Echo Blaster 64, Echo Blaster 128, LS64, LS128, ClarUs, SmartUs, MicrUs and ArtUs Series Ultrasound Systems

Echo Wave II Software

DICOM Conformance Statement

TELEMED

Ultrasound Medical Systems

Content

1. Introduction

This document describes the conformance of the TELEMED Echo Blaster 64, Echo Blaster 128, LS64, LS128, ClarUs, SmartUs, MicrUs and ArtUs Series Ultrasound Systems "Echo Wave II" Software to the ACR-NEMA DICOM (Digital Imaging and Communications in Medicine) standard and satisfies the DICOM requirement for a vendor conformance specification.

This document is written with respect to the ACR-NEMA Digital Imaging and Communications in Medicine (DICOM) version number 3.0.

- Acronyms and Abbreviations

ACR	American College of Radiology
AE	Application Entity
ANSI	American National Standards Institute
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
HIS	Hospital Information System
IE	Information Entity
IOD	Information Object Definition
ISO	International Standards Organization
MB	Megabyte
MPPS	Modality Performed Procedure Step
MWL	Modality Worklist
NEMA	National Electrical Manufacturers Association
OSI	Open Systems Interconnections
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
RIS	Radiology Information System
SC	Service Class
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
TS	Transfer Syntax
UID	Unique Identifier
US	Ultrasound
VR	Value Representation

For complete definitions of terms and acronyms please refer to the Digital Imaging and Communications in Medicine (DICOM) Standard.

1.1. Important Note to the Reader

This document is intended for the (potential) users and integrators of medical equipment who plan to connect this system to their HIS/RIS (Hospital/Radiology Information System) that has DICOM support.

It is assumed that the reader of this document is familiar with the DICOM standard.

It is important to note that this Conformance Statement by itself does not guarantee successful interoperation between systems of different manufacturers.

It is responsibility of the (potential) user/integrator to analyze Conformance Statements of desired to connect systems and perform configuration and tests of these systems in order to make sure that tested systems have desired interoperability, performance, stability and proper data exchange.

2. Implementation Model

"Echo Wave II" software supports the following DICOM functionality:
- Verify communication to remote Application Entity (AE).
- Retrieve ultrasound Modality Worklist (MWL) from RIS/HIS.
- Send Modality Performed Procedure Step (MPPS) information to remote server.
- Transfer single frame or multiframe image to DICOM storage server.
- Print grayscale or color image to networked DICOM printer.

2.1. Application Data Flow Diagram

The diagram below represents real-world activities, "Echo Wave II" Application Entities (AE) and their relationships.
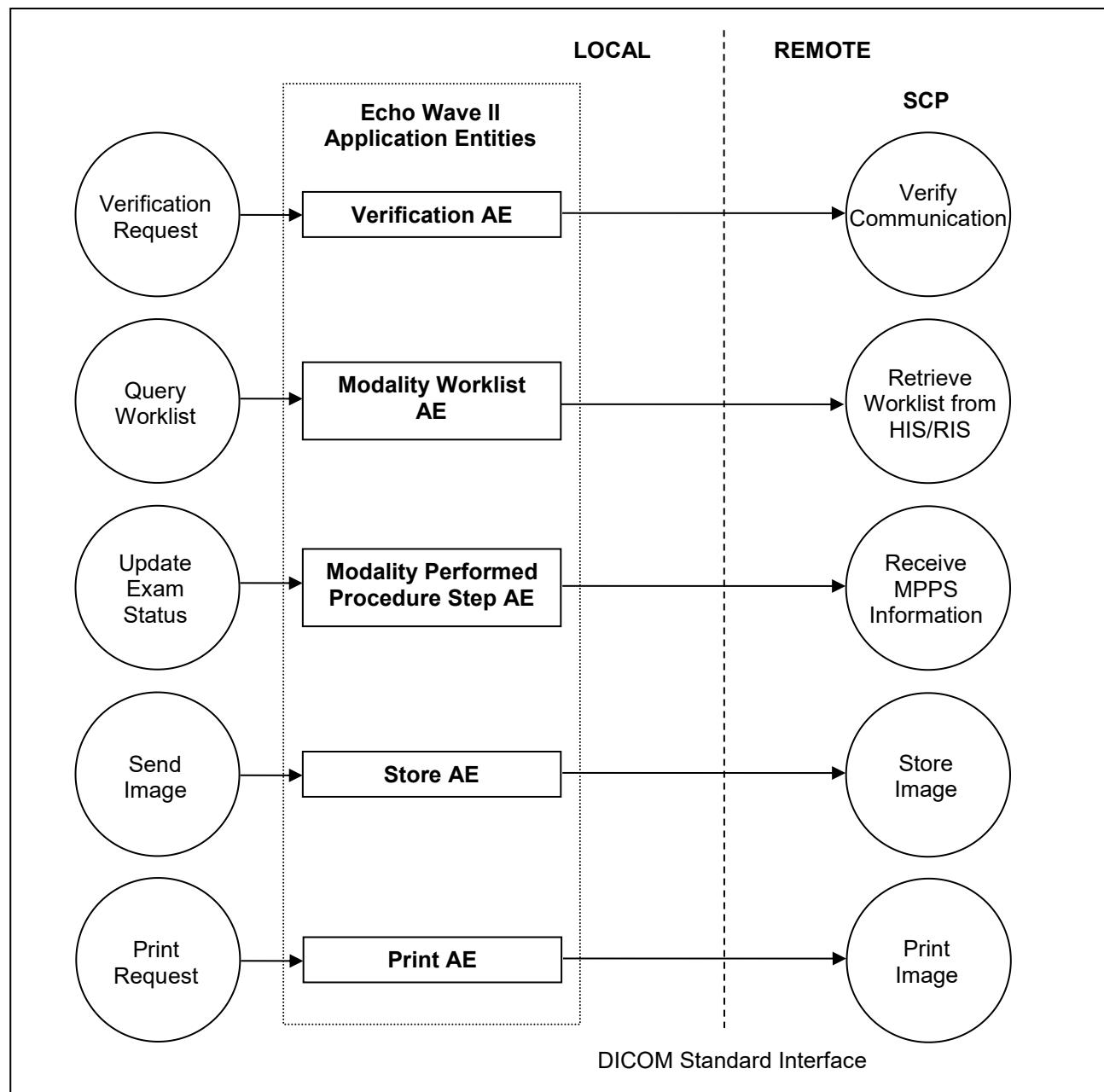
Implementation Model

Verification Request

Using "Echo Wave II" software the user can send verification request to remote storage server (PACS), worklist server, MPPS server (or HIS/RIS) or printer. This feature is available at software options window and is used for checking connectivity to remote server.

Query Worklist

The user can send query to worklist server (HIS/RIS) in order to get the list of scheduled patients and information about these patients. This is done either manually or automatically when is opened worklist panel inside patient information window.

Update Exam Status

When the user selects patient from worklist and clicks buttons in order to start/finish/discontinue exam of selected worklist patient, software sends MPPS message to MPPS server (HIS/RIS) in order to update the status of examination.

Send Image

After scanning ultrasound image or cine (multiframe image), the user can send it to DICOM compliant archiving server on the network (PACS).

Print Request

After scanning ultrasound image, the user can send it to DICOM compliant printer on the network.

2.2. Functional Definitions of AEs

2.2.1. Verification AE

Verification AE acts as an SCU and performs the following functions:
- Negotiates and establishes DICOM association with remote AEs (PACS, HIS/RIS, MWL, MPPS servers).
- Verifies communication to a remote AE by issuing an echo request.
- Releases the association with a remote AE.
- Notifies the user about communication status.

2.2.2. Modality Worklist AE

Modality Worklist AE acts as an SCU and performs the following functions:
- Negotiates and establishes DICOM association with remote HIS/RIS server (SCP).
- Queries for patient and scheduled procedures information using the modality worklist information model.
- Releases the association with a remote AE.
- Displays received worklist information to the user.

2.2.3. Modality Performed Procedure Step AE

Modality Performed Procedure Step AE acts as an SCU and performs the following functions:
- Negotiates and establishes DICOM association with remote HIS/RIS MPPS server (SCP).
- Notifies MPPS server about started, finished and discontinued examination.
- Releases the association with a remote AE.
- Updates local information about examination status.

2.2.4. Store AE

Store AE acts as an SCU and handles sending of ultrasound images to a networked storage server (PACS) that acts as a DICOM store SCP. Store AE performs the following actions:
- Negotiates and establishes DICOM association with remote AE (PACS).
- Sends single frame and multiframe ultrasound images to server.
- Releases the association with a remote AE.
- Notifies the user about operation result.

2.2.5. Print AE

Print AE acts as an SCU and handles printing of ultrasound images to a networked printer that acts as a DICOM print SCP. Print AE performs the following actions:
- Negotiates and establishes DICOM association with remote AE (printer).
- Sends grayscale or color image to printer:
  - Gets Printer (N-GET),
  - Creates Film Session (N-CREATE),
  - Creates Film Box (N-CREATE),
  - Sets Grayscale or Color Image Box (N-SET),
  - Invokes print action for Film Session (N-ACTION),
  - Deletes Film Session (N-DELETE).
- Releases the association with a remote AE.
- Notifies the user about operation result.

2.3. Sequencing of Real-World Activities

Under normal scheduled workflow conditions the sequencing of real-world activities is as follows:
1. Query worklist automatically or on the user's request.
2. Receive worklist and display it to the user.
3. When inside worklist panel the user selects desired worklist item and clicks "Start exam" button, send "IN PROGRESS" message to MPPS server and update local information about patient and examination status.
4. Acquire ultrasound images and on the user request send single frame and multiframe images to PACS or print images to DICOM printer. After image sending display operation status to the user.
5. When inside worklist panel the user clicks "Finish exam" or "Discontinue exam" buttons, send "COMPLETED" or "DISCONTINUED" message to MPPS server and update local information about examination status.

Other workflow situations (e.g. in the case of unscheduled procedure or if MWL and MPPS servers are not configured) will have other sequencing of real-world activities.

2.4. Mapping of DICOM Entities to Software Entities

DICOM	Software
Patient	Patient
Study	Exam
Series	Exam
Image	Image

3. AE Specifications

3.1. Verification AE Specification

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

SOP Class Name	SOP Class UID	Conformance Level
Verification	1.2.840.10008.1.1	Standard

3.1.1. Association Establishment Policies

3.1.1.1. General

The maximum PDU size is 16384 bytes.

3.1.1.2. Number of Associations

The number of simultaneous associations is 1.

3.1.1.3. Asynchronous Nature

There is no asynchronous activity in this implementation.

3.1.1.4. Implementation Identifying Information

Implementation Class UID: 1.2.276.0.7230010.3.0.3.6.0
Implementation Version: OFFIS_DCMTK_360

3.1.2. Association Initiation by Real-world Activity

The association is initiated when the user in software options window clicks "Echo" button. Timeout occurs if response from remote server is not received in 30 seconds. The user is notified about the result of performed operation.

3.1.2.1. Proposed Presentation Contexts

Verification AE Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.3. SOP Specific Conformance of SCU

The Verification AE provides standard conformance. Extended negotiation is not supported.

3.2. Modality Worklist AE Specification

The Modality Worklist AE provides conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID	Conformance Level
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Standard

3.2.1. Association Establishment Policies

3.2.1.1. General

The maximum PDU size is 16384 bytes.

3.2.1.2. Number of Associations

The number of simultaneous associations is 1.

3.2.1.3. Asynchronous Nature

There is no asynchronous activity in this implementation.

3.2.1.4. Implementation Identifying Information

Implementation Class UID: 1.2.276.0.7230010.3.0.3.5.5
Implementation Version: OFFIS_DCMTK_355

3.2.2. Association Initiation by Real-world Activity

The association is initiated when the user opens worklist panel inside patient information window, when the user manually clicks "Send query" button, when worklist panel is opened and user activity is not detected for 5 minutes. When worklist is received, association is closed and received worklist items are displayed to the user.

3.2.2.1. Proposed Presentation Contexts

Modality Worklist AE Proposed 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
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.2.3. SOP Specific Conformance of SCU

This section and its subsections describe modules and attributes of Modality Worklist Information Model that are used in C-FIND request to the MWL server. It is assumed that each returned worklist item contains one procedure step.

Match: R - Required, O - Optional.
Return: 1 - Mandatory; 2 - Mandatory, may be empty; 3 - Optional; 1C - Conditional; 2C - Conditional.
Tag format: (group,element).
VR (Value Representation) - see DICOM standard.

3.2.3.1. Scheduled Procedure Step Module

Name	Tag	VR	Match	Return	Comments
Scheduled Procedure Step Sequence	(0040,0100)	SQ	R	1	-
> Scheduled Station AE Title	(0040,0001)	AE	R	1	"This AE Title" from "Options" window if is checked MWL query option "Get only scheduled for this application entity".
> Scheduled Procedure Step Start Date	(0040,0002)	DA	R	1	User input or generated at MWL interface.
> Scheduled Procedure Step Start Time	(0040,0003)	TM	R	1	User input or generated at MWL interface.
> Modality	(0008,0060)	CS	R	1	Always US.
> Scheduled Performing Physician's Name	(0040,0006)	PN	R	2	User input at MWL interface.
> Scheduled Procedure Step Description	(0040,0007)	LO	O	1C	-
> Scheduled Station Name	(0040,0010)	SH	O	2	-
> Scheduled Procedure Step Location	(0040,0011)	SH	O	2	-
> Scheduled Protocol Code Sequence	(0040,0008)	SQ	O	1C	-
>> Code Value	(0008,0100)	SH	O	1	-
>> Coding Scheme Designator	(0008,0102)	SH	O	1	-
>> Code Meaning	(0008,0104)	LO	O	3	-
> Pre-Medication	(0040,0012)	LO	O	2C	-
> Scheduled Procedure Step ID	(0040,0009)	SH	O	1	-
> Requested Contrast Agent	(0032,1070)	LO	O	2C	-
> Scheduled Procedure Step Status	(0040,0020)	CS	O	3	Defined terms: SCHEDULED - Procedure Step scheduled; ARRIVED - patient is available for the Scheduled Procedure Step; READY - all patient and other necessary preparation for this step has been completed; STARTED - at least one Performed Procedure Step has been created that references this Scheduled Procedure Step.
> Comments on the Scheduled Procedure Step	(0040,0400)	LT	O	3	-

3.2.3.2. Requested Procedure Module

Name	Tag	VR	Match	Return	Comments
Requested Procedure ID	(0040,1001)	SH	O	1	-
Reason for the Requested Procedure	(0040,1002)	LO	O	3	-
Requested Procedure Description	(0032,1060)	LO	O	1C	-
Requested Procedure Code Sequence	(0032,1064)	SQ	O	1C	-
> Code Value	(0008,0100)	SH	O	1	-
> Coding Scheme Designator	(0008,0102)	SH	O	1	-
> Code Meaning	(0008,0104)	LO	O	3	-
Requested Procedure Comments	(0040,1400)	LT	O	3	-
Study Instance UID	(0020,000D)	UI	O	1	-
Referenced Study Sequence	(0008,1110)	SQ	O	2	-
> Referenced SOP Class UID	(0008,1150)	UI	O	1	-
> Referenced SOP Instance UID	(0008,1155)	UI	O	1	-
Requested Procedure Priority	(0040,1003)	SH	O	2	Defined terms: STAT, HIGH, ROUTINE, MEDIUM, LOW

3.2.3.3. Imaging Service Request Module

Name	Tag	VR	Match	Return	Comments
Accession Number	(0008,0050)	SH	R	1	User input at MWL interface.
Requesting Physician	(0032,1032)	PN	O	2	-

3.2.3.4. Patient Identification Module

Name	Tag	VR	Match	Return	Comments
Patient's Name	(0010,0010)	PN	R	1	User input at MWL interface.
Patient ID	(0010,0020)	LO	R	1	User input at MWL interface.
Issuer of Patient ID	(0010,0021)	LO	O	3	-

3.2.3.5. Patient Demographic Module

Name	Tag	VR	Match	Return	Comments
Patient's Birth Date	(0010,0030)	DA	R	2	User input at MWL interface.
Patient's Sex	(0010,0040)	CS	O	2	Return values: M - male, F - female, O - other.
Patient's Size	(0010,1020)	DS	O	2	-
Patient's Weight	(0010,1030)	DS	O	2	-

3.2.3.6. Patient Medical Module

Name	Tag	VR	Match	Return	Comments
Contrast Allergies	(0010,2110)	LO	O	2	-
Medical Alerts	(0010,2000)	LO	O	2	-
Pregnancy Status	(0010,21C0)	US	O	2	-

3.3. Modality Performed Procedure Step AE Specification

The Modality Performed Procedure Step AE provides conformance to the following DICOM SOP Classes as an SCU:

SOP Class Name	SOP Class UID	Conformance Level
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Standard

3.3.1. Association Establishment Policies

3.3.1.1. General

The maximum PDU size is 16384 bytes.

3.3.1.2. Number of Associations

The number of simultaneous associations is 1.

3.3.1.3. Asynchronous Nature

There is no asynchronous activity in this implementation.

3.3.1.4. Implementation Identifying Information

Implementation Class UID: 1.2.276.0.7230010.3.0.3.5.5
Implementation Version: OFFIS_DCMTK_355

3.3.2. Association Initiation by Real-world Activity

The association is initiated when the user clicks "Start exam", "Finish exam" or "Discontinue exam" buttons after selecting desired MWL item inside worklist panel of patient information window. After sending appropriate MPPS message to MPPS server association is released.

3.3.2.1. Proposed Presentation Contexts

Modality Performed Procedure Step AE Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.3.3. SOP Specific Conformance of SCU

This section describes modules and attributes that are used by Modality Performed Procedure Step AE.
Requirement Type: 1 - Mandatory; 2 - Mandatory, may be empty; 3 - Optional; 1C - Conditional; 2C - Conditional.
Tag format: (group,element).
VR (Value Representation) - see DICOM standard.

3.3.3.1. Performed Procedure Step Relationship Module

Name	Tag	VR	Req. Type N-CREATE	Req. Type N-SET	Comments
Scheduled Step Attribute Sequence	(0040,0270)	SQ	1	Not allowed	From MWL.
>Study Instance UID	(0020,000D)	UI	1	Not allowed	From MWL.
>Referenced Study Sequence	(0008,1110)	SQ	2	Not allowed	From MWL.
>>Referenced SOP Class UID	(0008,1150)	UI	1	Not allowed	From MWL
>>Referenced SOP Instance UID	(0008,1155)	UI	1	Not allowed	From MWL
>Accession Number	(0008,0050)	SH	2	Not allowed	From MWL.
>Requested Procedure ID	(0040,1001)	SH	2	Not allowed	From MWL.
>Requested Procedure Description	(0032,1060)	LO	2	Not allowed	From MWL.
>Scheduled Procedure Step ID	(0040,0009)	SH	2	Not allowed	From MWL.
>Scheduled Procedure Step Description	(0040,0007)	LO	2	Not allowed	From MWL.
>Scheduled Protocol Code Sequence	(0040,0008)	SQ	2	Not allowed	Empty.
>> Code Value	(0008,0100)	SH	1	Not allowed	-
>> Coding Scheme Designator	(0008,0102)	SH	1	Not allowed	-
>> Code Meaning	(0008,0104)	LO	1	Not allowed	-
Patient's Name	(0010,0010)	PN	2	Not allowed	From MWL.
Patient ID	(0010,0020)	LO	2	Not allowed	From MWL.
Patient's Birth Date	(0010,0030)	DA	2	Not allowed	From MWL.
Patient's Sex	(0010,0040)	CS	2	Not allowed	From MWL.
Patient's Size	(0010,1020)	DS	3	Not allowed	From MWL.
Patient's Weight	(0010,1030)	DS	3	Not allowed	From MWL.
Referenced Patient Sequence	(0008,1120)	SQ	2	Not allowed	Empty.
> Referenced SOP Class UID	(0008,1150)	UI	1	Not allowed	-
> Referenced SOP Instance UID	(0008,1155)	UI	1	Not allowed	-

3.3.3.2. Performed Procedure Step Information Module

Name	Tag	VR	Req. Type N-CREATE	Req. Type N-SET	Comments
Performed Procedure Step ID	(0040,0253)	SH	1	Not allowed	From MWL.
Performed Station AE Title	(0040,0241)	AE	1	Not allowed	"This AE Title" from "Options" window.
Performed Station Name	(0040,0242)	SH	2	Not allowed	Empty.
Performed Location	(0040,0243)	SH	2	Not allowed	Empty.
Performed Procedure Step Start Date	(0040,0244)	DA	1	Not allowed	-
Performed Procedure Step Start Time	(0040,0245)	TM	1	Not allowed	-
Performed Procedure Step Status	(0040,0252)	CS	1	3	Defined terms: IN PROGRESS - started

Name	Tag	VR			Comments
					but not complete; DISCONTINUED - canceled or unsuccessfully terminated; COMPLETED - successfully completed.
Performed Procedure Step Discontinuation Reason Code Sequence	(0040,0281)	SQ	3	3	Used if (0040,0252) was set to DISCONTINUED.
> Code Value	(0008,0100)	SH	1	1	From CID 9300.
> Coding Scheme Designator	(0008,0102)	SH	1	1	Always DCM.
> Coding Scheme Version	(0008,0103)	SH	3	3	Empty.
> Code Meaning	(0008,0104)	LO	3	3	Empty.
Performed Procedure Step Description	(0040,0254)	LO	2	3	From MWL.
Performed Procedures Type Description	(0040,0255)	LO	2	3	Empty.
Performed Procedure Code Sequence	(0008,1032)	SQ	2	3	Empty.
> Code Value	(0008,0100)	SH	1	1	-
> Coding Scheme Designator	(0008,0102)	SH	1	1	-
> Coding Scheme Version	(0008,0103)	SH	3	3	-
> Code Meaning	(0008,0104)	LO	3	3	-
Performed Procedure Step End Date	(0040,0250)	DA	2	3	Updated when study is finished.
Performed Procedure Step End Time	(0040,0251)	TM	2	3	Updated when study is finished.

3.3.3.3. Image Acquisition Results Module

Name	Tag	VR	Req. Type N-CREATE	Req. Type N-SET/Final	Comments
Modality	(0008,0060)	CS	1	Not allowed	Always US.
Study ID	(0020,0010)	SH	2	Not allowed	From MWL.
Performed Protocol Code Sequence	(0040,0260)	SQ	2	3	Empty.
> Code Value	(0008,0100)	SH	1	1	-
> Coding Scheme Designator	(0008,0102)	SH	1	1	-
> Coding Scheme Version	(0008,0103)	SH	3	3	-
> Code Meaning	(0008,0104)	LO	3	3	-
Performed Series Sequence	(0040,0340)	SQ	2	3/1	-
> Performing Physician's Name	(0008,1050)	PN	2	2/2	"Sonographer name" from "Patient" window.
> Protocol Name	(0018,1030)	LO	1	1/1	User input at MWL interface.
> Operator's Name	(0008,1070)	PN	2	2/2	Empty.
> Series Instance UID	(0020,000E)	UI	1	1/1	Generated.
> Series Description	(0008,103E)	LO	2	2/2	"Note" from "Patient" window.
> Retrieve AE Title	(0008,0054)	AE	2	2/2	From MWL.
> Referenced Image Sequence	(0008,1140)	SQ	2	2/2	-
>> Referenced SOP Class UID	(0008,1150)	UI	1	1	-
>> Referenced SOP Instance UID	(0008,1155)	UI	1	1	-
> Referenced Non-Image Composite SOP Instance Sequence	(0040,0220)	SQ	2	2/2	Empty.
>> Referenced SOP Class UID	(0008,1150)	UI	1	1	-
>> Referenced SOP Instance UID	(0008,1155)	UI	1	1	-

3.4. Store AE Specification

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

SOP Class Name	SOP Class UID	Conformance Level
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Standard
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Standard
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Standard

3.4.1. Association Establishment Policies

3.4.1.1. General

The maximum PDU size is 16384 bytes.

3.4.1.2. Number of Associations

The number of simultaneous associations is 1.

3.4.1.3. Asynchronous Nature

There is no asynchronous activity in this implementation.

3.4.1.4. Implementation Identifying Information

Implementation Class UID: 1.2.276.0.7230010.3.0.3.6.0
Implementation Version: OFFIS_DCMTK_360

3.4.2. Association Initiation by Real-world Activity

The Store AE will open an association to the Storage Server when the real-world activity occurs corresponding to the user invocation of software menu item for sending single frame or multiframe image to DICOM server. When the image is sent, association is automatically closed.

3.4.2.1. Proposed Presentation Contexts

Store AE Proposed Presentation Contexts to a Storage Server

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	JPEG Baseline	1.2.840.10008.1.2.4.50	SCU	None
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	JPEG Baseline	1.2.840.10008.1.2.4.50	SCU	None

Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	JPEG Baseline	1.2.840.10008.1.2.4.50	SCU	None

Note. Depending on software configuration, also can be used Explicit VR Little Endian (1.2.840.10008.1.2.1) and Explicit VR Big Endian (1.2.840.10008.1.2.2) transfer syntaxes.

3.4.3. SOP Specific Conformance of SCU

This section describes modules and attributes that are used by Store AE.
Uses: 1 - Mandatory; 2 - Mandatory, may be empty; 3 - Optional; 1C - Conditional; 2C - Conditional.
Tag format: (group,element).
VR (Value Representation) - see DICOM standard.

3.4.3.1. Patient Module

Name	Use	Tag	VR (Type)	Comments
Patient's Name	2	(0010,0010)	PN	From MWL or user input at "Patient" window.
Patient ID	2	(0010,0020)	LO	From MWL or user input at "Patient" window.
Patient's Birth Date	2	(0010,0030)	DA	From MWL or user input at "Patient" window. Format: YYYYMMDD
Patient's Sex	2	(0010,0040)	CS	From MWL or user input at "Patient" window. M - male, F - female
Responsible Person	2C	(0010,2297)	PN	User input at "Patient" window.

3.4.3.2. General Study Module

Name	Use	Tag	VR (Type)	Comments
Study Instance UID	1	(0020,000D)	UI	From MWL or generated.
Study ID	2	(0020,0010)	SH	From MWL.
Study Date	2	(0008,0020)	DA	Exam date. Format: YYYYMMDD
Study Time	2	(0008,0030)	TM	Exam time. Format: hhmmss
Accession Number	2	(0008,0050)	SH	From MWL.
Study Description	3	(0008,1030)	LO	Exam type from "Patient" window.
Referenced Study Sequence	3	(0008,1110)	SQ	From MWL.
> Referenced SOP Class UID	1C	(0008,1150)	UI	From MWL.
> Referenced SOP Instance UID	1C	(0008,1155)	UI	From MWL.

3.4.3.3. General Series Module

Name	Use	Tag	VR (Type)	Comments
Modality	1	(0008,0060)	CS	US or SC.
Series Instance UID	1	(0020,000E)	UI	Generated.
Series Number	2	(0020,0011)	IS	Generated 1..n.
Laterality	2C	(0020,0060)	CS	Empty.
Performing Physician's Name	3	(0008,1050)	PN	User input. "Sonographer's name" at "Patient" window.
Series Description	3	(0008,103E)	LO	User input. "Note" at "Patient" window.
Performed Procedure Step Start Date	3	(0040,0244)	DA	From MPPS.
Performed Procedure Step Start Time	3	(0040,0245)	TM	From MPPS.
Performed Procedure Step ID	3	(0040,0253)	SH	From MWL Scheduled Procedure

Name	Use	Tag	VR (Type)	Comments
				Step ID.
Performed Procedure Step Description	3	(0040,0254)	LO	From MWL Scheduled Procedure Step Description.
Referenced Performed Procedure Step Sequence	3	(0008,1111)	SQ	From MPPS.
> Referenced SOP Class UID	1C	(0008,1150)	UI	MPPS SOP Class UID.
> Referenced SOP Instance UID	1C	(0008,1155)	UI	MPPS SOP Instance UID.
Request Attributes Sequence	3	(0040,0275)	SQ	From MWL.
> Requested Procedure ID	1C	(0040,1001)	SH	From MWL.
> Scheduled Procedure Step ID	1C	(0040,0009)	SH	From MWL.
> Scheduled Procedure Step Description	3	(0040,0007)	LO	From MWL.
> Scheduled Protocol Code Sequence	3	(0040,0008)	SQ	From MWL.
>> Code Value	1C	(0008,0100)	SH	From MWL.
>> Coding Scheme Designator	1C	(0008,0102)	SH	From MWL.
>> Code Meaning	1C	(0008,0104)	LO	From MWL.

3.4.3.4. General Equipment Module

Name	Use	Tag	VR (Type)	Comments
Manufacturer	2	(0008,0070)	LO	TELEMED
Institution Name	3	(0008,0080)	LO	"Hospital/clinic name" entered by the user at "Patient" window.
Manufacturer's Model Name	3	(0008,1090)	LO	Beamformer code.
Software Versions	3	(0018,1020)	LO	Software version.

3.4.3.5. General Image Module

Name	Use	Tag	VR (Type)	Comments
Instance Number	2	(0020,0013)	IS	Generated 1..n.
Patient Orientation	2C	(0020,0020)	CS	Empty.
Content Date	2C	(0008,0023)	DA	Generated.
Content Time	2C	(0008,0033)	TM	Generated.
Image Type	3	(0008,0008)	CS	ORIGINAL\PRIMARY DERIVED\SECONDARY
Image Comments	3	(0020,4000)	LT	"Comment" entered by the user at "Patient" window.
Lossy Image Compression	3	(0028,2110)	CS	If present and value is "01" - image was lossy compressed.
Lossy Image Compression Method	3	(0028,2114)	CS	If present and value is "ISO_10918_1" - was used JPEG Lossy Compression.

3.4.3.6. Image Pixel Module

Name	Use	Tag	VR (Type)	Comments
Samples Per Pixel	1	(0028,0002)	US	3 for RGB and YBR_FULL_422, 1 for MONOCHROME2.
Photometric Interpretation	1	(0028,0004)	CS	RGB, YBR_FULL_422, MONOCHROME2.
Number of Frames	1	(0028,0008)	IS	Is set to the number of frames in image.
Frame Increment Pointer	1C	(0028,0009)	AT	Frame Time Vector (0018,1065) if the image is multiframe IOD. Not used if the image is a single frame IOD.
Rows	1	(0028,0010)	US	Used
Columns	1	(0028,0011)	US	Used

Bits Allocated	1	(0028,0100)	US	8
Bits Stored	1	(0028,0101)	US	8
High Bit	1	(0028,0102)	US	7
Pixel Representation	1	(0028,0103)	US	0
Pixel Data	1	(7FE0,0010)	OB	Used
Planar Configuration	1C	(0028,0006)	US	1 - for single frame RGB color images. 0 - in other cases.

3.4.3.7. US Region Calibration Module

Name	Use	Tag	VR (Type)	Comments
Sequence of Ultrasound Regions	1	(0018,6001)	SQ	If present, sequence contains one or more regions of ultrasound data.
> Region Location Min x0	1	(0018,6018)	UL	Region's bounding rectangle is defined as (left, top, right, bottom) = (x0, y0, x1, y1).
> Region Location Min y0	1	(0018,601a)	UL	- // -
> Region Location Max x1	1	(0018,601c)	UL	- // -
> Region Location Max y1	1	(0018,601e)	UL	- // -
> Physical Units X Direction	1	(0018,6024)	US	0 - none, 3 - cm, 4 - seconds, 7 - cm/s
> Physical Units Y Direction	1	(0018,6026)	US	- // -
> Physical Delta X	1	(0018,602c)	FD	The physical value increments per positive X pixel increment.
> Physical Delta Y	1	(0018,602e)	FD	The physical value increments per positive Y pixel increment.
> Region Spatial Format	1	(0018,6012)	US	The spatial organization of the data within the region. 0 - none, 1 - 2D, 2 - M mode, 3 - PW mode.
> Region Data Type	1	(0018,6014)	US	The type of data within the region.
> Region Flags	1	(0018,6016)	UL	Flags used for special handling of the region.

3.4.3.8. US Image Module

Name	Use	Tag	VR (Type)	Comments
Image Type	2	(0008,0008)	CS	See "General Image Module".
Samples Per Pixel	1	(0028,0002)	US	See "Image Pixel Module".
Photometric Interpretation	1	(0028,0004)	CS	- // -
Number of Frames	1	(0028,0008)	IS	- // -
Frame Increment Pointer	1C	(0028,0009)	AT	- // -
Bits Allocated	1	(0028,0100)	US	- // -
Bits Stored	1	(0028,0101)	US	- // -
High Bit	1	(0028,0102)	US	- // -
Pixel Representation	1	(0028,0103)	US	- // -
Planar Configuration	1C	(0028,0006)	US	- // -
Lossy Image Compression	1C	(0028,2110)	CS	See "General Image Module".
Cine Rate	3	(0018,0040)	IS	Cine FPS (frames per second) if the image is multiframe IOD.
Frame Time Vector	1C	(0018,1065)	DS	Interframe times in milliseconds if the image is multiframe IOD.
Heart Rate	3	(0018,1088)	IS	Set to heart rate.

3.4.3.9. SC Image Module

Name	Use	Tag	VR (Type)	Comments
Image Type	2	(0008,0008)	CS	See "General Image Module".
Samples Per Pixel	1	(0028,0002)	US	See "Image Pixel Module".
Photometric Interpretation	1	(0028,0004)	CS	- // -
Number of Frames	1	(0028,0008)	IS	- // -
Frame Increment Pointer	1C	(0028,0009)	AT	- // -
Bits Allocated	1	(0028,0100)	US	- // -
Bits Stored	1	(0028,0101)	US	- // -
High Bit	1	(0028,0102)	US	- // -
Pixel Representation	1	(0028,0103)	US	- // -
Planar Configuration	1C	(0028,0006)	US	- // -
Lossy Image Compression	1C	(0028,2110)	CS	See "General Image Module".
Cine Rate	3	(0018,0040)	IS	Cine FPS (frames per second) if the image is multiframe IOD.
Frame Time Vector	1C	(0018,1065)	DS	Interframe times in milliseconds if the image is multiframe IOD.
Heart Rate	3	(0018,1088)	IS	Set to heart rate.

3.4.3.10. SOP Common Module

Name	Use	Tag	VR (Type)	Comments
SOP Class UID	1	(0008,0016)	UI	1.2.840.10008.5.1.4.1.1.6.1 (US)
SOP Instance UID	1	(0008,0018)	UI	Generated when the image is created.
Specific Character Set	1C	(0008,0005)	CS	From software "Options" window.
Instance Creation Date	3	(0008,0012)	DA	Generated.
Instance Creation Time	3	(0008,0013)	TM	Generated.

3.5. Print AE Specification

The Print AE provides conformance to the following DICOM SOP Classes as an SCU for Grayscale printing:

SOP Class Name	SOP Class UID	Conformance Level
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Standard
Printer SOP Class	1.2.840.10008.5.1.1.16	Standard
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

The Print AE provides conformance to the following DICOM SOP Classes as an SCU for Color printing:

SOP Class Name	SOP Class UID	Conformance Level
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	Standard
Printer SOP Class	1.2.840.10008.5.1.1.16	Standard
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

3.5.1. Association Establishment Policies

3.5.1.1. General

The maximum PDU size is 16384 bytes.

3.5.1.2. Number of Associations

The number of simultaneous associations is 1.

3.5.1.3. Asynchronous Nature

There is no asynchronous activity in this implementation.

3.5.1.4. Implementation Identifying Information

Implementation Class UID: 1.2.276.0.7230010.3.0.3.6.0
Implementation Version: OFFIS_DCMTK_360

3.5.2. Association Initiation by Real-world Activity

The association is initiated when the user selects "Send Image to DICOM Printer" menu item. After sending image to printer, association is released.

3.5.2.1. Proposed Presentation Contexts

Print AE Proposed Presentation Contexts for Grayscale printing

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	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

Print AE Proposed Presentation Contexts for Color printing

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	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

3.5.3. SOP Specific Conformance of SCU

This section describes modules and attributes that are used by Print AE.
Requirement Type: M - Mandatory; U - Optional.
Tag format: (group,element).
VR (Value Representation) - see DICOM standard.

3.5.3.1. Printer SOP Class

DIMSE services supported by Print AE as an SCU

Name	Comments
N-GET	Get status of the printer.

Supported N-GET Printer Module Attributes

Name	Use	Tag	VR (Type)	Comments
Printer Name	U	(2110,0030)	LO	Displayed to the user (if returned by the printer) when in "Options" window is clicked printer's status button.
Printer Status	U	(2110,0010)	CS	-//-
Printer Status Info	U	(2110,0020)	CS	-//-
Manufacturer	U	(0008,0070)	LO	-//-
Manufacturer Model Name	U	(0008,1090)	LO	-//-
Device Serial Number	U	(0018,1000)	LO	-//-
Software Versions	U	(0018,1020)	LO	-//-

Date of Last Calibration	U	(0018,1200)	DA	-//-
Time of Last Calibration	U	(0018,1201)	TM	-//-

3.5.3.2. Basic Film Session SOP Class

DIMSE services supported by Print AE as an SCU

Name	Comments
N-CREATE	Request to create film session.
N-ACTION	Request to print all images.
N-DELETE	Request to delete film session (all hierarchy).

Supported N-CREATE Basic Film Session Attributes

Name	Use	Tag	VR (Type)	Comments
Number of Copies	U	(2000,0010)	IS	Always 1.
Medium Type	U	(2000,0030)	CS	User input: BLUE FILM, CLEAR FILM, PAPER or other printer-specific value.
Film Destination	U	(2000,0040)	CS	User input: MAGAZINE, PROCESSOR, BIN_1, BIN_2, BIN_3, BIN_4 or other printer-specific value.

3.5.3.3. Basic Film Box SOP Class

DIMSE services supported by Print AE as an SCU

Name	Comments
N-CREATE	Request to create film box.

Supported N-CREATE Basic Film Box Attributes

Name	Use	Tag	VR (Type)	Comments
Image Display Format	M	(2010,0010)	ST	Always STANDARD\1,1.
Referenced Film Session Sequence	M	(2010,0500)	SQ	Used.
> Referenced SOP Class UID	M	(0008,1150)	UI	1.2.840.10008.5.1.1.1
> Referenced SOP Instance UID	M	(0008,1155)	UI	From created Film Session SOP Instance.
Film Orientation	U	(2010,0040)	CS	User input: PORTRAIT or LANDSCAPE.
Film Size ID	U	(2010,0050)	CS	User input: 8INX10IN, 8_5INX11IN, 10INX12IN, 10INX14IN, 11INX14IN, 11INX17IN, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM, A4, A3 or other printer-specific value.

3.5.3.4. Basic Grayscale Image Box SOP Class

DIMSE services supported by Print AE as an SCU

Name	Comments
N-SET	Request to set image box.

Supported N-SET Basic Grayscale Image Box Attributes

Name	Use	Tag	VR (Type)	Comments
Image Position	M	(2020,0010)	US	1
Basic Grayscale Image Sequence	M	(2020,0110)	SQ	-
> Samples Per Pixel	M	(0028,0002)	US	1
> Photometric Interpretation	M	(0028,0004)	CS	MONOCHROME2
> Rows	M	(0028,0010)	US	-
> Columns	M	(0028,0011)	US	-
> Bits Allocated	M	(0028,0100)	US	8
> Bits Stored	M	(0028,0101)	US	8
> High Bit	M	(0028,0102)	US	7
> Pixel Representation	M	(0028,0103)	US	0
> Pixel Data	M	(7FE0,0010)	OB	-

3.5.3.5. Basic Color Image Box SOP Class

DIMSE services supported by Print AE as an SCU

Name	Comments
N-SET	Request to set image box.

Supported N-SET Basic Color Image Box Attributes

Name	Use	Tag	VR (Type)	Comments
Image Position	M	(2020,0010)	US	1
Basic Color Image Sequence	M	(2020,0111)	SQ	-
> Samples Per Pixel	M	(0028,0002)	US	3
> Photometric Interpretation	M	(0028,0004)	CS	RGB
> Planar Configuration	M	(0028,0006)	US	1
> Rows	M	(0028,0010)	US	-
> Columns	M	(0028,0011)	US	-
> Bits Allocated	M	(0028,0100)	US	8
> Bits Stored	M	(0028,0101)	US	8
> High Bit	M	(0028,0102)	US	7
> Pixel Representation	M	(0028,0103)	US	0
> Pixel Data	M	(7FE0,0010)	OB	-

4. Communication Profile

This implementation supports the TCP/IP protocol stack that is inherited from the underlying Microsoft Windows operating system.

This implementation is indifferent to the physical medium and inherits the medium from the underlying Microsoft Windows operating system.

5. Extensions, Specializations, Privatizations

No private SOP Classes, private Transfer Syntaxes or private Elements are used in this implementation.

6. Configuration

The user can configure the following parameters using software options dialog:
- This AE title.
- Storage server's AE title, IP address and port. Advanced users can configure max PDU size, preferred transfer syntax.
- MWL server's AE title, IP address and port.
- MPPS server's AE title, IP address and port.
- Printer's AE title, IP address, port, color mode (grayscale/color), page layout (portrait/landscape), medium type (paper, film type), destination (bin), film size. It is possible to configure several printers with different parameters.
- Character set.

7. Support of Extended Character Sets

Supported character sets

DICOM Name	Character Set	Coverage
ISO_IR 100	Latin 1	Afrikaans, Albanian, Basque, Breton, Catalan, Danish, English (UK and US), Faroese, Galician, German, Icelandic, Irish (new orthography), Italian, Kurdish (The Kurdish Unified Alphabet), Latin (basic classical orthography), Leonese , Luxembourgish (basic classical orthography), Norwegian (Bokmål and Nynorsk), Occitan, Portuguese (Portuguese and Brazilian), Rhaeto-Romanic, Scottish Gaelic, Spanish, Swahili, Swedish, Walloon.
ISO_IR 101	Latin 2	Bosnian, Croatian, Czech, German, Hungarian, Polish, Serbian Latin, Slovak, Slovene, Upper Sorbian, Lower Sorbian, Romanian.
ISO_IR 109	Latin 3	Turkish, Maltese, Esperanto.
ISO_IR 110	Latin 4	Estonian, Latvian, Lithuanian, Greenlandic, Sami.
ISO_IR 148	Latin 5	Turkish.
ISO_IR 144	Cyrillic	Belarusian, Bosnian, Bulgarian, Kazakh, Kyrgyz, Macedonian, Moldovan, Mongolian, Russian, Serbian, Tajik, Tuvan, Ukrainian, Uzbek.
ISO_IR 127	Arabic	-
ISO_IR 126	Greek	-
ISO_IR 138	Hebrew	-
ISO_IR 192	Unicode	-
ISO_IR 6	ASCII	-

8. Security Profiles

This product does not conform to any DICOM Security Profiles.

It is assumed that the product is used within a secured environment where security is ensured at least by appropriately configured firewalls, routers, and communication is performed through secure network channels (e.g., Virtual Private Network).

9. References

1. Digital Imaging and Communications in Medicine (DICOM), NEMA Standard Publication No. PS 3.1-3.13, NEMA, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209.

2. World Wide Web: http://www.nema.org. Digital Imaging and Communications in Medicine (DICOM).

10. Revision History

Revision	Revision Date	Description of Revision	Revision Author
1.0.0	2009.03.04	Initial Release	V.Perlibakas
1.1.0	2009.03.12	Added section "US Region Calibration Module".	V.Perlibakas
1.2.0	2010.12.02	Added information about multiframe images.	V.Perlibakas
1.3.0	2011.02.09	Added information about Verification, Modality Worklist, Modality Performed Procedure Step. Updated Store AE modules information.	V.Perlibakas
1.4.0	2011.03.29	Added information about Print AE.	V.Perlibakas
1.5.0	2011.04.06	Added list of supported character sets.	V.Perlibakas
1.5.1	2011.06.21	Added attributes to Store AE modules.	V.Perlibakas
1.6.0	2014.02.13	Changed storing of comments from "Patient" window (MPPS AE, Store AE), added storing of software version and beamformer code (Store AE).	V.Perlibakas
1.6.1	2014.05.19	Updated information about Store AE.	V.Perlibakas
1.6.2	2016.09.30	Updated information about Store AE tags (0008,0008), (0020,0011), (0020,0013), added tags (0008,0012), (0008,0013), (0020,0060).	V.Perlibakas
1.6.3	2016.10.07	Added information about Store AE tags (0008,0023), (0008,0033).	V.Perlibakas
1.6.4	2018.12.07	To document header added "Echo Wave II" release version.	V.Perlibakas