Elekta Limited.

DICOM Conformance Statement

For

PrecisePLAN® 2.15 *Import*

(DICOM Release 2.15)

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1. Introduction

This chapter provides general information about the purpose, scope and content of this Conformance Statement.

1.1 Scope and field of application

The scope of this DICOM Conformance Statement is to facilitate data exchange with equipment of Elekta Limited.. This document specifies the compliance to the DICOM standard (formally called the NEMA PS 3.X-1993 standards). It contains a short description of the applications involved and provides technical information about the data exchange capabilities of the equipment. The main elements describing these capabilities are the supported DICOM Service Object Pair (SOP) Classes, Roles, Information Object Definitions (IOD) and Transfer Syntax's.

The field of application is the integration of the Elekta Limited equipment into an environment of medical devices.

This Conformance Statement should be read in conjunction with the DICOM standard and its addenda.

1.2 Intended audience

This Conformance Statement is intended for:

- (potential) customers,
- system integrators of medical equipment,
- marketing staff interested in system functionality,
- software designers implementing DICOM interfaces.

It is assumed that the reader is familiar with the DICOM standard.

1.3 Contents and structure

The DICOM Conformance Statement is contained in chapter 2 through 6 and follows the contents and structuring requirements of DICOM PS 3.2-2001. Additionally, the appendixes following chapter 6 specify the details of the applied IODs.

1.4 Used definitions, terms and abbreviations

- DICOM definitions, terms and abbreviations are used throughout this Conformance Statement. For a description of these, see the DICOM Standard 2001.
- The abbreviation Elekta in this document refers to Elekta Limited.
- The word rtServer in this document refers to the Elekta rtServer DICOM-RT Server for Prec*i*sePLAN R2.15

- The term “local database” in this document is used to refer to an rtServer database accessed directly by the local rtServer application software (irrespective of whether the database itself is physically stored on the local machine or on another network server).

- The term “remote database” in this document is used to refer to a database accessed during the DICOM protocol.

1.5 References

[DICOM] The Digital Imaging and Communications in Medicine (DICOM) standard:
DICOM PS 3.X (X refers to the part 1-13) and Supplements.
National Electrical Manufacturers Association (NEMA) Publication Sales
1300 N. 17th Street, Suite 1752
Rosslyn, VA 22209, USA.

1.6 Important note to the reader

This Conformance Statement by itself does not guarantee successful interoperability of Elekta equipment with non-Elekta equipment. The user (or user’s agent) should be aware of the following issues:

- Scope

The goal of DICOM is facilitate interconnectivity rather than interoperability. Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into a networked environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of Elekta equipment with non-Elekta equipment. It is the user’s responsibility to analyze thoroughly the application requirements and to specify a solution that integrates Elekta equipment with non-Elekta equipment.

- Validation

Elekta equipment has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance Statement. Where Elekta equipment is linked to non-Elekta equipment, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user’s agent) to specify the appropriate test suite and to carry out the additional validation tests.

- New versions of the DICOM Standard

The DICOM Standard will evolve in future to meet the user’s growing requirements and to incorporate new features and technologies. Elekta is actively involved in this evolution and plans to adapt its equipment to future versions of the DICOM Standard. In order to do so, Elekta reserves the right to make changes to its products or to discontinue its delivery. The user should ensure that any non-Elekta provider linking to Elekta equipment also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into Elekta equipment may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

2. Implementation Model

The rtServer is a DICOM-RT Server for use with Prec*i*sePLANTreatment Planning Systems. It is used in conjunction with the DICOM Import module for Plans and StructureSet. It provides the following features:

- Responding to DICOM Echo Request for verification of connectivity.
- Receiving CT images from a remote database, which are then stored into a local database.
- Receiving RT Plans and Structures from a remote database, which are then stored into a local database.

The remote database access and image transfer functions are implemented using the DICOM Storage Services.

2.1 Application Data Flow Diagram

The rtServer application behaves as a single Application Entity (AE). The related Implementation Model is shown in Figure 1.

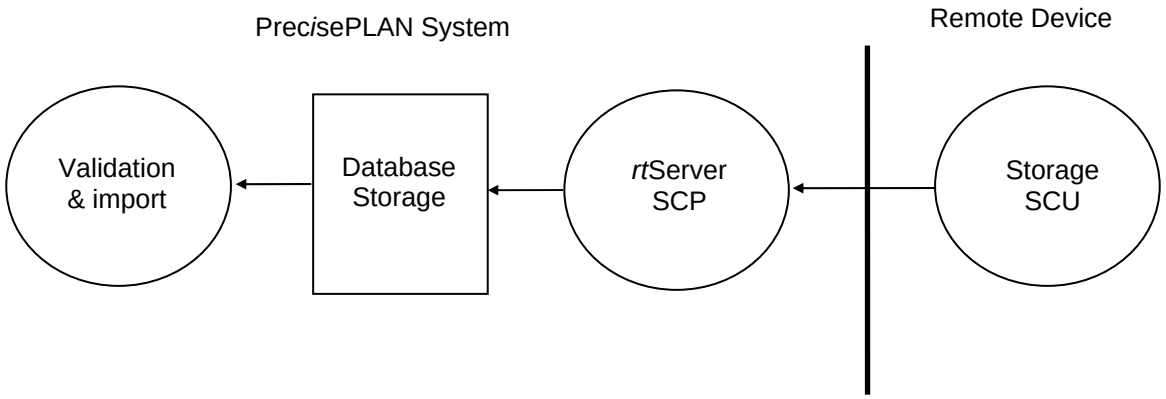

Figure 1. Import Implementation Model

2.2 Functional definition of Application Entities

The rtServer Application Entity acts as a Service Class Provider for Verification and Storage Service Classes. The application is active when the Prec*i*sePLAN system is powered up.

2.3 Sequencing of Real-World Activities

From Revision 2.2.b of rtServer any sequence of objects will be accepted. .

3. AE Specifications

3.1 rtServer AE Specification

The rtServer Application Entity provides Standard Conformance to the following DICOM 3.0 SOP Classes as an SCP.

Table 1. Storage SOP Classes supported by rtServer as SCP

SOP Class Name	UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3

3.1.1 Association Establishment Policies

3.1.1.1 General

The maximum PDU size for rtServer is configurable from a minimum of 2048 bytes. There is no upper limit. It is limited by the available system resources. The default value is 64 Kbytes.

3.1.1.2 Number of Associations

rtServer will accept one association at a time. The number of simultaneous pending associations is 5.

3.1.1.3 Asynchronous Nature

rtServer does not support asynchronous operations and will not perform asynchronous window negotiation.

3.1.1.4 Implementation Identifying Information

Implementation Class UID: 2.840.1015.15.1.2.2
Implementation Version Name: rtServer 2.3.a

3.1.2 Association Initiation Policy

rtServer awaits association from a remote application and does not initiate an association

3.1.3 Association Acceptance Policy

rtServer accepts associations for following purposes:

- To allow remote applications to store images and radiotherapy data into the local rtServer database (see section 3.1.3.1 below).

- To allow remote applications to verify application level communication with rtServer (see section 3.1.3.2 below).

3.1.3.1 Store Images into rtServer Local Database

3.1.3.1.1 Associated Real World Activity

rtServer accepts associations from remote systems that wish to send images or RT data for storage into a local rtServer database.

3.1.3.1.2 Presentation Context Table

Any of the presentation contexts shown in Table 2 below are acceptable:

Table 2. Acceptable Presentation Contexts for rtServer Image Storage

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

Table 3. Acceptable Presentation Contexts for rtServer Radiotherapy Object Storage

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

3.1.3.1.3 C-STORE SCP Conformance

rtServer provides standard conformance.

The AE is a Conformance Level 0 Storage SCP: not all DICOM Type 1 and 2 attributes are stored. The attributes that are stored for internal use of rtServer are listed in Appendices. All other received attributes will be discarded. The SOP Instance UIDs are used for internal cross referencing of the objects. Only the Structure Set UID is preserved at export and only if no changes have been made to the structures.

For safety reasons, incoming images are stored into a local database dedicated to DICOM Import. An rtServer function allows the subsequent interactive relocation of the images into the main rtServer clinical database at the rtServer operators discretion.

The duration of storage is determined by the operator of the Prec*i*sePLAN system.

3.1.3.1.4 Presentation Context Acceptance Criterion

rtServer accepts all contexts in the intersection of the proposed and acceptable presentation contexts. There is no check for duplicate contexts. Duplicate contexts are accepted.

3.1.3.1.5 Transfer Syntax Selection Policies

rtServer Big Endian byte ordering, and will prefer explicit over implicit VR for Little Endian byte ordering.

3.1.3.2 Verify Application Level Communication

3.1.3.2.1 Associated Real World Activity

rtServer accepts associations from systems that wish to verify the application level communication using the C-ECHO command.

3.1.3.2.2 Presentation Context Table

Any of the presentation contexts shown in Table 4 below are acceptable:

Table 4. Acceptable Presentation Contexts for Verification

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
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		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

3.1.3.2.3 C-ECHO SCP Conformance

rtServer provides standard conformance.

3.1.3.2.4 Presentation Context Acceptance Criterion

rtServer accepts all contexts in the intersection of the proposed and acceptable presentation contexts. There is no check for duplicate contexts. Duplicate contexts are accepted.

3.1.3.2.5 Transfer Syntax Selection Policies

rtServer prefers Big Endian byte ordering, and will prefer explicit over implicit VR for Little Endian byte ordering.

4. Communication Profiles

4.1 Supported Communication Stacks

The rtServer application provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.2 TCP/IP Stack

rtServer inherits its TCP/IP stack from the operating system upon which it executes.

4.3 Physical Media Support

rtServer supports Ethernet ISO.8802-3.

On Elekta supplied hardware platforms the connection types provided is 10BASE-T (RJ45 twisted pair).

5. Extensions/Specialisations/Privatisations

Not applicable.

6. Configuration

The configuration of an rtServer system is accomplished using a graphical configuration tool as described in the PrecisePLAN Connectivity and Reference Manual. The configuration changes are intended to be performed by Elekta service engineers or by Customers with reference to the User Documentation.

6.1 AE Title/Presentation Address mapping

6.1.1 Local AE Titles and Presentation Addresses

The local Application Entity Title is derived from the rtServer Workstation Name, which is configurable. Only printable ASCII characters are used. All other characters are replaced with underscore. Resultant string is truncated to 16 characters, if needed, to conform to the standard. A message is logged, if the AE Title is different from the hostname. The listen port number is configurable.

6.1.2 Remote AE Titles and Presentation Addresses

Not applicable.

6.2 Configurable Parameters

The Maximum PDU size is configurable.

The AE can be configured either to accept or reject association requests offering an incorrect Called and Calling AE title.

DICOM Upper Layer Timeouts are configurable.

For correct import of non IEC scaled accelerators the DICOM Machine Setup must be configured for the target Treatment Machine.

Table 5. Configurable parameters

Parameter	Default	Notes
Listen Port	3001	TCP/IP listening port
Maximum PDU length	16 * 1024	In bytes, minimum value is 4 Kbyte.
Association request timeout	60	In seconds
Read timeout	45	In seconds
Write timeout	15	In seconds
Accepted SCUs	Accept all	By default, all devices are allowed to connect, regardless of Calling and Called AE Title. If this setting is used, then both AE Titles are enforced. Multiple Calling AE Titles in the environment string should be separated by a comma. e.g., SCU_A, scu B, Another SCU.

APPENDIX A Mapping of RT Structure Set IOD

The modules of RT Structure Set IOD are listed in Table 6 below Please refer to the DICOM Standard 2001 for complete definition of the entities, modules and attributes.

Table 6. RT Structure Set Information Object Definitions

Entity Name	Module Name	Usage	Reference
Patient	Patient	M	Table 7
Study	General Study	M	Table 8
	Patient Study	U	Not used
Series	RT Series	M	Table 9
Equipment	General Equipment	M	Not used
Structure Set	Structure Set	M	Table 10
	ROI Contour	M	Table 11
	RT ROI Observations	M	Not used
	Approval	U	Not used
	Audio	U	Not used
	SOP Common	M	Table 12

Table 7. Patient Module

Attribute Name	Tag	Type	Mapping and Notes
Patient Name	(0010,0010)	2	Presented to user during import selection
Patient ID	(0010,0020)	2	Presented to user during import selection

Table 8. General Study Module

Attribute Name	Tag	Type	Mapping and Notes
Study Instance UID	(0020,000D)	1	Used as the primary key for mapping to plans and CT slice sets.

Table 9. RT Series Module

Attribute Name	Tag	Type	Mapping and Notes
Modality	(0008,0060)	1	Checked for the value of 'RTSTRUCT'

Table 10. Structure Set Module

Attribute Name	Tag	Type	Mapping and Notes
Structure Set Label	(3006,0002)	1	If numeric, presented to user during import selection
Structure Set Name	(3006,0004)	1	Presented to user during import selection
Structure Set Date	(3006,0008)	1	Presented to user during import selection
Structure Set Time	(3006,0009)	1	Presented to user during import selection
Referenced Frame of Reference Sequence	(3006,0010)	3	Checked for presence and further processing
> Frame of Reference UID	(0020,0052)	1C	Required. Checked against the CT Frame of Reference UID
> RT Referenced Study Sequence	(3006,0012)	3	Ignored
Structure Set ROI Sequence	(3006,0020)	3	Checked for presence and further processing
> ROI Number	(3006,0022)	1C	Used for cross referencing ROI Contour Sequence
> Referenced Frame of Reference UID	(3006,0024)	1C	Required. Checked against the CT Frame of Reference UID
> ROI Name	(3006,0026)	2C	Truncated to 20 chars

Table 11. ROI Contour Module

Attribute Name	Tag	Type	Mapping and Notes
ROI Contour Sequence	(3006,0039)	1	Checked for presence and further processing
> Referenced ROI Number	(3006,0084)	1	Used for cross referencing Structure Set ROI Sequence
> ROI Display Color	(3006,002A)	3	RGB values are mapped to the closest of the standard 69 Prec*i*sePLAN colors.
> Contour Sequence	(3006,0039)	1	Checked for presence and further processing
>> Contour Number	(3006,0048)	3	Not processed.
>> Attached Contours	(3006,0049)	3	Not processed.
>> Contour Image Sequence	(3006,0016)	3	Not processed. Instead, the CT Images and Contours are linked by Z coordinate in Contour Data (3006,0050) and the Z coordinate of Image Position Patient (0020,0032)
>>> Referenced SOP Class UID	(0008,1150)	1C	
>>> Referenced SOP Instance UID	(0008,1155)	1C	
>> Contour Geometric Type	(3006,0042)	1C	CLOSED_PLANER, OPEN_PLANAR or OPEN_NONPLANAR stored as structures. POINT stored as labels.
>> Contour Slab Thickness	(3006,0044)	3	Not processed.
>> Number of Contour Points	(3006,0046)	1C	Truncated to 1000 points.
>> Contour Data	(3006,0050)	1C	Transformed into Prec*i*sePLAN coordinate system.

Table 12. SOP Common Module

Attribute Name	Tag	Type	Mapping and Notes
SOP Class UID	(0008,0016)	1	Used for verification of incoming data
SOP Instance UID	(0008,0018)	1	Saved for cross reference to RT PLAN

APPENDIX B Mapping of RT Plan IOD

The modules of RT Structure Set IOD are listed in Table 13 below Please refer to the DICOM Standard 2001 for complete definition of the entities, modules and attributes.

Table 13. RT Plan Information Object Definitions

Entity Name	Module Name	Usage	Reference
Patient	Patient	M	Table 7
Study	General Study	M	Table 8
	Patient Study	U	Not used
Series	RT Series	M	Table 14
Equipment	General Equipment	M	Not used
Plan	RT General Plan	M	Table 15
	RT Prescription	U	Not used
	RT Tolerance Tables	U	Not used
	RT Patient Setup	U	Table 16
	RT Fraction Scheme	U	Table 17
	RT Beam	C	Table 18
	RT Brachy App Setup	C	Not used
	Approval	U	Not used
	Audio	U	Not used
	SOP Common	M	

Table 14. RT Series Module

Attribute Name	Tag	Type	Mapping and Notes
Modality	(0008,0060)	1	Checked for the value of 'RTPLAN'

Table 15. RT General Plan Module

Attribute Name	Tag	Type	Mapping and Notes
RT Plan Label	(300A,0002)	1	If numeric, presented to user during import selection
RT Plan Name	(300A,0003)	1	Presented to user during import selection
RT Plan Date	(3006,0006)	1	Presented to user during import selection
RT Plan Time	(3006,0007)	1	Presented to user during import selection
Ref. Structure Set Sequence	(300C,0060)	1C	Checked for presence and further processing
> Referenced SOP Class UID	(0008,1150)	1C	Checked for value of '1.2.840.10008.5.1.4.1.1.481.3'
> Referenced SOP Instance UID	(0008,1155)	1C	Used for referencing Structures and Markers (if not present or valid, a structure set cannot be read in)

Table 16. Patient Setup Module

Attribute Name	Tag	Type	Mapping and Notes
Patient Setup Sequence	(300A,0180)	1	Checked for Treatment Position of Head First. Feet first treatment positions are not currently supported.
> Patient Setup Number	(300A,0182)	1	
> Patient Position	(0018,5100)	1C	

Table 17. Fraction Scheme Module

Attribute Name	Tag	Type	Mapping and Notes
Fraction Sequence	(300A,0070)	1	
> Fraction Group Number	(300A,0071)	1	Used to label the imported fraction group
> Number of Fractions Planned	(300A,0078)	1C	Set number of treatments for this fraction group
> Number of Beams	(300A,0080)	1C	
> Referenced Beam Sequence	(300C,0004)	1C	
>> Referenced Beam Number	(300C,0006)	1C	Used to map MU value to referenced beam.
>> Beam Dose	(300A,0084)	1C	Not used
>> Beam Meterset	(300A,0086)	1C	Beam MU for this beam

Table 18. RT Beam Module

Attribute Name	Tag	Type	Mapping and Notes
Beam Sequence	(300A,00B0)	1	Checked for presence and further processing
> Beam Number	(300A,00C0)	1	Required, used for cross referencing to Fraction Groups.
> Beam Name	(300A,00C2)	3	Used for Beam name label
> Beam Type	(300A,00C4)	1	Not checked.
> Radiation Type	(300A,00C6)	2	Only 'PHOTON' and 'ELECTRON' processed. Other modalities result in abort of the import.
> Treatment Machine Name	(300A,00B2)	2	If matches 5 character code of Treatment Machine known by PrecisePLAN will be used directly. Otherwise a manual mapping is required.
> Source Axis Distance	(300A,00B4)	3	Must be present and must match the SAD of the Treatment Machine of this beam within 5mm. or the import will be aborted.
> Beam Limiting Device Sequence	(300A,00B6)	1	Checked for presence and further processing
>> RT Beam Limiting Device Type	(300A,00B8)	1	'X', 'Y', 'ASYMX', 'ASYMY', 'MLCX' and 'MLCY' processed, all others ignored. MLC type must match the configuration of the Treatment Machine of this beam.
>> Number of Leaf/Jaw Pairs	(300A,00BC)	1	Must match the number of leaf pairs configured for the Treatment Machine of this beam.
>> Leaf Position Boundaries	(300A,00BE)	2C	Must match the leaf widths configured for the Treatment Machine of this beam.
> Referenced Patient Setup Number	(300C,006A)	3	Not processed
> Number of Wedges	(300A, 00D0)	1	Must be 0 or 1
> Wedge Sequence	(300A, 00D1)	1C	Must be present and contain only the details of the one single wedge used in the Control Point Sequence.
>> Wedge Number	(300A, 00D2)	1C	Not used.
>> Wedge Type	(300A, 00D3)	2C	Not used.
>> Wedge Id	(300A, 00D4)	3	Not used.
>> Wedge Angle	(300A, 00D5)	2C	Must match a configured wedge angle for the selected Treatment Machine.
>> Wedge Factor	(300A, 00D6)	2C	Not used. The measured beam data of the selected Treatment Machine is used.
>> Wedge Orientation	(300A, 00D8)	2C	Must match a configured available wedge orientation for the selected Treatment Machine.

>> Source to Wedge Tray Distance	(300A, 00DA)	3	Not used. The configured value of the selected Treatment Machine is used.
> Number of Compensators	(300A,00E0)	1	0. If greater than 0, user is given option to import without compensators, or abort import.
> Number of Boli	(300A, 00ED)	1	Boli not processed. If not 0 a warning is given to the user.
> Number of Blocks	(300A,00F0)	1	Must match number of blocks in Block Sequence (300A,00F6)
> Block Sequence	(300A,00F6)	1C	Checked for presence and further processing
>> Block Type	(300A,00F8)	1C	Only 'SHIELDING' and 'APERTURE' processed.
>> Block Name	(300A,00FE)	3	Label for block.
>> Block Transmission	(300A,0102)	3	Clamped to value between 0.0 and 1.0 and used for transmission of the block. For APERTURE type blocks this value should be the same for all APERTURE blocks of this beam to avoid a warning to the operator.
>> Source to Block Tray Distance	(300A,00f6)	3	Used for distance from source to block. For APERTURE type blocks this value should be the same for all APERTURE blocks of this beam to avoid a warning to the operator.
>> Block Number of Points	(300A,0104)	2C	Total point count for all blocks of each type is limited to 700. If this value is exceeded all block vertex lists are filtered until the limit is met. The user is warned that the filtering was applied.
>> Block Data	(300A,0106)	2C	
> Applicator Sequence	(300A, 0107)	3	Only valid for Electron beams. User warning otherwise.
>> Applicator Id	(300A, 0108)	1C	Not used.
>> Applicator Type	(300A, 0109)	1C	Must be one of: ELECTRON_SQUARE, ELECTRON_RECT, ELECTRON_CIRC, ELECTRON_SHORT. If a Cone is configured for the selected Treatment Machine with that type and with the field size matching the Beam Limiting Device Position values the Cone will be accepted. Otherwise the beam will be created with the first configured cone and the user will be warned of a mismatch.
>> Applicator Description	(300A, 010A)	3	Not used.
> Final Cumulative Meterset Weight	(300A,010E)	1C	Must match Final Cumulative Meterset Weight (300A,0134) of final Control Point.
> Control Point Sequence	(300A,0111)	1	Checked for presence and further processing
> Control Point Index	(300A,0112)	1	Checked for presence and further processing

>> Nominal Beam Energy	(300A,0114)	3	Used to select energy for this beam. If doesn't match an available energy for the Treatment Machine of this beam, or is not specified, the first configured energy of that Treatment Machine is used and the user is notified.
>> Wedge Position Sequence	(300A,0116)	1C	Checked for presence and further processing
>>> Referenced Wedge Number	(300C,01C0)	1C	References wedge defined in Wedge Sequence (300A,00D1)
>>> Wedge Position	(300A,0118)	1C	IN or OUT. Wedge IN is only permitted for beams with 2 control points.
>> Beam Limiting Device Position Sequence	(300A,011A)	1C	Checked for presence and further processing
>>> Beam Limiting Device Type	(300A,00B8)	1C	'X', 'Y', 'ASYMX', 'ASYMY', 'MLCX' and 'MLCY' processed.
>>> Leaf/Jaw Positions	(300A,011C)	1C	Processing depends upon value in Beam Limiting Device Type (300A,00B8)
>> Gantry Angle	(300A,011E)	1C	Sets the gantry angle for each radiating segment.
>> Gantry Rotation Direction	(300A,011F)	1C	Not used, direction is determined from the angles specified in this and the next control point.
>> Beam Limiting Device Angle	(300A,0120)	1C	Sets the collimator angle for each radiating segment.
>> Beam Limiting Device Rotation Direction	(300A,0121)	1C	Not used, direction is determined from the angles specified in this and the next control point.
>> Patient Support Rotation Angle	(300A,0122)	1C	Value in first Control Point sets the couch angle for each radiating segment. All subsequent control points must have the same value or not contain a value.
>> Patient Support Rotation Direction	(300A,0123)	1C	Must be NONE in first Control Point, and NONE or not present in subsequent control points.
>> Table Top Vertical Position	(300A,0128)	2C	If Isocenter Position (300A,012C) not present, used to define vertical component of the beam isocenter.
>> Table Top Longitudinal Position	(300A,0129)	2C	If Isocenter Position (300A,012C) not present, used to define longitudinal component of the beam isocenter.
>> Table Top Lateral Position	(300A,012A)	2C	If Isocenter Position (300A,012C) not present, used to define lateral component of the beam isocenter.
>> Isocenter Position	(300A,012C)	2C	If present, used to define the beam isocenter.
>> Surface Entry Point	(300A,012E)	3	Not used
>> Source to Surface Distance	(300A,0130)	3	Not used
>> Cumulative Meterset Weight	(300A,0134)	2C	Used to set the weight of each segment

APPENDIX C Mapping of CT Image IOD

The modules of CT Image IOD are listed in Table 19 below. Please refer to the DICOM Standard 2001 for complete definition of the entities, modules and attributes.

Table 19. CT Image Information Object Definitions

Entity Name	Module Name	Usage	Reference
Patient	Patient	M	Table 19
Study	General Study	M	Table 20
	Patient Study	U	Not used
Series	General Series	M	Table 21
Frame of Reference	Frame of Reference	M	Table 22
Equipment	General Equipment	M	Table 23
Image	General Image	M	Not used
	Image Plane	M	Table 24
	Image Pixel	M	Table 25
	Contrast/Bolus	C	Not used
	CT Image	M	Table 26
	Overlay Plane	U	Not used
	VOI LUT	U	Not used
	SOP Common	M	Table 27

Table 19. Patient Module

Attribute Name	Tag	Type	Mapping and Notes
Patient Name	(0010,0010)	2	Required as default patient name
Patient ID	(0010,0020)	2	Required as default patient id

Table 20. General Study Module

Attribute Name	Tag	Type	Mapping and Notes
Study Instance UID	(0020,000D)	1	Required. Used as primary key for mapping to StructureSet and Plans.
Study Id	(0020,0010)	1	Required

Table 21. General Series Module

Attribute Name	Tag	Type	Mapping and Notes
Modality	(0008,0060)	1	Checked for the value of 'CT'
Series Instance UID	(0020,000E)	1	Ignored
Series Number	(0020,0011)	2	Required
Patient Position	(0018,5100)	1C	Required

Table 22. Frame of Reference

Attribute Name	Tag	Type	Mapping and Notes
Frame of Reference UID	(0020,0052)	1	Required. Used as base frame of reference for export and as key for import of StructureSet.

Table 23. General Equipment Module

Attribute Name	Tag	Type	Mapping and Notes
Manufacturer	(0008,0070)	2	Required. Used for selecting appropriate CT to Density conversion curve.

Table 24. Image Plane Module

Attribute Name	Tag	Type	Mapping and Notes
Pixel Spacing	(0028,0030)	1	Required.
Image Orientation (Patient)	(0020,0037)	1	Required. Total Z component must be less than .175mm to assure transverse slices.
Image Position (Patient)	(0020,0032)	1	Required. X and Y coordinate must be same for all images.
Slice Location	(0020,1041)	3	Ignored.

Table 25. Image Pixel Module

Attribute Name	Tag	Type	Mapping and Notes
Rows	(0028,0010)	1	Required.
Columns	(0028,0011)	1	Required.
Pixel Representation	(0028,0103)	1	Required.
Pixel Data	(7FE0,0010)	1	Required.

Table 26. CT Image Module

Attribute Name	Tag	Type	Mapping and Notes
Image Type	(0008,0008)	1	Ignored.
Samples Per Pixel	(0028,0002)	1	Must be 1
Photometric Interpretation	(0028,0004)	1	Ignored. MONOCHROME2 assumed.
Bits Allocated	(0028,0100)	1	Must be 16
Bits Stored	(0028,0101)	1	All 16 bits assumed. Embedded overlays not permitted.
High Bit	(0028,0102)	1	Assumed to be 15
Rescale intercept	(0028,1052)	1	Required.
Rescale slope	(0028,1053)	1	Required.
KVP	(0018,0060)	2	Required.
Acquisition Number	(0020,0012)	2	Optional. Defaults to 0 if not set.
Reconstruction Diameter	(0018,1100)	3	If sent must match product of pixelSpacing.x and number of columns within 3mm.
Gantry/Detector Tilt	(0018,1120)	3	If sent must be less than 1 degree from zero

Table 27. SOP Common Module

Attribute Name	Tag	Type	Mapping and Notes
SOP Class UID	(0008,0016)	1	Used for verification of incoming data
SOP Instance UID	(0008,0018)	1	Saved for cross reference to RTSTRUCT if RTSTRUCT is sent