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LOWEST LATENCY FOR VIDEO OVER IP TRANSMISSION JPEG XS

The standardized JPEG XS codec was developed to handle media workflows from acquisition to distribution by using Ethernet settings and infrastructure only. Until very recently, digital image transmission for production and contribution could be done only by using specific interfaces such as SDI, IEEE1394, or CameraLink. However, with the availability of higher bandwidth of Ethernet interfaces, the handling of highest-quality images over internet protocol (IP) in local and wide area networks was required and JPEG XS is a codec enabling these requirements.

An update to the new video production codec for professional video

A low compression of up to 10:1 allows near-transparent transmission.

JPEG XS – developed to offer lowest latency for multiple encoding-decoding cycles and moderate computational resource requirements while preserving image quality at the highest level – fulfills these demands to facilitate production/contribution settings, even for 4 and 8k images.

The core coding system of JPEG XS was standardized in ISO at the end of 2018 as ISO/IEC 21122-1, the remaining parts in 2019.

What is available for industry applications today are the compression of RGB and YCbCr images in 444 and 422 sampling formats with up to 12 bits per component for broadcast and prosumer use cases. Some smaller extensions, like compression of 420 sampling formats and lossless compression, are under development.

Integration of JPEG XS into cameras and image sensors

The current standardization activity is a big step forward to enable JPEG-XS for compression of RAW Bayer image data. During this JPEG XS development phase, a PSNR gain of 5 dB in coding efficiency could be achieved and will be included in a new amendment.

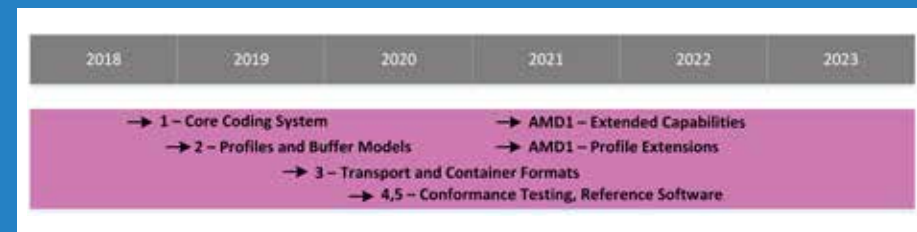
This allows the industry to integrate the codec into today's cameras and image sensors. It offers the use of the codec in the complete production pipeline – from the image capturing to the distribution encoder. It facilitates the use of the codec in other use cases, like integration in cameras for machine vision, automotive, or high quality surveillance, too.

JPEG XS already exists as transport and file formats, like RTP, MPEG2-TS, JXS, MP4, and HEIF. The standardization of JPEG XS inside the MXF file container is under progress in SMPTE under the item ST 2124. With these activities, a complete suite of formats is now available for JPEG XS allowing the transport and storage of this format in the postproduction workflow.

JPEG XS SDK available

Fraunhofer IIS offers development kits for CPU and GPU usage, as well as consulting projects for integration into products to the industry. Initial implementations for JPEG XS were carried out successfully, even in 8k.

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JPEG XS – Advantages in brief

Professional formats: Support of RGB/444, RGBA/4444, YCbCr 444/422, YCbCrA 4444/42224 and YCbCr 420 image formats of up to 12 bits per color component sample precision with the option to extend it to 16 bits in the future

Highest fidelity: Visually lossless, i.e. no visible degradation, even over multiple compression/decompression cycles. The latter is known under the term “multi-generation robustness”.

Low latency: Maximum 32 lines end-to-end (compression-decompression) latency in hardware, in special modes even subline-latency.

Bitrate: Exact bitrate allocation per frame slice avoiding data overshooting

Parallelism: Support for multiple platforms e.g. FPGA, ASIC, GPU and CPU, by high degree of parallelism

High Performance: Real-time software implementation capability for 4k/60p formats on today's standard computers.

Low complexity: defined as a maximum percentage of a specific low-cost FPGA.
No external frame buffer required in embedded applications. In particular, individual frames shall be decoded independently

Typical compression ratios: 2:1 – 10:1

Transport/Container	Type	Description – Main purpose	Extension
RTP	RTP Payload Format for JPEG XS (IETF draft)	IP based transport	
MPEG2-TS	ISO/IEC 13818-1:2019 AMD1:2020	Carriage of associated CMAF boxes for audio-visual elementary streams and JPEG XS in MPEG-2 TS	
Video over IP	SMPTE 2110-22:2019	Encapsulation of compressed video streams in SMPTE 2110 as RTP stream	
JXS	JPEG XS file format (defined in ISO/IEC 21122-3 Annex A)	For storing of single images JPEG 2000 syntax based	.jxs
MP4	ISO Base Media File format (ISO/BMFF) (defined in ISO/IEC 21122-3 Annex B)	For storing of video ISO/BMFF syntax based	.mp4
HEIF	High Efficiency Image File Format (defined in ISO/IEC 21122-3 Annex C)	For storing of mixed image and video content	.heif
MXF	SMPTE 2124 (FCD)	For storing of video MXF syntax based	.mxf

Notes: Status is as of 01.June.2020

Transport and File formats for JPEG XS