

## 4K Video over IP workflows

### The benefits of intoPIX TICO® lightweight compression

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#### Introduction

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



The lightweight compression **TICO** is visually lossless, guaranteeing compression at very low compression ratios with only few pixel lines of latency, low cost of implementation on FPGA, with a high efficiency in CPU. Moreover it enables a perfect mapping for 4K streams over 3G-SDI links and 10GbE networks. In December 2014, this compression has been submitted for a SMPTE Registered Disclosure Document (see SMPTE RDD35) and is supported by the TICO Alliance ([www.tico-alliance.org](http://www.tico-alliance.org)), a coalition of 40+ AV manufacturers.

#### Uncompressed 4K over IP: 3 important facts

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

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

#### More bandwidth for 4K

Uncompressed storage and transmission becomes unaffordable and unmanageable within systems and infrastructures: Moving 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 1GbE & 10GbE, are the obvious affordable ports. Compared to SDI, it enables a reduction of cost, size and number of cables. The cost of a 10GbE port from an Ethernet switch is going down significantly (compared to 25GbE, 40GbE,...) and is expected to be more affordable than a 3G-SDI in a near future. However, 4K cannot fit in a 10GbE Ethernet (11 880 Mbps). Only 4:2:0 goes below 10GbE and higher bandwidth (i.e. 40GbE, 100GbE) ports are too expensive for a large adoption. And Pro-AV industries need true 4K 60fps at 4:2:2 or 4:4:4 with 10bit per color.

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 at enabling Live IP Production capability with independent essence mapping specified now using VSF TR03 / SMPTE 2110, thanks to an effort conducted by the JT-NM VSF/SMPTE/EBU/AIMS.

## 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 reduces 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 that can easily be implemented in existing infrastructures and FPGAs and ease upgrading on the field. Ideally, the compressed 4K stream should even fit on a single 3G-SDI. The compression needs to also 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 workflow familiarity, operational practice and interoperability.



## Moving to IP

“Lightly compressed” 4K is needed to fit in a single 10GbE cable. For the legacy deployed infrastructure, the compression has to be capable of leveraging already deployed SMPTE 2022 5/6 equipment and put 3 x 4K streams on the 3G-SDI mapped on 10GbE. It can also be positive if the compression can go up to mathematically lossless compression for a single 4K stream over a 10GbE link. It is strongly required to get a compression with a low FPGA complexity (and in software) to cover all needs of the 4K over IP workflows. And finally Live production is not just about sending a single stream, it is about many streams.

## TICO compression - Solving the 4K over IP Challenge

Available in FPGAs, intoPIX TICO is a lightweight mezzanine compression codec that has been specifically designed to achieve near lossless quality at very low compression ratios, 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 has been submitted to SMPTE as SMPTE RDD35, providing open specifications to enable interoperability in the case of 4K over IP application in Broadcast workflows.

TICO SMPTE RDD35 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 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 & HDR compliant
- Optimized for **TV & computer generated content**
- Designed **for industry-wide support**: Adapted to multiple usual transport schemes
  - TICO SMPTE RDD35 specifies today:
    - How to carry TICO over SDI and over SMPTE 2022-6
    - How to carry TICO as an independent RTP essence for VSF TR03/ SMPTE 2110 system.

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

TICO guarantees a low complexity of implementation with a low compression ratio and 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 infrastructures.

An 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"><li>• Only few lines of latency</li><li>• Fixed latency</li><li>• Eases the synchronization with audio</li></ul>	<ul style="list-style-type: none"><li>• Enables UHDTV 4K over both 3G-SDI &amp; 10GbE</li><li>• Compressed video data shall be transported in the full 10 bits of the SDI video words. Codec shall avoid the forbidden values</li><li>• Fixed bitrate (fully CBR)</li></ul>	<ul style="list-style-type: none"><li>• Guarantees a visually lossless quality at the necessary compression ratio</li><li>• Guarantees a visually lossless quality on any types of content</li><li>• Is robust to multiple generations of encoding</li><li>• Can be mathematically lossless at low compression rate</li></ul>	<ul style="list-style-type: none"><li>• Is small to be added easily on many deployed FPGAs</li><li>• Runs also on software</li><li>• Low power</li><li>• Low cost</li></ul>

## Conclusion

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

Using TICO light-weight video compression, over IP Networks (i.e. 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
- Lightweight compression on hardware & software
- Pushed at SMPTE for a wide adoption and interoperability

## Take the NEXT STEP using TICO

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



[www.intopix.com/TICO](http://www.intopix.com/TICO)



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