUTO

4.1.9 Cine Module

TABLE 23 CINE MODULE ATTRIBUTES

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

4.1.10 Multi-frame Module

TABLE 24 MULTI-FRAME ATTRIBUTES

Attribute Name	Tag	Value	Presence of Value	Source
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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

4.1.11 US Image Module

TABLE 25 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 – color by pixel	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	Set to 1 when “Use Lossy Compression” selected and negotiated by server.	ANAP	AUTO

4.1.12 SOP Common Module

TABLE 26 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

4.2 US Region Calibration Module

TABLE 27 US REGION CALIBRATION MODULE B-MODE

Attribute Name	Tag	VR	Value	Presence of Value	Source
Sequence of Ultrasound Regions	(0018,6011)	SQ		ALWAYS	AUTO
Region Spatial Format	(0018,6012)	US	1	ALWAYS	AUTO
Region Data Type	(0018,6014)	US	1	ALWAYS	AUTO
Region Flags	(0018,6016)	UL	2	ALWAYS	AUTO
Region Location Min x0	(0018,6018)	UL		ALWAYS	AUTO
Region Location Min y0	(0018,601A)	UL		ALWAYS	AUTO
Region Location Max x1	(0018,601C)	UL		ALWAYS	AUTO
Region Location Max y1	(0018,601E)	UL		ALWAYS	AUTO
Reference Pixel x0	(0018,6020)	SL		ALWAYS	AUTO
Reference Pixel y0	(0018,6022)	SL		ALWAYS	AUTO
Physical Units X Direction	(0018,6024)	US		ALWAYS	AUTO
Physical Units Y Direction	(0018,6026)	US		ALWAYS	AUTO
Reference Pixel Physical Value X	(0018,6028)	FD		ALWAYS	AUTO
Reference Pixel Physical Value Y	(0018,602A)	FD		ALWAYS	AUTO
Physical Delta X	(0018,602C)	FD		ALWAYS	AUTO
Physical Delta Y	(0018,602E)	FD		ALWAYS	AUTO

TABLE 28 US REGION CALIBRATION MODULE M-MODE

Attribute Name	Tag	VR	Value	Presence of Value	Source
Sequence of Ultrasound Regions	(0018,6011)	SQ		ALWAYS	AUTO
Region Spatial Format	(0018,6012)	US	2	ALWAYS	AUTO
Region Data Type	(0018,6014)	US	1	ALWAYS	AUTO
Region Flags	(0018,6016)	UL	3	ALWAYS	AUTO
Region Location Min x0	(0018,6018)	UL		ALWAYS	AUTO
Region Location Min y0	(0018,601A)	UL		ALWAYS	AUTO
Region Location Max x1	(0018,601C)	UL		ALWAYS	AUTO
Region Location Max y1	(0018,601E)	UL		ALWAYS	AUTO
Reference Pixel x0	(0018,6020)	SL		ALWAYS	AUTO
Reference Pixel y0	(0018,6022)	SL		ALWAYS	AUTO
Physical Units X Direction	(0018,6024)	US		ALWAYS	AUTO
Physical Units Y Direction	(0018,6026)	US		ALWAYS	AUTO
Reference Pixel Physical Value X	(0018,6028)	FD		ALWAYS	AUTO
Reference Pixel Physical Value Y	(0018,602A)	FD		ALWAYS	AUTO
Physical Delta X	(0018,602C)	FD		ALWAYS	AUTO
Physical Delta Y	(0018,602E)	FD		ALWAYS	AUTO

TABLE 29 US REGION CALIBRATION MODULE SPECTRAL DOPPLER

Attribute Name	Tag	VR	Value	Presence of Value	Source
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Sequence of Ultrasound Regions	(0018,6011)	SQ		ALWAYS	AUTO
Region Spatial Format	(0018,6012)	US	3	ALWAYS	AUTO
Region Data Type	(0018,6014)	US	3 - PW 4 - CW	ALWAYS	AUTO
Region Flags	(0018,6016)	UL	3	ALWAYS	AUTO
Region Location Min X0	(0018,6018)	UL		ALWAYS	AUTO
Region Location Min Y0	(0018,601A)	UL		ALWAYS	AUTO
Region Location Max X1	(0018,601C)	UL		ALWAYS	AUTO
Region Location Max Y1	(0018,601E)	UL		ALWAYS	AUTO
Reference Pixel x0	(0018,6020)	SL		ALWAYS	AUTO
Reference Pixel y0	(0018,6022)	SL		ALWAYS	AUTO
Physical Units X Direction	(0018,6024)	US		ALWAYS	AUTO
Physical Units Y Direction	(0018,6026)	US		ALWAYS	AUTO
Reference Pixel Physical Value X	(0018,6028)	FD		ALWAYS	AUTO
Reference Pixel Physical Value Y	(0018,602A)	FD		ALWAYS	AUTO
Physical Delta X	(0018,602C)	FD		ALWAYS	AUTO
Physical Delta Y	(0018,602E)	FD		ALWAYS	AUTO