intoPIX JPEG 2000 Encoder and Decoder IP-Cores respect and protect high value images. Handling simultaneously deep color, low and high data rates and extensive JPEG 2000 encoding know-how, intoPIX IP-Cores enable best-in-class picture quality. Amongst all the existing JPEG 2000 FPGA products, the intoPIX solution is currently the most widely adopted by the industry.

intoPIX IP-Cores achieve low and high frame rate and resolution with unprecedented performances. They are available and optimized for the most recent FPGA platforms.

intoPIX IP-Cores combine more power, more flexibility and more efficiency while ensuring lower consumption, lower temperature dissipation and lower bill of material.

Fully benefiting from a modular architecture and completed with a wide range of companion IP-Cores, the intoPIX solutions provide an easy, timely and cost-effective way to implement JPEG 2000 technology.

**High Quality Picture**
- From Lossy to Lossless compression

**Customizable Design**
- Single Chip FPGA
- Altera Stratix V & IV
- Altera Arria V & II
- Altera Cyclone V

**Cost Effective**
- Reduced BOM
- Ultra dense
- Optimized per application

**Future-Proof**
- HD & ULTRA-HD 4K & 8K
- High Frames Rates for cinema and slow-motion
- Zero-Latency mode (<5ms) for video over IP
- J2K-Raw (Bayer) for cameras

**Companion IP-Cores**
- DDR2/DDR3 Memory Controller
- MPEG2-TS Layer

**Security IP-Cores**
- AES Security IP-Cores
- RSA Security IP-Cores
- Hash Function

Easy integration
- J2K HDK on Altera reference boards
- Team training
- Application reference designs

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Take IMAGING to the NEXT LEVEL
The HD Family
JPEG 2000 for Content Production

The JPEG 2000 HD Family allows you to preserve image quality throughout your complete production process.

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 them to address all known broadcast standards in terms of resolution and frame rates.

- Single Chip
- Broadcast and IMF profile compliant (JPEG 2000 Part 1 Amd 3 and Amd 8)
- Any resolution up to 1080p-120 fps
- Up to 1Gbps Compressed Bitrates
- Progressive/interlaced
- 4:2:2/4:4:4
- Easy 3D stereoscopy
- 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

Ultra Low Latency Option
JPEG 2000 for Live streams

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

- Sub intra-frame latency
- Visually lossless quality

APPLICATIONS
- SMPTE2022 / AVB
- Video over IP and Contribution
- Wireless Transmission
- Remote Control & Monitoring

The Lossless Family
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

The Digital Cinema Family
DCI compliant 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 30 fps
- Bitrates up to 1Gbps

APPLICATIONS
- Cinema Medialblock
- Cinema Post-production
- Faster than real-time encoder

The Ultra HD
4K/8K Family
JPEG 2000 for extreme resolutions

The intoPIX 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 newly defined ITU UHDTV standards, 4K and 8K.

- Single Chip
- IMF profile compliant (JPEG 2000 Part 1 Amd 8)
- 4K resolution at up to 60fps
- 8K resolution at up to 60fps
- High bitrate flexibility

APPLICATIONS
- UHDTV
- Digital signage, Shows & Theme park
- Advanced Cinema Medialblock
- Geospace/Aerospace
- IMF
The J2K-RAW Family
Best bayer pattern images compression

intoPIX J2K-RAW compression IP-cores preserve perfectly the RAW output (Bayer pattern images) of Bayer-filter cameras with best-in-class JPEG 2000 compression. Offering a visually lossless quality, J2K-RAW allows also 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

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
DDR3 and DDR2 cores
The IPX-DDR2 and IPX-DDR3 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 Avalon 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).

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 connect seamlessly 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, characteristics and to speed-up the integration of a fully functional JPEG 2000 core.

Hardware Development Kit (HDK)
intoPIX HDK enables faster and reliable integration. Using a flexible structure, it focuses on providing a seamless environment for the integration of any intoPIX JPEG 2000 IP-cores, using a FPGA reference board as starting point. It validates efficiently 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 high-performance IP-cores.

- SMPTE2022 JPEG 2000 video over IP
- UHD4K JPEG 2000 acceleration
- Cyclone V J2K compact implementation
- ...

For more information on the available possibilities, please contact sales@intopix.com
Image features
- Bit depth: 8, 10, 12, 14, 16
- Color Space: Any (RGB, YUV, XYZ, YCbCr,...)
- 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 and irreversible color transforms
- Decomposition levels: up to 5 levels
- Quantization steps: programmable per level and per component
- Quality layer: 1-layer
- Digital Cinema (DCI) compliant - JPEG 2000 Part 1 Amd 8
- Broadcast profiles compliant - JPEG 2000 Part 1 Amd 3
- IMF profiles compliant - JPEG 2000 Part 1 Amd 8
- Tiling: Single tile
- Progression Order: CPRL
- Code Block Size: 32x32, 32x64, 64x32, 64x64, 128x32
- Contrast sensitivity function
- Quality layer: 1-layer
- Decomposition levels: up to 6 levels
- Reversible and irreversible color transforms
- Wavelet transforms: 5/3 and 9/7
- JPEG 2000 (ISO 15444-1)
- Any resolutions (SD, HD, 2K, 4K, 8K, ...)
- Monochrome, 3 and 4 components, Bayer pattern
- Interlace field, progressive frame
- Bit depth: 8, 10, 12, 14, 16

Quality and Bit Rate Control
- Variable bit rate (VBR): The overall bit rate is variable for a Lossless compression
  - 2 Gbps and 8 Gbps for Lossy compression and unlimited for Uncompressed.
- Quality and bit rate control
  - Nearly Mathematically Lossless (NMLS):
  - 5/3 wavelet transform - no max bit rate
  - Compression: 3:1 - 5:1 compression
  - Maximum 50ms
- True Mathematically Lossless (MLLS): 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 (fields) at encoding; from 0.5 to 1 frame(field) at decoding (i.e. 1080p60 end-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 tile border protection (i.e. down to 5 milliseconds with end-to-end compression in 1080p60)

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 video interface
  - On-the-fly checksum integrity check
  - Optional automatic frame repeater or interlacer
  - Auto-upscaling capability from HD/2K to UHD/4K

Hardware requirement and delivery:
- External memory: support DDR3, DDR2, LPDDR2...
- FPGA: support the latest Altera V family and the Stratix IV and Arria II families
- Fully customizable IP-core per application, delivered and silicon proven with intoPIX HDK for fast integration

IP-Cores Examples

**HD**
- **Encoder**: 1920x1080
  - 30p (60i)
  - Max Bitrate: 250 Mbps
- **Decoder**: 1920x1080
  - 30p (60i)
  - Max Bitrate: 250 Mbps

**HD-2K**
- **Encoder**: 1920x1080
  - 60p (120i)
  - Max Bitrate: 500 Mbps
- **Decoder**: 1920x1080
  - 60p (120i)
  - Max Bitrate: 500 Mbps

**4K-Enc**
- **Encoder**: 1920x1080
  - 120p (240i)
  - Max Bitrate: 1 Gbps
- **Decoder**: 1920x1080
  - 120p (240i)
  - Max Bitrate: 1 Gbps

**4K-MLS**
- **Encoder**: 2048x1080
  - Math.Lossless
  - Max Bitrate: 500 Mbps
- **Decoder**: 2048x1080
  - Math.Lossless
  - Max Bitrate: 500 Mbps

**4K-4K**
- **Encoder**: 4096x2160
  - Max Bitrate: 3 Gbps
  - Max Bitrate: 3 Gbps
- **Decoder**: 4096x2160
  - Max Bitrate: 3 Gbps
  - Max Bitrate: 3 Gbps

**4K-120**
- **Encoder**: 4096x2160
  - Max Bitrate: 2 Gbps
  - Max Bitrate: 2 Gbps
- **Decoder**: 4096x2160
  - Max Bitrate: 2 Gbps
  - Max Bitrate: 2 Gbps