Lotfi El Hafi
Engineer at intoPIX

February 28th, 2014

intoPIX
secure image technology

Mapping SDI with a Light-Weight Compression for High Frame Rates and Ultra-HD 4K Transport over SMPTE 2022-5/6

VSF
VIDEO SERVICES FORUM

Take **IMAGING** to the **NEXT LEVEL**

Background

- ## intoPIX
  - Leading technology provider of image compression technology
  - Expert in JPEG 2000 IP-cores for FPGA
  - Founded in 2006, based in Belgium

- ## Markets
  - Digital Cinema
  - Broadcast
  - Pro-AV
  - Medical
  - Aerospace
  - Military

VSF
VIDEO SERVICES FORUM

Take **IMAGING** to the **NEXT LEVEL**

Transporting Video

- SDI-based transport: the legacy workflow for broadcast
  - Point-to-point video transmission
  - Familiar, operational practice and interoperability
  - Transport uncompressed video, multiple compression cycles
  - Need for expensive dedicated hardware

- SDTI-based transport: a nice addition
  - SDTI (SMPTE 305M) uses standard SDI interfaces
  - Enables compression, less degradation through multiple I/O systems

- Interfaces deployed in broadcast facilities
  - HD-SDI (SMPTE 292M) = 1.5Gbps
  - 3G-SDI (SMPTE 424M) = 3Gbp
  - (6G UHD-SDI (SMPTE 32NF-70) = 6Gbps)

Take **IMAGING** to the **NEXT LEVEL**

VSF
VIDEO SERVICES FORUM

- **IP-based transport: a strong market trend in broadcast**
  - Packetized video transmission
  - Use of COTS, standard IT technologies
  - Reduction of cost, size, number of cables
  - Agile, flexible, and scalable workflow
  - Dealing agnostically with a multiplicity of formats
  - Reconfiguring systems without changing physical configurations
  - Ubiquitous accessibility
- **Readily available interfaces**
  - 1GB Ethernet = 1Gbps
  - 10GB Ethernet = 10Gbps

VSF
VIDEO SERVICES FORUM

How to upgrade legacy SDI infrastructure in studios by taking advantage of an IP-based network while maintaining the operational practices of a SDI-based workflow?

VSF
VIDEO SERVICES FORUM

Take **IMAGING** to the **NEXT LEVEL**

Growing Bandwidth

HD 1080i60	HD 1080p60	HFR HD 1080p120	Ultra-HD 4K 60fps
1.5Gbps	3Gbps	6Gbps	+12Gbps
1	x2	x4	x8
HD-SDI	3G-SDI	10GB Ethernet	?

- Bandwidth requirements are growing fast
  - Higher video resolutions, frame rates to transport
  - Growing number of parallel streams to manage
- Uncompressed video distribution is a real challenge
  - ~~HFR HD on a single 3G-SDI link~~
  - ~~Ultra-HD 4K on a single 10GB Ethernet link~~

VSF
VIDEO SERVICES FORUM

Take IMAGING to the NEXT LEVEL

How to transport higher resolutions, frame rates and number of streams, basically more pixels, without compromising latency and visual quality?

VSF

VIDEO SERVICES FORUM

Take **IMAGING** to the **NEXT LEVEL**

Rising to the Challenge

- Reality facts
  - Existing infrastructures (3G-SDI, 10GB Ethernet) limit the transport of higher quality video
  - 10Gbps is practically the upper limit to transport video over a single link
  - Broadcast industry has just upgraded from SDI to 3G-SDI and will face heavy investments to enable the transport of 4K video

- 3 keys to a smart solution
  - SMPTE 2022-5/6
  - SDI mapping
  - Light-weight compression

Take **IMAGING** to the **NEXT LEVEL**

SDI Mapping

- SMPTE 2022-5/6 standard
  - Enables the mapping of raw SD/HD/3G-SDI video on Ethernet.
  - Supports the transfer of compressed video if:
    - Less than one frame latency
    - Sufficient compression ratio to fit
    - Visually lossless picture quality

- Light-weight visually lossless guaranteeing compression at very low compression ratio with no impact on latency seems optimal to perfectly map SDI links over Ethernet

Take **IMAGING** to the **NEXT LEVEL**

VSF
VIDEO SERVICES FORUM

Potential Uses Cases

Content		Bitrate	Target	Ratio
Faster pixels	HFR HD 1080p120	6Gbps	HD-SDI	4:1
More pixels	Ultra-HD 4K 60fps	12Gbps	3G-SDI	4:1
More streams	6 x HD 1080p60	18Gbps	10G-Eth	2:1

- Light compression at visually lossless ratios enables the transport of multiple video streams over a single 10GB Ethernet link
  - 3 Ultra-HD 4K streams
  - 6 HFR HD streams
  - 6 HD streams (half bandwidth)

VSF
VIDEO SERVICES FORUM

Take IMAGING to the NEXT LEVEL

Subsampling	Description	Compression
4:4:4	Full color resolution	1:1
4:2:2	Half horizontal color resolution	3:2
4:2:0	Half horizontal, vertical color resolution	2:1

- Today 4:2:0 allows Ultra-HD 4K over 10GB Ethernet / HDMI 2.0

- Because the human eye has lower acuity for color differences than for luminance, chroma subsampling achieves low compression ratios by simply dropping some color information

VSF
VIDEO SERVICES FORUM

Chroma Subsampling Limitations

- Chroma subsampling requires little processing, but
  - 4:1 compression ratio is out of reach
  - 4:4:4 (digital cinema) and 4:2:2 (broadcast) are mandatory for industrial compliance

- Image compression can achieve better results visually

- Hence the need for a codec specifically designed to operate at low levels of compression, without compromising visual quality and latency

Take **IMAGING** to the **NEXT LEVEL**

VSF
VIDEO SERVICES FORUM

- **Introducing TICO**
  - Light-weight video compression
  - Visually lossless compression
    - up to 4:1 ratio
  - Fixed latency
    - 1 to 8 pixel lines
  - Very low hardware requirements
    - No external memory
    - Low power consumption
  - Wide range of formats
    - From mobile to 8K Ultra-HD
  - Designed to be a standard for industry-wide support

VSF
VIDEO SERVICES FORUM

Take **IMAGING** to the **NEXT LEVEL**
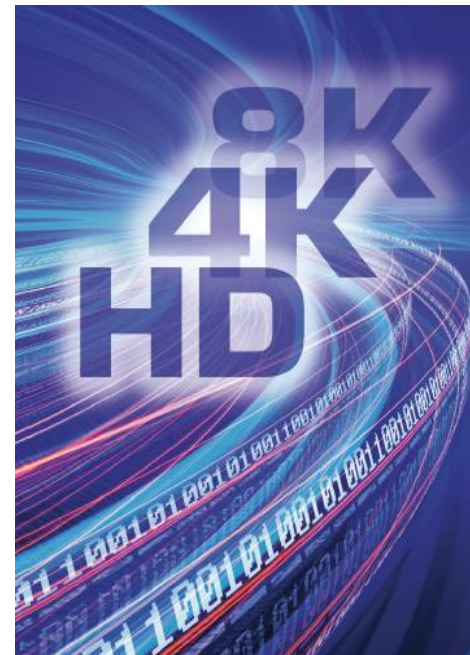
Mezzanine Solution

10 Coding generations

EBU UHD4K Set 422 10bit compressed at 2:1
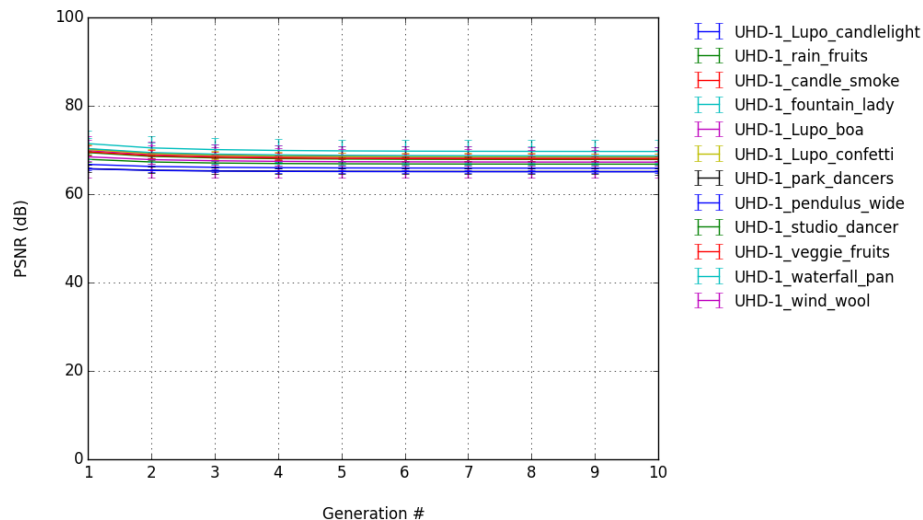
- **Robustness against multiple generations**
  - Wavelet-based, sub-intra frame compression
  - Constant quality through multiple encoding/decoding passes
  - No interference with the final compression format used for delivery

Take **IMAGING** to the **NEXT LEVEL**

Using a light-weight video compression, such as TICO, over SMPTE 2022-5/6 through SDI mapping is a smart upgrade path to manage higher resolutions, frame rates and number of streams while assuring visual quality and very low hardware complexity and cost

Take **IMAGING** to the **NEXT LEVEL**

VSF
VIDEO SERVICES FORUM

Future Demonstrations

- ## Macnica SMPTE 2022-5/6
  - video over IP reference design
  - TICO 3G-HD and Ultra-HD 4K transport over 10GB Ethernet

Thank you for your attention

Take **IMAGING** to the **NEXT LEVEL**

VSF
VIDEO SERVICES FORUM