DICOM℠
Digital Imaging and Communications in Medicine

Supplement 212:
XA Protocol Storage

Supplement is developed by DICOM Working Group 02 (WG-02 Projection Radiography and Angiography)

Jan 13, 2021

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--- *Author Contacts* ---

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Summary

1. Motivation

Existing Standard

- Supp 121: Defines a method for storage and retrieval of CT acquisition protocols.

Limitations on the Standard

- Supp 121 includes CT modality only.
- XA Image & RDSR IODs include few protocol-related attributes.

Goals of Sup 212 XA Protocol Storage

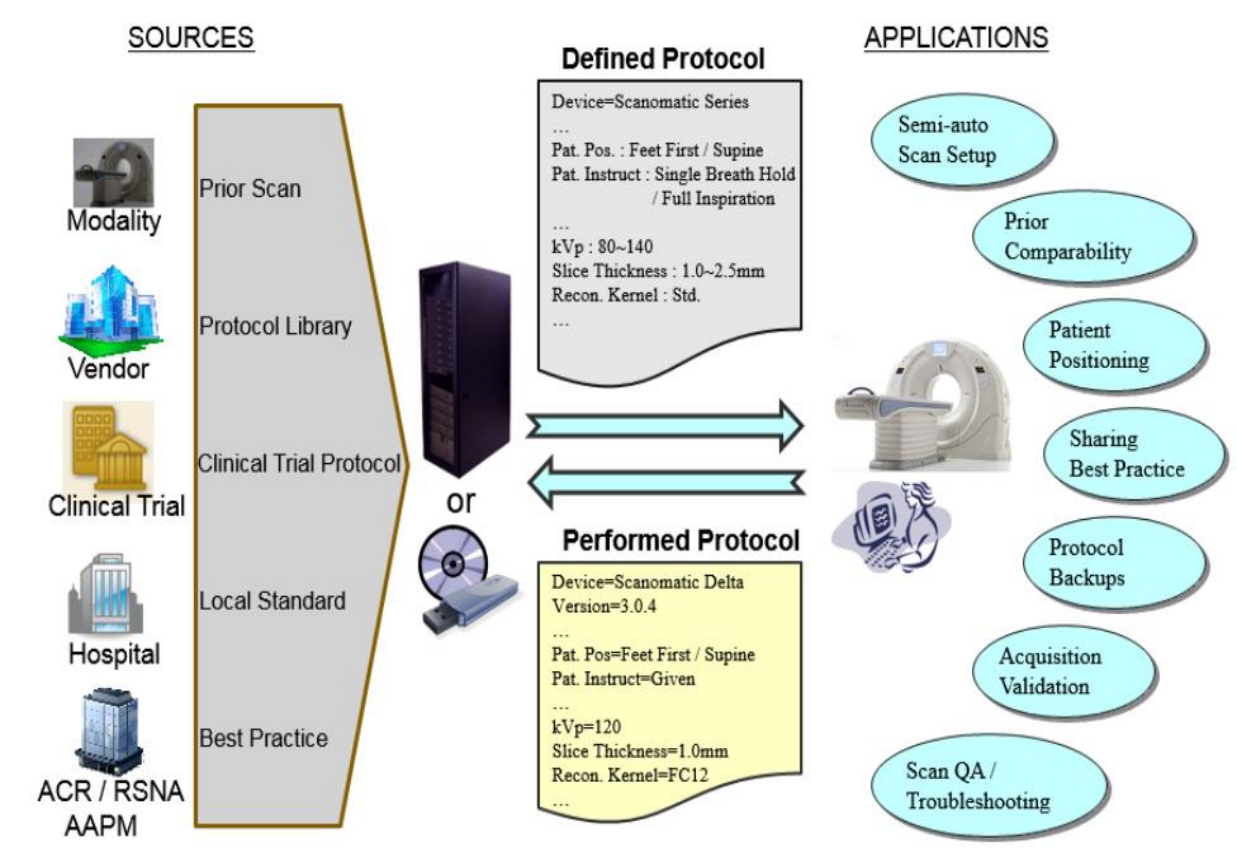
- To define a method for storage and retrieval of XA protocols
- Similar use cases as for CT (see next slide)
- Facilitate compliance to NEMA XR-27: Export defined protocols from devices to a central repository to facilitate management of consistency and dose.
  - *Refer to NEMA XR-27 "X-ray Equipment for Interventional Procedures User Quality Control Mode"*

New DICOM Work Item Proposal approved: **[2018-09-A] XA_ModalityProtocolStorage**

2. Use Cases

Use Cases (from Supp 121 – applicable to XA)

Quality of Care → Good, consistent image quality depends on good protocols, used consistently
Dose Management → Managing dose depends on managing protocols
Analytics → Summarizing data depends on consistent tagging



AAAA.1 PROTOCOL STORAGE CONCEPTS

AAAA.1.1 Use Cases

The primary applications (use cases) considered during the development of the CT Procedure Protocol Storage IODs were the following:

- Managing protocols within a site for consistency and dose management
  (Using Defined Protocols)
- Recording protocol details for a performed study so the same or similar values can be used when performing followup or repeat studies, especially for oncology which does comparative measurements
  (Using Performed Protocols)
- Vendor troubleshooting image quality issues that may be due to poor protocol/technique
  (Using Performed Protocols, Defined Protocols)
- Distributing departmental, "best practice" or reference protocols (such as AAPM) to modality systems
  (Using Defined Protocols)
- Backing up protocols from a modality to PACS or removable media (e.g., during system upgrades or replacement). Most vendors have a proprietary method for doing this which would essentially become redundant when Protocol Management is implemented.
  (Using Defined Protocols)

3. XA Acquisition Workflow: Series vs. Images

An ***XA examination*** performs minimally invasive image-guided diagnosis and/or treatment to a patient.

- ✓ *It typically corresponds to a Requested Procedure selected in the Worklist → One Study UID*
- ✓ *It may be performed in several steps, typically corresponding to several Scheduled Procedure Steps → Several Series UID*

XA examinations are not fully planned in advance, they are interactive because the physician's actions will depend on real-time information from the live images, and on how the patient reacts to the treatment. During the examination:

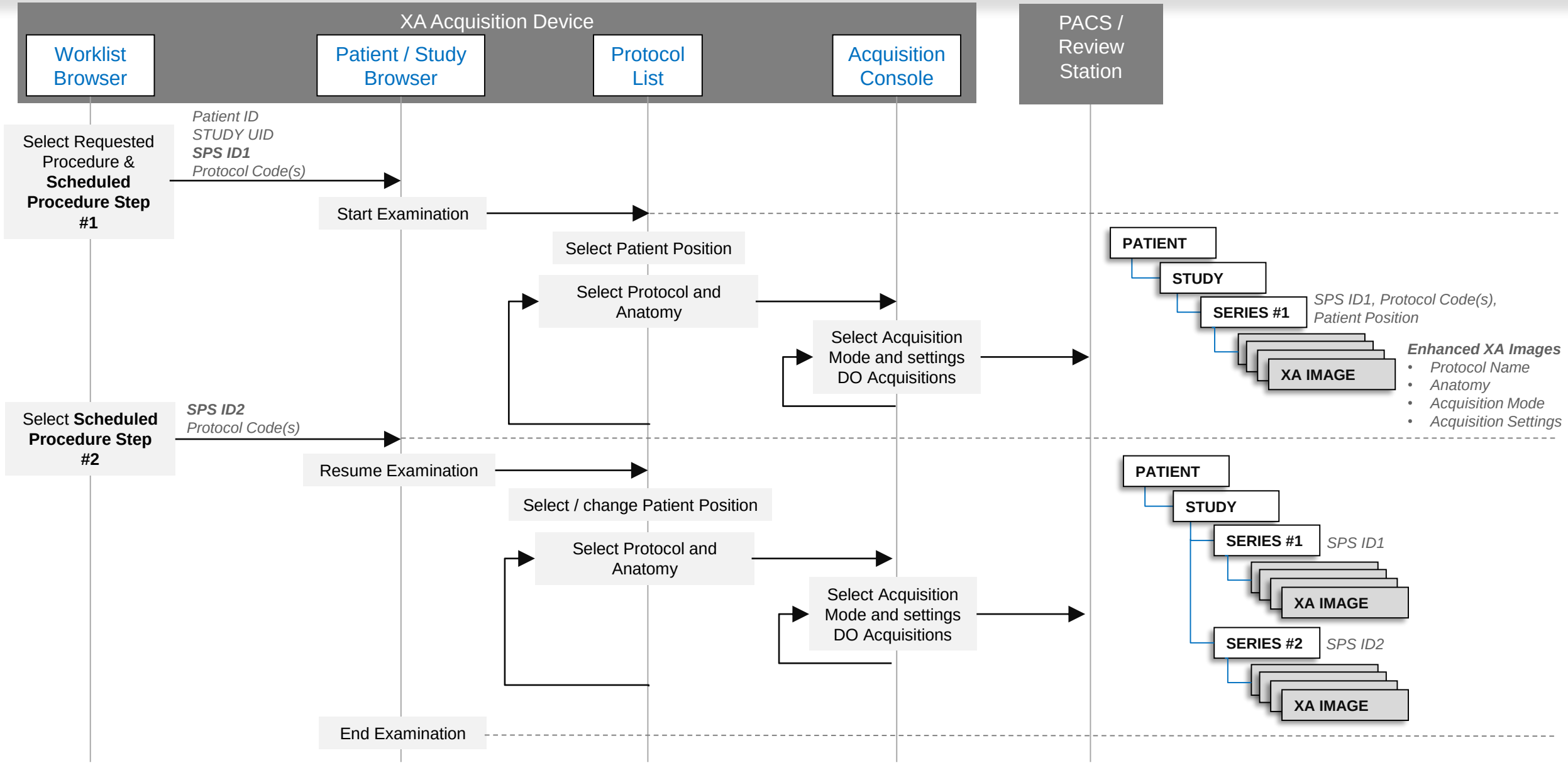
- ✓ *The physician may need to change sequentially the protocols and the anatomy being imaged (e.g. heart and carotids).*
- ✓ *The patient position on the table may change depending on the patient's size and type of procedure.*
- ✓ *Different Series will be created as key Series attributes are changing during the examination (SPS, Patient Position).*

On the other hand, for a given procedure step, many XA multi-frame images of different protocols and anatomies are acquired with the same patient position, and they are sent to Review Stations as they are acquired:

- ✓ *Legacy review stations (e.g. Cardiology) expect that these images are grouped into the same Series for easy review and post-processing (e.g. image browsing). Typically, a new Series is created for a new Procedure Step (i.e. examination is resumed).*
- ✓ *DICOM requires all images in a Series to share the same Frame of Reference (geometrical context). So all images in the Series are inherently registered and can share the spatial calibration assumptions. A new Series is always created when the patient position changes.*

Traditional XA IOD did not include protocol and anatomy attributes at image level, while Enhanced XA IOD and Radiation Dose SR included these attributes at Image level and Irradiation Event level.

3. Example of XA Acquisition Workflow



3. XA Technical Highlights

Main differences between XA and CT

1- XA studies are less planned than CT

- ❑ XA protocol is typically selected manually from the device console.
- ❑ Rules may exist on the device to pre-select a default protocol based on procedure type (e.g. neuro vs. cardiac) and patient characteristics (e.g. adult vs. pediatrics).

2- XA studies may use several protocols during the same series of images, CT uses one protocol per series

- ❑ Each XA DICOM Image will include references to the Defined Protocol and Elements used.

3- XA protocol usage during the procedure is more interactive than CT

- ❑ XA is changing continuously the acquisition modes (Fluoroscopy, DSA, Rotational Angio…) and the parameters (Field of View, frame rate, IQ/Dose levels). Several Performed Protocol Elements may be recorded for the same used Defined Protocol Element.

4- XA stores DICOM 2D images and 3D volumes

- ❑ XA reconstruction protocol parameters shall include 2D and 3D processing, for the creation of both 2D and/or 3D Instances.

3. Technical Highlights

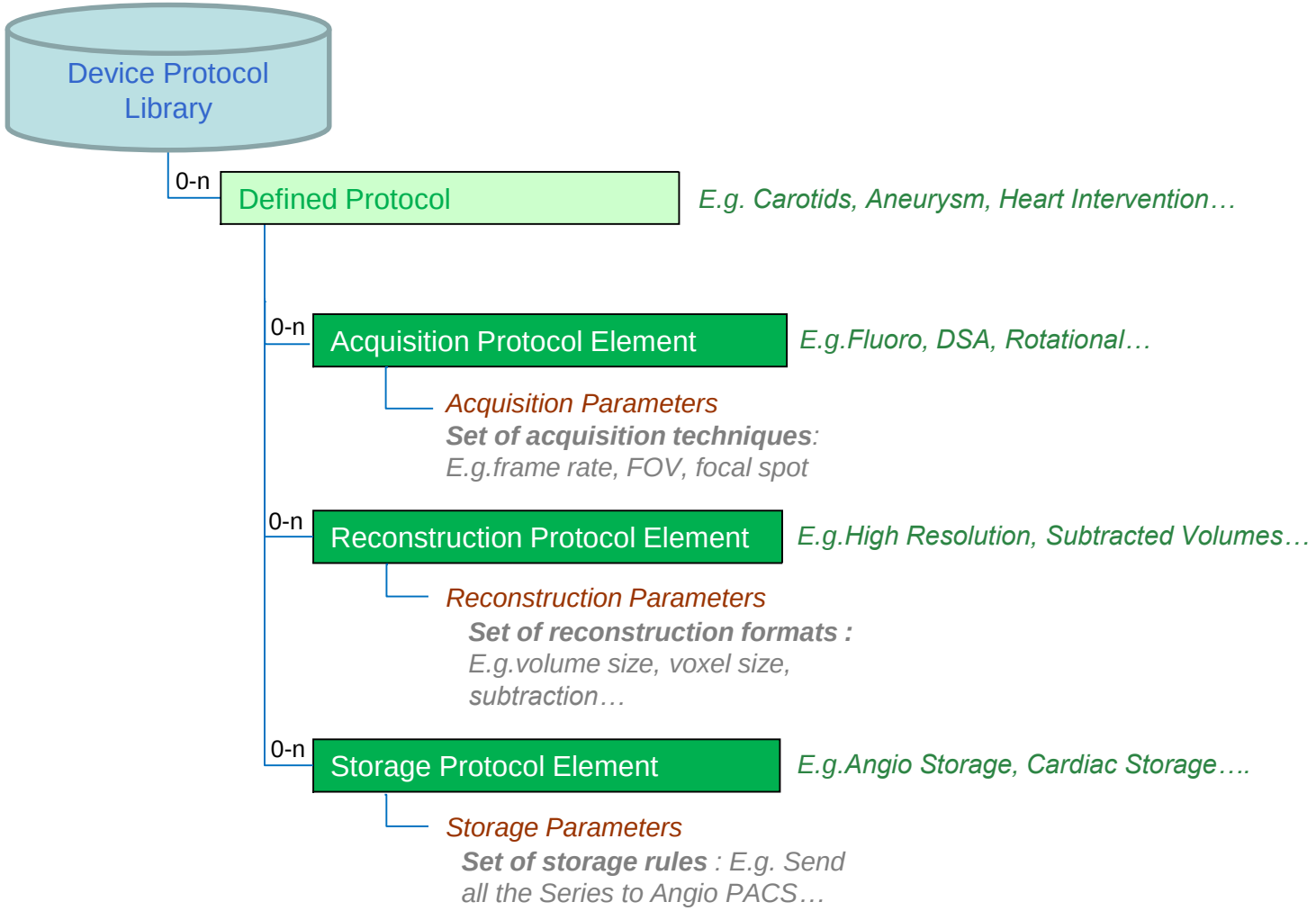
New IODs in Supplement 212

- The work will introduce two new IODs
  - *XA **Defined** Procedure Protocol IOD*
  - *XA **Performed** Procedure Protocol IOD*
- These IODs will use the constructs of the existing CT protocol management IODs introduced by Supp 121.

XA Protocols Content

- XA **Acquisition Protocols** will contain the **acquisition modes** and their related **acquisition parameters**. Acquisition modes are encoded as Acquisition Protocol Elements. Acquisition parameters are those used to create the XA 2D ORIGINAL Instances.
- XA **Reconstruction Protocols** will contain the processing parameters to create **2D XA DERIVED** and **3D XA** Instances.
- **Acquisition and Reconstruction Parameters** may be both standard and private. New parameters have been defined specifically for XA.
- Several XA **Defined Protocols** may be used within one single DICOM Series.
- XA **Performed Protocol** will record the actual parameters applied during the various acquisition modes. Several Performed Protocol Elements may be recorded for the same used Defined Protocol Element.

Example of XA Defined Procedure Protocol database in the acquisition equipment



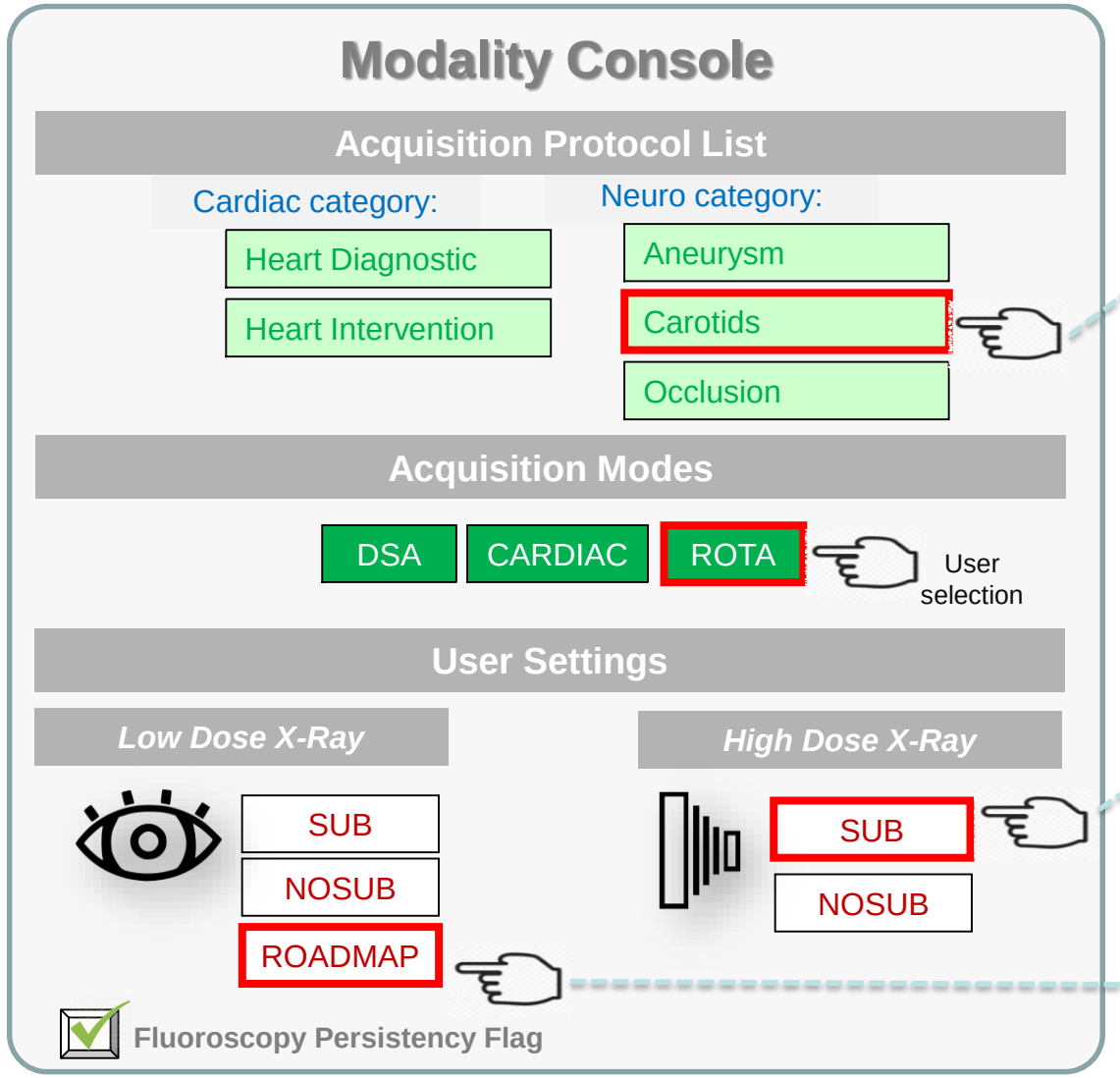
3. XA Protocol and Settings selection

Example of selecting the Defined Acquisition Protocol in the acquisition equipment

1. **The XA Defined Acquisition Protocol is typically selected manually** from the device console, although rules may exist on the device to pre-select a default protocol based on procedure type and patient characteristics. Each element of the protocol contains the parameters of one acquisition mode of either fluoroscopy or high dose acquisitions. In case of biplane system, the parameters for both planes are contained in the same protocol element.
2. **After selecting the protocol**, the parameter values are loaded on the device for all the acquisition modes enabled in the protocol, and for both fluoroscopy and high dose acquisitions. Some parameters of the protocol may be displayed on the console for further adjustements by the operator (e.g. patient position, anatomy…).
3. **During the XA procedure** the acquisition modes are selected manually on the console (e.g. DSA, Rotational, Fluoro Roadmap, etc.) plus some other selections (e.g. IQ preferences, etc.). The protocol elements corresponding to these selected modes are loaded, and their default values will be used. The X-Ray acquisitions are performed sequentially by activating the fluoroscopy or the high dose acquisition switches (e.g. pedal press).

3. Technical Highlights

Example of selecting the Defined Acquisition Protocol in the acquisition equipment



Load Carotids **Protocol**

Load ROTA SUB parameters for **High Dose acquisitions**

Load FLUORO ROADMAP parameters for **Fluoroscopy**

Defined Protocol:

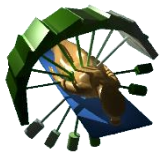
- Carotids Protocol
  - Acquisition Protocol Element #1 — **DSA**
    - *Acquisition Parameters for DSA*
  - Acquisition Protocol Element #2 — **CHASE**
    - *Acquisition Parameters for CHASE*
  - Acquisition Protocol Element #3 — **ROTA NOSUB**
    - *Acquisition Parameters for Rotational NOSUB*
  - Acquisition Protocol Element #4 — **ROTA SUB**
    - *Acquisition Parameters for Rotational SUB*
  - Acquisition Protocol Element #5 — **Fluoroscopy SUB**
    - *Acquisition Parameters Fluoro SUB*
  - Acquisition Protocol Element #6 — **Fluoroscopy NOSUB**
    - *Acquisition Parameters Fluoro NOSUB*
  - Acquisition Protocol Element #7 — **Fluoroscopy ROADMAP**
    - *Acquisition Parameters Fluoro ROADMAP*

Example of Parameters:

- *Frame Rate*
- *Field Of View*
- *Focal Spot*
- *IQ level [H/M/L]*
- *Filters [ON/OFF]*
- *Auto-injection settings*

6. XA Protocol Parameters

Defined Procedure Protocols: XA example of rotational acquisition & 3D reconstruction workflow



Perform Rotational Acquisition — 1-1 → Raw Data — 1-1 → *Perform 2D Raw Data Processing* → **DICOM** ORIGINAL 2D XA Pixels (PACS) — 1-N → *Perform 2D Image Processing* → **DICOM** DERIVED 2D XA Pixels (PACS) → Displayed 2D image

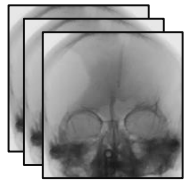
ACQUISITION PROTOCOL ELEMENT

X-Ray ACQUISITION Parameters:
- ❑ *Frame Rate*
- ❑ *Field Of View*
- ❑ *Focal Spot*
- ❑ *IQ level [H/M/L]*
- ❑ *Filters [ON/OFF]*
- ❑ *Auto-injection settings*

2D Raw Data Processing Parameters:
- ❑ *Detector Binning*
- ❑ *Bad pixel correction*
- ❑ *Dynamic range opt Correction of offset*
- ❑ *Correction for geometrc distortion*

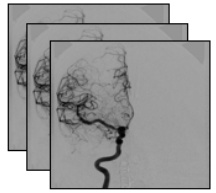
Fluoro Local Recording:
- ❑ *YES / NO*

1-N



RECONSTRUCTION PROTOCOL ELEMENT

2D Image PRESENTATION Processing Parameters:
- ❑ *DSA masking*
- ❑ *DSA LUTs*
- ❑ *Windowing*
- ❑ *Spatial filters*



PACS

Perform 3D RECON → **DICOM** ORIGINAL 3D XA voxels (PACS) — 1-N → *Perform 3D Image Processing* → 3D Volume for DISPLAY → Displayed 3D volume

RECONSTRUCTION PROTOCOL ELEMENT

3D RECONSTRUCTION Parameters:
- ❑ *volume size*
- ❑ *slice thickness*
- ❑ *artifact removal algorithms*
- ❑ *spatial filtering*

3D Image PRESENTATION Processing Parameters:
- ❑ *Windowing*

Note:

Reconstruction elements include 2D and 3D processing parameters. 2D parameters may be used also to generate 3D reconstruction.

Each element of the Reconstruction Protocol Element Specification Sequence shall indicate the purpose of the processing pipeline: either for 2D or for 3D.

Cross References between Defined Protocols and Images

The Reconstruction Protocol Elements contain a “pointer” to the Acquisition Protocol Elements to be reconstructed.

CT Solution

In CT it is assumed that the Raw Data “knows” the Acquisition Protocol Element used.

XA Problem Statement

In XA, the 2D Projections are created as a DICOM multi-frame Image, that can be sent to a Reconstruction Workstation. If the 3D worstation is a separate device on the network, it must be able to identify from the image header the Defined Acquisition Protocol Element used.

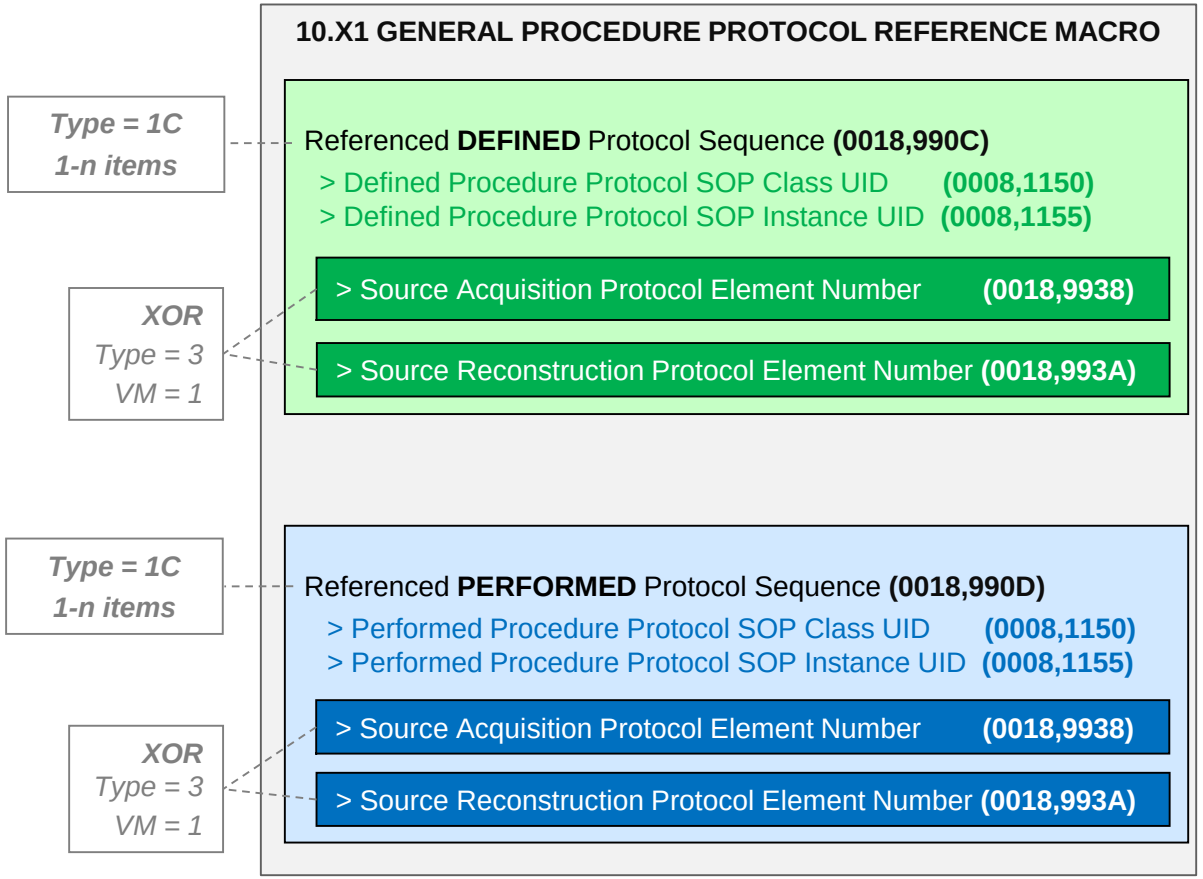
Indeed, the Series of images include the Defined Protocols used to create all the images of the Series (in the Referenced Defined Protocol Sequence (0018,990C)). However, XA practice often includes in the same Series several images created from different defined protocols. Therefore, there is no mechanism in the Series to identify the Defined Acquisition Protocol Element used to create each image.

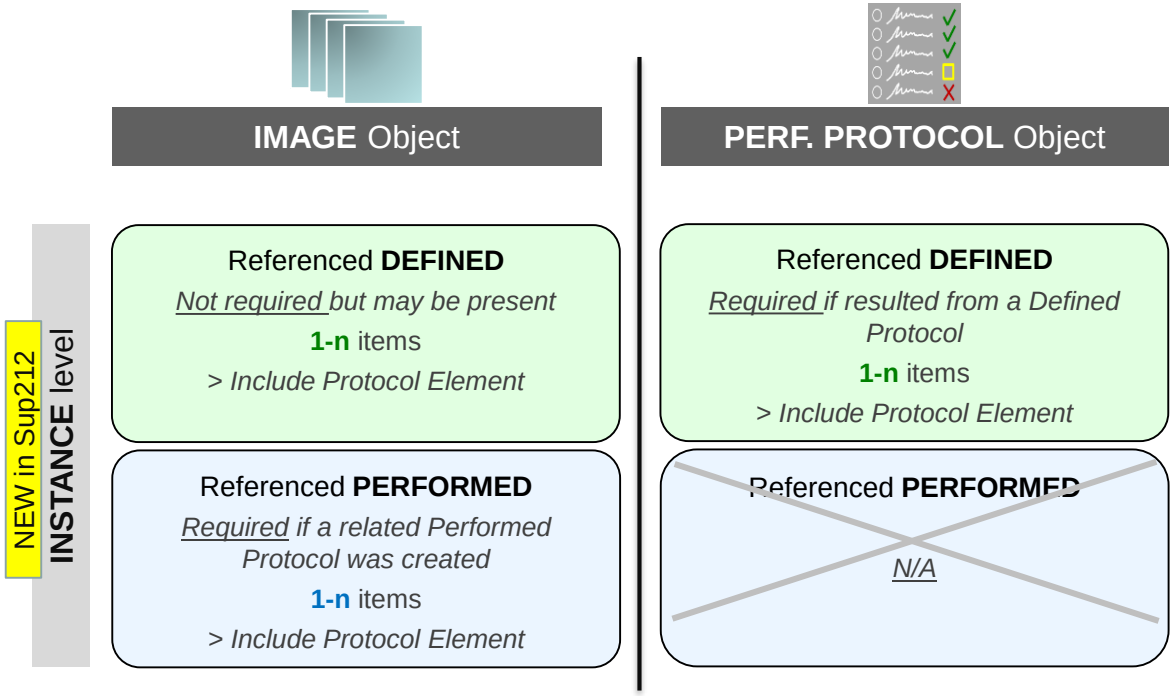
XA Solution

Supp 212 has created a new **General Procedure Protocol Reference** Macro, which contains references to Defined/Performed Protocols and Elements. This Macro has been added to the Image Modules: X-Ray Image Module, Enhanced XA/XRF Image Module, and X-Ray 3D Image Module.

6. XA Protocol Parameters

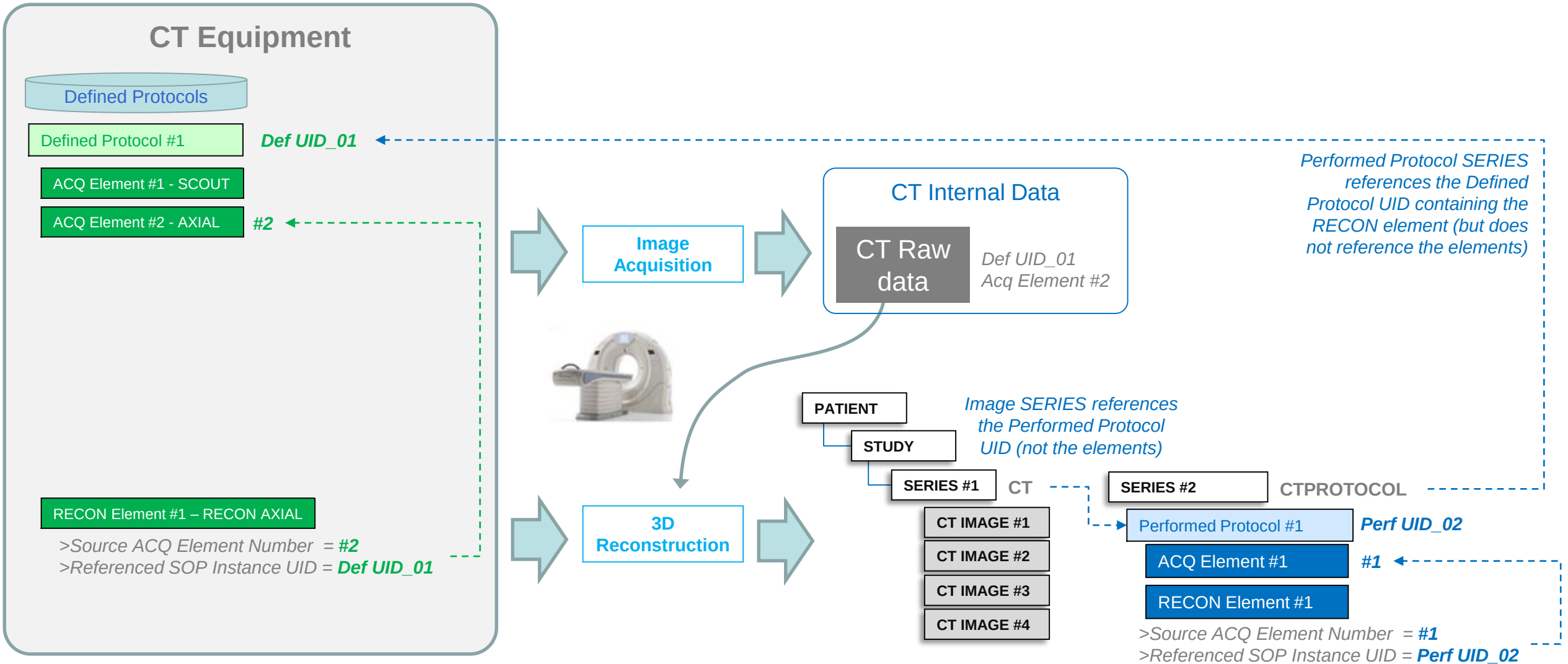
New Macro in DICOM PS3.3: 10.X1 GENERAL PROCEDURE PROTOCOL REFERENCE MACRO





3. Technical Highlights

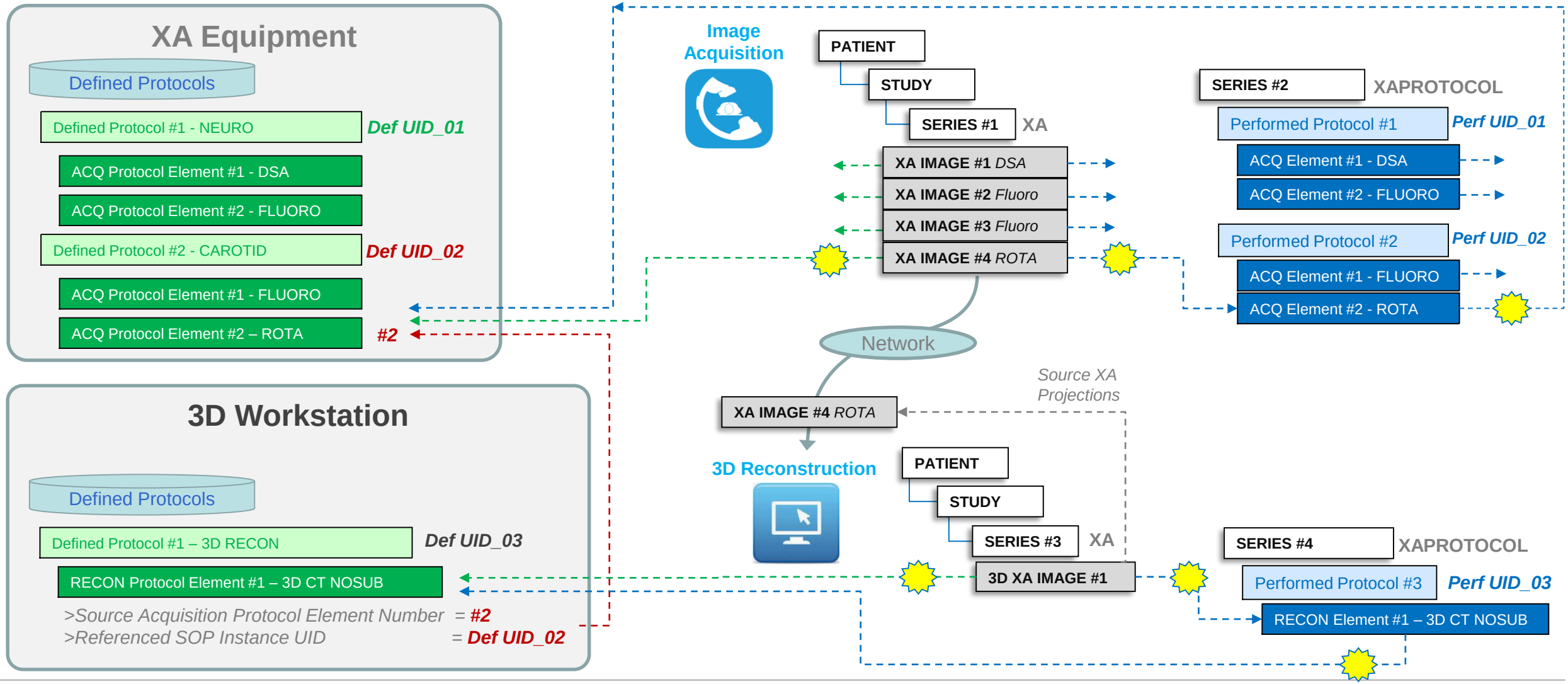
CT Acquisition and Reconstruction (on same device)



3. Technical Highlights

XA Acquisition and Reconstruction on different devices

= 10.X1 GENERAL PROCEDURE PROTOCOL REFERENCE MACRO



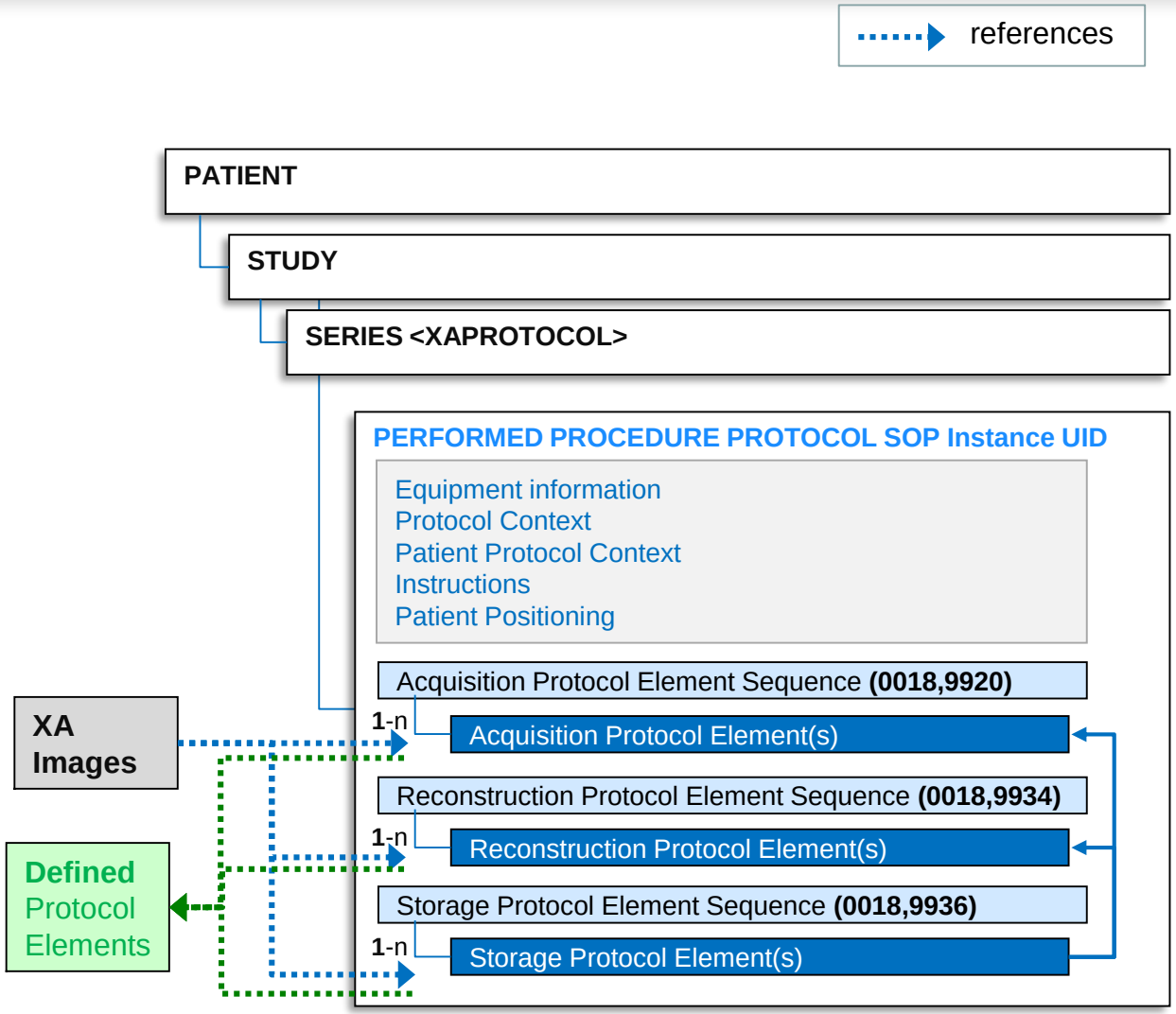
XA Performed Procedure Protocol

XA Performed Protocol **records the actual parameters applied** during the various acquisition modes.

General Series Module references the Performed Protocol Instances that describe the conditions by which this Series was generated. In CT it is assumed that all images in the series described by the same performed protocol. However, in XA, the same Series contains images acquired/reconstructed described by several performed protocols, and by several elements within the same protocol.

For **Quality Control**: For a given XA image, we need to identify the Performed Acquisition and Reconstruction Protocol Elements allowing to know exactly what protocol parameters have been used. They can be used to the interpretation of the image quality and dose.

Supp 212 adds a Referenced Procedure Protocols Macro, and includes it at image level in: X-Ray Image Module, Enhanced XA/XRF Image Module, and X-Ray 3D Image Module.



3. Technical Highlights – Cross references

There are cross-references between

- Protocols and Protocol Codes,
- Defined Procedure Protocol, and
- Performed Procedure Protocol

… through the overall workflow:

- Modality Worklist
- Device Defined Procedure Protocols
- Images
- Performed Procedure Protocols

(see next page)

3. Technical Highlights – Cross references

DICOM Modality Worklist

Requested Procedure:
- STUDY UID
- Procedure ID / Description
- Procedure Code

1-n

Scheduled Procedure Step:
- SPS ID / Description
- Modality <**CT, XA**…>
- **Referenced Defined Protocol UID**
- **Scheduled Protocol Code(s)**

The Modality selects one Scheduled Procedure Step (SPS) and maps it to one Defined Procedure Protocol… but several defined protocols may be used

Acquisition Equipment

Protocol Library

1-n

DEFINED PROCEDURE PROTOCOL:
- **SOP Instance UID**
- **Potential Scheduled Protocol Code(s)**
- *Protocol Elements with parameters pre-defined*

DICOM Patient Study

STUDY:
- STUDY UID
- Study ID
- Performed Procedure Code(s)

1-n

SERIES (Images):
- Modality <**XA**>
- Requested Attributes Sequence
  - Requested Procedure ID / Desc.
  - SPS ID / Description
  - **Scheduled Protocol Code(s)**
- **Protocol Name**
- **Performed Protocol Code(s)**

1-n

IMAGE:
- SOP Instance UID / Irradiation Event UID
- Ref. to **Defined** Procedure Protocol SOP Instance UID & Element
- Ref. to **Performed** Procedure Protocol SOP Instance UID & Element
- **Acquisition Protocol Name**
- Acquisition Mode
- Acquisition Settings/Parameters

New

1-n

SERIES (Protocols):
- Modality <**XAPROTOCOL**>

1-n

PERFORMED PROCEDURE PROTOCOL:
- **SOP Instance UID**
- *Protocol Elements with parameters actually used*
  - Each element: Ref. to **Defined** Procedure Protocol SOP Instance UID & Element

New

3. Technical Highlights – Example of cross references

In this example:

The **Defined protocol 1** (Head) is selected on the device, one acquisition is performed with **Element 1**:

- An XA image 1 is created in Series 1, and its corresponding **Performed protocol 1** (and element) is created in Series 2

Then, the **Defined protocol 2** (Carotids) is selected on the device, one acquisition is performed with **Element 1** :

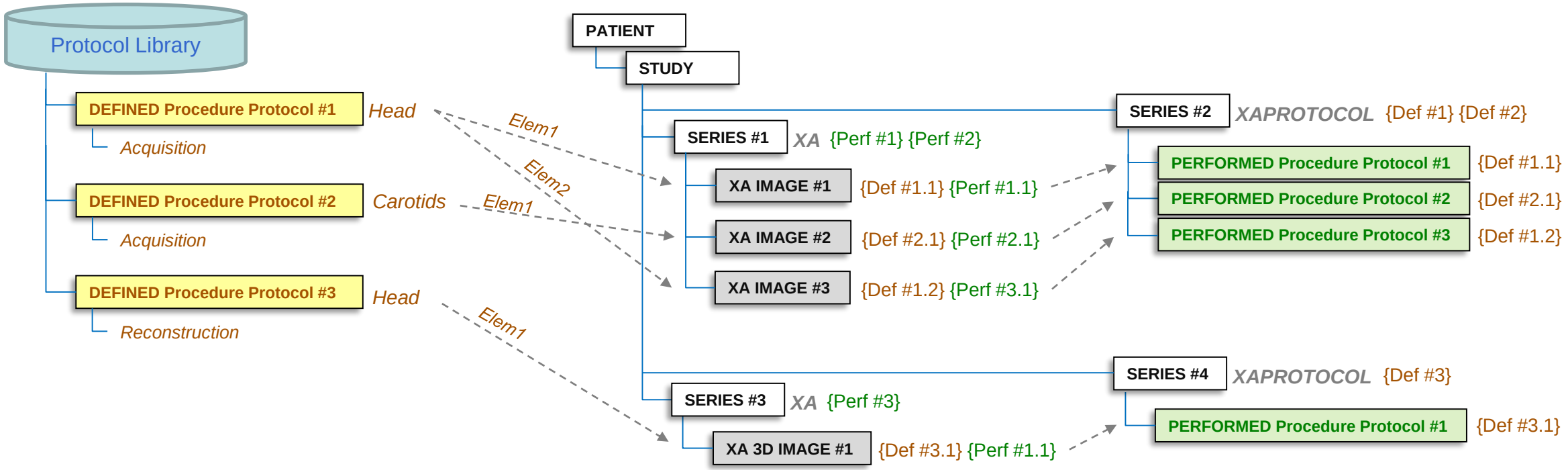
- An XA image 2 is created in Series 1, and its corresponding **Performed protocol 2** (and element) is created in Series 2

Then, the **Defined protocol 1** (Head) is selected again on the device, one acquisition is performed with **Element 2** :

- An XA image 3 is created in Series 1, and its corresponding **Performed protocol 3** (and element) is created in Series 2

Then, the image 3 is reconstructed by the **Defined protocol 3** (Head) – on the device or on a 3D Workstation:

- An XA 3D volume 1 is created in Series 3, and its corresponding **Performed protocol 1** (and element) is created in Series 4



Author Contacts

- Nicholas Bevins nickb@rad.hfh.edu
- Heinz Blendinger heinz.blendinger@t-online.de
- Steve Massey steve.massey@pacshealth.com
- Donald Peck donaldp@mtu.edu
- Pritham Shetty pritham.shetty@philips.com
- Francisco Sureda (Editor) francisco.sureda@med.ge.com
- Annalisa Trianni annalisa.trianni@apss.tn.it

DICOM Secretariat: dicom@medicalimaging.org

Technical Details

4. Background

Protocol

A Protocol is a specification of actions prescribed by a Procedure Plan to perform a specific Procedure Step. A Scheduled Procedure Step (from Modality Worklist) contains only one Protocol, which may be conveyed by one or more Protocol Codes.

A Protocol may be specified by a Defined Procedure Protocol to be used on any appropriate patient. A Protocol can be documented, once a Procedure Step has been performed, in a Performed Procedure Protocol.

Defined Procedure Protocol

A Defined Procedure Protocol describes a set of parameters and associated details for the prescribed action. The Defined Procedure Protocol may provide specific values for relevant parameters, or may provide constraints on those parameters (such as an acceptable range) to guide the choice of specific values.

Defined Procedure Protocol is not associated with any particular Patient or Scheduled Procedure Step. A Defined Procedure Protocol may contain parameters specific to a particular model or version of device, or it may be generic in that it only describes parameters common to multiple device models.

A Defined Procedure Protocol may include information such as the clinical purpose, indications, and appropriate device models, intended for selection and management.

Performed Procedure Protocol

A Performed Procedure Protocol encodes the parameter values used. A Performed Procedure Protocol is always associated with a specific Patient and Performed Procedure Step. The Performed Procedure Protocol may reference the Defined Procedure Protocol on which it was based, but does not otherwise record the orginal constraints and whether or not they were satisfied by the final values as recorded in the Performed Procedure Protocol.

4. Background

Defined Procedure Protocols

- Vendor/Model Specific content
- Private tags expected for model-specific details
- Specifies Constraints on Parameters (Specific value, set, range, etc)
- Instructions to tech

Device ONLY encodes the parameters it needs/supports

Device Protocol Library

0-n

DEFINED PROCEDURE PROTOCOL SOP Instance

Equipment information
Protocol Context
Clinical Trial Context
Patient Specification
Equipment Specification
Instructions
Patient **Positioning**

Acquisition Protocol Element Specification Sequence **(0018,991F)**

1-n Acquisition Protocol Element

Reconstruction Protocol Element Specification Sequence **(0018,9933)**

1-n Reconstruction Protocol Element

Storage Protocol Element Specification Sequence **(0018,9935)**

1-n Storage Protocol Element

Patient exam

Performed Procedure Protocols

- Encodes the parameter values used
- Always associated with a specific Patient and Performed Procedure Step

PATIENT

STUDY

SERIES

1-n

PERFORMED PROCEDURE PROTOCOL SOP Instance

Equipment information
Protocol Context
Patient Protocol Context
Instructions
Patient Positioning

Acquisition Protocol Element Sequence **(0018,9920)**

1-n Acquisition Protocol Element

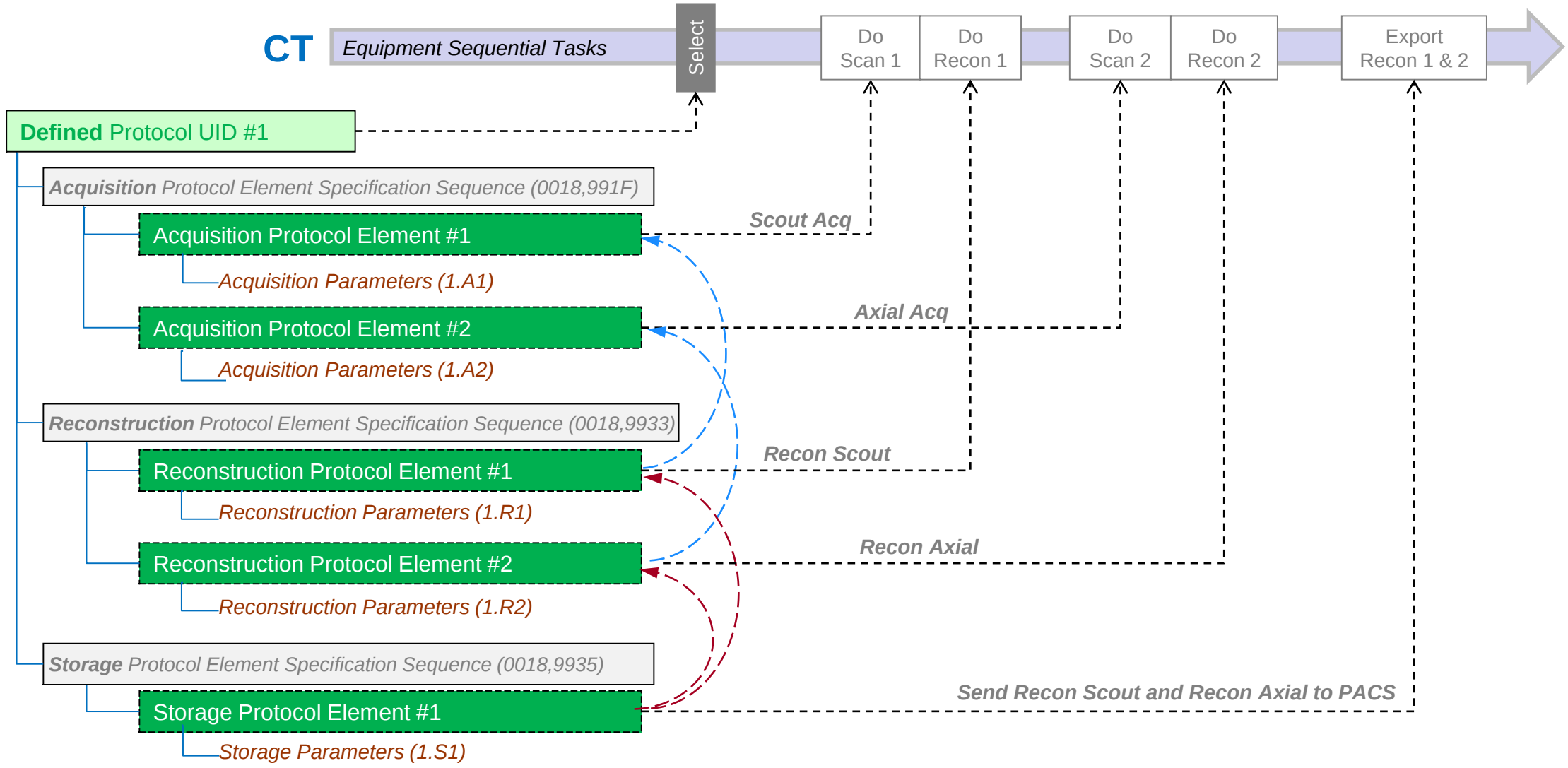
Reconstruction Protocol Element Sequence **(0018,9934)**

1-n Reconstruction Protocol Element

Storage Protocol Element Sequence **(0018,9936)**

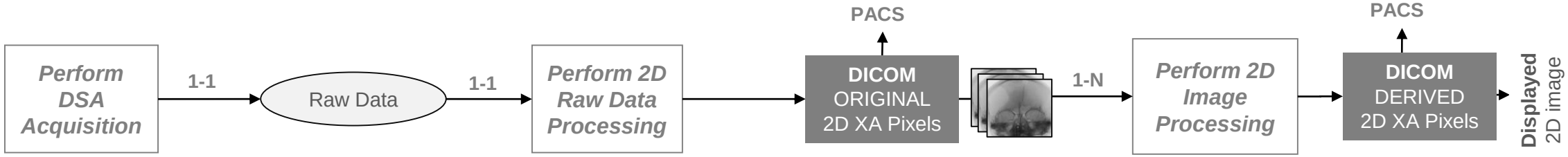
1-n Storage Protocol Element

CT Procedure Step Example of Defined Protocol usage



6. XA Protocol Parameters

Defined Procedure Protocols: XA example of DSA acquisition



ACQUISITION PROTOCOL ELEMENT

X-Ray ACQUISITION Parameters:
- ❑ *Frame Rate*
- ❑ *Field Of View*
- ❑ *Focal Spot*
- ❑ *IQ level [H/M/L]*
- ❑ *Filters [ON/OFF]*
- ❑ *Auto-injection settings*

2D Raw Data Processing Parameters:
- ❑ *Detector Binning*
- ❑ *Bad pixel correction*
- ❑ *Dynamic range opt Correction of offset*
- ❑ *Correction for geometrc distortion*

Fluoro Local Recording:
- ❑ *YES / NO*

Clarifications of the meaning of Acquisition and Reconstruction Protocol Elements:

Acquisition: creation of DICOM 2D ORIGINAL pixel data (including Image-Independent corrections as defined in IEC 62220-1-3). The access to the Raw Data is locked and not intended to be kept for re-processing.

Reconstruction: manipulation of DICOM 2D ORIGINAL pixel data to create a DICOM 2D DERIVED or 3D RECONSTRUCTED data

Note:

Parameters to display an image on a non-persistent device (e.g. on monitors) should not be in the protocols, rather in another Presentation workflow. However, if the parameters are used to create a DERIVED image within the acquisition workflow (e,g, DSA subtracted pixels) then the parameters can be in the Reconstruction Protocol.

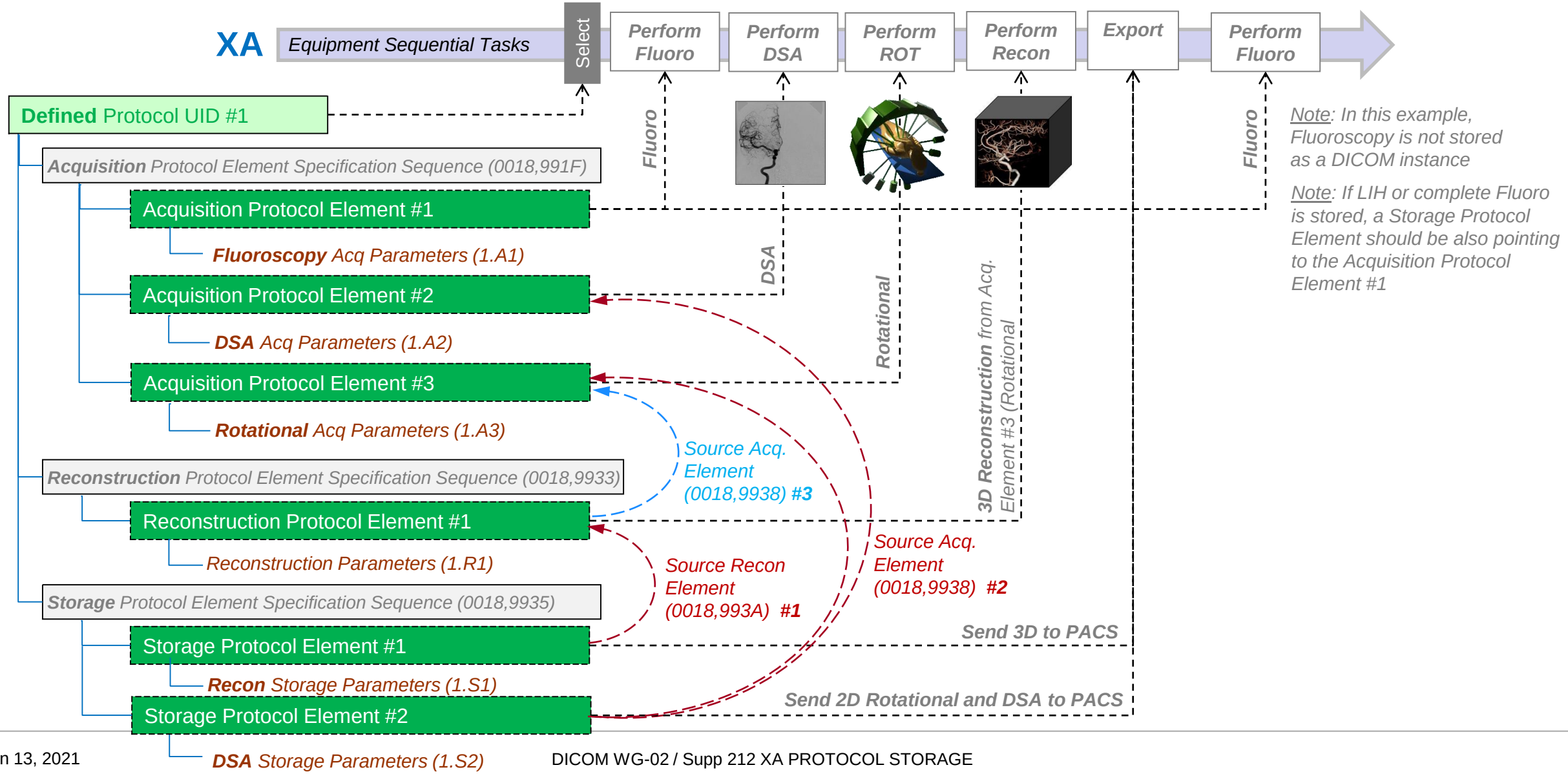
IEC 62220-1-3 Par.5 Corrections of RAW DATA

The following linear and image-independent corrections of the RAW DATA are allowed in advance of the processing of the data for the determination of the CONVERSION FUNCTION, the NOISE POWER SPECTRUM, and the MODULATION TRANSFER FUNCTION.
All the following corrections if used shall be made as in normal clinical use:

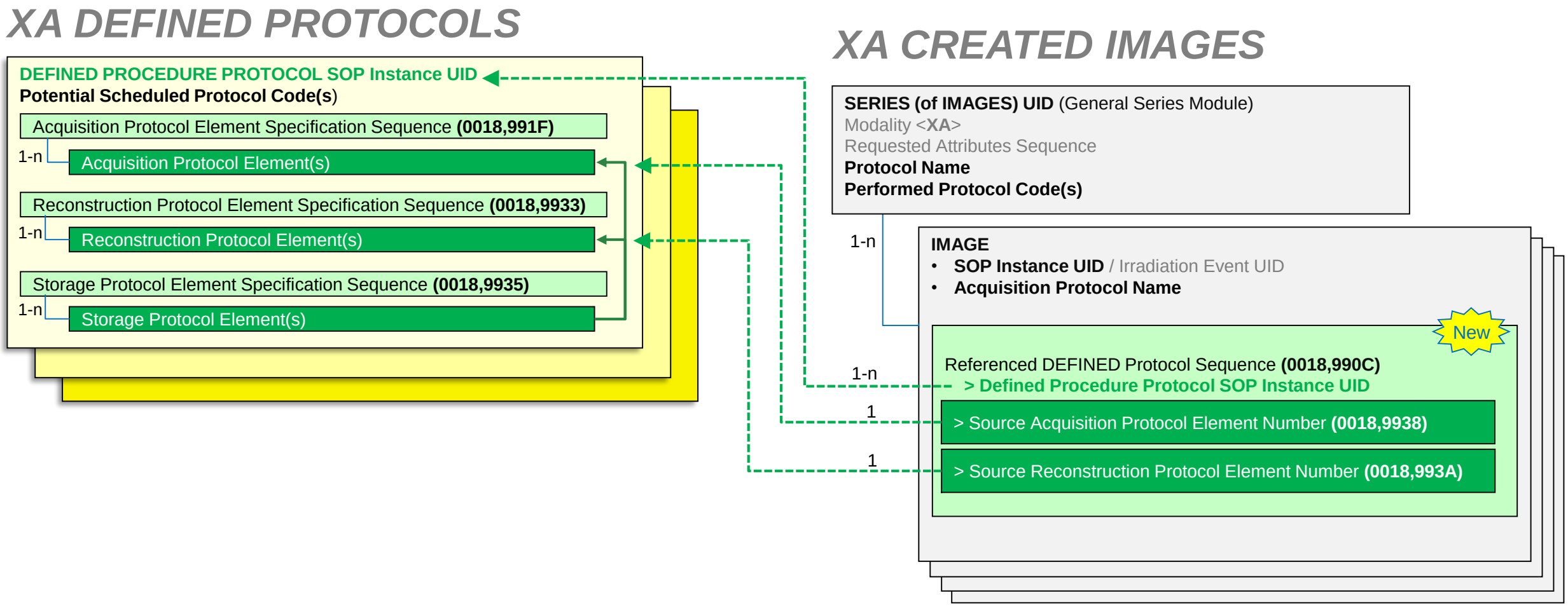
- replacement of the RAW DATA of bad or defective pixels by appropriate data;
- a flat-field correction comprising correction of the non-uniformity of the RADIATION FIELD; correction for the offset of the individual pixels; and gain correction for the individual pixels;
- a correction for geometrical distortion.

NOTE 1 Some detectors execute linear image processing due to their physical concept. As long as this image processing is linear and image-independent, these operations are allowed as an exception.
NOTE 2 Image correction is considered image-independent if the same correction is applied to all images independent of the image contents.

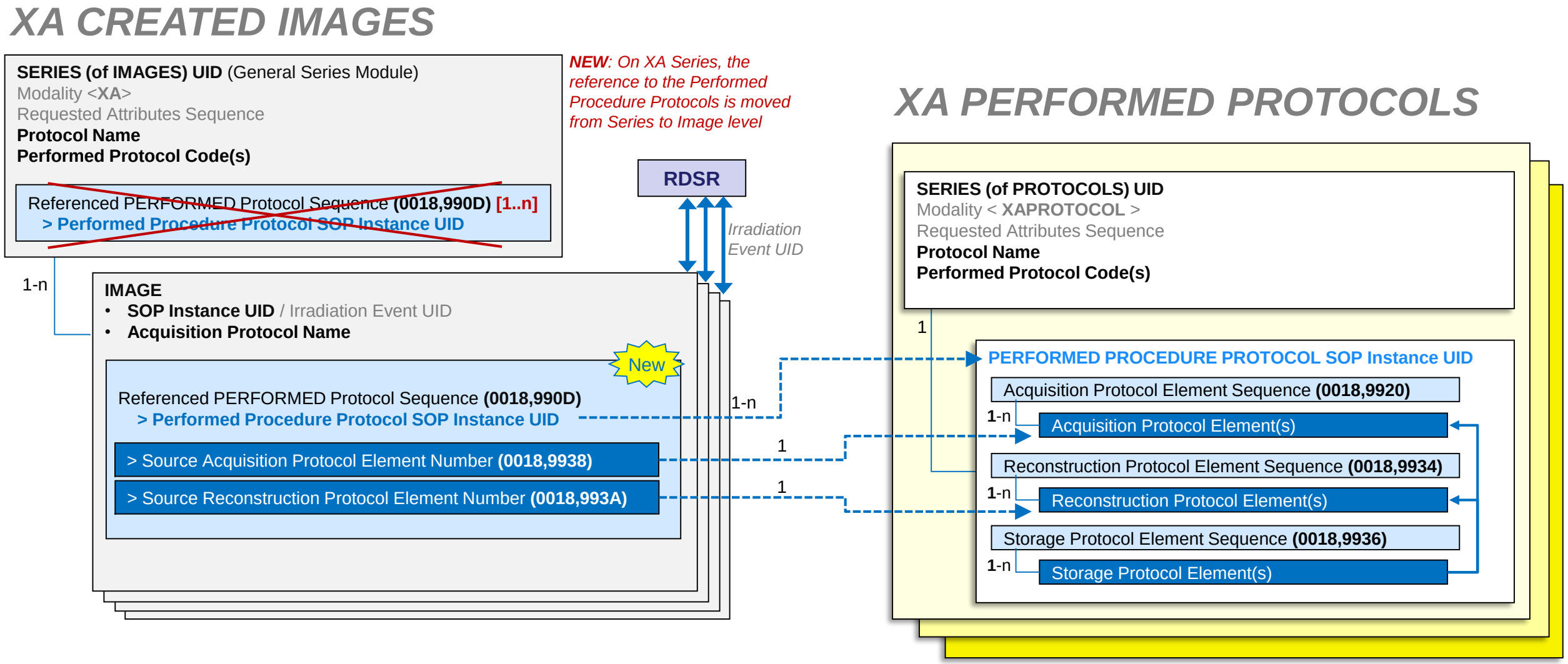
Example of XA Procedure Step – Acquisition and Reconstruction on same device



Cross References between Defined Protocols and Images

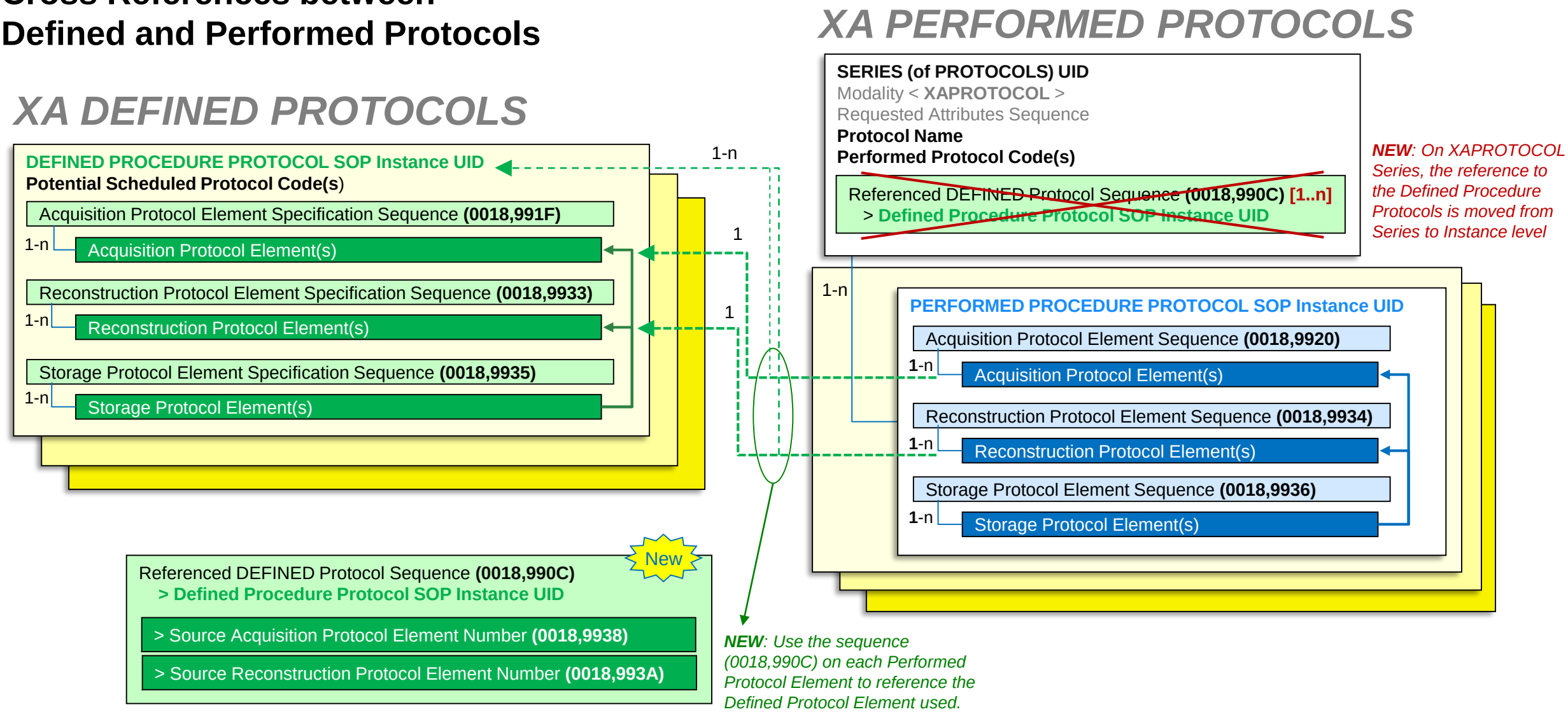


Cross References between Performed Protocols and Images

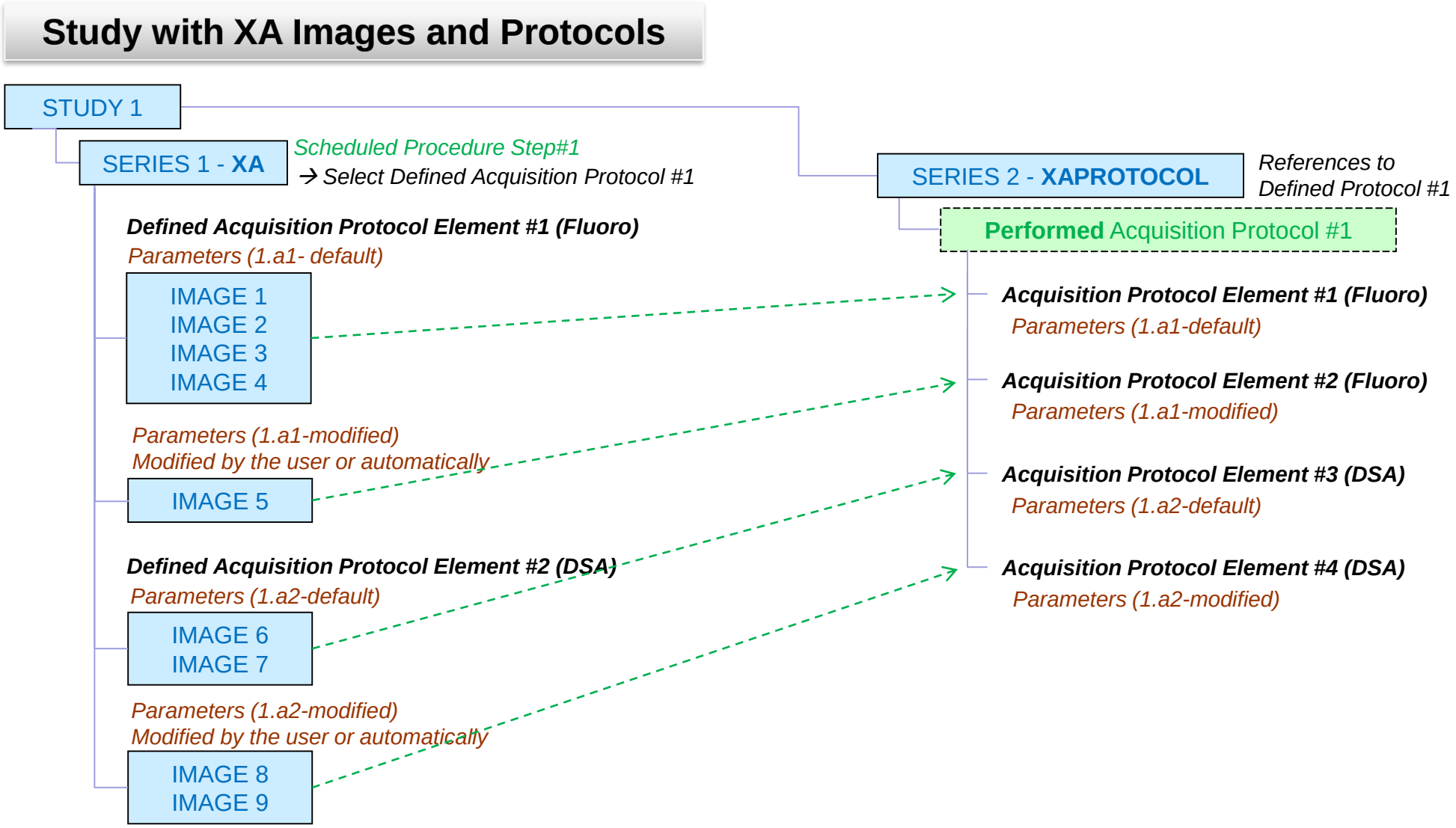


6. XA Protocol Parameters

Cross References between Defined and Performed Protocols



Performed Protocol Storage: Example of one single Series



Example 1: Single XA Device for Acquisition and Reconstruction

One Defined Protocol example of an Adult Carotid Stenting Protocol for one XA equipment model. It contains the following protocol elements:

- Three Acquisition Protocol Elements corresponding to Fluoroscopy, DSA and Rotational acquisition modes.
- One Reconstruction Protocol Element corresponding to the 3D reconstruction of the rotational acquisition.

Example 2: Two XA Devices for Acquisition and Reconstruction

Two Defined Protocols, one in the acquisition device, the other in the 3D reconstruction device. This example illustrates the workflow where the user selects one acquisition protocol on the acquisition device, acquires one rotational image, this image is sent to the 3D reconstruction device, and the 3D reconstruction is performed based on the protocol references of the image header.

PS3.7 - AAAA.X1 Example 1: Single XA Equipment for Acquisition and Reconstruction

One Defined Protocol with protocols elements (Acquisition and Reconstruction) on the Acq System

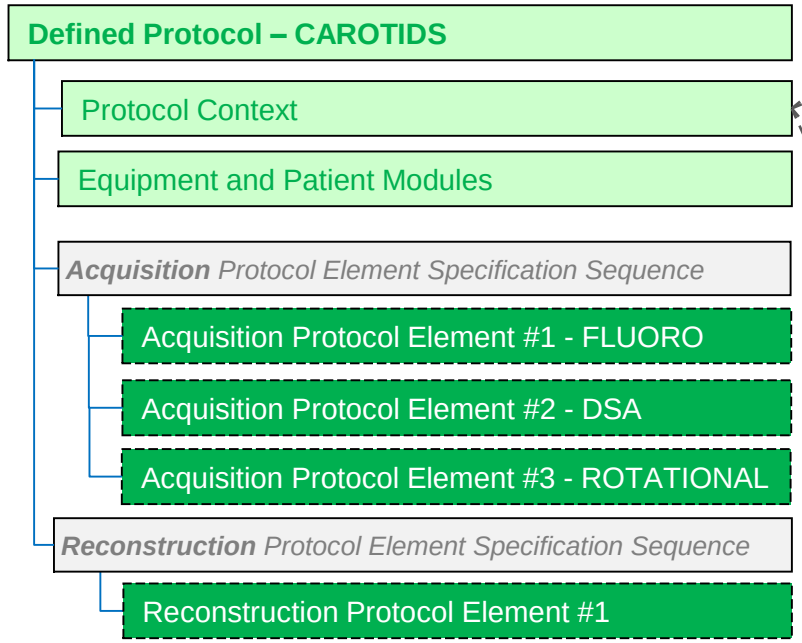


Table AAAA.X1-1. Adult Carotid Stenting Protocol - Context

Equipment Specification Module	**PS3.3 - C.34.6**	
Equipment Modality	(0008,0221)	**XA**
Protocol Context Module	**PS3.3 - C.34.2**	
Custodial Organization Sequence	(0040,A07C)	
> Institution Name	(0008,0800)	**Mercy Hospital**
Responsible Group Code Sequence	(0008,0220)	**(C3872675, UMLS, "Interventional Radiology Service")**
Protocol Name	(0018,1030)	**CAROTIDS**
Potential Requested Procedure Code Sequence	(0018,9907)	**(C0522776, UMLS, "Stent placement") etc…**
Contraindications Code Sequence	(0018,990B)	**(C0570563, UMLS, "X-ray Contrast Media Allergy")**
Protocol Design Rationale	(0018,9910)	*<Rationale>*
Instructions Module	**PS3.3 - C.34.7**	
Instruction Sequence	(0018,9914)	
> Instruction Index	(0018,9915)	**1**
> Instruction Text	(0018,9916)	*<Instruction Title>*
> Instruction Description	(0018,9917)	*<Instruction Description>*
Patient Positioning Module	**PS3.3 - C.34.8**	
Protocol Defined Patient Position	(0018,9947)	**HFS**
Anatomic Region Sequence	(0008,2218)	**(C0460004, UMLS, "Head and Neck")**

PS3.7 - AAAA.X1 Example 1

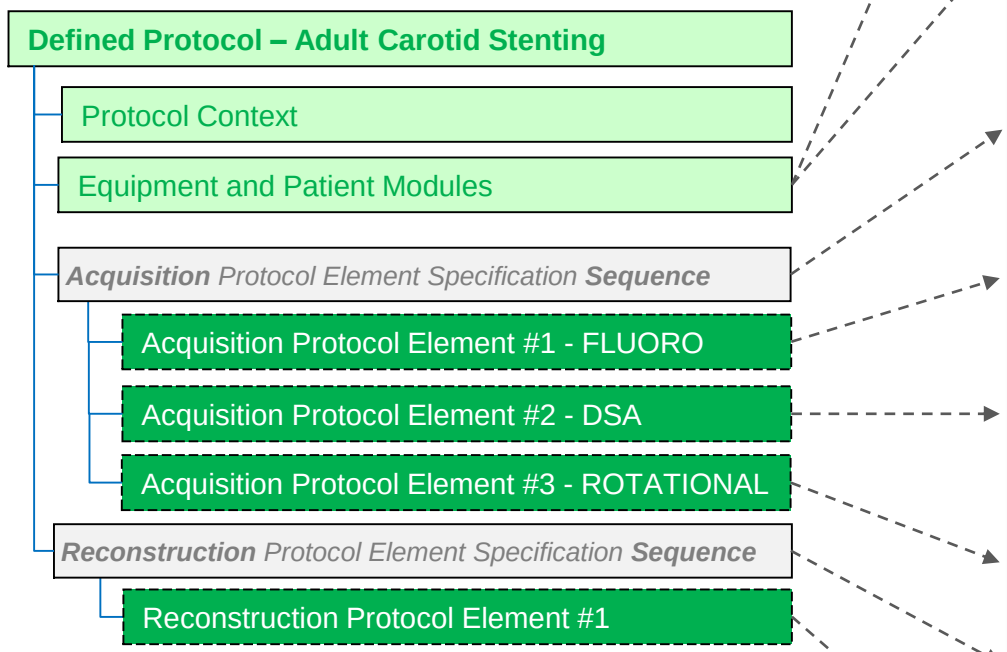


Table AAAA.X1-2. Adult Carotid Stenting Protocol - Details - Angiotech

Equipment Specification Module	**PS3.3 - C.34.6**	
Model Specification Sequence	**(0018,9912)**	
> Manufacturer	(0008,0070)	**Angiotech**
> Manufacturer's Related Model Group	(0008,0222)	**Angiomatic**
> Software Versions	(0018,1020)	**v.XA01**
Patient Specification Module	**PS3.3 - C.34.5**	
Patient Specification Sequence	**(0018,9911)**	
> See **Table AAAA.X1-2a** "Patient Specification"		
General Defined Acquisition Module	**PS3.3 - C.34.9**	
Acquisition Protocol Element Specification Sequence	**(0018,991F)**	
> Protocol Element Number	(0018,9921)	**1**
> Parameters Specification Sequence	(0018,9913)	
>> See **Table AAAA.X1-2b** "First Acquisition Protocol Element Specification – **FLUOROSCOPY NOSUB**"		
> Protocol Element Number	(0018,9921)	**2**
> Parameters Specification Sequence	(0018,9913)	
>> See **Table AAAA.X1-2c** "Second Acquisition Protocol Element Specification - **DSA**"		
> Protocol Element Number	(0018,9921)	**3**
> Parameters Specification Sequence	(0018,9913)	
>> See **Table AAAA.X1-2d** "Third Acquisition Protocol Element Specification – **ROTATIONAL SUB**"		
General Defined Reconstruction Module	**PS3.3 - C.34.8**	
Reconstruction Protocol Element Specification Sequence	**(0018,9933)**	
> Protocol Element Number	(0018,9921)	**1**
> Parameters Specification Sequence	(0018,9913)	
>> See **Table AAAA.X1-2e** "First Reconstruction Protocol Element Specification – **3D SUB RECONSTRUCTION**"		

PS3.7 - AAAA.X1 Example 1

Table AAAA.X1-2a. “Patient Specification”

Attribute	Selector Attribute (0072,0026)	Selector Value Number (0072,0028)	Selector Sequence Pointer (0072,0052)	Selector Sequence Pointer Items (0074,1057)	Constraint Type	Constraint Value
Patient's Age	(0010,1010)	1	absent	absent	GREATER_THAN	"18Y"

PS3.7 - AAAA.X1 Example 1

Attribute	Selector Attribute (0072,0026)	Selector Value Number (0072,0028)	Selector Sequence Pointer (0072,0052)	Table AAAA.X1-2b: Selector Sequence Pointer Items (0074,1057)	Table AAAA.X1-2b: Constraint Type	Table AAAA.X1-2b: Constraint Value	Table AAAA.X1-2c: Selector Sequence Pointer Items (0074,1057)	Table AAAA.X1-2c: Constraint Type	Table AAAA.X1-2c: Constraint Value	Table AAAA.X1-2d: Selector Sequence Pointer Items (0074,1057)	Table AAAA.X1-2d: Constraint Type	Table AAAA.X1-2d: Constraint Value
Acquisition Protocol Element Sequence (0018,9920)				Element #1: **Fluoroscopy**			Element #2: **DSA**			Element #3: **Rotational**		
Protocol Element Number	(0018,9921)	1	(0018,9920)	*1*	*EQUAL*	**1**	*2*	*EQUAL*	**2**	*3*	*EQUAL*	**3**
Protocol Element Name	(0018,9922)	1	(0018,9920)	*1*	*EQUAL*	**"FLUOROSCOPY NOSUB"**	*2*	*EQUAL*	**"DSA"**	*3*	*EQUAL*	**"ROTATIONAL SUB"**
Radiation Setting	(0018,1155)	1	(0018,9920)	*1*	*EQUAL*	**"SC"**	*2*	*EQUAL*	**"GR"**	*3*	*EQUAL*	**"GR"**
Acquisition Mode	(xxxx,xx02)	1	(0018,9920)	*1*	*EQUAL*	**"Fluoroscopy"**	*2*	*EQUAL*	**"DSA"**	*3*	*EQUAL*	**"Rotational"**
Acquired Subtraction Mask Flag	(xxxx,xx04)	1	(0018,9920)	*1*	*EQUAL*	**"NO"**	*2*	*EQUAL*	**"YES"**	*3*	*EQUAL*	**"YES"**
Planes in Acquisition	(0018,9410)	1	(0018,9920)	*1*	*EQUAL*	**"SINGLE PLANE"**	*2*	*EQUAL*	**"SINGLE PLANE"**	*3*	*EQUAL*	**"SINGLE PLANE"**
> XA Plane Details Sequence (xxxx,xx12)												
Plane Identification	(0018,9457)	1	(0018,9920)\ (xxxx,xx12)	*1\1*	*EQUAL*	**"MONOPLANE"**	*2\1*	*EQUAL*	**"MONOPLANE"**	*3\1*	*EQUAL*	**"MONOPLANE"**
Beam Number	(300A,00C0)	1	(0018,9920)\ (xxxx,xx12)	*1\1*	*EQUAL*	**1**	*2\1*	*EQUAL*	**1**	*3\1*	*EQUAL*	**1**
Field of View Dimension(s) in Float	(0018,9461)	0	(0018,9920)\ (xxxx,xx12)	*1\1*	*RANGE_INCL*	**120.0, 300.0**	*2\1*	*RANGE_INCL*	**120.0, 300.0**	*3\1*	*EQUAL*	**300.0**
Primary Positioner Scan Start Angle	(0018,9510)	1	(0018,9920)\ (xxxx,xx12)	*1\1*	*absent*	*absent*	*2\1*	*absent*	*absent*	*3\1*	*EQUAL*	**-100**
Primary Positioner Scan Arc	(0018,9508)	1	(0018,9920)\ (xxxx,xx12)	*1\1*	*absent*	*absent*	*2\1*	*absent*	*absent*	*3\1*	*EQUAL*	**200**
Rotational Primary Angle Rotation Step	(0018,9514)	1	(0018,9920)\ (xxxx,xx12)	*1\1*	*absent*	*absent*	*2\1*	*absent*	*absent*	*3\1*	*EQUAL*	**0.5**
>> X-Ray Filter Details Sequence (xxxx,xx14)												
Filter Thickness Minimum	(0018,7052)	1	(0018,9920)\ (xxxx,xx12)\ (xxxx,xx14)	*1\1\1*	*EQUAL*	**0.5**	*2\1\1*	*EQUAL*	**0.5**	*3\1\1*	*EQUAL*	**1.0**
Filter Thickness Maximum	(0018,7054)	1	(0018,9920)\ (xxxx,xx12)\ (xxxx,xx14)	*1\1\1*	*EQUAL*	**1.0**	*2\1\1*	*EQUAL*	**1.0**	*3\1\1*	*EQUAL*	**1.0**

PS3.7 - AAAA.X1 Example 1

Table AAAA.X1-2e "First Reconstruction Protocol Element Specification"

Attribute	Selector Attribute (0072,0026)	Selector Value Number (0072,0028)	Selector Sequence Pointer (0072,0052)	Selector Sequence Pointer Items (0074,1057)	Constraint Type	Constraint Value
Reconstruction Protocol Element Sequence (0018,9934)				Element #1: **Reconstruction SUB**		
Protocol Element Number	(0018,9921)	1	(0018,9934)	*1*	*EQUAL*	**1**
Protocol Element Name	(0018,9922)	1	(0018,9934)	*1*	*EQUAL*	**"3D SUB RECONSTRUCTION"**
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9934)	*1*	*EQUAL*	**3**
Source Acquisition Beam Number	(0018,9939)	1	(0018,9934)	*1*	*EQUAL*	**1**
Reconstruction Pipeline Type	(xxxx,xx16)	1	(0018,9934)	*1*	*EQUAL*	**"3D"**
Applied Mask Subtraction Flag	(xxxx,xx19)	1	(0018,9934)	*1*	*EQUAL*	**"YES"**
Rows	(0028,0010)	1	(0018,9934)	*1*	*EQUAL*	**512**
Columns	(0028,0011)	1	(0018,9934)	*1*	*EQUAL*	**512**
Algorithm Type	(0018,9527)	1	(0018,9934)	*1*	*EQUAL*	**"FILTER_BACK_PROJ"**
Number Of Slices	(0054,0081)	1	(0018,9934)	*1*	*EQUAL*	**512**
Slice Thickness	(0018,0050)	1	(0018,9934)	*1*	*EQUAL*	**0.2**
Reconstruction Field of View	(0018,9317)	0	(0018,9934)	*1*	*EQUAL*	**300.0**
> Image Filter Details Sequence (xxxx,xx17)						
Image Filter	(0018,9320)	1	(0018,9934)\, (xxxx,xx17)	*1\1*	*EQUAL*	**"Metal_MEDIUM"**
Image Filter Description	(0018,9941)	1	(0018,9934)\ (xxxx,xx17)	*1\1*	*EQUAL*	**"Metal artifact removal"**

*Reconstruction of the images acquired with the acquisition protocol element #**3** (Rotational)*

PS3.7 - AAAA.X2 Example 2: Two XA devices: one for Acquisition, another one for Reconstruction

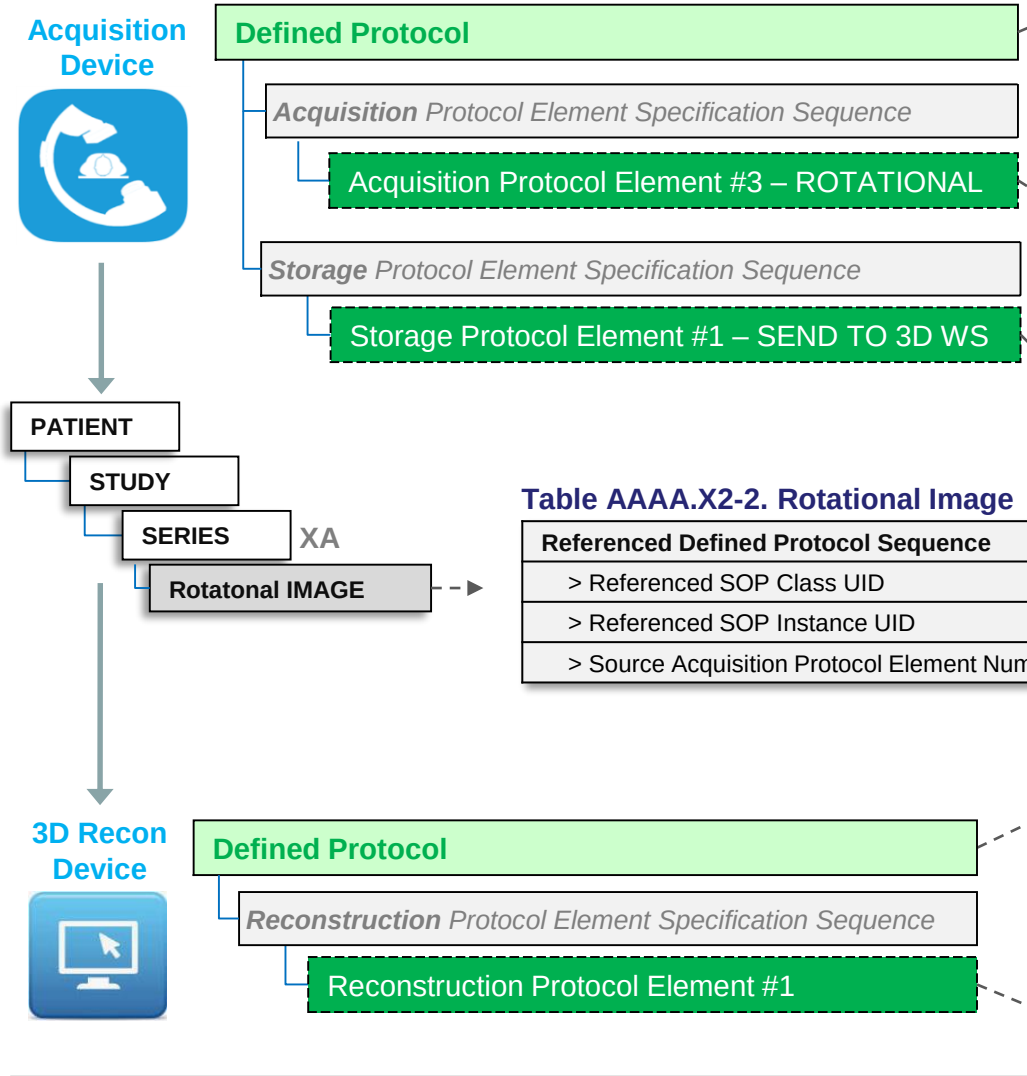


Table AAAA.X2-1. Acquisition and Storage Protocol

SOP Common Module	**PS3.3 - C.12.1**	
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.200.X1
SOP Instance UID	(0008,0018)	UID_01
General Defined Acquisition Module	**PS3.3 - C.34.9**	
Acquisition Protocol Element Specification Sequence	**(0018,991F)**	
> Protocol Element Number	(0018,9921)	3
> Parameters Specification Sequence	(0018,9913)	
>> See Table AAAA.X2-1a "First Acquisition Protocol Element Specification – **ROTATIONAL SUB ACQ**"		
Defined Storage Module	**PS3.3 - C.34.13**	
Storage Protocol Element Specification Sequence	**(0018,9935)**	
> Protocol Element Number	(0018,9921)	1
> Parameters Specification Sequence	(0018,9913)	
>> See Table AAAA.X2-1b "First Storage Protocol Element Specification - **SEND TO 3D WS**"		

Table AAAA.X2-2. Rotational Image

Referenced Defined Protocol Sequence	**(0018,990C)**	
> Referenced SOP Class UID	(0008,1150)	1.2.840.10008.5.1.4.1.1.200.X1
> Referenced SOP Instance UID	(0008,1155)	UID_01
> Source Acquisition Protocol Element Number	(0018,9938)	3

Table AAAA.X2-3. Reconstruction Protocol

SOP Common Module	**PS3.3 - C.12.1**	
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.200.X1
SOP Instance UID	(0008,0018)	UID_03
General Defined Reconstruction Module	**PS3.3 - C.34.8**	
Reconstruction Protocol Element Specification Sequence	**(0018,9933)**	
> Protocol Element Number	(0018,9921)	1
> Parameters Specification Sequence	(0018,9913)	
>> See Table AAAA.X2-3a "First Reconstruction Protocol Element Specification – **3D SUB RECONSTRUCTION**"		

PS3.7 - AAAA.X2 Example 2: Two XA devices: one for Acquisition, another one for Reconstruction

Acquisition Device

Table AAAA.X2-1a

Table AAAA.X2-1b

Attribute	Selector Attribute (0072,0026)	Selector Value Number (0072,0028)	Selector Sequence Pointer (0072,0052)	Selector Sequence Pointer Items (0074,1057)	Constraint Type	Constraint Value
Acquisition Protocol Element Sequence (0018,9920)				Acquisition Element #3: **Rotational Acquisition**		
Protocol Element Number	(0018,9921)	1	(0018,9920)	*1*	*EQUAL*	3
Protocol Element Name	(0018,9922)	1	(0018,9920)	*1*	*EQUAL*	"ROTATIONAL SUB ACQ"
Acquisition Mode	(xxxx,xx02)	1	(0018,9920)	*1*	*EQUAL*	"Rotational"
Storage Protocol Element Sequence (0018,9936)				Storage Element #1: **Send to 3D Workstation**		
Protocol Element Number	(0018,9921)	1	(0018,9936)	*1*	*EQUAL*	1
Protocol Element Name	(0018,9922)	1	(0018,9936)	*1*	*EQUAL*	"SEND TO 3D WS"
Protocol Element Purpose	(0018,9924)	1	(0018,9936)	*1*	*EQUAL*	"For 3D Reconstruction"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9936)	*1*	*EQUAL*	3
> Output Information Sequence (0040,4033) *>> DICOM Retrieval Sequence (0040,4071)*						
Destination AE	(2100,0140)	1	(0018,9936\, (0040,4033) (0040,4071)	*1\1\1*	*EQUAL*	"AET_3D_WS"

Network

3D Recon Device

Table AAAA.X2-3a

Attribute	Selector Attribute (0072,0026)	Selector Value Number (0072,0028)	Selector Sequence Pointer (0072,0052)	Selector Sequence Pointer Items (0074,1057)	Constraint Type	Constraint Value
Reconstruction Protocol Element Sequence (0018,9934)				Reconstruction Element #1: **3D SUB Reconstruction**		
Protocol Element Number	(0018,9921)	1	(0018,9934)	*1*	*EQUAL*	1
Protocol Element Name	(0018,9922)	1	(0018,9934)	*1*	*EQUAL*	"3D SUB RECONSTRUCTION"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9934)	*1*	*EQUAL*	3
Referenced SOP Class UID	(0008,1150)	1	(0018,9934)	*1*	*EQUAL*	1.2.840.10008.5.1.4.1.1.200.X1
Referenced SOP Instance UID	(0008,1155)	1	(0018,9934)	*1*	*EQUAL*	UID_01

7. Changes to the Standard

Table A.1-9. Composite Information Object Modules Overview - Protocols

IODs Modules	XA Performed Procedure Protocol	XA Defined Procedure Protocol
Patient	M	
Clinical Trial Subject	U	
General Study	M	
Patient Study	U	
Clinical Trial Study	U	
General Series	M	
Clinical Trial Series	U	
Enhanced Series	M	
XA Protocol Series	M	
Frame of Reference	M	
General Equipment	M	M
Enhanced General Equipment	M	M
Protocol Context	M	M
Patient Protocol Context	U	
Clinical Trial Context		U
Patient Specification		U
Equipment Specification		M
Instructions	U	U
Patient Positioning	U	U
General Defined ~~CT~~ Acquisition		U
Performed XA Acquisition	U	
General Defined ~~CT~~ Reconstruction		U
Performed XA Reconstruction	U	
Defined Storage		U
Performed Storage	U	
Protocol Approval		
SOP Common	M	M

Section A.82.Y1
XA Performed Procedure Protocol IOD

Module	Reference	Usage
Patient	C.7.1.1	M
Clinical Trial Subject	C.7.1.3	U
General Study	C.7.2.1	M
Patient Study	C.7.2.2	U
Clinical Trial Study	C.7.2.3	U
General Series	C.7.3.1	M
Clinical Trial Series	C.7.3.2	U
Enhanced Series	C.7.3.3	M
XA Protocol Series	C.34.X1	M
Frame of Reference	C.7.4.1	M
General Equipment	C.7.5.1	M
Enhanced General Equipment	C.7.5.2	M
Protocol Context	C.34.2	M
Patient Protocol Context	C.34.3	U
Instructions	C.34.7	U
Patient Positioning	C.34.8	U
Performed XA Acquisition	C.34.X3	U
Performed XA Reconstruction	C.34.X5	U
Performed Storage	C.34.14	U
SOP Common	C.12.1	M

Table A.82.Y2
XA Defined Procedure Protocol IOD

Module	Reference	Usage
General Equipment	C.7.5.1	M
Enhanced General Equipment	C.7.5.2	M
Protocol Context	C.34.2	M
Clinical Trial Context	C.34.4	U
Patient Specification	C.34.5	U
Equipment Specification	C.34.6	M
Instructions	C.34.7	U
Patient Positioning	C.34.8	U
General Defined ~~CT~~ Acquisition	C.34.9	U
General Defined ~~CT~~ Reconstruction	C.34.11	U
Defined Storage	C.34.13	U
SOP Common	C.12.1	M

7. Changes to the Standard

Section		Sub-Section		Modifications and additions
Part 2: Conformance				
Section A.1	Conformance Statement Overview	**Table A.1-2**	UID Values	Add two new SOP Classes for XA Defined and Performed Procedure Protocol Storage
Part 3: Information Object Definitions				
Section 2	Normatives and References	**Section 2.6**	Other References	Add reference to [NEMA XR-27] X-ray Equipment for Interventional Procedures User Quality Control Mode.
Section 3	Definitions	**Section 3.8**	DICOM Information Object	Modify definitions of Protocol Elements, to make them generic to all modalities (or at least, include XA XA examples in addition to CT)
Section 10	Miscelaneous Macros	**Section 10**	Miscelaneous Macros	Add section for new Macro: **10.X1** GENERAL PROCEDURE PROTOCOL REFERENCE MACRO **Table 10.X1** General Procedure Protocol Reference Macro Attributes **10.X1.1** General Procedure Protocol Reference
Section A.1.4	Overview of the Composite IOD Module Content	**Table A.1-9**	Composite Information Object Modules Overview - Protocols	Add XA Defined and Performed Procedure Protocol IODs
Section A.82	Procedure Protocol Information Object Definitions	**Section A.82.2.3**	A.82.2.3 CT Defined Procedure Protocol IOD Module Table	Change the name of the modules to: "General Defined Acquisition" and "General Defined Reconstruction"
Section A.82	Procedure Protocol Information Object Definitions	**Section A.82**	Procedure Protocol Information Object Definitions	Modify introduction to make it generic to all modalities Add sections for the two new XA Protocol IODs: **A.82.Y1** XA Performed Procedure Protocol IOD **A.82.Y2** XA Defined Procedure Protocol IOD
Section C.7.3.1.1	General Series Attribute Descriptions	**Section C.7.3.1.1.1**	Modality	Add **XAPROTOCOL** to the list of Modality Terms
Section C.8.7.1	X-Ray Image Module	**Table C.8-26**	X-Ray Image Module Attributes	Include Table 10.X1 General Procedure Protocol Reference Macro Attributes
Section C.8.19.2	Enhanced XA/XRF Image Module	**Table C.8.19.2-1**	Enhanced XA/XRF Image Module Table	Include Table 10.X1 General Procedure Protocol Reference Macro Attributes
Section C.8.21.1	X-Ray 3D Image Module	**Table C.8.21.1-1**	X-Ray 3D Image Module Attributes	Include Table 10.X1 General Procedure Protocol Reference Macro Attributes
Section C.34.2	Protocol Context Module	**Table C.34.2-1**	Protocol Context Module Attributes	Add new **CID XAProt01** "Contraindications For XA Imaging" within the Contraindications Code Sequence (0018,990B)
Section C.34.7	Instructions Module	**Table C.34.7-1**	Instructions Module Attributes	Add XA PerformedProcedure Protocol Storage SOP Class UID in the conditions of Instruction Performed Flag (0018,9918)
Section C.34.8	Patient Positioning Module	**Table C.34.8-1**	Patient Positioning Module Attributes	Add XA PerformedProcedure Protocol Storage SOP Class UID in the conditions of Instruction Performed Flag (0018,9918)
Section C.34.9	Defined CT Acquisition Module	**Section C.34.9**	Defined CT Acquisition Module	Make it generic to all modalities, not specific to CT. Call it "**General Defined Acquisition**" module, add XA stuff
Section C.34.9	Defined CT Acquisition Module	**Table C.34.9.3**	Attribute Value Constraint Macro	Make it generic to all modalities, not specific to CT.
Section C.34.9	Defined CT Acquisition Module	**Table C.34.9.4**	Modifiable Constraint Flag	Make it generic to all modalities, not specific to CT. Add XA example.
Section C.34.10	Performed CT Acquisition Module	**Table C.34.10-1**	Performed CT Acquisition Module Attributes	Add Requested Series Description Code Sequence (xxxx,xx20)
Section C.34.11	Defined CT Reconstruction Module	**Section C.34.11**	Defined CT Reconstruction Module	Make it generic to all modalities, not specific to CT. Call it "**General Defined Reconstruction**" module, add XA stuff

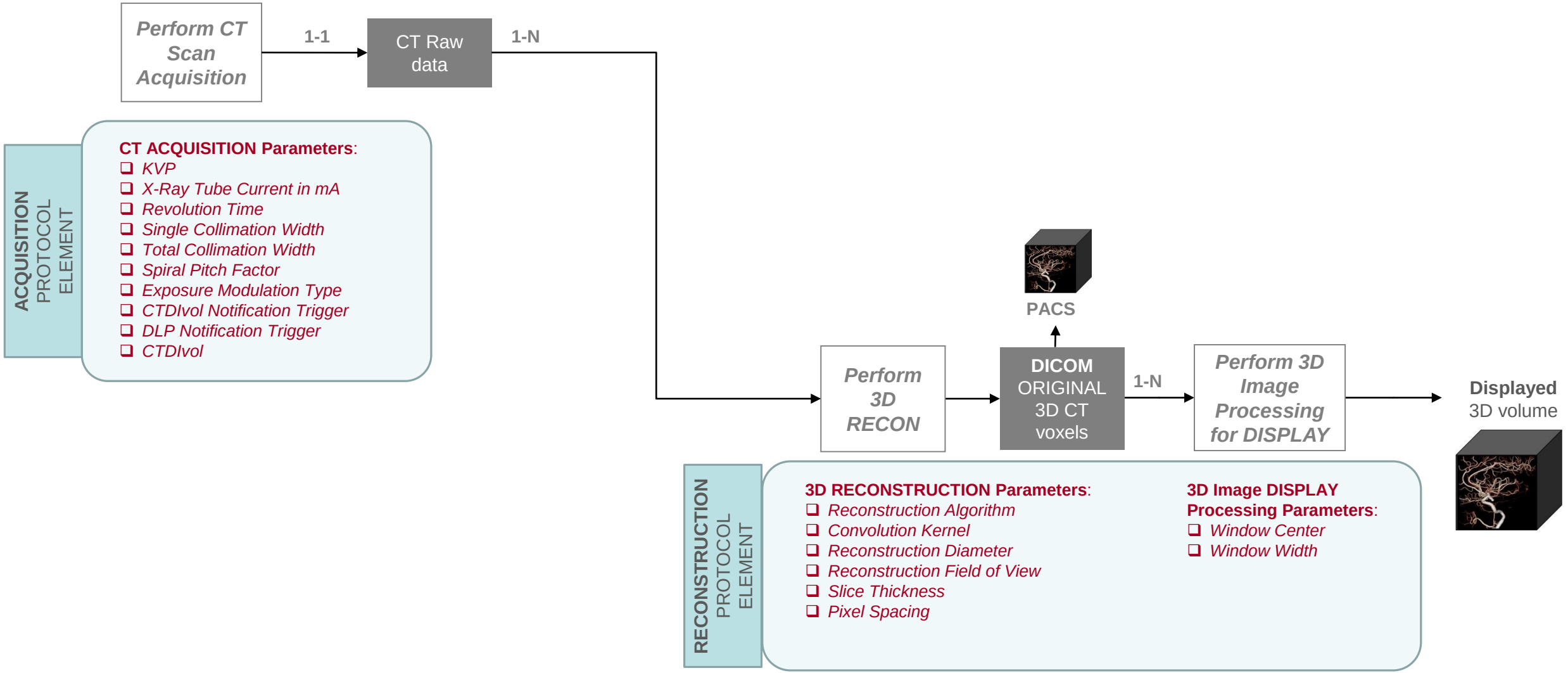
7. Changes to the Standard

Section		Sub-Section		Modifications and additions
Section C.34.12	Performed CT Reconstruction Module	**Table C.34.12-1**	Performed CT Reconstruction Module Attributes	Add Requested Series Description Code Sequence (xxxx,xx20)
Section C.34.13	Defined Storage Module	**Section C.34.13.1**	Storage Protocol Elements	Make it generic to all modalities, not specific to CT.
Section C.34.14	Performed Storage Module	**Table C.34.14-1**	Performed Storage Module Attributes	Add notes to Storage Protocol Element Sequence (0018,9936). Add XA Performed Procedure Protocol Storage SOP Class UID in the conditions and in the Enumerated terms
Section C.34	Procedure Protocol Modules	**Section C.34**	Procedure Protocol Modules	Add modules for the new XA Protocol IODs (at the end of Section C.34): **C.34.X1** XA Protocol Series Module **C.34.X3** Performed XA Acquisition Module **C.34.X5** Performed XA Reconstruction Module
Part 4: Service Class Specifications				
Section B.5	Standard SOP Classes	**Table B.5-1**	Standard SOP Classes	Add new SOP Class for XA Performed Procedure Protocol Storage
Section B.5.1	Specialization for Standard SOP Classes	**Section B.5.1.21**	CT Performed Procedure Protocol Storage SOP Class	Update title and add XA: CT and XA Performed Procedure Protocol Storage SOP Classes
Section GG.3	SOP Classes	**Table GG.3-1**	Standard SOP Classes	Add new SOP Class for XA Defined Procedure Protocol Storage to the Non-Patient Object Storage Service Class definition
Section GG.6	Application Behavior for Standard SOP Classes	**Section GG.6.4**	CT Defined Procedure Protocol Storage SOP Class	Update title and add XA: CT and XA Defined Procedure Protocol Storage SOP Classes
Part 6: Data Dictionary				
Section 6	Registry of DICOM Data Elements	**Table 6-1**	Registry of DICOM Data Elements	Add new elements
Section A	Registry of DICOM Unique Identifiers (UIDs) (Normative)	**Table A-1**	UID Values	Add two new SOP Classes for XA Defined and Performed Procedure Protocol Storage
Section A	Registry of DICOM Unique Identifiers (UIDs) (Normative)	**Table A-3**	Context Group UID Values	Add new CID XAProt01 "Contraindications For XA Imaging"
Part 15: Security and System Management Profiles				
Section E	Attribute Confidentiality Profiles	**Section E.1.1**	De-identifier	Add to Table E.1-1 the Attributes (0018,9937) Requested Series Description, and (xxxx,xx13) Acquisition Field Of View Label.
Part 16: Content Mapping Resource				
Section B	DCMR Context Groups (Normative)	**Section B**	DCMR Context Groups (Normative)	Add new CID XAProt01 "Contraindications For XA Imaging"
Section AAAA	Protocol Storage Examples and Concepts (informative)	**Section AAAA.1**	Protocol Storage Concepts	Make it generic to all modalities, not specific to CT Add **AAAA.1.3 XA Workflow**
Section AAAA	Protocol Storage Examples and Concepts (informative)	**Section AAAA.2**	Routine Adult Head Protocol	Change the name to be CT-specific: CT Routine Adult Head Protocol
Section AAAA	Protocol Storage Examples and Concepts (informative)	**Section AAAA**	Protocol Storage Examples and Concepts (informative)	Add sections for XA-specific examples of Protocol Storage **AAAA.X1** Single XA Device for Acquisition and Reconstruction **AAAA.X2** Two XA Devices for Acquisition and Reconstruction

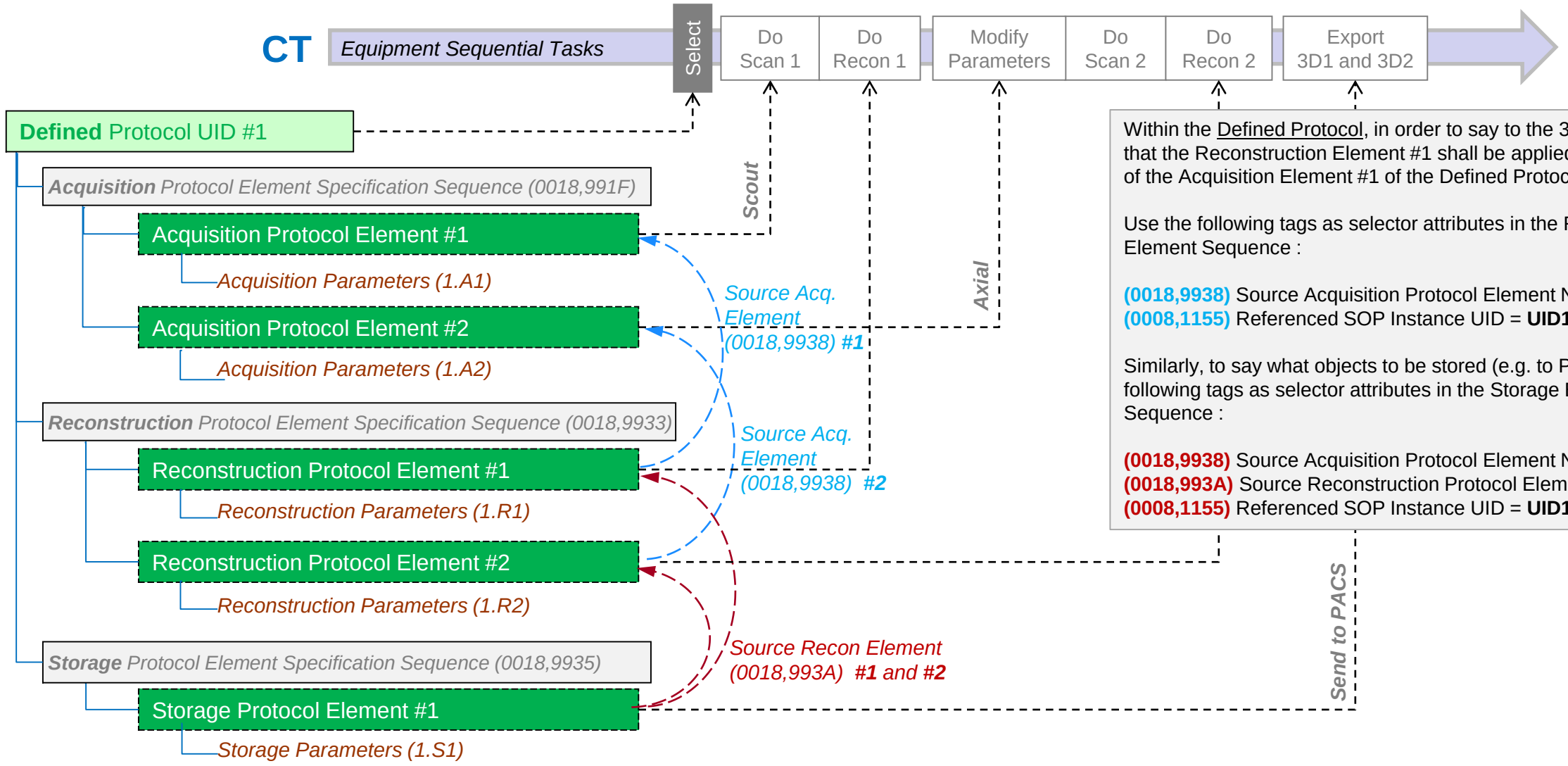
APPENDIX

CT Acquisition and Reconstruction Workflow

CT Defined Procedure Protocols: example of acquisition & 3D reconstruction workflow



CT Procedure Step Example of Defined Protocol



Within the Defined Protocol, in order to say to the 3D workstation that the Reconstruction Element #1 shall be applied to acquisitions of the Acquisition Element #1 of the Defined Protocol UID #1:

Use the following tags as selector attributes in the Reconstruction Element Sequence :

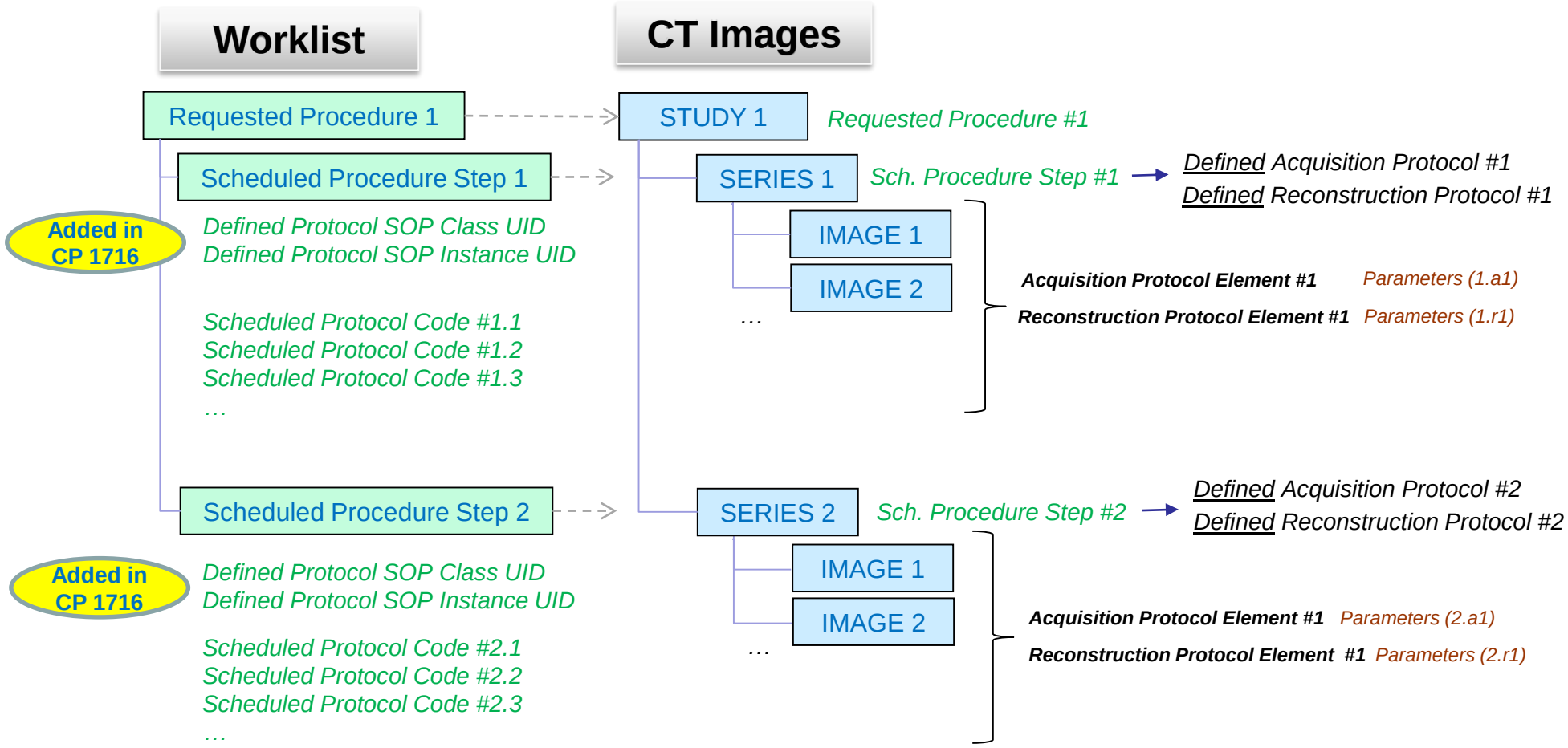
(0018,9938) Source Acquisition Protocol Element Number = **#1**
(0008,1155) Referenced SOP Instance UID = **UID1**.

Similarly, to say what objects to be stored (e.g. to PACS), use the following tags as selector attributes in the Storage Element Sequence :

(0018,9938) Source Acquisition Protocol Element Number = **#1**
(0018,993A) Source Reconstruction Protocol Element Number = **#1**
(0008,1155) Referenced SOP Instance UID = **UID1.**

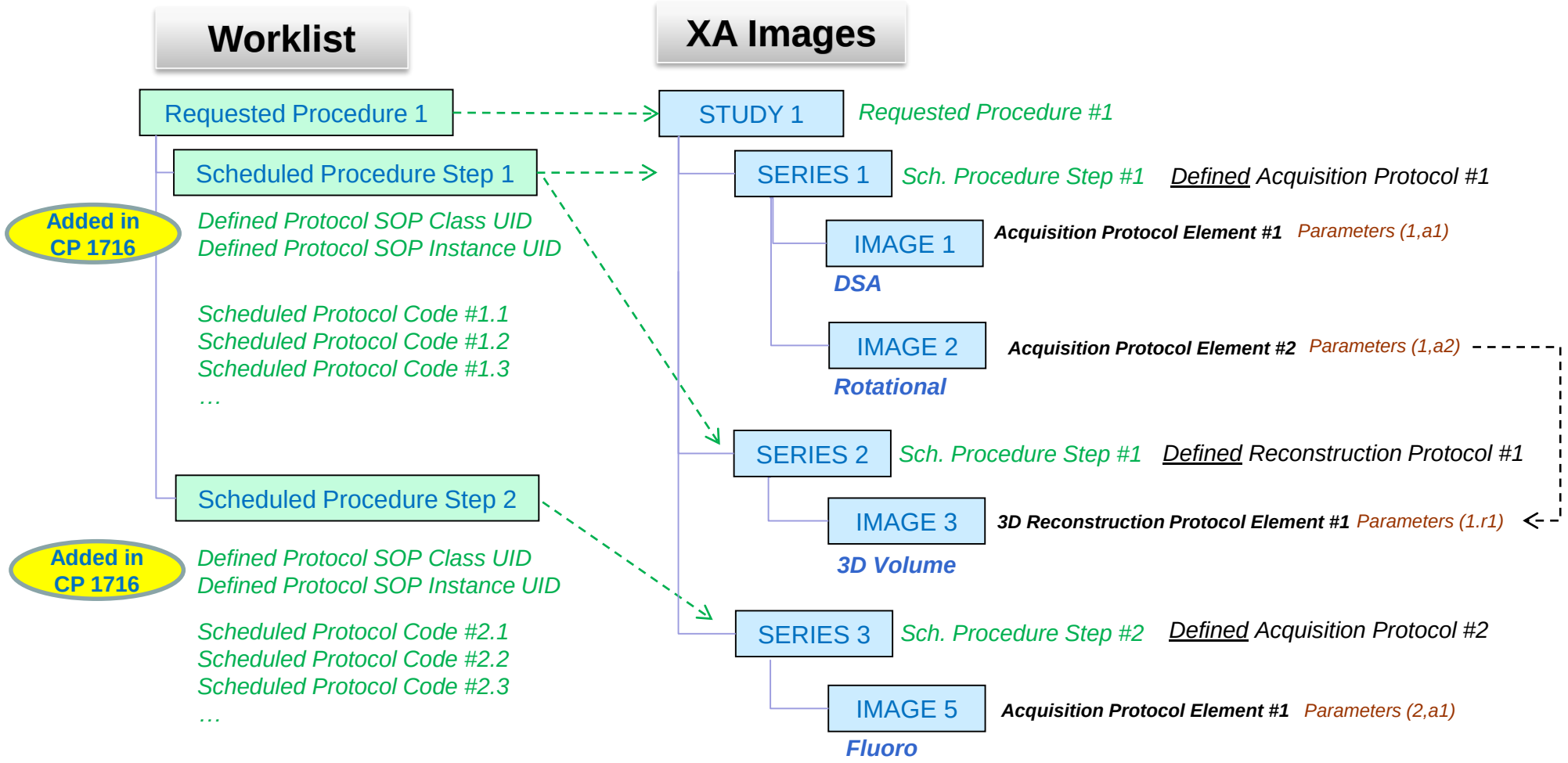
Data Structure of CT Acquisition Workflow

Example of usage of Defined Protocols and mapping with Worklist protocols:



Data Structure of XA Acquisition Workflow

Example of usage of Defined Protocols and mapping with Worklist protocols:



CT Protocols IODs & modules in PS3.3

Table A.1-9. Composite Information Object Modules Overview - Protocols

IODs Modules	CT Performed Procedure Protocol	CT Defined Procedure Protocol	Protocol Approval
Patient	M		
Clinical Trial Subject	U		
General Study	M		
Patient Study	U		
Clinical Trial Study	U		
General Series	M		
Clinical Trial Series	U		
Enhanced Series	M		
CT Protocol Series	M		
Frame of Reference	M		
General Equipment	M	M	M
Enhanced General Equipment	M	M	M
Protocol Context	M	M	
Patient Protocol Context	U		
Clinical Trial Context		U	
Patient Specification		U	
Equipment Specification		M	
Instructions	U	U	
Patient Positioning	U	U	
General Defined Acquisition		U	
Performed CT Acquisition	U		
General Defined Reconstruction		U	
Performed CT Reconstruction	U		
Defined Storage		U	
Performed Storage	U		
Protocol Approval			M
SOP Common	M	M	M

Table A.82.1.3-1. Table CT Performed Procedure Protocol IOD Modules

Module	Reference	Usage
Patient	C.7.1.1	M
Clinical Trial Subject	C.7.1.3	U
General Study	C.7.2.1	M
Patient Study	C.7.2.2	U
Clinical Trial Study	C.7.2.3	U
General Series	C.7.3.1	M
Clinical Trial Series	C.7.3.2	U
Enhanced Series	C.7.3.3	M
CT Protocol Series	C.34.1	M
Frame of Reference	C.7.4.1	M
General Equipment	C.7.5.1	M
Enhanced General Equipment	C.7.5.2	M
Protocol Context	C.34.2	M
Patient Protocol Context	C.34.3	U
Instructions	C.34.7	U
Patient Positioning	C.34.8	U
Performed CT Acquisition	C.34.10	U
Performed CT Reconstruction	C.34.12	U
Performed Storage	C.34.14	U
SOP Common	C.12.1	M

Table A.82.2.3-1. CT Defined Procedure Protocol IOD Modules

Module	Reference	Usage
General Equipment	C.7.5.1	M
Enhanced General Equipment	C.7.5.2	M
Protocol Context	C.34.2	M
Clinical Trial Context	C.34.4	U
Patient Specification	C.34.5	U
Equipment Specification	C.34.6	M
Instructions	C.34.7	U
Patient Positioning	C.34.8	U
General Defined Acquisition	C.34.9	U
General Defined Reconstruction	C.34.11	U
Defined Storage	C.34.13	U
SOP Common	C.12.1	M

Table A.82.3.1.3-1. Protocol Approval IOD Modules

Module	Reference	Usage
General Equipment	C.7.5.1	M
Enhanced General Equipment	C.7.5.2	M
Protocol Approval	C.34.15	M
SOP Common	C.12.1	M