Digital Imaging and Communications in Medicine (DICOM)

Supplement 162: Comprehensive 3D SR Storage SOP Class

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Scope and Field of Application

This Supplement defines an IOD and SOP Class for storage of comprehensive SRs that include 3D spatial coordinates in addition to the 2D spatial coordinates in the existing Comprehensive SRs.

There is an increasing need to encode 3D coordinates (patient-relative rather than image-relative) in general-purpose SR instances, especially when there is not an obvious image to apply the coordinates to (and hence conversion to 2D image-relative coordinates is not possible).

In practice, implementers have been either encoding this incorrectly (by sending three rather than two coordinates in SCOORD Graphic Data) or "correctly" but in a creative but non-interoperable manner (by sending the individual coordinates as NUM content items with private coded concept names +/- a private coded Frame of Reference).

The SCOORD3D content item is intended for this purpose, but there has previously been no general purpose IOD in which to encoded it (only the virtual colonoscopy CAD IOD).

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A.35.X Comprehensive 3D SR Information Object Definition

A.35.X.1 Comprehensive 3D SR Information Object Description

The Comprehensive 3D SR IOD is a superset of the Comprehensive SR IOD, which specifies a class of
5   documents, the content of which may include textual and a variety of coded information, numeric
measurement values, references to the SOP Instances and 2D or 3D spatial or temporal regions of interest
within such SOP Instances. Relationships by-reference are enabled between Content Items.

A.35.X.2 Comprehensive 3D SR IOD Entity-Relationship Model

The E-R Model in Section A.1.2 of this Part applies to the Comprehensive 3D SR IOD. The IEs at the level
10 of the Image IE in Section A.1.2 are not components of the Comprehensive 3D SR IOD. Table A.35.X-1
specifies the Modules of the Comprehensive 3D SR IOD.

A.35.X.3 Comprehensive 3D SR IOD Module Table

Table A.35.X-1
COMPREHENSIVE 3D SR IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	SR Document Series	C.17.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	U
	Synchronization	C.7.4.2	U
Equipment	General Equipment	C.7.5.1	M
Document	SR Document General	C.17.2	M
	SR Document Content	C.17.3	M
	SOP Common	C.12.1	M

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A.35.X.3.1   Comprehensive 3D SR IOD Content Constraints

A.35.X.3.1.1   Value Type

Value Type (0040,A040) in the Content Sequence (0040,A730) of the SR Document Content Module is
constrained to the following Enumerated Values (see Table C.17.3-7 for Value Type definitions):

20   TEXT
             CODE
             NUM
             DATETIME
             DATE
25   TIME
             UIDREF
             PNAME
             SCOORD
             SCOORD3D
30   TCOORD
             COMPOSITE
             IMAGE

WAVEFORM
CONTAINER

A.35.X.3.1.2   Relationship Constraints

Relationships between content items in the content of this IOD may be conveyed either by-value or by-reference. Table A.35.X-2 specifies the relationship constraints of this IOD. See Table C.17.3-8 for Relationship Type definitions.

Table A.35.X-2
RELATIONSHIP CONTENT CONSTRAINTS FOR COMPREHENSIVE 3D SR IOD

Source Value Type	Relationship Type (Enumerated Values)	Target Value Type
CONTAINER	CONTAINS	TEXT, CODE, NUM, DATETIME, DATE, TIME, UIDREF, PNAME, SCOORD, SCOORD3D, TCOORD, COMPOSITE[1], IMAGE[1], WAVEFORM[1], CONTAINER (See below).
TEXT, CODE, NUM, CONTAINER	HAS OBS CONTEXT	TEXT, CODE, NUM, DATETIME, DATE, TIME, UIDREF, PNAME, COMPOSITE[1]
CONTAINER, IMAGE[1], WAVEFORM[1], COMPOSITE[1], NUM	HAS ACQ CONTEXT	TEXT, CODE, NUM, DATETIME, DATE, TIME, UIDREF, PNAME, CONTAINER.
any type	HAS CONCEPT MOD	TEXT, CODE[2]
TEXT, CODE, NUM	HAS PROPERTIES	TEXT, CODE, NUM, DATETIME, DATE, TIME, UIDREF, PNAME, IMAGE[1], WAVEFORM[1], COMPOSITE[1], SCOORD, SCOORD3D, TCOORD, CONTAINER.
PNAME	HAS PROPERTIES	TEXT, CODE, DATETIME, DATE, TIME, UIDREF, PNAME
TEXT, CODE, NUM	INFERRED FROM	TEXT, CODE, NUM, DATETIME, DATE, TIME, UIDREF, PNAME, IMAGE[1], WAVEFORM[1], COMPOSITE[1], SCOORD, SCOORD3D, TCOORD, CONTAINER.
SCOORD	SELECTED FROM	IMAGE[1]
TCOORD	SELECTED FROM	SCOORD, SCOORD3D, IMAGE[1], WAVEFORM[1]

Note: 1. Which SOP Classes the IMAGE, WAVEFORM or COMPOSITE Value Type may refer to, is documented in the Conformance Statement for an application (see PS 3.2 and PS 3.4).

2. The HAS CONCEPT MOD relationship is used to modify the meaning of the Concept Name of a Source Content Item, for example to provide a more descriptive explanation, a different language translation, or to define a post-coordinated concept.

3. SCOORD3D has no children, since its coordinates are patient rather than image-relative.

The HAS CONCEPT MOD and CONTAINS relationships shall not be conveyed by-reference.

Relationships by-reference to ancestor Content Items are forbidden in this IOD to prevent loops.

For reference (unchanged), the description of the 3D Spatial Coordinates Macro used for SCOORD3D:

C.18.9 3D Spatial Coordinates Macro

Table C.18.9-1 specifies the Attributes that convey 3D Spatial Coordinates in an SCOORD3D Content Item.

Table C.18.9-1
3D SPATIAL COORDINATES MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Referenced Frame of Reference UID	(3006,0024)	1	Uniquely identifies the Frame of Reference within which the coordinates are defined.
Graphic Data	(0070,0022)	1	An ordered set of (x,y,z) triplets (in mm and may be negative) that define a region of interest in the patient-relative Reference Coordinate System defined by Referenced Frame of Reference UID (3006,0024). See Section 3.17.1. See C.18.9.1.1 for further explanation.
Graphic Type	(0070,0023)	1	See C.18.9.1.2 for Enumerated Values.
Fiducial UID	(0070,031A)	3	The globally unique identifier for this fiducial item. Note: The fiducial UID can be used to associate this set of graphics with other Content Items.

C.18.9.1 3D Spatial Coordinates Macro Attribute Descriptions

C.18.9.1.1 Graphic Data

Graphic Data may be used to associate an anatomic or spatial Concept with a defined set of patient relative 3D locations in a defined frame of reference, independent of any image. Graphic Data may be defined explicitly as a single point (i.e. to denote the epicenter of an anatomic site or lesion) or more than one point (i.e. representing a set of points or an open or closed polygon).

C.18.9.1.2 Graphic Type

This attribute defines the type of geometry of the region of interest. The following Enumerated Values are specified for 3D spatial coordinate geometries:

POINT = a single location denoted by a single (x,y,z) triplet.

MULTIPOINT = multiple locations each denoted by an (x,y,z) triplet; the points need not be coplanar.

POLYLINE = a series of connected line segments with ordered vertices denoted by (x,y,z) triplets; the points need not be coplanar.

POLYGON = a series of connected line segments with ordered vertices denoted by (x,y,z) triplets, where the first and last vertices shall be the same forming a polygon; the points shall be coplanar.

ELLIPSE = an ellipse defined by four (x,y,z) triplets, the first two triplets specifying the endpoints of the major axis and the second two triplets specifying the endpoints of the minor axis.

ELLIPSOID = A three-dimensional geometric surface whose plane sections are either ellipses or circles and contains three intersecting orthogonal axes, "a", "b", and "c". The ellipsoid is defined by six (x,y,z) triplets, the first and second triplets specifying the endpoints of axis "a", the third and fourth triplets specifying the endpoints of axis "b", and the fifth and sixth triplets specifying the endpoints of axis "c".

Notes: 1. A circle is a special case of ELLIPSE where the major and minor axis points are equidistant from the center.

2. Coplanar is in the mathematical sense and is not necessarily related to a specific image instance.

Add new SOP Class to PS 3.4 Annex B.3.1.4 Related General SOP Classes:

B.3.1.4 Related General SOP Classes (A-ASSOCIATE-RQ)

A limited set of Standard SOP Classes in the Storage Service Class are defined to have one or more Related General SOP Classes. The Related General SOP Classes may be conveyed using the SOP Class Relationship Extended Negotiation during association establishment as defined in PS 3.7. Table B.3-3 identifies which Standard SOP Classes participate in this mechanism. If a Standard SOP Class is not listed in this table, Related General SOP Classes shall not be included in a Related Storage SOP Class Extended Negotiation Sub-Item.

Note: Implementation-defined Specialized SOP Classes (see PS3.2) of the Storage Service Class may convey a Related General SOP Class.

Table B.3-3
STANDARD AND RELATED GENERAL SOP CLASSES

SOP Class Name	Related General SOP Class Name
…	…
Basic Text SR	Enhanced SR
	Comprehensive SR
	Comprehensive 3D SR
Enhanced SR	Comprehensive SR
	Comprehensive 3D SR
Comprehensive SR	**Comprehensive 3D SR**
Procedure Log	Enhanced SR
	Comprehensive SR
	Comprehensive 3D SR
X-Ray Radiation Dose SR	Enhanced SR
	Comprehensive SR
	Comprehensive 3D SR

Add new SOP Class to PS 3.4 Annex B and I tables:

B.5 STANDARD SOP CLASSES

The SOP Classes in the Storage Service Class identify the Composite IODs to be stored. Table B.5-1 identifies Standard SOP Classes.

Table B.5-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
…	…	…
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Basic Text SR
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Enhanced SR
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR
Procedure Log	1.2.840.10008.5.1.4.1.1.88.40	Procedure Log
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	Mammography CAD SR IOD

Key Object Selection	1.2.840.10008.5.1.4.1.1.88.59	Key Object Selection Document
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	Chest CAD SR IOD
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR
Comprehensive 3D SR	**1.2.840.10008.5.1.4.1.1.88.34**	**Comprehensive 3D SR**
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Encapsulated PDF IOD
…	…	…

…

B.5.1.5   Structured Reporting Storage SOP Classes

The requirements of Annex O apply to the following SOP Classes:

5
- Basic Text SR

- Enhanced SR, and SOP Classes for which it is the Related General SOP Class

- **Comprehensive 3D,** Comprehensive SR, and SOP Classes for which ~~it is~~ **they are** the Related General SOP Class**es**

- Mammography CAD SR

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- Chest CAD SR

- Procedure Log

- X-Ray Radiation Dose SR

- Spectacle Prescription Report

- Colon CAD SR

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- Macular Grid Thickness and Volume Report

- Implantation Plan SR Document

Annex O requirements do not apply to the Key Object Selection Document SOP Class.

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20 **I.4   MEDIA STORAGE STANDARD SOP CLASSES**

The SOP Classes in the Media Storage Service Class identify the Composite and Normalized IODs to be stored. The following Standard SOP Classes are identified in Table I.4-1

Table I.4-1
Media Storage Standard SOP Classes

SOP Class Name	SOP Class UID	IOD Specification
…	…	…
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Basic Text SR

Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Enhanced SR
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR
Procedure Log	1.2.840.10008.5.1.4.1.1.88.40	Procedure Log
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	Mammography CAD SR IOD
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Key Object Selection Document
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	Chest CAD SR IOD
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR
<u>Comprehensive 3D SR</u>	**<u>1.2.840.10008.5.1.4.1.1.88.34</u>**	**<u>Comprehensive 3D SR</u>**
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Encapsulated PDF IOD
…	…	…

…

I.4.1.2 Structured Reporting Storage SOP Classes

The requirements of Annex O apply to the following SOP Classes:

- Basic Text SR

- Enhanced SR

- Comprehensive SR

- **<u>Comprehensive 3D SR</u>**

- Mammography CAD SR

- Chest CAD SR

- Procedure Log

- X-Ray Radiation Dose SR

- Spectacle Prescription Report

- Colon CAD SR

- Macular Grid Thickness and Volume Report

- Implantation Plan SR Document

Annex O requirements do not apply to the Key Object Selection Document SOP Class.

Add new SOP Class to PS 3.6 Table A-1:

…	…	…	...
1.2.840.10008.5.1.4.1.1.88.1	*Text SR Storage – Trial (Retired)*	*SOP Class*	*PS 3.4*
1.2.840.10008.5.1.4.1.1.88.2	*Audio SR Storage – Trial (Retired)*	*SOP Class*	*PS 3.4*
1.2.840.10008.5.1.4.1.1.88.3	*Detail SR Storage – Trial (Retired)*	*SOP Class*	*PS 3.4*
1.2.840.10008.5.1.4.1.1.88.4	*Comprehensive SR Storage – Trial (Retired)*	*SOP Class*	*PS 3.4*
1.2.840.10008.5.1.4.1.1.88.11	Basic Text SR Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.22	Enhanced SR Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.40	Procedure Log Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.50	Mammography CAD SR Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.59	Key Object Selection Document Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.65	Chest CAD SR Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.88.34	**Comprehensive 3D SR Storage**	**SOP Class**	**PS 3.4**
1.2.840.10008.5.1.4.1.1.104.1	Encapsulated PDF Storage	SOP Class	PS 3.4
…	…	…	…

Add new SOP Class to PS 3.2 Table A.1-2:

Table A.1-2

UID VALUES

UID Value	UID NAME	Category
…	…	…
1.2.840.10008.5.1.4.1.1.88.11	Basic Text SR	Transfer
1.2.840.10008.5.1.4.1.1.88.22	Enhanced SR	Transfer
1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR	Transfer
1.2.840.10008.5.1.4.1.1.88.40	Procedure Log Storage	Transfer
1.2.840.10008.5.1.4.1.1.88.50	Mammography CAD SR	Transfer
1.2.840.10008.5.1.4.1.1.88.59	Key Object Selection Document	Transfer
1.2.840.10008.5.1.4.1.1.88.65	Chest CAD SR	Transfer
1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR	Transfer
1.2.840.10008.5.1.4.1.1.88.34	**Comprehensive 3D SR**	**Transfer**
1.2.840.10008.5.1.4.1.1.104.1	Encapsulated PDF Storage SOP Class	Transfer

…	…	…