JPEG 2000

- Improved R-D performance at low and medium bit-rates
- Covers low bit-rate lossy coding up to lossless coding
- Progressive Transmission Capability (resolution & SNR)
- Region of interest (ROI) representation and editing
- Error Resilience

Approach:

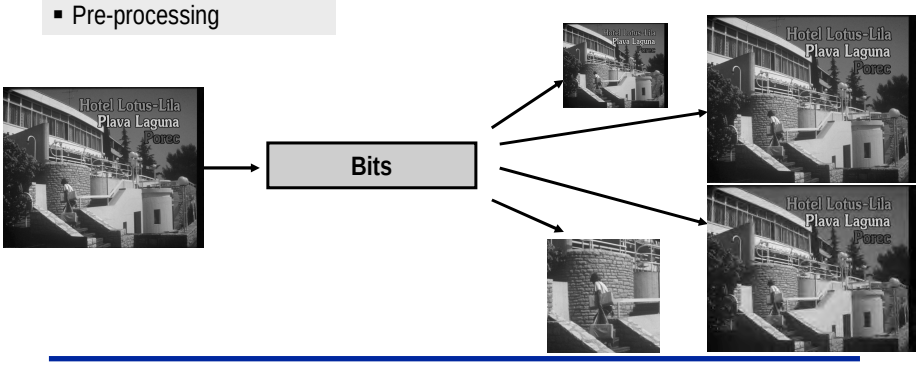
Wavelet Transformation + EBCOT* + Adaptive Arithmetic Coding

*Embedded Block Coding with Optimized Truncation

JPEG-2000 Options

Encoder Options
- Lossless and lossy coding
- Partitioning
- Quantization
- Pre-processing

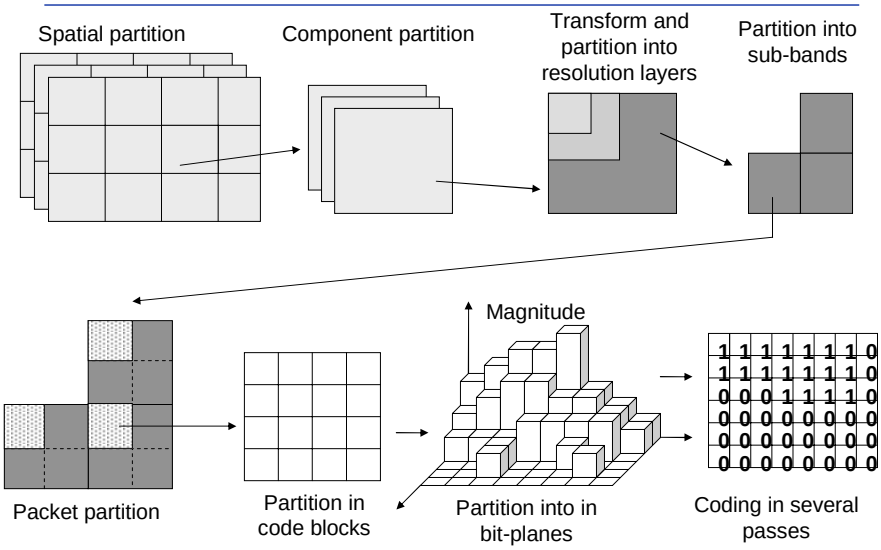
Decoder Options
- Resolution and quality
- Region-of-Interest (ROI)
- Partial decoding



Flexibility and Applications

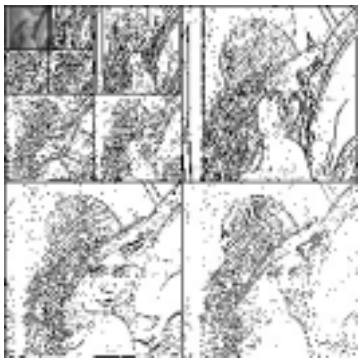
- Medical Imaging
  - Lossless coding, ROI
- Digital cameras
  - Limited storage capacity
  - Limited transmission bit-rate (mobile devices)
- Archiving
  - Encode and store on server
  - Decode to match application display requirements (mobile display, CRT, LCD)
- WWW
  - Progressive decoding
  - User interaction: ROI

JPEG-2000 Process



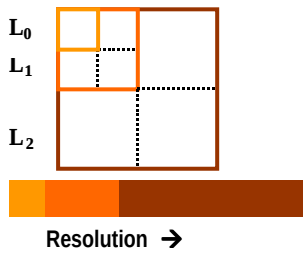
Wavelet Transform

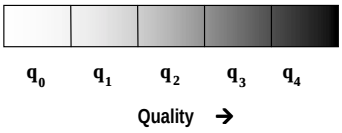
- Dyadic Partition
- Irreversible (9/7)
- reversible (5/3)
- Other partitions in Part 2
- Irreversible case: Scalar Quantization with dead zone (separate approach for every sub-band possible)



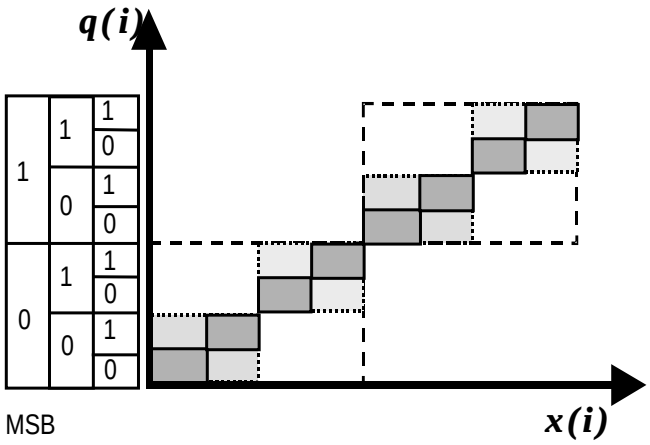
Scalability

- Embedded codes permit decoding with reduced quality with parts of the complete code
- Resolution scalability
  - Straight forward (DWT property)
  - Sort bits from lowest to highest sub-band
- SNR scalability
  - Embedded quantization
  - Transmit sequence of quantizers





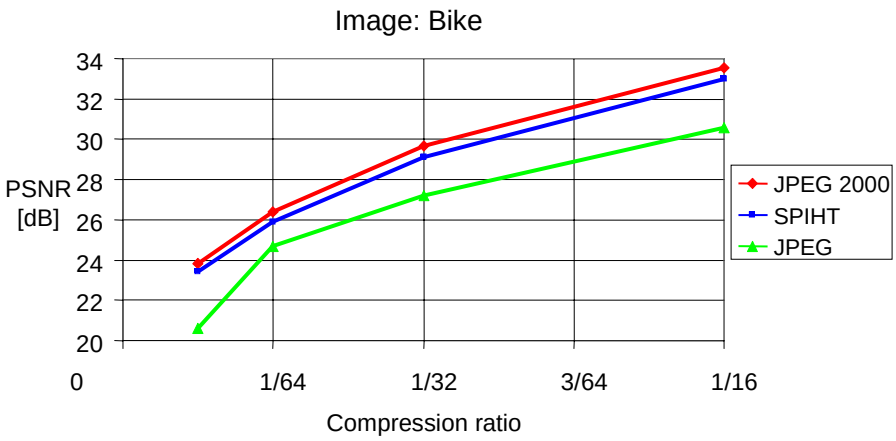
Embedded Quantization



JPEG: Hotel @ 0,145 bpp

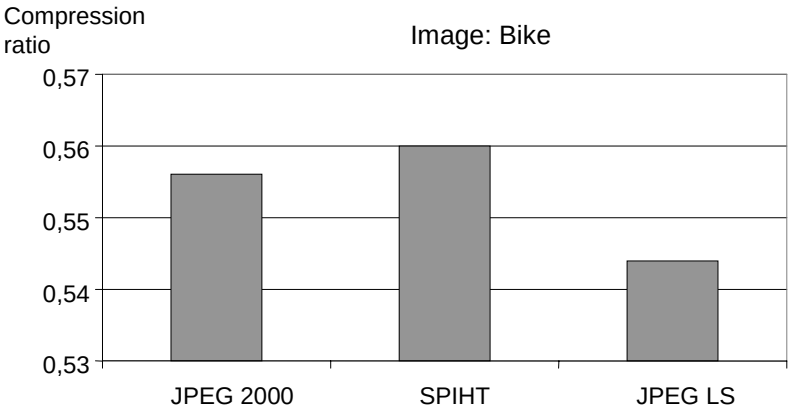
JPEG-2000: Hotel @ 0,145 bpp

Objective Comparison: Lossy Coding



From: M. D. Adams, H. Man, F. Kossentini, T. Ebrahimi,
JPEG2000: The Next Generation Still Image Compression Standard

Objective Comparison: Lossless Coding



From: M. D. Adams, H. Man, F. Kossentini, T. Ebrahimi,
JPEG2000: The Next Generation Still Image Compression Standard

Resolution Scalability: Level 1 of 5

Resolution Scalability: Level 3 of 5

Resolution Scalability: Level 3 of 5

Resolution Scalability: Level 4 of 5

Resolution Scalability: Level 5 of 5

SNR Scalability: Level 1 of 6, 0.0625 bpp

SNR Scalability: Level 2 of 6, 0.125 bpp

SNR Scalability: Level 3 of 6, 0.25 bpp

SNR Scalability: Level 4 of 6, 0.5 bpp

SNR Scalability: Level 5 of 6, 1.0 bpp

SNR Scalability: Level 6 of 6, 2.0 bpp

ROI, Area: Circle, 0.0625 bpp

ROI, Area: Circle, 0.125 bpp

ROI, Area: Circle, 0.25 bpp

ROI, Area: Circle, 0.5 bpp

ROI, Area: Circle, 1.0 bpp

ROI, Area: Circle, 2.0 bpp

Summary

- International Standardization of Image Coding is conducted to achieve inter-operability and to provide state-of-the-art technology
- Only syntax and decoder are specified
- JPEG started in 1986 and is a well established image coding standard
- JPEG still provides competitive performance for the medium bit-rate range
- JPEG-2000 mostly provides improved performance at for low and high bit-rates
- JPEG-2000 yields a useful set of functionalities