Clarius DICOM Conformance Statement

Clarius Mobile Health Corp.

DICOM Conformance Statement

clarius Ultrasound Anywhere

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1. Conformance Statement Overview

The "Scanner" device developed by Clarius Mobile Health Corp. uses ultrasound technology to scan patients and produce medical images of various formats. DICOM is the standard for the communication and management of medical imaging information and related data [1]. The Clarius implementation provides functionality to transfer saved images or live image data to DICOM servers in several selectable image formats. In addition, the app also allows the user to download DICOM Worklists from their DICOM Worklist Servers to automatically fill in patient information.

The following is the table of Supported Networking DICOM Service (SOP) Classes with roles (User/Provider).

Table 1-1. Network Services

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Ultrasound Image Storage	Yes	No
Ultrasound Multi-frame Image Storage	Yes	No
Modality Worklist Information	Yes	No
Comprehensive SR	Yes	No

2. Introduction

2.1. Audience

This document is intended for health-related workers, software engineers, and designers. It is assumed that the reader has a working knowledge of DICOM.

2.2. Remarks

The Clarius DICOM implementation uses a subset of the functionality and features present in the DICOM Standard. The output allows for multiple choices of data compression:

Bitmap (uncompressed) - **Implicit VR Little Endian, Explicit VR Little Endian**

- The Implicit VR Little Endian and Explicit VR Little Endian Transfer Syntax are used for uncompressed images and the pixel data is straight RGB triplets per pixel for width x height pixels.

Lossless JPEG (compressed) - **JPEG (Lossless, Process 14)**

- Lossless JPEG refers to the JPEG Lossless, Nonhierarchical, First-Order Prediction (Process 14 [Selection Value 1]) Transfer Syntax
- 1993 addition to 1992 JPEG standard algorithm
- https://en.wikipedia.org/wiki/Lossless_JPEG
- standard designation is ISO/IEC 10918-1 : 1993(E)

JPEG-LS Lossless (more compressed) - **JPEG-LS (Lossless)**

- JPEG-LS (Lossless) Transfer Syntax
- 1999 addition to 1992 JPEG standard algorithm
- https://en.wikipedia.org/wiki/Lossless_JPEG#JPEG-LS
- standard designation is ISO-14495-1/ITU-T.87

For most images, the Bitmap option is appropriate, but for very large images with large regions of black, white, or grey, a compressed JPEG option may be more appropriate, to save space and transfer time.

2.3. Definitions, Terms, and Abbreviations

The definitions, terms, and abbreviations used in this document are defined in the DICOM standard. Abbreviations and terms are as follows:

Table 2-1. Definitions, Terms, and Abbreviations

Term	Definition
ACSE	Association Control Service Element
AE	Application Entity
AET	Application Entity Title

Term	Definition
DIMSE	DICOM Message Service Element
IE	Information Entity
IOD	Information Object Definition
ISO	International Organization for Standardization
PDU	Protocol Data Unit
PDV	Protocol Data Value
SCP	Service Class Provider (DICOM Server)
SCU	Service Class User (DICOM Client)
SOP	Service-Object Pair

2.4. References

- NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard - http://medical.nema.org/
- DCMTK - DICOM Toolkit - https://dcmtk.org/

3. Networking

3.1. Implementation Model

3.1.1. Application Data Flow

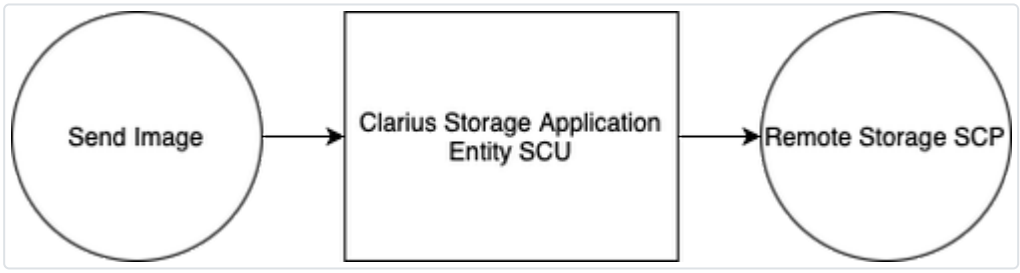

Figure 3-1. Application Data Flow Diagram (Storage)

The Storage Application Entity sends images to a Remote Application Entity. Sending images is done for each study completed, and for all images in the study. There is the option of selecting 1 or more Remote Application Entities upon completion of the study, or later in a separate list of completed studies.

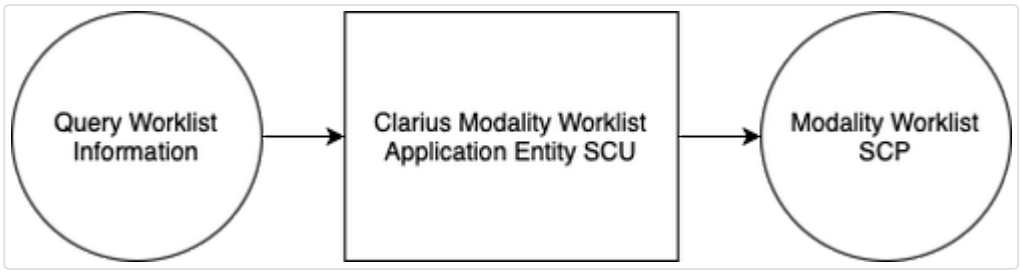

Figure 3-2. Application Data Flow Diagram (Worklist)

The Modality Worklist Application Entity downloads worklists from the user's DICOM worklist server listed in the DICOM Settings Page.

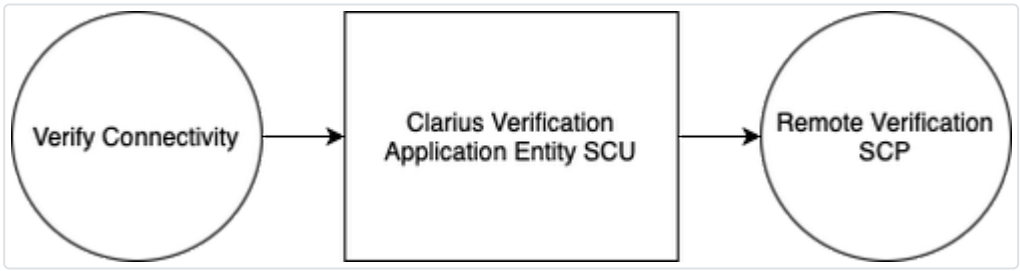

Figure 3-3. Application Data Flow Diagram (Verification)

The Verification Application Entity sends an echo request to the DICOM servers to check connection on the network.

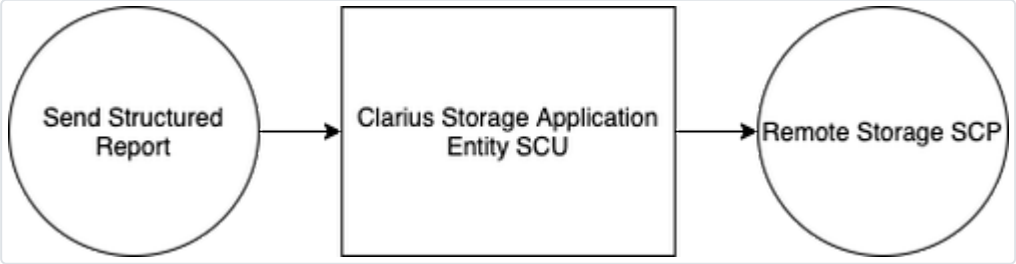

Figure 3-4. Application Data Flow Diagram (Structured Report)

The Storage Application Entity sends images to a Remote Application Entity. Sending images is done for each study completed, and for all images in the study. There is the option of selecting 1 or more Remote Application Entities upon completion of the study, or later in a separate list of completed studies.

3.1.2. Function Definition of AE

3.1.2.1. Storage Application Entity and Structured Report Application Entity

The selection of Remote Application Entities upon completion of the study, or the selection of a Remote Application Entity in a separate list of completed studies, puts upload entries in a queue to be uploaded one at a time. Before a study in the queue is sent to the Remote Storage Application Entity, the app checks if the app is connected to a Wi-Fi or cellular network. If connected, Verify Connectivity, outlined in 3.1.2.3. Verification Application Entity , is performed repeatedly until successful or the maximum number of attempts is reached.

The Clarius Storage Application Entity sends an association request to the Remote Storage Application Entity, with an Abstract Syntax (Ultrasound Image Storage, Ultrasound Multi-frame Image Storage and Photographic Image Storage), and with a list of desired Transfer Syntaxes. Upon successful negotiation, the image transfer is started using the first accepted Transfer Syntax from the list. An attempt, defined as a failure in either Verify Connectivity or storage request, is performed up to 5 times before marking the upload as failed. If the association cannot be negotiated , the upload entry is set to failed and the user can restart the upload through the interface.

3.1.2.2. Modality Worklist Application Entity

When the app is connected to a Wi-Fi or cellular network, the Modality Worklist software will attempt to establish an association every two minutes or when the DICOM Worklist page is refreshed.

3.1.2.3. Verification Application Entity

The Verification software sends an echo request to all Remote Application Entities listed in the DICOM Server Settings page when a new Remote Application Entity is added or the DICOM Settings Page is refreshed. Individual DICOM servers can also be pinged by clicking on each server’s Echo Server Button.

Verification of the remote DICOM device’s presence in the network is performed before a Send Image. The echo request is sent to check the connection between the Clarius Application Entity and Remote Application Entity. If verification fails, the study is kept in queue. Verification is repeated every two seconds when an internet connection is detected. However, if the verification is successful, send image proceeds.

3.2. AE Specifications

3.2.1. Storage Application Entity Specification

3.2.1.1. SOP Classes

Table 3-1. SOP Classes for AE Storage

SOP Class Name	SOP Class UID	SCU	SCP
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	No
Ultrasound Image-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	No

3.2.2. Modality Worklist Application Entity Specification

3.2.2.1. SOP Classes

Table 3-2. SOP Classes for AE Worklist

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

3.2.3. Verification Application Entity Specification

3.2.3.1. SOP Classes

Table 3-3. SOP Classes for AE Verification

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

3.2.4. Structured Report Application Entity Specification

3.2.4.1. SOP Classes

Table 3-4. SOP Classes for AE Structured Report

SOP Class Name	SOP Class UID	SCU	SCP
Comprehensive Structured Report Storage	1.2.840.10008.5.1.4.1.1.88.33	Yes	No

3.2.5. Association Policies

3.2.5.1. General

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

Table 3-5. DICOM Application Context for AE

Application Context Name	1.2.840.10008.3.1.1.1

3.2.5.2. Number of Associations

Clarius initiates one Association at a time for each destination and each request is processed one at a time.

3.2.5.3. Asynchronous Nature

Clarius does not support asynchronous communication (multiple outstanding transactions over a single Association).

3.2.5.4. Implementation Identifying Information

The implementation information for these Application Entities are:

Table 3-6. DICOM Implementation Identifying Information

OFFIS DCMTK 3.6.5	1.2.276.0.7230010.3.0.3.6.5

3.2.6. Association Initiation Policy

3.2.6.1. Activity - Send Images (C-STORE)

3.2.6.1.1. Proposed Presentation Contexts

Table 3-7. Proposed Presentation Contexts for Storing Single / Multi-frame Images

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70		
		JPEG-LS Lossless	1.2.840.10008.1.2.4.80		
Ultrasound Multi-frame 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
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70		
		JPEG-LS Lossless	1.2.840.10008.1.2.4.80		
Comprehensive Structured Report Storage	1.2.840.10008.5.1.4.1.1.88.33	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70		
		JPEG-LS Lossless	1.2.840.10008.1.2.4.80		

3.2.6.1.2. SOP-Specific Conformance for Storage SOP Classes

All SOP Classes supported by the Storage Application Entity exhibit the same behaviour. The Application Entity Title used in Association Negotiation Request is either the Client AE Title set in the DICOM Server Settings page or the Scanner's Serial Number without '-' or spaces and truncated to 16 characters.

Table 3-8. Storage C-STORE Response Status Handling Behaviour

Service Status	Further Meaning	Error Code	Behaviour
Success	Success	0x0000	The system continues to send SOP instances.
Failure	Refused: Out of Resources	0xA7xx	The association is released, the Error Code and the error message is logged, and the system reports a failure.
Failure	Error: Data Set does not match SOP Class	0xA9xx	The association is released, the Error Code and the error message is logged, and the system reports a failure.
Failure	Error: Cannot understand	0xCxxx	The association is released, the Error Code and the error message is logged, and the system reports a failure.
Warning	Coercion of Data Elements	0xB000	The Error Code and the error message is logged. The system continues to send SOP instances.
Warning	Elements Discarded	0xB006	

Service Status	Further Meaning	Error Code	Behaviour
			The Error Code and the error message is logged. The system continues to send SOP instances.
Warning	Data Set does not match SOP Class	0xB007	The Error Code and the error message is logged. The system continues to send SOP instances.
Generic Warning	All other warning values that don't fall under Service Status "Warning"	0x0001, 0xBxxx, 0x0107, 0x0116	The Error Code and the error message is logged. The system continues to send SOP instances.
*	Failure	Any other Error Code	The association is released, the Error Code and the error message is logged, and the system reports a failure.

If all responses indicate success or warning with no failures, the system displays success and the exam is removed from the upload queue. However, if the exam failed to upload, it is kept in queue and an upload attempt is retried the next time the app is restarted.

3.2.6.2. Activity - Query Worklist Information (C-FIND)

3.2.6.2.1. Proposed Presentation Contexts

Table 3-9. Proposed Presentation Contexts for Activity Query Worklist Server

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

3.2.6.2.2. SOP-Specific Conformance for Modality Worklist SOP Class

All SOP Classes supported by the Worklist Application Entity exhibit the same behaviour. The Application Entity Title used in Association Negotiation Request is either the Client AE Title set in the DICOM Server Settings page or "Clarius".

Table 3-10. Optional Matching Key Attributes for Basic Modality Worklist SOP Class

Attribute Name	Tag	Handling
Scheduled Procedure Step		
Scheduled Procedure Step Sequence	(0040,0100)	
>Scheduled Procedure Step Start Date	(0040,0002)	Current date or empty

Attribute Name	Tag	Handling
>Scheduled Procedure Step Start Time	(0040,0003)	empty
>Modality	(0008,0060)	"US" or empty
>Scheduled Performing Physician's Name	(0040,0006)	empty
Requested Procedure		
Study Instance UID	(0020,000D)	empty
Imaging Service Request		
Accession Number	(0008,0050)	empty
Referring Physician's Name	(0008,0090)	empty
Visit Identification		
Institution Name	(0008,0080)	empty
Institution Address	(0008,0081)	empty
Visit Status		
Visit Relationship		
Visit Admission		
Patient Relationship		
Patient Identification		
Patient's Name	(0010,0010)	empty
Patient ID	(0010,0020)	User-specified value or empty
Patient Demographic		
Patient's Birth Date	(0010,0030)	empty
Patient's Sex	(0010,0040)	empty
Patient Medical		
C-Find Identifier		
Time zone Offset From UTC	(0008,0201)	empty

Table 3-11. Worklist C-FIND Response Status Handling Behaviour

Service Status	Further Meaning	Error Code	Behaviour
Failure	Refused: Out of Resources	0xA700	The system reports a failure, the Error Code and the error message is logged, and the association is released.
Failure	Error: Data Set does not match SOP Class	0x900	The system reports a failure, the Error Code and the error message is logged, and the association is released.
Failure	Failed: Unable to process	0xCxxx	The system reports a failure, the Error Code and the error message is logged, and the association is released.
Failure	Generic Failure Error Codes	0xAxxx, 0x0200, 0x1xx except for 0x0107 and 0x116	The system reports a failure, the Error Code and the error message is logged, and the association is released.
Cancel	Matching terminated due to Cancel request	0xFE00	If the query is canceled, the system reports a failure, the Error Code and the error message is logged, and the association is released.
Success	Matching is complete – No final Identifier is supplied.	0x0000	The system reports a success. The worklist items are displayed.
Pending	Matches are continuing – Current match is supplied and any Optional Keys were supported in the same manner as Required Keys.	0xFF00	The worklist item contained in the identifier is collected for later display.
Pending	Matches are continuing – Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier.	0xFF01	The worklist item contained in the identifier is collected for later display. The Error Code and the error message is logged.

The Association is released after going through the response list. If all responses indicate success or warning with no failures, the system displays success.

3.2.6.3. Activity - Verify Connectivity (C-ECHO)

3.2.6.3.1. Proposed Presentation Contexts

Table 3-12. Proposed Presentation Contexts for Activity Verify Connectivity

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**			
Name	**UID**	**Name List**	**UID List**	**Role**	**Ext. Neg.**
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.2.6.3.2. SOP-Specific Conformance for Verification SOP Class

All SOP Classes supported by the Verification Application Entity exhibit the same behaviour. The Application Entity Title used in Association Negotiation Request is either the Client AE Title set in the DICOM Server Settings page or "Clarius".

Table 3-13. Verification C-ECHO Response Status Handling Behaviour

Service Status	Further Meaning	Error Code	Behaviour
Success	Success	*	The system reports a success.

4. Media Interchange

The Clarius DICOM implementation does not support media interchange.

5. Support of Character Sets

The Clarius DICOM implementation supports the default repertoire, designated by the ISO registration number ISO-IR 6 and character set ISO_IR 192.

6. Security

The Clarius DICOM implementation does not support any specific security measures.

6.1. Security Profiles

No Security Profiles are supported.

6.2. Association Level Security

The Clarius application does not accept Association Open Requests.

6.3. Application Level Security

No application-level security measures are supported.

Appendix A IOD Details

A.1. Supported IODs

The following A.1.1. Ultrasound Image IOD Modules and Table A-2. Ultrasound Multi-frame Image IOD Modules define the IODs (Information Object Definition) associated with Ultrasound Image Storage and Ultrasound Multi-frame Storage SOP Classes respectively.

A value of "Not implemented" in the Module Description column indicates that the Module is NOT used and is therefore ignored by the application.

A.1.1. Ultrasound Image IOD Modules

Table A-1. Ultrasound Image IOD Modules

IE	Module	Module Description
Patient	Patient	Table A-4. Patient Module
	Clinical Trial Subject	Not Implemented
Study	General Study	Table A-5. General Study Module
	Patient Study	Not Implemented
	Clinical Trial Study	Not Implemented
Series	General Series	Table A-6. General Series Module
	Clinical Trial Series	Not Implemented
Frame of Reference	Frame of Reference	Not Implemented
	Synchronization	Not Implemented
Equipment	General Equipment	Table A-7. General Equipment Module
Image	General Image	Table A-8. General Image Module
	General Reference	Not Implemented
	Image Pixel	Table A-10. Image Pixel Module
	Contrast/Bolus	Not Implemented
	Palette Color Lookup Table	Not Implemented
	Device	Not Implemented
	Specimen	Not Implemented
	US Region Calibration	Table A-11. US Region Calibration Module
	US Image	Table A-13. US Image Module

IE	Module	Module Description
	Overlay Plane	Not Implemented
	VOI LUT	Not Implemented
	ICC Profile	Not Implemented
	SOP Common	Table A-16. SOP Common Module
	Common Instance Reference	Not Implemented

Table A-2. Ultrasound Multi-frame Image IOD Modules

IE	Module	Module Description
Patient	Patient	Table A-4. Patient Module
	Clinical Trial Subject	Not Implemented
Study	General Study	Table A-5. General Study Module
	Patient Study	Not Implemented
	Clinical Trial Study	Not Implemented
Series	General Series	Table A-6. General Series Module
	Clinical Trial Series	Not Implemented
Frame of Reference	Frame of Reference	Not Implemented
	Synchronization	Not Implemented
Equipment	General Equipment	Table A-7. General Equipment Module
Image	General Image	Table A-8. General Image Module
	General Reference	Not Implemented
	Image Pixel	Table A-10. Image Pixel Module
	Contrast/Bolus	Not Implemented
	Cine	Table A-9. Cine Module
	Multi-frame	Table A-12. Multi-frame Module
	Frame Pointers	Not Implemented
	Palette Color Lookup Table	Not Implemented
	Device	Not Implemented

IE	Module	Module Description
	Specimen	Not Implemented
	US Region Calibration	Table A-11. US Region Calibration Module
	US Image	Table A-13. US Image Module
	VOI LUT	Not Implemented
	ICC Profile	Not Implemented
	SOP Common	Table A-16. SOP Common Module
	Common Instance Reference	Not Implemented
	Frame Extraction	Not Implemented

Table A-3. Comprehensive SR IOD Modules

IE	Module	Module Description
Patient	Patient	Table A-4. Patient Module
Study	General Study	Table A-5. General Study Module
	Patient Study	Not Implemented
Series	SR Document Series	Table A-24. SR Document Series
Equipment	General Equipment	Table A-7. General Equipment Module
Document	SR Document General	Table A-25. SR Document General Module
	SR Document Content	Table A-26. SR Document Content Module
	SOP Common	Table A-16. SOP Common Module

A.1.2. Ultrasound Image IOD Attributes

A value of "Not Implemented" in the Handling column indicates that the attribute is not sent to the SCP and that they will be addressed in a future software release.

If a value contains leading or trailing white spaces, these are removed during handling.

Table A-4. Patient Module

Attribute Name	Tag	Type*	Handling
Patient's Name	(0010,0010)	2	Uses the value from worklist if downloaded otherwise uses the patient's full name (LAST^FIRST^MIDDLE) from first, middle, and last names entered into the Exam form.

Attribute Name	Tag	Type*	Handling
Patient ID	(0010,0020)	2	Uses the value from worklist if downloaded otherwise uses the patient's given ID, entered into the Exam form.
Patient's Birth Date	(0010,0030)	2	Uses the value from worklist if downloaded otherwise uses the patient's selected Date of Birth, entered into the Exam form.
Patient's Sex	(0010,0040)	2	Uses the value from worklist if downloaded otherwise uses the patient's selected Gender, entered into the Exam form.
Patient Comments	(0010,4000)	3	Contains the "Indications Notes" entered in the patient demographics. If "Embed Annotations" option is activated in the app, also contains a comma-separated list of the annotations added to the capture. If both the indication notes and the annotation list are present, they are separated by a comma. The attribute is present but left empty otherwise.
Patient Species Description	(0010,2201)	1C	Not Implemented
Patient Species Code Sequence	(0010,2202)	1C	Not Implemented
>Include Table 8.8-1 "Code Sequence Macro Attributes"			Not Implemented
Patient Breed Description	(0010,2292)	2C	Not Implemented
Patient Breed Code Sequence	(0010,2293)	2C	Not Implemented
>Include Table 8.8-1 "Code Sequence Macro Attributes"			Not Implemented
Breed Registration Sequence	(0010,2294)	2C	Not Implemented
>Breed Registration Number	(0010,2295)	1	Not Implemented
>Breed Registry Code Sequence	(0010,2296)	1	Not Implemented
			Not Implemented

Attribute Name	Tag	Type*	Handling
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			
Responsible Person	(0010,2297)	2C	Not Implemented
Responsible Person Role	(0010,2298)	1C	Not Implemented
Responsible Organization	(0010,2299)	2C	Not Implemented

Table A-5. General Study Module

Attribute Name	Tag	Type*	Handling
Study Date	(0008,0020)	2	The date the first Series was created
Study Time	(0008,0030)	2	The time the first Series was created
Accession Number	(0008,0050)	2	Uses the value from the worklist if downloaded and present, otherwise uses the given accession number value entered by the user (if provided), otherwise no value.
Referring Physician's Name	(0008,0090)	2	Referring physician's name from worklist. The attribute is present but left empty otherwise.
Study Description	(0008,1030)	3	User-specified value or empty
Performed Procedure Step Description	(0040,0254)	3	Uses the joined values of the Scheduled Procedure Step Description Attribute (0040,0007) and Requested Procedure Description Attribute (0032,1060) obtained from the modality worklist if downloaded and present. If both values are present, they are separated by a comma. The result is truncated to 64 characters.
Study Instance UID	(0020,000D)	1	Uses the value from worklist if downloaded otherwise uses generated by the Exam (Study) UUID
Study ID	(0020,0010)	2	Attribute present but left empty

Table A-6. General Series Module

Attribute Name	Tag	Type*	Handling
Modality	(0008,0060)	1	"US"
Series Instance UID	(0020,000E)	1	Generated by the Session (Series) UUID

Attribute Name	Tag	Type*	Handling
Series Number	(0020,0011)	2	Starts at 1 for the first Session (Series) then increments by 1 for each subsequent Series in the Exam (Study)
Laterality	(0020,0060)	2C	"L" (for left), "R" (for right), or not included if no laterality pictogram or label is provided. Laterality is derived from Breast Pictograms or labels (LT, RT, RT BREAST, LT BREAST) with labels taking precedence.
Series Date	(0008,0021)	3	The date of the Series the Capture (Instance) belongs to
Series Time	(0008,0031)	3	The time of the Series the Capture (Instance) belongs to
Performing Physician's Name	(0008,1050)	3	Scheduled Performing Physician's Name from worklist if downloaded. The attribute is present but left empty otherwise.
Operators' Name	(0008,1070)	3	The name of the current user (LAST^FIRST) or his/her email address prefixed with a "^"
Anatomical Orientation Type	(0010,2210)	1C	Not Implemented

Table A-7. General Equipment Module

Attribute Name	Tag	Type*	Handling
Manufacturer	(0008,0070)	2	"Clarius Mobile Health Corporation"
Institution Name	(0008,0080)	3	Institution from worklist if available or user institution from the cloud. The attribute is present but left empty otherwise.
Institution Address	(0008,0081)	3	Institution address from worklist or user institution address from the cloud. The attribute is present but left empty otherwise.
Station Name	(0008,1010)	3	Probe's Friendly Name or Probe Serial Number without the "-".
Manufacturer's Model Name	(0008,1090)	3	Probe Model
Device Serial Number	(0018,1000)	3	Probe Serial Number
Software Versions	(0018,1020)	3	Current version of the Clarius software with major number, minor number, revision number, and build

Table A-8. General Image Module

Attribute Name	Tag	Type*	Handling
	(0020,0013)	2	

Attribute Name	Tag	Type*	Handling
Instance Number			Starts at 1 for the first still or cine capture (Instance) then increments by 1 for each subsequent Instance in the Session (Series) that contains them
Patient Orientation	(0020,0020)	2C	Attribute present but left empty
Content Date	(0008,0023)	2C	Current Date exam is submitted to DICOM
Content Time	(0008,0033)	2C	Current Time exam is submitted to DICOM

Table A-9. Cine Module

Attribute Name	Tag	Type*	Handling
Frame Time Vector	(0018,1065)	1C	Millisecond numbers with 6 decimal places (for nanosecond precision) separated by "\". Used when the image capture is a cine and not a single still frame, and the images come from an Exam (Study) instead of a separate list of images.

Table A-10. Image Pixel Module

Attribute Name	Tag	Type*	Handling
Include Table C.7-11c "Image Pixel Description Macro Attributes "			Table A-17. Image Pixel Description Macro Attributes
Pixel Data	(7FE0,0010)	1C	Contains the RGB triplets, uncompressed for Explicit VR Little Endian Transfer Syntax and Implicit VR Little Endian Transfer Syntax, or compressed for JPEG Lossless and JPEG-LS Lossless Transfer Syntaxes

Table A-11. US Region Calibration Module

Attribute Name	Tag	Type*	Handling
Sequence of Ultrasound Regions	(0018,6011)	1	There is one sequence item created for each region present per frame
>Region Spatial Format	(0018,6012)	1	• 0001H: 2D (B-Mode) • 0002H: M-Mode • 0003H: Spectral (PW Doppler)
>Region Data Type	(0018,6014)	1	0001H (Tissue)
>Region Flags	(0018,6016)	1	

Attribute Name	Tag	Type*	Handling
			00000001H for Low-Priority Region Pixels, Scaling Protection off, Velocity Doppler Scale Type, and Unspecified Scrolling Region
>Region Location Min x0	(0018,6018)	1	The left x value of the region boundary of the frame
>Region Location Min y0	(0018,601A)	1	The upper y value of the region boundary of the frame
>Region Location Max x1	(0018,601C)	1	The right x value of the region boundary of the frame (left + width - 1)
>Region Location Max y1	(0018,601E)	1	The lower y value of the region boundary of the frame (top + height - 1)
>Physical Units X Direction	(0018,6024)	1	First unit the physical pixel size (in the X direction) can be converted to: cm, sec, cm/sec, cm^2, cm^3, degrees, percent, dB, and hertz of the frame
>Physical Units Y Direction	(0018,6026)	1	First unit the physical pixel size (in the Y direction) can be converted to: cm, sec, cm/sec, cm^2, cm^3, degrees, percent, dB, and hertz of the frame
>Physical Delta X	(0018,602C)	1	A pixel size using the Physical Units X Direction of the frame
>Physical Delta Y	(0018,602E)	1	A pixel size using the Physical Units Y Direction of the frame
>Transducer Frequency	(0018,6030)	3	Transducer imaging frequency in kHz

Table A-12. Multi-frame Module

Attribute Name	Tag	Type*	Handling
Frame Increment Pointer	(0028,0009)	1	Set to the Frame Time Vector (0018,1065)
Number of Frames	(0028,0008)	1	Number of frames for cine

Table A-13. US Image Module

Attribute Name	Tag	Type*	Handling
Samples Per Pixel	(0028,0002)	1	3
Photometric Interpretation	(0028,0004)	1	"RGB"
Bits Allocated	(0028,0100)	1	8
Bits Stored	(0028,0101)	1	8

Attribute Name	Tag	Type*	Handling
High Bit	(0028,0102)	1	7
Planar Configuration	(0028,0006)	1C	0
Pixel Representation	(0028,0103)	1	0
Frame Increment Pointer	(0028,0009)	1C	Table A-12. Multi-frame Module (only for multi-frame images)
Image Type	(0008,0008)	2	"ORIGINAL\PRIMARY\<VALUE3>\<VALUE4>" Where <VALUE3> is mapped from the selected Clarius workflow according to Table A-14. Image Type Value 3 mapping to Clarius Workflow . And <VALUE4> contains the constituent modalities that compose the US image.
Lossy Image Compression	(0028,2110)	1C	"01"
Ultrasound Color Data Present	(0028,0014)	3	Not Implemented
Include Table 10-25 "Optional View and Slice Progression Direction Macro Attributes "			Table A-18. Optional View and Slice Progression Direction Macro Attributes
Transducer Type	(0018,6031)	3	Table A-15. Transducer Type Mapping to Clarius Models
Mechanical Index	(0018,5022)	3	Calculated value for MI calculated of a frame.
Bone Thermal Index	(0018,5024)	3	Calculated value for bone TI of a frame.
Cranial Thermal Index	(0018,5026)	3	Calculated value for cranial TI of a frame.
Soft Tissue Thermal Index	(0018,5027)	3	Calculated value for soft tissue TI of a frame.

Table A-14. Image Type Value 3 mapping to Clarius Workflow

Attribute Name	Tag
ABDOMINAL	Abdomen, Large Animal, Medium Animal, Small Animal
BREAST	Breast, Diagnostic Breast
CHEST	Lung
ENDORECTAL	Prostate
ENDOVAGINAL	IVF

Attribute Name	Tag
MUSCULOSKELETAL	MSK, Foot, Elbow, Hip, Hip Joint, Knee, Plantar/Achilles, Shoulder, Spine, Hand/Wrist, Nerve, Equine MSK
OBSTETRICAL	Early OB, OB/GYN
OPHTHALMIC	Ocular
PELVIC	Bladder, Pelvic
RETROPERITONEAL	Oncoustic Liver
SMALL PARTS	Small Parts, Superficial, Tongue
TTE	Cardiac, Large Animal Cardiac, Medium Animal Cardiac, Small Animal Cardiac
US BIOPSY	Interventional Breast
VASCULAR	Plastic Surgery, Vascular

Table A-15. Transducer Type Mapping to Clarius Models

Attribute Name	Tag
LINEAR	L7-38, L7ARX, L7HOL, L7VET, L7HD, L7HDVET, L15HD, L20HD
CURVED LINEAR	C3-45, C3-60, C3ARX, C3VET, C3HD, C3HDVET, C7-20, C7VET, C7HD, C7HDVET
ENDOCAV_CLA	EC7-10, EC7HD
SECTOR_PHASED	PA2HD

Table A-16. SOP Common Module

Attribute Name	Tag	Type*	Handling
SOP Class UID	(0008,0016)	1	Ultrasound Image Storage SOP Class UID for single still frame captures, or the Ultrasound Multi-frame Image Storage SOP Class UID for cine captures , or the Structured Report SOP Class UID for DSR
SOP Instance UID	(0008,0018)	1	Generated by the Capture (Instance) UUID. A new unique UID will be generated every time an image without all of the original overlays is exported
Specific Character Set	(0008,0005)	1C	"ISO_IR 192"
Timezone Offset From UTC Attribute	(0008,0201)	3	A string in the format "&ZZXX" where & = "+" or "-", and ZZ = Hours and XX = Minutes of offset. The offset for UTC is "+0000"

Table A-17. Image Pixel Description Macro Attributes

Attribute Name	Tag	Type*	Handling
Samples Per Pixel	(0028,0002)	1	3
Photometric Interpretation	(0028,0004)	1	"RGB"
Rows	(0028,0010)	1	Pixel height of the image
Columns	(0028,0011)	1	Pixel width of the image
Bits Allocated	(0028,0100)	1	8
Bits Stored	(0028,0101)	1	8
High Bit	(0028,0102)	1	7
Pixel Representation	(0028,0103)	1	0
Planar Configuration	(0028,0006)	1C	0

Table A-18. Optional View and Slice Progression Direction Macro Attributes

Attribute Name	Tag	Type*	Handling
View Code Sequence	(0054,0220)	3	
>Code Sequence Macro Attributes			Attributes are defined in Table A-19. Code Sequence Macro Attributes. This item is populated with values from Table A-22. View Code Sequence. Table A-20. View Code Sequence Mapping shows how labels from the system are mapped to their values in Table A-22. View Code Sequence using Code Meaning values as keys. If no labels are detected, this item is not included.
>View Modifier Code Sequence	(0054,0222)	3	
>>Code Sequence Macro Attributes			Attributes are defined in Table A-19. Code Sequence Macro Attributes. This item is populated with values from Table A-23. View Modifier Code Sequence. Table A-21. View Modifier Code Sequence Mapping show how labels from the system are mapped to their values in Table A-23. View Modifier Code Sequence using Code Meaning values as keys. More than one item can be included and if no labels are detected, this item is not included.

Table A-19. Code Sequence Macro Attributes

Attribute Name	Tag	Type*	Handling
Code Value	(0008,0100)	1C	Table A-22. View Code Sequence or Table A-23. View Modifier Code Sequence
Coding Scheme Designator	(0008,0102)	1C	Table A-22. View Code Sequence or Table A-23. View Modifier Code Sequence
Code Meaning	(0008,0104)	1	Table A-22. View Code Sequence or Table A-23. View Modifier Code Sequence
Context Identifier	(0008,010F)	3	Table A-22. View Code Sequence or Table A-23. View Modifier Code Sequence
Context UID	(0008,0117)	3	Table A-22. View Code Sequence or Table A-23. View Modifier Code Sequence
Mapping Resource	(0008,0105)	1C	Table A-22. View Code Sequence or Table A-23. View Modifier Code Sequence
Context Group Version	(0008,0106)	1C	Table A-22. View Code Sequence or Table A-23. View Modifier Code Sequence

Table A-20. View Code Sequence Mapping

Code Meaning	Labels
Breast	12:00, 3:00, 6:00, 9:00
Lower inner quadrant of breast	7:00 or 8:00 and laterality is left
	4:00 or 5:00 and laterality is right
	LIQ
Lower outer quadrant of breast	4:00 or 5:00 and laterality is left
	7:00 or 8:00 and laterality is right
	LOQ
Upper inner quadrant of breast	10:00 or 11:00 and laterality is left
	1:00 or 2:00 and laterality is right
	UIQ
Upper outer quadrant of breast	1:00 or 2:00 and laterality is left
	10:00 or 11:00 and laterality is right
	UOQ

Table A-21. View Modifier Code Sequence Mapping

Code Meaning	Labels
Left	LEFT
Right	RIGHT
Medial	MEDIAL
Lateral	LATERAL
Superior	SUPERIOR
Inferior	INFERIOR
Central	CENTRAL
Transverse	TRANS
Longitudinal	LONG
Sagittal	SAG

Table A-22. View Code Sequence

CID	Context UID	Context Group Version	Mapping Resource	Code Scheme Designator	Code Value	Code Meaning
4	1.2.840.10008.6.1.2	20170914	DCMR	SRT	T-04000	Breast
4	1.2.840.10008.6.1.2	20170914	DCMR	SRT	T-04003	Lower inner quadrant of breast
4	1.2.840.10008.6.1.2	20170914	DCMR	SRT	T-04005	Lower outer quadrant of breast
4	1.2.840.10008.6.1.2	20170914	DCMR	SRT	T-04002	Upper inner quadrant of breast
4	1.2.840.10008.6.1.2	20170914	DCMR	SRT	T-04004	Upper outer quadrant of breast

Table A-23. View Modifier Code Sequence

CID	Context UID	Context Group Version	Mapping Resource	Code Scheme Designator	Code Value	Code Meaning
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	G-A100	Right
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	G-A101	Left

CID	Context UID	Context Group Version	Mapping Resource	Code Scheme Designator	Code Value	Code Meaning
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	G-A104	Lateral
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	R-404D5	Medial
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	G-A110	Central
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	R-42191	Superior
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	R-4094A	Inferior
5	1.2.840.10008.6.1.3	20160314	DCMR	SRT	G-A117	Transverse
6	1.2.840.10008.6.1.4	20040322	DCMR	SRT	G-A143	Longitudinal
6	1.2.840.10008.6.1.4	20040322	DCMR	SRT	G-A145	Sagittal

Table A-24. SR Document Series

Attribute Name	Tag	Type*	Handling
Modality	(0008,0060)	1	"SR"
Series Instance UID	(0020,000E)	1	Auto-generated
Series Number	(0020,0011)	1	Unique number

Table A-25. SR Document General Module

Attribute Name	Tag	Type*	Handling
Instance Number	(0020,0013)	1	Unique number
Completion Flag	(0040,A491)	1	"PARTIAL"
Verification Flag	(0040,A493)	1	"UNVERIFIED"
Content Date	(0008,0023)	3	Date content created
Content Time	(0008,0033)	3	Time content created
Performed Procedure Code Sequence	(0040,A372)	2	Attribute present but left empty

Table A-26. SR Document Content Module

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	" C ONTAINER"

Attribute Name	Tag	Type*	Handling
Concept Name Code Sequence	(0040,A043)	1	From DICOM Nema Standards
>Code Value	(0008,0100)	1	"125000" (OB-GYN/IVF) "125100" (Vascular) "125200" (Cardiac) "126000" (AI)
>Coding Scheme Designator	(0008,0102)	1	"DCM"
>Code Meaning	(0008,0104)	1	"OB-GYN Procedure Report" "Vascular Ultrasound Procedure Report" "Adult Echocardiography Procedure Report" "Imaging Measurement Report"
Continuity of Content	(0040,A050)	1	"SEPARATE"
Content Template Sequence	(0040,A504)	1	
>Mapping Resource	(0008,0105)	1	"DCMR"
>Template Identifier	(0040,DB00)	1	"5000" (OB-GYN/IVF) "5100" (Vascular) "5200" (Cardiac) "1500" (AI)
Content Sequence	(0040,A730)	1	
>Relationship Type	(0040,A010)	1	Based on DICOM Nema Standards
Numeric Measurement Macro			One of: Table A-27. Text Code Macro Table A-28. Num Code Macro Table A-29. Code Code Macro Table A-30. Date Code Macro Table A-31. Time Code Macro Table A-32. Image Code Macro Table A-33. SCoord Code Macro

Table A-27. Text Code Macro

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	"TEXT"

Attribute Name	Tag	Type*	Handling
Concept Name Code Sequence	(0040,A043)	1C	From DICOM Nema Standards
Text Value	(0040,A160)	1C	Subject Name and Subject ID
Content Sequence	(0040,A730)	1C	
>Relationship Type	(0040,A010)	1	"CONTAINS" or "HAS OBS CONTEXT"

Table A-28. Num Code Macro

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	"NUM"
Concept Name Code Sequence	(0040,A043)	1C	From DICOM Nema Standards
Measured Value Sequence	(0040,A300)	2	
>Numeric Value	(0040,A30A)	1	Numeric Measurement Value
>Measurement Units Code Sequence	(0040,08EA)	1	One of: "MilliMeter" "CentiMeter" "Week" "SquareCentiMeter" "cubic centimeter" "MicroMeter" "Percent" Note: these follow the UCUM standard except "cubic centimeter" which is not defined by UCUM.
Content Sequence	(0040,A730)	1C	
>Relationship Type	(0040,A010)	1	"CONTAINS"

Table A-29. Code Code Macro

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	"CODE"
	(0040,A043)	1C	From DICOM Nema Standards

Attribute Name	Tag	Type*	Handling
Concept Name Code Sequence			
Concept Code Sequence	(0040,A168)	1	Value of Content Item
Content Sequence	(0040,A730)	1C	
>Relationship Type	(0040,A010)	1	"CONTAINS" or "HAS CONCEPT MOD" or "HAS PROPERTIES"

Table A-30. Date Code Macro

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	"DATE"
Concept Name Code Sequence	(0040,A043)	1C	From DICOM Nema Standards
Date	(0040,A121)	1C	Value for Date of Observation

Table A-31. Time Code Macro

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	"TIME"
Concept Name Code Sequence	(0040,A043)	1C	From DICOM Nema Standards
Time	(0040,A122)	1C	Value for Time of Observation

Table A-32. Image Code Macro

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	"IMAGE"
Referenced SOP Sequence	(0008,1199)	1	
>Referenced SOP Class UID	(0008,1150)	1	"1.2.840.10008.5.1.4.1.1.6.1" UltrasoundImageStorage
>Referenced SOP Instance UID	(0008,1155)	1	Instance UID From Source Image
Content Sequence	(0040,A730)	1C	
>Relationship Type	(0040,A010)	1	"SELECTED FROM"

Table A-33. SCoord Code Macro

Attribute Name	Tag	Type*	Handling
Value Type	(0040,A040)	1	"SCOORD"
Concept Name Code Sequence	(0040,A043)	1C	From DICOM Nema Standards
Graphic Data	(0070,0022)	1	Measurement Points Dependent on the Type of Measurement
Graphic Type	(0070,0023)	1	"MULTIPOINT" or "POLYLINE" or "ELLIPSE"
Content Sequence	(0040,A730)	1C	
>Relationship Type	(0040,A010)	1	"INFERRED FROM"

* Type codes:

Type code	Meaning
1	Required to be in the SOP Instance (DICOM file) and shall have a valid value.
2	Required to be in the SOP Instance (DICOM file) but may contain the value of "unknown", or a zero-length value.
3	Optional. May or may not be included and could be zero length.
1C	Conditional. If a condition is met, then it is a Type 1 (required, cannot be zero). If the condition is not met, then the tag is not sent.
2C	Conditional. If a condition is met, then it is a Type 2 (required, zero length OK). If the condition is not met, then the tag is not sent.

A.1.3. Attribute Mapping

Table A-34. Attribute Map

Modality Worklist	Image IOD	Multi-frame IOD
Scheduled Procedure Step Start Date	Not mapped	Not mapped
Scheduled Procedure Step Start Time	Not mapped	Not mapped
Modality	Not mapped	Not mapped
Scheduled Performing Physician’s Name	Performing Physician’s Name	Performing Physician’s Name
Study Instance UID	Study Instance UID	Study Instance UID

Modality Worklist	Image IOD	Multi-frame IOD
Accession Number	Accession Number	Accession Number
Referring Physician’s Name	Referring Physician’s Name	Referring Physician’s Name
Institution Name	Institution Name	Institution Name
Institution Address	Institution Address	Institution Address
Patient's Name	Patient's Name	Patient's Name
Patient ID	Patient ID	Patient ID
Patient's Birth Date	Patient's Birth Date	Patient's Birth Date
Patient's Sex	Patient's Sex	Patient's Sex