

**Digital Imaging and Communications in Medicine (DICOM)**

*Supplement 228: DICOMweb API for Server-Side Volumetric Rendering*

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### Document History

4 June 2021	01	SJN	1 <sup>st</sup> draft
28 June 2021	02	SJN	Updates after 1 <sup>st</sup> WG-27 review <ul style="list-style-type: none"> <li>Table formatting in section 8.x</li> <li>Update reference for Rendering Method tag in 8.3.5.1.6.3</li> <li>Define input volume in 8.3.5.1.6 and 8.7.2-1</li> </ul>
1 Sept 2021	03	SJN	Update Open/Closed issues and flagged TODO items after WG-06 review 31 Aug 2021.

2

### Open Issues

1.	<p>There is a strong case to include animation (rotate a 3D object) in the API (e.g. render a movie for ppt or multimedia report)</p> <p>Is the <a href="#">Presentation Animation Module</a> too complex for the basic use case?</p> <p>Swivel is a basic 3D parameter. MPR cross curve is more complex, requiring start, end, step, step size.</p> <p>Do we:</p> <ul style="list-style-type: none"> <li>Maintain 2 sets of parameters (swivel &amp; crosscurve)?</li> <li>Define common parameters: start, end and step? If 3D, step in degrees, if MPR step in mm.</li> </ul>
2.	<p>How should 4D animation (beating heart) be addressed? This is currently addressed in the Presentation Animation Style, PRESENTATION_SEQ in the <a href="#">Presentation Animation Module</a>.</p>
3.	<p>Is the proposed text in PS18 8.11 sufficient to address recognizable visual features that could be displayed by volumetric rendering?</p>
4.	<p>Is there a use case that supports rendering of STL, OBJ, polygon mesh object types?</p>
5.	<p>Oblique planes would be useful for clients to modify <code>anatomicorientation</code> in addition to perpendicular planes. Should a set of projections be established based on clinical vocabulary to express oblique projections?</p> <p>Examples should be based on a common clinical vocabulary such as cardiac cath. projections (RAO, LAO, cranial, caudal) or a subset based on SNOMED (SCTID: 260419006).</p>
6.	<p>Can any of the 3dorientation values be left empty, or should they all be required as written (c.f. viewport scaling)?</p>
7.	<p>Should viewport scaling be allowed as an overriding parameter for Volumetric Presentation States? Note: This conflicts with PS18 8.3.5.1.3 but establishes a consistency with <code>preset</code> and URI.</p>
8.	<p>What should be the approach for the "3D aware" use case?</p>

Commented [NS(H1)]: TODO rename to "Protocol" throughout

	<p>What is the desired approach for 3D aware? Should a client use STOW to create a VPS for rendering and then apply basic overriding parameters, or should the client be allowed to specify a GET with VPS payload (omitting the Patient, Study, Series Frame of Reference, Equipment, Volumetric Presentation State Identification and Volumetric Presentation State Relationship modules)</p> <p>Should the supplement include a json representation for the volumetric presentation based on the volumetric presentation IOD for the 3D Aware use case?</p>
9.	<p>Should multiple static volumes (e.g. merging CT and PET) be supported in the Basic Use case or reserved for 3D Aware?</p> <p>How should transparency be addressed?</p>
10.	<p>Should there be an API (POST) to save a Volumetric Presentation State?</p> <p>Should there be an API (POST) to save a or batch reformat?</p> <p>or is STOW sufficient?</p>
11.	<p>From a Conformance perspective, should servers be required to support both Basic and 3D Aware use cases?</p>
12.	<p>Is it appropriate to apply an iccprofile to a color Volume Rendering?</p>
13.	<p>Should there be a patient instance based on the Preset, or is the Volumetric Presentation sufficient? (i.e. Preset applied to a Study)</p>
14.	<p>Should this service be extensible? If so, how?</p>
15.	<p><b>(WG-06 31-Aug):</b> Should there be a service to define volumes?</p>

3

### Closed Issues

1.	<p>How to address tradeoffs in quality vs. size of video for lightweight devices (addressed with existing quality / scaling parameters) .</p> <p><b>Answer:</b> The existing quality parameter addresses this.</p>
2.	<p>What is the desired level of "interactivity" for the Basic Client?</p> <p><b>Answer:</b> pan, zoom, rotate</p>
3.	<p>Need to support Volume Rendering presets that can be applied in hanging protocols for a ZFP viewer.</p> <p><b>Answer:</b> This is addressed in the preset IOD</p>
4.	<p>What is the level of Ultrasound support?</p> <p><b>Answer:</b> MPR should address most needs</p>
5.	<p>How is vendor proprietary binary data supported</p> <p><b>Answer:</b> Out of scope</p>

6.	<p>Parameters potentially conflicting with preset UID include render method, slab thickness and annotation.</p> <p>Part 18 prescribes origin server behavior for conflicting presentation state parameters (Frame Number, Source Image Region, or Windowing)</p> <p>Should the basic use case be as strict? Options include:</p> <ol style="list-style-type: none"> <li>1. 1<sup>st</sup> apply the preset and 2<sup>nd</sup> apply overriding parameters?</li> <li>2. Let the server decide to apply overriding parameters that are not in conflict?</li> <li>3. Return an error?</li> </ol> <p><b>Answer:</b> This supplement defines conflicting parameters.</p>
7.	<p>Should Anatomical Orientation, Viewpoint coordinates (3D) or MPR coordinates (MPR) be accepted as an overriding parameter for rendering a Volumetric Presentation State?</p> <p>This is inconsistent with the pattern of the 2D presentation state render behavior, however, could be useful to allow the client to set the desired orientation of a Volumetric Presentation State.</p> <p>One could also argue that, in Volume Rendering, the orientation is moving the camera and not changing the rendered object (resource). See 8.3.5.1.6.6</p>
8.	<p>Should either the preset UID or the presentation UID required as a mandatory parameter?</p> <p><b>No</b></p>
9.	<p>Should this service be extended to the URI Web Service PS18 9.x? or is it sufficient to limit it to the Retrieve Transaction of the Studies Web Service? <b>No</b></p>
10.	<p>What approach should be taken for selection of multi-phasic inputs?</p> <ul style="list-style-type: none"> <li>• Preset?</li> <li>• Volume Definition Object?</li> <li>• Let the Server Decide?</li> <li>• Combination?</li> </ul> <p><b>Answer (WG-06 31-Aug):</b></p> <ol style="list-style-type: none"> <li>1. define predictable standardized cases and let the server identify the applicable scenario and handle according to requirements</li> <li>2. use a preset / volume definition object (split current preset into 2 IODs)</li> </ol>
11.	<p>Is the approach for return media sufficient for multi-phasic volumes?</p> <p>Does the client need to know the number of images that will be returned in a multipart response?</p> <p><b>Answer (WG-06 31-Aug):</b></p> <p>Should be based on the input and rendering instructions (e.g. animated vs static rendering)</p>
12.	<p>Should this supplement establish the “volume” or the “input” instances as the Target Resource? This is important for clarity of the supplement and to differentiate 2D from 3D rendered resources for implementers.</p> <p><b>Answer (WG-06 31-Aug):</b></p> <p>The volume should be the Target Resource, as this is the common collection parameters apply to. There are many variations in the collection of inputs that must be first identified before the server can construct the volume(s) and apply query parameters.</p>
13.	<p>Are there too many subsections of 8.3.5.1.6.x? This was done to allow for “in-line” informational sections, otherwise, these can be moved to 7.x.</p> <p><b>Answer (WG-06 31-Aug):</b></p> <p>Nesting level is acceptable</p>

**Scope and Field of Application**

This supplement extends the retrieve rendered series resource by establishing parameters to specify real time volumetric rendering behavior for creating new images, presenting 3D or 4D rendered volume of DICOM slice data as non-DICOM media types. ,TODO reword> Parameters direct the behavior of rendering display algorithms, such as multi-planar reconstruction, surface rendering and volume rendering in accordance with the principles already established for Volumetric Presentation States.

This service is intended to provide the client, typically a zero footprint viewer, the ability to request a volumetric representation of series or request the rendering a persistent Volumetric Presentation State as a single frame image, multi frame image or movie MIME type. This use case considers two types of clients:

1. the Basic client, capable of fundamental operations to select the rendering type, select a rendering preset, or manipulate volumetric view and transformations, and
2. the 3D Aware client, capable of defining and manipulating the full breadth of parameters contained within the Volumetric Presentation State IOD. In this case, capabilities are limited to Volumetric Presentation State definition, origin server capabilities and the level of client "awareness".

**Table 1-1. Functionality per Client Type**

Basic Client	3D Aware
<ul style="list-style-type: none"> <li>• Pan</li> <li>• Zoom</li> <li>• Set Quality</li> <li>• Rotate</li> <li>• Animate</li> <li>• Set Render Method</li> <li>• Apply a Preset</li> </ul>	<p>Capable of defining a Volumetric Presentation State:</p> <ul style="list-style-type: none"> <li>• Basic capabilities plus:</li> <li>• Set Display, Color</li> <li>• Set Shading, Lighting</li> <li>• Crop</li> <li>• Merge Multiple Volumes</li> <li>• Render a Composite MPR</li> <li>• Render a Curved MPR</li> <li>• Add Annotation</li> <li>• Specify Projection vs Orthographic rendering</li> <li>• Specify an Endoluminal rendering</li> </ul>

**Commented [NS(H2)]:** TODO include:  
Rendering pipeline compare/contrast to VPS  
Basic use case covers 80% of the needs

Inputs

- Input requirements
- Differences in handling vs VPS
- Provide examples
- Complexity past, present and future?
- if I know a volume we can present
- if I have a complex dataset, how can I show it as a simple volume?
- if I have a complex dataset with multiple volumes, how can I show it as multiple simple volumes?

Outputs

- Define 3D vs 4D (static vs animation) and influence on media type

Preset IOD

- Anticipated use (server ships with default, customer tweaks)
- Typical use case of protocolizing the identification and application of presets (vs try-do of searching for presets)

Animation

- Explain animation in the context of this supplement
- Scope of animation (fly through, no fly in/fly out)

Annotation

- Two meanings 1) overlay demographics 2) VPS annotation module (c.f 322)

Functionality

- Basic 3D vs DICOMweb (categorize)
- Merge multiple volumes – update terminology based on VPS (confirm if in scope)

Other scope

- segmentation
- bone removal
- 3D, MPR
- Blending / transparency

Security

- Defer to security notes in Part 18.1



24 **Update PS3.2 Table A.1-2 as follows:**

25 **Table A.1-2. UID Values**

UID Value	UID NAME	Category
...		
1.2.840.10008.5.1.4.xxuid.1	Volumetric Rendering Preset Storage	Transfer
1.2.840.10008.5.1.4.xxuid.2	Volumetric Rendering Preset FIND	Query/Retrieve
1.2.840.10008.5.1.4.xxuid.3	Volumetric Rendering Preset MOVE	Query/Retrieve
1.2.840.10008.5.1.4.xxuid.4	Volumetric Rendering Preset GET	Query/Retrieve

27 **<Placeholder> suggested updates to supp 209**

Commented [NS(H3)]: TODO

28 **Table 0-1: Rendered Media Types**

Category	Media Type	User Agent	Origin server	Transformation
Single Frame Image	image/jpeg			
	image/gif			
	image/png			
	image/jp2			
Multi-Frame Image	image/gif			
Video	video/mpeg			
	video/mp4			
	video/H265			
Text	text/html			
	text/plain			
	text/xml			
	text/rtf			
	application/pdf			
<b>Volume</b>	<b>image/jpeg</b>			
	<b>image/gif</b>			
	<b>image/png</b>			
	<b>image/jp2</b>			
	<b>video/mpeg</b>			
	<b>video/mp4</b>			
	<b>video/H265</b>			

Commented [NS(H4)]: TODO:  
•add jpegxl  
•add Category of Static Volumetric Rendering vs Animated Volumetric rendering

31 **Add Volumetric Rendering Preset to PS3.3 Section 7.13 as follows:**

32 **7.13.x Volumetric Rendering Preset Information Entity**

33 A Volumetric Rendering Preset Information Entity specifies the viewing preferences of a specific user or  
34 group, for a specific type of Study (Modality, Anatomy, and optionally Procedure, and/or Reason). A  
35 Volumetric Rendering Preset definition includes descriptors that identify the Volumetric Rendering Preset,  
36 an Icon providing a representation of the rendered volume resulting from the preset, the Modality it  
37 addresses, the Render Method and the Render Type.

38 The Volumetric Rendering Preset IE does not have any relationships with other Information Entities. See  
39 Figure 7.13-x

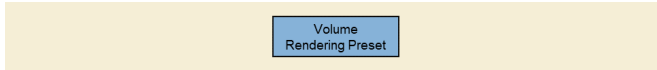


Figure 7.13-x. DICOM Model of the Real World - Volumetric Rendering Preset

**Add Volumetric Rendering Preset IOD to PS3.3 Section A.1.4 summary table as follows:**

– DICOM editor to select appropriate table (create new table for Non-Patient Objects with Color Palette and Hanging Protocol from Table A.1-3?)

**Commented [NS(H5)]:** From sup 223  
TODO: check what is in current sup 223

**A.1.4 Overview of the Composite IOD Module Content**

...

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

Module	IODs	Volumetric Rendering Preset
Preset Context		M
Patient Specification		U
Instructions		U
SOP Common		M
Volume Render Geometry		C
Render Shading		UC
Render Display		C
Multi-Planar Reconstruction Geometry		C
MPR Volumetric Presentation State Display		C
Presentation Animation		U

**Add new section for Volumetric Rendering Preset IOD to PS3.3 Annex A Composite Information Object Definitions**

**A.XX Volumetric Rendering Preset IOD**

**A.XX.1 Volumetric Rendering Preset IOD Description**

A Volumetric Rendering Preset IOD specifies the viewing preferences of a specific user or group, for a specific type of Study (Modality, Anatomy, and optionally Procedure, and/or Reason), that may be exchanged between connecting devices that claim conformance to the DICOM Standard. A Volumetric Rendering Preset includes descriptors that identify the preset, an icon that provides a representation of the rendered volume that results from the preset, , as well as shading parameters, geometry parameters and the rendering method for 3D or MPR rendering types.

Note:

See additional explanatory information in Annex XXXX in PS3.17.

**Commented [NS(H6)]:** General question – how to handle links?

**A.XX.2 Volumetric Rendering Preset IOD Entity-Relationship Model**

Volumetric Rendering Preset IOD uses the E-R Model specified in Section 7.13.X.

62 **A.XX.3 Volumetric Rendering Preset IOD Module Table**

63 Table A.XX.3-1 lists the Modules that make up the Volumetric Rendering Preset IOD.

64 **Table A.XX.3-1. Volumetric Rendering Preset IOD Modules**

IE	Module	Reference	Usage
Volumetric Rendering Preset	Preset Context	TBD	M
	SOP Common	C.12.1	M
Presentation State	Volume Render Geometry	C.11.30	C
	Render Shading	C.11.31	UC
	Render Display	C.11.32	C
	Multi-Planar Reconstruction Geometry	C.11.26	C
	MPR Volumetric Presentation State Display	C.11.27	C
	Presentation Animation	C.11.29	U

65 **Add new section for Volumetric Rendering Preset Modules to PS3.3 Annex C Information Module**  
66 **Definitions**

67 **C.XX Volumetric Rendering Preset Modules**

68 **C.XX.1 Preset Context Module**

69 The attributes of the Preset Context Module are shown in Table C.XX.1-1.

70 **Table C.XX.1-1 Preset Context Module Attributes**

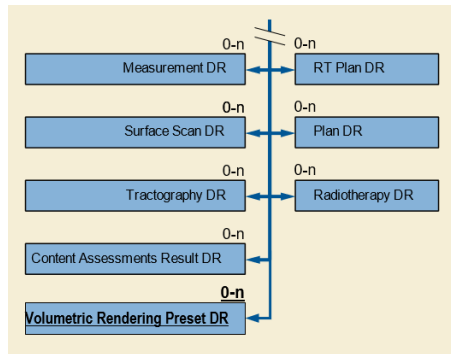
Name	Tag	Type	Description
Preset Name	(aaaa,aaaa)	1	Name for this Preset
Equipment Modality	(0008,0221)	1	Modality of the equipment to which the Preset is applicable. See Section C.7.3.1.1.1 for Defined Terms.
Reformatting Operation Type	(0072,0510)	1	Reformatting operation to be applied to the Image Set.  Defined Terms:  MPR  3D_RENDERING

**Commented [NS(H7)]: TODO:**  
•Add Dimension Pointer (volume definition module)?  
•Add description

Name	Tag	Type	Description
3D Rendering Type	(0072,0520)	1	Describes the intended 3D rendering type. One or more values shall be present.  Defined Terms:  VOLUME_RENDERING  MIP  MINIP  AVERAGE
Custodial Organization Sequence	(0040,A07C)	3	Custodial organization for this Preset Instance. Represents the organization that is currently in charge of maintaining this protocol Instance.  Note: This may or may not be identical to the Institution identified in the Equipment Module. This may or may not be the Institution that originally created this Instance.  Only a single Item is permitted in this Sequence.
Responsible Group Code Sequence	(0008,0220)	2	The department, unit or service that is responsible for the management of this Preset.  See Section C.34.2.3.  Zero or more Items shall be included in this Sequence
Icon Image Sequence	(0088,0200)	1	A preview image representing the rendered model.  Only a single Item is permitted in this Sequence.
>Include Table C.7-11b "Image Pixel Macro Attributes"			See Section C.7.6.1.1.6
Content Creator's Name	(0070,0084)	2	Name of operator (such as a technologist or physician) creating the content of the SOP Instance.
Content Creator's Identification Code Sequence	(0070,0086)	3	Identification of the person who created the content. Only a single Item is permitted in this Sequence.
Include Table 10-1 "Person Identification Macro Attributes Description"			
Anatomic Region Sequence	(0008,2218)	2	Sequence that identifies the anatomic region of interest for this Preset.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			CID 4030 "CT, MR and PET Anatomy Imaged" CID 4042 "XA/XRF Anatomy Imaged"
Potential Scheduled Protocol Code Sequence	(0018,9906)	3	A list of Protocol Codes for which this Preset may be considered a match.  One or more Items are permitted in this Sequence.
Potential Requested Procedure Code Sequence	(0018,9907)	3	A list of Protocol Codes for which this Preset may be considered a match.  One or more Items are permitted in this Sequence.

Name	Tag	Type	Description
Potential Reasons for Procedure	(0018,9908)	3	List of reasons deemed appropriate by the Preset author for a procedure using this Preset.  Each reason shall be encoded in a separate value of this multi-value Attribute.
Potential Reasons for Procedure Code Sequence	(0018,9909)	3	List of reasons deemed appropriate by the Preset author for a procedure using this Preset.  One or more Items are permitted in this Sequence.
Potential Diagnostic Tasks	(0018,990A)	3	List of diagnostic tasks deemed appropriate by the Preset author for a procedure using this Preset.  E.g., detect collections of blood, identify brain masses.
Instance Creation Date	(0008,0012)	1	Date the SOP Instance was created.
Instance Creation Time	(0008,0013)	1	Time the SOP Instance was created.

71 **Update PS3.4 Section F.4 as follows:**



72  
73 **Figure F.4-1. Basic Directory IOD Information Model**

74  
75 **Table F.4-1. Relationship Between Directory Records**

Directory Record Type	Section	Directory Record Types that may be included in the next lower-level directory Entity
(Root Directory Entity)		PATIENT, HANGING PROTOCOL, ... <b>VOLUMETRIC RENDERING PRESET</b> , PRIVATE
<b>INVENTORY</b>	<b>F.5.x</b>	<b>PRIVATE</b>

77  
78 **Update PS3.4 Table GG.3-1 as follows:**

79

**Table GG.3-1. Standard SOP Classes**

SOP Class Name	SOP Class UID	IOD Specification (defined in PS3.3)
Hanging Protocol Storage	1.2.840.10008.5.1.4.38.1	Hanging Protocol IOD
Color Palette Storage	1.2.840.10008.5.1.4.39.1	Color Palette IOD
Generic Implant Template Storage	1.2.840.10008.5.1.4.43.1	Generic Implant Template IOD
Implant Assembly Template Storage	1.2.840.10008.5.1.4.44.1	Implant Assembly Template IOD
Implant Template Group Storage	1.2.840.10008.5.1.4.45.1	Implant Template Group IOD
CT Defined Procedure Protocol Storage	1.2.840.10008.5.1.4.1.1.200.1	CT Defined Procedure Protocol IOD
Protocol Approval Storage	1.2.840.10008.5.1.4.1.1.200.3	Protocol Approval IOD
XA Defined Procedure Protocol Storage	1.2.840.10008.5.1.4.1.1.200.7	XA Defined Procedure Protocol IOD
<b>Volumetric Rendering Preset Storage</b>	<b>1.2.840.10008.5.1.4.xxuid.1</b>	<b>Volumetric Rendering Preset IOD</b>

80

81 **Add new section for Volumetric Rendering Preset to PS3.4 GG Non-Patient Object Storage:**

82 **GG.6.X Volumetric Rendering Preset SOP Class**

83 **GG.6.X.1 Instance Creator**

84 The following behavior shall be documented in the Conformance Statement of any implementation  
85 claiming conformance to a Volumetric Presentation State Storage SOP Class as an SCU:

- 86 • the manner in which presentation related Attributes are used to influence the display of an image,
- 87 • the Image Storage SOP Classes that are supported by the SCU and referenced in the Volumetric  
88 Rendering Preset Storage SOP Class,
- 89 • the Reformatting Operation Types and 3D Rendering Types that the SCP is capable of  
90 referencing in the Volumetric Rendering Preset Storage SOP Class,
- 91 • whether the Presentation Animation Module is supported, and if not supported, and
- 92 • optional Attributes of the Volumetric Rendering Preset IOD that it is capable of interpreting and  
93 those that are not supported.

94 **GG.6.X.2 Display Application**

95 The following behavior shall be documented in the Conformance Statement of any implementation  
96 claiming conformance to a Volumetric Rendering Preset Storage SOP Class as an SCP and interprets  
97 the contents of instances of the SOP Class to affect the display of images:

- 98 • the manner in which presentation related Attributes are used to influence the display of an image,
- 99 • the Reformatting Operation Types and 3D Rendering Types Attributes that the SCP is capable of  
100 rendering as a Rendered Volume that are supported by the SCP, may be rendered as a volume,  
101 and influenced by the Volumetric Rendering Preset Storage SOP Class,

- 102
- the manner in which the Volumetric Rendering Preset is applied to a collection of Image Instances or frames within Image Instances containing multiple volume subsets (See Section 8.3.5.1.6 PS3.18),
  - whether the Presentation Animation Module is supported, and if not supported, any notifications or lack of notifications to the user that the context information is not displayed, and
  - optional Attributes of the Volumetric Rendering Preset IOD that it is capable of interpreting and those that are not supported.
- 103  
104  
105  
106  
107  
108

109

110 **Add new section for Volumetric Rendering Preset Query/Retrieve Service Class to PS3.4**

111 **XX Volumetric Rendering Preset Query/Retrieve Service Class**

Commented [NS(H8)]: TODO: add Volumetric Definition IOD

112 **XX.1 Overview**

113 **XX.1.1 Scope**

114 The Volumetric Rendering Preset Query/Retrieve Service Class defines an application-level class-of-service that facilitates discovery of and access to Volumetric Rendering Preset composite objects.

116 **XX.1.2 Conventions**

117 See Conventions for the Basic Worklist Management Service (see Section K.1.2).

118 **XX.1.3 Query/Retrieve Information Model**

119 In order to serve as an SCP of the Volumetric Rendering Preset Query/Retrieve Service Class, a DICOM AE possesses information about the Attributes of a number of Volumetric Rendering Preset composite SOP Instances. The information is organized into a Volumetric Rendering Preset Information Model.

122 **XX.1.4 Service Definition**

123 Two peer DICOM AEs implement a SOP Class of the Volumetric Rendering Preset Query/Retrieve Service Class with one serving in the SCU role and one serving in the SCP role. SOP Classes of the Volumetric Rendering Preset Query/Retrieve Service Class are implemented using the DIMSE-C C-FIND, C-MOVE and C-GET services as defined in PS3.7.

127 The semantics of the C-FIND service are the same as those defined in the Service Definition of the Basic Worklist Management Service Class (see Section K.1.4).

129 The semantics of the C-MOVE and C-GET services are the same as those defined in the Service Definition of the Query/Retrieve Service Class (see Section C.1.4), with the exception that there is only one level of retrieval.

132 **XX.2 Volumetric Rendering Preset Information Model Definition**

Commented [NS(H9)]: Protocol

133 The Volumetric Rendering Preset Information Model is identified by the SOP Class negotiated at Association establishment time. The SOP Class is composed of both an Information Model and a DIMSE-C Service Group.

136 The Volumetric Rendering Preset Information Model is defined, with the Entity-Relationship Model Definition and Key Attributes Definition analogous to those defined in the Worklist Information Model Definition of the Basic Worklist Management Service (see Section K.2).

137  
138

139 **XX.3 Volumetric Rendering Preset Information Model**

140 The Volumetric Rendering Preset Information Model is based upon a one level entity:

- 141 • Volumetric Rendering Preset object instance

142 The Volumetric Rendering Preset object instance contains Attributes associated with the Volumetric  
143 Rendering Preset object IE of the Composite IODs as defined in PS3.3.

144 **XX.4 DIMSE-C Service Groups**

145 **XX.4.1 C-FIND Operation**

146 See the C-FIND Operation definition for the Basic Worklist Management Service Class (K.4.1), and  
147 substitute "Volumetric Rendering Preset" for "Worklist". The "Worklist" Search Method shall be used.

148 The SOP Class UID identifies the Volumetric Rendering Preset Information Model against which the C-  
149 FIND is to be performed. The Key Attributes and values allowable for the query are defined in the SOP  
150 Class definition for the Volumetric Rendering Preset Information Model.

151 **XX.4.2 C-MOVE Operation**

152 See the C-MOVE Operation definition for the Query/Retrieve Service Class (Section C.4.2). No Extended  
153 Behavior or Relational-Retrieve is defined for the Volumetric Rendering Preset Query/Retrieve Service  
154 Class.

155 Query/Retrieve Level (0008,0052) is not relevant to the Volumetric Rendering Preset Query/Retrieve  
156 Service Class, and therefore shall not be present in the Identifier. The Unique Key Attribute of the  
157 Identifier is the SOP Instance UID (0008,0018). The SCU shall supply one UID or a list of UIDs.

158 Note:

159 More than one Volumetric Rendering Preset SOP Instance may be retrieved, using List of UID  
160 matching.

161  
162 **XX.4.3 C-GET Operation**

163 See the C-GET Operation definition for the Query/Retrieve Service Class (Section C.4.3). No Extended  
164 Behavior or Relational-Retrieve is defined for the Volumetric Rendering Preset Query/Retrieve Service  
165 Class.

166 Query/Retrieve Level (0008,0052) is not relevant to the Volumetric Rendering Preset Query/Retrieve  
167 Service Class, and therefore shall not be present in the Identifier. The Unique Key Attribute of the  
168 Identifier is the SOP Instance UID (0008,0018). The SCU shall supply one UID or a list of UIDs.

169 Note:

170 More than one Volumetric Rendering Preset SOP Instance may be retrieved, using List of UID  
171 matching.

172  
173 **X.5 Association Negotiation**

174 See the Association Negotiation definition for the Basic Worklist Management Service Class (K.5).



175 **XX.6 SOP Class Definitions**

176 **XX.6.1 Volumetric Rendering Preset Information Model**

177 **XX.6.1.1 E/R Model**

178 The Volumetric Rendering Preset Q/R Information Model is a single level entity. In response to a given C-  
179 FIND request, the SCP shall send one C-FIND response per matching Volumetric Rendering Preset  
180 Instance.

Volume  
Rendering Preset

181 **XX.6.1.2 Volumetric Rendering Preset Attributes**

183 Table XX.6-1 defines the Attributes of the Volumetric Rendering Preset Information Model.

184 **Table XX.6.1.2-1. Attributes for the Volumetric Rendering Preset Information Model**

Description / Module	Tag	Matching Key Type	Return Key Type	Remark / Return Key Type
<b>SOP Common</b>				
Specific Character Set	(0008,0005)	-	1C	This Attribute is required if expanded or replacement character sets are used. See Section C.2.2.2 and Section C.4.1.1.
SOP Class UID	(0008,0016)	R	1	
SOP Instance UID	(0008,0018)	U	1	
<b>Preset Context</b>				
Preset Name	(aaaa,aaaa)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Equipment Modality	(0008,0221)	R	1	
Reformatting Operation Type	(0072,0510)	R	1	
3D Rendering Type	(0072,0520)	R	1	
Custodial Organization Sequence	(0040,A07C)	R	2	
>Institution Name	(0008,0080)	R	2	
>Institution Code Sequence	(0008,0082)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
<i>&gt;&gt;Include Table 8-1a "Enhanced SCU/SCP Coded Entry Macro with SCU Support, Matching Key Support and Mandatory Meaning"</i>				
Responsible Group Code Sequence	(0008,0220)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
<i>&gt;Include Table 8-1a "Enhanced SCU/SCP Coded Entry Macro with SCU Support, Matching Key Support and Mandatory Meaning"</i>				
Content Creator's Name	(0070,0084)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Anatomic Region Sequence	(0008,2218)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
<i>&gt;Include Table 8-1a "Enhanced SCU/SCP Coded Entry Macro with SCU Support, Matching Key Support and Mandatory Meaning"</i>				
Potential Scheduled Protocol Code Sequence	(0018,9906)	R	1	This Attribute shall be retrieved with Sequence or Universal matching.

Description / Module	Tag	Matching Key Type	Return Key Type	Remark / Return Key Type
<i>&gt;Include Table 8-1a "Enhanced SCU/SCP Coded Entry Macro with SCU Support, Matching Key Support and Mandatory Meaning"</i>				
Potential Requested Procedure Code Sequence	(0018,9907)	R	1	This Attribute shall be retrieved with Sequence or Universal matching.
<i>&gt;Include Table 8-1a "Enhanced SCU/SCP Coded Entry Macro with SCU Support, Matching Key Support and Mandatory Meaning"</i>				
Potential Reasons for Procedure	(0018,9908)	-	2	Potential Reasons for Procedure
Potential Reasons for Procedure Code Sequence	(0018,9909)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
<i>&gt;Include Table 8-1a "Enhanced SCU/SCP Coded Entry Macro with SCU Support, Matching Key Support and Mandatory Meaning"</i>				
Potential Diagnostic Tasks	(0018,990A)	-	2	
Instance Creation Date	(0008,0012)	R	1	Shall be retrieved with Single Value or Range Matching.  See Instance Creation Time for further details.
Instance Creation Time	(0008,0013)	R	1	Shall be retrieved with Single Value or Range Matching.  If both Instance Creation Date and Instance Creation Time are specified for Range Matching, they are to be treated as if they were a single DateTime Attribute e.g., the date range July 5 to July 7 and the time range 10am to 6pm specifies the time period starting on July 5, 10am until July 7, 6pm.

186

187 **XX.6.1.3 Conformance Requirements**

188 An implementation may conform to one of the Volumetric Rendering Preset Query/Retrieve Service SOP  
189 Classes as an SCU, SCP or both. The Conformance Statement shall be in the format defined in PS3.2.

190 **XX.6.1.3.1 SCU Conformance**

191 **XX.6.1.3.1.1 C-FIND SCU Conformance**

192 An implementation that conforms to the Volumetric Rendering Preset FIND SOP Class as an SCU shall  
193 support queries against the Volumetric Rendering Preset Q/R Information Model using the C-FIND SCU  
194 Behavior described for the Basic Worklist Management Service Class (see Section K.4.1.2 and  
195 Section XX.4.1).

196 An implementation that conforms to one of the Volumetric Rendering Preset Information Model SOP  
197 Classes as an SCU shall state in its Conformance Statement whether it requests Type 3 Return Key  
198 Attributes and shall list these Optional Return Key Attributes.

199 An implementation that conforms to one of the Volumetric Rendering Preset Information Model SOP  
200 Classes as an SCU shall state in its Conformance Statement how it makes use of Specific Character Set  
201 (0008,0005) when encoding queries and interpreting responses.

202 **XX.6.1.3.1.2 C-MOVE SCU Conformance**

203 An implementation that conforms to the Volumetric Rendering Preset MOVE SOP Class as an SCU shall  
204 support transfers against the Volumetric Rendering Preset Q/R Information Model using the C-MOVE  
205 SCU baseline behavior described for the Query/Retrieve Service Class (see Section C.4.2.2.1 and  
206 Section XX.4.2).

207 **XX.6.1.3.1.3 C-GET SCU Conformance**

208 An implementation that conforms to the Volumetric Rendering Preset GET SOP Class as an SCU shall  
209 support transfers against the Volumetric Rendering Preset Q/R Information Model using the C-GET SCU  
210 baseline behavior described for the Query/Retrieve Service Class (see Section C.4.3.2).

211 **XX.6.1.3.2 SCP Conformance**

212 **XX.6.1.3.2.1 C-FIND SCP Conformance**

213 An implementation that conforms to the Volumetric Rendering Preset FIND SOP Class as an SCP shall  
214 support queries against the Volumetric Rendering Preset Q/R Information Model using the C-FIND SCP  
215 Behavior described for the Basic Worklist Management Service Class (see Section K.4.1.3).

216 An implementation that conforms to one of the Volumetric Rendering Preset Information Model SOP  
217 Classes as an SCP shall state in its Conformance Statement whether it requests Type 3 Return Key  
218 Attributes and shall list these Optional Return Key Attributes.

219 An implementation that conforms to one of the Volumetric Rendering Preset Information Model SOP  
220 Classes as an SCP shall state in its Conformance Statement how it makes use of Specific Character Set  
221 (0008,0005) when encoding queries and interpreting responses.

222 **XX.6.1.3.2.2 C-MOVE SCP Conformance**

223 An implementation that conforms to the Volumetric Rendering Preset MOVE Class as an SCP shall  
224 support transfers against the Volumetric Rendering Preset Q/R Information Model using the C-MOVE  
225 SCP baseline behavior described for the Query/Retrieve Service Class (see Section C.4.2.3.1).

226 An implementation that conforms to the Volumetric Rendering Preset Storage SOP Class as an SCP,  
227 which generates transfers using the C-MOVE operation, shall state in its Conformance Statement  
228 appropriate Storage Service Class, under which it shall support the C-STORE sub-operations generated  
229 by the C-MOVE.

230 **XX.6.1.3.2.3 C-GET SCP Conformance**

231 An implementation that conforms to the Volumetric Rendering Preset GET SOP Class as an SCP shall  
232 support transfers against the Volumetric Rendering Preset Q/R Information Model using the C-GET SCP  
233 baseline behavior described for the Query/Retrieve Service Class (see Section C.4.3.3.1).

234 **XX.6.1.4 SOP Classes**

235 The SOP Classes of the Volumetric Rendering Preset Query/Retrieve Service Class identify the  
236 Volumetric Rendering Preset Q/R Information Model, and the DIMSE-C operations supported. The  
237 following Standard SOP Classes are identified:

238 **Table XX.6.1.4-1. Volumetric Rendering Preset Q/R Service SOP Classes**  
239

SOP Class Name	SOP Class UID
Volumetric Rendering Preset FIND	1.2.840.10008.5.1.4.xxuid.2
Volumetric Rendering Preset MOVE	1.2.840.10008.5.1.4.xxuid.3

SOP Class Name	SOP Class UID
Volumetric Rendering Preset GET	1.2.840.10008.5.1.4.xxuid.4

240

241 **Update PS3.6 Table 6-1 as follows:**

**Table 6-1. Registry of DICOM Data Elements**

242  
243

Tag	Name	Keyword	VR	VM	
...					
Preset Name	(aaaa,aaaa)	VolumetricPresetName	LO	1	
...					

244 **Update PS3.6 Table 6-1 as follows:**

**Table A-1. UID Values**

245

UID Value	UID NAME	UID Type	Part
...			
1.2.840.10008.5.1.4.xxuid.1	Volumetric Rendering Preset Storage	SOP Class	PS3.4
1.2.840.10008.5.1.4.xxuid.2	Volumetric Rendering Preset FIND	SOP Class	PS3.4
1.2.840.10008.5.1.4.xxuid.3	Volumetric Rendering Preset MOVE	SOP Class	PS3.4
1.2.840.10008.5.1.4.xxuid.4	Volumetric Rendering Preset GET	SOP Class	PS3.4

246

247 **Update PS3.18 Section 7.1.2 as follows:**

Commented [NS(H10)]: TODO: preset service goes here?

248

249 **Update PS3.18 Table 8.3.5-1 as follows:**

**Table 8.3.5-1. Retrieve Rendered Query Parameters**

250

Key	Values	Target Resource Category	Section
accept	Rendered Media Type	All Categories	8.3.3.1
annotation	"patient" and/or "technique"	Image (single, or multi-frame, or volume) or Video	8.3.5.1.1
charset	character set token	All Categories	8.3.3.2
quality	uint	Image (single, or multi-frame, or volume) or Video	8.3.5.1.2
viewport	vw, vh, [ sx, sy, sw, sh ]	Non-Presentation States, or Non-Volume images	8.3.5.1.3
viewport	vw, vh,	Presentation States, or Volume Images	8.3.5.1.3
window	center, width, shape	Non-Presentation States	8.3.5.1.4

Key	Values	Target Resource Category	Section
iccprofile	"no", "yes", "srgb", "adobergb" or "rommrgb"	Image (single- or multi-frame, or volume) or Video	8.3.5.1.5
<u>preset</u>	<u>uid</u>	Image Volume	<b>8.3.5.1.6.1</b>
<u>operationtype</u>	"3d" or "mpr"	Image Volume	<b>8.3.5.1.6.2</b>
<u>renderingmethod</u>	"vr", "mip", "minip" or "average"	Image Volume	<b>8.3.5.1.6.3</b>
<u>mprview</u>	<u>tx , ty , tz , [ mw , mh , st ]</u>	Image Volume	<b>8.3.5.1.6.4</b>
<u>animation</u>		Image Volume	<b>8.3.5.1.6.5</b>
<u>anatomicorientation</u>	"a", "p", "z", "l", "h" or "f"	Image Volume	<b>8.3.5.1.6.6.1</b>
<u>3dorientation</u>	<u>px , py , pz , lx , ly , lz , ux , uy , uz</u>	Image Volume	<b>8.3.5.1.6.6.2</b>
<u>mprorientation</u>	<u>wx , wy , wz , hx , hy , hz</u>	Image Volume	<b>8.3.5.1.6.6.3</b>

Commented [NS(H11)]: TODO: open item

Commented [NS(H12)]: TODO:  
•double-check parameters for naming consistency  
•add preset find

251

252 **Insert the following after PS3.18 Section 8.3.5.1.5 as follows:**

253 **8.3.5.1.6 Rendered Image Volume**

254 The Image Volume Target Resource Category enables volumetric data requests that create new 3D or  
255 MPR images in accordance with the principles established for Volumetric Presentation States. These new  
256 images are returned as Acceptable Media Types in the response payload.

Commented [NS(H13)]: TODO: update based on WG-6 feedback

257 Note:

258 While the Image Volume Target Resource Category uses concepts established in the Volumetric  
259 Presentation States and provides a generic description of basic rendering behaviors, capabilities  
260 available in origin servers are inevitable. Nevertheless, reasonable consistency is provided to produce  
261 what is expected for a clinically acceptable result.

262 The Image Volume Target Resource is a collection of

- 263 1. A Series containing a collection of Single Frame Images, or  
264 2. frames within Image Instances, or  
265 3. a Volumetric Presentation State Instance.

266 A Series containing a collection of Single Frame Images and frames within Image Instances shall conform  
267 to the following input requirements:

- 268 • All Image Instances shall have the same values of  
269 ○ SOP Class UID(0008,0016)  
270 ○ Series Instance UID (0020,000E)  
271 ○ Frame of Reference UID (0020,0052) or Volume Frame of Reference UID (0020,9312)  
272 • All Instances or frames shall have the following Attributes of the same value:  
273 ○ Samples per Pixel (0028,0002)  
274 ○ Photometric Interpretation (0028,0004)  
275 ○ Rows (0028,0010)  
276 ○ Columns (0028,0011)  
277 ○ Bits Allocated (0028,0100)  
278 ○ Bits Stored (0028,0101)  
279 ○ High Bit (0028,0102)  
280 ○ Pixel Representation (0028,0103)  
281 ○ Pixel Spacing (0028,0030)

- 282
- Photometric Interpretation (0028,0004) shall be MONOCHROME2
  - Pixel Data (7FE0,0010) is present.
  - All Instances or Frames have orthogonal row and column vectors
  - An Image Volume Target input shall have more than one frame.
  - All Instances or Frames shall be parallel. Instances or Frames may be treated as parallel if the differences in their Image Orientation (Patient) (0020,0037) or Image Orientation (Volume) (0020,9302) are sufficiently small.
  - All Instances or Frames shall be sufficiently aligned such that a single ray can pass through the upper-left hand corner of all Instances or Frames. That ray shall be orthogonal to the plane of the frame (i.e., normal to the input frames). Instances or Frames may be treated as aligned if the degree of misalignment between frames or relative to the normal is sufficiently small.
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293 An Image Volume Target Resource input may have:

- Variable spacing between slices
  - Overlapping slice thicknesses
  - Gaps between slice thicknesses
  - Instances or Frames that share the same Image Position (Patient) (0020,0032) or Image Position (Volume) (0020,9301).
- 294
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- 298

299 Note:

300 These input requirements correspond to the Volumetric Presentation Input Type Volume Input  
301 Requirements in Section C.11.23.1 of PS3.3. In order to support temporal rendered volumes, the Image  
302 Volume Target Resource Input Requirements allow for multiple volume subsets consisting of Instances  
303 or Frames that share the same Image Position. This is to reproduce the behavior supported in the Input  
304 Sequence Position Index in Section C.11.23.2 of PS3.3  
305

306 If the Target Resource includes multiple volume subsets and the media type is a single frame image , the  
307 origin server may choose to:

1. render the first subset and return one image,
  2. render each subset and return an image for each subset, or
  3. utilize an implementation-specific method to decide which subset(s) to render, or
  4. require that the Target Resource reference a Volumetric Presentation State Instance. In this case, the origin server may return 400 (Bad Request) and include a payload containing an appropriate Status Report.
- 308
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314 If the Target Resource includes multiple volume subsets and the media type is a video, the origin server  
315 may choose to:

1. render the first subset and return one multi-frame image or video,
  2. render each subset and return a multi-frame image or video for each subset,
  3. render each subset and return one composite temporal multi-frame image or video,
  4. utilize an implementation-specific method to decide which subset(s) to render, the composition of the multi-frame image(s) or video(s) to return, or
  5. require that the Target Resource reference a Volumetric Presentation State Instance. In this case, the origin server may return 400 (Bad Request) and include a payload containing an appropriate Status Report.
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Commented [NS(H14)]: TODO: update based on WG-6

**Table 8.3.5.1.6-1. Retrieve Rendered Volume Parameter Compatibility**

Parameter	Image Instances or frames within Image Instances			Volumetric Presentation State					
	3D	MPR	Volumetric Rendering Preset NPI	Grayscale Planar MPR Volumetric Presentation State	Compositing Planar MPR Volumetric Presentation State	Volume Rendering Volumetric Presentation State	Segmented Volume Rendering Volumetric Presentation State	Multiple Volume Rendering Volumetric Presentation State	Curved MPR Volumetric Presentation State
accept	•	•	•	•	•	•	•	•	•
annotation	•	•	•	•	•	•	•	•	•
charset	•	•	•	•	•	•	•	•	•
quality	•	•	•	•	•	•	•	•	•
viewport	vw, vh values only								
window		•							
iccprofile		•							
renderingmethod	•	•	•						
mprview		•	if type = mpr						
animation	•	•							
anatomicorientation	•	•	•	•	•	•	•	•	
3dorientation	•		if type = 3d			•	•	•	
mprorientation		•	if type = mpr	•	•				

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328 **8.3.5.1.6.1 Volumetric Rendering Preset**

329 The "volumetricpreset" parameter applies a Volumetric Rendering Preset NPI that specifies the  
330 Rendering Type, Method, View and Orientation to be applied to a volume of DICOM slice data.

Commented [NS(H16)]: TODO: add preset identification service

331 The syntax of this parameter for a Rendered Volume is:

332 %s" volumetricpreset =" uid "

333 Where

uid Is the Unique Identifier of a Volumetric Rendering Preset NPI

335 One valid parameter value shall be present.

336 If additional Rendered Volume parameters are present, the origin server may choose to:

- 337 • apply parameters compatible with the Volumetric Rendering Preset Rendering Type and ignore
- 338 parameters conflicting with the Volumetric Rendering Preset Rendering Type, after applying the
- 339 Volume Rendering Preset,
- 340 • ignore all additional parameters, and apply only the Volume Rendering Preset, or
- 341 • return 400 (Bad Request) and may include a payload containing an appropriate Status Report

342 If any of the following are true:

- 343 • any the parameter value is missing or ill-formed,
- 344 • the Target Resource is a Volumetric Presentation State, or
- 345 • the Target Volumetric Rendering Preset NPI definition is incompatible with origin server rendering
- 346 capabilities,
- 347 • the Target Volumetric Rendering Preset NPI definition is incompatible with the Target Resource,

348 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
349 Status Report.

350 **8.3.5.1.6.2 Operation Type**

351 The "operationtype" parameter specifies whether a 3D or a Planar MPR Type is to be applied to a volume  
352 of DICOM slice data.

353 The syntax of this parameter for a Rendered Volume is:

354 %s" operationtype =" 1#( %s"3d" / %s"mpr" )

355 Where

3d Applies thresholding, ray-casting, volume rendering, or other methods to display a  
volume of slice data as a three dimensional projection.

mpr Displays a cross-section of a volume of slice data as a Euclidean plane.

356 Note:

357 These are adopted from the differently capitalized and punctuated values of the Reformatting Operation  
358 Type (0072,0510). See Section C.23.3 in PS3.3.

360

361 One valid parameter value shall be present.



362 If any of the following are true:

- 363 • any the parameter value is missing or ill-formed,
- 364 • the Target Resource is a Volumetric Presentation State,

365 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
366 Status Report.

367

### 368 8.3.5.1.6.3 Rendering Method

369 The "renderingmethod" parameter specifies the rendering method used during the ray casting  
370 compositing operation.

371 The syntax of this parameter for a 3D or Planar MPR Type Rendered Volume is:

```
372 %s" renderingmethod =" 1#( %s"vr" / %s"mip" / %s"minip" / %s"average" )
```

373 Where

vr	A method where each XY pixel of the rendered view is determined by accumulating the set of non-transparent voxel samples along a ray.
mip	A method that projects the interpolated sample with maximum intensity that falls in the path of each ray traced from the viewpoint to the plane of projection.
minip	A method that projects the interpolated sample with minimum intensity that falls in the path of each ray traced from the viewpoint to the plane of projection.
average	A method that projects the mean intensity of all interpolated samples that fall in the path of each ray traced from the viewpoint to the plane of projection.

374

375 Note:

376 These correspond to the differently capitalized and punctuated values of the Rendering Method  
377 (0070,120D). See Section C.11.23 in PS3.3.

378

379 If "renderingmethod" is not present, the origin server may choose to apply a default rendering method,  
380 based on the operationtype, or alternatively, return 400 (Bad Request) and may include a payload  
381 containing an appropriate Status Report.

382 If any of the parameter values are ill-formed, or the Target Resource is a Volumetric Presentation State,  
383 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
384 Status Report.

385 If any of the following are true:

- 386 • any of the parameter value is ill-formed,
- 387 • the Target Resource is a Volumetric Presentation State, or
- 388 • the Volumetric Rendering Preset parameter is also present,

389 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
390 Status Report.

391 **8.3.5.1.6.4 MPR Slice**

392 The "mprview" parameter specifies the location and dimensions of a planar MPR within the Rendered  
393 Volume. This parameter specifies the top left hand corner, and optionally, the width, height and thickness  
394 of the plane.

395 The syntax of this parameter for a Planar MPR Type Rendered Volume is:

396 %s"mprview =" tx "," ty "," tz ["," [mw] "," [mh] "," [st] ]

397 **Where**

tx, ty and tz	The 3D point (x,y,z) in the VPS-RCS of the upper left hand corner of the MPR View rectangle.
mw	Width of the MPR view, in mm. If sw is not specified, the origin server shall apply a default MPR view width.
mh	Height of the MPR view, in mm. If sh is not specified, the origin server shall apply a default MPR view height.
st	Slab thickness of the orthographic rendering of a volume as a value greater than zero, in mm. If st is not specified, the origin server shall return a thin rendering of nominally minimal but unspecified thickness.

398

399 **Note:**

400 These correspond to the differently capitalized and punctuated values of the MPR Top Left Hand  
401 Corner (0070,1505) and MPR Slab Thickness (070,1503). See Section C.11.26 in PS3.3.

402

403 If "mprview" is not present, the origin server may choose to apply a default MPR plane location and  
404 render the full volume at a nominally minimal thickness or alternatively, return 400 (Bad Request) and  
405 may include a payload containing an appropriate Status Report.

406 If any of the optional parameter values are not present, the default value shall be used. Individual values  
407 may be elided, but the commas between the values shall be present. For example:

408 mprview=64,64,64,,,5

409 If trailing values are elided, then the trailing commas shall be omitted. For example:

410 mprview=64,64,64

411 The missing sw, sh and st will have their default values, i.e., the full volume shall be rendered in the MPR  
412 plane at a nominally minimal thickness.

413 If any of the following are true:

- 414 • any of the parameter values are ill-formed,
- 415 • the Target Resource is a Volumetric Presentation State, or
- 416 • the operationtype parameter is "3d",

417 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
418 Status Report.

419 **8.3.5.1.6.5 Animation**

420 The "animation" parameter defines animation of the rendered view

Commented [NS(H17)]: TODO: Help from Jonathan

421 The syntax of this parameter for a Rendered Volume is:

422 %s"animation ="

423 Where

<todo>	
--------	--

424

425 If the Target Resource is a Volumetric Presentation State and the Presentation Animation Module is  
426 present, the origin server shall apply the Animation parameters instead of the animation specified in the  
427 Volumetric Presentation State.

428 **8.3.5.1.6.6 Volumetric Orientation (Informational)**

429 The Rendered Volume resource category utilizes the Volumetric Presentation State Reference  
430 Coordinate System (VPS-RCS). See Section C.11.30.1 in PS3.3 for more information.

431 If "anatomicorientation" and "3dorientation" or "mprorientation" are not present, the origin server may  
432 choose to apply a default orientation or return 400 (Bad Request) and may include a payload containing  
433 an appropriate Status Report.

434 If the Target Resource is a Volumetric Presentation State and compatible "anatomicorientation",  
435 "3dorientation" or "mprorientation" Volumetric Orientation parameters are present, the origin server shall  
436 apply the Volumetric Orientation parameter instead of the geometry specified in the Volumetric  
437 Presentation State.

438 **8.3.5.1.6.6.1 Anatomical Orientation**

439 The "anatomicorientation" parameter specifies the patient's orientation as seen by the camera for the  
440 current 3D frame or MPR plane. The anatomical orientation shall be designated using the capital letters:

441 The syntax of this parameter for a 3D or a Planar MPR Type Rendered Volume is:

442 %s"anatomicorientation =" 1#( %s"a" / %s"p" / %s"r" / %s"l" / %s"h" / %s"f" )

443

444 Where

- a The camera is viewing the patient's anterior, or coronal plane.
- p The camera is viewing the patient's posterior.
- r The camera is viewing the patient's right, or sagittal plane.
- l The camera is viewing the patient's left, or sagittal plane.
- h The camera is viewing the patient from above, or superior, in the axial plane.
- f The camera is viewing the patient from below, or inferior.

445

446 Note:

447 These correspond to the differently capitalized and punctuated values of the Anatomical Orientation  
448 Type (0010,2210). See Section C.7.6.1.1.1 in PS3.3.

449

450 One valid parameter value shall be present.

451 If any of the following are true:

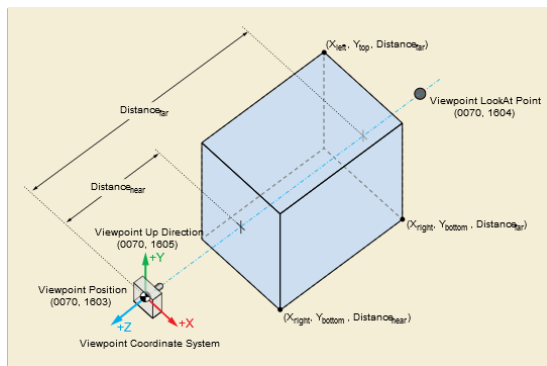
- 452 • any the parameter value is missing or ill-formed,
- 453 • the Target Resource is a Curved MPR Volumetric Presentation State, or
- 454 • either the "3dorientation" or "mprorientation" parameter are present,

455 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
456 Status Report.

457

### 458 8.3.5.1.6.6.2 3D Orientation

459 The "3dorientation" parameter specifies the position of the camera for the current frame, with regards to  
460 the patient. For 3D Rendered Volumes, the viewpoint is positioned and oriented within the VPS-RCS by  
461 Viewpoint Position, Viewpoint LookAt Point, and Viewpoint Up Direction. This position and orientation  
462 establish a Viewpoint Coordinate System (VCS), which is a right-hand coordinate system in which the  
463 viewpoint is positioned at (0,0,0) and is looking at a point at (0,0,-z) and the up direction is along the +y  
464 axis.



465

466 **Figure 8.3.5.1.6.6.2-1. 3D Orientation**

467 Note:

468 The Rendered Volume resource category is limited to Orthographic projection for simplicity and ease of  
469 use.

470 The syntax of this parameter for a 3D Type Rendered Volume is:

471 %s"3dorientation =" px "," py "," pz "," lx "," ly "," lz "," ux "," uy "," uz

472 Where

- px, py and pz Position of the viewpoint in volume space.  
A point (x,y,z) in the VPS-RCS.
- lx, ly and lz Point the viewpoint is looking at.  
A vector (x,y,z) in the VPS-RCS.
- ux, uy and uz Vertical orientation of the view.  
A vector (x,y,z) in the VPS-RCS.

Commented [NS(H18)]: TODO reference graphics, don't copy them

Commented [NS(H19)]: Orthographic = good for measurement (include in scope)

473

474 Note:

475 These correspond to the differently capitalized and punctuated values of the Viewpoint Position  
476 (0070,1603), Viewpoint LookAt Point (0070,1604) and Viewpoint Up Direction (0070,1605). See  
477 Section C.11.30 in PS3.3.

478 All nine parameters shall be present with valid values.

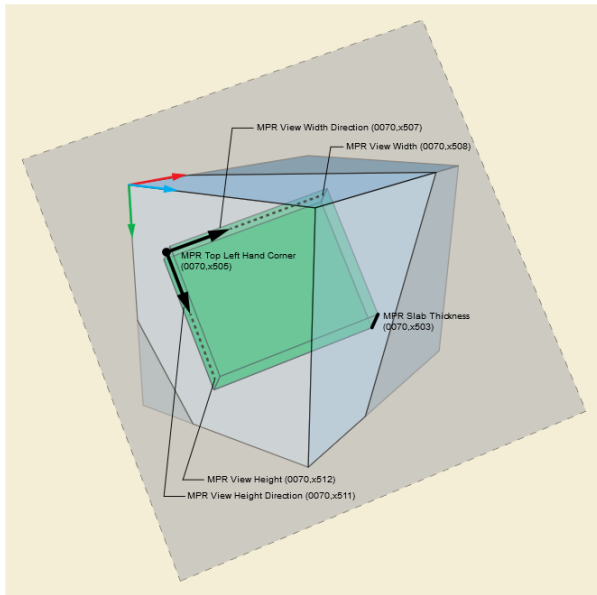
479 If any of the following are true:

- 480 • any of the parameter values are missing or ill-formed,
- 481 • the Target Resource is a Grayscale Planar MPR Volumetric Presentation State,
- 482 • the Target Resource is a Compositing Planar MPR Volumetric Presentation State,
- 483 • the Target Resource is a Curved MPR Volumetric Presentation State,
- 484 • the "operationtype" parameter is "mpr", or
- 485 • the "anatomicorientation" parameter is also present,

486 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
487 Status Report.

#### 488 8.3.5.1.6.6.3 MPR Orientation

489 The "mprorientation" parameter specifies the orientation of the MPR plane within the Rendered Volume.  
490 The MPR plane is oriented within the VCS-RCS by MPR View Width Direction, MPR View Width, MPR  
491 View Height , and MPR View Height. See Section C.11.26 in PS3.3 for more information.



492

493

Figure 8.3.5.1.6.6.3-1. MPR Orientation

494 The syntax of this parameter for a Planar MPR Type Rendered Volume is:

495 %s"mprorientation =" wx "," wy "," wz "," hx "," hy "," hz

496 Where

wx, wy and wz Direction cosine (x,y,z) indicating the direction within the VPS-RCS of the top row of the MPR view.

hx, hy and hz Direction cosine (x,y,z) indicating the direction within the VPS-RCS of the leftmost column of the MPR view.

497

498 Note:

499 These correspond to the differently capitalized and punctuated values of the MPR View Width Direction  
500 (0070,1507), MPR View Width (0070,1508), MPR View Height Direction (0070,1511), and MPR View  
501 Height (0070,1512). See Section C.11.26 in PS3.3.

502 All six parameters shall be present with valid values.

503 If any of the following are true:

- 504 • any of the parameter values are missing or ill-formed,
- 505 • the Target Resource is a Volume Rendering Volumetric Presentation State,
- 506 • the Target Resource is a Segmented Volume Rendering Volumetric Presentation State,
- 507 • the Target Resource is a Multiple Volume Rendering Volumetric Presentation State,
- 508 • the "operationtype" parameter is "3d", or
- 509 • the "anatomicorientation" parameter is also present,

510 then the response shall be 400 (Bad Request) and may include a payload containing an appropriate  
511 Status Report.

512 **Update PS3.18 Table 8.7.2-1 as follows:**

513 **Table 8.7.2-1. Resource Categories**

Resource Category	Definition
Single Frame Image	This category includes all resources that are: <ol style="list-style-type: none"> <li>1. Instances of a single frame SOP Class, or</li> <li>2. Instances of a multi-frame SOP Class that contain only one frame, or</li> <li>3. a single frame selected from an Instance of a multi-frame SOP Class.</li> </ol>
Multi-Frame Image	This category includes all resources that are Instances of a multi-frame SOP Class, that are not Video and that contain more than one frame.
<b>Image Volume</b>	<b><u>This category includes resources that are volume data set of Instances, Frames or a Volumetric Presentation Instance for rendering a 3D or an MPR Image that conform to the input requirements in Section 8.3.5.1.6.</u></b>
Video	This category includes all resources that contain more than one frame and are: <ol style="list-style-type: none"> <li>1. Instances encoded in the MPEG family of Transfer Syntaxes (which includes MPEG2, MPEG-4 AVC/H.264 and HEVC/H.265), or</li> </ol>

Commented [NS(H20)]: TODO: Move width and height to 8.3.5.1.6.4

Resource Category	Definition
	2. time-based (motion) multi-frame images that the origin server is capable of encoding in the MPEG family.
Text	This category includes all resources that contain: <ol style="list-style-type: none"> <li>1. the SR Document Content Module (see Section C.17.3 "SR Document Content Module" in PS3.3), such as narrative text, Structured Reports, CAD, measurement reports, and key object selection documents, or</li> <li>2. the Encapsulated Document Module (see Section C.24.2 "Encapsulated Document Module" in PS3.3).</li> </ol>
Other	This category includes all resources that are not included above, for example waveforms.

514

515

516 **Update PS3.18 Section 8.6 as follows:**

517 **8.6 Conformance**

518 An implementation claiming conformance to this Part of the Standard shall function in accordance with all  
519 its mandatory sections.

520 DICOM Web Services are used to transmit Composite SOP Instances. All Composite SOP Instances  
521 transmitted shall conform to the requirements specified in other Parts of the Standard.

522 An implementation may conform to the DICOM Web Services by supporting the role of origin server or  
523 user agent, or both, for any of the Services defined in this Part of the Standard. The structure of  
524 Conformance Statements is specified in PS3.2.

Commented [NS(H21)]: TODO: discuss fit with WG-33 (sup 209)

525 An implementation shall describe in its Conformance Statement the Real-World Activity associated with  
526 its use of DICOM Web Services, including any proxy functionality between a Web Service and the  
527 equivalent DIMSE Service.

528 An implementation shall describe in its Conformance Statement the security mechanisms utilized by the  
529 implementation. See Section 8.11.

530 **An implementation supporting the Volume Target Resource Category shall document:**

- 531 • **whether a Volumetric Rendering Preset can be applied to a Rendered Volume (volumetricpreset)**
- 532
- 533 • **the Reformatting Operation Types (operationtype) and 3D Rendering Types (renderingmethod) that the origin server is capable of reconstructing as a Rendered Volume.**
- 534
- 535 • **the query parameters supported for orientation (anatomicorientation, 3dorientation and mporientation)**
- 536
- 537 • **whether Animation (animation) is supported.**
- 538 • **default behaviors for omitted parameters.**
- 539

- 540 • **the manner in which the origin server renders a Target Resource that includes multiple**
- 541 **subsets of instances, and**
- 542 • **the handling of single image and video media types for a Target Resource that includes**
- 543 **multiple subsets of instances.**

544 **Update PS3.18 Section 8.11 as follows:**

#### 545 8.11 Security and Privacy

546 It is very likely that DICOM objects contain Protected Health Information. Privacy regulations in the United  
547 States (HIPAA), Europe (GDPR), and elsewhere, require that Individually Identifiable Information be kept  
548 private. **Origin servers supporting Rendered Volumes may inadvertently render recognizable**  
549 **visual features.** It is the responsibility of those implementing and deploying the DICOM Standard to  
550 ensure that applicable regulations for security and privacy are satisfied.

551 See, for example, [ONC Privacy Security Guide].

552 The DICOM PS3.10 File Format has security considerations that will apply whenever DICOM PS3.10 File  
553 format is used. See Section 7.5 in PS3.10 .

554 **Update PS3.18 Section 10.4.1.1.3 as follows:**

#### 555 10.4.1.1.3 Rendered Resources

556 A Retrieve Transaction on a Rendered Resource will return a response that contains representations of a  
557 DICOM Resource rendered as appropriate images, videos, text documents, or other representations. Its  
558 primary use case is to provide user agents with a simple means to display medical images, **and** related  
559 documents, **and Rendered Volumes** without requiring deep knowledge of DICOM data structures and  
560 encodings.

561 A Rendered Resource contains one or more rendered representations, i.e., in a Rendered Media type, of  
562 its parent DICOM Resource **or Rendered Volume**. [Table 10.4.1-3](#) shows the Rendered Resources  
563 supported by the Retrieve transaction along with their associated URI templates.

564 **Table 10.4.1-3. Retrieve Transaction Rendered Resources**

Resource	URI Template
Rendered Study	/studies/{study}/rendered
Rendered Series	/studies/{study}/series/{series}/rendered
Rendered Instance	/studies/{study}/series/{series}/instances/{instance}/rendered
Rendered Frames	/studies/{study}/series/{series}/instances/{instance}/frames/{frames}/rendered

565

566 The origin server shall be able to render all valid Instances of:

- 567 • the Composite SOP classes for which conformance is claimed, e.g., origin server shall be able to
- 568 render all Photometric Interpretations that are defined in the IOD for that SOP class, **and**



- 569 • **Reformatting Operation Types, 3D Rendering Types and Image Storage SOP Classes for**  
570 **which conformance is claimed.**

571 The content type of the response payload shall be a Rendered Media Type. See Section 8.7.4.

572 **Update PS3.18 Section 10.4.1.2 as follows:**

573 **10.4.1.2 Query Parameters**

574 The origin server shall support Query Parameters as required in [Table 10.4.1-5](#).

575 The user agent shall supply in the request Query Parameters as required in [Table 10.4.1-5](#).

576 **Table 10.4.1-5. Query Parameters by Resource**

Key	Resource Category	Usage		Section
		User Agent	Origin Server	
accept	All	O	M	<a href="#">Section 8.3.3.1</a>
charset	Text	O	M	<a href="#">Section 8.3.3.2</a>
annotation	Rendered	O	M	<a href="#">Section 8.3.5.1.1</a>
quality	Rendered	O	M	<a href="#">Section 8.3.5.1.2</a>
viewport	Rendered	O	M	<a href="#">Section 8.3.5.1.3</a>
	Thumbnail	O	O	
window	Rendered	O	M	<a href="#">Section 8.3.5.1.4</a>
iccprofile	Rendered	O	O	<a href="#">Section 8.3.5.1.5</a>
<b>volumetricpreset</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.1</b>
<b>operationtype</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.2</b>
<b>renderingmethod</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.3</b>
<b>mprview</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.4</b>
<b>animation</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.5</b>
<b>anatomicorientation</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.6.1</b>
<b>3dorientation</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.6.2</b>
<b>mprorientation</b>	<b>Rendered</b>	<b>O</b>	<b>O</b>	<b>Section 8.3.5.1.6.6.3</b>

577

578 **Update PS3.18 Section 10.4.1.4 as follows:**

Commented [NS(H22)]: TODO: based on 3D Aware

579 **10.4.1.4 Request Payload**

580 **Except for the Image Volume Target Resources,** the request shall have no payload.

581 **Image Volume Target Resources without Retrieve Rendered Query Parameters may be encoded**  
 582 **with a Volumetric Presentation State Storage SOP Classes payload that omits the Patient, Study,**  
 583 **Series Frame of Reference, Equipment, Volumetric Presentation State Identification and**  
 584 **Volumetric Presentation State Relationship modules:**

- 585 • **XML request messages shall be encoded as described in the Native DICOM Model defined**  
 586 **in PS3.19.**
- 587 • **JSON request messages shall be encoded as an array of DICOM JSON Model Objects**  
 588 **defined in Annex F.**

589 **Update PS3.18 Section 12.1.1 as follows:**

590 **12.1.1 Resource Descriptions**

591 An NPI Service manages resources from the same NPI Category. Target URIs have the following  
 592 templates:

593 /{npi-name}  
 594 /{npi-name}/{uid}

595 Where

596 npi-name = "color-palettes"  
 597 / "defined-procedure-protocols"  
 598 / "hanging-protocols"  
 599 / "implant-templates"  
 600 / "volumetric-rendering-preset"

601 uid ; is the Unique Identifier of an NPI Instance

602 Table 12.1.1-1 contains the templates for the NPI Resource Categories.

603 **Table 12.1.1-1. Resource Categories, URI Templates and Descriptions**

Resource Category	URI Template and Description	Corresponding IOD	Storage Class	Information Model
Color Palette	/color-palettes/{uid}	<a href="#">Section A.58 "Color Palette IOD" in PS3.3</a>	<a href="#">Section GG "Non-Patient Object Storage Service Class" in PS3.4</a>	<a href="#">Section X.1.3 "Query/Retrieve Information Model" in PS3.4</a>
Defined Procedure Protocol	/defined-procedure-protocols/{uid}	<a href="#">Section A.82 "Procedure Protocol Information Object Definitions" in PS3.3</a>	<a href="#">Section GG "Non-Patient Object Storage Service Class" in PS3.4</a>	<a href="#">Section HH.1.3 "Query/Retrieve Information Model" in PS3.4</a>

Resource Category	URI Template and Description	Corresponding IOD	Storage Class	Information Model
Hanging Protocol	/hanging-protocols/{uid}	<a href="#">Section A.44 "Hanging Protocol IOD" in PS3.3</a>	<a href="#">Section GG "Non-Patient Object Storage Service Class" in PS3.4</a>	<a href="#">Section U.1.3 "Query/Retrieve Information Model" in PS3.4</a>
Implant Template	/implant-templates/{uid}	<a href="#">Section A.61 "Generic Implant Template IOD" in PS3.3</a>	<a href="#">Section GG "Non-Patient Object Storage Service Class" in PS3.4</a>	<a href="#">Section BB.1.3 "Query/Retrieve Information Model" in PS3.4</a>
<b>Volumetric Rendering Preset</b>	<b>/volumetric-rendering-preset/{uid}</b>	<b>Section A.xx "Volumetric Rendering Preset IOD" in PS3.3</b>	<b>Section GG "Non-Patient Object Storage Service Class" in PS3.4</b>	<b>Section XX.1.3 "Query/Retrieve Information Model" in PS3.4</b>

604

605 The NPI SOP Classes are listed in [Table GG.3-1 "Standard SOP Classes" in PS3.4](#).

606 **Update PS3.18 Section 12.1.1 as follows:**

607

608 **12.6.1.2 Query Parameters**

609 The user agent shall supply, and the origin server shall support, the Common Query Parameters in  
610 Section 12.1.2.

611 The origin server shall support Query Parameters as required in Table 8.3.4-1.

612 The user agent shall supply in the request Query Parameters as required in Table 8.3.4-1.

613 For each Resource Category the origin server supports, it shall support the behaviors and matching key  
614 Attributes specified in the corresponding sections in Table 12.6.1-2.

615 **Table 12.6.1-2. NPI Resource Search Attributes**

616

Resource Category	Behaviors and Matching Key Attributes
Color Palette	Section X.6.1.2 "Color Palette Attributes" in PS3.4.
Defined Procedure Protocol	Section HH.6.1.2 "Defined Procedure Protocol Attributes" in PS3.4.
Hanging Protocol	Section U.6.1.2 "Hanging Protocol Attributes" in PS3.4.
Implant Template	Section BB.6.1.2 "Implant Template Attributes" in PS3.4.
<b>Volumetric Rendering Preset</b>	<b>Section XX.6.1.2 "Color Palette Attributes" in PS3.4.</b>

617

618