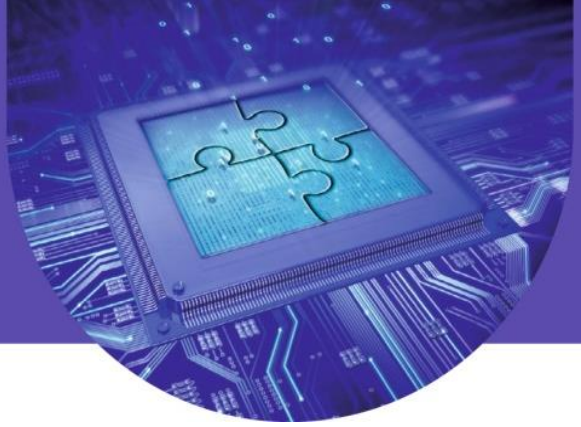

4K Video over IP Workflows

The Benefits of TICO Light-weight compression

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Introduction

Considering the necessary bandwidth for the next generation of television with UHDTV resolutions video and higher frame rates, live uncompressed transport across 10GB Ethernet network or existing SDI infrastructure is not possible anymore. Indeed, uncompressed 4K video at 60fps 4:2:2 requires 12Gbps or more for 4:4:4.

The light-weight compression **TICO** is a visually lossless guaranteeing compression at very low compression ratio with only few pixel lines of latency, a small FPGA cost of implementation, with a high efficiency in CPU. Moreover it enables a perfect mapping 4K streams over 10GbE networks (and 3G-SDI), or simply HD over 1GbE. In December 2014, this compression has been submitted for a SMPTE Registered Disclosure Document (SMPTE RDD35).

Uncompressed 4K over IP: 3 important facts

In the transition to 4K over IP in the broadcast and pro-AV, 3 important facts have to be considered:

- UHDTV needs more video bandwidth: that's not for free.
- Broadcast & Pro-AV facilities move to IP : true 4K does not fit into a single 10GE port
- Broadcast industry lives in a SDI world : and massively invested in 3G-SDI

More bandwidth for 4K

Uncompressed storage and transmission becomes unaffordable and unmanageable within systems and infrastructures: The move to 4K requires an expensive hardware upgrade, a heavy renewal of infrastructure and will increase the power consumption.

Transition to IP

Use of standard IT technologies, building an Agile, flexible, reconfigurable and scalable workflow, dealing agnostically with a multiplicity of formats with a ubiquitous accessibility is what IP will bring to AV workflows.

Today 1GE & 10GE, are the obvious affordable ports. Compared to SDI it enables a reduction of cost, size, and number of cables. The cost of a 10GE port from an Ethernet switch goes significantly down and is expected to be more affordable than a 3G-SDI in a near future. However, 4K cannot fit in 10GE Ethernet (11 880 Mbps). Only 4:2:0 goes below 10GE and higher bandwidth (ie 40GE, 100GE) ports are too expensive for a large adoption. And the industry needs to support real 4K 60fps at 4:2:2 or 4:4:4.

SMPTE 2022 5/6 and new related standards such as VSF TR04 and VSF TR03 are evolving rapidly. Up to now, it was used for point to point IP transmission of uncompressed HD and 3G-SDI. But today, it enables Live IP Production capability with independent essence mapping under specification, thanks to an effort conducted by the JT-NM VSF/SMPTE/EBU.

The SDI World is not dead

SDI is massively deployed in AV facilities but 4K needs too many cables (4 x 3G-SDI links) and will require more SDI ports on routers and switchers. An upgrade to 12G-SDI will also cost more than 3G-SDI.

Lightly Compressed 4K over IP: the ideal answer

Reducing the bandwidth of 4K

Lightly compressed" storage and transmission remains affordable and manageable within systems and infrastructures. It involves a low cost hardware upgrade and reduce the renewal of infrastructures for the same power consumption.

Extending the Life of SDI Workflows

Existing 3G-SDI infrastructures can be scaled with "Lightly compressed" 4K. It requires a small compression can be easily implemented in existing infrastructure and FPGAs and ease upgrade on the field. It also requires ideally that the compressed 4K stream fit on a single 3G-SDI. The compression needs also to meet the key requirements to operate in live production infrastructures. It is important not to lose the advantages of current point-to-point, SDI-based systems in terms of familiar workflow, operational practice and interoperability.

Moving to IP

"Lightly compressed" 4K is needed to fit in a single 10GE cable. For the legacy deployed infrastructure, the compression has to be capable to leverage already deployed and new SMPTE 2022 5/6/VSF TR04/ TR03 equipment and put 3 x 4K streams on 3G-SDI and 10GE. It is also positive if the compression can goes up to mathematically lossless compression for a single 4K stream over a 10GE link. It is strongly require to get a compression with a low FPGA complexity (and in software) to cover all needs of the 4K over IP workflows.

TICO compression - Solving the 4K over IP Challenge

Available in Altera FPGAs, intoPIX TICO is a light-weight mezzanine compression codec that has been

specifically studied to achieve near lossless quality at very low compression ratios and for a very low FPGA complexity and cost.

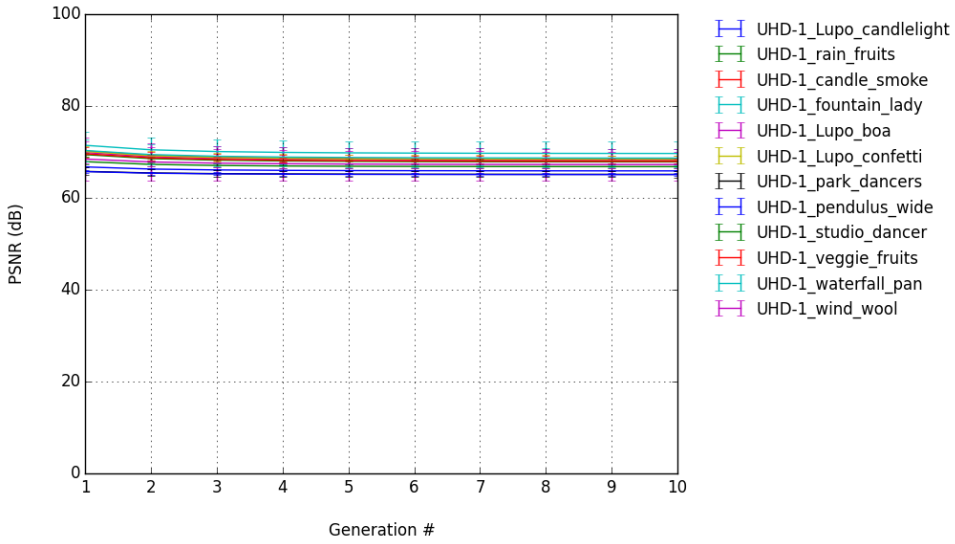

Figure 1 TICO Quality Robustness : 10 Coding generations
EBU UHD Set 422 10bit compressed at 2:1 (10bpp)

TICO has been proposed as a technology to the Joint Task Force on Professional Networked Streamed Media (JT-NM) and is moving to a first step of standardization with its submission as SMPTE RDD35 to enable interoperability in the case of 4K over IP application in Broadcast workflows.

TICO Unique features are:

- Visually **lossless compression** quality up to 4:1
  - Even Mathematically Lossless at lower compression ratio
- **Robustness to multiple encoding generations**
- Fixed l**ow latency**: Selectable from 2 to 16 pixel lines
- Very **low Altera FPGA resource** requirement:
  - **No** external DDR memory – only pixel line buffer
  - Low power consumption
- **Fast in software** (highly parallelizable algorithm)
- **Wide range of resolutions** and formats:
  - from HD to 4K/8K UHDTV
  - in 8, 10, 12bit
  - in 422, 444 and Raw-bayer
- Optimized for **TV & computer generated content**
- Designed **for industry-wide support**: Adapted to multiple usual transport schemes

Mapping SDI and IP (SMPTE 2022 5/6 or VSF TR03) for 4K

TICO guarantees low complexity of implementation with low compression ratio, with no compromise on latency and visual quality to transport UHDTV 4K over IP. It is perfectly matching the requirements to be carried across both SDI and IP infrastructure. Here is a small overview in the case of a mapping in SDI and IP (SMPTE 2022-6/VSFTR03/VSFTR04) standards.

Less than one frame latency	Sufficient compression ratio to fit	Visually lossless picture quality	Low complexity
•has only few lines of latency. •Fixed latency. •eases the synchronization with audio.	•enables UHDTV 4K over both 3G-SDI & 10GE. •compressed video data shall be transported in the full 10 bits of the SDI video words. Codec shall avoid the forbidden values. •Fixed bitrate (fully CBR)	•guarantee a visually lossless quality at the necessary compression ratio. •guarantee a visually lossless quality on any types of content. • robust to multiple generations of encoding. •Can be mathematically lossless at low compression rate.	•Is small to be added easily on many deployed FPGA. •Run also in software. •Low power •Low cost

Conclusion

AV industry faces heavy investments to enable the transport of 4K video in a regular way.

Using a TICO light-weight video compression, over IP Networks or through SDI mapping is a smart upgrade path to manage UHDTV 4K, frame rates and number of streams while assuring visual quality and very low hardware complexity and cost.

TICO brings the necessary key attributes for UHDTV 4K

- Existing infrastructures based on 3G-SDI, 10GB Ethernet
- SMPTE 2022-5/6 , SDI mapping, independent RTP essence mapping
- Light-weight compression on hardware & software
- Open Specifications at SMPTE as RDD35 to ease interoperability

Take the NEXT STEP using TICO on Altera FPGAs

For more details about intoPIX 4K over IP compression FPGA solutions including TICO

1. www.intopix.com/AlteraTICO
2. www.intopix.com/AlteraTransport

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