



4K Video over IP Workflows

The Benefits of intoPIX 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 3G-SDI links and 10GbE networks. In December 2014, this compression has been submitted for a SMPTE Registered Disclosure Document (RDD).

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 industry lives in a SDI world : and massively invested in 3G-SDI
- Broadcast & Pro-AV facilities move to IP : 4K does not fit into a single 10GE port

More bandwidth for 4K

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



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.

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 Pro-AV industries need real 4K 60fps at 4:2:2 or 4:4:4.

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

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 SMPTE 2022 5/6 equipment and put 3 x 4K streams on the 3G-SDI mapped on 10GE. It is also positive if the compression can go 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 Xilinx 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.

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 RDD 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 **low latency**: Selectable from 2 to 16 pixel lines
- Very **low Xilinx FPGA resource** requirement:
 - **No** external DDR memory – only pixel line buffer
 - Low power consumption
- **Fast in software** (highly parallelizable algorithm)
- **Wide range of resolutions**: from HD to 4K/8K UHD TV
- Optimized for **TV & computer generated content**
- Designed **for industry-wide support**: Adapted to multiple usual transport schemes

Mapping SDI and SMPTE 2022 5/6 for 4K over IP

TICO guarantees low complexity of implementation with low compression ratio, with no compromise on latency and visual quality to transport UHD TV 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 SMPTE 2022 5/6 standards.

Less than one frame latency	Sufficient compression ratio to fit	Visually lossless picture quality	Low complexity
<ul style="list-style-type: none">•TICO has only few lines of latency.•Fixed latency.•TICO eases the synchronization with audio.	<ul style="list-style-type: none">•TICO enables UHD TV 4K over both 3G-SDI & 10GE.•TICO 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)	<ul style="list-style-type: none">•TICO guarantee a visually lossless quality at the necessary compression ratio.•TICO guarantee a visually lossless quality on any types of content.•TICO is robust to multiple generations of encoding.•Can be mathematically lossless at low compression rate.	<ul style="list-style-type: none">•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 (ie SMPTE 2022) 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
- Light-weight compression on hardware & software
- Pushed at SMPTE for a wide adoption and interoperability

Take the NEXT STEP using TICO on Xilinx FPGAs

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

1. www.intopix.com/XilinxTICO
2. www.intopix.com/XilinxTransport

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