ACR-ACC-NEMA

Digital Imaging and Communications in Medicine (DICOM)

Supplement 6
X-Ray Radiofluoroscopic Image Object

Status: **Final Text - July 3, 1995**

Table of Contents

Foreword

ACR (the American College of Radiology) and NEMA (the National Electrical Manufacturers Association) formed a joint committee to develop a Standard for Digital Imaging and Communications in Medicine. This DICOM Standard was developed according to the NEMA Procedures. The ACC (American College of Cardiology) has decided to join this standardization effort with a particular interest in the definition of Digital Media Storage Standards.

This Supplement to the Standard is developed in liaison with other Standard Organizations including CEN TC251 in Europe and JIRA in Japan, with review also by other organizations member of the ANSI HISPP in the USA which includes IEEE, HL7 and X12.

The DICOM standard is structured as a multi-part document using the guidelines established in the following document:

- ISO/IEC Directives, 1989 Part 3 - Drafting and Presentation of International Standards.

This document is a Supplement to the DICOM Standard. It is an extension to Part 3, 4 and 6 of the published DICOM Standard which consists of the following parts:

Part 1	—	Introduction and Overview
Part 2	—	Conformance
Part 3	—	Information Object Definitions
Part 4	—	Service Class Specifications
Part 5	—	Data Structures and Encoding
Part 6	—	Data Dictionary
Part 7	—	Message Exchange
Part 8	—	Network Communication Support for Message Exchange
Part 9	—	Point-to-Point Communication Support for Message Exchange
Part 10	—	Media Storage and File Format
Part 13	—	Print Management Point-to-Point Communication Support

These Parts are independent but related documents.

This Supplement for a X-Ray RF Image Information Object Definition (IOD) is largely based on the X-Ray Angiographic Information Object Definition (XA IOD) which is being developed in parallel under a joint effort of ACC, ACR and NEMA.

The focus for this X-Ray RF Image IOD (XRF IOD) is to address the requirements for image transfer found in general Radiofluoroscopic applications performed on a table with a column (generally with a tilting ability). For applications performed on X-Ray RF acquisition systems equipped with an X-Ray source and an image Receptor positioned by what is general called a c-arm (e.g. Interventional Procedures, Myelography, Biopsy, and Neurology) the XA Image IOD is applicable.

Scope and Field of Application

This Supplement to the DICOM Standard specifies a DICOM image Information Object for X-Ray Radiofluoroscopy. It specifies the semantic content of X-Ray RF Images. It is commonly abbreviated the XRF IOD. It also includes the corresponding Storage SOP Class so that this IOD be used in Network and Media Storage exchanges.

The scope of the XRF IOD is general radiofluoroscopy where the image Receptor plane remains parallel to the table whether it is horizontal or tilted. An equipment based coordinate is used. The X-Ray source may be positioned by a column with an angulation ability. For RF clinical areas using a c-arm to position the X-Ray source and image receptor (e.g. Interventional Procedures and Myelography and Biopsy/Localization), the X-Ray Angiographic Image Object should be used.

Since this document proposes changes to existing Parts of DICOM the reader should have a working understanding of the Standard as well as of the Supplement 4 for X-Ray Angiographic Images. All Modules common to RF and XA are specified in the XA Supplement.

This proposed Supplement includes a number of Addenda to existing Parts of DICOM:

1. Part 3 Addenda (Extension to the body, Annex A, C and D)
2. Part 4 Addenda (Extension to Annex B)
3. Part 6 Addenda (Extension to Section 6 and Annex A)

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Digital Imaging and Communications in Medicine (DICOM)

Part 3 Addendum
X-Ray RF Image
Information Object Definition

Item # 1
Add the following to the list of Section 4 Symbol and Abbreviations:

2 XRF: X-Ray Radiofluoroscopy

4

6

Item #2
Add in Table A.1-1 - all modifications to existing table is in BOLD font

8

Table A.1-1 - Composite Information Object Modules Overview

IODs Modules	CR	CT	MR	NM	US	US-mf	Sec. Capt	St. Over-lay	St. Curve	Study Descr.	St. Mod LUT	St. VOI LUT	RF
Patient	M	M	M	M	M	M	M	M	M		M	M	**M**
Patient Summary										M			
General Study	M	M	M	M	M	M	M	M	M		M	M	**M**
Patient study	U	U	U	U	U	U	U	U	U		U	U	**U**
Study Content										M			
General Series	M	M	M	M	M	M	M	M	M		M	M	**M**
CR Series	M												
NM Series				M									
Frame Of Reference		M	M	U	U	U							
US Frame of Ref.					C	C							
General Equipment	M	M	M	M	M	M	U	M	M		M	M	**M**
NM Equipment				U									
SC Equipment							M						
General Image	M	M	M	M*	M*	M	M						**M**
Image Plane		M	M	U*									
Image Pixel	M	M	M	M*	M*	M	M						**M**
Contrast/Bolus	C	C	C		C*	C							**C**
Cine				C		C							**C**
Multi-frame				C		M							**C**
Frame Pointers													**U**
Mask													**C**
Display Shutter													**U**
Device													**U**
Therapy													**U**
CR Image	M												
CT Image		M											
MR Image			M										
NM Image				M*									

NM SPECT				C									
NM Multi-Gated				C									
US Region Calibration					U*	U							
US Image					M*	M							
SC Image							M						
X-Ray Image													**M**
X-Ray Acquisition													**M**
X-Ray Collimator													**U**
X-Ray Table													**U**
XRF Positioner													**U**
XRF Tomo Acquisition													**C**
Overlay Identification				M*				M					
Overlay Plane	U	U	U	M*	U*		U	M					**U**
Multi-frame Overlay				U									**C**
Curve Identification				M*	M*	M*			M				
Curve				M*	M*	M*			M				**U**
Audio					U	U							
Modality LUT	U						U				M		**C***
VOI LUT	U	U	U	U*	U*	U	U					M	**U**
LUT Identification											M	M	
SOP Common	M	M	M	M*	M*	M*	M	M	M	M	M	M	**M**

* The notation next to M and U indicates a special condition for these modules. Refer to the corresponding Information Object Definitions in this Annex for details.

Item #3
After Section A.14 add the following:

A.X Proposed X-Ray RF Image Information Object Definition

A.X.1 XRF Image IOD Description

The focus for this X-Ray RF Image IOD (XRF IOD) is to address the requirements for image transfer found in general Radiofluoroscopic applications performed on a table with a column. For applications performed on X-Ray RF acquisition systems which support a patient based coordinate system with cranial/caudal, LAO/RAO angles, etc. the XA Image IOD may be used.

Note: An example of a case where the XA IOD may be preferred to the RF IOD are RF acquisition system equipped with an X-Ray source and an image Receptor positioned by what is generally called a c-arm (e.g. Interventional Procedures, Myelography, Biopsy, and Neurology).

This section defines the Information Object for X-Ray Radiofluoroscopic Imaging which includes those data elements and information objects necessary for the interchange of digital X-Ray RF Image data. The XRF IOD is applicable to X-Ray acquisition systems equipped with an image receptor whose plane is parallel to the table plane where the patient is. This Table has in general the ability to be tilted. Furthermore the X-Ray source may be supported by a column which can be angulated to adjust the incidence of the X-Ray beam on the image receptor plan. An equipment based coordinated system is used to track these angles.

Notes: 1) For the purpose of X-Ray Radiofluoroscopy, this IOD can be used to encode a single frame image, or a cine run encoded in a single multi-frame image.

2) A typical study might include all the images generated between the time a patient gets on and gets off the procedure table. As several separable diagnostic or therapeutic processes may occur during a single study, a series may be defined as comprising a set of images (single or Multi-Frame) associated with one such process within a study.

A.X.2 XRF Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 of this part depicts those components of the DICOM Application Information Model which directly reference the X-Ray RF Image IOD, with exception of the Frame of Reference entity which is not used. Additionally, "Image" in figure A.1.2 may represent a Single Frame or a Multi-Frame image. A frame denotes a two-dimensional organization of pixels recorded as a single exposure.

Note: When a Study (or Study Component) contains a number of Multi-frame images which do not need to be grouped under different Series, a single Series may be used with a series number containing an arbitrary value (e.g. 1).

A.X.3 XRF Image IOD Module Table

2 **Table A.X.3-1 - XRF Image IOD Modules**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Contrast/bolus	C.7.6.4	C-Required if contrast media was used in this Image
	Cine	C.7.6.5	C-Required if pixel data is Multi-Frame Cine Data
	Multi-Frame	C.7.6.6	C-Required if pixel data is Multi-Frame Cine Data
	Frame Pointers	C.7.6.9	U
	Mask	C.7.6.10	C-Required if the Image may be subtracted
	X-Ray Image	C.8.7.1	M
	X-Ray Acquisition	C.8.7.2	M
	X-Ray Collimator	C.8.7.3	U
	Display Shutter	C.7.6.11	U
	Therapy	C.7.6.12	U
	Device	C.7.6.13	U
	X-Ray Table	C.8.7.4	U
	XRF Positioner	C.8.7.6	U
	XRF Tomo Acquisition	C.8.7.7	C-Required if Scan Option (0018,0022) is TOMO
	Overlay Plane	C.9.2	U
	Multi-frame Overlay	C.9.3	C-Required if Overlay Data contains multiple frames
	Curve	C.10.2	U
	Modality LUT	C.11.1	C-Required if Pixel Intensity Relationship (0028,1040) is LOG U-Optional if Pixel Intensity Relationship

			(0028,1040) is DISP
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M

Item #4
Add new Section C.8.7.6

C.8.7.6 XRF Positioner Module

Table C.8.7.8-1 - XRF Positioner Module

Attribute Name	Tag	Type	
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center.
Distance Source to Patient	(0018,1111)	3	Distance in mm from source to isocenter (center of field of view).
Estimated Radiographic Magnification Factor	(0018,1114)	3	Ratio of SID (Source Image Distance) over SOD (Source Object Distance).
Column Angulation	(0018,1450)	3	Angle of the X-Ray beam in degree relative to an orthogonal axis to the detector plane. Positive values indicate that the tilt is towards the head of the table. Note: The detector plane is assumed to be parallel to the table plane.

Item #5
Add new Section C.8.7.7

C.8.7.7 XRF Tomography Acquisition Module

This Module describes the attributes of a Tomography RF acquisition (translation of X-Ray source during the acquisition of a single frame image).

Table 8.7.9-1 RF Tomography Acquisition Module

Attribute	Tag	Type	
Tomo Layer Height	(0018,1460)	1	Distance in mm between the table surface and the sharp image plane.
Tomo Angle	(0018,1470)	3	Angle span in degrees of rotation of X-Ray Source during X-Ray acquisition.
Tomo Time	(0018,1480)	3	Time in seconds the source has taken to rotate the Tomo Angle

			during X-Ray acquisition.

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Digital Imaging and Communications in Medicine (DICOM)

Part 4 Addendum
X-Ray RF Image Storage SOP Class

Item #1
Add the following to Section B.5 of Part 4:

B.5 Standard SOP Classes

SOP Class Name	SOP Class UID
X-Ray Radiofluoroscopic Image Storage	**1.2.840.10008.5.1.4.1.1.12.2**

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Part 6 Addendum
X-Ray RF Data Dictionary

Item #1
Add the following Data Elements to Part 6 Section 6:

Tag	Name	VR	VM
(0018,1450)	Column Angulation	CS	1
(0018,1460)	Tomo Layer Height	DS	1
(0018,1470)	Tomo Angle	DS	1
(0018,1480)	Tomo Time	DS	1

Item #2
Add the following UID to Part 6 Annex A:

UID Value	UID NAME	UID TYPE	Part
1.2.840.10008.5.1.4.1.1.12.2	X-Ray Radiofluoroscopic Image Storage	SOP Class	Part 4