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Digital Imaging and Communications in Medicine (DICOM)

Supplement 232

JPEG XL Transfer Syntax

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Document History

2019/02/21	Version 3	DAC	Updated to reflect conventions in DocBook publishing
2022/01/10	Version 1	WEW	First version of JPEG XL Transfer Syntax supplement
2022/05/02	2	WEW	Updated version with WG-04 comments
2024/01/13	3	WEW	Restarted work to look at JPEG XL encoding again since Safari at least seems to have adopted it and there is other interest

43

Open Issues

1.	Should SCP's and DICOMweb origin servers be required to decode to JPEG baseline from the JPEG XL JPEG Recompression Transfer Syntax?
2.	Is the description of lossy compression method and ratio appropriate for the reversible transcoding case to communicate how much loss has accumulated?
3.	For working purposes, we have named the recompression Transfer Syntax "JPEG XL JPEG Recompression". Is there a better/shorter/more descriptive name?

44

Closed Issues

1.	For rendered multiframe (NOT transfer syntax) JPEG XL be allowed as a DICOMweb response for multiple frames? Yes The image/gif type is inadequate for acceptable quality, so allowing image/jxl enables much higher quality images to be returned when a multiframe is returned as a single object.
2.	Should rendered images be permitted to have more than 8 bits when rendered with JPEG XL? The availability of HDR monitors is becoming much more common, and these would allow for display of HDR content, so it could be allowed to return HDR rendered images. Yes This should be added as a separate CP.
3.	Should rendered images be allowed to request lossless JPEG XL images? Currently the only lossless format permitted for rendered images is PNG, which is fairly slow to encode/decode. Yes This should be added as a separate CP.

4	<p>Is it ok to limit the size of each frame to 4 gb for the convenience of limiting each frame to one fragment?</p> <p>Yes. This simplifies decoding/handling of JPEG XL</p>
5	<p>Should PALETTE_COLOR be permitted using the JPEG XL specific palette handling in a way different from the DICOM standard?</p> <p>No. Palette color is a specific encoding mostly used internally by RLE. The palette color in JPEG XL uses an internal palette, and allows for mixing of palette elements to improve rendering fidelity. This would be very different from DICOM RLE. However, generic palette color encoding the same way as other compression methods handle palette color should be permitted</p>
6	<p>Should floating point content be encoded as JPEG XL lossless?</p> <p>The JPEG XL format allows for 32 bit floating point. However, this is encoded in a separate tag from regular pixel data. That SOP Class allows for both 32 and 64 bit floating point values, so it isn't quite clear how to distinguish between the two for retrieval etc. This requires more consideration if it is desired to be included.</p> <p>No, not in this supplement. Yes, a separate supplement will be added for floating point for several transfer syntaxes as this is a separate application that needs to be addressed by itself.</p>
7	<p>Should a JPEG XL multiframe "video" transfer syntax be defined, encoded with fragments not matching frames but as a single instance object?</p> <p>Reasoning is that this can produce better encoding capabilities.</p> <p>No, this would be a separate type of supplement that needs individual approval</p>

45

46

Scope and Field of Application

47 This supplement adds several JPEG XL Transfer Syntaxes.

- 48 ● JPEG XL has demonstrated improved compression of color images
- 49 ● Existing Baseline JPEG images can be transcoded without additional loss to smaller JPEG XL
- 50 images (particularly useful for WSI)
- 51 ● Supports multi-frame encoding more effectively than animated gif, the only other multiframe
- 52 rendered format
- 53 ● JPEG XL has both lossless and lossy modes that can be natively displayed in some browsers
- 54 ● Has flexible encoding options (including > 8 bits, single bit)

55 JPEG XL is also added to the set of rendered formats for DICOMweb.

56

57 *Update PS3.2 Table N.5-61*

59

Table N.5-61. Supported Rendered Media Types

Category	Media Type	URI User Agent	URI Origin Server
Single Frame Image	<i>image/jpeg</i>		
	<i>image/gif</i>		
	<i>image/png</i>		
	<i>image/jp2</i>		
	<i>image/jph</i>		
	<u><i>image/jxl</i></u>		
Multi-Frame Image	<i>image/gif</i>		
	<u><i>image/jxl</i></u>		
Video	<i>video/mpeg</i>		
	<i>video/mp4</i>		
	<i>video/H265</i>		
Text	<i>text/html</i>		
	<i>text/plain</i>		
	<i>text/xml</i>		
	<i>text/rtf</i>		
	<i>application/pdf</i>		

60

61

Update PS3.2 Table N.5-70

Category	Media Type	Transfer Syntax UID	Transfer Syntax Name	User Agent	Origin Server
Single Frame Image	image/jpeg	1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction(Process 14 Selection Value 1) :Default Transfer Syntax for Lossless JPEG Image Compression		
		1.2.840.10008.1.2.4.50	<i>JPEG Baseline (Process 1) :Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression</i>		
		1.2.840.10008.1.2.4.51	<i>JPEG Extended (Process 2 & 4) :Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)</i>		
		1.2.840.10008.1.2.4.57	<i>JPEG Lossless, Non-Hierarchical (Process 14)</i>		
	image/x-dicom-rle	1.2.840.10008.1.2.5	RLE Lossless		
	image/x-jls	1.2.840.10008.1.2.4.80	JPEG-LS Lossless Image Compression		

		1.2.840.10008.1.2.4.81	JPEG-LS Lossy (Near-Lossless) Image Compression		
	image/jp2	1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)		
		1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression		
	image/jpx	1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)		
		1.2.840.10008.1.2.4.93	JPEG 2000 Part 2 Multi-component Image Compression		
	<u>image/jxl</u>	<u>1.2.840.10008.1.2.4.XX0</u>	<u>JPEG XL Lossless</u>		
		<u>1.2.840.10008.1.2.4.XX2</u>	<u>JPEG XL Lossy</u>		
		<u>1.2.840.10008.1.2.4.XX1</u>	<u>JPEG XL JPEG Recompression</u>		
Multi-frame Image	image/jpeg	1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction(Process 14 Selection Value 1) :Default Transfer Syntax for Lossless JPEG Image Compression		

		1.2.840.10008.1.2.4.50	JPEG Baseline (Process 1) :Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression		
		1.2.840.10008.1.2.4.51	JPEG Extended (Process 2 & 4) :Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)		
		1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)		
	image/x-dicom-rle	1.2.840.10008.1.2.5	RLE Lossless		
	image/x-jls	1.2.840.10008.1.2.4.80	JPEG-LS Lossless Image Compression		
		1.2.840.10008.1.2.4.81	JPEG-LS Lossy (Near-Lossless) Image Compression		
	image/jp2	1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)		
		1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression		

	image/jpx	1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)		
		1.2.840.10008.1.2.4.93	JPEG 2000 Part 2 Multi-component Image Compression		
	<u>image/jxl</u>	<u>1.2.840.10008.1.2.4.XX0</u>	<u>JPEG XL Lossless</u>		
		<u>1.2.840.10008.1.2.4.XX2</u>	<u>JPEG XL Lossy</u>		
		<u>1.2.840.10008.1.2.4.XX1</u>	<u>JPEG XL JPEG Recompression</u>		

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Update PS3.2 Table N.5-71

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Table N.5-71. Rendered Media Types

68

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

69

70

71 *Update PS3.2 Table N.5-74*

Header Field	Supported Values	Comments
Instance resource		
Accept	<i>multipart/related; type="application/dicom"; transfer-syntax={uid}</i>	See in the Overview section Table N.1-1 the supported DICOM SOP Classes / Transfer Syntaxes. Look for "Y" in the "UA" column.
	<i>multipart/related; type="application/octet-stream"</i>	
Metadata resource		
Accept	<<multipart/related; type="application/dicom+xml" multipart/related; type="application/dicom+json">>	
Bulkdata and Pixel Data resource		

Accept	<p>Uncompressed:</p> <pre><<multipart/related; type="application/octet-stream">></pre> <p>Compressed:</p> <pre><<multipart/related; type="{media-type}">></pre> <p>supported {media-type} being</p> <pre><<image/jpeg image/x-dicom-rle image/x-jls image/jphc <u>image/jxl</u> image/jp2 image/jpx video/mpeg2 video/mp4>></pre>	See details in Section N.5.3.2.1.2.
Rendered Resource		
Accept	<pre><<image/jpeg image/gif image/png image/jp2 image/jph <u>image/jxl</u> image/gif video/mpeg video/mp4 video/H265 text/html text/plain text/xml>></pre>	See details in Section N.5.3.2.1.3.
Thumbnail Resource		

Accept	<<image/jpeg image/gif image/png <i>image/jp2</i> <i>image/jph</i> <u>image/jxl</u> <i>image/gif</i> <i>video/mpeg</i> <i>video/mp4</i> <i>video/H265</i> text/html text/plain <i>text/xml</i> >>	See details in Section N.5.3.2.1.3.
All Resources		
Accept-charset	<<UTF-8 ISO-8859-1 ...>>	

73

74 *Update PS3.2 Table N.5-77*

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76

Table N.5-77. Header Fields for Retrieve Transaction - Origin Server

Header Field	Supported Values	Comments
Instance resource		

Accept	multipart/related; type="application/dicom"; transfer-syntax={uid}	See in the Overview section Table N.1-1 the supported DICOM SOP Classes / Transfer Syntaxes. Look for "Y" in the "OS" column.
	multipart/related; type="application/octet-stream"	
Metadata resource		
Accept	<<multipart/related; type="application/dicom+xml" multipart/related; type="application/dicom+json">>	
Bulkdata and Pixel Data resource		
Accept	Uncompressed: <<multipart/related; type="application/octet-stream">> Compressed: <<multipart/related; type="{media-type}">> supported {media-type} being <<Image/jpeg <i>image/x-dicom-rle</i> <i>image/x-jls</i> <i>image/jp2</i> <i>image/jphc</i> <i>image/jxl</i> <i>image/jpx</i> <i>video/mpeg2</i> <i>video/mp4</i> >>	See details in Section N.5.3.2.1.2 .
Rendered Resource		

Accept	<<image/jpeg image/gif image/png <i>image/jp2</i> <i>image/jph</i> <u>image/jxl</u> <i>image/gif</i> <i>video/mpeg</i> <i>video/mp4</i> <i>video/H265</i> text/html text/plain <i>text/xml</i> >>	See details in Section N.5.3.2.1.3.
Thumbnail Resource		
Accept	<<image/jpeg image/gif image/png <i>image/jp2</i> <i>image/jph</i> <u>image/jxl</u> <i>image/gif</i> <i>video/mpeg</i> <i>video/mp4</i> <i>video/H265</i> text/html text/plain <i>text/xml</i> >>	See details in Section N.5.3.2.1.3.
All Resources		

Content-Type	Content-Type returned by the origin server in the response. It contains the media type of the Payload. See Accept for supported Values	
	<i>Accept-charset</i>	<<UTF-8 ISO-8859-1 ...>>

77

78

79

Update PS3.2 Table N.5-79

Header Field	Supported Values	Comments
Content-Type	multipart/related; type="application/dicom"; transfer-syntax={uid}	See in the Overview section Table N.1-1 the supported DICOM SOP Classes / Transfer syntaxes (look for "Y" in the "UA" column)
	multipart/related; type="application/dicom+xml"; boundary={messageBoundary} multipart/related; type="application/dicom+json"; boundary={messageBoundary}	
	Uncompressed: multipart/related; type="application/octet-stream" Compressed: multipart/related; type="{media-type}" supported {media-type} being <<Image/jpeg image/x-dicom-rle image/x-jls image/jp2 image/jphc <u>image/jxl</u> image/jpx video/mpeg2 video/mp4>>	See details in Section N.5.3.2.1.2 .
Content-Length		<i>[If Content-Encoding is not present]</i>
Content-Encoding		<i>[If Content-Length is not present]</i>

81

82 *Update PS3.2 Table N.5-81*

83

Table N.5-81. Header Fields for Store Transaction - Origin Server

Header Field	Supported Values	Comments
Content-Type	multipart/related; type="application/dicom"; boundary={messageBoundary} multipart/related; type="application/dicom+xml"; boundary={messageBoundary} multipart/related; type="application/dicom+json"; boundary={messageBoundary}	See in the Overview section Table N.1-1 the supported DICOM SOP Classes / Transfer syntaxes (look for "Y" in the "OS" column)
	multipart/related; type="application/dicom+xml"; boundary={messageBoundary} multipart/related; type="application/dicom+json"; boundary={messageBoundary}	

	<p>Uncompressed: multipart/related; type="application/octet-stream"</p> <p>Compressed: multipart/related; type="{media-type}" supported {media-type} being <<Image/jpeg image/x-dicom-rle image/x-jls image/jp2 image/jphc <u>image/jxl</u> image/jpx video/mpeg2 video/mp4>></p>	<p>See details in Section N.5.3.2.1.2.</p>
Content-Length		[If Content-Encoding is not present.]

84

85 *Update PS3.3 Section 2.1*

86 **2.1 International Organization for Standardization (ISO) and International Electrotechnical**
87 **Commission (IEC)**

88

89 [ISO/IEC 15444-15] ISO/IEC. 2019. JPEG 2000 Image Coding System — Part 15: High-Throughput JPEG 2000.

90 [ISO 15076-1] ISO. 2005. Image technology colour management - Architecture, profile format, and data structure. Also
91 available as ICC.1:2004-10 (Profile version 4.2.0.0), International Color Consortium, available at
92 <http://www.color.org/v4spec.xalter> .

93 **[ISO/IEC 18181-1] ISO/IEC. 2022. Information technology - JPEG XL Image Coding System - Part 1**
94 **Core Coding System.**

95 **...**

96

97 *Update PS3.3 C.7.6.1.1.5.1*

98 **C.7.6.1.1.5.1 Lossy Image Compression Method**

99 Lossy Image Compression Method (0028,2114) may be multi-valued if successive lossy compression
100 steps have been applied; the value order shall correspond to the values of Lossy Image Compression
101 Ratio (0028,2112), if present.

102

103 Defined Terms for Lossy Image Compression Method (0028,2114):

104

105 ISO_10918_1

106 JPEG Lossy Compression [ISO/IEC 10918-1]

107

108 ISO_15444_15

109 JPEG 2000 image coding system — Part 15: High-Throughput JPEG 2000 [ISO/IEC 15444-15]

110

111 **ISO 18181 1**

112 **JPEG XL Lossy Compression [ISO/IEC 18181-1]**

113

114 ISO_14495_1

115 JPEG-LS Near-lossless Compression [ISO/IEC 14495-1]

116

117 ISO_15444_1

118 JPEG 2000 Irreversible Compression [ISO/IEC 15444-1]

119

120 ISO_13818_2

121 MPEG2 Compression [ISO/IEC 13818-2]

122

123 ISO_14496_10

124 MPEG-4 AVC/H.264 Compression [ISO/IEC 14496-10]

125

126 ISO_23008_2

127 HEVC/H.265 Lossy Compression [ISO/IEC 23008-2]

128

129

130 *Update PS 3.3 Section C.7.6.3.1.2*

131 C.7.6.3.1.2 Photometric Interpretation

132 The value of Photometric Interpretation (0028,0004) specifies the intended interpretation of the image pixel
133 data.

134

135 See PS3.5 for additional restrictions imposed by compressed Transfer Syntaxes.

136

137 See Section 8.2.13 in PS3.5 for constraints that apply when using DICOM Real-Time Video.

138

139 The following values are defined. Other values are permitted if supported by the Transfer Syntax but the
140 meaning is not defined by this Standard.

141

142 Defined Terms:

143

144 MONOCHROME1

145 Pixel data represent a single monochrome image plane. The minimum sample value is intended to be
146 displayed as white after any VOI gray scale transformations have been performed. See PS3.4. This value
147 may be used only when Samples per Pixel (0028,0002) has a value of 1. May be used for pixel data in a
148 Native (uncompressed) or Encapsulated (compressed) format; see Section 8.2 in PS3.5 .

149

150 MONOCHROME2

151 Pixel data represent a single monochrome image plane. The minimum sample value is intended to be
152 displayed as black after any VOI gray scale transformations have been performed. See PS3.4. This value
153 may be used only when Samples per Pixel (0028,0002) has a value of 1. May be used for pixel data in a
154 Native (uncompressed) or Encapsulated (compressed) format; see Section 8.2 in PS3.5 .

155

156 PALETTE COLOR

157 Pixel data describe a color image with a single sample per pixel (single image plane). The pixel value is
158 used as an index into each of the Red, Blue, and Green Palette Color Lookup Tables (0028,1101 -
159 1103&1201-1203). This value may be used only when Samples per Pixel (0028,0002) has a value of 1. May

160 be used for pixel data in a Native (uncompressed) or Encapsulated (compressed) format; see Section 8.2
161 in PS3.5 . When the Photometric Interpretation is Palette Color; Red, Blue, and Green Palette Color Lookup
162 Tables shall be present.

163

164 RGB

165 Pixel data represent a color image described by red, green, and blue image planes. The minimum sample
166 value for each color plane represents minimum intensity of the color. This value may be used only when
167 Samples per Pixel (0028,0002) has a value of 3. Planar Configuration (0028,0006) may be 0 or 1. May be
168 used for pixel data in a Native (uncompressed) or Encapsulated (compressed) format; see Section 8.2 in
169 PS3.5 .

170

171 HSV

172 Retired.

173

174 ARGB

175 Retired.

176

177 CMYK

178 Retired.

179

180 **XYB**

181 **XYB is a long/medium/short wavelength (LMS) based color model inspired by the human visual**
182 **system, facilitating perceptually uniform quantization. It uses a gamma of 3 for computationally**
183 **efficient decoding. The exact details of the XYB encoding are defined as part of specific image**
184 **being encoded in order to optimize image fidelity. Images in XYB transcoded to other Transfer**
185 **Syntaxes will use RGB or the appropriate equivalent (eg YBR FULL 422 for JPEG).**

186 **Note:**

187 **This is the color space used in JPEG XL [ISO 18181-1]**

188

189 YBR_FULL

190 Pixel data represent a color image described by one luminance (Y) and two chrominance planes (CB and
191 CR). This photometric interpretation may be used only when Samples per Pixel (0028,0002) has a value of
192 3. May be used for pixel data in a Native (uncompressed) or Encapsulated (compressed) format; see
193 Section 8.2 in PS3.5 . Planar Configuration (0028,0006) may be 0 or 1.

194

195 This Photometric Interpretation is primarily used with RLE compressed bit streams, for which the Planar
196 Configuration (0028,0006) may be 0 or 1; see Section 8.2.2 in PS3.5 and Section G.2 in PS3.5 . When
197 used in the US Image Module, the Planar Configuration (0028,0006) is required to be 1; see Section
198 C.8.5.6.1.16 "Planar Configuration".

199

200 Black is represented by Y equal to zero. The absence of color is represented by both CB and CR values
201 equal to half full scale.

202

203 Note

204 In the case where Bits Allocated (0028,0100) has value of 8 half full scale is 128.

205

206 In the case where Bits Allocated (0028,0100) has a value of 8 then the following equations convert between
207 RGB and YCBCR Photometric Interpretation.

208

209 $Y = + .2990R + .5870G + .1140B$

210

211 $CB = - .1687R - .3313G + .5000B + 128$

212

213 $CR = + .5000R - .4187G - .0813B + 128$

214

215 Note

216 The above is based on CCIR Recommendation 601-2 dated 1990.

217

218 YBR_FULL_422

219 The same as YBR_FULL except that the CB and CR values are sampled horizontally at half the Y rate and
220 as a result there are half as many CB and CR values as Y values.

221

222 Planar Configuration (0028,0006) shall be 0. May be used for pixel data in a Native (uncompressed) or
223 Encapsulated (compressed) format; see Section 8.2 in PS3.5 .

224

225 Note

226 This Photometric Interpretation is primarily used with JPEG compressed bit streams, but is also
227 occasionally used for pixel data in a Native (uncompressed) format.

228

229 Though the chrominance channels are downsampled, there are still nominally three channels, hence
230 Samples per Pixel (0028,0002) has a value of 3, not 2. I.e., for pixel data in a Native (uncompressed) format,
231 the Value Length of Pixel Data (7FE0,0010) is not:

232

233 $\text{Rows (0028,0010)} * \text{Columns (0028,0011)} * \text{Number of Frames (0028,0008)} * \text{Samples per Pixel}$
234 $\text{(0028,0002)} * \lfloor (\text{Bits Allocated (0028,0100)} - 1) / 8 \rfloor + 1$

235

236 padded to an even length, as it would otherwise be, but rather is:

237

238 $\text{Rows (0028,0010)} * \text{Columns (0028,0011)} * \text{Number of Frames (0028,0008)} * 2 * \lfloor (\text{Bits Allocated}$
239 $\text{(0028,0100)} - 1) / 8 \rfloor + 1$

240

241 padded to an even length.

242

243 When used to describe JPEG compressed bit streams, the chrominance sub-sampling in the JPEG bit
244 stream may differ from this description. E.g., though many JPEG codecs produce only horizontally sub-
245 sampled chrominance components (4:2:2), some sub-sample vertically as well (4:2:0). Though inaccurate,
246 the use of YBR_FULL_422 to describe both has proven harmless. For a discussion of the sub-sampling
247 notation, see [Poynton 2008].

248

249 Two Y values shall be stored followed by one CB and one CR value. The CB and CR values shall be
250 sampled at the location of the first of the two Y values. For each Row of Pixels, the first CB and CR samples
251 shall be at the location of the first Y sample. The next CB and CR samples shall be at the location of the
252 third Y sample etc.

253

254 Note

255 This subsampling sited on the even luminance pixels is often referred to as cosited sampling. The cositing
256 applies when describing pixel data in a Native (uncompressed) form. When used to describe compressed
257 bit streams, the siting depends on the compression scheme. E.g., for JPEG according to JFIF [ISO/IEC
258 10918-5], the siting is midway between luminance samples, whereas for MPEG2 [ISO/IEC 13818-2], the
259 sampling is cosited with the even luminance pixels. See also [Poynton 2008].

260

261 YBR_PARTIAL_422

262 Retired. See PS3.3-2017b.

263

264 YBR_PARTIAL_420

265 Pixel data represent a color image described by one luminance (Y) and two chrominance planes (CB and
266 CR).

267

268 This photometric interpretation may be used only when Samples per Pixel (0028,0002) has a value of 3.
269 The CB and CR values are sampled horizontally and vertically at half the Y rate and as a result there are
270 four times less CB and CR values than Y values.

271

272 Planar Configuration (0028,0006) shall be 0. Shall only be used for pixel data in an Encapsulated
273 (compressed) format; see Section 8.2 in PS3.5 .

274

275 Note

276 This Photometric Interpretation is primarily used with MPEG compressed bit streams. For a discussion of
277 the sub-sampling notation and siting, see [Poynton 2008].

278

279 Luminance and chrominance values are represented as follows:

280

281 black corresponds to $Y = 16$;

282

283 Y is restricted to 220 levels (i.e., the maximum value is 235);

284

285 CB and CR each has a minimum value of 16;

286

287 CB and CR are restricted to 225 levels (i.e., the maximum value is 240);

288

289 lack of color is represented by CB and CR equal to 128.

290

291 In the case where Bits Allocated (0028,0100) has value of 8 then the following equations convert between
292 RGB and YBR_PARTIAL_420 Photometric Interpretation

293

294 $Y = + .2568R + .5041G + .0979B + 16$

295

296 $CB = -.1482R - .2910G + .4392B + 128$

297

298 $CR = +.4392R - .3678G - .0714B + 128$

299

300 Note

301 The above is based on CCIR Recommendation 601-2 dated 1990.

302

303 The CB and CR values shall be sampled at the location of the first of the two Y values. For the first Row
304 of Pixels (etc.), the first CB and CR samples shall be at the location of the first Y sample. The next CB and
305 CR samples shall be at the location of the third Y sample etc. The next Rows of Pixels containing CB and
306 CR samples (at the same locations than for the first Row) will be the third etc.

307

308 YBR_ICT

309 Irreversible Color Transformation:

310

311 Pixel data represent a color image described by one luminance (Y) and two chrominance planes (CB and
312 CR).

313

314 This photometric interpretation may be used only when Samples per Pixel (0028,0002) has a value of 3.
315 Planar Configuration (0028,0006) shall be 0. Shall only be used for pixel data in an Encapsulated
316 (compressed) format; see Section 8.2 in PS3.5 .

317

318 Note

319 This Photometric Interpretation is primarily used with JPEG 2000 compressed bit streams.

320

321 Black is represented by Y equal to zero. The absence of color is represented by both CB and CR values
322 equal to zero.

323

324 Regardless of the value of Bits Allocated (0028,0100), the following equations convert between RGB and
325 YCBCR Photometric Interpretation.

326

327 $Y = +.29900R + .58700G + .11400B$

328

329 CB= - .16875R - .33126G + .50000B

330

331 CR= + .50000R - .41869G - .08131B

332

333 Note

334 The above is based on [ISO/IEC 15444-1] (JPEG 2000).

335

336 In a JPEG 2000 bit stream, DC level shifting (used if the untransformed components are unsigned) is
337 applied before forward color transformation, and the transformed components may be signed (unlike in
338 JPEG ISO/IEC 10918-1).

339

340 In JPEG 2000, spatial down-sampling of the chrominance components, if performed, is signaled in the
341 JPEG 2000 bit stream.

342

343 YBR_RCT

344 Reversible Color Transformation:

345

346 Pixel data represent a color image described by one luminance (Y) and two chrominance planes (CB and
347 CR).

348

349 This photometric interpretation may be used only when Samples per Pixel (0028,0002) has a value of 3.
350 Planar Configuration (0028,0006) shall be 0. Shall only be used for pixel data in an Encapsulated
351 (compressed) format; see Section 8.2 in PS3.5 .

352

353 Note

354 This Photometric Interpretation is primarily used with JPEG 2000 compressed bit streams.

355

356 Black is represented by Y equal to zero. The absence of color is represented by both CB and CR values
357 equal to zero.

358

359 Regardless of the value of Bits Allocated (0028,0100), the following equations convert between RGB and
360 YBR_RCT Photometric Interpretation.

361 $Y = \lfloor (R + 2G + B) / 4 \rfloor$ (Note: [...] mean floor)

362 CB= B - G

363 CR= R - G

364 The following equations convert between YBR_RCT and RGB Photometric Interpretation.

365 $G = Y - [(CR + CB) / 4]$

366 $R = CR + G$

367 $B = CB + G$

368 Note

369 The above is based on [ISO/IEC 15444-1] (JPEG 2000).

370 In a JPEG 2000 bit stream, DC level shifting (used if the untransformed components are unsigned) is
371 applied before forward color transformation, and the transformed components may be signed (unlike in
372 JPEG ISO/IEC 10918-1).

373 This photometric interpretation is a reversible approximation to the YUV transformation used in PAL and
374 SECAM.

375 *Update PS3.5 Section 2*

376 2 Normative References

377 The following standards contain provisions that, through references in this text, constitute provisions of this Standard.
378 At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to
379 agreements based on this Standard are encouraged to investigate the possibilities of applying the most recent editions
380 of the standards indicated below.

381 ...

382 [ISO/IEC 15444-9] ISO/IEC. 2005. Information technology - JPEG 2000 image coding system: Interactivity tools, APIs
383 and protocols.

384

385 [ISO/IEC 15444-15] ISO/IEC. 2019. Information technology - JPEG 2000 image coding system — Part 15: High-
386 Throughput JPEG 2000

387

388 **[ISO/IEC 18181-1] ISO/IEC. 2022. Information technology - JPEG XL Image Coding System - Part 1.**

389

390 *Add PS3.5 Sections 8.2.X (choose X based on insert point)*

391 **8.2.X JPEG XL Image Compression**

392 DICOM provides a mechanism for supporting the use of JPEG XL Image Compression through the
393 Encapsulated Format. Annex A defines a number of Transfer Syntaxes that reference the JPEG XL
394 Standard. The JPEG XL Lossless Transfer Syntax provides a compression scheme that preserves the bits
395 of the original image, i.e., lossless. The JPEG XL JPEG Recompression Transfer Syntax preserves the bits
396 of the (lossy) JPEG encoding. The JPEG XL Transfer Syntax is a potentially lossy compression of the
397 original image.

398 **Note**

399 *The context where the usage of lossy compression of medical images is clinically acceptable is beyond*
400 *the scope of the DICOM Standard. The policies associated with the selection of appropriate compression*
401 *parameters (e.g., compression ratio) for JPEG XL lossy compression are also beyond the scope of this*
402 *Standard.*

403 The use of the DICOM Encapsulated Format to support JPEG XL Compressed Pixel Data requires that the
404 Data Elements that are related to the Pixel Data encoding (e.g., Photometric Interpretation, Samples per
405 Pixel, Planar Configuration, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns,
406 etc.) shall contain values that are consistent with the characteristics of the compressed data stream. The
407 Pixel Data characteristics included in the JPEG XL bit stream shall be used to decode the compressed
408 data stream.

409 The requirements when using a Standard Photometric Interpretation (i.e., a Defined Term from PS.3.
410 C.7.6.3.1.2) are specified in Table 8.2.4-1. No other Standard Photometric Interpretation values shall be
411 used.

412 **Table 8.2.X-1. Valid Values of Pixel Data Related Attributes for JPEG XL Transfer Syntaxes using**
413 **Standard Photometric Interpretations**

Photometric Interpretation	Transfer Syntax	Transfer Syntax UID	Samples per Pixel	Planar Configuration	Pixel Representation	Bits Allocated	Bits Stored	High Bit
MONOCHROME1 MONOCHROME2	JPEG XL Lossless JPEG XL	1.2.840.1000 8.1.2.4.XX0 1.2.840.1000 8.1.2.4.XX2	1	absent	0 or 1	1,8,16, 24	1-24	0-23

MONOCHROME2	JPEG XL JPEG Recompression	1.2.840.1000 8.1.2.4.XX1	1	absent	0	8	8	7
XYB YBR_RCT	JPEG XL Lossless JPEG XL Lossy	1.2.840.1000 8.1.2.4.XX0 1.2.840.1000 8.1.2.4.XX2	3	0	0	8,16,2 4	8-24	7-23
YBR_FULL_422 XYB	JPEG XL JPEG Recompression	1.2.840.1000 8.1.2.4.XX1	3	0	0	8	8	7

414

415 Note

- 416 1. These requirements are specified in terms of consistency with what is encapsulated,
417 rather than in terms of the uncompressed pixel data from which the compressed data
418 stream may have been derived.
- 419 2. JPEG XL does not encode RGB directly, but internally converts the data into either XYB
420 for lossy encoding or into YBR_RCT for lossless encoding.

421

422 When decompressing, should the characteristics explicitly specified in the compressed data stream be
423 inconsistent with those specified in the DICOM Data Elements, those explicitly specified in the
424 compressed data stream should be used to control the decompression. The DICOM data elements, if
425 inconsistent, can be regarded as suggestions as to the form in which an uncompressed Data Set might
426 be encoded, subject to the general and IOD-specific rules for uncompressed Photometric Interpretation
427 and Planar Configuration, which may require that decompressed data be converted to one of the permitted
428 forms.

429 PS3.3 may constrain the values of Photometric Interpretation for specific IODs.

430 The JPEG XL bit stream is capable of encoding both signed and unsigned pixel values, hence the value
431 of Pixel Representation (0028,0103) may be either 0 or 1 for monochrome Photometric Interpretations
432 depending on what has been encoded.

433 The value of Planar Configuration (0028,0006) is irrelevant since the manner of encoding components is
434 specified in the JPEG 2000 standard, hence it shall be set to 0.

435

436 *Add PS3.5 Sections 10.X*

437 **10.X Transfer Syntax for a DICOM Default of Lossless and Lossy JPEG XL Compression**

438 One Transfer Syntax is specified for JPEG XL Lossless Image Compression, one for JPEG XL JPEG
439 Recompression, which allows for transcoding JPEG encoded data without additional loss, and a general
440 JPEG XL Image Compression scheme for any JPEG XL encoded data. Any of these may be negotiated
441 separately and there is no default or baseline specified (other than as described in Section 10.1).

442

443 Note:

444 *When a JPEG baseline encoded image is transcoded to JPEG XL, if the JPEG XL JPEG*
445 *Recompression Transfer Syntax is used rather than the JPEG XL Transfer Syntax, then it is known that*
446 *the exact bitwise representation of JPEG may be recovered.*

447

448

Add PS3.5 Section A.4.X

449 **A.4.X JPEG XL Image Compression**

450 The International Standards Organization ISO/IEC has developed an International Standard, [ISO/IEC
451 18181-1] (JPEG XL) for coding of bi-level, continuous-tone grayscale, or continuous-tone color, or
452 multichannel digital images (see Annex F for further details).

453 A DICOM Transfer Syntax for JPEG XL Image Compression shall be identified by a UID value, appropriate
454 to its JPEG XL coding process.

455 Three Transfer Syntaxes are specified for JPEG XL:

456 1. A Transfer Syntax with a UID of "1.2.840.10008.1.2.4.XX0 ", which specifies the use of the lossless
457 mode of JPEG XL.

458 2. A Transfer Syntax with a UID of "1.2.840.10008.1.2.4.XX1", which specifies the use of Reversible JPEG
459 transcoding.

460 3. A Transfer Syntax with a UID of "1.2.840.10008.1.2.4.XX2", which specifies the use of the lossy, lossless
461 or JPEG recompression mode of JPEG XL

462

463 If the SOP Class is a multi-frame object, then each frame shall be encoded separately. Each fragment
464 shall contain encoded data from a single frame.

465 Note

466 *Encoding each frame in a single fragment limits the total frame size to just under 4 gb.*

467

468 A JPEG baseline image re-coded to JPEG XL is not a derived image unless the original JPEG image was
469 a derived image, and does not require Derivation Code Sequence (0008,9215) to be added. Lossy Image
470 Compression Ratio (0028,2112) and Lossy Image Compression Method (0028,2114) shall be updated if
471 additional lossy compression is performed.

472

473

474 *Add PS3.5 Section F.X*

475 **F.X Encapsulated JPEG XL Encoded Images**

476 The International Standards Organization (ISO/IEC) has prepared an International Standard, ISO/IEC
477 18181-1 (JPEG XL), for the digital compression and coding of continuous-tone still images. This standard
478 is known as the JPEG XL Standard.

479 A JPEG XL stream allows for bit depths up to 24 bits and up to 8192 components. Components do not
480 need to all be the same type or bit depth. The color space of the image is specified in the JPEG XL
481 encoding.

482 Inclusion of a JPEG XL coded image in a DICOM message is facilitated by the use of specific Transfer
483 Syntaxes that are defined in Annex A.

484

485

486

Update PS 3.6 Table A- 1

487

Table A-1. UID Values

UID Value	UID Name	UID Keyword	UID Type	Part
1.2.840.10008.1. 1	Verification SOP Class	Verification	SOP Class	<u>PS3.4</u>
...				

488

<u>1.2.840.10008.1. XX0</u>	<u>JPEG XL Lossless</u>	<u>JPEGXLLossles s</u>	<u>Transfer Syntax</u>	<u>PS3.5</u>
---------------------------------	-------------------------	----------------------------	----------------------------	--------------

489

<u>1.2.840.10008.1. XX1</u>	<u>JPEG XL JPEG Recompression</u>	<u>JPEGXLJPEGRE compression</u>	<u>Transfer Syntax</u>	<u>PS3.5</u>
---------------------------------	-----------------------------------	-------------------------------------	----------------------------	--------------

490

<u>1.2.840.10008.1. XX2</u>	<u>JPEG XL Lossy</u>	<u>JPEGXLLossy</u>	<u>Transfer Syntax</u>	<u>PS3.5</u>
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491

492

493

Update PS 3.18 Table 8.7.3-2

494

Table 8.7.3-2. Transfer Syntax UIDs for application/dicom Media Types

495

Category	Transfer Syntax UID	Transfer Syntax Name	Optionality
Single Frame Image	1.2.840.10008.1.2.1	Explicit VR Little Endian	D
	1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction(Process 14 [Selection Value 1]): Default Transfer Syntax for Lossless JPEG Image Compression	O
	1.2.840.10008.1.2.4.50	JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	O
	1.2.840.10008.1.2.4.51	JPEG Extended (Process 2 & 4): Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)	O
	1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)	O
	1.2.840.10008.1.2.5	RLE Lossless	O
	1.2.840.10008.1.2.4.80	JPEG-LS Lossless Image Compression	O
	1.2.840.10008.1.2.4.81	JPEG-LS Lossy (Near-Lossless) Image Compression	O
	1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)	O
	1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression	O
	1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)	O
	1.2.840.10008.1.2.4.93	JPEG 2000 Part 2 Multi-component Image Compression	O
	<u>1.2.840.10008.1.2.4.X</u> <u>X0</u>	<u>JPEG XL Lossless</u>	<u>O</u>

	<u>1.2.840.10008.1.2.4.X X1</u>	<u>JPEG XL JPEG Recompression</u>	<u>0</u>
	<u>1.2.840.10008.1.2.4.X X2</u>	<u>JPEG XL Lossy</u>	<u>0</u>
Multi-frame Image	1.2.840.10008.1.2.1	Explicit VR Little Endian	D
	1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)	0
	1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression	0
	1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)	0
	1.2.840.10008.1.2.4.93	JPEG 2000 Part 2 Multi-component Image Compression	0
	<u>1.2.840.10008.1.2.4.X X0</u>	<u>JPEG XL Lossless</u>	<u>0</u>
	<u>1.2.840.10008.1.2.4.X X1</u>	<u>JPEG XL JPEG Recompression</u>	<u>0</u>
	<u>1.2.840.10008.1.2.4.X X2</u>	<u>JPEG XL Lossy</u>	<u>0</u>
Video	1.2.840.10008.1.2.1	Explicit VR Little Endian	D
	1.2.840.10008.1.2.4.100	MPEG2 Main Profile @ Main Level	0
	1.2.840.10008.1.2.4.101	MPEG2 Main Profile @ High Level	0
	1.2.840.10008.1.2.4.102	MPEG-4 AVC/H.264 High Profile / Level 4.1	0
	1.2.840.10008.1.2.4.103	MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1	0

	1.2.840.10008.1.2.4.104	MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	O
	1.2.840.10008.1.2.4.105	MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video	O
	1.2.840.10008.1.2.4.106	MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	O
	1.2.840.10008.1.2.4.100.1	Fragmentable MPEG2 Main Profile @ Main Level	O
	1.2.840.10008.1.2.4.101.1	Fragmentable MPEG2 Main Profile @ High Level	O
	1.2.840.10008.1.2.4.102.1	Fragmentable MPEG-4 AVC/H.264 High Profile / Level 4.1	O
	1.2.840.10008.1.2.4.103.1	Fragmentable MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1	O
	1.2.840.10008.1.2.4.104.1	Fragmentable MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	O
	1.2.840.10008.1.2.4.105.1	Fragmentable MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video	O
	1.2.840.10008.1.2.4.106.1	Fragmentable MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	O
	1.2.840.10008.1.2.4.107	HEVC/H.265 Main Profile / Level 5.1	O
	1.2.840.10008.1.2.4.108	HEVC/H.265 Main 10 Profile / Level 5.1	O
Text	1.2.840.10008.1.2.1	Explicit VR Little Endian	D
Other	1.2.840.10008.1.2.1	Explicit VR Little Endian	D

496 Note

497 The Transfer Syntaxes used in a DICOM-RTV Metadata Flow are not included, since they are not used to
498 produce a representation of an Instance encoded in the DICOM File Format.

499 *Update PS 3.18 Table 8.7.3-5*

500 **Table 8.7.3-5. Media Types and Transfer Syntax UUIDs for Compressed Data**
501 **in Bulkdata**

502

Resource Category	Media Type	Transfer Syntax UID	Transfer Syntax Name	Optionality
Single Frame Image	image/jpeg	1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction(Process 14 [Selection Value 1]) :Default Transfer Syntax for Lossless JPEG Image Compression	D
		1.2.840.10008.1.2.4.50	JPEG Baseline (Process 1) :Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	O
		1.2.840.10008.1.2.4.51	JPEG Extended (Process 2 & 4) :Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)	O

		1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)	O
	image/dicom-rle	1.2.840.10008.1.2.5	RLE Lossless	D
	image/jls	1.2.840.10008.1.2.4.80	JPEG-LS Lossless Image Compression	D
		1.2.840.10008.1.2.4.81	JPEG-LS Lossy (Near-Lossless) Image Compression	O
	image/jp2	1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)	D
		1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression	O
	image/jpx	1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)	D
		1.2.840.10008.1.2.4.93	JPEG 2000 Part 2 Multi-component Image Compression	O
	<u>image/jxl</u>	<u>1.2.840.10008.1.2.4.XX0</u>	<u>JPEG XL Lossless</u>	<u>D</u>

		<u>1.2.840.10008.1.2.4.XX1</u>	<u>JPEG XL JPEG Recompression</u>	<u>O</u>
		<u>1.2.840.10008.1.2.4.XX2</u>	<u>JPEG XL Lossy</u>	<u>O</u>
Multi-frame Image	image/jpeg	1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction(Process 14 [Selection Value 1]) :Default Transfer Syntax for Lossless JPEG Image Compression	D
		1.2.840.10008.1.2.4.50	JPEG Baseline (Process 1) :Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	O
		1.2.840.10008.1.2.4.51	JPEG Extended (Process 2 & 4) :Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)	O
		1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)	O

	image/dicom-rle	1.2.840.10008.1.2.5	RLE Lossless	D
	image/jls	1.2.840.10008.1.2.4.80	JPEG-LS Lossless Image Compression	D
		1.2.840.10008.1.2.4.81	JPEG-LS Lossy (Near-Lossless) Image Compression	O
	image/jp2	1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)	D
		1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression	O
	image/jpx	1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)	D
		1.2.840.10008.1.2.4.93	JPEG 2000 Part 2 Multi-component Image Compression	O
	<u>image/jxl</u>	<u>1.2.840.10008.1.2.4.XX0</u>	<u>JPEG XL Lossless</u>	<u>D</u>
		<u>1.2.840.10008.1.2.4.XX1</u>	<u>JPEG XL JPEG Recompression</u>	<u>O</u>

		<u>1.2.840.10008.1.2.4.XX1</u>	<u>JPEG XL Lossy</u>	<u>O</u>
Video	video/mpeg2	1.2.840.10008.1.2.4.100	MPEG2 Main Profile @ Main Level	O
		1.2.840.10008.1.2.4.101	MPEG2 Main Profile @ High Level	D
	video/mp4	1.2.840.10008.1.2.4.102	MPEG-4 AVC/H.264 High Profile / Level 4.1	D
		1.2.840.10008.1.2.4.103	MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1	O
		1.2.840.10008.1.2.4.104	MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	O
		1.2.840.10008.1.2.4.105	MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video	O
		1.2.840.10008.1.2.4.106	MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	O
Text		N/A (no defined compression transfer syntaxes for Text)		

Other		N/A (no defined compression transfer syntaxes for Other)	
-------	--	--	--

503

504 *Update PS 3.18 Section 8.7.3.5*

505 **8.7.3.5 Media Type Syntax**

506 The syntax of Media Type usage in DICOM is:

507

508 dicom-media-type = (dcm-singlepart / dcm-multipart) [dcm-parameters]

509 Where

510

511 dcm-singlepart = dcm-mt-name

512 dcm-multipart ;see Section 8.7.3.5.1

513 dcm-parameters = transfer-syntax-mtp ;see Section 8.7.3.5.2

514 / charset-mtp;see Section 8.7.3.5.3

515 dcm-mt-name = dicom / dicom-metadata / bulkdata / pixeldata ;DICOM Media Type name

516 dicom = "application/dicom"

517 dicom-metadata = dicom-xml / dicom-json

518 dicom-xml = "application/dicom+xml"

519 dicom-json = "application/dicom+json"

520 bulkdata = octet-stream / pixeldata

521 octet-stream = "application/octet-stream"

522 pixeldata = image-pixel / video-pixel

523 rendered = image-pixel / video-pixel

524 image-pixel = "image/jpeg" / "image/dicom-rle" / "image/jls" / "image/jp2" / "image/jpx" / **"image/jxl"**

525

526

527 *Update PS 3.18 Section 8.7.4*

528 **8.7.4 Rendered Media Types**

529 **8.7.4 Rendered Media Types**

530 DICOM Instances may be converted by a rendering process into non-DICOM Media Types. This can be
531 useful to display or process them using non-DICOM software, such as browsers.

532

533 For example, an Instance containing:

534 an image could be rendered into the image/jpeg, image/jxl, or image/png Rendered Media Types.

535 a multi-frame image in a lossless Transfer Syntax could be rendered into a video/mpeg or video/mp4 or
536 image/jxl Rendered Media Type.

537 a Structured Report could be rendered into a text/html, text/plain, or application/pdf Rendered Media
538 Type.

539

540 Note

541 Rendered Media Types are usually consumer format media types. Some of the same non-DICOM Media
542 Types are also used as Bulkdata Media Types, that is, for encoding Bulkdata extracted from Encapsulated
543 Pixel Data (used with compressed Transfer Syntaxes), without applying a rendering process. See Section
544 8.7.3.3.

545

546 Rendered images shall contain no more than 8 bits per channel.

547

548 Origin servers shall support rendering Instances of different Resource Categories into Rendered Media
549 Types as specified in Table 8.7.4-1.

550

551 **Table 8.7.4-1. Rendered Media Types by Resource Category**

Category	Media Type	UR I	RESTful
Single Frame Image	image/jpeg	D	D
	image/gif	O	R
	image/png	O	R
	image/jp2	O	O

Category	Media Type	UR I	RESTful
	<u>image/jxl</u>	<u>O</u>	<u>O</u>
Multi-frame Image	image/gif	O	O
	<u>image/jxl</u>	<u>O</u>	<u>O</u>
Video	video/mpeg	O	O
	video/mp4	O	O
	video/H265	O	O
Text	text/html	D	D
	text/plain	R	R
	text/xml	O	R
	text/rtf	O	O
	application/pdf	O	O

552

553

554