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JPEG 2000

ADVANCED FEATURES OF JPEG 2000

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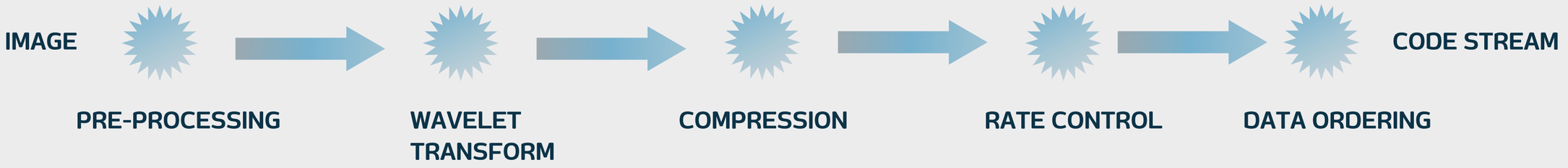
INTRODUCTION

OBJECTIVES:

- Introduced in 2001
- Added Wavelet-based compression
- Variable resolution output
- Lossless and Lossy encoding
- Royalty-free standard
- Open standard

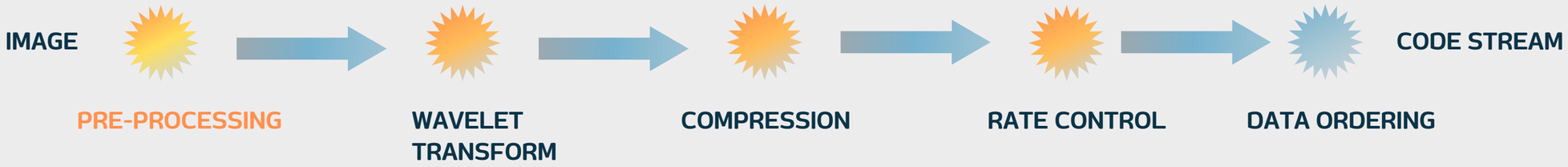
CORE CONCEPTS OF JPEG 2000

JPEG 2000 employs wavelet compression, breaking images into frequency components to achieve higher efficiency and scalability



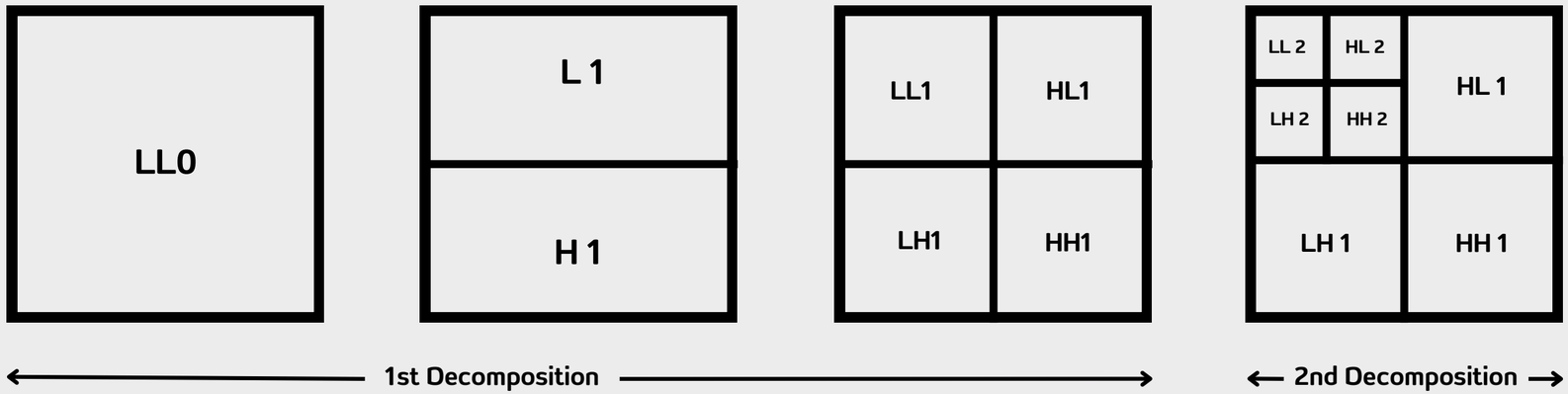
PRE-PROCESSING

- Divides the image into non-overlapping blocks called tiles.
- Each tile is treated independently
- Easier for Wavelet Transform
- Level offset
- ICT

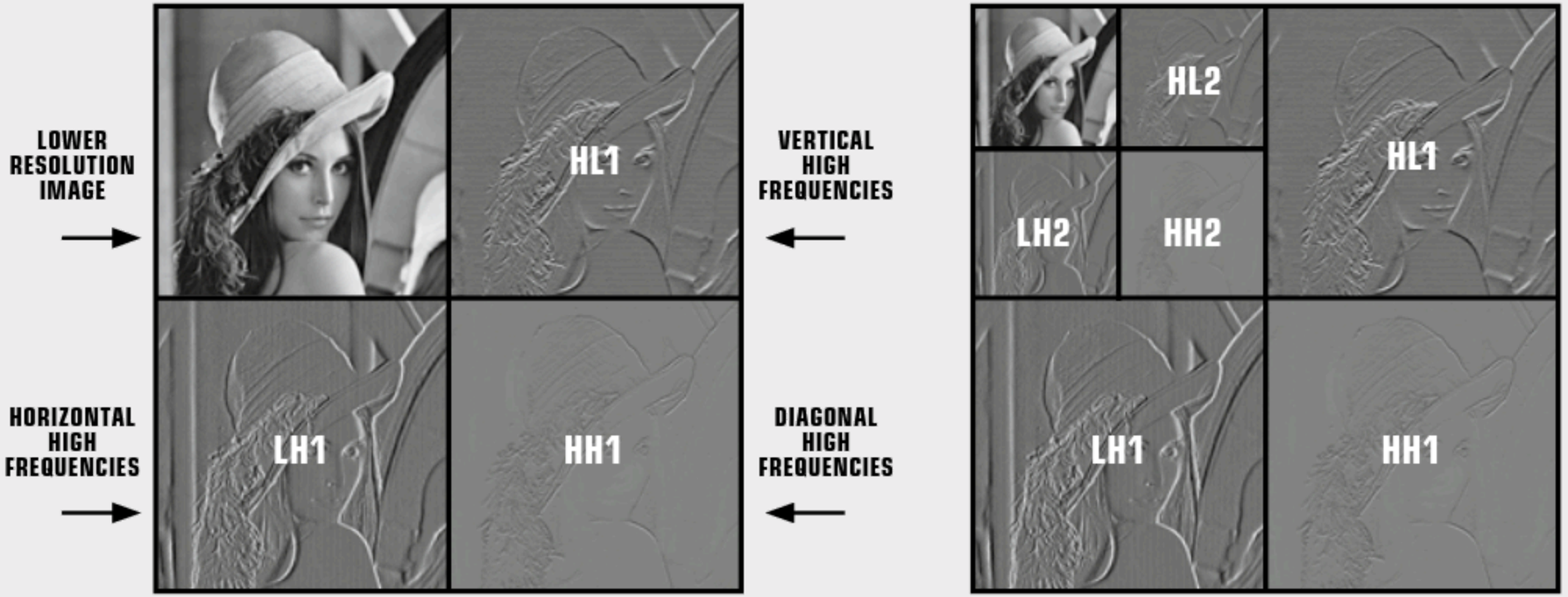


WAVELET TRANSFORM

During the Wavelet Transform, image components are passed recursively through low pass and high pass Wavelet filters.



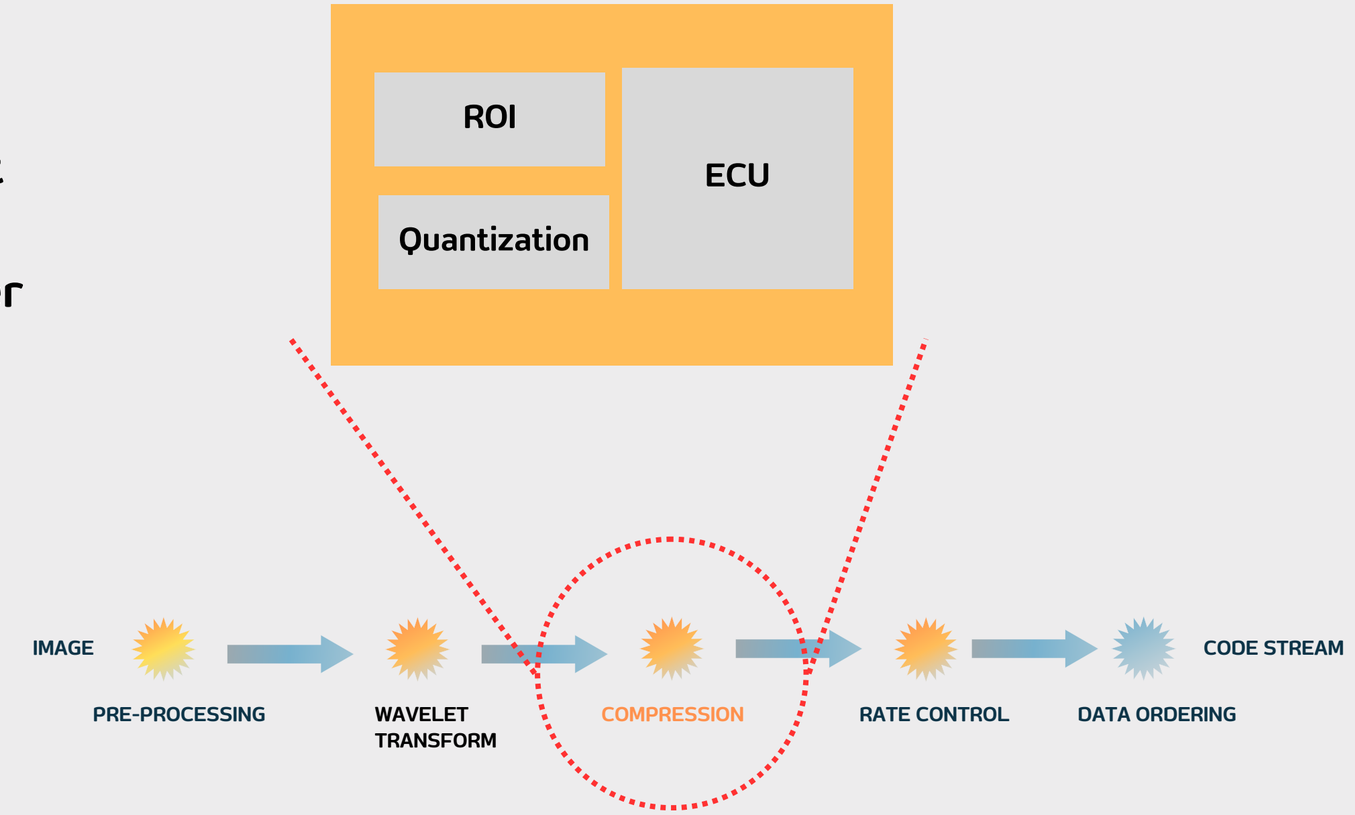
WAVELET TRANSFORM



COMPRESSION

Wavelet Transform doesn’t compress images by itself, but the fact that it divides the image into 2 frequency bands makes it easy to compress.

- **Region Of Interest**
- **Entropy Coding Unit**
  - **Bit Modeler**
  - **Arithmetic Coder**



RATE CONTROL

The Rate-Control module adjusts the coding precision of each pixel according to a defined bit rate

DATA ORDERING

Every group of pixels is embedded in a series of packets by the data ordering module. The preferred scalability (or progression order) is chosen in the final "data ordering" block.

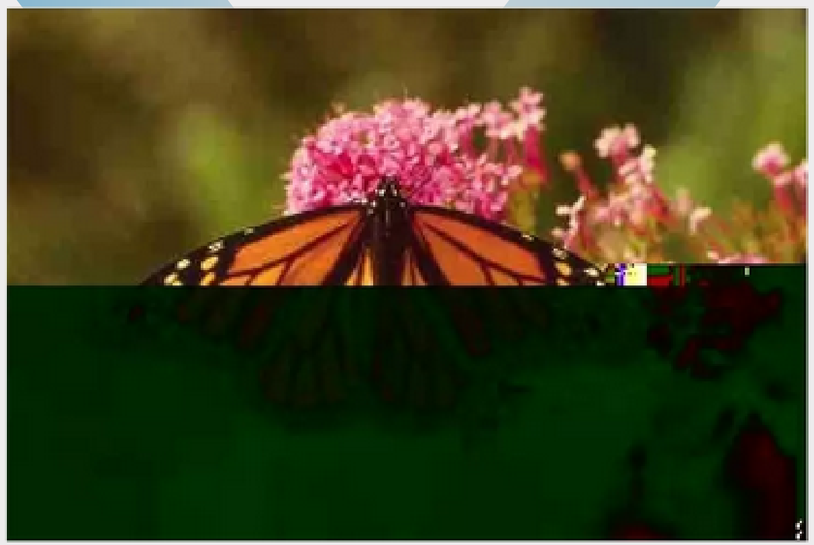
ADVANCED FEATURES OF JPEG 2000

- **Error Resilience:** Techniques for error handling, especially in transmission.
- **Scalability:** Progressive transmission and resolution scalability.
- **Region-of-Interest Coding:** Focusing compression quality on important image areas.
- **Support for lossless and lossy compression.**
- **Constant Quality through multiple Generations:** Doesn't degrade with multiple encoding-decoding passes

ERROR RESILIENCE

- Higher priority for fundamental data packets
- Increased redundancy

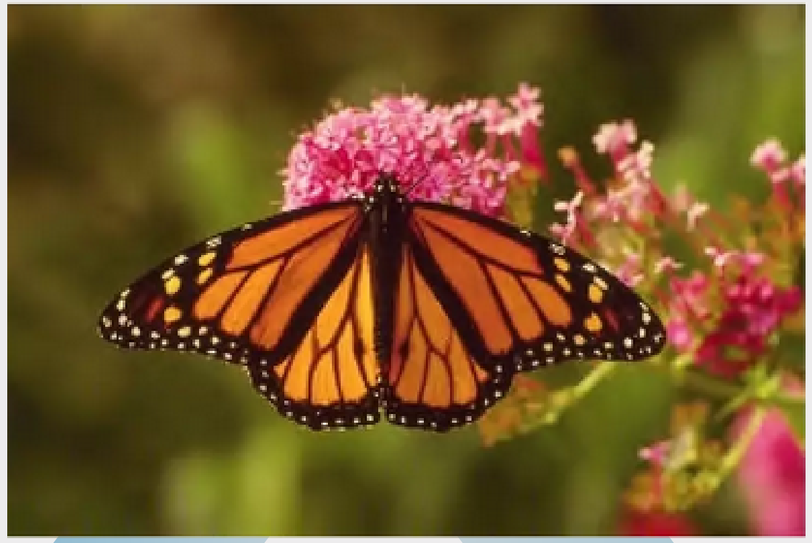
Change of 16 Bytes to ‘0’



JPEG

ROBUST TRANSMISSION

- Prevents dramatic visual impact when some packets are missing
- The impact of missing frames is limited to a single frame



JPEG2000

SCALABILITY

- The user can extract multiple versions out of a single compressed file.
- Depending on the end use, we can extract different images that will help with production.

BENEFITS

- Proxy Generation
- Region of Interest
- Bandwidth optimization and adaptive transmission

REGION OF INTEREST

- Allows to prioritize user-defined areas of the image with full quality.
- This can be applied in the decoding and encoding process
- Beneficial for cropping functions and PAN&SCAN (Less computation required)

LOSSLESS/LOSSY COMPRESSION

Lossless Compression

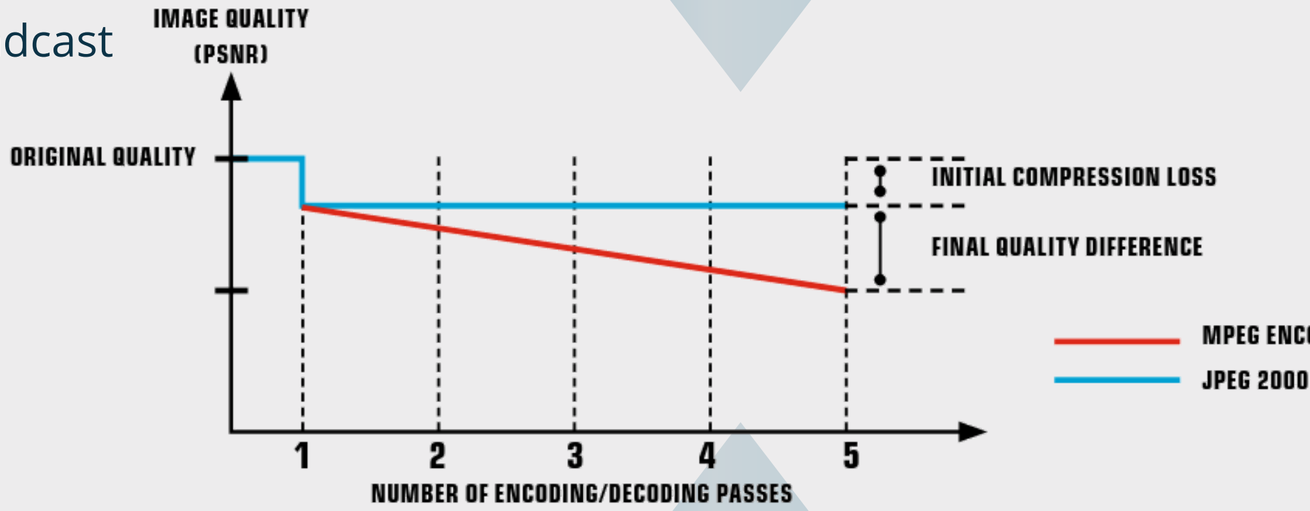
- Enables a reduction of size between the order of 2:1 to 3:1 without loss

Lossy Compression

- We can get a visually lossless image with compression ratios of 10:1 up to 20:1
- Allows compression ratios from 50:1 up to 100:1
    - Compression loss becomes visible but the image is still adequate for web browsing

CONSTANT QUALITY THROUGH MULTIPLE GENERATIONS:

- Encoding and Decoding are normal in the broadcast processing chain.
- MPEG compression-decompression process introduces degratation at each step
- JPEG 2000 doesn’t decrease quality



ENCODING DECODING PROCESSING POWER

- JPEG 2000 has a symmetrical compression technology which is beneficial for storage servers

USE CASES AND APPLICATIONS

Digital Cinema
JPEG 2000’s high dynamic range, lossless compression, and metadata capabilities make it ideal for preserving the cinematic quality of digital movies.

Broadcast Market
Adopted in live production workflows, JPEG 2000 provides high-quality, low-latency compression, suitable for video over IP and master content storage.

USE CASES AND APPLICATIONS

Image Archives and Databases
JPEG 2000 simplifies storage by combining high-quality lossless compression with metadata-rich environments, enabling dynamic resolution and quality adjustments on demand.

Medical Imaging
Supports lossless compression critical for diagnostic accuracy, ensuring no image distortion while maintaining efficient storage and transmission.

COMPARISON WITH ORIGINAL JPEG

Lossless Compression: JPEG 2000 supports both lossy and lossless compression, preserving complete image data when needed.

Error Resilience: Ensures image integrity during transmission.

Scalability: Allows progressive image transmission and region-specific quality control.

Higher Quality: Better visual fidelity and dynamic range at similar or smaller file sizes.

Image Quality: JPEG 2000 delivers sharper and more detailed images with less degradation during compression.

Error Handling: JPEG 2000 is more robust against data corruption.

Adoption: JPEG remains more compatible across platforms, whereas JPEG 2000 is better suited for niche applications.

QUESTIONS?

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