Digital Imaging and Communications in Medicine (DICOM)

HTJ2K Transfer Syntax

Supplement 235

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Table of Contents

Closed Issues

1.	Should rendered images be permitted to have more than 8 bits when rendered with HTJ2K? 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. No: But WG-27 agrees that this might be another supplement on Part 18.
2.	Should rendered images permit HTJ2K lossless images? Currently the only lossless format permitted for rendered images is PNG. No: But WG-27 agrees that this might be another CP on Part 18.
3.	Should there be a transfer syntax for floating point pixel data encoded as HTJ2K lossless? No: This should be done as a separate supplement in the future, as the changes are largely orthogonal to this supplement.
4.	Each frame is restricted to a single fragment, restricting each frame size to 2^31-4 bytes (4 gb). Does this cause any issues? No: For grayscale and RGB images, this allows for up to 64k-1 on a side to be encoded. For WSI images with high bit depth/number of color channels, it allows for image frames of 11,500 on a side, which are larger than any foreseen for WSI.
5.	Are the constrained HTJ2K parameters excessive or insufficient? (See 10.X below) Only the required constraints for progressive decoding are required. Other performance parameters were noted but not required.
6.	Should a box header be required or forbidden for HTJ2K bitstreams? (The box header is the metadata which prefixes file instances for HTJ2K - eg the JP2 file header in Part 5 A.4.4) Forbidden: The same requirements are used for HTJ2K as for JPEG 2000. This prevents duplication of data in the DICOM and compression headers, which can become very large for WSI and other multiframes. Note that based on experience with JPEG 2000, it is likely that some implementations will include it anyways and receiver implementations probably will need to strip off the header for general compatibility.

Scope and Field of Application

This supplement adds HTJ2K (High Throughput JPEG 2000 image compression) Transfer Syntaxes.

The addition of HTJ2K is intended to address some of the shortcomings of JPEG 2000 which have prevented wider adoption of JPEG 2000. These include making it easier to stream and decode thumbnails as well as improving the performance of encoding and decoding and decreasing the encoder and decoder complexity.

Update PS3.5 Section 2

2 Normative References

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

…

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

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

…

Update PS3.3 C.7.6.1.1.5.1

C.7.6.1.1.5.1 Lossy Image Compression Method

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

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

ISO_10918_1

JPEG Lossy Compression [ISO/IEC 10918-1]

ISO_14495_1

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

ISO_15444_1

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

ISO_15444_15

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

ISO_13818_2

MPEG2 Compression [ISO/IEC 13818-2]

ISO_14496_10

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

ISO_23008_2

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

PS 3.3 Section C.7.6.3.1.2 is not updated because HTJ2K re-uses JPEG2000 existing color spaces.

Add PS3.5 Sections 8.2.X

8.2.X High-Throughput JPEG 2000 Image Compression

DICOM provides a mechanism for supporting the use of the HTJ2K Image Compression through the Encapsulated Format (see PS3.3). Annex A defines three Transfer Syntaxes that reference the HTJ2K Standard and provide a lossy compression scheme, and two lossless compression schemes, the second of which is optimized for display of progressive bit streams.

Note

The context where the usage of lossy compression of medical images is clinically acceptable is beyond the scope of the DICOM Standard. The policies associated with the selection of appropriate compression parameters (e.g., compression ratio) for HTJ2K lossy compression are also beyond the scope of this Standard.

The use of the DICOM Encapsulated Format to support HTJ2K Compressed Pixel Data requires that the Data Elements that are related to the Pixel Data encoding (e.g., Photometric Interpretation, Samples per Pixel, Planar Configuration, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns, etc.) shall contain values that are consistent with the characteristics of the compressed data stream. The Pixel Data characteristics included in the HTJ2K bit stream shall be used to decode the compressed data stream.

The requirements when using a Standard Photometric Interpretation (i.e., a Defined Term from PS.3. C.7.6.3.1.2) are specified in Table 8.2.X-1. No other Standard Photometric Interpretation values shall be used.

Table 8.2.X-1. Valid Values of Pixel Data Related Attributes for HTJ2K Transfer Syntaxes using 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	HTJ2KLossless	1.2.840.10008.1.2.4.XX0	1	absent	0 or 1	8, 16, 24, 32 or 40	1-38	0-37
	HTJ2KLosslessRPCL	1.2.840.10008.1.2.4.XX1						
	HTJ2K	1.2.840.10008.1.2.4.XX2						
PALETTE COLOR	HTJ2KLossless	1.2.840.10008.1.2.4.XX0	1	absent	0	8 or 16	1-16	0-15
	HTJ2KLosslessRPCL	1.2.840.10008.1.2.4.XX1						
YBR_RCT	HTJ2KLossless	1.2.840.10008.1.2.4.XX0	3	0	0	8, 16, 24, 32 or 40	1-38	0-37
	HTJ2KLosslessRPCL	1.2.840.10008.1.2.4.XX1						

	HTJ2K	1.2.840.10008.1.2.4.XX2						
YBR_ICT	HTJ2K	1.2.840.10008.1.2.4.XX2	3	0	0	8, 16, 24, 32 or 40	1-38	0-37
RGB	HTJ2KLossless	1.2.840.10008.1.2.4.XX0	3	0	0	8, 16, 24, 32 or 40	1-38	0-37
	HTJ2KLosslessRPCL	1.2.840.10008.1.2.4.XX1						
	HTJ2K	1.2.840.10008.1.2.4.XX2						
YBR_FULL	HTJ2KLossless	1.2.840.10008.1.2.4.XX0	3	0	0	8, 16, 24, 32 or 40	1-38	0-37
	HTJ2KLosslessRPCL	1.2.840.10008.1.2.4.XX1						
	HTJ2K	1.2.840.10008.1.2.4.XX2						

Note

These requirements are specified in terms of consistency with what is encapsulated, rather than in terms of the uncompressed pixel data from which the compressed data stream may have been derived.

When decompressing, should the characteristics explicitly specified in the compressed data stream be inconsistent with those specified in the DICOM Data Elements, those explicitly specified in the compressed data stream should be used to control the decompression. The DICOM Data Elements, if inconsistent, can be regarded as suggestions as to the form in which an uncompressed Data Set might

be encoded, subject to the general and IOD-specific rules for uncompressed Photometric Interpretation and Planar Configuration, which may require that decompressed data be converted to one of the permitted forms.

The HTJ2K bit stream specifies whether or not a reversible or irreversible multi-component (color) transformation [ISO 15444-1 Annex G], if any, has been applied. If no multi-component transformation has been applied, then the components shall correspond to those specified by the DICOM Attribute Photometric Interpretation (0028,0004). If the JPEG 2000 Part 1 reversible multi-component transformation has been applied then the DICOM Attribute Photometric Interpretation (0028,0004) shall be YBR_RCT. If the JPEG 2000 Part 1 irreversible multi-component transformation has been applied then the DICOM Attribute Photometric Interpretation (0028,0004) shall be YBR_ICT.

Note

1. For example, single component may be present, and the Photometric Interpretation (0028,0004) may be MONOCHROME2.
2. The application of a JPEG 2000 Part 1 reversible multi-component transformation is signaled in the HTJ2K bit stream by a value of 1 rather than 0 in the SGcod Multiple component transformation type of the COD marker segment [ISO 15444-1 Table A.17]. No other Value of Photometric Interpretation than YBR_RCT or YBR_ICT is permitted when SGcod Multiple component transformation type is 1.
3. Though it would be unusual, would not take advantage of correlation between the red, green and blue components, and would not achieve effective compression, a Photometric Interpretation of RGB could be specified as long as no multi-component transformation [ISO 15444-1 Annex G] was specified by the HTJ2K bit stream. For some applications the use of RGB is permitted, e.g., Whole Slide Microscopy Images, to allow conversion to DICOM from proprietary formats without loss due to color space transformation. Alternative methods of decorrelation of the color components than those specified in [ISO 15444-1 Annex G] are permitted as defined in PS3.3, such as a Photometric Interpretation of YBR_FULL; this may be useful when converting existing YBR_FULL Pixel Data (e.g., in a different Transfer Syntax) without further loss.

In either case (Photometric Interpretation of RGB or YBR_FULL), the value of SGcod Multiple component transformation type would be 0.

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

4. Despite the application of a multi-component color transformation and its reflection in the Photometric Interpretation Attribute, the "color space" remains undefined. There is currently no means of conveying "standard color spaces" either by fixed values (such as sRGB) or by ICC profiles. Note in particular that the JP2 file header is not sent in the HTJ2K bit stream that is encapsulated in DICOM.
5. If HTJ2K Compressed Pixel Data is decompressed and re-encoded in Native (uncompressed) form, then the Data Elements that are related to the Pixel Data encoding are updated accordingly. If color components are converted from YBR_ICT or YBR_RCT to RGB during decompression and Native re-encoding, the Photometric Interpretation will be changed to RGB in the Data Set with the Native encoding.
6. The upper limit of 40 on Bits Allocated (0028,0100) and 38 on Bits Stored (0028,0101) reflects the maximum HTJ2K sample precision of 38 and the DICOM requirement to describe Bits Allocated (0028,0100) as multiples of bytes (octets).

The HTJ2K bit stream is capable of encoding both signed and unsigned pixel values, hence the Value of Pixel Representation (0028,0103) may be either 0 or 1 for monochrome Photometric Interpretations depending on what has been encoded (as specified in the SIZ marker segment in the precision and sign of component parameter).

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

Add PS3.5 Section 10.X

10.X Transfer Syntax for High-Throughput JPEG 2000 Compression

Two Transfer Syntaxes are specified for High-Throughput JPEG 2000 Lossless Image Compression (HTJ2KLossless and HTJ2KLosslessRPCL), and one for unconstrained High-Throughput JPEG 2000 Image Compression (HTJ2K). Any of these may be negotiated separately and there is no default or baseline specified (other than described in Section 10.1).

Note

1. All HTJ2K codecs are required by [ISO/IEC 15444-1] to support both reversible and irreversible wavelet and multi-component transformations. The reason for specifying three separate Transfer Syntaxes in DICOM is to allow an application to request the transfer of images in a lossless manner when possible. The HTJ2K Image Compression Transfer Syntax allows for either lossless or lossy compression to be used at the sender's discretion.
2. No baseline using other compression schemes is required.
3. When the pixel data has been received in the HTJ2K Image Compression Transfer Syntax, since it may have been lossy compressed, the waiver of the requirement in Section 10.1 to support the DICOM Default Little Endian Transfer Syntax still applies.

10.X.1 HTJ2K Lossless RPCL

The HTJ2K Lossless RPCL Transfer Syntax allows for progressive display of images, as well as retrieval of thumbnail images.

The progression order shall be RPCL (Resolution Position Component Layer). This sequences the resolution blocks so that lower resolutions can be read first.

The number of decompositions shall be sufficient for the width or height of the base resolution to be <= 64. This permits retrieving a thumbnail resolution image.

The Tile Length Markers (TLM) shall be present. This allows finding the resolution breakpoints to support smart streaming.

The following parameters may improve decoding performance:

Block Size: 64x64

Number of tiles: 1

Update PS3.5 Section 8.4.1

8.4.1 JPIP Referenced Pixel Data

DICOM provides a mechanism for supporting the use of JPEG 2000 Interactive Protocol through the inclusion of a URL reference to a pixel data provider service. Annex A defines two Transfer Syntaxes that utilize URL references to a JPIP pixel data provider service.

The use of these Transfer Syntaxes requires that the Pixel Data Provider URL specify a URL that will represent the JPIP request including the specific target information. Additional parameters required by the application may be appended to the URL when accessing the pixel data provider.

Note

For example, a JPIP request for a 200 by 200 pixel rendition of the entire image can be constructed from the Pixel Data Provider URL as follows:

Pixel Data Provider URL (0028,7FE0) = http://server.xxx/jpipserver.cgi?target=imgxyz.jp2

URL Generated by the application = http://server.xxx/jpipserver.cgi?target=imgxyz.jp2&fsiz=200,200

The JPIP client shall only request a JPEG 2000 **or HTJ2K** bit stream **depending on the negotiated Transfer Syntax.**

The JPIP server shall return a Content-type of image/jp2, image/jpp-stream or image/jpt-stream **or image/jph or image/jphc**, all of which shall be supported by the JPIP client**, depending on the supported Transfer Syntaxes**.

The Number of Frames (0028,0008) Attribute, if present in the Data Set, identifies the number of frames available for this image. Each frame is accessible as a separate JPIP code stream. Code streams referenced in the URL Target shall be sequentially numbered starting with stream 1.

Note

For example, a JPIP request for a 200 by 200 pixel rendition of frame 17 of a multi-frame image can be constructed from Pixel Data Provider URL as follows:

Pixel Data Provider URL (0028,7FE0) = http://server.xxx/multiframeimage.jp2

URL Generated by the application = http://server.xxx/multiframeimage.jp2?fsiz=200,200&stream=17

A valid stream query parameter value is always less than or equal to the value in the Number of Frames (0028,0008).

The syntax of the Pixel Data Provider URL (0028,7FE0) is defined in [ISO/IEC 15444-9] Annex C (Client Request). That standard respects the URI recommendations [RFC3986]. The transport protocol shall be HTTP or HTTPS.

Note

1. According to [ISO/IEC 15444-9], "Each JPIP request is directed to a specific representation of a specific original named resource or a specific portion of that resource. That resource may be a physically stored file or object, or may be something that is created virtually by the server upon request."

   "The Target request field specifies the original named resource to which the request is directed. It is specified using a PATH, which could be a simple string or a URI. If the Target field is not specified and the request is carried over HTTP, then the JPIP request shall be directed to the resource specified through the path component of the JPIP request URL.

2. Transport over UDP or other protocols is not supported.

Update PS3.5 Section A.4.4

A.4.4 JPEG 2000 **and HTJ2K** Image Compression

The International Standards Organization ISO/IEC JTC1 has developed an International Standard, [ISO/IEC 15444-1] (JPEG 2000 Part 1), for digital compression and coding of continuous-tone still images (see Annex F for further details). **Additionally, there is the High Throughput JPEG 2000 image compression scheme defined in [ISO/IEC 15444-15] (JPEG 2000 Part 15 HTJ2K).**

A DICOM Transfer Syntax for JPEG 2000 Image Compression shall be identified by a UID, appropriate to the choice of JPEG 2000 coding process.

Two Transfer Syntaxes are specified for JPEG 2000 Part 1:

1. A Transfer Syntax with a UID of "1.2.840.10008.1.2.4.90 ", which specifies the use of the lossless (reversible) mode of JPEG 2000 Part 1 ([ISO/IEC 15444-1]) (i.e., the use of a reversible wavelet transformation and a reversible color component transformation, if applicable, and no quantization).
2. A Transfer Syntax with a UID of "1.2.840.10008.1.2.4.91", which specifies the use of either:
    - the lossless (reversible) mode of JPEG 2000 Part 1 ([ISO/IEC 15444-1]) (i.e., the use of a reversible wavelet transformation and a reversible color component transformation, if applicable, and no quantization or code stream truncation), or
    - the lossy (irreversible) mode of JPEG 2000 Part 1 ([ISO/IEC 15444-1]) (i.e., the use of an irreversible wavelet transformation and an irreversible color component transformation, if applicable, and optionally quantization, or the use of a reversible wavelet transformation and a reversible color component transformation, if applicable, followed by code stream truncation).

The choice reversible versus irreversible is at the discretion of the sender (SCU or FSC/FSU).

Note

1. When using the irreversible wavelet transformation and an irreversible color component transformation, if applicable, even if no quantization is performed, some loss will always occur due to the finite precision of the calculation of the wavelet and multi-component transformations.
2. Only the features defined in JPEG 2000 Part 1 ([ISO/IEC 15444-1]) are permitted for these two Transfer Syntaxes. Additional features and extensions that may be defined in other parts of JPEG 2000 shall not be included in the compressed bit stream unless they can be decoded or ignored without loss of fidelity by all Part 1 compliant implementations.

A DICOM Transfer Syntax for HTJ2K Image Compression shall be identified by a UID value, appropriate to its HTJ2K coding process.

Three Transfer Syntaxes are specified for HTJ2K:

1. A Transfer Syntax with a UID of "1.2.840.10008.1.2.4.XX0", which specifies the use of the lossless mode of HTJ2K.

2. A Transfer Syntax with a UID of "1.2.840.10008.1.2.4.XX1", which specifies the use of the lossless mode of HTJ2K, with compression parameters to allow for progressive rendering.

3. A Transfer Syntax with a UID of “1.2.840.10008.1.2.4.XX2”, which specifies either:

- **the lossless (reversible) mode of HTJ2K ([ISO/IEC 15444-15]) (i.e., the use of a reversible wavelet transformation and a reversible color component transformation, if applicable, and no quantization or code stream truncation), or**

- **the lossy (irreversible) mode of HTJ2K ([ISO/IEC 15444-15]) (i.e., the use of an irreversible wavelet transformation and an irreversible color component transformation, if applicable, and optionally quantization, or the use of a reversible wavelet transformation and a reversible color component transformation, if applicable, followed by code stream truncation).**

If the object allows multi-frame images in the pixel data field, then for ~~these~~ **both** JPEG 2000 Part 1 Transfer Syntaxes **and HTJ2K Transfer Syntaxes**, each frame shall be encoded separately. Each fragment shall contain encoded data from a single frame.

Note

That is, the processes defined in [ISO/IEC 15444-1] **or [ISO/IEC 15444-15]** shall be applied on a per-frame basis. The proposal for encapsulation of multiple frames in a non-DICOM manner in so-called "Motion-JPEG" or "M-JPEG" defined in 15444-3 is not used.

Though a fragment may not contain encoded data from more than one frame, the encoded data from one frame may span multiple fragments **for JPEG-2000 transfer syntaxes**. **For HTJ2K encoding, each frame shall be encoded separately as a single fragment.** See note in Section 8.2.

For all images, including all frames of a multi-frame image, the JPEG 2000 bit stream specified in [ISO/IEC 15444-1] **or [ISO/IEC 15444-15]** shall be used. The optional JP2 file format header shall NOT be included.

Note

The role of the JP2 file format header is fulfilled by the non-pixel data Attributes in the DICOM Data Set.

The International Standards Organization ISO/IEC JTC1 has also developed JPEG 2000 Part 2 ([ISO/IEC 15444-2]), which includes Extensions to the compression techniques described in Part 1 of the JPEG 2000 Standard. Annex J of JPEG 2000 Part 2 describes extensions to the ICT and RCT multiple component transformations allowed in Part 1. Two types of multiple component transformations are defined in Annex J of Part 2 of JPEG 2000:

Array based multiple component transforms that form linear combinations of components to reduce the correlation between components. Array based transforms include prediction based transformations such as DPCM as well as more complicated transformations such as the KLT. These array based transformations can be implemented reversibly or irreversibly.

Wavelet based multiple component transformations using the same two wavelet filters as used in Part 1 of JPEG 2000 (5-3 reversible wavelet and 9-7 irreversible wavelet).

Annex J of JPEG 2000 Part 2 also describes a flexible mechanism to allow these techniques to be applied in sequence. Furthermore, it provides mechanisms that allow components to be re-ordered and grouped into component collections. Different multiple component transformation can then be applied to each component collection.

Two additional Transfer Syntaxes are specified for Part 2 JPEG 2000:

A Transfer Syntax with a UID of 1.2.840.10008.1.2.4.92, which specifies the use of the lossless (reversible) mode of JPEG 2000 Part 2 ([ISO/IEC 15444-2]) multiple component transformation extensions, as defined in Annex J of JPEG 2000 Part 2 (i.e., the use of a reversible wavelet transformation and a reversible multiple component transformation, and no quantization or code stream truncation).

A Transfer Syntax with a UID of 1.2.840.10008.1.2.4.93, which specifies the use of either:

the lossless (reversible) mode of JPEG 2000 Part 2 ([ISO/IEC 15444-2]) multiple component transformation extensions, as defined in Annex J of JPEG 2000 Part 2 (i.e., the use of a reversible wavelet transformation and a reversible multiple component transformation, and no quantization), or

the lossy (irreversible) mode of JPEG 2000 Part 2 ([ISO/IEC 15444-2]) multiple component transformation extensions, as defined in Annex J of JPEG 2000 Part 2 (i.e., the use of an irreversible wavelet transformation and an irreversible multiple component transformation, and optionally quantization, or the use of an reversible wavelet transformation and a reversible multiple component transformation, followed by code stream truncation).

Only the multiple component transformation extensions defined in Annex J of JPEG 2000 Part 2 ([ISO/IEC 15444-2]) are permitted for these two Transfer Syntaxes. Additional features and extensions that may be defined in other Annexes of JPEG 2000 Part 2 shall not be included in the compressed bit stream.

Note

the arbitrary wavelet transformations, as defined in Annex H of JPEG 2000 Part 2 ([ISO/IEC 15444-2]) are not allowed for these two Transfer Syntaxes. The only wavelet transformations that are allowed to be used as multiple component transformations are the reversible 5-3 wavelet transformation and the irreversible 9-7 wavelet transformation, as defined in Annex F of JPEG 2000 Part 1 ([ISO/IEC 15444-1]).

If the object allows multi-frame images in the pixel data field, then, for these JPEG 2000 Part 2 Transfer Syntaxes, the frames in the object are first processed using the multi-component transformation. After the multiple component transformation has been applied, the transformed frames are encoded using the process described in JPEG 2000 Part 1.

Optionally, the frames can be grouped into one or more component collections. The multiple component transformations are then applied to each component collection independently. The use of component collections can be used to reduce computational complexity and to improve access to specific frames on the decoder. If component collections are used, each fragment shall contain encoded data from a single component collection.

Note

The 3rd dimension transformations that are described in this Supplement are treated in Part 2 of JPEG 2000 as direct extensions to the color component transformations (RGB to YUV) that are described in Part 1 of JPEG 2000. For this reason, each image or frame in the sequence is called a "component". Although the term component is used as a generic term to identify an element of the 3rd dimension, no restriction is made or implied that the transformations in this Supplement apply only to multi-component (or multiple color channel) data. To compress a volumetric Data Set using this Transfer Syntax, each frame of the DICOM image is treated as a component of a multi-component image.

The progressive nature of the JPEG 2000 code stream allows for the decompression of the image before the complete image has been transferred. If a Storage SCP truncates the code stream by aborting the association, the instance has not been completely transferred and hence should not persist unless different UIDs are assigned (even though it may have been transiently used for display purposes).

It has been shown that the use of component collections does not significantly affect the compression efficiency (for details, see http://medical.nema.org/Dicom/minutes/WG-04/2004/2004-02-18/3D_compression_RSNA_2003_ver2.pdf).

Though a fragment may not contain encoded data from more than one component collection, the encoded data from one component collection may span multiple fragments.

Add PS3.5 Section F.X

F.X Encapsulated HTJ2K Encoded Images

The International Standards Organization (ISO/IEC) has prepared an International Standard, [ISO/IEC 15444_15] (JPEG 2000 Part 15 HTJ2K), for the digital compression and coding of continuous-tone still images. This standard is known as the JPEG 2000 Part 15 HTJ2K Standard, or just the HTJ2K standard.

An HTJ2K stream allows for bit depths up to 38 bits per channel and up to 255 components. Components do not need to all be the same type or bit depth. The color space of the image is specified in the HTJ2K encoding.

Inclusion of a HTJ2K coded image in a DICOM message is facilitated by the use of specific Transfer Syntaxes that are defined in Annex A.

Update PS3.6 Table A-1

Table A-1. UID Values

UID Value	UID Name	UID Keyword	UID Type	Part
…				
1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)	JPEG 2000Lossless	Transfer Syntax	PS3.5
1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression	JPEG2000	Transfer Syntax	PS3.5

…

1.2.840.10008.1.XX0	**High-Throughput JPEG 2000 Lossless Image Compression**	**HTJ2KLossless**	**Transfer Syntax**	**PS3.5**
1.2.840.10008.1.XX1	**High-Throughput JPEG 2000 Lossless Image Compression with RPCL Options**	**HTJ2KLossless RPCL**	**Transfer Syntax**	**PS3.5**
1.2.840.10008.1.XX2	**High-Throughput JPEG 2000 Image Compression**	**HTJ2K**	**Transfer Syntax**	**PS3.5**

Update PS 3.18 Table 8.7.3-5

Table 8.7.3-5. Media Types and Transfer Syntax UIDs for Compressed Data in Bulkdata

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
	image/jph	**1.2.840.10008.1.2.4.XX0**	**High-Throughput JPEG 2000 Lossless Image Compression**	**D**

		1.2.840.10008.1.2.4.XX1	**High-Throughput JPEG 2000 Lossless Image Compression with RPCL Options**	**O**
		1.2.840.10008.1.2.4.XX2	**High-Throughput JPEG 2000 Image Compression**	**O**
Multi-frame Image	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
	image/jph	**1.2.840.10008.1.2.4.XX0**	**High-Throughput JPEG 2000 Lossless Image Compression**	**D**
		1.2.840.10008.1.2.4.XX1	**High-Throughput JPEG 2000 Lossless Image Compression with RPCL Options**	**O**

		1.2.840.10008.1.2.4.XX2	**High-Throughput JPEG 2000 Image Compression**	**O**

Update PS 3.18 Section 8.7.3.5

8.7.3.5 Media Type Syntax

The syntax of Media Type usage in DICOM is:

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

Where

dcm-singlepart = dcm-mt-name

dcm-multipart ;see Section 8.7.3.5.1

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

/ charset-mtp;see Section 8.7.3.5.3

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

dicom = "application/dicom"

dicom-metadata = dicom-xml / dicom-json

dicom-xml = "application/dicom+xml"

dicom-json = "application/dicom+json"

bulkdata = octet-stream / pixeldata

octet-stream = "application/octet-stream"

pixeldata = image-pixel / video-pixel

rendered = image-pixel / video-pixel

image-pixel = "image/jpeg" / "image/dicom-rle" / "image/jls" / "image/jp2" / "image/jpx" **/ “image/jph” / “image/jphc”**

Update PS 3.18 Table 8.7.3-2

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

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
	1.2.840.10008.1.2.4.XX0	**High-Throughput JPEG 2000 Lossless Image Compression**	**O**

	1.2.840.10008.1.2.4.XX1	**High-Throughput JPEG 2000 Lossless Image Compression with RPCL Options**	**O**
	1.2.840.10008.1.2.4.XX2	**High-Throughput JPEG 2000 Image Compression**	**O**
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)	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
	1.2.840.10008.1.2.4.XX0	**High-Throughput JPEG 2000 Lossless Image Compression**	**O**
	1.2.840.10008.1.2.4.XX1	**High-Throughput JPEG 2000 Lossless Image Compression with RPCL Options**	**O**
	1.2.840.10008.1.2.4.XX2	**High-Throughput JPEG 2000 Image Compression**	**O**
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	O
	1.2.840.10008.1.2.4.101	MPEG2 Main Profile @ High Level	O
	1.2.840.10008.1.2.4.102	MPEG-4 AVC/H.264 High Profile / Level 4.1	O

	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
	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

Note

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

Update PS 3.18 Section 8.7.4

8.7.4 Rendered Media Types

8.7.4 Rendered Media Types

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

For example, an Instance containing:

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

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

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

Note

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

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

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

Table 8.7.4-1. Rendered Media Types by Resource Category

Category	Media Type	URI	RESTful
Single Frame Image	image/jpeg	D	D
	image/gif	O	R

Category	Media Type	URI	RESTful
	image/png	O	R
	image/jp2	O	O
	image/jph	**O**	**O**
Multi-frame Image	image/gif	O	O
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