

DICOM Conformance Statement

Ambu® aBox™ 2

Applies to DICOMconnect V03.03

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CONFORMANCE STATEMENT OVERVIEW

The Ambu aBox 2 implements the necessary DICOM services to download work lists from an information system, save acquired endoscopic images and videos to a network storage.

Table B.1-1 provides an overview of the network services supported by Ambu aBox 2.

NETWORK SERVICES		
SOP Classes	Use of Service (SCU)	Provider of Service (SCP)
Verification	Yes	No
Transfer		
Video Endoscopic Image Storage	Yes	No
VL Endoscopic Image Storage	Yes	No
Workflow Management		
Modality Worklist	Yes	No

Table B.1-1

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	receives DICOM information objects or messages. A single device may have multiple Application Entities.
Application Entity Title (AET)	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.
Media Application Profile	The specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)
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.
Protocol Data Unit (PDU)	A packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.
Security Profile	A set of mechanisms, such as encryption, user authentication, or digital signatures, used by an Application Entity to ensure confidentiality, integrity, and/or availability of exchanged DICOM data

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 Class (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 Instance (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.

1.5 BASICS OF DICOM COMMUNICATION

This section describes terminology used in this Conformance Statement for the non-specialist. 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.

1.6 ABBREVIATIONS, REFERENCES

Definitions, terms and abbreviations used in this document are defined within the different parts of the DICOM standard.

Additional Abbreviations and terms are as follows:

AE	DICOM Application Entity
AET	Application Entity Title
ASCII	American Standard Code for Information Interchange
CSE	Customer Service Engineer
DB	Database
DCS	DICOM Conformance Statement
DICOM	Digital Imaging and Communications in Medicine
FSC	File Set Creator
FSR	File Set Reader
FSU	File Set Updater
GSDF	Grayscale Standard Display Function

HIS	Hospital Information System
IE	Information Entity
IHE	Integrating the Healthcare Enterprise
IOD	DICOM Information Object Definition
ISO	International Standard Organization
MPPS	Modality Performed Procedure Step
n. a.	not applicable
NEMA	National Electrical Manufacturers Association
PDU	DICOM Protocol Data Unit
RIS	Radiology Information System
RP	Reference Point
SC	Secondary Capture
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM Server)
SOP	DICOM Service-Object Pair
SPS	Scheduled Procedure Step
SR	Structured Report
TFT	Thin Film Transistor (Display)
TID	Template ID
UID	Unique Identifier
UTF-8	Unicode Transformation Format-8
VR	Value Representation

1.7 REFERENCES

[NEMA PS3] Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>¹

¹ The DICOM Standard is under continuous maintenance, the current official version is available at <http://dicom.nema.org>

2 NETWORKING

2.1 IMPLEMENTATION MODEL

2.1.1 Application Data Flow

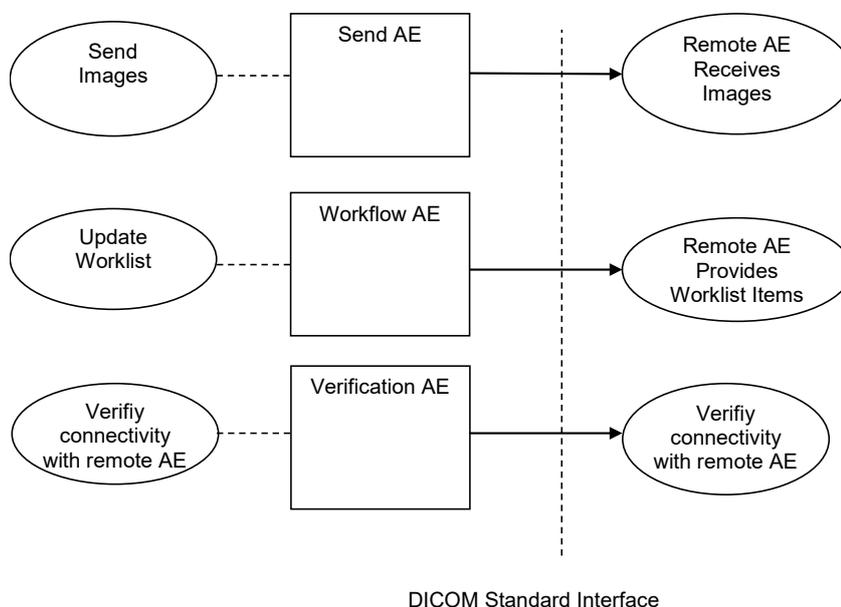


Figure 4-1 Ambu aBox 2 DATA FLOW DIAGRAM

Conceptually the network services may be modeled as the following separate AEs, though in fact all the AEs share a single (configurable) AE Title:

The Send Application Entity sends images and videos to a remote AE. It is associated with the real-world activity “Send Images” which is performed upon user request for images selected by the user. If the remote AE is configured as an archive device, the Send AE will record successful transfers, this success is indicated by a green checkmark icon, failure with a red failure icon (red-cross).

The Workflow Application Entity receives worklist information from a remote AE. It is associated with the real-world activity “Update Worklist”. Update Worklist is performed as a result of an operator request. The Workflow AE queries a remote AE for worklist items matching a query request defined by the operator and updating with a fixed interval.

The Verification AE sends verification requests to a remote AE.

2.1.2 Functional Definition of AE's

2.1.2.1 Functional Definition of Verification Application Entity

The DICOM Verification AE is used to check if the configuration of the remote AE is correct, and the remote AE is listening. The echo request can be triggered by the user. The result of the request is displayed to him, immediately.

2.1.2.2 Functional Definition of Send Application Entity

If a send-job is triggered for a file or a study, an association request is sent to the destination AE and upon successful negotiation of a Presentation Context the image transfer is started. If the association cannot be opened, an error is displayed to the user. The user must re-trigger the send job manually.

2.1.2.3 Functional Definition of Workflow Application Entity

The Workflow Application Entity attempts to download a Worklist from a remote node. If the Workflow AE establishes an Association to a remote AE, it will transfer all worklist items via the open Association. During receiving the worklist response items are counted and the query processing is canceled if the configurable limit of items is reached. The results will be displayed in a separate list, which will be cleared with the next Worklist Update.

2.1.3 Sequencing of Real-World Activities

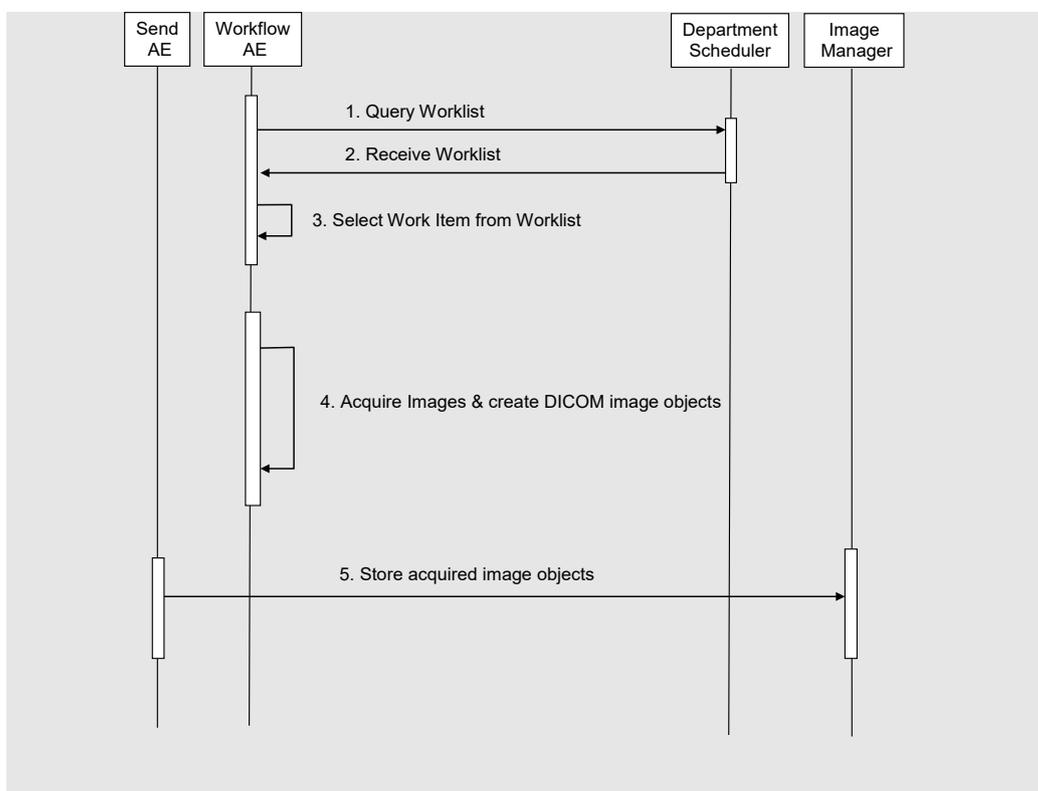


Figure 4-2 SEQUENCE DIAGRAM – IMAGE ACQUISITION AND ARCHIVING TRIGGERED BY WORKLIST

Figure 4-2 shows the sequence of activities to receive worklist items, create images and archive them. Other workflow situations (e.g., unscheduled procedure steps) will have other sequencing constraints.

2.2 AE SPECIFICATIONS

2.2.1 Send Application Entity Specification

2.2.1.1 SOP Classes

The Send Application Entity provides Standard Conformance to the following SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Yes	No
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	No

Table 4-1 SOP CLASSES FOR SEND AE

2.2.1.2 Association Policies

2.2.1.2.1 General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Application Context Name	1.2.840.10008.3.1.1.1
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Table 4-2 DICOM APPLICATION CONTEXT FOR SEND AE

2.2.1.2.2 Number of Associations

The Send AE initiates one Association at a time for each destination to which a transfer request is being processed in the active job queue list. Only one job will be active at a time, the other remains pending until the active job is completed or failed.

Maximum number of simultaneous Associations	1
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Table 4-3 NUMBER OF ASSOCIATIONS INITIATED FOR SEND AE

2.2.1.2.3 Asynchronous Nature

The Send AE does not support asynchronous communication (multiple outstanding transactions over a single Association).

Maximum number of outstanding asynchronous transactions	1
---	---

Table 4-4 ASYNCHRONOUS NATURE AS A SCU FOR SEND AE

2.2.1.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.826.0.1.3680043.2.891.113
Implementation Version Name	DICOM_CONNECT_32

Table 4-5 DICOM IMPLEMENTATION CLASS AND VERSION FOR SEND AE

2.2.1.3 Association Initiation Policy

2.2.1.3.1 Activity – Send Images

2.2.1.3.1.1 Description and Sequencing of Activities

A user can select images and videos and request them to be sent to a configured destination. SOP instances of a specific study can be sent together or in different associations.

If a send-job is triggered for a file or a study, an association request is sent to the destination AE. Upon successful negotiation of a Presentation Context, the object transfer is started, and a C-STORE request is initiated for each object selected for storage. If the association cannot be opened, an error is displayed to the user. For each file sent in a send-job, the C-STORE response is received. If one or more C-STORE operations fail, a message is displayed to the user. The user must re-trigger the send job manually for files that could not be sent, either because the association could not be established, or the C-STORE response status differs from the status SUCCESS or WARNING.

After all files of a send-job are sent, the association is released, and any files not transmitted is marked with a red icon displaying their failure to transmit, these are subject to manual re-transmission via a new session.

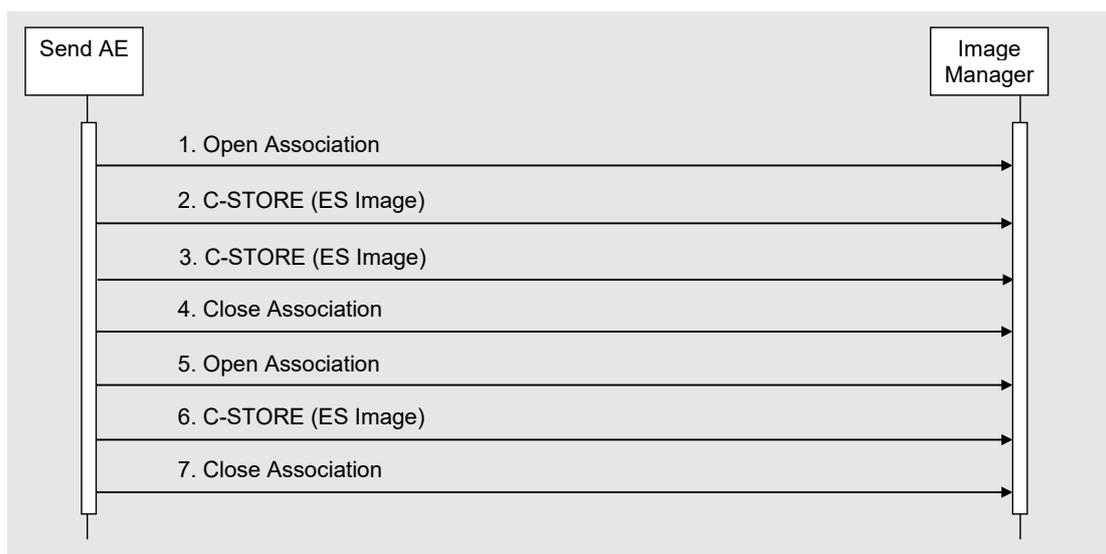


Figure 4-3 SEQUENCING OF ACTIVITY – SEND IMAGES

A possible sequence of interactions between the Send AE and an Image Manager (a storage or archive device supporting the Storage SOP Classes as a SCP) is illustrated in Figure 4-3.

1. The Send AE opens an association with the Image Manager.
2. An acquired ES image is transmitted to the Image Manager using a C-STORE request and the Image Manager replies with a C-STORE response (status success).
3. An acquired ES image is transmitted to the Image Manager using a C-STORE request over the same association and the Image Manager replies with a C-STORE response (status success).
4. The Send AE closes the association with the Image Manager.

5. The Send AE opens another association with the Image Manager.
6. An acquired ES image is transmitted to the Image Manager using a C-STORE request over the same association and the Image Manager replies with a C-STORE response (status success).
7. The Send AE closes the association with the Image Manager.

2.2.1.3.1.2 Proposed Presentation Contexts

The Send AE is capable of proposing the Presentation Contexts shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	MPEG4 AVC/H.264 High Profile Level 4.1	1.2.840.10008.1.2.4.102	SCU	None
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Implicit VR Little Endian Explicit VR Little Endian JPEG Baseline JPEG Lossless Hier 14	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.70	SCU	None

Table 4-6 PROPOSED PRESENTATION CONTEXTS FOR ACTIVITY SEND IMAGES

The Transfer Syntaxes listed in this table define the potential Transfer Syntaxes which might be proposed. The uncompressed Transfer Syntaxes in this table will always be proposed. Compressed Transfer Syntaxes may not be proposed if they are inappropriate for a concrete SOP Instance to be transferred.

2.2.1.3.1.3 SOP Specific Conformance for Image Storage SOP Classes

All Image SOP Classes supported by the Send AE exhibit the same behavior, except where stated, and are described together in this section.

If none of the proposed Presentation Contexts is accepted by the SCP then the Association is aborted by the Send AE using A-ABORT and the send job is marked as failed. The job failure's full description is logged, and a simplified error message is reported to the user.

The behavior of Send AE when encountering status codes in a C-STORE response is summarized in the Table below:

Service Status	Further Meaning	Error Code	Behavior
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 marked as complete.

Refused	Out of Resources	A700-A7FF	The Association is released using A-RELEASE-RQ and the send job is marked as failed. The status meaning is logged, and the job failure is reported to the user. This is a transient failure.
Error	Data Set does not match SOP Class	A900-A9FF	The Association is released using A-RELEASE-RQ and the send job is marked as failed. The status meaning is logged, and the job failure is reported to the user via the job control application.
Error	Cannot Understand	C000-CFFF	The Association is released using A-RELEASE-RQ and the send job is marked as failed. The status meaning is logged, and the job failure is reported to the user.
Warning	Coercion of Data Elements	B000	Image transmission is considered successful, but the status meaning is logged.
Warning	Data Set does not match SOP Class	B007	Image transmission is considered successful, but the status meaning is logged.
Warning	Elements Discarded	B006	Image transmission is considered successful, but the status meaning is logged.
*	*	Any other status codes.	The Association is released using A-RELEASE-RQ and the send job is marked as failed. The status code is logged, and the job failure is reported to the user.

Table 4-7 STORAGE C-STORE RESPONSE STATUS HANDLING BEHAVIOR

The behavior of Storage AE during communication failure is summarized in the Table below:

Exception	Behavior
Timeout	The Association is released using A-RELEASE-RQ and the send job is marked as failed. The reason is logged, and the job failure is reported to the user.
Association aborted by the SCP or network layers	The send job is marked as failed. The reason is logged, and the job failure is reported to the user.

Table 4-8 STORAGE COMMUNICATION FAILURE BEHAVIOR

A failed send job can be restarted by user interaction.

The contents of all Image Storage SOP Instances created by Ambu aBox 2 conform to the DICOM IOD definitions and are described in section 8.1.

If the destination for the send-job has marked the transmission of the images as successful, the device will record the success and mark the images with a green icon (checkmark) indicating that the file has been exported successfully. If the operator fails the transfer, the images will be indicated with a red-cross for failure, the operator will then manually need to re-transmit.

2.2.2 Workflow Application Entity Specification

2.2.2.1 SOP Classes

The Workflow AE provides Standard Conformance to the following 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

Table 4-9 SOP CLASSES FOR WORKFLOW AE

2.2.2.2 Association Policies

2.2.2.2.1 General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Application Context Name	1.2.840.10008.3.1.1.1
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Table 4-10 DICOM APPLICATION CONTEXT FOR WORKFLOW AE

2.2.2.2.2 Number of Associations

The Workflow AE initiates one Association at a time for a Worklist request.

Maximum number of simultaneous Associations	1
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Table 4-11 NUMBER OF ASSOCIATIONS INITIATED FOR WORKFLOW AE

The Workflow AE does not accept Association Requests by remote AEs.

2.2.2.2.3 Asynchronous Nature

The Workflow AE does not support asynchronous communication (multiple outstanding transactions over a single Association).

Maximum number of outstanding asynchronous transactions	1
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Table 4-12 ASYNCHRONOUS NATURE AS A SCU FOR WORKFLOW AE

2.2.2.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.826.0.1.3680043.2.891.113
Implementation Version Name	DICOM_CONNECT_32

Table 4-13 DICOM IMPLEMENTATION CLASS AND VERSION FOR WORKFLOW AE

2.2.2.3 Association Initiation Policy

The Workflow AE will initiate an Association in order to issue a C-FIND request according to the Modality Worklist Information Model.

2.2.2.3.1 Activity – Worklist Update

2.2.2.3.1.1 Description and Sequencing of Activities

If the Worklist server is configured (AE Title, hostname, and port), a request for a Worklist Update can be initiated by user interaction. A user can select different search criteria, i.e. The start date of the Schedule Procedure, and how long back to look for them, along with a Modality.

Upon initiation of the request, the Workflow AE will build a Request Identifier for the C-FIND request, initiate an Association to send the request with the search criteria and will wait for the Worklist responses. During receiving the worklist response items are counted and the query processing is canceled by issuing a C-FIND-CANCEL if the configurable limit of items is reached. The results will be displayed in a list, which will be cleared with the next worklist update.

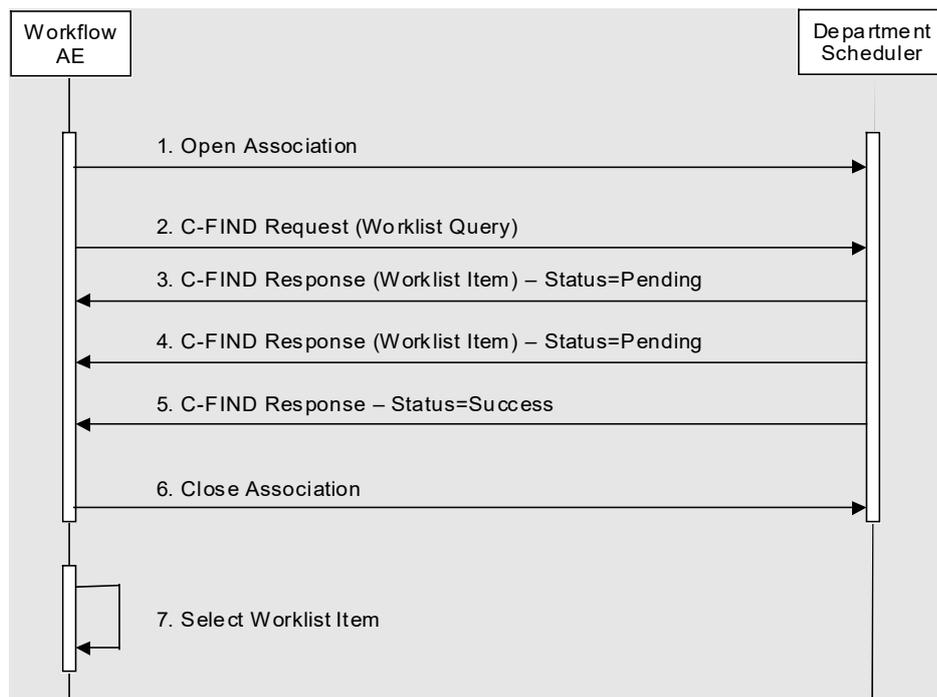


Figure 4-4 SEQUENCING OF ACTIVITY – WORKLIST UPDATE

A possible sequence of interactions between the Workflow AE and a Departmental Scheduler (e.g. a device such as a RIS or HIS which supports the Modality Worklist SOP Class as a SCP) is illustrated in the Figure above:

1. The Worklist AE opens an association with the Departmental Scheduler.
2. The Worklist AE sends a C-FIND request to the Departmental Scheduler containing the Worklist Query attributes.
3. The Departmental Scheduler returns a C-FIND response containing the requested attributes of the first matching Worklist Item.
4. The Departmental Scheduler returns another C-FIND response containing the requested attributes of the second matching Worklist Item.
5. The Departmental Scheduler returns another C-FIND response with status Success indicating that no further matching Worklist Items exist. This example assumes that only 2 Worklist items match the Worklist Query.
6. The Worklist AE closes the association with the Departmental Scheduler.
7. The user selects a Worklist Item from the Worklist and prepares to acquire new images.

2.2.2.3.1.2 Proposed Presentation Contexts

The Workflow AE will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
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
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

Table 4-14 PROPOSED PRESENTATION CONTEXTS FOR ACTIVITY WORKLIST UPDATE

2.2.2.3.1.3 SOP Specific Conformance for Modality Worklist

The Table below provides a description of the Ambu aBox 2s Worklist Request Identifier and specifies the attributes that are copied into the images. Unexpected attributes returned in a C-FIND response are ignored.

Requested return attributes not supported by the SCP are set to have no value. Non-matching responses returned by the SCP due to unsupported optional matching keys are handled like matches of the request identifier. No attempt is made it filter out possible duplicate entries.

If an extended character set is used in the Request Identifier, Specific Character Set (0008,0005) will be included in the Identifier (see section 6 for supported values). Otherwise, Specific Character Set (0008,0005) will not be sent

The worklist request is capable of many more tags, but only the listed below are used in Ambu aBox 2 C-FIND request.

The table below should be read as follows:

Attribute Name	Attributes supported to build an Ambu aBox 2 Worklist Request Identifier. Ambu aBox 2 will supply this attribute as Return Key with zero-length for Universal Matching if it is not supplied as a matching key otherwise.
Tag	DICOM tag for this attribute.
Match	Type of matching supported for this attribute by Ambu aBox 2. Matching keys for Worklist Update. A "S" will indicate that Ambu aBox 2 will supply an attribute value for Single Value Matching, a "R" will indicate Range Matching and a "*" will denote wild card matching.
Query	An "x" " will indicate that that Ambu aBox 2 will supply this attribute as matching key automatically. An (x) will indicate that this matching key is provided only, if entered in the Query Patient Worklist dialog.
Display	Displayed keys. An "x" indicates that this worklist attribute is displayed to the user during a patient registration dialog. For example, Patient Name will be displayed when registering the patient prior to an examination.
IOD	An "x" indicates that this Worklist attribute is included into all Object Instances created during performance of the related Procedure Step.

Table 4-15: MODALITY WORKLIST - FIND SOP Class - C-FIND REQUEST IDENTIFIER

Attribute Name	Tag	Match	Query	Display	IOD	Note
Scheduled Procedure Step						
Scheduled Procedure Step Sequence	(0040,0100)					Only one item allowed

> Scheduled Station AE Title	(0040,0001)	S	x			
> Scheduled Procedure Step Start Date	(0040,0002)	S,R	(x)	x		
> Scheduled Procedure Step Start Time	(0040,0003)	S,R	(x)	x		
> Modality	(0008,0060)	S	x			
> Scheduled Physicians Name	(0040,0006)	S,*	x		x	Set as Performing Physician in IOD
> Scheduled Procedure Step Description	(0040,0007)					
> Scheduled Protocol Code Sequence	(0040,0008)					
>> Code Value	(0008,0100)					
>> Coding Scheme Designator	(0008,0102)					
>> Code Meaning	(0008,0104)					
> Scheduled Procedure Step ID	(0040,0009)					
> Scheduled Station Name	(0040,0010)	S	x			
> Scheduled Procedure Step Location	(0040,0011)	S	x			
> Pre-Medication	(0040,0012)					
> Requested Contrast Agent	(0032,1070)					
Requested Procedure						
Requested Procedure ID	(0040,1001)	S	x		x	Set as Study ID in IOD
Requested Procedure Description	(0032,1060)				x	Set as Study Description in IOD
Requested Procedure Code Sequence	(0032,1064)					Only one item allowed.
> Code Value	(0008,0100)					
> Coding Scheme Designator	(0008,0102)					
> Code Meaning	(0008,0104)					
Study Instance UID	(0020,000D)		x		x	
Patient Transport Arrangements	(0040,1004)					
Reason for the Requested Procedure	(0040,1002)					
Reason for Requested Procedure Code Sequence	(0040,100A)					

> Code Value	(0008,0100)					
> Coding Scheme Designator	(0008,0102)					
> Code Meaning	(0008,0104)					
Requested Procedure Priority	(0040,1003)					
Names Of Intended Recipients Of Results	(0040,1010)					
Requested Procedure Comments	(0040,1400)					
Imaging Service Request						
Accession Number	(0008,0050)	S	x	x	x	
Referring Physician's Name	(0008,0090)				x	
Requesting Physician	(0032,1032)					
Imaging Service Request Comments	(0040,2400)					
Visit Identification						
Admission ID	(0038,0010)				x	
Institution Name	(0008,0080)				x	
Institution Address	(0008,0081)				x	
Institutional Department Name	(0008,1040)				x	
Visit Status						
Current Patient Location	(0038,0300)					
Patient Identification						
Patient's Name	(0010,0010)	S,*	x	x	x	
Patient ID	(0010,0020)	S	x	x	x	
Issuer of Patient ID	(0010,0021)	S	x		x	
Patient Demographic						
Patient's Birth Date	(0010,0030)		x	x	x	
Patient's Sex	(0010,0040)		x	x	x	
Patient's Size	(0010,1020)				x	
Patient's Weight	(0010,1030)				x	
Patient Medical						
Patient State	(0038,0500)					
Pregnancy Status	(0010,21C0)					
Medical Alerts	(0010,2000)					

Allergies	(0010,2110)					
Special Needs	(0038,0050)					
Patient Comments	(0010,4000)				x	
Ethnic Group	(0010,2160)				x	
Additional Patient History	(0010,21B0)					
Confidentiality Constraint on Patient Data Description	(0040,3001)					

The behavior of The Workflow AE, when encountering status codes in a Modality Worklist C-FIND response is summarized in the Table below. If any other SCP response status than "Success" or "Pending" is received by The Workflow AE, a message "query failed" will appear on the user interface.

Service Status	Further Meaning	Error Code	Behavior
Success	Matching is complete	0000	The SCP has completed the matches. Worklist items are available for display or further processing.
Refused	Out of Resources	A700	The Association is released using A-RELEASE-RQ and the worklist query is marked as failed. The status meaning is logged and reported to the user. Any additional error information in the Response will be logged.
Failed	Identifier does not match SOP Class	A900	The Association is released using A-RELEASE-RQ and the worklist query is marked as failed. The status meaning is logged and reported to the user. Any additional error information in the Response will be logged.
Failed	Unable to Process	C000 – CFFF	The Association is released using A-RELEASE-RQ and the worklist query is marked as failed. The status meaning is logged and reported to the user. Any additional error information in the Response will be logged.
Cancel	Matching terminated due to Cancel request	FE00	Worklist items are available for display or further processing. The status meaning is logged.
Pending	Matches are continuing	FF00	The worklist item contained in the Identifier is collected for later display or further processing.
*	*	Any other status code.	The Association is released using A-RELEASE-RQ and the worklist is marked as failed. The status meaning is logged and reported to the user. Any additional error information in the Response will be logged.

Table 4-16 MODALITY WORKLIST C-FIND RESPONSE STATUS HANDLING BEHAVIOR

The behavior of The Workflow AE during communication failure is summarized in the Table below.

Exception	Behavior
-----------	----------

Timeout	The Association is aborted using A-ABORT and the worklist query marked as failed. The reason is logged and reported to the user if an interactive query.
Association aborted by the SCP or network layers	The worklist query is marked as failed. The reason is logged and reported to the user if an interactive query.

Table 4-17 MODALITY WORKLIST COMMUNICATION FAILURE BEHAVIOR

Acquired images will always use the Study Instance UID specified for the Scheduled Procedure Step (if available). If an acquisition is unscheduled, a Study Instance UID will be generated locally.

2.2.2.4 Association Acceptance Policy

The Workflow AE does not accept Associations.

2.2.3 Verification Application Entity

2.2.3.1 SOP Classes

The Verification Application Entity provides Standard Conformance to the following SOP Class(es):

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	No

2.2.3.2 Association Policies

The Verification AE can propose Association Requests for the Verification Service.

2.2.3.2.1 General

The DICOM standard Application Context Name for DICOM 3.0 is always accepted and proposed

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

Table 4-18 DICOM APPLICATION CONTEXT FOR VERIFICATION AE

2.2.3.2.2 Number of Associations

The Verification AE initiates one Association at a time for each destination that DICOM connectivity shall be verified.

The association will be rejected if the maximum allowable number of associations is exceeded.

Maximum number of simultaneous Associations initiated by the Verification AE	1 (not configurable)
--	----------------------

Table 4-19

NUMBER OF SIMULTANEOUS ASSOCIATIONS FOR VERIFICATION AE

2.2.3.2.3 Asynchronous Nature

The Verification AE does not support asynchronous communication (multiple outstanding transactions over a single Association).

Maximum number of outstanding asynchronous transactions	1
---	---

Table 4-20 ASYNCHRONOUS NATURE AS A SCU FOR VERIFICATION AE

2.2.3.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.826.0.1.3680043.2.891.113
Implementation Version Name	DICOM_CONNECT_32

Table 4-21 DICOM IMPLEMENTATION CLASS AND VERSION FOR VERIFICATION AE

2.2.3.3 Association Initiation and Acceptance Policy

Due to the trivial functionality of the Verification SOP class, both association initiation and acceptance policy are combined in this chapter. In Chapter 4.1.1 it is shown that “Verify connectivity with remote AE” is an asymmetric activity that is executed by the local Verification AE.

The Verification AE rejects all association requests by any remote AE. See 8.5 for details.

2.2.3.3.1 Activity: Verify connectivity with remote AE

2.2.3.3.1.1 Description and Sequencing of Activity

The Verification AE will initiate a new Association each time the user selects to verify connectivity for a specific AE. This scenario is illustrated in Figure 4-5.

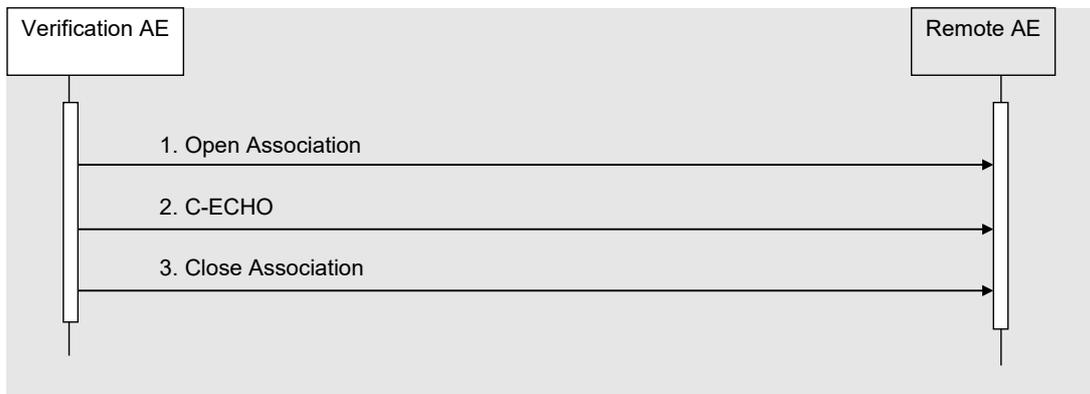


Figure 4-5 SEQUENCING OF ACTIVITY: VERIFY CONNECTIVITY WITH REMOTE AE

Ambu aBox 2 verifies the connectivity to a Remote AE

1. The Verification AE opens an Association with the Remote AE
2. The Verification AE sends a C-ECHO-Request to the remote AE. It awaits the C-ECHO-Response and propagates the result of the verification (successful/unsuccessful) to the user
3. The Verification AE closes the association

2.2.3.3.1.2 Proposed / Accepted Presentation Contexts

Presentation Context Table			
Abstract Syntax	Transfer Syntax		

Name	UID	Name List	UID List	Role	Ext. Neg.
Verification	1.2.840.10008.1.1	Implicit VR Little Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

The Verification AE will propose Presentation Contexts as shown in the following table:

Table 4-22 PROPOSED PRESENTATION CONTEXTS FOR VERIFICATION AE

2.2.3.3.1.3 SOP Specific Conformance for Verification SOP Class

The Verification AE provides standard conformance to the Verification SOP Class as an SCU.

The Verification AE treats a successfully received C-ECHO response with 0000 (Success) status code as a successful verification. Any other result will be treated as a verification failure.

2.3 NETWORK INTERFACES

2.3.1 Physical Network Interface

The DICOM Interface of the Ambu aBox 2 provides DICOM TCP/IP Network Communication Support and uses the TCP/IP protocol stack from the operating system. All available Ethernet interfaces are supported.

2.3.2 Additional Protocols

Not applicable.

3 CONFIGURATION

3.1 AE Title/Presentation Address Mapping

3.1.1 Local AE Titles

AE Title can be configured via the configuration interface. The default AE Title is the devices serial-number. All local AE's are using the same local AE Title.

Application Entity	Default AE Title	Default TCP/IP Port
Send	Device serial number	Not Applicable
Workflow		Not Applicable
Verification		Not Applicable

Table 5-1 AE CONFIGURATION TABLE

3.2 Parameters

A large number of parameters related to acquisition and general operation can be configured using the Service/Installation Tool or through editing configuration files manually. The Table below only shows those configuration parameters relevant to DICOM communication.

Parameter	Configurable (Yes/No)	Default Value
General Parameters		
Max PDU Receive Size	Yes	64234 Bytes
Max PDU Send Size (larger PDUs will never be sent, even if the receiver supports a larger Max PDU Receive Size. If the receiver supports a smaller Max PDU Receive Size then the Max PDU Send Size will be reduced accordingly for the duration of the Association. Max PDU Receive Size information is exchanged during DICOM Association Negotiation in the Maximum Length Sub-Item of the A-ASSOCIATION-RQ and A-ASSOCIATE-AC)	Yes	64234 Bytes
Time-out waiting for association request or waiting for the peer to shut down an association. (ARTIM Timeout)	Yes	30 s
Time-out awaiting a reply to associate request	Yes	30s
Time-out awaiting a reply to associate release	Yes	30s
Time-out awaiting a network-write to be accepted.	Yes	30s
Time-out awaiting a network-connect to be accepted.	Yes	30s

Table 5-2 CONFIGURATION PARAMETERS TABLE

4 SUPPORT OF CHARACTER SETS

Ambu aBox 2 support character sets

- ISO_IR 6 (ISO 646 Default repertoire)
- ISO_IR 100 (ISO 8859-1 Latin Alphabet No. 1 supplementary set)
- ISO_IR 101 (ISO 8859-2 Latin Alphabet No. 2 supplementary set)
- ISO_IR 109 (ISO 8859-3 Latin Alphabet No. 3 supplementary set)
- ISO_IR 110 (ISO 8859-4 Latin Alphabet No. 4 supplementary set)
- ISO_IR 148 (ISO 8859-9 Latin Alphabet No. 5 supplementary set)
- ISO_IR 144 (ISO 8859-5 Cyrillic Alphabet supplementary set)
- ISO_IR 127 (ISO 8859-6 Arabic Alphabet supplementary set)
- ISO_IR 126 (ISO 8859-7 Greek Alphabet supplementary set)
- ISO_IR 138 (ISO 8859-8 Hebrew Alphabet supplementary set)
- ISO_IR 13 (JIS X 0201: Katakana)
- ISO_IR 166 (TIS 620-2533: Thai)
- ISO_IR 192 (Unicode in UTF-8 for Chinese Alphabet)
- GB18030
- GBK

Ambu aBox 2 does not support code extension techniques as described in ISO/IEC 2022:1994

5 SECURITY

5.1 Security Profiles

5.1.1 Default Security Configuration

Ambu aBox 2 does not support any specific security measures.

It is assumed that Ambu aBox 2 is used within a secured environment. It is assumed that a secured environment includes at a minimum:

- a. Firewall or router protections to ensure that only approved external hosts have network access to Ambu aBox 2.
- b. Firewall or router protections to ensure that Ambu aBox 2 only has network access to approved external hosts and services.
- c. Any communication with external hosts and services outside the locally secured environment use appropriate secure network channels (e.g. such as a Virtual Private Network (VPN))

Other network security procedures such as automated intrusion detection may be appropriate in some environments. Additional security features may be established by the local security policy and are beyond the scope of this conformance statement.

6 ANNEXES

6.1 IOD CONTENTS

6.1.1 Created SOP Instances

The sections in this chapter specify the attributes of SOP Instances handled by Ambu aBox 2. This refers to both, SOP Instances created by Ambu aBox 2 and sent to remote AEs by the Send AE.

The following tables use a number of abbreviations. The abbreviations used in the “Presence of ...” column are:

VNAP	Value Not Always Present (attribute sent zero length if no value is present)
ANAP	Attribute Not Always Present
ALWAYS	Always Present
EMPTY	Attribute is sent without a value

The abbreviations used in the “Source” column:

MWL	the attribute value source Modality Worklist, see chapter 8.1.4
USER	the attribute value source is from User input
AUTO	the attribute value is generated automatically
CONFIG	the attribute value source is a configurable parameter

NOTE: All dates and times are encoded in the local configured calendar and time. Date, Time and Time zone are configured using the Service/Installation Tool.

6.1.1.1 Visible Light Endoscopic IOD

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-3	ALWAYS
	Clinical Trial Subject	-	NEVER
Study	General Study	Table 8-4	ALWAYS
	Patient Study	-	NEVER
	Clinical Trial Study	-	NEVER
Series	General Series	Table 8-5	ALWAYS
	Clinical Trial Series	-	NEVER
Equipment	General Equipment	Table 8-6	ALWAYS
Image	General Image	Table 8-7	ALWAYS
	Image Pixel	Table 8-8	ALWAYS
	Acquisition Context	Table 8-12	ALWAYS
	Device	-	NEVER
	Specimen	-	NEVER
	VL Image	Table 8-13	ALWAYS
	Overlay Plane	-	NEVER
	ICC Profile	-	NEVER
	SOP Common	Table 8-9	ALWAYS
	Common Instance Reference	-	NEVER

Table 8-1 IOD OF CREATED VL Endoscopic SOP INSTANCES

6.1.1.2 Video Endoscopic IOD

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-3	ALWAYS
	Clinical Trial Subject	-	NEVER
Study	General Study	Table 8-4	ALWAYS
	Patient Study	-	NEVER
	Clinical Trial Study	-	NEVER
Series	General Series	Table 8-5	ALWAYS
	Clinical Trial Series	-	NEVER
Equipment	General Equipment	Table 8-6	ALWAYS
Image	General Image	Table 8-7	ALWAYS
	Cine	Table 8-10	ALWAYS

IE	Module	Reference	Presence of Module
	Multi-frame	Table 8-11	ALWAYS
	Image Pixel	Table 8-8	ALWAYS
	Acquisition Context	Table 8-12	ALWAYS
	Device	-	NEVER
	Specimen	-	NEVER
	VL Image	Table 8-13	ALWAYS
	ICC Profile	-	NEVER
	SOP Common	Table 8-9	ALWAYS
	Common Instance Reference	-	NEVER
	Frame Extraction	-	NEVER

Table 8-2 IOD OF CREATED VIDEO ENDOSCOPIC IMAGE SOP INSTANCES

6.1.2 IOD Module Definitions

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Name	(0010,0010)	PN	From Modality Worklist or user input. Values supplied via Modality Worklist will be entered as received. Maximum 64 characters.	VNAP	MWL/ USER
Patient ID	(0010,0020)	LO	From Modality Worklist or user input. Maximum 64 characters.	VNAP	MWL/ USER
Issuer of Patient ID	(0010,0021)	LO	From Modality Worklist or user input. Maximum 64 characters.	ANAP	MWL/ USER
Patient's Birth Date	(0010,0030)	DA	From Modality Worklist or user input	VNAP	MWL/ USER
Patient's Sex	(0010,0040)	CS	From Modality Worklist or user input	VNAP	MWL/ USER
Ethnic Group	(0010,2160)	SH	From Modality Worklist or user input	ANAP	MWL/ USER

Table 8-3 PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	UI	From Modality Worklist or generated by device	ALWAYS	MWL/ AUTO
Study Date	(0008,0020)	DA	Generated by device	ALWAYS	AUTO
Study Time	(0008,0030)	TM	Generated by device	ALWAYS	AUTO
Referring Physician's Name	(0008,0090)	PN	From Modality Worklist or user input	VNAP	MWL/ USER
Study ID	(0020,0010)	SH	From Modality Worklist or user input	VNAP	USER

Accession Number	(0008,0050)	SH	From Modality Worklist or user input	VNAP	MWL/ USER
Study Description	(0008,1030)	LO	User Input	VNAP	USER

Table 8-4 GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	ES	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	Generated by device	ALWAYS	AUTO
Series Number	(0020,0011)	IS	Generated by device	VNAP	AUTO
Laterality	(0020,0060)	CS	Never sent	VNAP	AUTO
Performing Physician's Name	(0008,1050)	PN	Physician field in Study list. Maximum 64 characters.	ANAP	USER
Series Date	(0008,0021)	DA	Generated by device	VNAP	AUTO
Series Time	(0008,0031)	TM	Generated by device	VNAP	AUTO
Series Description	(0008,103E)	LO	User input	ANAP	USER

Table 8-5 GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Manufacturer	(0008,0070)	LO	Ambu	ALWAYS	AUTO
Institution Name	(0008,0080)	LO	From Configuration or Worklist	ANAP	CONFIG
Institution Address	(0008,0080)	ST	From Configuration or Worklist	ANAP	CONFIG
Station Name	(0008,1010)	SH	From Configuration	ANAP	CONFIG
Institutional Department Name	(0008,1040)	LO	From Configuration or Worklist	ANAP	CONFIG
Manufacturer's Model Name	(0008,1090)	LO		ANAP	AUTO
Software Version	(0018,1020)	LO	From Configuration, provides the version and build-tag of the application layer software.	ANAP	CONFIG

Table 8-6 GENERAL EQUIPMENT MODULE ATTRIBUTES OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	Generated by device	ALWAYS	AUTO
Patient Orientation	(0020,0020)	CS	Value set by user	ANAP	USER

Table 8-7 GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Samples per Pixel	(0028,0002)	US	3	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	Generated by device	ALWAYS	AUTO
Rows	(0028,0010)	US	Generated by device	ALWAYS	AUTO
Columns	(0028,0011)	US	Generated by device	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	Generated by device	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	Generated by device	ALWAYS	AUTO
High Bit	(0028,0102)	US	Generated by device	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0000H	ALWAYS	AUTO
Pixel Data	(7FE0,0010)	OW		ALWAYS	AUTO
Planar Configuration	(0028,0006)	US	0	ANAP	AUTO

Table 8-8 IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Specific Character Set	(0008,0005)	CS	Configuration dependent, depending on the locale settings of the device. See Chapter 6.	ALWAYS	CONFIG
SOP Class UID	(0008,0016)	UI	Dependent on / according to the type of created object	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	Generated by device	ALWAYS	AUTO

Table 8-9 SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Frame Time	(0018,1063)	DS	Generated by device, calculated from Cine Rate	ALWAYS	AUTO
Cine Rate	(0018,0040)	IS	Generated by device	ALWAYS	AUTO

Table 8-10 CINE MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Number Of Frames	(0028,0008)	IS	Generated by device	ALWAYS	AUTO

Frame Increment Pointer	(0028,0009)	AT	(0018,1063)	ALWAYS	AUTO
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Table 8-11 MULTIFRAME MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Acquisition Context Sequence	(0040,0555)	SQ	Empty Sequence generated by device	ALWAYS	AUTO

Table 8-12 ACQUISITION CONTEXT MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Type	(0008,0008)	CS	ORIGINAL\PRIMARY	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	Generated by Device	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	Generated by device	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	Generated by device	ALWAYS	AUTO
High Bit	(0028,0102)	US	Generated by device	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0000H	ALWAYS	AUTO
Pixel Data	(7FE0,0010)	OW		ALWAYS	AUTO
Planar Configuration	(0028,0006)	US	0, when Samples per Pixel = 3, attribute not present otherwise	ANAP	AUTO
Lossy Image Compression	(0028,2110)	CS	Generated by device	VNAP	AUTO
Window Center	(0028,1050)	DS	From user input	ANAP	AUTO/ USER
Window Width	(0008,1051)	DS	From user input	ANAP	AUTO/ USER
Anatomic Region Sequence	(0008.2218)	SQ	An empty sequence is always included in Video Objects, never present in Visible Light Objects	EMPTY	AUTO

Table 8-13 VL IMAGE MODULE ATTRIBUTES

6.1.3 Used Fields in received IOD by application

n.a.

6.1.4 Attribute mapping

The relationships between attributes received via Modality Worklist, stored in acquired images are summarized in Table 8-14. The format and conventions used in Table 8-14 are the same as the corresponding table in DICOM Part 2, Table B.8.1-31. [DICOM].

Modality Worklist	Instance IOD
Patient Name	Patient Name

Patient ID	Patient ID
Issuer of Patient ID	Issuer of Patient ID
Patient's Birth Date	Patient's Birth Date
Patient's Sex	Patient's Sex
Patient's Size	Patient's Size
Patient's Weight	Patient's Weight
Ethnic Group	Ethnic Group
Patient Comments	Patient Comments
----	----
----	Series Instance UID
----	Series Description
----	Protocol Name
----	Operator's Name
----	----
----	SOP Class UID
----	SOP Instance UID
Scheduled Performing Physician's Name	Performing Physician's Name
Referring Physician's Name	Referring Physician's Name
Admission ID	Admission ID
----	----
Study Instance UID	Study Instance UID
Accession Number	Accession Number
Scheduled Protocol Code Sequence	----
Requested Procedure Description	Study Description
Requested Procedure ID	Study ID
Scheduled Procedure Step ID	----
Modality	Modality ²
Scheduled Station AE Title	----
Scheduled Station Name	----
Scheduled Procedure Step Location	----
Scheduled Procedure Step Description	----
Scheduled Protocol Code Sequence	----
Requested Procedure Code Sequence	----
Institution Name	Institution Name
Institution Address	Institution Address
Institutional Department Name	Institutional Department Name

Table 8-14 ATTRIBUTE MAPPING BETWEEN MODALITY WORKLIST, AND CREATED INSTANCES

² These attributes may be changed if the Performed Procedure Step is different from the Scheduled Procedure Step

6.1.5 Coerced/Modified Fields

No coercion / modification of fields received by other DICOM AEs is performed by the AEs which are part of Ambu aBox 2.

6.2 GRAYSCALE IMAGE CONSISTENCY

The Ambu aBox 2 does not support image display compliant with the DICOM Grayscale Standard Display Function (GSDF).

6.3 STANDARD EXTENDED / SPECIALIZED / PRIVATE SOP Classes

No Specialized or Private SOP Classes are supported.

6.4 PRIVATE TRANSFER SYNTAXES

No Private Transfer Syntaxes are supported.

6.5 Association Rejection Reasons

The device does not accept incoming DICOM associations, hence this section is not applicable.

The current iteration does not support any DICOM SCP on the device.