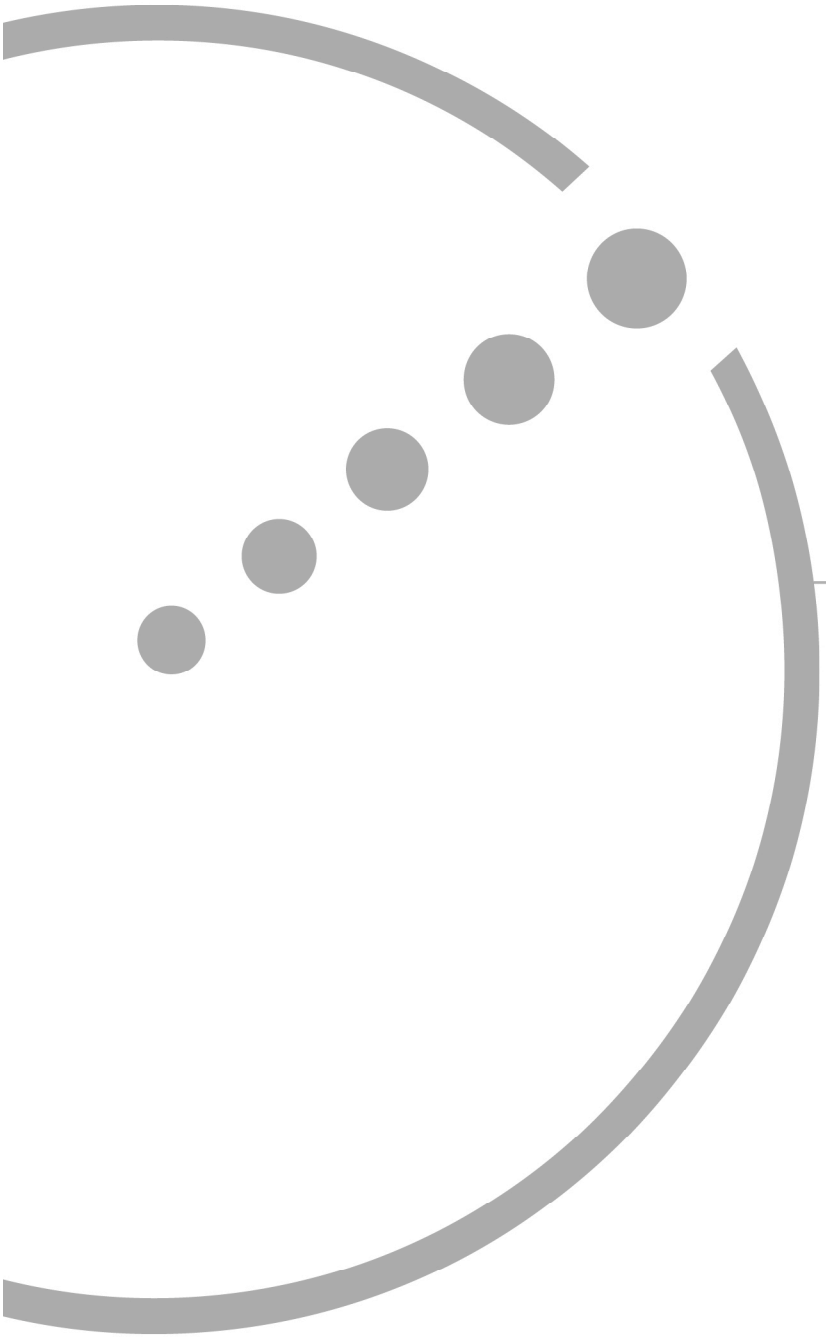
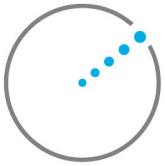


ERGO++

DICOM Conformance Statement
DICOM 3.0



ELEKTA
CMS SOFTWARE

Revision History

Revision	Date	Changes
ERGO_DCS_A.pdf	05/19/2008	New document

Trademarks

All terms mentioned in this manual that are known trademarks, registered trademarks, or service marks have been appropriately labeled as such. Other products, services, or terms that are referred to in this manual may be trademarks, registered trademarks, or service marks of their respective owners. CMS makes no claim to these trademarks. Use of a term in this manual should not be regarded as affecting the validity of any trademark, registered trademark, or service mark.

CMS Software® is a registered trademark of Elekta, Inc.

ERGO ++® is a registered trademark of Elekta, Inc.

Adobe™, Acrobat™, and the Acrobat logo are trademarks of Adobe Systems Incorporated, which may be registered in certain jurisdictions.

Hewlett-Packard™ is a trademark of Hewlett-Packard Corporation.

Netscape® and Netscape Navigator® are registered trademarks of Netscape Communications Corporation in the United States and other countries. Netscape's logos and Netscape product and service names are also trademarks of Netscape Communications Corporation, which may be registered in other countries.

UNIX® is a registered trademark in the United States and other countries, licensed exclusively through X/Open Company Ltd.

Red Hat and all Red Hat-based trademarks and logos are trademarks or registered trademarks of Red Hat, Inc. in the United States and other countries.

Microsoft®, Windows®, and Windows NT® are registered trademarks of Microsoft Corporation in the United States and other countries.

Performance characteristics given in this manual are for reference only and are not intended as guaranteed specifications

Table of Contents

Introduction

References

NEMA Standards Publication on DICOM3.

Purpose

The purpose of this conformance statement is to facilitate the communication with CMS Software's DSERV and DCMD module.

General

This document specifies the compliance of the DSERV and DCMD DICOM server to the DICOM 3.0 standard. The structure of the document follows the guideline given in annex A of part 2 (PS 3.2) of the DICOM standard.

This conformance statement applies to version 2.0 of the dSERV software and to version 1.0 of the DCMD software. DPush is the SCU part of the dSERV.

All above mentioned SW modules will be referred hereinafter as "DSERV".

Intended audience

The conformance statement is intended for:

- Clients
- Potential clients
- Marketing persons interested in supported DICOM functionality
- System integrators of medical equipment

It is assumed that the reader is familiar with the DICOM 3.0 standard.

Important note to the reader

The conformance statement in itself does not guarantee correct interoperability with non CMS Software equipment. The user (or user's agent) should pay careful attention to the following issues:

- Interoperability

The integration of two or more medical devices is beyond the scope of the DICOM V3.0 standard and this conformance statement. The DICOM V3.0 standard provides the means to establish interfaces and the conformance statement specifies which of those means are supported by a specific device. So, even if, based on the conformance statements, one may conclude that a non CMS Software device can interface with the DSERV, this does not guarantee successful interoperability. Therefore careful attention should be paid to this matter by the user (or the user' agent), when the DSERV is interfaced with a non-CMS Software device.

- Validation

  The DSERV software has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this conformance statement. If DSERV is to be interconnected to non CMS Software equipment, first of all the relevant conformance statements must be compared. If this comparison leads to the conclusion that successful interconnection should be possible, additional validation tests are necessary to ensure a correctly functioning interface. It is the responsibility of the user (or the user's agent) to specify and carry out these additional validation tests. CMS Software will assist the user in this process as much as possible through a direct contact between CMS Software and the non-CMS Software equipment manufacturer.

- Future developments

  The DICOM standard will evolve to meet the user's growing requirements. CMS Software is actively involved in this evolution, e.g. in the working group of the DICOM information object-radiation section, and plans to adapt its equipment to future versions of the DICOM standard.

  Therefore, CMS Software reserves the right to change its product or to discontinue its delivery.

  The user should ensure that any non-CMS Software provider, which connects CMS Software equipment, also adapts to future versions of the DICOM standard. If not, the incorporation of DICOM enhancements into DSERV may lead to loss of connectivity.

Implementation model

Application Data Flow Diagram

The DSERV server application stores received DICOM message information within a standard UNIX directory. This directory is specified on the command line of the application launched when PMM is started.

The messages may then be imported into the PMM database via the Import capability.

For DICOM RT messages, import is performed within the ERGO application. The Plan or Structure Set information is added to the plan being edited.

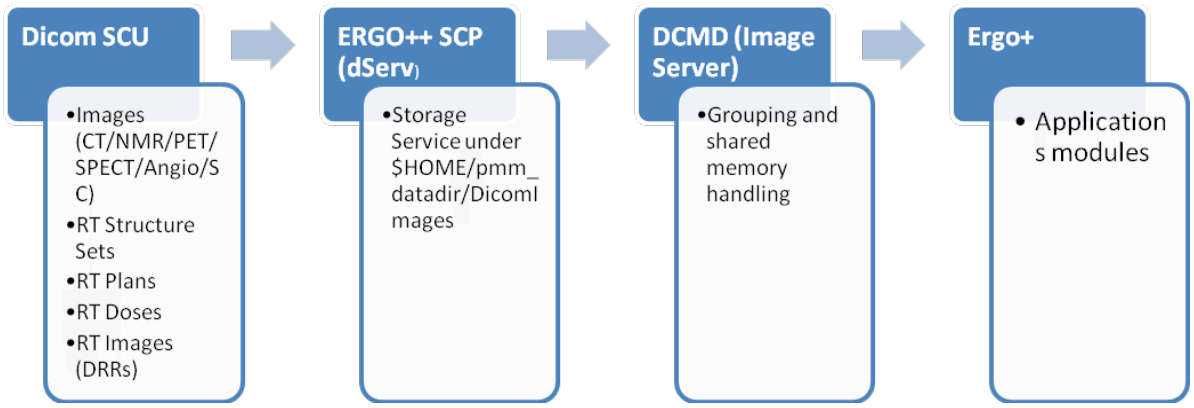
DSERV is a daemon, started when the system is started, which runs continuously.

No DICOM-to-ERGO translation is provided as ERGO uses DICOM RT structure as its internal format. Therefore no conversion is needed.

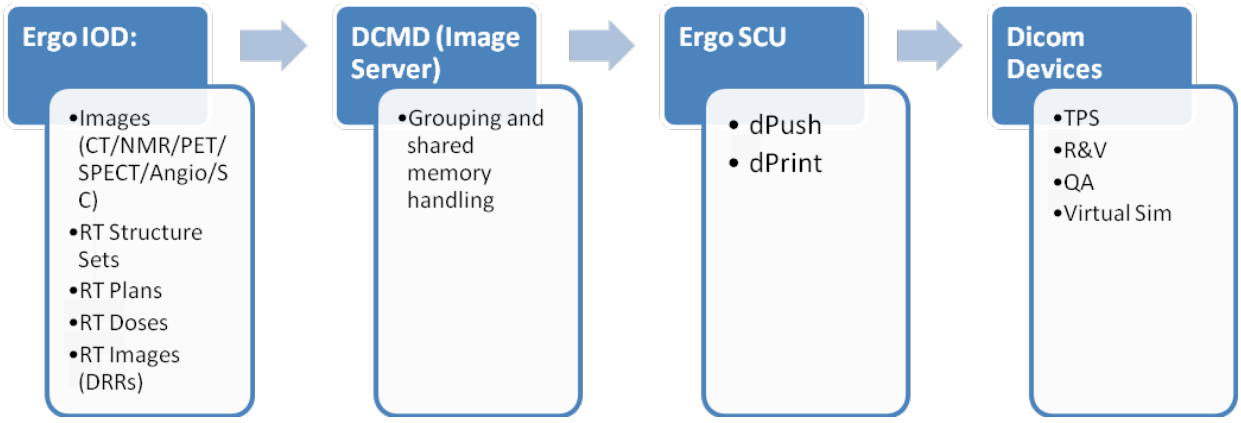
Print and RT transmission requests are submitted as requested by the user in the PMM export feature. It can also send the received CT, MR, NM, and PET images back to the remote server via DICOM Export feature of PMM.

For more detailed info, see also the ERGO++ User Guide.

ERGO SCP Flow Diagram



ERGO SCU Flow Diagram



Functional definitions of AEs

When activated, dSERV establishes an association with the selected source and transfers the images. After the image transfer it releases the association.

ERGO SCP

The DSERV server application waits until it receives a C-STORE request from a remote SCU. Upon receipt it saves the received data to a directory with a unique file name. The server is capable of handling multiple associations.

DSERV is a daemon, started with the operating system, which runs continuously.

ERGO SCU

Importing RT Structure Set IODs happens within ERGO. The user does not need to create a plan or patient. The message files will automatically be scanned for RT messages and the selections presented to the user. On import the patient data will be populated with the information described in the selected RT Plan and/or RT Structure Set messages.

The dSERV also communicates with a remote SCP to transfer RT Plan and RT Structure Set IODs. Upon request, an association is established with an AE defined during installation. After completion of the transmission, the association is closed. It is also capable of sending the CT, MR, NM and PET images back to the remote server, via PMM's DICOM Image Export feature or CT image used as the primary dataset of the DMS plan within PMM's DICOM Image Export feature.

DMS also communicates with a remote SCP to transfer computed radiography and secondary capture IODs. Upon request, an association is established with an AE defined during installation. After completion of the transmission the association is closed.

Sequencing of Real-World Activities

Not applicable.

AE specifications

The Network capabilities of the system consist of two DICOM Application Entities:

- An Imaging and RT Plan and Structure Set Import Storage AE (ERGO SCP, dSERV)
- A Send Print, RT Plan and Structure Set, Computed Radiography, Secondary Capture, and Imaging AE (ERGO SCU, dPush)

Throughout this document, dSERV and dPush are used to specify the AE Title representing the ERGO application. In the field, the presented AE Title will be the capitalized hostname of the machine sending the message.

dSERV SCP Specification

The dSERV Application Entity provides Standard Conformance to the following DICOM V3.0

Table 1: Supported SOP Classes as SCP by DSERV AE

SOP Class Name	UID	Notes
Verification	1.2.840.10008.1.1	
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	
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	
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	

Association Establishment Policies

General

The PDU size is configurable in a range between 4096 and 131072 bytes. The default size is 16384 bytes.

Number of Associations

The number of simultaneous associations which will be accepted by DSERV is limited only by system resources. DSERV will spawn a new process to handle each connection request it receives.

Therefore, DSERV can support multiple simultaneous connections, and there are no inherent limitations on the total number of simultaneous associations.

The DSERV application entity opens a single association for each request.

Asynchronous Nature

dSERV does not support asynchronous operations. Therefore, dSERV will not perform asynchronous operations window negotiation.

Implementation Identifying Information

dSERV will provide following implementation identifying information:

Implementation Class UID 2.16.840.1.113669.2.931128

Implementation version name 001

Association acceptance policy

When DSERV accepts an association, it will receive supported SOP Instances and store the messages to disk. There are neither limitations on who may connect to the SCP, nor on the number of simultaneous associations it will support.

When DSERV receives a verification request it responds with a success status.

Import of the data into ERGO is a separate operation requested by the user.

Upon import the attribute values contained in the message will be verified. Import may be performed from the standard directory, written by the SCP.

dPush/dPrint SCU specification

The dPush and dPrint Application Entity provide Standard Conformance to the following DICOM V3.0

Table 1: Supported SOP Classes as SCU by dPush and dPrint AE

SOP Class Name	UID	Notes
Verification	1.2.840.10008.1.1	dEcho
Basic Grayscale Print Management (META)	1.2.840.10008.5.1.1.9	dPrint
Basic Color Print Management (META)	1.2.840.10008.5.1.1.18	dPrint
Basic Film Session	1.2.840.10008.5.1.1.1	dPrint
Basic Film Box	1.2.840.10008.5.1.1.2	dPrint

Basic Grayscale Image Box	1.2.840.10008.5.1.1.4	dPrint
Printer	1.2.840.10008.5.1.1.16	dPrint
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	dPush
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	dPush
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	dPush
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	dPush
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	dPush
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	dPush
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	dPush
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	dPush
RT Dose	1.2.840.10008.5.1.4.1.1.481.2	dPush

Association establishment policies

General

The PDU size is configurable in a range between 4096 and 131072 bytes. The default size is 16384 bytes.

Number of associations

The dPush and dPrint application entities open a single association for each user requested transfer.

Asynchronous nature

dPush and dPrint do not support asynchronous operations. Therefore, dPush and dPrint will not perform asynchronous operations window negotiation.

Implementation identifying information

dPush and dPrint will provide following implementation identifying information:

Implementation Class UID 2.16.840.1.113669.2.931128

Implementation version name 001

Association acceptance policy

The dPrint, dPush and dEcho modules never accept an association as they are acting as an SCU for storage, printing and verification only.

Communication Profiles

Supported Communication Stacks

dSERV provides DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8

Physical media support

dSERV supports Ethernet IEEE 802. Standard connectors: RJ-45 (10BASE-T), BNC (thin coax) and AUI (thick coax).

Extensions/specializations/privatizations

Not applicable.

Configuration

dSERV/dPush/dPrint obtains its configuration from a number of configuration files. The settings in these files may only be changed by CMS Software service engineers.

AE title/presentation address mapping

The mapping of the presentation address to an AE title is configurable. For that purpose following parameters can be set:

- host name

Name or IP address of the system on which the remote AE executes.

- port number

TCP/IP socket on which the remote AE listens for association requests.

- application title

Application Entity Title of the remote AE.

Configurable parameters

The following parameters may be changed for dSERV:

- Application Entity Title
- PDU size

Support of Extended Character Sets

If a non-standard keyboard is used, i.e. a German or French keyboard, DSERV supports

Extended Character Set ISO-IR 100.

Annex - Supported DICOM data elements

The tables in this annex list the DICOM data elements supported by dSERV. A description of the information shown in each column is given in 10.2.

Supported data elements per module

Patient Module

RT	Tag	Name	VR	VM	Default	Description/notes
2	0010, 0010	Patient's name	PN	1		Patient's full legal name.
2	0010, 0020	Patient ID	LO	1		Primary hospital identification number or code for the patient.
2	0010, 0030	Patient's birthdate	DA	1		Date of birth of the named patient. Empty in case of a phantom. The format is yyyymmdd for DICOM, yyyy.mm.dd for ACR-Nema.
2	0010, 0040	Patient's sex	CS	1		Gender of the named patient: M = male, F = female, O = other.Empty in case of a phantom.

General study module

RT	Tag	Name	VR	VM	Default	Description/notes
1	0020, 000D	Study instance UID	UI	1		Unique identifier for the study.
2	0008 0020	Study date	DA	1		The date on which the study started. The format is yyyymmdd for DICOM, yyyy.mm.dd for ACR-Nema. dSERV session date is used here.
2	0008 0030	Study time	TM	1		The time the study started. The format is hh:mm:ss.frac. dSERV session time is used here.
2	0008 0090	Referring physician's name	PN	1		Null Patient's primary referring physician.

2	0020, 0010	Study ID	SH	1		Study identification that is used in labeling the image. May be assigned by the imaging device, generated by an external information system, or derived by some other means. Here dSERV session number is used.
2	0008 0050	Accession number	SH	1		Null A RIS generated number which identifies the order for the study.

General Series Module

RT	Tag	Name	VR	VM	Default	Description/notes
1	0008 0060	Modality	CS	1		CT Type of equipment that originally acquired the data used to create the image in this series.
1	0020, 000E	Series instance UID	UI	1		Unique identifier of the series.
2	0020, 0011	Series number	IS	1		A number that identifies this series. This element always has a value 1, as dSERV doesn't support series.
2C	0020, 0060	Laterality	CS	1		Null Laterality of (paired) body part examined. Required if the body part examined is a paired structure. Possible values: R = right, L = left.
2C	0018 5100	Patient position	CS	1		Patient position descriptor relative to the equipment. Required for CT and MR images. Possible values: HFP = head first-prone, HFS = head first-supine, HFDR = head first-decibitus right, HFDL = head first-decubitus left, FFP = feet first-prone, FFS, FFDR, FFDL.

Frame of Reference Module

RT	Tag	Name	VR	VM	Default	Description/notes
1	0020, 0052	Frame of reference	UI	1		Uniquely identifies the frame of reference for a

		UID				series.
2	0020 1040	Position reference indicator	LO	1		Null Part of the patient's anatomy used as a reference, such as the iliac crest, orbital-metal, sternalnotch, symphysis pubis, xiphoid, lower coastal margin, external auditory measures.

General equipment module

RT	Tag	Name	VR	VM	Default	Description/notes
2	0008 0070	Manufacturer	LO	1		Manufacturer of the equipment that produced the digital image.
3	0008 0080	Institution name	LO	1		Institution at which the digital image originated.
3	0008 1090	Manufacturer's model name	LO	1		Manufacturer's model name/number of the equipment that produced the digital images.
3	0018 1020	Software versions	LO	1-n		Alphabetic and numeric representation of software that generated the image.

General image module

RT	Tag	Name	VR	VM	Default	Description/notes
2	0020, 0013	Image number	IS	1		A number that identifies this image.
2C	0008 0023	Image date	DA	1		The date the image pixel data creation started. Required if image is part of a series in which the images are temporarily related.
2C	0008 0033	Image time	TM	1		The time the image pixel data creation started. Required if image is part of a series in which the images are temporally related.
1	0008 0008	Image type	CS	1-n		Original \ Primary \ Axial Image identification characteristics.
2	0020, 0012	Acquisition number	IS	1		A number identifying the single continuous

						gathering of data over a period of time which resulted in this image.
3	0008 0022	Acquisition date	DA	1		The date on which the acquisition started.
3	0008 0032	Acquisition time	TM	1		The time the acquisition started.

Image plane module

RT	Tag	Name	VR	VM	Default	Description/notes
1	0028 0030	Pixel spacing	DS	2		Also named pixel size. Physical distance in the patient between the center of each pixel, specified by a numeric pair - row value (delimiter) column value in mm.
1	0020, 0037	Image orientation (patient)	DS	6		The direction cosines of the first row and the first column with respect to the patient.
1	0020, 0032	Image position (patient)	DS	3		The x, y and z coordinates of the upper left hand corner (first pixel transmitted) of the image. The absolute value of the z-coordinate has no meaning. The relative value of the z-coordinate conforms to the DICOM standard.
2	0018 0050	Slice thickness	DS	1		Nominal slice thickness in mm.

Image Pixel Module

RT	Tag	Name	VR	VM	Default	Description/notes
1	0028 0002	Samples per pixel	US	1	1	Number of samples (planes) in this image.
1	0028 0004	Photometric interpretation	CS	1		Monochrome2 Specifies the intended interpretation of the pixel data. Possible values: monochrome1, monochrome2; respectively denoting black or white for high intensities.

1	0028 0010	Rows	US	1		Number of rows in the image.
1	0028 0011	Columns	US	1		Number of columns in the image.
1	0028 0100	Bits allocated	US	1		Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated.
1	0028 0101	Bits stored	US	1 16		Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.
1	0028 0102	High bit	US	1 15		Most significant bit for pixel sample data. Each sample shall have the same high bit.
1	0028 0103	Pixel representation	US	1 1		Data representation of the pixels. Possible values: 0 = unsigned integer, 1 = 2's complement.
1	7FE0, 0010	Pixel data	OW	1		Data as described in group 28. Row 1 followed by row 2 etc. Data type given by element (0028, 0103), each with the number of bits given in elements (0028,0100) and (0028, 0101). Bits not used for pixels can be used for overlay planes described in Groups 6000-601E (even).

CT Image Module

RT	Tag	Name	VR	VM	Default	Description/notes
1	0008 0008	Image type	CS	1-n	Original \ Primary\ Axial	Image identification characteristics.
1	0028 0002	Samples per pixel	US	1	1	Number of samples (planes) in this image.
1	0028 0004	Photometric interpretation	CS	1	Monochrome 2	Specifies the intended interpretation of the pixel data. Possible values: monochrome1, monochrome2; respectively denoting

						black or white for high intensities.
1	0028 0100	Bits allocated	US	1		Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated.
1	0028 0101	Bits stored	US	1	16	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.
1	0028 0102	High bit	US	1	15	Most significant bit for pixel sample data. Each sample shall have the same high bit.
1	0028 1052	Rescale intercept	DS	1	0.0	The value b in the relationship between stored values (SV) and Hounsfield Units (HU). HU=m*SV+b.
1	0028 1053	Rescale slope	DS	1	1.0	The value m in the relationship between stored values (SV) and Hounsfield Units (HU). HU=m*SV+b.
2	0018 0060	Kilovolt peak voltage	DS	1	Null	Peak kilo voltage output of the x-ray generator used.
2	0020, 0012	Acquisition number	IS	1		A number identifying the single continuous gathering of data over a period of time which resulted in this image.
3	0018 0090	Data collection diameter	DS	1		The diameter in mm of the region over which data were collected.
3	0018 1100	Reconstruction diameter	DS	1		Diameter in mm of the region from which data were used in creating the reconstruction of the image. Data can exist outside this region and portions of the patient can exist outside this region.
3	0018 1120	Gantry / detector tilt	DS	1		Nominal angle of tilt in degrees of the scanning gantry. Not intended for mathematical computations.

RT Structure Set

The following table describes the structure set to be used for saving the above defined structures.

DICOM Tag	Description and DICOM level	VM VR	Default value	Check Type	Patient data structure
0008,0016	SOP Class	UI	1.2.840.10008.5.1.4.1.1.481.3	CHECK_PNE and equal to default	N/A
0008,0018	SOP Instance	UI	same as images	CHECK_PNE and same as images	N/A
0008,0020	Study date	DA	same as images	CHECK_PNE	N/A
0008,0030	Study time	TI	same as images	CHECK_PNE	N/A
0008,0060	Modality	CS	"RTSTRUCT"	CHECK_PNE and equal to default	N/A
0008,0070	Manufacturer	LO	"3D Line"	CHECK_NONE.	N/A
0008,1010	Station Name	SH	"ERGO"	CHECK_NONE.	N/A
0008,1090	Manufacturer's Model Name	LO	"DYNART"	CHECK_NONE.	N/A
0010,0010	Patient's Name	PN	same as images	CHECK_PNE and same as images	N/A
0010,0020	Patient ID	LO	same as images	CHECK_PNE and same as images	N/A
0010,0030	Patient birth date	DA	same as images	CHECK_NONE. If present, must be same as images,	N/A
0010,0040	Patient Sex	CS	same as images	CHECK_NONE. If present, must be same as images,	N/A
0020,000D	Study Instance	UI	2.16.840.1.123652.3.URGN URGN must be an unique random generated number	CHECK_PNE	N/A
0020,000E	Series Instance UID	UI	same as images	CHECK_PNE	N/A
0020,0010	Study ID	SH	same as images	CHECK_PNE and same as images	N/A
0020,0011	Series number	IS	1	CHECK_PNE	N/A
3006,0002	Structure set label	SH	"STRUCT"	CHECK_PNE	None
3006,0020	Structure set ROI sequence	SQ		CHECK_PNE	"ROI" is an equivalent name to the above described "VOI"
3006,0022	>ROI Number	IS	Incremental value	CHECK_PNE and unique	None

DICOM Tag	Description and DICOM level	VM VR	Default value	Check Type	Patient data structure
3006,0026	>ROI Name	LO	N/A	CHECK_PNE	TVOI.Name
3006,0028	>ROI Description	ST	"unnamed"	CHECK_PNE	TissueType Name
3006,0036	>ROI Generation Algorithm	CS	"MANUAL"	CHECK_PNE	None
3006,0039	ROI Contour Sequence	SQ		CHECK_PNE	N/A
3006,0084	>Referenced ROI number	IS	Refer to 3006,0022	CHECK_PNE and correctly referring to 3006,0022	N/A
3006,0040	>Contour sequence	SQ		CHECK_PNE	N/A
3006,0016	>>Contour Image sequence	SQ		CHECK_PNE	N/A
0008,1150	>>>References SOP class UID	UI	Refers the contour to the corresponding image	CHECK_PNE and correctly referring to existing image	N/A
0008,1155	>>>References SOP instance UID	UI	Refers the contour to the correspondent image	CHECK_PNE and correctly referring to existing image	N/A
3006,0042	>>Contour Geometric Type	CS	POINT if marker CLOSED_PLANAR if contour if other type, do not load contour	CHECK_PNE	Tcontour.Type
3006,0046	>> Number of contour points	IS	None	CHECK_PNE	Tcontour. PointNumber =1 if marker
3006,0050	>>Contour data	DS 3-3n	None	CHECK_PNE	Tcontour.Points
3006,0080	RT ROI observation sequence	SQ		CHECK_PNE	if not existing must be added with ELE_DES = 1.0
3006,0082	>Observation Number	IS	Unique number	CHECK_PNE and unique	None
3006,0084	>Referenced ROI number	IS	Identify the related ROI number (3006,0022)	CHECK_PNE and correctly referring ROI number	N/A
3006,00B0	>ROI Physical Properties Sequence	SQ		CHECK_PNE. At least 2 elements must be present.	

DICOM Tag	Description and DICOM level	VM VR	Default value	Check Type	Patient data structure
3006,00B2	>>ROI Physical Property	CS	REL_ELEC_DENSITY	CHECK_PNE	None
3006,00B4	>>ROI Physical Property Value	DS	1.0	CHECK_PNE	TVOI.RED

* CPNE = CHECK_PRESENT_NOT_EMPTY

RT PLAN Set

The following table describes the structure set to be used for reading and writing the plan data. The "data structure" field uses the following convention:

struct GeneralPlan = GP

struct Fraction = FR

struct Beams = BE

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
300A,0002	RT Plan Label	SH	N/A		GP.PlanLabel
300A,0004	RT Plan Description	ST	"ERGO Plan"		GP.PlanDescription
300A,0006	RT Plan Date	DA	N/A		GP.PlanDate
300A,0007	RT Plan Time	TM	N/A		GP.PlanTime
300A,000C	RT Plan Geometry	CS	PATIENT		none
300C,0060	Referenced Struct. Set Seq.	SQ	N/A		from structure sequence
0008,1150	>Ref. SOP Class UID	UI	N/A		from structure sequence
0008,1155	>Ref. SOP Class UID	UI			from structure sequence
300A,0070	Fraction Group Sequence	SQ			none
300A,0071	>Fraction Group Number	IS	unique incremental value = 0		none
300A,0078	>Number of Fractions	IS	N/A		FR.NumberOf
300A,0080	>Number of Beams	IS	= 1		FR.BeamsNumber
300C,0004	>Referenced Beam Sequence	SQ			
300C,0006	>>Referenced beam number	IS			from beam struct
300A,0084	>>Beam Dose	DS			FR.BeamDose
300A,0086	>>Beam Meterset	DS			FR.MU
300A,00B0	Beam Sequence	SQ			

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
300A,00C0	>Beam Number	IS	unique identifier		BE.Number
300A.00C2	>Beam Name	LO			BE.Name
300A,00C3	>Beam Description	ST			BE.Description
300A,00C4	>Beam Type	CS			BE.Type (enum STATIC or DYNAMIC)
300A,00C6	>Radiation Type	CS	PHOTON		BE.RadiationType
300A,00B2	>Treatment Machine Name	SH			BE.TreatmentMachine
300A,00B3	>Primary Dosimeter Unit	CS	MU		BE.PrimaryDosimUnit
300A,00B4	>Source Axis Distance	DS	1000		BE.SAD
300A,00B6	>Beam Limiting Device Sequence	SQ			2 sequences for X and Y jaws and "numleaves" sequences for MLCX and MLCY
300A,00B8	>>RT Beam Limiting Device Type	CS			see above
300A,00BC	>>Number of Leaf/Jaw pairs	IS			1 if X,Y Leaves number if MLCX or MLCY
300A,00BE	>>Leaf Position Boundaries	DS 2-2n			BE.Leaves[].Boundaries
300A,00CE	>Treatment Delivery Type	CS	TREATMENT		
300A,00D1	>Number of Wedges		0		BE.NumWedges
300A,00D1	>Wedge Sequence	SQ			
300A,00D2	>>Wedge Number	IS			BE.Wedge[].Number
300A,00D3	>>Wedge Type	CS			BE.Wedge[].Type
300A,00D4	>>Wedge ID	SH			BE.Wedge[].ID
300A,00D5	>>Wedge Angle	IS			
300A,00D6	>>Wedge Factor	DS			BE.Wedge[].Factor
300A,00D8	>>Wedge Orientation	DS			BE.Wedge[].Orientation
300A,00DA	>>Source to Wedge Tray Distance	DS			BE.Wedge[].STD

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
300A,00F0	>Number of Blocks	IS			BE.NumBlocks
300A,00F4	>Block Sequence	SQ			
300A,00F5	>>Block Tray ID	SH			BE.Block[].TrayID
300A,00F8	>>Block Type	CS			BE.Block[].Type (enum)
300A,00FA	>>Block Divergence	CS			BE.Block[].Divergence
300A,00FC	>>Block Number	IS			BE.Block[].Number
300A,00FE	>>Block Name	LO			BE.Block[].Name
300A,00E1	>>Material ID	SH			BE.Block[].Material
300A,0100	>>Block Thickness	DS			BE.Block[].Thickness
300A,0102	>> Block Transmission	DS			BE.Block[].Trans
300A,0104	>>Block Number of Points	IS			BE.Block[].NumPoints
300A,0106	>>Block Data	DS 2-2n			BE.Block[].Points[]
300A,010E	>Final Cumulative meterset weight	DS			BE.FinalMeterWeight
300A,0111	>Control Point Sequence	SQ			2 control points for static beams. If dynamic arc is present, multiple control points (one every 5 or 10 degrees must be created).
300A,0112	>>Control Point Index	IS			unique number
300A,0134	>>Cumulative Meterset weight	DS			BE.Control[].MeterWeight
300A,0114	>>Nominal Beam Energy	DS			BE.Control[].Energy
300A,011A	>>Beam Limiting Device Position Sequence	SQ			4 elements: 2 for X and Y jaws and 2 for MLC X and MLC Y leaves
300A,00B8	>>>RT Beam Limiting Device Type	CS			
300A,011C	>>>Leaf/Jaws Positions	DS 2-2n			BE.Control[].JawsX BE.Control[].JawsY BE.Control[].Leaves[]
300A,011E	>>Gantry Angle	DS			BE.Control[].Gantry

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
300A,011F	>>Gantry Rotation Direction	CS			BE.Control[].GantryRotDir (enum)
300A,0120	>>Beam Limiting Device Angle	DS			BE.Control[].CollAngle
300A,0121	>>Beam Limiting Device Rotation Direction	CS	NONE		
300A,0122	>>Patient Support Angle	DS			BE.Control[].CouchAngle
300A,0122	>>Patient Support Rotation Direction	CS	NONE		
300A,0125	>>Table top eccentric angle	DS			BE.Control[].CouchTopAngle
300A,0126	>>Table top eccentric rotation direction	CS	NONE		
300A,0128	>>Table top Vertical Position	DS			BE.Control[].CouchVert
300A,0129	>>Table top Longitudinal Position	DS			BE.Control[].CouchLong
300A,012A	>>Table top Lateral Position	DS			BE.Control[].CouchLat
300A,012C	>>Isocenter Position	DS 3			BE.Control[].Isocenter (struct with X,Y,and Z)

RT Dose set

The following table describes the structure set to be used for reading and writing the Dose data. The "data structure" field uses the following convention:

struct GeneralPlan = GP

struct Fraction = FR

struct Beams = BE

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
0008,0000	_____ GRP LEN _____	UL/UL	ISO_IR 100		
0008,0005	Specific Character Set	CS/CS	ORIGINAL\PRIMARY\DOSE		

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
0008,0008	Image Type	CS/CS			
0008,0012	Instance Creation Date	DA/DA			
0008,0013	Instance Creation Time	TM/TM			
0008,0016	SOP Class	UI/UI			
0008,0018	SOP Instance	UI/UI			
0008,0020	Study Date	DA/DA			
0008,0030	Study Time	TM/TM			
0008,0050	Accession Number	SH/SH			
0008,0060	Modality	CS/CS	RTDOSE		
0008,0070	Manufacturer	LO/LO	3DLine_Medical_Systems		
0008,0090	Referring Physician's N	PN/PN			
0008,1010	Station Name	SH/SH	ERGO		
0008,1070	Operators' Name	PN/PN			
0008,1090	Manufacturer's Model N	LO/LO	DYNART		
0010,0000	GRP LEN	UL/UL			
0010,0010	Patient's Name	PN/PN			
0010,0020	Patient ID	LO/LO			
0010,0030	Patient's Birth Date	DA/DA			
0010,0040	Patient's Sex	CS/CS			
0018,0000	GRP LEN	UL/UL			
0018,1020	Software Version(s)	LO/LO	DOSE2RT		
0018,1050	Spatial Resolution	DS/DS			
0020,0000	GRP LEN	UL/UL			
0020,000D	Study Instance	UI/UI			
0020,000E	Series Instance	UI/UI			
0020,0010	Study ID	SH/SH			
0020,0011	Series Number	IS/IS			
0020,0012	Acquisition Number	IS/IS			

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
0020,0013	Instance Number	IS/IS			
0020,0020	Patient Orientation	CS/CS			
0020,0032	Image Position (Patient	DS/DS			
0020,0037	Image Orientation (Pat	DS/DS			
0020,0052	Frame of Reference	UI/UI			
0020,1040	Position Reference Indi	LO/LO			
0020,4000	Image Comments	LT/LT			
0028,0000	GRP LEN	UL/UL			
0028,0002	Samples per Pixel	US/US			
0028,0004	Photometric Interpretation	CS/CS	MONOCHROME2		
0028,0008	Number of Frames	IS/IS			
0028,0009	Frame Increment Pointe	AT/AT			
0028,0010	Rows	US/US			
0028,0011	Columns	US/US			
0028,0030	Pixel Spacing	DS/DS			
0028,0100	Bits Allocated	US/US			
0028,0101	Bits Stored	US/US			
0028,0102	High Bit	US/US			
0028,0103	Pixel Representation	US/US			
3004,0000	GRP LEN	UL/UL			
3004,0002	Dose Units	CS/CS	GY		
3004,0004	Dose Type	CS/CS	PHYSICAL		
3004,0006	Dose Comment	LO/LO			
3004,000A	Dose Summation Type	CS/CS			
3004,000C	Grid Frame Offset Vect	DS/DS			
3004,000E	Dose Grid Scaling	DS/DS			
300C,0000	GRP LEN	UL/UL			

DICOM Tag	Description and DICOM level	VR/VM	Default value	Check Type	Data Structure
300C,0002	Referenced RT Plan Sequ	SQ/SQ			
>> FFFE,E000	GRP LEN	/			
>> 0008,1150	Referenced SOP Class	UI/UI			
>> 0008,1155	Referenced SOP Instance	UI/UI			
7FE0,0000	GRP LEN	UL/UL			
7FE0,0010	Pixel Data	OW/OW			

Validation table

The following table identifies all elements that must be checked and how this check has to be performed.

Group	Element	Description	Check Type	C Type	Note
0x0008	0x0008	Image Type	CHECK_PRESENT	char *	Must be ORIGINAL, PRIMARY
0x0008	0x0020	Study Date	CHECK_NONE	char *	
0x0008	0x0030	Study Time	CHECK_NONE	char *	
0x0008	0x0060	Modality	CHECK_PRESENT,	char *	Must be: MR, US, PT, ST, NM, OT
0x0008	0x0070	Manufacturer	CHECK_NONE	char *	
				char *	
0x0010	0x0010	Patient Name	CHECK_PRESENT	char *	
0x0010	0x0020	Patient ID	CHECK_PRESENT	char *	
0x0010	0x0030	Patient Birth Date	CHECK_NONE	char *	
0x0010	0x0040	Patient Sex	CHECK_NONE	char *	
0x0018	0x0050	Slice Thickness	CHECK_PRESENT_NOT_ZERO	Float	
0x0018	0x1130	Table Height	CHECK_NONE	Float	
0x0018	0x5100	Patient Position	CHECK_PRESENT	Char *	Verify if equal to only: HFS, HFP, FFS or FFP.

Group	Element	Description	Check Type	C Type	Note
0x0020	0x000d	Study Instance UID	CHECK_PRESENT_NOT_EMPTY	Char *	
0x0020	0x000e	Series Instance UID	CHECK_PRESENT_NOT_EMPTY	Char *	
0x0020	0x0010	Study ID	CHECK_NONE	Char *	
0x0020	0x0011	Series Number	CHECK_NONE	Int	
0x0020	0x0012	Acquisition Number	CHECK_NONE	Int	
0x0020	0x0013	Image Number	CHECK_PRESENT_NOT_EMPTY	Int	
0x0020	0x0032	Image Position (Patient)	CHECK_PRESENT	Float[3]	Can be also X,Y,Z
0x0020	0x0037	Image Orientation (Patient)	CHECK_PRESENT	Float[6]	Can be also (X,Y,Z)[2]
0x0020	0x1041	Slice Location	CHECK_NONE	Float	If not existing make it equal to Image Position (Z value)
0x0028	0x0002	Sample per pixel	CHECK_PRESENT_NOT_ZERO	Int	
0x0028	0x0010	Rows	CHECK_PRESENT_NOT_ZERO	Int	Rows = Columns
0x0028	0x0011	Columns	CHECK_PRESENT_NOT_ZERO	Int	Rows = Columns
0x0028	0x0030	Pixel Spacing	CHECK_PRESENT_NOT_ZERO	Float[2]	
0x0028	0x0100	Bits Allocated	CHECK_PRESENT_NOT_ZERO	Int	
0x0028	0x0101	Bits Stored	CHECK_NONE	Int	
0x0028	0x0102	High Bit	CHECK_NONE	Int	
0x0028	0x0103	Pixel Representation	CHECK_NONE	Int	
0x7fe0	0x0010	Pixel Data	CHECK_PRESENT_NOT_EMPTY	Short[]	

Legend:

CHECK_PRESENT_NOT_EMPTY: must exist and must be not empty, otherwise refuse image

CHECK_PRESENT_NOT_ZERO: must exist and must be not equal to zero, otherwise refuse image

CHECK_PRESENT: must exists but can have any value

CHECK_NONE: if not existing, add an empty value

NOTE: The elements in **bold** can have different values on every image. Consequently the data structure should take into account this characteristic.

If the validation of the image fails: the images must be (according to a user-defined value):

- moved on a separated directory
- deleted
- left on the validation directory

Grouping table

The following rules must be followed in order to group images:

Group	Element	Description	Must be
0x0008	0x0008	Image Type	EQUAL
0x0008	0x0020	Study Date	EQUAL
0x0008	0x0030	Study Time	EQUAL
0x0008	0x0060	Modality	EQUAL
0x0010	0x0010	Patient Name	EQUAL
0x0010	0x0020	Patient ID	EQUAL
0x0010	0x0030	Patient Birth Date	EQUAL
0x0010	0x0040	Patient Sex	EQUAL
0x0018	0x1130	Table Height	EQUAL
0x0018	0x5100	Patient Position	EQUAL
0x0020	0x000d	Study Instance UID	EQUAL
0x0020	0x000e	Series Instance UID	EQUAL
0x0020	0x0010	Study ID	EQUAL
0x0020	0x0011	Series Number	EQUAL
0x0020	0x0013	Image Number	DIFFERENT
0x0020	0x0032	Image Position (Patient)	DIFFERENT
0x0020	0x1041	Slice Location	DIFFERENT
0x0028	0x0010	Rows	EQUAL
0x0028	0x0011	Columns	EQUAL
0x0028	0x0030	Pixel Spacing	EQUAL

If the grouping procedure fails, it must create separate directories with all the grouped studies (even if it is only a one image group).

e.g.: if the directory contains 2 set of images, 9 CT images and 10 MR images, and supposing that those 2 sets are both valid, the system will create 2 studies: the 9 CT scans and the MRI volume.

Description of the information per column

The definitions used are in accordance with the DICOM standard. Column 1 specifies the requirement type RT as follows. Refer to [1], part 4 for a detailed description. Only data elements for information object modules that are mandatory for CT images are included. Refer to [1], part 3, table

Requirement type Meaning

1	Required element, and null values are not allowed.	DSERV always requires this element.
2	Required element, but null values are allowed.	DSERV always provides this element, possibly with a null value.
3	Optional element.	DSERV provides this element if this is configured. Even if configured a null value may be provided.

1C, 2C, 3C Conditional versions of 1, 2, 3. It is specified which conditions must be met in order to provide the element.

Column 2 contains the group number and the element number, together referred to as tag.

Column 3 contains the name of the element.

Column 4 specifies the value representation VR as follows. Refer to [1], part 5 for a detailed description.