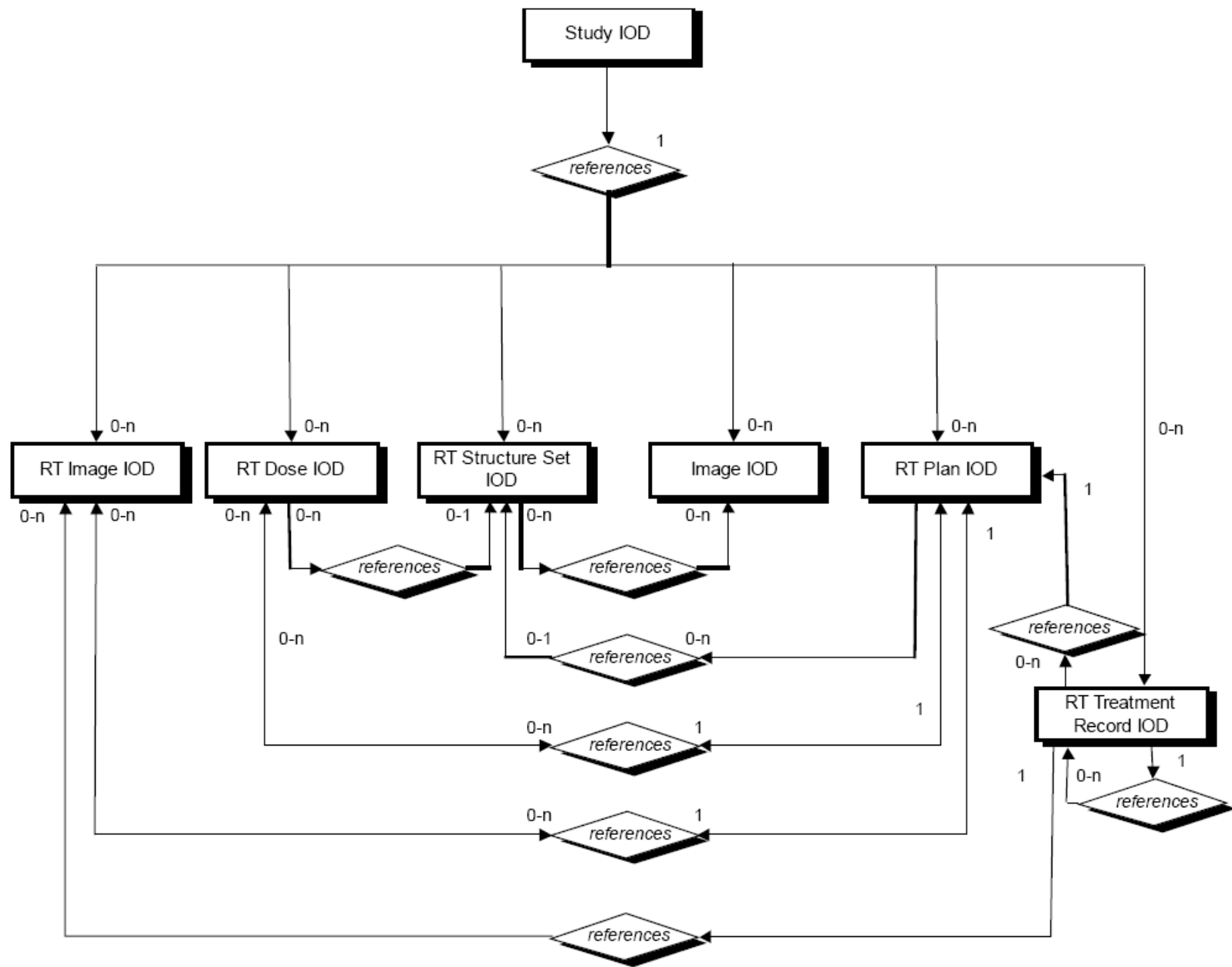


Fifteen minutes to DICOM-RT
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Tuesday, Jan 10, 2012

DICOM-RT Basic facts

- Extensions to DICOM 3.0 (1997)
- Good support by vendors
- Support for new data objects
 - RT Dose
 - RT Structure set
 - RT Plan
 - *RT Image*
 - *RT Treatment record, etc.*



RT Structure Set

(0020,000d) StudyInstanceUID	# Same as image
(0020,000e) SeriesInstanceUID	# Unique
(3006,0010) ReferencedFrameOfReferenceSequence	
(fffe,e000) Item	
(0020,0052) FrameOfReferenceUID	# Image FrameOfReferenceUID
(3006,0012) RTReferencedStudySequence	
(fffe,e000) Item	
(0008,1150) ReferencedSOPClassUID	
(0008,1155) ReferencedSOPInstanceUID	# Image StudyInstanceUID
(3006,0014) RTReferencedSeriesSequence	
(fffe,e000) Item	
(0020,000e) SeriesInstanceUID	# Image SeriesInstanceUID
(3006,0016) ContourImageSequence	
(fffe,e000) Item	
(0008,1150) ReferencedSOPClassUID	
(0008,1155) ReferencedSOPInstanceUID	# UID of 1st image
(fffe,e00d) EndItem	
(fffe,e000) Item	
(0008,1150) ReferencedSOPClassUID	
(0008,1155) ReferencedSOPInstanceUID	# UID of 2nd image
(fffe,e00d) EndItem	

...

RT Structure Set

(3006,0020) StructureSetROISequence

(ffe,e000) Item

(3006,0022) ROINumber

Needed for cross reference

(3006,0024) ReferencedFrameOfReferenceUID # Still the same FOR UID

(3006,0026) ROIName

E.g. "Prostate"

(ffe,e00d) EndItem

... repeat for each structure

RT Structure Set

(3006,0039) ROIContourSequence

(ffe,e000) Item

(3006,002a) ROIDisplayColor

(3006,0040) ContourSequence

(ffe,e000) Item

(3006,0016) ContourImageSequence

(ffe,e000) Item

(0008,1150) ReferencedSOPClassUID

(0008,1155) ReferencedSOPInstanceUID

UID of Slice for this contour

(ffe,e00d) EndItem

(ffe,e0dd) EndSequence

(3006,0042) ContourGeometricType

CLOSED_PLANAR or POINT

(3006,0046) NumberOfContourPoints

(3006,0050) ContourData

(ffe,e00d) EndItem

... repeat for more contours in this structure

(ffe,e0dd) EndSequence

(3006,0084) ReferencedROINumber

ROI number from prev slide

(ffe,e00d) EndItem

... repeat for more structures

RT Structure Set

(3006,0080) RTROIObservationsSequence

(ffe,e000) Item

(3006,0082) ObservationNumber

ROI Number of 1st structure

(3006,0084) ReferencedROINumber

ROI Number of 1st structure

(3006,0085) ROIObservationLabel

Structure name of 1st structure

(ffe,e00d) EndItem

... repeat for other ROIs

RT Structure Set

- ContourData is typically a 3D closed planar polyline, such as:

(3006,0050) ContourData DS

```
[6.09375\22.031517028809\46.25\7.03125\22.031517028809\46.25\7.96  
875\22.031517028809\46.25\8.90625\22.031517028809\46.25\9.84375\  
22.031517028809\46.25\10.781200408936\22.031517028809\46.25\11.  
718799591064\22.031517028809\46.25\12.656200408936\22.03151702  
8809\46.25\13.593799591064\22.031517028809\46.25\14.53120040893  
6\22.031517028809\46.25\15.468799591064\22.031517028809\46.25\1  
6.406200408936\22.031517028809\46.25\17.343799591064\22.968482  
971191\46.25\18.281200408936\22.968482971191\46.25\19.218799591  
064\23.906517028809\46.25\20.156200408936\23.906517028809\46.25  
\21.093799591064\23.906517028809\46.25\22.031200408936\23.90651  
7028809\46.25\22.968799591064\24.843482971191\46.25\23.90620040  
8936\24.843482971191\46.25\24.843799591064\24.843482971191\46.2  
5\25.781200408936\25.781517028809\46.25\...
```


RT Structure Set

C.8.8.6.3 Representing Inner and Outer Contours on an Image

When a single ROI describes an excluded inner volume, this can be encoded with a single contour, using a “keyhole” technique. In this method, an arbitrarily narrow channel is used to connect the outer contour to the inner contour, so that it is drawn as a single contour. An example of such a structure is shown in Figure C.8.8.6-1

Points in space lying along the path defined by the contour are considered to be inside the ROI.

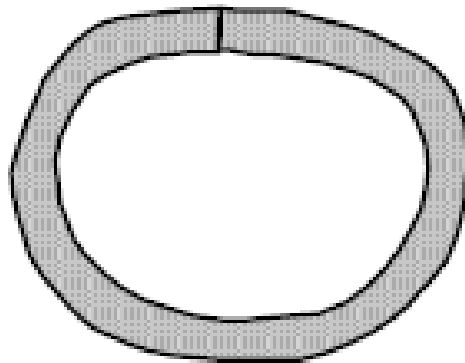


Figure C.8.8.6-1
Example of ROI with excluded inner volume

RT Dose

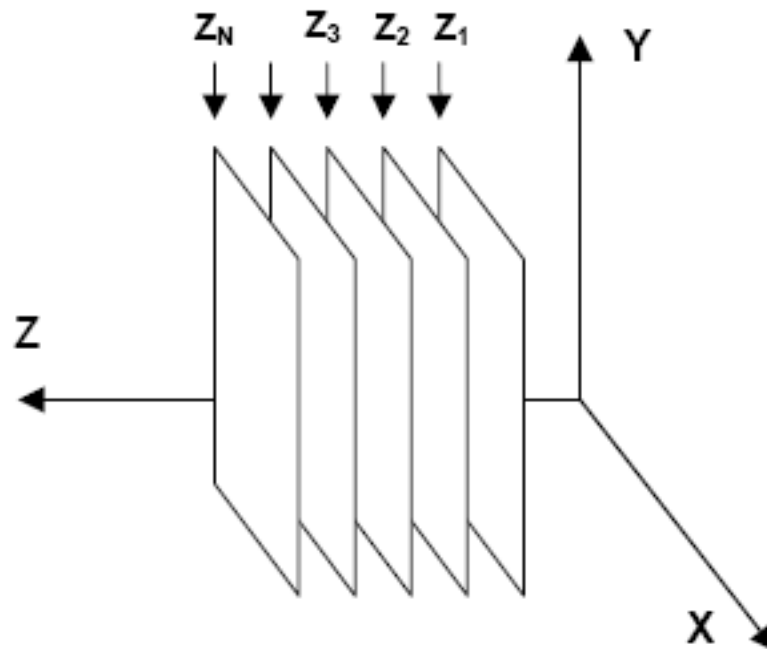
- References RT Plan
- Might have a DVH section
- Usually contains 3D dose data
 - Transmitted as multi-frame pixel data
- Usually physical dose, units Gray

RT Dose

C.8.8.3.2 Grid Frame Offset Vector

Grid Frame Offset Vector (3004,000C) shall be provided if a dose distribution is sent as a multi-frame image. Values of the Grid Frame Offset Vector (3004,000C) shall vary monotonically and are to be interpreted as follows:

- a. If Grid Frame Offset Vector (3004,000C) is present and its first element is zero, this attribute contains an array of n elements indicating the plane location of the data in the right-handed image coordinate system, relative to the position of the first dose plane transmitted, i.e., the point at which the Image Position (Patient) (0020,0032) attribute is defined, with positive offsets in the direction of the cross product of the row and column directions.



RT Dose

(0020,0032) DS [-223.9880065918\ -158.08148193359\ -117.78499603271]
50, 3 ImagePositionPatient

(0020,0037) DS [1\0\0\0\1\0]
12, 6 ImageOrientationPatient

(0028,0008) IS [75]
2, 1 NumberOfFrames

(0028,0010) US 88
2, 1 Rows

(0028,0011) US 114
2, 1 Columns

(0028,0030) DS [4\4]
4, 2 PixelSpacing

(3004,000c) DS [0\4\8\12\16\20\24\28\32\36\40\44\48\52\56\60\64\68\72\76\...]
272,75 GridFrameOffsetVector

RT Plan

- References RT Structure Set
- FractionGroupSequence
 - Number of fractions
 - Dose & monitor units per beam
- Tolerance table
- BeamSequence

RT Plan

(300a,00b0) BeamSequence

(ffe,e000) Item

(300a,00b6) BeamLimitingDeviceSequence

... describe jaw and MLC geometry used for this beam

(ffe,e0dd) EndSequence

(300a,00c0) BeamNumber

(300a,00c2) BeamName

(300a,0110) NumberOfControlPoints

(300a,0111) ControlPointSequence

(ffe,e000) Item

... Sets energy, couch angle, isocenter, jaw positions and MLC positions, etc.

(ffe,e00d) EndItem

(ffe,e000) Item

Must have at least 2 control points

... Changing parameters defined (e.g. jaw positions, MLC positions,
cumulative MU for step-and-shoot)

(ffe,e00d) EndItem

....

(ffe,e0dd) EndSequence