myQA iON

DICOM Conformance Statement

1. Conformance Statement Overview

This document provides specification for the DICOM interface of the myQA iON product. myQA iON only supports DICOM Import of CT images, RT Structure Set, RT Ion plans, RT Doses and RT Ion Beams Treatments. No DICOM export functionalities are provided by the software.

myQA iON supports import from disk or over the DICOM network protocol. In the latter case, myQA iON accepts data pushed by other software through Storage SCP service.

SOP Class Name	SOP Class UID	User of Service	Provider of Service
Transfer			
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	No	Yes
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	No	Yes
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8	No	Yes
RT Ion Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.9	No	Yes

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3. Introduction

3.1. Revision History

Version	Date of change	Author, Dept.	Description of change
1	JAN 2019	G. Vanhoutte	Fist Version
2	OCT 2019	M. Van Puymbroeck	Documented changes for v1.1
3	APRIL 2020	X. Planckaert	Document changes for v1.1.1
4	OCT 2020	X. Planckaert	Document changes for v1.2
5	SEPT 2022	D. Fischer	Document changes for v2.0

3.2. Audience

This document is written for the people that need to understand how myQA iON will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader will understand how this product implements DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how functionality integrates with other devices that support compatible DICOM features.

3.3. Remarks

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

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

- The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between the product and other DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.

3.4. Terms and Definitions

Term	Definition
Abstract Syntax	The information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality

	Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class
Application Entity (AE)	An end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.
Application Entity Title (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).
Beam Data Library (BDL)	A file with parameters that characterize an ion beam for various energies. These parameters are used by the dose engine of myQA iON and are tuned for each treatment delivery system.
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.
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.

3.5. 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.

3.6. Abbreviations

Abbreviation	Meaning
AE	Application Entity
AET	Application Entity Title
CD-R	Compact Disc-Recordable
CT	Computed Tomography
DICOM	Digital Imaging and Communication in Medicine
IOD	Information Object Definition
O	Optional (Key Attribute)
PACS	Picture Archiving and Communication System
PT	Proton Therapy
PTS	Proton Therapy System
RT	Radiotherapy
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SR	Structured Reporting
U	Unique (Key Attribute)

3.7. References

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

[2] Orthanc DICOM Server, available at https://www.orthanc-server.com/

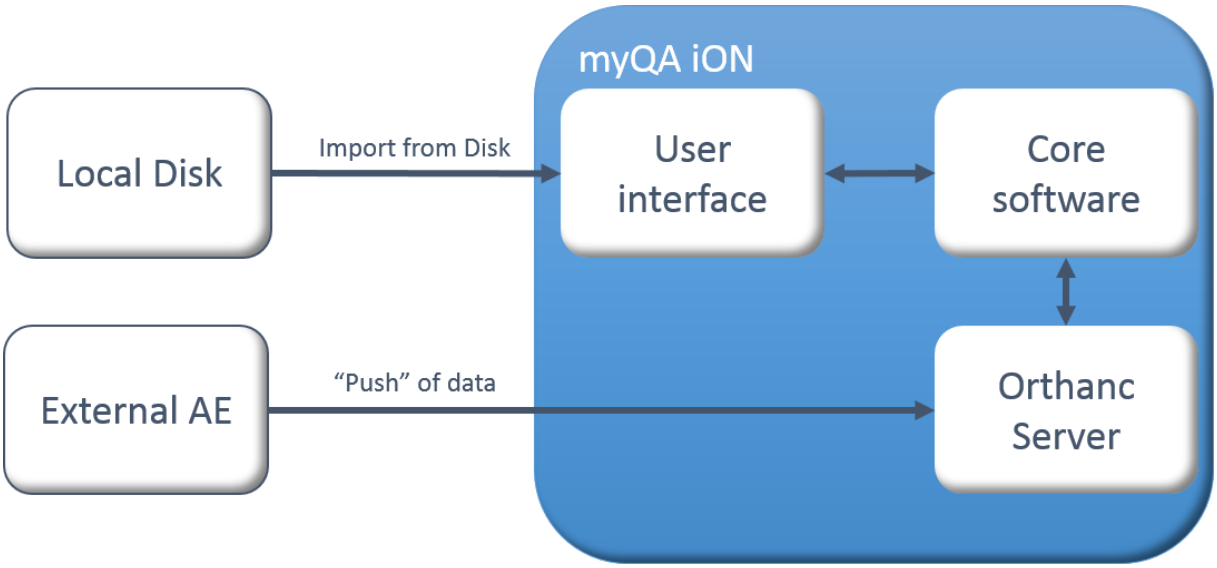
4. Networking

4.1. Implementation Model

4.1.1. Application Data flow

myQA iON supports both manual and network-based data import. myQA iON does not support export of DICOM data. Network communication only occurs through pushed datasets using the C-STORE command.

myQA iON uses a third-party open source DICOM server to provide all DICOM services [2].



4.1.2. Functional Definition of AEs

Functional Definition of the "Orthanc Application Entity"

The Orthanc AE serves as unique DICOM storage point for myQA iON. It provides SCP service accepting incoming data and sorting them in the Orthanc database. Settings for the SCP service are defined in the Orthanc configuration and can be modified during the installation.

4.2. AE Specifications

4.2.1. Orthanc Application Entity

SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	No	Yes
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	No	Yes
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8	No	Yes
RT Ion Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.9	No	Yes
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	No	Yes

Association Policies

The general DICOM application context name is used:

DICOM Application Context	
Application Context Name	1.2.840.10008.3.1.1.1

For the SCP interfaces, there are no software restrictions on the PDU size.

Role	PDU Size (bytes)
SCP	Unlimited

For the SCP interface, there are no upper limit to the maximum number of associations.

Number of association as an association acceptor	
Maximum number of simultaneous associations	There is no upper limit for the maximum number of associations accepted by the DICOM AE. This number has to be determined depending of the hardware capacity of the server where the product has to be installed. However, regarding the activity in which the product is involved, there should be no more than a few associations requested and handled to the product at the same time.

Association Initiation Policy

The Application Entity does not initiate association

Association Acceptance Policy

There are no constraints on the association acceptance by the DICOM AE. At least all the associations using SOP classes supported by the AE will be accepted. When something has to be rejected by the product (bad SOP classes for a C-Store, bad sequence of requests, bad timing regarding the activity running, …), it is handled at a higher and further level than the DICOM association and its DICOM requests, but the association will be accepted, and its requests will be proceeded at the DICOM level with as response a success status.

Accepted Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None

5. Media Interchange

No media interchange is supported.

6. Support of Character Sets

Extended Character Sets are not supported.

7. Security

No Security profiles are supported during network communication.

8. Annex 1 – IOD Contents

8.1. Usage of Attributes from Received IODs

8.1.1. RT Dose Image IOD

IE	Module	Usage
Patient	Patient	Used
	Clinical Trial Subject	Not used
Study	General Study	Used
	Patient Study	Not used
	Clinical Trial Study	Not used
Series	RT Series	Used
	Clinical Trial Series	Not used
Frame of Reference	Frame of Reference	Used
Equipment	General Equipment	Not used
Dose	General Image	Not used
	Image Plane	Used
	Image Pixel	Used
	Multi-Frame	Used
	Overlay Plane	Not used
	Multi-frame Overlay	Not used
	Modality LUT	Not used
	RT Dose	Used
	RT DVH	Not used
	Structure Set	Not used
	ROI Contour	Not used
	RT Dose ROI	Not used
	SOP Common	Used
	Common Instance Reference	Not used
	Frame Extraction	Not used

RT Dose IOD – Patient Module

Attribute Name	Element Tag	Type	myQA iON Usage
Patient's name	(0010,0010)	2	Read, encodes the last name, first name and middle initials. Both first name and last name must be present. Two patients may have the same "patient's name" as long as they have 2 different "patient ID"s. Consistency checks are not case sensitive. Used to display patient name.
Patient ID	(0010,0020)	2	Read, used to identify the patient. Used to display patient ID
Patient's Birth Date	(0010,0030)	2	Read, used to display patient's birthdate
Patient's Sex	(0010,0040)	2	Read, if present, must be one of "M", "F" or "O". Used to display patient's sex

RT Dose IOD – General Study Module

Attribute name	Element Tag	Type	myQA iON Usage
Study Instance UID	(0020,000D)	1	Read. Used to associate RT structure and CT
Referring Physician's Name	(0008,0090)	2	Read.
Study Description	(0008,1030)	3	Read. Used to distinguish RT Doses issued by the TPS from RT Doses generated internally by myQA iON
Physician(s) of Record	(0008,1048)	3	Used in certain configurations instead of the Referring Physician's Name

RT Dose IOD – RT Series Module

Attribute Name	Tag	Type	myQA iON usage
Modality	(0008,0060)	1 (1)	Read, must be "RTDOSE"
Series Description	(0008,103E)	3	Read. Used to distinguish between different kinds of internally generated RT Doses.

RT Dose IOD – Frame of Reference Module

Attribute Name	Tag	Type	myQA iON usage
Frame of Reference UID	(0020,0052)	1	Read

RT Dose IOD – Image Plane Module

Attribute Name	Tag	Type	myQA iON usage
Pixel Spacing	(0028,0030)	1	Read
Image Orientation (Patient)	(0020,0037)	1	Read
Image Position (Patient)	(0020,0037)	1	Read
Slice Thickness	(0018,0050)	1	Read

RT Dose IOD – RT Dose Module

Attribute Name	Tag	Type	myQA iON usage
Samples per Pixel	(0028,0002)	1C	Read: Must be "1"
Dose Units	(3004,0002)	1	Read
Dose Summation Type	(3004,000A)	1	Read: Must be "PLAN" for the independent dose computation. Must be "BEAM" for pre-treatment log analysis of PT. Must be "PLAN" for pre-treatment log analysis of RT. Can be either "PLAN" or "BEAM" for MatriXX analysis
Dose Type	(3004,0004)	1	Read: Must be "PHYSICAL" or "EFFECTIVE" and match the definition in the application configuration.
Referenced RT Plan Sequence	(300C,0002)	1C	Read
>Referenced SOP Instance UID	(0008,1155)	1	Read: used to associate the RT Dose to the referenced RT Ion Plan
>Referenced Fraction Group Sequence	(300C,0020)	1C	Read
>>Referenced Beam Sequence	(300C,0004)	1C	Read
>>> Referenced Beam Number	(300C,0006)	1	Read: used to associate the RT Dose with a beam of the referenced RT Ion Plan
Referenced Treatment Record Sequence	(3008,0030)	1C	Read
>Referenced SOP Instance UID	(0008,1155)	1	Read: Used to associate internally generated RT Doses with their original RT Ion Beams Treatment Record
>Referenced Beam Sequence	(300C,0004)	1	Read

Attribute Name	Tag	Type	myQA iON usage
>>Referenced Beam Number	(300C,0006)	1	Read: Used to associate internally generated RT Doses with a beam of their original RT Ion Beams Treatment Record
Grid Frame Offset Vector	(3004,000C)	1C	Read
Grid Dose Scaling	(3004,000E)	1C	Read

RT DOSE IOD – SOP Common Module

Attribute Name	Tag	Type	myQA iON usage
SOP Class UID	(0008,0016)	1	Read, must be set to 1.2.840.10008.5.1.4.1.1.481.2
SOP Instance UID	(0008,0018)	1	Read, used to identify the DICOM object

8.1.2. RT Structure Set IOD

IE	Module name	Use
Patient	Patient	Used
	Clinical Trial Subject	Not Used
Study	General Study	Used
	Patient Study	Not Used
	Clinical Trial Study	Not Used
Series	RT Series	Used
Equipment	General Equipment	Not Used
Structure Set	Structure Set	Used
	ROI Contour	Used
	RT ROI Observations	Used
	Approval	Not Used
	SOP Common	Used

RT Structure Set IOD – Patient Module

Attribute name	Element Tag	Type	Comment
Patient's Name	(0010,0010)	2	Read. Cannot be empty.
Patient ID	(0010,0020)	2	Read. Unique identifier for patient. Cannot be empty.
Patient's Birth Date	(0010,0030)	2	Read.
Patient's Sex	(0010,0040)	2	Read. If Patient's Sex is not encoded, the default value of "O" is used. Supported values: M = Male F = Female O = Other

RT Structure Set IOD - General Study Module

Attribute name	Element Tag	Type	Comment
Referring Physician's Name	(0008,0090)	2	Read
Physician(s) of Record	(0008,1048)	3	Used in certain configurations instead of the Referring Physician's Name
Study Instance UID	(0020,000D)	1	Read. Cannot be empty.

RT Structure Set IOD – RT Series Module

Attribute name	Element Tag	Type	Comment
Modality	(0008,0060)	1	Read. Must be RTSTRUCT

RT Structure Set IOD – Structure Set Module

Attribute name	Element Tag	Type	Comment
Structure Set Label	(3006,0002)	1	Read.
Referenced Frame of Reference Sequence	(3006,0010)	3	Read.
>Frame of Reference UID	(0020,0052)	1	Read.
>RT Referenced Study Sequence	(3006,0012)	3	Read.
>>Referenced SOP Instance UID	(0008,1155)	1	Read.
>> RT Referenced Series Sequence	(3006,0014)	1	Read.
>>>Series Instance UID	(0020,000E)	1	Read.
>>>Contour Image Sequence	(3006,0016)	1	Read.
>>>>Referenced SOP Instance UID	(0008,1155)	1	Read. Referenced image has to be imported. Used to verify completeness of CT.
Structure Set ROI Sequence	(3006,0020)	3	Read.
>ROI Number	(3006,0022)	1	Read.
>Referenced Frame of Reference UID	(3006,0024)	1	Read.
>ROI Name	(3006,0026)	2	Read. Used by the viewer to display or not a particular structure set. If two structures have the same name, the selection of structures will not work correctly.

RT Structure Set IOD – ROI Contour Module

Attribute name	Element Tag	Type	Comment
ROI Contour Sequence	(3006,0039)	1	Read.
>Referenced ROI Number	(3006,0084)	1	Read.
>ROI Display Color	(3006,002A)	3	Read. Used for visualization
>Contour Sequence	(3006,0040)	3	Read. If undefined the referenced ROI will not be imported. At least one sequence must be defined.
>>Contour Image Sequence	(3006,0016)	3	Read.
>>>Referenced SOP Instance UID	(0008,1155)	1	Read
>>Contour Geometric Type	(3006,0042)	1	Must be “POINT” or “CLOSED_PLANAR”

>>Number of Contour Points	(3006,0046)	1	Read.
>>Contour Data	(3006,0050)	1	Read.

RT Structure Set IOD – RT ROI Observation Module

Attribute name	Element Tag	Type	Comment
RT ROI Observations Sequence	(3006,0080)	1	Read.
>Referenced ROI Number	(3006,0084)	1	Read.
>ROI Observation Label	(3006,0085)	3	Read.
>RT ROI Interpreted Type	(3006,00A4)	1	Read. The RT Structure Set must contain at least one RT ROI Observations Sequence with an Interpreted Type equal to “EXTERNAL” for PT cases.
>ROI Physical Properties Sequence	(3006,00B0)	3	Read.
>>ROI Physical Property	(3006,00B2)	1	Read.
>>ROI Physical Property Value	(3006,00B4)	1	Read in case of the electron density property (REL_ELEC_DENSITY)

RT Structure Set IOD – SOP Common Module

Attribute name	Element Tag	Type	Comment
SOP Class UID	(0008,0016)	1	Read, must be set to 1.2.840.10008.5.1.4.1.1.481.3
SOP Instance UID	(0008,0018)	1	Read, used to identify the DICOM object

8.1.3. RT Ion Plan IOD

IE	Module	Usage
Patient	Patient	Used
	Clinical Trial Subject	Not used
Study	General Study	Used
	Patient Study	Not used
	Clinical Trial Study	Not used
Series	RT Series	Used
	Clinical Trial Series	Not used
Frame of Reference	Frame of Reference	Used
Equipment	General Equipment	Not used
Plan	RT General Plan	Used
	RT Prescription	Not used
	RT Ion Tolerance Table	Not used
	RT Patient Setup	Used
	RT Fraction Scheme	Used
	RT Ion Beams	Used
	Approval	Not used
	SOP Common	Used
	Common Instance Reference	Not Used

RT Ion Plan IOD - Patient Module

Attribute Name	Tag	Type	myQA iON Usage
Patient's name	(0010,0010)	2	Read. Encodes the last name, first name and middle initials. Both first name and last name must be present. Two patients may have the same "patient's name" as long as they have 2 different "patient ID"s. Consistency checks are not case sensitive. Used to display patient name.
Patient ID	(0010,0020)	2	Read. Used to identify the patient. Used to display patient ID
Patient's Birth Date	(0010,0030)	2	Read. Used to display patient's birthdate
Patient's Sex	(0010,0040)	2	Read. If present, must be one of "M", "F" or "O". Used to display patient's sex

RT Ion Plan IOD - General Study Module

Attribute Name	Tag	Type	myQA iON usage
Referring Physician's Name	(0008,0090)	2	Used to display referring physician's name
Physician(s) of Record	(0008,1048)	3	Used in certain configurations instead of the Referring Physician's Name

RT Ion Plan IOD – RT Series Module

Attribute Name	Tag	Type	myQA iON usage
Modality	(0008,0060)	1 (1)	Must be "RTPLAN"

RT Ion Plan IOD – Frame of Reference Module

Attribute Name	Tag	Type	myQA iON usage
Frame of Reference UID	(0020,0052)	1	Read

RT ION Plan IOD – RT General Plan

Attribute Name	Tag	Type	myQA iON usage
RT Plan Label	(300A,0002)	1	Read. Used for case description
RT Plan Date	(300A,0006)	2	Read. Plans created after the expiration date of the myQA iON license are refused.
Plan Intent	(300A,000A)	3	Read. The following are accepted for patient QA: CURATIVE, PALLIATIVE, PROPHYLACTIC, RESEARCH Accepted for isocenter measurement: VERIFICATION If absent plan is rejected by myQA iON All other intents are rejected by myQA iON
RT Plan Geometry	(300A,000C)	1	Read
Referenced Structure Set Sequence	(300C,0060)	1C	Read. Used to associate RT ION plan to Structure Set
>Referenced SOP Class UID	(0008,1150)	1	Read. Must be 1.2.840.10008.5.1.4.1.1.481.3
>Referenced SOP Instance UID	(0008,1155)	1	Read. Identifies Structure Set for RT Ion plan.
Referenced RT Plan Sequence	(300C,0002)	3	Read if plan intent is VERIFICATION
>Referenced SOP Class UID	(0008,1150)	1	If set, must be SOP Class UID of RT Ion plan
>Referenced SOP Instance UID	(0008,1155)	1	Used to associate a patient RT ION plan and the RT ION Plan used for verification using measurement at isocenter
>RT Plan Relationship	(300A,0055)	1	If set, must be VERIFIED_PLAN

RT ION Plan IOD – RT Patient Setup

Attribute Name	Tag	Type	myQA iON usage
Patient Setup Sequence	(300A,0180)	1	Read
>Patient Setup Number	(300A,0182)	1	Read
>Patient Position	(0018,5100)	1C	Read

RT ION Plan IOD – RT Fraction Scheme

Attribute Name	Tag	Type	myQA iON usage
Fraction Group Sequence	(300A,0070)	1	Read
>Number of Fractions Planned	(300A,0078)	2	Read

RT ION Plan IOD – RT Ion Beams

Attribute Name	Tag	Type	myQA iON usage
Ion Beam Sequence	(300A,03A2)	1	Read
>Beam Number	(300A,00C0)	1	Read
>Beam Name	(300A,00C2)	1	Read
>Beam Type	(300A,00C4)	1	Read. Must be “STATIC”
>Radiation Type	(300A,00C6)	1	Read. Must be “PROTON”. Other radiation type will be rejected
>Scan Mode	(300A,0308)	1	Read. Must be “MODULATED”
>Treatment Machine Name	(300A,00B2)	1	Read. Used to associate beam model to plan
>Primary Dosimeter Unit	(300A,00B3)	1	Read
>Referenced Patient Setup Number	(300C,006A)	3	Read
>Treatment Delivery Type	(300A,00CE)	1	Read
>Snout Sequence	(300A,030C)	3	Read
>>Snout ID	(300A,030F)	1	Read
>Number of range shifters	(300A,0312)	1	Read
>Recorded Range Shifter Sequence	(3008,00F2)	1	Read, used to identify range shift for dose calculation
>>Range Shifter Number	(300A,0316)	1	Read
>>Range Shifter ID	(300A,0318)	1	Read
>>Range Shifter Type	(300A,0320)	1	Read
>Final Cumulative Meterset Weight	(300A,010E)	1C	Read
>Number of control Points	(300A,0110)	1	Read
>Ion Control Point Sequence	(300A,03A8)	1	Read. Used to identify irradiation spot sequence
>>Cumulative Meterset Weight	(300A,0134)	2	Read
>>Nominal Beam Energy	(300A,0114)	1C	Read
>>Range Shifter Settings Sequence	(300A,0360)	1C	Read
>>>Referenced Range Shifter Number	(300C,0100)	1	Read
>>>Range Shifter Setting	(300A,0362)	1	Read
>>>Isocenter to Range Shifter Distance	(300A,0364)	3	Read. This tag is required for myQA iON.
>>>Range Shifter Water Equivalent Thickness	(300A,0366)	3	Read. If the tag is not present, the Water Equivalent Thickness (WET) defined in the BDL is used instead.
>>Gantry Angle	(300A,011E)	1C	Read
>>Scan Spot Tune ID	(300A,0390)	1C	Read
>>Number of Scan Spot Position	(300A,0392)	1C	Read
>>Scan Spot Position Map	(300A,0394)	1C	Read

Attribute Name	Tag	Type	myQA iON usage
>>Scan Spot Meterset Weights	(300A,0396)	1C	Read
>>Scanning Spot Size	(300A,0398)	3	Read
>>Number of paintings	(300A,039A)	1C	Read
>>Patient Support Angle	(300A,0122)	1C	Read
>>Patient Support Rotation Direction	(300A,123)	1C	Read
>> Table Top Pitch Angle	(300A,0140)	2C	Read
>>Table Top Pitch Rotation Direction	(300A,0142)	2C	Read
>>Table Top Roll Angle	(300A,0144)	2C	Read
>> Table Top Roll Rotation Direction	(300A,0146)	2C	Read
>>Table top Vertical Position	(300A,0128)	2C	Read
>>Table Top Longitudinal Position	(300A,0129)	2C	Read
>>Table Top Lateral Position	(300A,012A)	2C	Read
>>Snout Position	(300A,030D)	2C	Read
>>Isocenter Position	(300A,012C)	2C	Read

RT ION Plan IOD – SOP Common

Attribute Name	Tag	Type	myQA iON usage
SOP Class UID	(0008,0016)	1	Read, must be set to 1.2.840.10008.5.1.4.1.1.481.8
SOP Instance UID	(0008,0018)	1	Read, used to identify the DICOM object

8.1.4. CT Image IOD

IE	Module	Usage
Patient	Patient	Used
	Clinical Trial Subject	Not Used
Study	General Study	Used
	Patient Study	Not Used
	Clinical Trial Study	Not Used
Series	General Series	Used
	Clinical Trial Series	Not Used
Frame of Reference	Frame of Reference	Used
Equipment	General Equipment	Used
Image	General Image	Not Used
	Image Plane	Used
	Image Pixel	Used
	Contrast/Bolus	Not Used
	Device	Not Used
	Specimen	Not Used
	CT Image	Used
	Overlay Plane	Not Used
	VOI LUT	Not Used
	SOP Common	Used

CT Image IOD - Patient Module

Attribute name	Tag	Type	Comment
Patient's Name	(0010,0010)	2	Read. Cannot be empty.
Patient ID	(0010,0020)	2	Read. Unique identifier for patient. Cannot be empty.
Patient's Birth Date	(0010,0030)	2	Read.
Patient's Sex	(0010,0040)	2	Read. Supported values: M = Male F = Female O = Other
Patient Position	(0018,5100)	3	Read. Must be “HFS”, “HFP”, “FFS” or “FFP”, otherwise the DICOM is rejected.

CT Image IOD – General Study Module

Attribute name	Element Tag	Type	Comment
Study Instance UID	(0020,000D)	1	Read. Used to associate RT structure and CT
Study Date	(0008, 0020)	1	Read. Cannot be empty.
Study Time	(0008, 0030)	1	Read. Cannot be empty.
Referring Physician's Name	(0008,0090)	2	Read.
Physician(s) of Record	(0008,1048)	3	Used in certain configurations instead of the Referring Physician’s Name

CT Image IOD – General Series Module

Attribute name	Element Tag	Type	Comment
Modality	(0008,0060)	1	Read. Supported values: CT Not supported values: OT
Series Instance UID	(0020,000E)	1	Read
Series Description	(0008,103E)	3	Read. Used in certain configurations instead of the Station Name (to identify the correct CT to density table).

CT Image IOD – Frame of reference Module

Attribute name	Element Tag	Type	Comment

Frame of Reference UID	(0020,0052)	1	Read. Used to group all images in image series. Cannot be empty.

CT Image IOD – General Equipment Module

Attribute name	Element Tag	Type	Comment
Station Name	(0008,1010)	3	Read. Used to identify the correct CT to density table

CT Image IOD – Image Plane Module

Attribute name	Element Tag	Type	Comment
Pixel Spacing	(0028,0030)	1	Read. Cannot be empty.
Image Orientation (Patient)	(0020,0037)	1	Read. Image orientation must be transversal. Supported values: 1\0\0\0\1\0 1\0\0\0\-1\0 -1\0\0\0\1\0 -1\0\0\0\-1\0
Image Position (Patient)	(0020,0032)	1	Read. Converted to internal image corner. Used to find slice direction, which must be constant throughout the series and along the Z-axis.

CT Image IOD – Image Pixel Module

Attribute name	Element Tag	Type	Comment
Samples per Pixel	(0028,0002)	1	Read. Specialized in modality specific Image Module. Supported values: 1
Rows	(0028,0010)	1	Read. Number of rows. Read from first imported dataset in image series and is required to be consistent for all datasets in the series.
Columns	(0028,0011)	1	Read. Number of Columns. Read from first imported dataset in image series and is required to be consistent for all datasets in the series.
Pixel Representation	(0028,0103)	1	Read. Is required to be consistent for all datasets in the same series. Supported values: 0 1
Pixel Data	(7FE0,0010)	1C	Read.
Photometric Representation	(0028,0004)	1	Read. Must be “MONOCHROME1” or “MONOCHROME2”

CT Image IOD - CT Image Module

Attribute name	Element Tag	Type	Comment
Rescale Intercept	(0028,1052)	1	Read. Must be the same for all images in the image stack.
Rescale Slope	(0028,1053)	1	Read. Must be the same for all images in the image stack.

KVP	(0018,0060)	2	Read. Used in certain configurations in addition to the Station Name (to identify the correct CT to density table).

CT Image IOD – SOP Common Module

Attribute name	Element Tag	Type	Comment
SOP Class UID	(0008,0016)	1	Read. Supported values: 1.2.840.10008.5.1.4.1.1.2
SOP Instance UID	(0008,0018)	1	Read. Used to uniquely identify instance.

8.1.5. RT Ion Beams Treatment Record IOD

IE	Module	Usage
Patient	Patient	Used
	Clinical Trial Subject	Not used
Study	General Study	Used
	Patient Study	Not used
	Clinical Trial Study	Not used
Series	RT Series	Used
	Clinical Trial Series	Not used
Equipment	General Equipment	Not used
Treatment Record	RT General Treatment Record	Used
	RT Patient Setup	Not used
	RT Treatment Machine Record	Not used
	Measured Dose Reference Record	Not used
	Calculated Dose Reference Record	Not used
	RT Ion Beams Session Record	Used
	RT Treatment Summary Record	Not used
	General Reference	Not used
	SOP Common	Used
	Common Instance Reference	Not used

RT Ion Beams Treatment Record IOD – Patient Module

Attribute Name	Element Tag	Type	myQA iON Usage
Patient's name	(0010,0010)	2	Read, encodes the last name, first name and middle initials. Both first name and last name must be present. Two patients may have the same "patient's name" as long as they have 2 different "patient ID"s. Consistency checks are not case sensitive. Used to display patient name.
Patient ID	(0010,0020)	2	Read, used to identify the patient. Used to display patient ID
Patient's Birth Date	(0010,0030)	2	Read, used to display patient's birthdate
Patient's Sex	(0010,0040)	2	Read, if present, must be one of "M", "F" or "O". Used to display patient's sex

RT Ion Beams Treatment Record IOD - General Study Module

Attribute Name	Tag	Type	myQA iON usage
Referring Physician's Name	(0008,0090)	2	Used to display referring physician's name
Physician(s) of Record	(0008,1048)	3	Used in certain configurations instead of the Referring Physician's Name

RT Ion Beams Treatment Record IOD – RT Series Module

Attribute Name	Tag	Type	myQA iON usage
Modality	(0008,0060)	1 (1)	Must be "RTRECORD"

RT Ion Beams Treatment Record IOD – RT General Treatment Record

Attribute Name	Element Tag	Type	myQA iON Usage
Treatment Date	(3008,0250)	2	Read, used to display
Treatment Time	(3008,0251)	2	Read, used to display
Referenced RT Plan Sequence	(300C,0002)	2	Read, used to associate the RT Ion Beams Treatment Record to the referenced RT Ion Plan

RT Ion Beams Treatment Record IOD – RT Ion Beams Session Record

Attribute Name	Element Tag	Type	myQA iON Usage
Treatment Session Ion Beam Sequence	(3008,0021)	1	Read
> Referenced Beam Number	(300C,0006)	1	Read, used to associate ion beams applied during a treatment session to beams defined in the RT Ion Plan
> Beam Name	(300A,00C2)	1	Read, used for display
> Radiation Type	(300A,00C6)	1	Read
> Scan Mode	(300A,0308)	1	Read
> Number of Range Shifters	(300A,0312)	1	Read
> Recorded Range Shifter Sequence	(3008,00F2)	1C	Read
>> Referenced Range Shifter Number	(300C,0100)	1	Read
>> Range Shifter ID	(300A,0318)	1	Read
> Treatment Delivery Type	(300A,00CE)	1	Read, only ion beams with delivery type “TREATMENT” will be taken into account (other instances will be ignored).
> Ion Control Point Delivery Sequence	(3008,0041)	1	Read
>> Specified Meterset	(3008,0042)	2	Read
>> Delivered Meterset	(3008,0044)	1	Read
>> Nominal Beam Energy	(300A,0114)	1C	Read
>> Range Shifter Settings Sequence	(300A,0360)	1C	Read
>>> Referenced Range Shifter Number	(300C,0100)	1	Read
>>> Range Shifter Setting	(300A,0362)	1	Read
>> Gantry Angle	(300A,011E)	1C	Read, only the gantry angle of the first control point is taken into account
>> Scan Spot Tune ID	(300A,0390)	1C	Read
>> Number of Scan Spot Positions	(300A,0392)	1C	Read
>> Scan Spot Position Map	(300A,0394)	1C	Read
>> Scan Spot Metersets Delivered	(3008,0047)	1C	Read
>> Number of Paintings	(300A,039A)	1	Read
>> Patient Support Angle	(300A,0122)	1	Read
>> Snout Position	(300A,030D)	2C	Read

RT Ion Beams Treatment Record IOD – SOP Common

Attribute Name	Tag	Type	myQA iON usage
SOP Class UID	(0008,0016)	1	Read, must be set to 1.2.840.10008.5.1.4.1.1.481.9
SOP Instance UID	(0008,0018)	1	Read, used to identify the DICOM object

8.1.1. RT Plan IOD

IE	Module	Usage
Patient	Patient	Used
	Clinical Trial Subject	Not used
Study	General Study	Used
	Patient Study	Not used
	Clinical Trial Study	Not used
Series	RT Series	Used
	Clinical Trial Series	Not used
Frame of Reference	Frame of Reference	Used
Equipment	General Equipment	Not used
Plan	RT General Plan	Used
	RT Prescription	Not used
	RT Tolerance Tables	Not used
	RT Patient Setup	Used
	RT Fraction Scheme	Used
	RT Beams	Used
	RT Brachy Application Setups	Not used
	Approval	Not used
	SOP Common	Used
	Common Instance Reference	Not used

RT Plan IOD - Patient Module

Attribute Name	Tag	Type	myQA iON Usage
Patient's name	(0010,0010)	2	Read. Encodes the last name, first name and middle initials. Both first name and last name must be present. Two patients may have the same "patient's name" as long as they have 2 different "patient ID"s. Consistency checks are not case sensitive. Used to display patient name.
Patient ID	(0010,0020)	2	Read. Used to identify the patient. Used to display patient ID
Patient's Birth Date	(0010,0030)	2	Read. Used to display patient's birthdate
Patient's Sex	(0010,0040)	2	Read. If present, must be one of "M", "F" or "O". Used to display patient's sex

RT Plan IOD - General Study Module

Attribute Name	Tag	Type	myQA iON usage
Referring Physician's Name	(0008,0090)	2	Used to display referring physician's name
Physician(s) of Record	(0008,1048)	3	Used in certain configurations instead of the Referring Physician's Name

RT Plan IOD – RT Series Module

Attribute Name	Tag	Type	myQA iON usage
Modality	(0008,0060)	1 (1)	Must be "RTPLAN"

RT Plan IOD – Frame of Reference Module

Attribute Name	Tag	Type	myQA iON usage
Frame of Reference UID	(0020,0052)	1	Read

RT Plan IOD – RT General Plan

Attribute Name	Tag	Type	myQA iON usage
RT Plan Label	(300A,0002)	1	Read. Used for case description
RT Plan Date	(300A,0006)	2	Read. Plans created after the expiration date of the myQA iON license are refused.
Plan Intent	(300A,000A)	3	Read. The following are accepted for patient QA: CURATIVE, PALLIATIVE, PROPHYLACTIC, RESEARCH If absent plan is rejected by myQA iON All other intents are rejected by myQA iON
RT Plan Geometry	(300A,000C)	1	Read
Referenced Structure Set Sequence	(300C,0060)	1C	Read. Used to associate RT ION plan to Structure Set
>Referenced SOP Class UID	(0008,1150)	1	Read. Must be 1.2.840.10008.5.1.4.1.1.481.3
>Referenced SOP Instance UID	(0008,1155)	1	Read. Identifies Structure Set for RT Ion plan.
>Referenced SOP Class UID	(0008,1150)	1	If set, must be SOP Class UID of RT plan

RT Plan IOD – RT Patient Setup

Attribute Name	Tag	Type	myQA iON usage
Patient Setup Sequence	(300A,0180)	1	Read
>Patient Setup Number	(300A,0182)	1	Read
>Patient Position	(0018,5100)	1C	Read

RT Plan IOD – RT Fraction Scheme

Attribute Name	Tag	Type	myQA iON usage
Fraction Group Sequence	(300A,0070)	1	Read
>Number of Fractions Planned	(300A,0078)	2	Read

RT Plan IOD – RT Beams

Attribute Name	Tag	Type	myQA iON usage
Beam Sequence	(300A,03A2)	1	Read
>Beam Number	(300A,00C0)	1	Read
>Beam Name	(300A,00C2)	1	Read
>Beam Type	(300A,00C4)	1	Read
>Radiation Type	(300A,00C6)	1	Read. Must be “PHOTON” or “ELECTRON”. Other the plan will be rejected by myQA iON.
>Wedge Sequence	(300A, 00D1)	1	Read.
>>Wedge Type	(300A, 00D3)	1	Read. If it does not exist, the plan is accepted. If the value is not “DYNAMIC” or “MOTORIZED”, the plan is rejected by myQA iON.

Attribute Name	Tag	Type	myQA iON usage
>Treatment Machine Name	(300A,00B2)	1	Read. Used to associate beam model to plan
>Primary Dosimeter Unit	(300A,00B3)	1	Read. Must be “MU”, otherwise the plan is rejected by myQA iON.
>Referenced Patient Setup Number	(300C,006A)	3	Read
>Treatment Delivery Type	(300A,00CE)	1	Read
>Final Cumulative Meterset Weight	(300A,010E)	1C	Read
>Number of control Points	(300A,0110)	1	Read
> Control Point Sequence	(300A,03A8)	1	Read. Used to identify irradiation spot sequence
>>Cumulative Meterset Weight	(300A,0134)	2	Read
>>Nominal Beam Energy	(300A,0114)	1C	Read
>>Gantry Angle	(300A,011E)	1C	Read
>>Patient Support Angle	(300A,0122)	1C	Read
>>Patient Support Rotation Direction	(300A,123)	1C	Read
>> Table Top Pitch Angle	(300A,0140)	2C	Read
>>Table Top Pitch Rotation Direction	(300A,0142)	2C	Read
>>Table Top Roll Angle	(300A,0144)	2C	Read
>> Table Top Roll Rotation Direction	(300A,0146)	2C	Read
>>Table top Vertical Position	(300A,0128)	2C	Read
>>Table Top Longitudinal Position	(300A,0129)	2C	Read
>>Table Top Lateral Position	(300A,012A)	2C	Read
>Number of Blocks	(300A,00F0)	1	Read. Rejection of the plan if value is 0.

RT Plan IOD – SOP Common

Attribute Name	Tag	Type	myQA iON usage
SOP Class UID	(0008,0016)	1	Read, must be set to 1.2.840.10008.5.1.4.1.1.481.5
SOP Instance UID	(0008,0018)	1	Read, used to identify the DICOM object

8.2. Export IOD Definitions

Currently the software does not provide DICOM export functionalities.

9. Annex 2 - Data Dictionary of Private Attributes

Currently the software does not use private attributes.