Glasswall
JPEG2000 Compression Filter
Overview

Background

JPEG (created in 1992) is superceeded by JPEG2000. Standardised filename extensions for JPEG2000 are:

- JP2 for ISO/IEC 15444-1
- JPX for ISO/IEC 15444-2

Apparently JPX is so large and complex that a more simple subset known as JPX BASELINE was defined and lies somewhere between JP2 & JPX.

JPEG2000 offers a unified approach to lossless and lossy compression, JPEG does not

The JPEG2000 specification revolves around a concept of boxes (and superboxes). This is illustrated on the next page – lifted from ISO/IEC 15444-1. There are at least six mandatory JP2 boxes which are as follows:

- A single JPEG 2000 Signature box
- A single File Type box and immediately follows the signature box.
- A single JP2 Header box (super box) that must have the following boxes.
    - An Image Header box to immediately follow the header box.
    - At least one Colour Specification box.
- At least one Contiguous Codestream box.

Table I.2 – Defined boxes

Box name	Type	Superbox	Required?	Comments
JPEG 2000 Signature box	'jP\040\040' (0x6A50 2020)	No	Required	This box uniquely identifies the file as being part of the JPEG 2000 family of files.
File Type box	'ftyp' (0x6674 7970)	No	Required	This box specifies file type, version and compatibility information, including specifying if this file is a conforming JP2 file or if it can be read by a conforming JP2 reader.
JP2 Header box	'jp2h' (0x6A70 3268)	Yes	Required	This box contains a series of boxes that contain header-type information about the file.
Image Header box	'ihdr' (0x6968 6472)	No	Required	This box specifies the size of the image and other related fields.
Bits Per Component box	'bpcc' (0x6270 6363)	No	Optional	This box specifies the bit depth of the components in the file in cases where the bit depth is not constant across all components.
Colour Specification box	'colr' (0x636F 6C72)	No	Required	This box specifies the colourspace of the image.
Palette box	'pclr' (0x7063 6C72)	No	Optional	This box specifies the palette which maps a single component in index space to a multiple-component image.
Component Mapping box	'cmap' (0x636D 6170)	No	Optional	This box specifies the mapping between a palette and codestream components.
Channel Definition box	'cdef' (0x6364 6566)	No	Optional	This box specifies the type and ordering of the components within the codestream, as well as those created by the application of a palette.
Resolution box	'res\040' (0x7265 7320)	Yes	Optional	This box contains the grid resolution.
Capture Resolution box	'resc' (0x7265 7363)	No	Optional	This box specifies the grid resolution at which the image was captured.
Default Display Resolution box	'resd' (0x7265 7364)	No	Optional	This box specifies the default grid resolution at which the image should be dis played.
Contiguous Codestream box	'jp2c' (0x6A70 3263)	No	Required	This box contains the codestream as defined by Annex A.
Intellectual Property box	'jp2i' (0x6A70 3269)	No	Optional	This box contains intellectual property information about the image.
XML box	'xml\040' (0x786D 6C20)	No	Optional	This box provides a tool by which vendors can add XML formatted information to a JP2 file.
UUID box	'uuid' (0x7575 6964)	No	Optional	This box provides a tool by which vendors can add additional information to a file without risking conflict with other vendors.
UUID Info box	'uinf' (0x7569 6E66)	Yes	Optional	This box provides a tool by which a vendor may provide access to additional information associated with a UUID.
UUID List box	'ulst' (0x7563 7374)	No	Optional	This box specifies a list of UUIDs.
URL box	'url\040' (0x7572 6C20)	No	Optional	This box specifies a URL.

Glasswall's JP2 compression filter.

Our module for dealing with JPEG2000 images is **pdf.compression.jpx.c** and seems to follow the specification JP2 specification ISO/IEC 15444-1 and JPX for ISO/IEC 15444-2[1].

Our JP2 compression filter checks for the following JP2 super boxes and boxes (the bolded reflect mandatory boxes as per the ISO specification – and Glasswall ensures that this specification is met):

- **JPEG 2000 Signature** box (0x6A50 2020)
- **File Type box** (0x6674 7970)
- **JP2 Header box** (0x6A70 3268)
    - **Read Requirements box** (0x7272 6571)[1]
    - **Image Header box** (0x6968 6472)
    - **Colour Specification box** (0x636F 6C72)
    - Palette box (0x7063 6C72)
    - Component Mapping box (0x636D 6170)
- **Contiguous codestream box** (0x6A70 3263)

JPEG200 Signature Box

Glasswall raises an issue if any of the following are invalid:

- Signature box length.
- The JPEG 2000 signature markers are not present for identifying it as being part of the JPEG2000 family of files. These markers are:
    - (0x6A50 2020)
    - (0x0D0A 870A)

File Type Box

This box specifies file type, version and compatibility information. Glasswall raises an issue any of the following are invalid:

- Presences of a File Type marker.
- Compatibility list does not exceed 63[2]

JP2 Header Box

This box contains a series of boxes that contain header-type information about the file. It contains the image and colour parameters for rendering the image. Only the following boxes are supported. Any other boxes will be raised as an issue[3].

Image Header Box

This box specifies the size of the image and other related fields. Glasswall raises an issue any of the following are invalid:

- Presences of image header marker.
- The length of the box is 22 as per the ISO specification.

---

[1] At least looking for a JPX Reader Requirements box whilst processing the **JP2 Header Box.** JPX embedded in PDFs needs to be tested. It looks like there are different box requirements under the JPX specification.

[2] Possibly reasonable limit cap by Glasswall?

[3] I question what would happen if we had one of the other optional boxes in our JP2 Header Box.

Colour Specification Box

This box specifies the colourspace of the image. Glasswall does not at the moment carry out any conformance checks.

Palette Box

This is an optional box and specifies the palette which maps a single component in index space to a multiple-component image. If detected we process but there are no conformance checks on this.

Component Mapping Box

This is an optional box and specifies the mapping between a palette and codestream components. If detected we read but there are no conformance checks on this.

Contiguous Codestream Box

The Contiguous Codestream box contains a valid and complete JPEG 2000 codestream, as defined in Annex A.

Glasswall raises an issue if:

- The required JP2 boxes are not present[4]:
- A non-codestream marker is detected, that is does not match pattern 0xFF.
- The required codestream markers are not all present.
- A codestream marker is detected but is not one of the following[5] (bolded reflects mandatory codestream markers):

  Delimiting markers and marker segments

  - **Start of codestream** (0xFF4F)
  - **Start of tile-part** (0xFF90)
  - Start of data (0xFF93)
  - End of codestream (0xFFD9)

  Fixed information marker segments

  - **Image and tile size** (0xFF51)

  Functional marker segments

  - Coding style default (0xFF52)
  - **Quantization default** (0xFF5C)

Start of codestream

Glasswall acknowledges marker seen.

Start of tile-part

- Raise an issue if too many tiles.
- Raise an issue if tile number is too large.
- Glasswall acknowledges marker seen.

---

[4] And as it stands I think our JPX compression is trying to deal with the JP2 specification **15444-1annexi.pdf** and just one of the boxes from **15444-2annexm.pdf**. The code is only applying the JP2 mandatory box checks.

[5] Why would we not want to support the remaining optional codestream markers?

Start of data

Glasswall reads but does not carry out any conformance checks.

End of codestream

Glasswall acknowledges marker seen and performs required markers conformance check.

Image and tile size

Glasswall raises the following issues if:

- There is not enough space for components determined from the image len.
- There are too many components.
- There are too many tiles.

Coding style default

Describes the coding style, number of decomposition levels, and layering that is the default used for compressing all components of an image (if in the main header) or a tile (if in the tile-part header). The parameter values can be overridden for an individual component by a COC marker segment in either the main or tile-part header.

Glasswall reads in data and does not perform any conformance check.

Quantizaion default

Describes the quantization default used for compressing all components not defined by a QCC marker segment. The parameter values can be overridden for an individual component by a QCC marker segment in either the main or tile-part header.

Glasswall reads in data and does not perform any conformance checks.