Limbus Contour

DICOM Conformance Statement

Purpose

This document provides information about the DICOM Conformance of Limbus Contour version 1.8.

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Document History

1	March 27, 2020	Initial version for Limbus Contour 1.1.0
2	December 19, 2020	Changes for Limbus Contour release 1.3.0. StructureSetLabel now configurable.
3	August 4, 2023	Updated product version - removed manufacturer address as its available through other channels
4	May 14, 2024	Updated product version - Support for Contributing Equipment Sequence.

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1 Introduction

1.1 Intended Readers

The reader of this document is concerned with software design and/or system integration with Limbus Contour. It is assumed that readers are familiar with the DICOM standard.

This document is based on the template definition in the DICOM standard (PS3.2).

1.2 Remarks

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

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:
- The comparison of different Conformance Statements is just the first step towards assessing the interconnectivity and interoperability between the product and other DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.

1.3 Abbreviations

There are a variety of terms and abbreviations used in the document that are defined in the DICOM Standard. Abbreviations and terms are as follows:

AE	DICOM Application Entity
AET	Application Entity Title
CT	Computed Tomography

DICOM   Digital Imaging and Communication In Medicine
FSC   File-Set Creator
FSR   File-Set Reader
FSU   File-Set Updater
GUI   Graphical User Interface
IOD   DICOM Information Object Definition
MR   Magnetic Resonance
ROI   Region-of-Interest
RT   Radiotherapy
SOP   DICOM Service-Object Pair
UID   Unique Identifier

1.4 References

NEMA PS3 / ISO 12052, Digital Imaging and Communications in Medicine (DICOM) Standard, National Electrical Manufacturers Association, Rosslyn, VA, USA (available free at http://medical.nema.org/)

1.5 Overview

Limbus Contour is a stand-alone, installable-executable, and single-purpose software application intended for use by trained radiation oncologists, dosimetrists, and medical physicists to derive optimal organ and clinical target volume contours for input to radiation treatment planning.

The core purpose of Limbus Contour is to perform automatic segmentation (contouring) of regions-of-interest (ROIs/structures) of user-imported computed tomography (CT) and magnetic resonance (MR) DICOM images and to export corresponding segmentations to DICOM RT-Structure Set files. Limbus Contour is controlled via a Graphical User Interface (GUI).

Limbus Contour also supports creation of placeholder structures. These are structures written to DICOM RT-Structure Sets that contain no contour data (user populates contour data manually after RT-Structure Set export).

Limbus Contour does not support any of the DICOM networking services (transfer, query/retrieve, workflow management, print management). Instead, a user interface is provided to import DICOM image files and export DICOM RT-Structure Set files.

This conformance statement will cover only conformance to the DICOM Structure Set IOD.

Limbus Contour can read/import the following IODs:

SOP Class Name	SOP Class UID
1.2.840.10008.5.1.4.1.1.2	CT Image Storage
1.2.840.10008.5.1.4.1.1.4	MR Image Storage

Table 1 – Supported IODs for read

Transfer Syntax	Transfer Syntax UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2

Table 2 – IMPORT-FSR IOD Transfer Syntax

Limbus Contour can write/export the following IODs:

SOP Class Name	SOP Class UID
1.2.840.10008.5.1.4.1.1.481.3	Radiation Therapy Structure Set Storage

Table 3 - Supported IODs for write

Transfer Syntax	Transfer Syntax UID
Implicit VR Little Endian	1.2.840.10008.1.2

Table 4 – EXPORT-FSC IOD Transfer Syntax

2 Networking

Limbus Contour does not provide any DICOM networking services or support any networking roles.

3 Media Interchange

Limbus Contour does not provide any media interchange services.

4 Transformation of DICOM to CDA

Limbus Contour does not support any Structured Reporting (SR) objects.

5 Support of Character Sets

5.1 Decoding

Limbus Contour supports decoding of the following character sets:

Character Set	Defined Term
Default repertoire	ISO_IR 6
Latin alphabet No. 1	ISO_IR 100
Latin alphabet No. 2	ISO_IR 101
Latin alphabet No. 3	ISO_IR 109
Latin alphabet No. 4	ISO_IR 110
Greek	ISO_IR 126
Arabic	ISO_IR 127
Hebrew	ISO_IR 138
Cyrillic	ISO_IR 144
Latin alphabet No. 5	ISO_IR 148
Thai	ISO_IR 166
Unicode in UTF-8	ISO_IR 192

Table 5 - Character sets supported for decoding from DICOM

The Specific Character Set value is read from the DICOM tag field 0008,0005.

When an unsupported character is received it shall be tried and decoded according the default repertoire. Otherwise unsupported characters shall be displayed as "?". Usage of non-latin characters should be validated carefully.

5.2 Encoding

The default character set used for encoding is ISO_IR 100, otherwise the exported DICOM RT Structure Set objects will have the same Specific Character set as the referring DICOM images.

6 Security

Limbus Contour does not support any specific DICOM security measures. It is assumed that Limbus Contour is used within a secured environment.

7 Annexes

7.1 IOD Contents

7.1.1 Usage of Attributes from Received IODs

The following table applies to read/import of the following IODs:

SOP Class Name	SOP Class UID
1.2.840.10008.5.1.4.1.1.2	CT Image Storage
1.2.840.10008.5.1.4.1.1.4	MR Image Storage

Table 6 - Supported IODs for read

A description of attributes read from received UID and their usage is provided in the following table:

Attribute Name	Tag	Usage/Comment
Patient's Name	0010,0010	Identification
Patient ID	0010,0020	Identification
Patient's Sex	0010,0040	Identification
Patient's Birth Date	0010,0030	Identification
Patient's Age	0010,1010	Identification
Study Instance UID	0020,000D	Identification
Study ID	0020,0010	Identification
Study Date	0008,0020	Identification
Study Time	0008,0030	Identification
Referring Physician's Name	0008,0090	Identification
Accession Number	0008,0050	Identification

Modality	0008,0060	Identification/Validation (CT and MR are supported)
Series Instance UID	0020,000E	Identification / organization of images in several series
Series Description	0008,103E	Identification
SOP Class UID	0008,0016	Verification, the application supports the following SOPs: 1.2.840.10008.5.1.4.1.1.2 1.2.840.10008.5.1.4.1.1.4
SOP Instance UID	0008,0018	Image object identification
Specific Character Set	0008,0005	The exported DICOM RT Structure Set objects will have the same Specific Character set as the referring DICOM images
Frame of Reference UID	0020,0052	Frame of Reference to other DICOM objects
Rescale Slope	0028,1053	Pixel data interpretation / reconstruction of images for segmentation
Rescale Intercept	0028,1052	Pixel data interpretation / reconstruction of images for segmentation
Window Center	0028,1050	Pixel data interpretation / reconstruction of images for segmentation
Window Width	0028,1051	Pixel data interpretation / reconstruction of images for segmentation
Pixel Spacing	0028,0030	Reconstruction of images for segmentation

Image Position (Patient)	0020,0032	Reconstruction of images for segmentation
Image Orientation Patient	0027,0037	Reconstruction of images for segmentation. Only [1, 0, 0, 0, 1, 0] orientation is supported.
Slice Thickness	0018,0050	Identification
Pixel Data	7FE0,0000	Pixel data interpretation / reconstruction of images for segmentation
Transfer Syntax UID	0002,0010	Criteria to perform byte swapping

Table 7 - Usage of Attributes for read IODs

7.1.1.1 Required Attributes

Images will not be imported (indicated by error messages) if they don't contain valid representations for the following tags (these tags are required for construction of RT-Structure Sets):

Name	Tag
Pixel Data	7FE0,0000
SOP Class UID	0008,0016
SOP Instance UID	0008,0018
Pixel Spacing	0028,0030
Image Position Patient	0020,0032
Image Orientation Patient	0020,0037
Frame of Reference UID	0020,0052
Study Instance UID	0020,000D
Series Instance UID	0020,000E
Modality	0008,0060

Table 8 - Required Attributes for read IODs

7.1.2 Created SOP Instances

IODs created by Limbus Contour are listed below along with supported modules and mapping between Attributes where applicable.

SOP Class Name	SOP Class UID
RT Structure Set Storage Class	1.2.840.10008.5.1.4.1.1.481.3

Table 9 - List of created SOP Classes

7.1.2.1 RT Structure Set Information Object Implementation

IE	Module	PS 3.3 Reference	Support
Patient	Patient	C.7.1.1	
	Clinical Trial Subject	C.7.1.3	Not Supported
Study	General Study	C.7.2.1	
	Patient Study	C.7.2.2	
	Clinical Trial Study	C.7.2.3	Not Supported
Series	RT Series	C.8.8.1	
Frame of Reference	Frame of Reference	C.7.4.1	Not Supported
Equipment	General Equipment	C.7.5.1	
Structure Set	Structure Set	C.8.8.5	
	ROI Contour	C.8.8.6	
	RT ROI Observations	C.8.8.8	
	Approval	C.8.8.16	
	Common Instance Reference	C.12.2	Not Supported
	SOP Common	C.12.1	

Table 10 - RT Structure Set IOD Modules Support

7.1.2.2 Modules and Attributes

This section specifies the IOD created by this application (RT-Structure Set only) and specifies the content of each IOD. For each attribute in the IOD the following information is provided:
- Attribute Name
- Tag

- VR (Value Representation)
- Value (Possible values)
- Presense (of Value)
- Source

The following tables use a number of abbreviations. The abbreviations used in the "Presence" column are:
- **VNAP** – Value Not Always Present (attribute saved with zero length if no value is present)
- **ANAP** – Attribute Not Always Present
- **ALWAYS** – Always Present
- **EMPTY** – Attribute is sent without a value
- **N/A** – Attribute does not have a value, e.g., a sequence (SQ)

The abbreviations used in the "Source" column are:
- **USER** – the attribute value source is from User input
- **AUTO** – the attribute value is generated automatically

PATIENT MODULE ATTRIBUTES					
Attribute Name	**Tag**	**VR**	**Value**	**Presence**	**Source**
Patient's Name	0010,0010	PN	Copied	VNAP	Patient's Name from referenced image series associated with the structure set
Patient ID	0010,0020	LO	Copied	VNAP	Patient ID from referenced image series associated with the structure set
Patient's Birth Date	0010,0030	DA	Copied	VNAP	Patient's Name from referenced image series associated with the structure set
Patient's Sex	0010,0040	CS	Copied	VNAP	Patient's Sex from referenced image series associated with the structure set

Table 11 - Patient Module Attributes

PATIENT STUDY MODULE ATTRIBUTES					
Attribute Name	**Tag**	**VR**	**Value**	**Presence**	**Source**

| Patient's Age | 0010,1010 | AS | Copied | VNAP | Patient's Age from referenced image series associated with the structure set |

Table 12 - Patient Study Module Attributes

GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence	Source
Study Instance UID	0020,000D	UI	Copied	ALWAYS	Study Instance UID from referenced images associated with the structure set
Study Date	0008,0020	DA	Copied	VNAP	Study Date from referenced images associated with the structure set
Study Time	0008,0030	DA	Copied	VNAP	Study Time from referenced images associated with the structure set
Referring Physician's Name	0008,0090	PN	Copied	VNAP	Referring Physician's Name from referenced images associated with the structure set
Study ID	0020,0010	SH	Copied	VNAP	Study ID from referenced images associated with the structure set
Accession Number	0008,0050	SH	Copied	VNAP	Accession Number from referenced images associated with the structure set
Study Description	0008,1030	LO	Copied	ANAP	Study Description from referenced images associated with the structure set

Table 13 - General Study Module Attributes

RT SERIES MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence	Source
Modality	0008,1080	CS	"RTSTRUCT"	ALWAYS	Set to 'RTSTRUCT'
Series Instance UID	0020,000E	UI	Generated UID	ALWAYS	AUTO

Series Number	0020,0011	IS		EMPTY	AUTO
Operator's Name	0008, 1070	PN	Copied	ANAP	Operator's Name from referenced images associated with the structure set

Table 14 - RT Series Module Attributes

GENERAL EQUIPMENT MODULE ATTRIBUTES					
Attribute Name	**Tag**	**VR**	**Value**	**Presence**	**Source**
Manufacturer	0008,0070	LO	"Limbus AI Inc."	ALWAYS	AUTO
Manufacturer's Model Name	0008,1090	LO	"Limbus Contour"	ALWAYS	AUTO
Software Versions	0018,1020	LO	Limbus Contour version number	ALWAYS	AUTO

Table 15 - General Equipment Module Attributes

STRUCTURE SET MODULE ATTRIBUTES					
Attribute Name	**Tag**	**VR**	**Value**	**Presence**	**Source**
Structure Set Label	3006,0002	SH	Default: "Limbus RTStruct"	ALWAYS	AUTO Configurable within application
Structure Set Name	3006,0004	LO	Copied	VNAP	Series Description of image series associated with the structure set
Structure Set Description	3006,0006	ST	"Limbus Contour"	ALWAYS	AUTO
Instance Number	0020,0013	IS		EMPTY	
Structure Set Date	3006,0008	DA	Date RT Structure Set was created	ALWAYS	AUTO

Structure Set Time	3006,0009	TM	Time RT Structure Set was created	ALWAYS	AUTO
Reference Frame of Reference Sequence	3006,0010	SQ	Only one item in this sequence is supported	N/A	
>Frame of Reference UID	0020,0052	UI	Copied	ALWAYS	Frame of Reference UID of image series associated with the structure set
>RT Referenced Study Sequence	3006,0012	SQ	Only one item in this sequence is supported.	N/A	Generated from images used to create the structure set.
>>Referenced SOP Class UID	0008,1150	UI	Copied	ALWAYS	SOP Class UID of image series associated with the structure set
>>Referenced SOP Instance UID	0008,1155	UI	Copied	ALWAYS	Study Instance UID of image study associated with the structure set
>>RT Referenced Series Sequence	3006,0014	SQ	Only one item in this sequence is supported.	N/A	Generated from images used to create the structure set.
>>>Series Instance UID	0020,000E	UI	Copied	ALWAYS	Series Instance UID of image series associated with the structure set
>>>Contour Image Sequence	3006,0016	SQ		N/A	One item per image in the series
>>>>Referenced SOP Class	0008,1150	UI	Copied	ALWAYS	SOP Class UID of referenced image series associated with the structure set

>>>>Referenced SOP Instance UID	0008,1155	UI	Copied	ALWAYS	SOP Instance UID of referenced image
Structure Set ROI Sequence	3006,0020	SQ		N/A	One item per structure
>ROI Number	3006,0020	IS	Uniquely generated (sequence starting at 1) ROI numbers are organized based on ROI Name (alphabetically)	ALWAYS	AUTO
>Referenced Frame of Reference UID	3006,0024	UI	Copied	ALWAYS	Frame of Reference UID of image series associated with the structure set
>ROI Name	3006,0026	LO	User defined ROI Name	ALWAYS	USER
>ROI Generation Algorithm	3006,0036	CS	"AUTOMATIC" for automatically segmented structures "MANUAL" for Empty Structures (placeholders)	ALWAYS	AUTO
>ROI Generation Description	3006,0038	LO	"Limbus Contour Machine Learning Auto-segmentation" for automatically segmented structures. EMPTY for Empty Structures (placeholders)	VNAP	AUTO

Table 16 - Structure Set Module Attributes

ROI CONTOUR MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence	Source
ROI Contour Sequence	3006,0039	SQ		N/A	One item per structure
>Referenced ROI Number	3006,0084	IS	Reference to structure ROI Number	ALWAYS	AUTO
>ROI Display Color	3006,002A	IS	User defined structure color	ALWAYS	USER
>Contour Sequence	3006,0040	SQ		N/A	One item per region in structure This sequence is EMPTY for Empty Structures (placeholders).
>>Contour Image Sequence	3006,0016	SQ		N/A	Only one item in this sequence is supported.
>>>Referenced SOP Class UID	0008,1150	UI	Copied	ALWAYS	SOP Class UID of referenced image series associated with the structure set
>>>Referenced SOP Instance UID	0008,1155	UI	Copied	ALWAYS	SOP Instance UID of referenced image
>>Contour Geometric Type	3006,0042	CS	"CLOSED_PLANAR"	ALWAYS	
>>Number of Contour Points	3006,0046	IS	Number of vertices in the structure.	ALWAYS	AUTO
>>Contour Data	3006,0050	DS	Vertex coordinates of structure in DICOM patient coordinate system	ALWAYS	AUTO

Table 17 - ROI Contour Module Attributes

RT ROI OBSERVATIONS MODULE ATTRIBUTES

Attribute Name	Tag	VR	Value	Presence	Source
RT ROI Observations Sequence	3006,0080	SQ	One item per structure	N/A	
>Observation Number	3006,0082	IS	Index starting at 0	ALWAYS	AUTO
>Referenced ROI Number	3006,0084	IS	Reference to structure ROI Number	ALWAYS	AUTO
>>RT ROI Identification Code Sequence	3006,0086	SQ	Only one item is supported	USER enabled/disabled	
>>Include Table 8.8-1 "Code Sequence Macro Attributes"					
>>Code Value	0008,0100	SH	User defined Code Value for structure	ANAP	USER
>>Coding Scheme Designator	0008,0102	SH	User defined Coding Scheme Designator for structure	ANAP	USER
>>Code Meaning	0008,0104	LO	User defined Code Meaning for structure	ANAP	USER
>>Context Identifier	0008,010F	CS	User defined Context Identifier	ANAP	USER
>>Mapping Resource	0008,0105	CS	User defined Mapping Resource	ANAP	USER
>>Context Group Version	0008,0106	DT	User defined Context Group Version	ANAP	USER
>RT ROI Interpreted Type	3006,00A4	CS	Defined for each automatically segmented structure.	ALWAYS	AUTO / USER

			User defined value for empty structures (placeholders).		
>ROI Interpreter	3006,00A6	PN		EMPTY	AUTO

Table 18 - RT ROI Observations Module Attributes

APPROVAL MODULE ATTRIBUTES					
Attribute Name	**Tag**	**VR**	**Value**	**Presence**	**Source**
Approval Status	300E,0002	CS	"UNAPPROVED"	ALWAYS	AUTO

Table 19 - Approval Module Attributes

SOP COMMON MODULE ATTRIBUTES					
Attribute Name	**Tag**	**VR**	**Value**	**Presence**	**Source**
SOP Class UID	0008,0016	UI	"1.2.840.10008.5.1.4.1.1.481.3" Radiotherapy Structure Set UID	ALWAYS	AUTO
SOP Instance UID	0008,0018	UI	Generated UID	ALWAYS	AUTO
Specific Character Set	0008,0005	CS	Copied	ALWAYS	Specific Character Set from referenced images associated with the structure set
Instance Creation Date	0008,0012	DA	Date RT Structure Set was created	ALWAYS	AUTO
Instance Creation Time	0008,0013	TM	Time RT Structure Set was created	ALWAYS	AUTO
Contributing Equipment Sequence	0018,A001	SQ	Only one item is supported	N/A	AUTO If enabled by user

> Manufacturer	0008,0070	LO	Copied	ANAP	Generated from images used to create the structure set.
> Institution Name	0008,0080	LO	Copied	ANAP	Generated from images used to create the structure set.
> Station Name	0008,1010	SH	Copied	ANAP	Generated from images used to create the structure set.
> Institutional Department Name	0008,1040	LO	Copied	ANAP	Generated from images used to create the structure set.
> Operators' Name	0008,1070	PN	Copied	ANAP	Generated from images used to create the structure set.
> Manufacturer's Model Name	0008,1090	LO	Copied	ANAP	Generated from images used to create the structure set.
> Device Serial Number	0008,1000	LO	Copied	ANAP	Generated from images used to create the structure set.
> Contribution DateTime	0018,A002	DT	Copied	ANAP	Generated from images used to create the structure set. Series Date / Series Time, Acquisition DateTime or Acquisition Date / Acquisition Time, or Content Date / Content Time tag of images.
> Contribution Description	0008,A003	SH	Copied	ALWAYS	Generated from images used to create the structure set. Modality tag of images.

> Purpose Of Reference Code Sequence	0040,A170	SQ			ALWAYS	AUTO
>> Code Value	0008,0100	SH	"109101"		ALWAYS	AUTO
>> Coding Scheme Designator	0008,0102	SH	"DCM"		ALWAYS	AUTO
>> Code Meaning	0008,104	LO	"Acquisition Equipment"		ALWAYS	AUTO

Table 20 - SOP Common Module Attributes

7.1.2.3 Attribute Mapping

No Attribute Mapping is performed.

7.1.2.4 Coerced/Modified Fields

No fields are coerced or modified.

7.2 Data Dictionary of Private Attributes

No Private Attributes are defined.

7.3 Coded Terminology and Templates

Not supported.

7.4 Private Transfer Syntaxes

No Private Transfer Syntaxes are supported.