# JPEG 2000 and Broadcast Applications

## Illustrative sketch for a reversible (lossless) codestream

For the U.S. Federal Agencies Audio-Visual Digitization Working Group, October 19, 2010.

### What is this document?

This illustrative sketch is inspired by the JPEG 2000 Broadcast Profiles under development by the ISO/IES still image working group (ISO/IEC JTC 1/SC 29/WG 1).[1] The profiles have not yet completed all of the steps in the ISO/IEC standards process and they are not yet available to the public.

The U.S. Federal Agencies Audio-Visual Digitization Working Group[2] requires an illustrative example of a broadcast profile to support the drafting of an MXF application specification (AS) for archiving and preservation.[3] For this reason, this illustrative sketch has been compiled as an interim measure. In this context of a preservation-oriented MXF AS, the most desirable JPEG 2000 broadcast profiles are those that feature the *reversible wavelet transform* ("lossless compression"). The illustrative sketch that follows features the reversible transform. Meanwhile, readers should note that ISO/IEC JPEG 2000 Broadcast Profiles, when published, are expected to include examples that employ the *irreversible wavelet transforms* ("lossy compression").

### Codestream restrictions for a broadcast-oriented reversible profile

The following listing presents several of the typical parameters of a JPEG 2000 profile. For comparison and for a look at a fully realized profile, readers may wish to review the two published profiles that support the digital cinema specification: ISO/IEC 15444-1:2004/Amd 1:2006.[4]

### 1. SIZ marker segment[5]

Profile Indication

0000 0011 0000 0110 for the reversible profile, high level

0000 0011 0000 0111 for the reversible profile, highest level

Tiles

1 or 4 tiles

If 1 tile

YTsiz + YTOsiz >= Ysiz

XTsiz + XTOsiz >= Xsiz

[1] http://www.iso.org/iso/iso_technical_committee.html?commid=45316

[2] http://www.digitizationguidelines.gov/audio-visual/

[3] http://www.digitizationguidelines.gov/audio-visual/documents/MXF_app_spec.html

[4] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=41719

[5] *Marker segments* in JPEG 2000 files describe the characteristics of an image, e.g., size, number of components, tile size, etc. A marker segment consists of a two-byte marker and associated marker parameters. Marker segments appear as the main header for a codestream and may also appear as a tile-part header to provide information about a tile.

If 4 tiles
Ysiz/4 <= YTsiz + YTOsiz <= Ysiz
Xsiz/2<= XTsiz + XTOsiz <= Xsiz
All tiles shall be of the same size

Image and tile origin

XOsiz = YOsiz = XTOsiz = YTOsiz = 0

Sub-sampling

(XRsizi = 1 for all components) or
(XRsiz1=1, XRsiz4=1 and XRsizi=2 for remaining components)
YRsizi=1

Number of components

Csiz ≤ 4

Bitdepth

7 ≤ Ssizi ≤ 11 (8-12 bits unsigned)

**2. RGN marker segments**

Disallowed, i.e., no region of interest

**3. Marker locations**

Packed headers (PPM, PPT)

Disallowed

COD,[6] COC,[7] QCD,[8] QCC[9]

Main header only

**4. COD/COC marker segments**

Number of decomposition levels

1 <= NL <= 5

Every component of every image of a codestream shall have the same number of wavelet transform levels. The number of deployed decomposition levels shall be set accordingly in all COD and COC markers.

Number of layers

Shall be exactly 1

Code-block size

5 ≤ xcb ≤ 7 and 5 ≤ ycb ≤ 6 and restrictions in [relevant table] apply. Codeblock sizes shall be the same across all components. The xcb and ycb values shall be set accordingly in all COD and COC markers.

Code-block style

SPcod, SPcoc = 0000 0000

Transformation

5-3 Reversible Transform

[6] COD = Coding style default marker
[7] COC = Coding style component marker
[8] QCD = Quantization default marker
[9] QCC = Quantization component marker

Precinct size

PPx = PPy = 7 for NLLL band, else 8. The corresponding values shall be set accordingly in all COD and COC markers.

**5. Progression order[10]**

CPRL, POC marker disallowed

**6. Tile-parts**

≤16; One for each tile component

**7. Tile-part lengths**

TLM marker segments are required in each image

**8. Application specific restrictions**

Maximum Components Sampling Rate (MSamples/sec)[11]

For example, reversible profile, high and highest level = 520

Maximum compressed (instantaneous) bit rate (Mbits/sec)

For example, at high levels = 1600

For example, reversible profile, highest level = unspecified

[10] Progression order is a design choice in the use of JPEG 2000. The standard defines five progression orders or packet orderings, denoted as LRCP, RLCP, RPCL, PCRL, and CPRL. The letters L, R, C, and P stand for quality Layer, Resolution, Component, and spatial Position. The most common progression order for still image applications is LRCP, in which the primary sorting directive is by quality. The likely choice for broadcast applications, however, is CPRL. It and other "layer-last" progressions keep the code-stream contributions to each precinct in a single segment, which supports efficient management of code-block data.

[11] Sampling Rate = (average components/pixel) x (pixels/line) x (total lines/ frame) x (frames/sec); where average components is two for 4:2:2, three for 4:4:4 or 4:2:2:4, and four for 4:4:4:4.