JPEG2000 for broadcast contribution applications

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Outline

- T-VIPS introduction
- Benefits of JPEG2000 for contribution
- JPEG2000 multiple generation performance
- T-VIPS TVG450 JPEG2000 Gateway
- Next steps and standardization activities
**T-VIPS solutions for broadcasters**

**Contribution and Distribution**
- Live sports production (stadium to studio)
- Low latency news applications (interviews)
- Remote production and unmanned studios
- Studio-to-studio media exchange
- Distribution from playout center to head-end

**Digital Terrestrial TV (DTT)**
- DVB-T/T2 and ATSC terrestrial distribution
- Local insertion (remultiplexing, PSI/SI/PSIP)
- Distribution to transmitter sites over IP
- Transport stream monitoring
- Transport stream redundancy switching
Main benefits of JPEG2000 for broadcast contribution

- **Quality**: JPEG2000 provides improved quality head-room in production with exceptional multi-generation performance
- **Latency**: very low end-to-end latency makes production easier to manage and enables distributed productions
- **Cost**: Lower capital investment for JPEG2000 and IP/Ethernet access network infrastructure (also more flexible because of multi-service capability)
**JPEG2000-based general contribution networks**

- Typically replacement of old ATM links & satellite due to limited capacity or high cost of maintenance
- Contribution between broadcast facilities, and common media POPs
- Contribution from sports stadiums back to studios
- Mobile production units with fixed infrastructure (network, encoders)
Multiple generation encoding

• EBU recommends:
  • A studio compression system should provide BT.500 "grade 4.5" image quality after 7th multi generation compression, including pixel shift.

BT.500 subjective quality scale:

5=Excellent  4=Good  3=Fair  2=Poor  1=Bad
Multiple Generation Performance:  
5th generation JPEG2000 has nearly no noise!

Degradation:
- 125 Mbps: < 0.7 dB for 5th generation
- Impairments < 1 LSB (in 10 bits range) from generation 1 to 5
- Blue – High PSNR
- Purple – Average PSNR
- Yellow – Low PSNR
# T-VIPS Video Gateways

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<th>Video Gateways</th>
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<th>Functionality</th>
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<td>TVG410</td>
<td>Uncompressed SDI over IP w/FEC</td>
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<td>TVG420</td>
<td>Up to 8 ASI over IP/Ethernet w/FEC</td>
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<td>HD/SD MPEG-4 AVC/MPEG-2 IRD with DVB-S/S2, ASI and IP interfaces</td>
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<td>TVG650</td>
<td>HD/SD MPEG-4 AVC 4:2:2 10-bit Encoder with ASI and IP output</td>
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TVG450 JPEG2000 Gateway

- TVG450 - SD/HD/3D/3G JPEG2000 over IP
  - Multi-channel encoding and decoding (4 SD, 2 HD, 1 3D/3G)
  - Full bidirectional operation for SD and HD
  - Metro Ethernet, IP/MPLS, SDH/SONET transport

- Gateway features
  - Visually lossless JPEG2000 compression (SD@20-50, HD@80-160)
  - Transparent handling of audio and ancillary data
  - MXF-based frame-aligned wrapping of all components
  - Built-in SDI monitoring and frame store on encoder
  - Built-in RTP/IP monitoring and frame store on decoder
  - Built-in frame synchronizer for direct-to-studio connections
Reliable contribution over IP

- IP networks are reliable but not perfect
- We need intelligent mechanisms to handle:
  - Out of order and duplicated packets -> RTP Seq. Nr.
  - Packet loss -> Forward Error Correction (FEC)
  - Burst loss, re-routing -> FEC, error concealment, dual path
  - Jitter (packet delay variation) -> IP buffer on RX
  - Long term drift in TX/RX timing reference -> frame skip and repeat (handled in frame synchronizer)
Dual path network redundancy

- IP smallcast: encoder transmits RTP stream on two IP links
- Input diversity reception: decoder receives packets from main and spare link simultaneously
- Enables hitless protection on packet loss and link failures
- Provides high reliability transmission over error-prone links
3D Sports Contribution

- Stereoscopic 3D video transport
- Dual channel JPEG2000 encoding @ 200-250 Mb/s
- Full resolution on L/R channels – and perfect sync
- Maintain quality and resolution of the 3D signal to improve end-user QoE and allow for centralized post-processing
- Conversion to SbS/TaB is irreversible and should not be done until the final emission encoding stage
Standardization activities

- The use of JPEG2000 for contribution is now well-accepted and wide-spread in the industry
- Currently there is no vendor interoperability
- Standards have been developed in JPEG and MPEG for carriage of JPEG2000 in MPEG-2 TS
- Interoperability efforts underway in VSF and DVB
- DVB AVC is adding implementation guidelines in revision of contribution specification TS 102 154
- VSF is planning interoperability tests for 2012
Potential standards for JPEG2000 over MPEG-2 TS

- JPEG2000 Code Stream
- JPEG2000 Elementary Stream
- JPEG2000 Packetized ES
- MPEG-2 Transport Stream
- Mapping
- FEC
- RTP/UDP/IP

**JPEG 2000 Part 1 (ISO/IEC 15441-1)**


**MPEG-2 Systems (13818-1:2007)**

**SMPTE 2022-1/2 CBR MPEG-2 TS over IP + FEC**

**RFC 3550 RTP**

*Preliminary: standardization and interoperability efforts are still in progress*
Potential standards for JPEG2000 over MXF/IP

- JPEG 2000 Part 1 (ISO/IEC 15441-1)
  JPEG 2000 Part 1 Amd 3 – Profiles for Broadcast Application (ISO/IEC 15444-1:2004/Amd3) (Constraints)

- SMPTE ST 422 Mapping JPEG 2000 Codestreams into the MXF Generic Container (SMPTE revision in progress)
- SMPTE ST 379-2-2010, MXF Refined Generic Container
- Low Latency Streaming MXF (SMPTE work in progress)
  SMPTE ST 378-2004, Operational pattern 1A
- SMPTE ST 377-1-2009, MXF File Format Specification
- SMPTE 2022-5/6 High Bit Rate Media Transport over IP Networks (SMPTE work in progress)

- RFC 3550 RTP

Preliminary: standardization and interoperability efforts are still in progress
Thanks for your attention

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