Interoperable JPEG XS with ST2110-22 and NMOS

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What is this talk all about?

- What is JPEG XS ?
- What is SMPTE ST 2110-22 ?
- What is AMWA NMOS ?
- How do these things work together?

JPEG XS: Yet Another Codec? Why?

ISO/IEC 21122-X -- a real standard from a real standards organization

"represent … images ***without visual loss*** at moderate compression rates"

"Typical compression rates… between 2:1 and 6:1 but can also be higher"

"allow ***lightweight*** encoder and decoder implementations that limit the end-to-end ***latency*** to a fraction of the frame size"

JPEG XS: Compared to Alternatives

- Significantly lower computational footprint than JPEG-2000
  - Performs at *similar* rates, especially –vs- low-latency striped J2K
- Significantly lower latency than even very highly tuned H.264
  - Codec latency is about 32 lines (buffering for transport adds more)
- Lots of papers in past shows and conferences about JPEG-XS

JPEG XS: Rates for Common Formats

- Bits-Per-Pixel (BPP)
  - 20 BPP = raw 4:2:2/10
  - 4 BPP = visually lossless
  - 3 BPP = excellent contrib
  - 2 BPP = medium contrib
  - 1 BPP = monitoring qual
- Add about 5% overhead for IP/UDP/RTP layers

Mbits/sec	1 BPP	2.5 BPP	4 BPP
1080i @ 50	54	136	217
1080i @ 59	65	162	260
1080p @ 50	108	271	434
1080P @ 59	130	325	520
2160p @ 50	520	1300	1736
2160p @ 59	596	1240	2080
4320p @ 50	1736	4340	6944
4320p @ 59	2080	5200	8320

JPEG XS is a video bitstream, what about transport?

- IETF RTP Payload Specification: RFC 9134 (Video ONLY)
  - Includes the spec for what MUST (and what MAY) be in the SDP
  - Covers several use cases, not just for television contribution
- What about using this as part of a system (with audio and ANC data?)
- SMPTE 2110-22 covers this – specifies how the timing and timestamps of the video can be coordinated with 2110-30/31 audio, 2110-40 ANC, and more
  - Has some more requirements about the SDP contents

How Do I Switch It? Can I Use NMOS with This?

Of Course You Can use NMOS!

- AMWA BCP-006-01 says exactly how to do it
- SDP identifies it as jxsv
- Some new FMTP parameters for JPEG XS
- 2110-22 SDP also includes the bit-rate information!

```
v=0
o=- 101802 53 IN IP4 10.0.81.54
s=237.0.0.50:20000
i=NMOS with JPEGXS 237.0.0.50:20000
t=0 0
a=recvonly
m=video 20000 RTP/AVP 102
c=IN IP4 237.0.0.50/32
a=source-filter: incl IN IP4 237.0.0.50 10.0.81.54
a=rtpmap:102 jxsv/90000
a=fmtp:102 sampling=YCbCr-4:2:2;width=1920;height=1080;
interlace;exactframerate=30000/1001;depth=10;TCS=SDR;
colorimetry=BT709;packetmode=0;level=2k-1;
SSN=ST2110-22:2019;TP=2110TPN;
b=AS:274000
a=ssrc:0 cname:nmos@nmos.tv
a=ts-refclk:ptp=IEEE1588-2008:08-00-11-FF-FE-22-91-3C:127
a=mediaclk:direct=0
```

AMWA specs are online for FREE! https://specs.amwa.tv/bcp-006-01/

JPEG-2000 often used M2TS Can I do that with JPEG XS?

You can do JPEG XS inside MPEG-2 Transport Streams – VSF TR-07

- VSF TR-07:2022 says exactly how to do this
  - Single-Program Transport Stream (SPTS)
  - PCR on a standalone PID, PAT & PMT defined
  - Audio is uncompressed using SMPTE ST 302
  - VANC is included using SMPTE ST 2038

- VSF TR-07 also defines some “capability sets” useful for marking gear
  - Set A: HD
  - Set B: UHD-1 (up to 4k)
  - Set C: UHD-2 (up to 8k)

VSF specs are online for FREE!
https://vsf.tv/download/technical_recommendations/VSF_TR-07_2022-04-20.pdf

Is there a single, simple spec for the ST 2110-22 case?

Introducing VSF TR-08 – the “top-level” spec JPEG XS over 2110-22

- Use JPEG XS as documented in ISO/IEC 21122-X
- Constrain some of the codec features, for the television use case
- Use RFC 9134 and constrain/extend it with ST 2110-22
- Audio uses ST 2110-30/31 in the normal way
- ANC data uses ST 2110-40 in the normal way
- Capability Sets are defined for common use cases (next slide)
- A table of interop formats is included that covers all the common ones

VSF specs are online for FREE!
https://vsf.tv/download/technical_recommendations/VSF_TR-08_2022-04-20.pdf

VSF TR-08 Capability Sets

- TR-08 Defines “Capability Sets” and “Conformance Levels”
- Requirements and Restrictions on video profiles, levels, mapping
- Requirements and Restrictions audio and ANC services
- Note this also ties into the IPMX work going on across AIMS/VSF/AMWA

LEVEL	A: Intra-Facility	B: Inter-Facility	C: Campus w/IPMX	D: Campus w/IPMX+
FHD	<=1080p59 4:2:2/10 <= 4 BPP 16ch audio Synchronous	<=1080p59 4:2:2/10 <= 4 BPP 16ch audio ASynchronous	<=1200p59 4:2:2/10 4:4:4/10 <= 4 BPP 16ch audio Async & IPMX	<=1200p59 4:2:0/8..12 4:2:2/8..12 4:4:4/8..12 <= 4 BPP 16ch audio Async & IPMX
UHD1	<=2160p59 4:2:2/10 <= 4 BPP 32ch audio Synchronous	<=2160p59 4:2:2/10 <= 4 BPP 32ch audio ASynchronous	<=2160p59 4:2:2/10 4:4:4/10 <= 4 BPP 16ch audio Async & IPMX	<=2160p59 4:2:0/8..12 4:2:2/8..12 4:4:4/8..12 <= 4 BPP 16ch audio Async & IPMX
UHD2	<=4320p59 4:2:2/10 <= 4 BPP 32ch audio Synchronous	<=4320p59 4:2:2/10 <= 4 BPP 32ch audio ASynchronous	<=4320p59 4:2:2/10 4:4:4/10 <= 4 BPP 16ch audio Async & IPMX	<=4320p59 4:2:0/8..12 4:2:2/8..12 4:4:4/8..12 <= 4 BPP 16ch audio Async & IPMX

Thank You ….. Or ….. Any Questions?

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