

## The most **powerful** and **flexible** **JPEG 2000** solution **available today**

intoPIX EMMY® Award-winning JPEG 2000 encoder and decoder IP-cores protect high value images. Simultaneously handling deep color, low and high data rates and extensive JPEG 2000 know-how, intoPIX IP-cores enable best-in-class picture quality.

The IP-cores are available for the most recent FPGA platforms and ensure lower consumption, lower temperature dissipation and lower bill of materials with unprecedented performances.

Fully benefiting from a modular architecture (image formats, frame rates and resolutions) and completed with a wide range of companion IP-cores (video transport, security, memory sharing, ...), intoPIX's solutions provide an easy, timely and cost-effective way to implement JPEG 2000 technology.

### High quality picture

- > From lossless down to visually lossless

### Customizable design

- > Artix-7, Kintex-7, Virtex-7
- > Kintex Ultrascale, Kintex Ultrascale +
- > Zynq-7, Zynq Ultrascale +

### Cost effective

- > Ultra dense
- > Optimized per application

### Future-proof

- > HD, 4K & 8K
- > High frames rates
- > Ultra-Low latency mode (<5ms)
- > 4:2:2/4:4:4/Monochrome/Raw Bayer

### Companion IP-cores

- > DDR4/DDR3/DDR2 controller (Multiport J2K)
- > MPEG-2 TS IP-core

### Security IP-cores

- > AES security IP-cores
- > RSA security IP-cores
- > Hash function

### Easy integration

- > J2K HDK on Xilinx reference boards
- > Team training
- > Application reference designs



## APPLICATIONS

### HD

The JPEG 2000 HD cores allow you to **preserve image quality throughout your complete AV workflow.**

These IP-cores have a decoded bitrate range from 250 Mbps up to 1 Gbps, and can process up to 120 progressive frames per second in HD resolution (1920 x 1080).

Moreover, the IP-cores flexibility enables to address all known broadcast standards in terms of resolution and frame rates.

- Single chip
- Broadcast and IMF profile compliant (JPEG 2000 Part 1 Amd3 and Amd7)
- Any resolution up to 1080p-120 fps
- Up to 1Gbps compressed bitrates
- Progressive/interlaced
- 4:2:2/4:4:4
- Multi streams support
- CBR/VBR



#### APPLICATIONS

Camera embedded encoder  
Field recorder  
Production video server  
Fill and key playout server  
High speed server for slow-motion  
VSF TR01 - Transport of J2K in MPEG-2 TS over IP



### Digital Cinema

#### DCI compliant & HFR IP-cores

The intoPIX Digital Cinema IP-cores are optimized to meet **the highest requirements of digital cinema including 2K-120 fps and 4K-3D formats.**

The Digital Cinema solution enables the integration within a single chip of a complete image processing chain, i.e. decryption-decoding-watermarking and encryption, together with video I/O interfaces, system control and system interfaces.

- Single chip
- DCI compliant (JPEG 2000 Part 1 Amd 1)
- 2K resolution at up to 120 fps
- 4K resolution at up to 60 fps
- Bitrates from 250Mbps up to 1Gbps



#### APPLICATIONS

Cinema mediablock (DCI & HFR)  
Cinema post-production  
Faster than real-time encoder  
Digital Cinema package (DCP)

### UHD 4K/8K

The JPEG 2000 Ultra HD 4K & 8K IP-cores go **one step further in terms of encoding power and high-end applications.** This range of IP-cores gives you access to the **ITU UHD TV standards, 4K and 8K.**



- PRO-AV
- Single chip
- Broadcast and IMF profile compliant (JPEG 2000 Part 1 Amd3 and Amd7)
- IMF profile compliant (JPEG 2000 Part 1 Amd7)
- 4K resolution at up to 60fps
- 8K resolution at up to 60fps
- High bitrate flexibility

#### APPLICATIONS

UHDTV 4K & UHDTV 8K  
Digital signage, shows & theme park  
Geospace/Aerospace  
IMF  
UHDTV 4K over 1GbE

### J2K-RAW

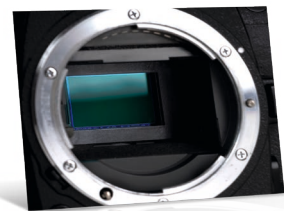
#### Best bayer pattern images compression

J2K-RAW compression IP-cores perfectly preserve the RAW output (Bayer pattern images) of Bayer-filter cameras with best-in-class JPEG 2000 compression. Offering a visually lossless quality, J2K-RAW also allows an automatic access to low-resolution preview thanks to the JPEG 2000 scalability.

- Compact J2K-RAW IP-cores
- Wavelet-based standardized compression
- Visually lossless and VBR support
- HD, 4K, 8K bayer pattern images at multiple frame rates
- Higher image quality possibilities within a reasonable storage and bandwidth
- Fast low-resolution preview access thanks to the JPEG 2000 scalability

#### APPLICATIONS

Cameras (HD, 4K, 8K,...)  
High-speed cameras  
Recorders  
Production and post-production servers



### Ultra Low Latency option JPEG 2000 for live streams

The HD & UHD family also offers an Ultra Low Latency option that enables you to carry video streams within the network **with a latency below 5 milliseconds** while guaranteeing high image quality.

- Sub intra-frame latency
- Visually lossless quality

#### APPLICATIONS

Video over IP (SMPTE2022, VSF TR01/03, AVB...)  
Wireless transmission  
Remote control & monitoring  
IP-based production



### Lossless

#### JPEG 2000 for pristine content

The intoPIX lossless encoders and decoders **preserve the original image information.** They support any image format up to 4K+ (4096x3112) with color depth up to 12 bit per component and JPEG 2000 lossless compression.

- Single chip
- Fully flexible image format up to 4K single tile
- Math. lossless encoding

#### APPLICATIONS

Archiving  
Store and forward  
Medical  
Aerospace  
Geospace







## Companion IP-cores

intoPIX proposes companion IP-cores specially designed to **ease the integration of JPEG 2000 and minimize your time-to-market.**

### DRAM Memory controller IP-cores

#### DDR4, DDR3 and DDR2 cores

The IPX-DDR IP-cores match various operating frequencies and physical bus size (8, 16, 32 or 64 bit), allowing you for instance to respectively reach peak transfer rate of 34Gbit/s and 68 Gbit/s on 64 bit wide interface. These IP-cores are fully-optimized to provide a powerful interface towards the JPEG 2000 IP-cores.

#### Multi-core memory bridge core

The IPX-MLB is an efficient IP-core enabling multiple JPEG 2000 IP-cores to share a memory access with a single controller. Thanks to the IPX-MLB, it is easy to boost a design that needs to run multiple JPEG 2000 cores in parallel. The IPX-MLB also enables to share the memory access with other processes through an AXI4 interface.

### Security IP-cores

#### AES encryption-decryption cores

The IPX-AES modules are encryptor-decryptor IP-cores providing an efficient FPGA implementation of the advanced encryption standard (AES).

Supporting a wide range of bitrates and combining several functions and operating modes, the IPX-AES cores can be customized for each specific application.

More on: [www.intopix.com/security](http://www.intopix.com/security)

#### Hash function core

The IPX-HMAC-SHA-1 IP-core is the hashing function required for content integrity check and content identification as specified in DCI documents. It enables computation of the keyed-hash message authentication code (HMAC) for audio and video assets.

#### RSA public key cryptography accelerator core

The IPX-RSA modular exponentiation accelerator is an efficient and low footprint arithmetic coprocessor for the RSA public-key cryptosystem. It performs the modular exponentiation calculation and therefore offloads the most computer intensive operation of RSA from the main processor. The RSA cryptosystem can be used for public key encryption, decryption and signature/authentication.

#### Watermarking memory bridge core

The IPX-WB watermarking memory bridge offers the possibility to seamlessly connect the Civolution Nextguard DCI Video Watermarking IP-core with intoPIX JPEG 2000 IP-cores and to share the same external memory.



## Evaluation and integration

intoPIX offers many different possibilities to assess the quality, capability and characteristics, to speed-up the integration of a fully functional JPEG 2000 core.

### Hardware development kit (HDK)

The intoPIX HDK enables faster and reliable integration. Using a flexible structure, it focusses on providing a seamless environment for the integration of any intoPIX JPEG 2000 IP-cores, using a FPGA reference board as starting point. It efficiently validates the integration with a smart step-by-step approach and accelerates the progress towards the final customer application even before the dedicated hardware is ready. Thanks to a layered structure, it significantly eases the porting from one hardware platform to the other, and facilitates switching between applications in the same hardware environment.

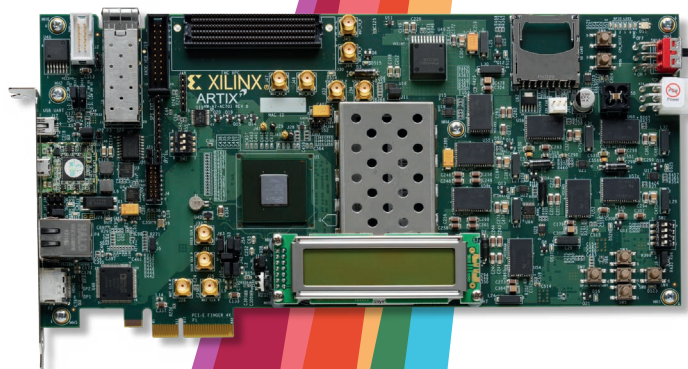
- Standalone implementation of the custom IP-core flavour on a FPGA reference board
- Fastest product time to market
- Increased integration friendliness and design re-usability

### Application reference designs

Additionally to the HDK, intoPIX also accelerates customer product developments with video application reference designs. The reference designs aim to bring powerful proof of concepts using intoPIX's high-performance IP-cores.

- SMPTE2022 JPEG 2000 video over IP (VSF TR01 and beyond)
- UHD4K JPEG 2000 acceleration
- ...

**For more information on the available possibilities, please contact [sales@intopix.com](mailto:sales@intopix.com)**



# FPGA implementation

## Image features

- Bit depth: 8, 10, 12, 14, 16
- Color space: Any (RGB, YUV, XYZ, YCbCr,...)
- Color sampling : 4:0:0, 4:2:0, 4:2:2, 4:4:4, 4:2:2:4, 4:4:4:4
- Interlaced field, progressive frame
- Monochrome, 3 and 4 components, Bayer pattern
- Any resolutions (SD, HD, 2K, 4K, 8K, ...)

## JPEG 2000 (ISO 15444-1)

- Wavelet transforms: 5/3 and 9/7
- Reversible (RCT) or irreversible color transforms (ICT)
- Decomposition levels: up to 6 levels
- Quantization steps: programmable per level and per component
- Quality layer: 1 layer
- Digital Cinema (DCI) compliant - JPEG 2000 Part 1 Amd1
- Broadcast profiles compliant - JPEG 2000 Part 1 Amd3
- IMF profiles compliant - JPEG 2000 Part 1 Amd7
- Tiling: single tile
- Progression order: CPRL
- Code block size: 32x32, 32x64, 64x32, 64x64, 128x32
- Contrast sensitivity function

## Quality and bit rate control

- Max codestream bitrate configurable: typically ranging up to 250Mbps, 500Mbps, 1Gbps, 4Gbps, 8Gbps to unlimited for lossless compression
- Variable bit rate (VBR): The overall bit rate is variable for a selectable constant quality
- Capped VBR: 9/7 wavelet filter - Constant quality but variable bit rate is capped at a given maximum limit
- Visually lossless VBR: 9/7 wavelet filter - Constant visual quality - No visually noticeable artifact - 8:1 compression used up to 20:1

- Nearly mathematically lossless (NMLS): 5/3 wavelet reversible transform with an applied maximum bit rate - 3:1 to 5:1 compression
- True mathematically lossless (MLS): 5/3 wavelet reversible transform - no max bit rate - bit to bit lossless compression - 2:1 to 3:1 compression

## Latency

- Low latency: configurable from 1 to 2 frames (field) at encoding; from 0,5 to 1 frame(field) at decoding (ie. 1080p60 or 2160p60 end-to-end is maximum 50ms)
- Ultra-low latency (Sub-I-frame): down to 2/16th of a frame (field) at encoding and to 1/16th of a frame(field) at decoding with stripe border protection (ie. down to 5 milliseconds with end-to-end compression in 1080p60 or 2160p60)

## Control

- Encoder:
  - Up to 64 preloaded configurations and frame per frame control
  - Configuration control: through control bus or through video interface
  - Real-time access to status registers for monitoring and debug
- Decoder:
  - Up to 16 preloaded channel configurations
  - Configuration control: through control bus or through codestream control packets
  - Real-time access to status registers for monitoring and debug
  - On-the-fly codestream integrity check and error robustness
  - Optional automatic frame repeater or interlacer
  - Auto-downscaling and auto-upscaling capability from HD/2K to UHD/4K

## Hardware requirement and delivery:

- External memory: DDR3, DDR2, LPDDR2, DDR4
- FPGA: support of the latest Xilinx Ultrascale and Ultrascale+ series and previous 7, 6 and 5 series
- Fully customizable IP-core per application, delivered and silicon proven with the intoPIX HDK for fast integration

# FPGA IP-core releases



Target Xilinx FPGA

Reference IP-cores (-enc or -dec)	Max resolution	Max frame rate (fps)	Max bitrate	Target Xilinx FPGA						
				Virtex-7 VH/VX	Kintex-7 K	Artix-7 A	Zynq Z	Kintex Ultrascale	Kintex Ultrascale+	
<b>HD</b>	IPX-J2K-HD-30-422-10-250	1920x1080	30p (60i)	250 Mbps	290T-1/330T-1	70T-1	75SLT-1	7020-1	025-1	3p
	IPX-J2K-HD-60-422-10-300	1920x1080	60p (120i)	300 Mbps	290T-1/330T-1	70T-1	100T-1	7020-1	025-1	3p
	IPX-J2K-HD-60-422-10-500	1920x1080	60p (120i)	500 Mbps	290T-1/330T-1	70T-1	100T-1	7020-1	025-1	3p
	IPX-J2K-HD-120-422-10-1000	1920x1080	120p (240i)	1 Gbps	290T-1/330T-1	160T-1	200T-1	7030-1	025-1	3p
<b>CINEMA</b>	IPX-J2K-2K-DCI-120-444-12-500	2048x1080	120p	500 Mbps	290T-1/330T-1	160T-1	100T-1	7020-1	025-1	3p
	IPX-J2K-4K-DCI-30-444-12-500	4096x2160	30p	500 Mbps	290T-1/330T-1	160T-1	200T-1	7030-1	025-1	3p
	IPX-J2K-4K-DCI-60-444-12-1000	4096x2160	60p	1 Gbps	290T-1/330T-1	325T-2	-	7030-1	035-1	5p
<b>M-LOSSLESS</b>	IPX-J2K-HD-MLS-60-422-10	2048x1080	60p	Math.Lossless	290T-1/330T-1	160T-1	200T-1	7030-1	025-1	3p
	IPX-J2K-UHD4K-MLS-422-10	4096x2160	NA	Math.Lossless	290T-1/330T-1	160T-1	200T-1	7030-1	025-1	3p
<b>UHD 4K/8K</b>	IPX-J2K-UHD4K-60-422-10-1000	4096x2160	60p	1 Gbps	330T-2	325T-2	-	7030-1	035-1	5p
	IPX-J2K-UHD4K-60-422-10-2000	4096x2160	60p	2 Gbps	330T-2	325T-2	-	7030-1	035-1	5p
	IPX-J2K-UHD8K-60-422-10-4000	8192x4320	60p	4 Gbps	485T-2	-	-	-	060-2	13p
	IPX-J2K-UHD8K-60-422-10-8000	8192x4320	60p	8 Gbps	485T-2	-	-	-	060-2	13p
<b>J2K-RAW (BAYER)</b>	IPX-J2K-HD-60-RAW-500	1920x1080	60p	500 Mbps	290T-1/330T-1	160T-1	200T-1	7030-1	025-1	3p
	IPX-J2K-UHD4K-120-RAW-2000	4096x2160	120p	2 Gbps	290T-1/330T-1	160T-1	200T-1	7045-1	025-1	3p

## CONTACT INTOPIX FOR YOUR OWN CUSTOM IP-CORE CONFIGURATION

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