



JPEG-XS and ST 2110

Jean-Baptiste Lorent
intoPIX



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IP SHOWCASE THEATRE

ST 2110 IS TAKING OFF

It is designed to become the infrastructure of choice

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GOING IP BRINGS MANY BENEFITS



REDUCING COMPLEXITY

- less cables
- bi-directional



INCREASING AGILITY

- re-routing
- easy configuration
- less space
- simplified workflows
- smaller buildings & OB



LOWERING COSTS

- less cables
- bi-directional
- COTS equipment



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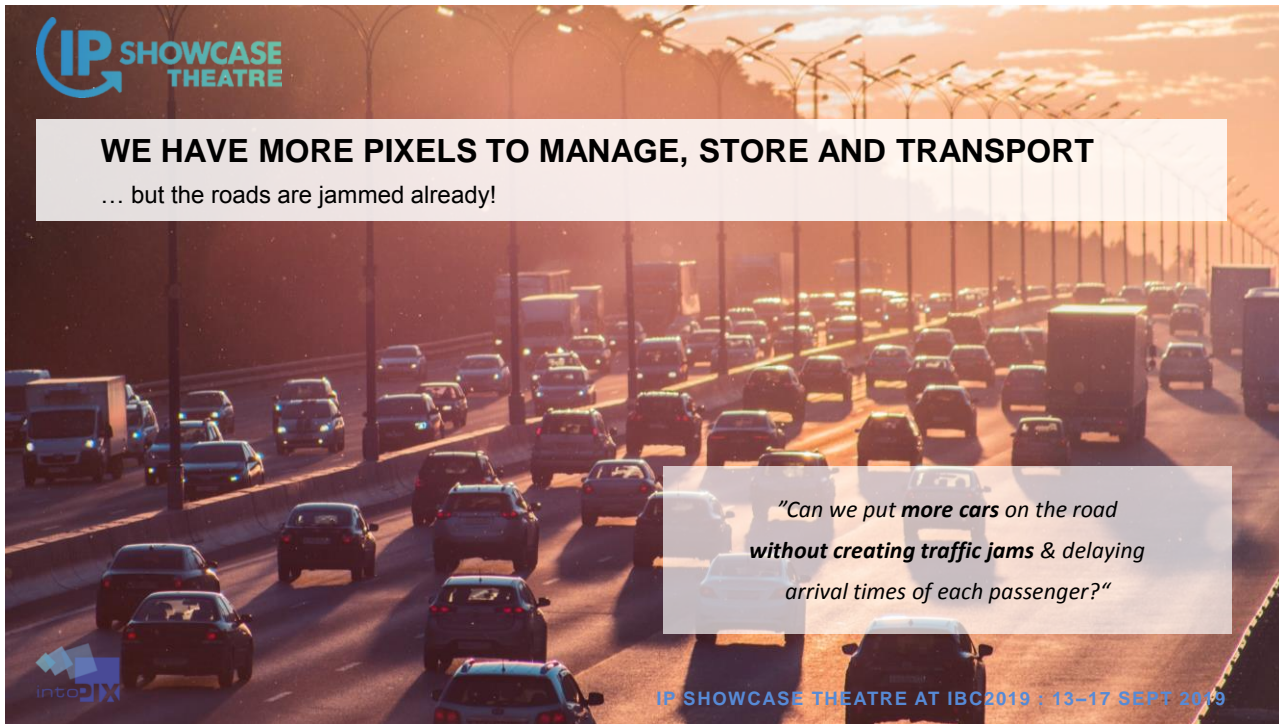


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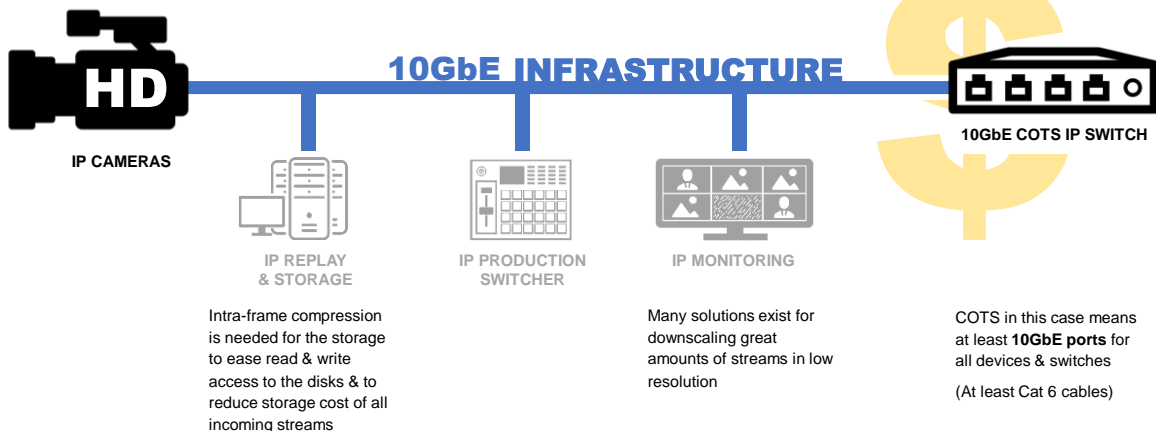


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HD NEEDS 10GBE INFRASTRUCTURES

Uncompressed = 2.4 Gbps for HD60

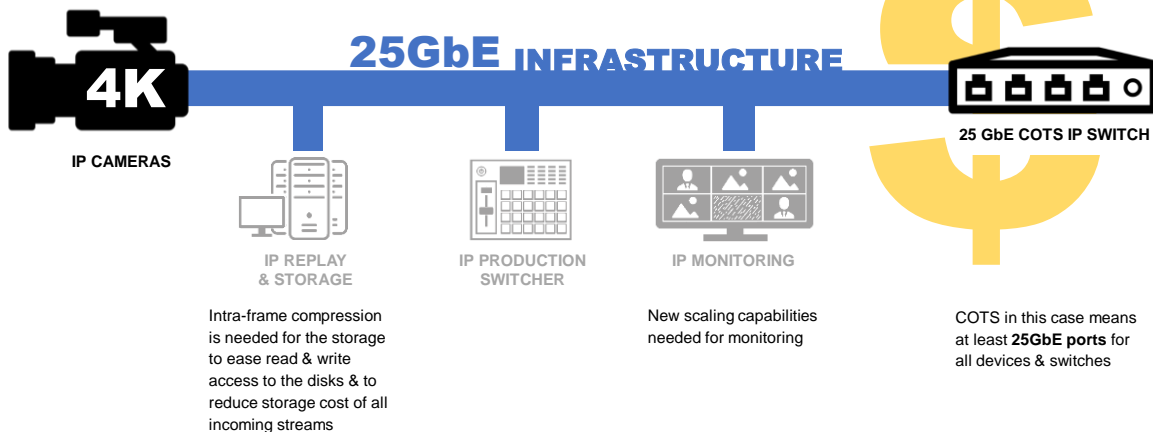


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4K NEEDS 25GBE INFRASTRUCTURES

Uncompressed = 9.6 Gbps for 4K60

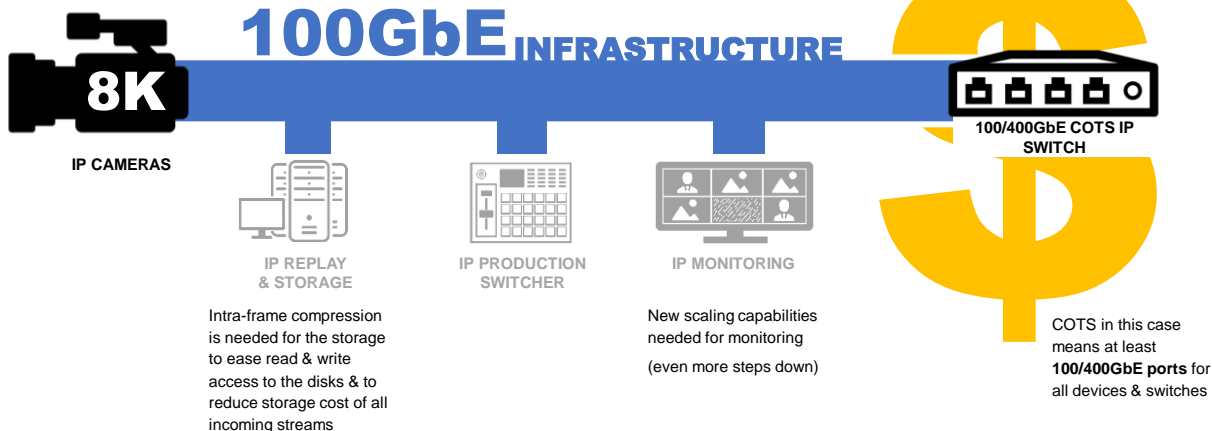


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8K NEEDS 100GBE INFRASTRUCTURES

Uncompressed: 38.4 Gbps for 8K60, 76.8 Gbps for 8K120



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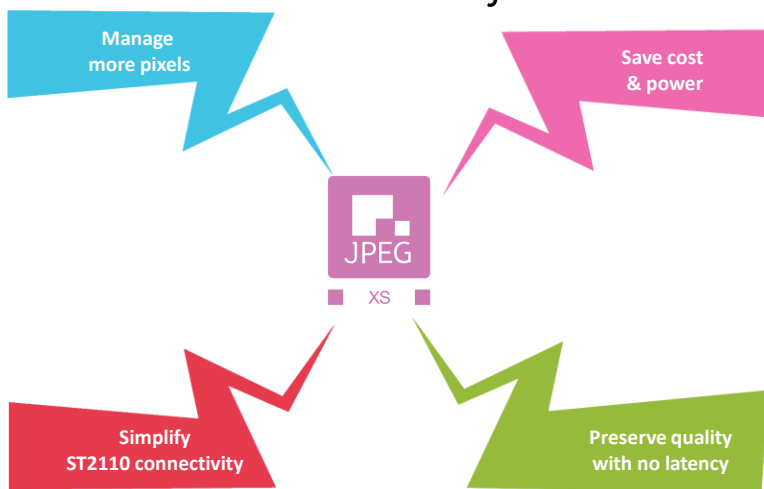
WHAT IF A TECHNOLOGY COULD HELP?

... easily *managing more pixels* over a **limited bandwidth**, safeguarding low latency and a pixel perfect quality?

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CALL FOR A NEW STANDARD
ISO-standardization of JPEG XS



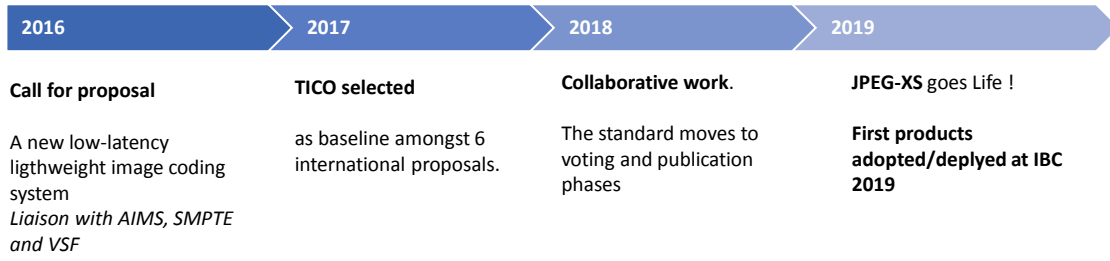
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CALL FOR A NEW STANDARD

ISO-standardization of JPEG XS

XS = Xtra Small Xtra Speed

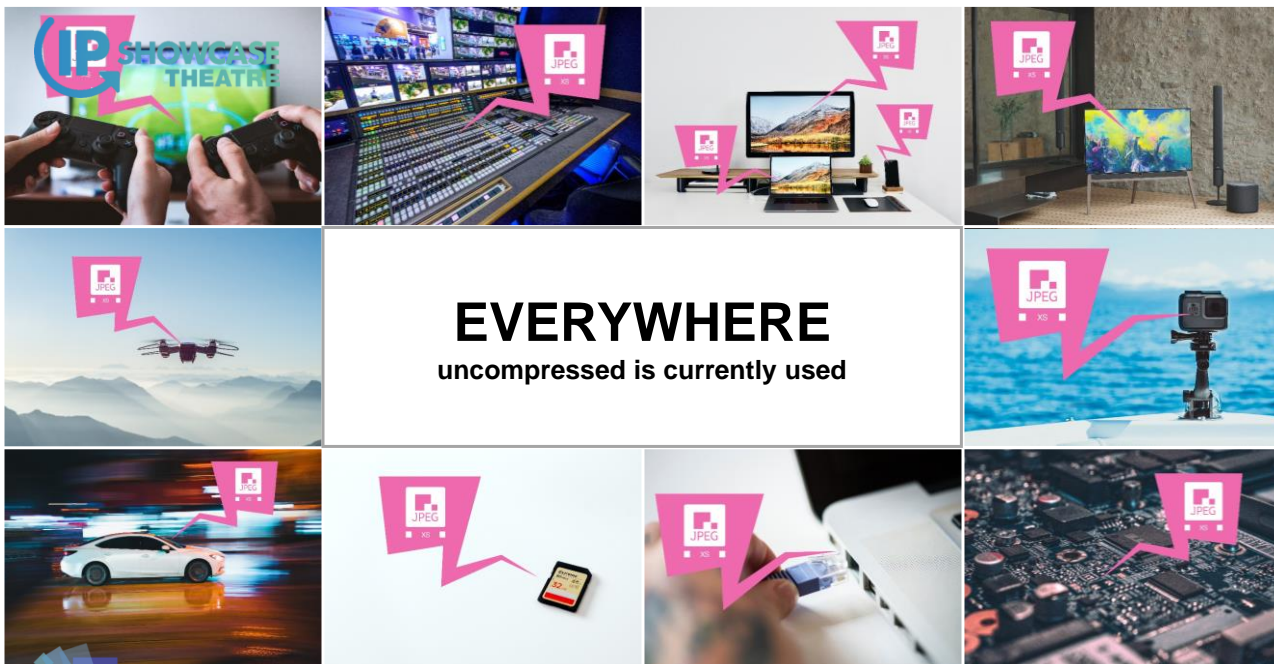


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WHERE
can JPEG XS be implemented?



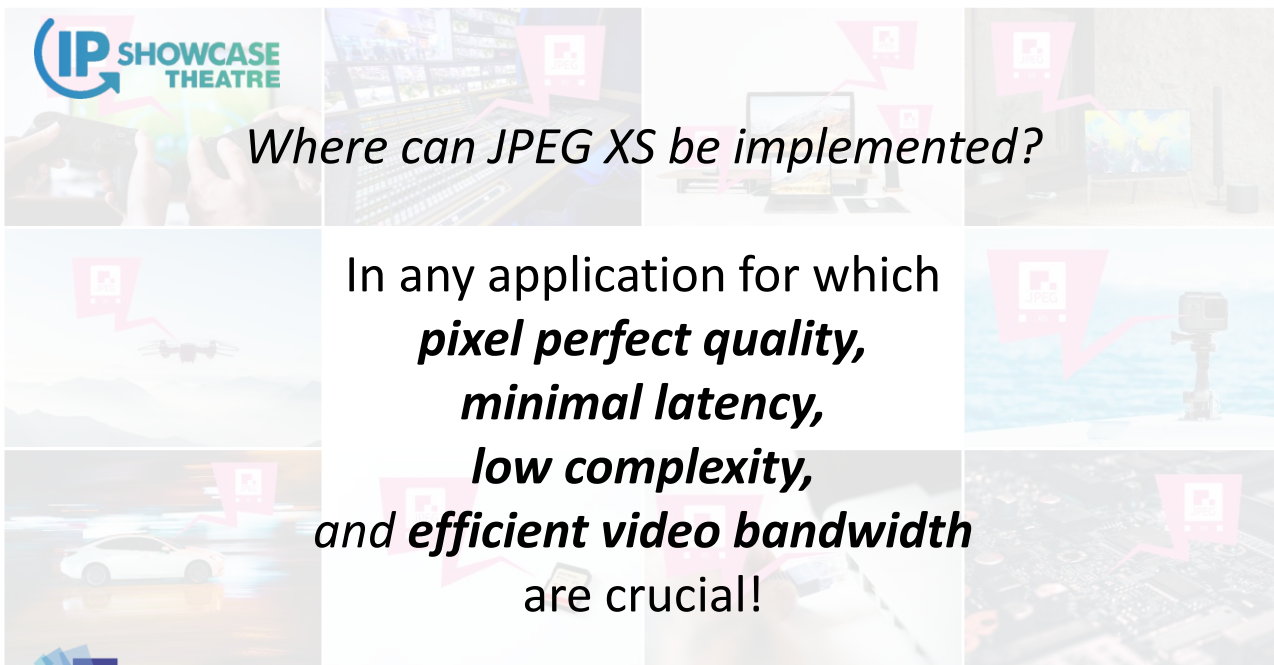
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EVERYWHERE
uncompressed is currently used

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Where can JPEG XS be implemented?

In any application for which
pixel perfect quality,
minimal latency,
low complexity,
and ***efficient video bandwidth***
are crucial!

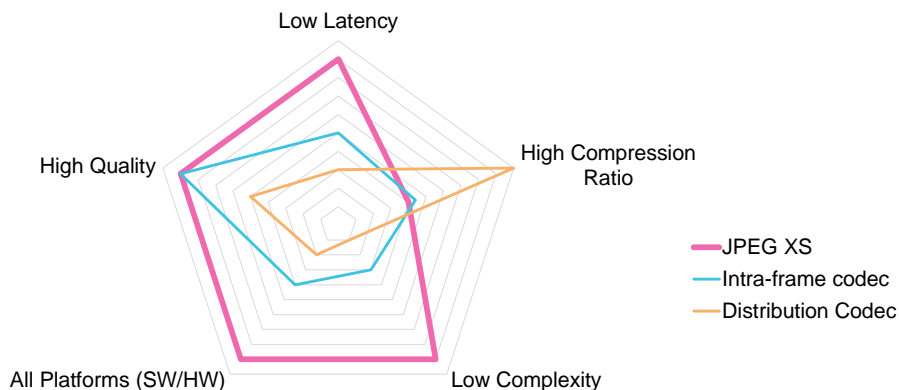
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A DIFFERENT APPROACH TO CREATING A CODEC

Combining the best speed, complexity and quality in one codec



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JPEG XS' BENEFITS

The most advanced lightweight codec



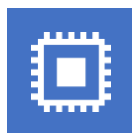
VISUALLY LOSSLESS



CONSTANT QUALITY



LOW COMPLEXITY



MULTI-PLATFORM



NO LATENCY



SCALABILITY



OPEN SPECIFICATIONS & INTEROPERABILITY

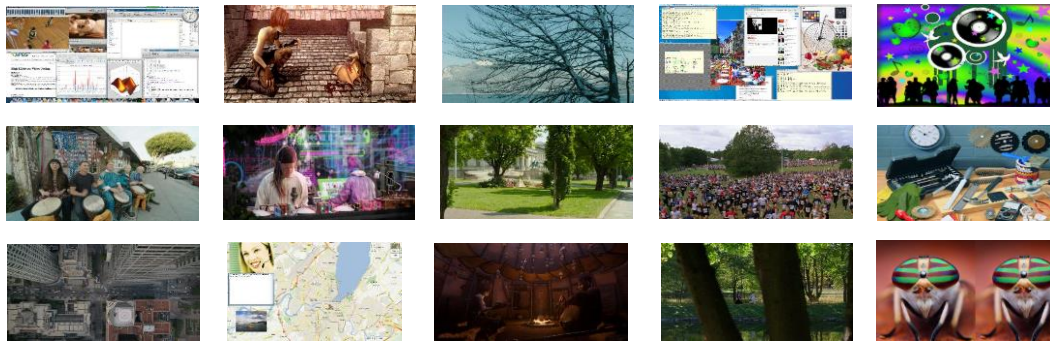


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SUBJECTIVE AND OBJECTIVE QUALITY EVALUATION

Using CGI, desktop and natural content



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RIGOROUS ISO QUALITY ASSESSMENTS

New **ISO/IEC 29170-2** method for near-lossless quality assessment on both natural & synthetic images)

- ✓ Full transparency to uncompressed down to 3bpp (10:1)
- ✓ Visually lossless down to 1.5bpp (20:1) on film/TV content
- ✓ Smooth degradation down to 0.5bpp (ringing artefacts/ no blocking artefacts!)

“FLICKER TEST”



Test on 360 scores (= persons) in total (from 4 universities/research centers)



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HIGH QUALITY IN MICROSECONDS

Natural image with equally distributed details vertically on JPEG-XS

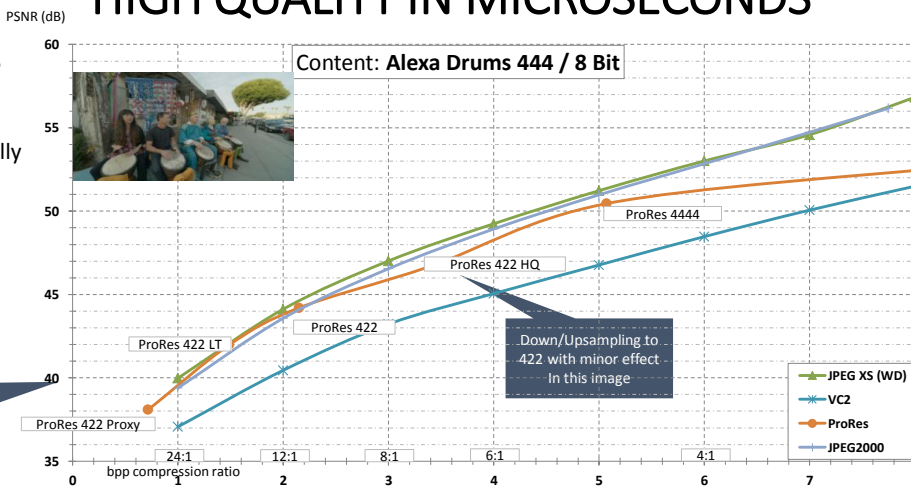


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HIGH QUALITY IN MICROSECONDS

Natural image with equally distributed details vertically on JPEG-XS



Above 40dB typically visual lossless

Down/Upsampling to 422 with minor effect in this image

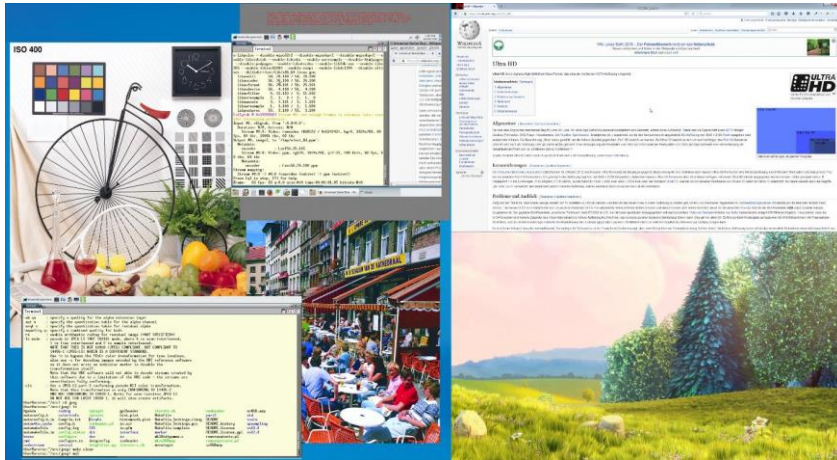


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HIGH QUALITY IN MICROSECONDS

Mixed desktop content with natural images, CGI content, and text on JPEG-XS

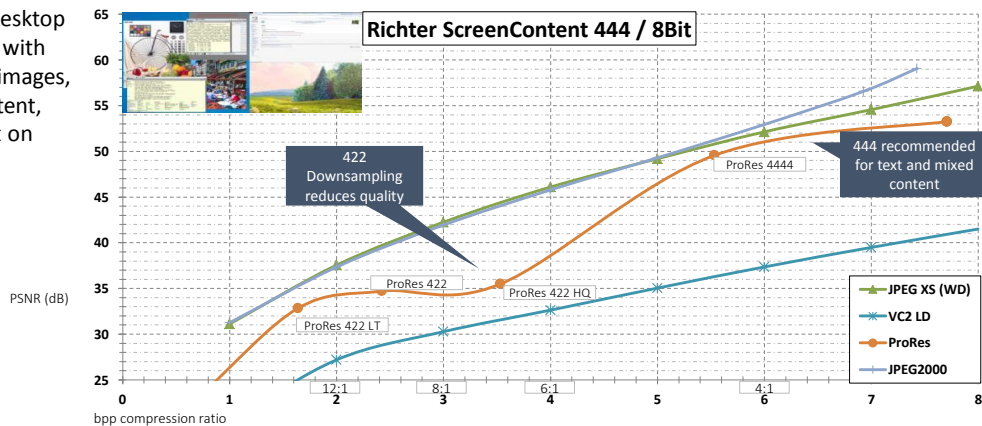


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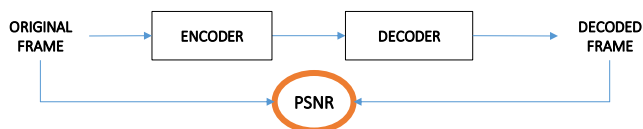


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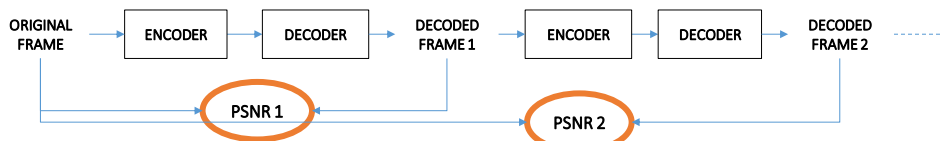
BEST QUALITY IN SINGLE- AND MULTI-GENERATION

SINGLE GENERATION EXPERIMENT



MULTI GENERATION EXPERIMENT

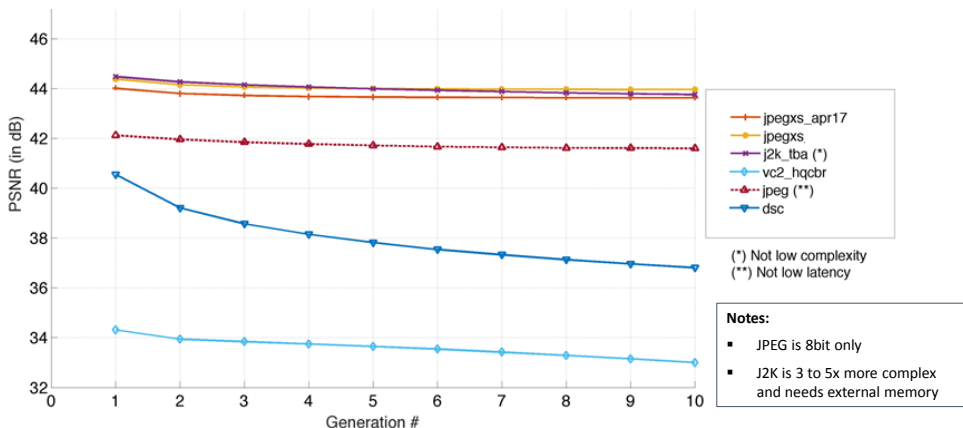
Performed for 10 generations



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BEST QUALITY IN MULTI-GENERATION



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MINIMAL COMPLEXITY ON ALL PLATFORMS

...leading to maximum efficiency

- Multiple degrees of parallelism for optimized CPU, GPU, FPGA and ASIC implementations.
- Multiple profiles for low power, Low logic
 - no external memory in hardware (FPGA, ASIC)
 - The smallest codec for FPGA at this efficiency
- Optimal syntax for software and speed optimizations (CPU, GPU)
 - *5x faster or more than JPEG2000 ISO standard in CPU, GPU*
- Best trade-off between cost, power consumption and quality



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MINIMAL LATENCY

- Down to a few **microseconds** (down to 1/10 of a millisecond) = only a few video lines.
- Maximum responsiveness (few μ s) - perfect for any latency critical applications
- CBR (constant bitrate) for reliable video over IP transport.



Humans are able to detect a latency only above 13 milliseconds.

Massachusetts Institute of Technology (MIT)



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MAXIMUM FLEXIBILITY

Future proof thanks to support of extensive number of video formats

- Multiple resolutions – HD, 4K, 8K... up to 16Kx16K
- Multiple chroma formats – 4:4:4, 4:2:2, 4:2:0, grayscale
- Multiple color formats – RGB, YUV, ...
- Multiple bit depths – From 8, 10, 12, 14 to 16bit
- HDR support



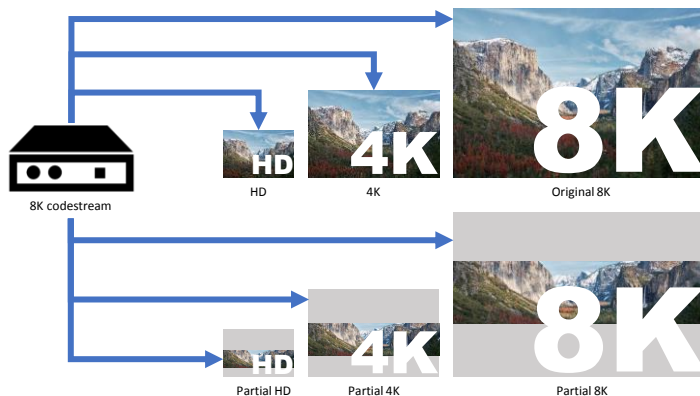
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MAXIMUM FLEXIBILITY

Built-in 1- to 2-level downscaler and partial extraction

- HD/4K/8K downscaler within workflows (i.e. for monitoring purpose)
- Lower CPU/GPU decoding requirements (less consumption to decode HD than 4K & 8K)
- Partial extraction for faster analytics and detection



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JPEG XS IS AN ISO STANDARD

Open specifications ensuring interoperability

ITEM	DESCRIPTION	STATUS	TARGET DATE
ISO/IEC 21122-1	Part 1: Core coding system	Published	n.a.
ISO/IEC 21122-2	Part 2: Profiles and buffer models	Published	n.a.
ISO/IEC 21122-3	Part 3: Transport and container formats	Published	n.a.
ISO/IEC 21122-4	Part 4: Conformance testing	Under last ballot - DIS	Q3 2019
ISO/IEC 21122-5	Part 5: Reference software	First ballot - CD	Q4 2019
ISO/IEC 21122-1 AMD1	Amd 1: extended capabilities	Working Draft	Q2 2020
ISO/IEC 13818-1 AMD1	Carriage of JPEG XS over MPEG-2 TS	Under last ballot (Draft AMD - DAM)	Q4 2019
IETF RFC JPEG XS RTP	JPEG XS RTP payload (https://datatracker.ietf.org/doc/draft-ietf-payload-rtp-jpegxs/)	Current version formally adopted by IETF payload WG	Q4 2019
SMPTE ST 2110-22	Compressed essence in ST2110	Published	n.a.



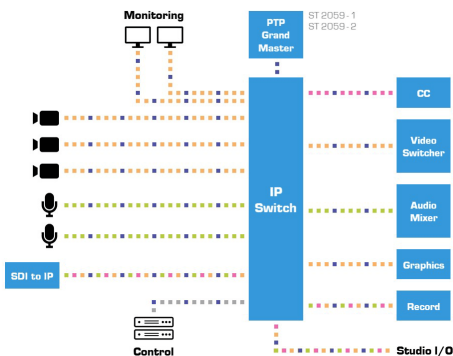
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JPEG-XS, WITH ST 2110

Part -22 (Compressed video essence)

- Video RTP Packet [Part 20/22]
- Audio RTP Packet [Part 30/31]
- Data RTP Packet [Part 40]
- PTP Sync Packet
- Control Packet



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MAX 10GbE or even just CAT5e (<2.5GbE)

JPEG XS → ST 2110 BANDWIDTH-EFFICIENT WORKFLOW

FORMATS	JPEG XS BITRATES	IP NETWORKS & SDI MAPPING	INFRASTRUCTURE
HD 720p60 HD 1080i60	70 Mbps - 200 Mbps	1 to x streams over 1GbE	CAT5e
HD 1080p60	150 Mbps - 400 Mbps	1 to x streams over 1GbE	CAT5e
4K 2160p60	500 Mbps - 1,6 Gbps	1 stream over 1GbE 1 to x streams over 10GbE Down to a single SDI cable	CAT5e CAT6 HD/3G-SDI
8K 4320p60	2 Gbps - 6,4 Gbps	1 stream over 2.5GbE up to 4 streams over 10GbE Down to a single SDI cable	CAT5e CAT6 3G/6G/12G-SDI
8K 4320p120	4 Gbps - 12,8 Gbps	2 streams over 10GbE Down to a single SDI cable	CAT6 6G/12G-SDI

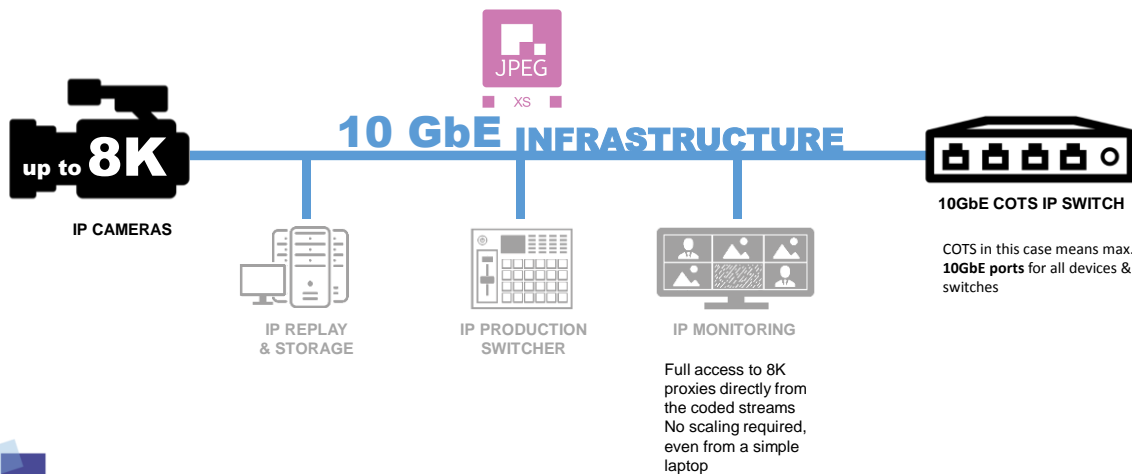


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MAX 10GbE or even just CAT5e (<2.5GbE)

JPEG XS → COST-EFFECTIVE ST2110 INFRASTRUCTURES



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**cost-effective, bandwidth-efficient,
and high quality IP production workflows**

- **XS meets all the ST2110 quality requirements**
 - CBR, latency, quality, complexity, ...
- **All existing advantages of moving to IP are kept**
 - flexibility, scalability, unlimited accessibility
- **XS bandwidth-reduction enables to achieve more with ST2110**
 - Higher pixel rates, more streams, cheaper cables (CAT5e, 3G-SDI) and interfaces (<1Gpbs, <10Gpbs), reduced costs, reduced storage, reduced IP packets, ...
 - Upgrade capability
 - Ease the remote production and cloud migration
- **Fully standardized**



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Thank You

Live CPU, GPU & FPGA demos at intoPIX booth (Hall 10 D31) in HD, 4K & 8K

jb.lorent@intopix.com

Thank you to our Media Partners



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About us, intoPIX

- Founded in 2006, HQ in Belgium.
- Technology provider of innovative compression technologies empowering visual communications.
- Member of AIMS, VSF, SMPTE and JPEG committees.
- Deliver unique FPGA/ASIC IP cores and fast CPU/GPU SDKs to manage more pixels, preserve quality with no latency, save cost & power and simplify connectivity.
- Track record in terms of success stories, innovation achievements and effectiveness in enhancing Broadcast applications.
 - EMMY for technology & engineering on JPEG2000 VSF TR01 , Invention & Standardization of TICO at SMPTE RDD35 and at JPEG as JPEG-XS, IABM Game Changer, IABM Peter Wayne Award for Innovation, EY Belgian Most promising growing company finalist, Delloite Fast50,...Serving 100+ customers worldwide
- [More info on : www.intoPIX.com](http://www.intoPIX.com)



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