Université Catholique de Louvain

Telecommunications and Remote Sensing Laboratory

JPEG2000 in a nutshell

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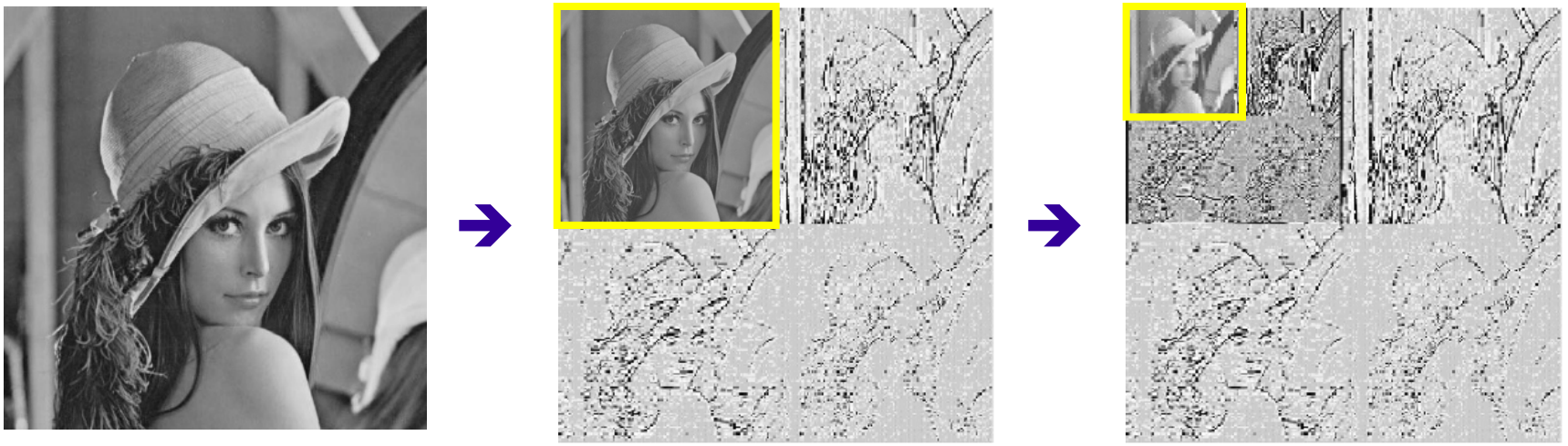
14/02/2025

Discrete Wavelet Transform

- DWT = intra-component decorrelation
  → concentrate image energy in a small area
- No blocking artefacts at high compression ratios
- Enables multi-resolution image representation



JPEG 2000 features

- Improved compression efficiency
- Lossy to lossless compression
- Single compression / Multiple decompression
- Progressive decoding
- Scalability :
  - Resolution
  - Quality (SNR scalability)
- Region of Interest Coding (ROI)
- Error Resilience

Compression efficiency

JPEG 1:137

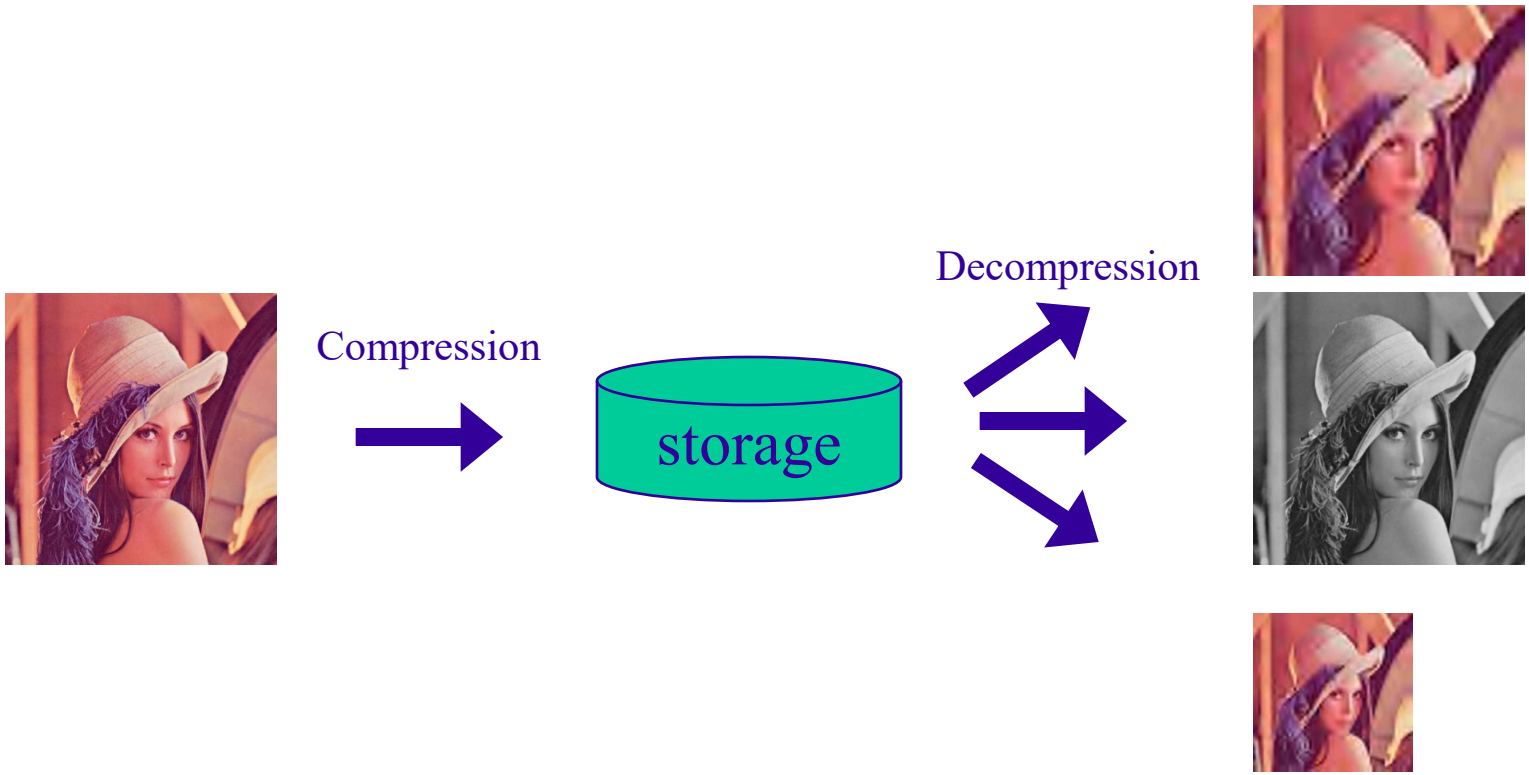
JPEG2000 1:137

Compression efficiency

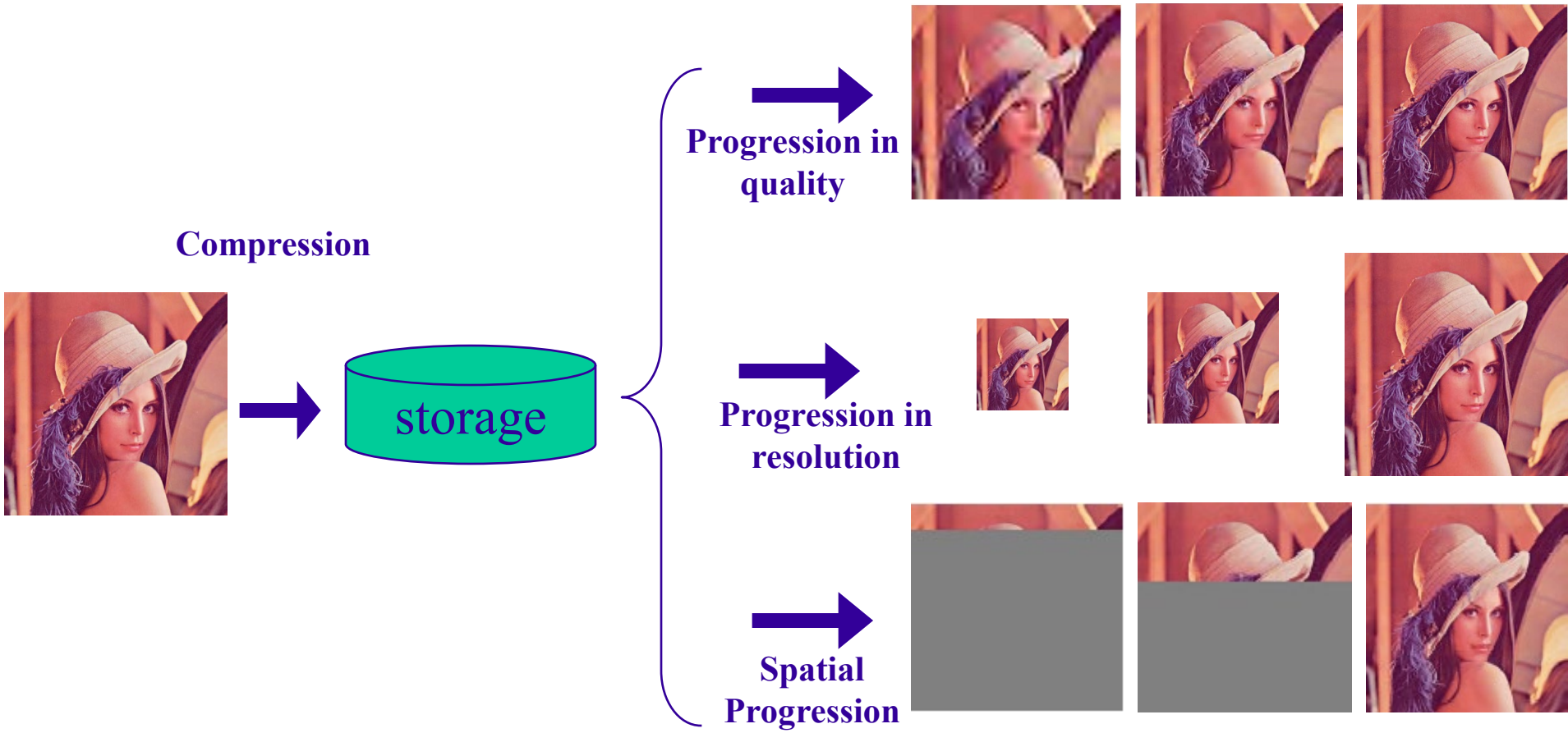
JPEG 1:126

JPEG2000 1:126

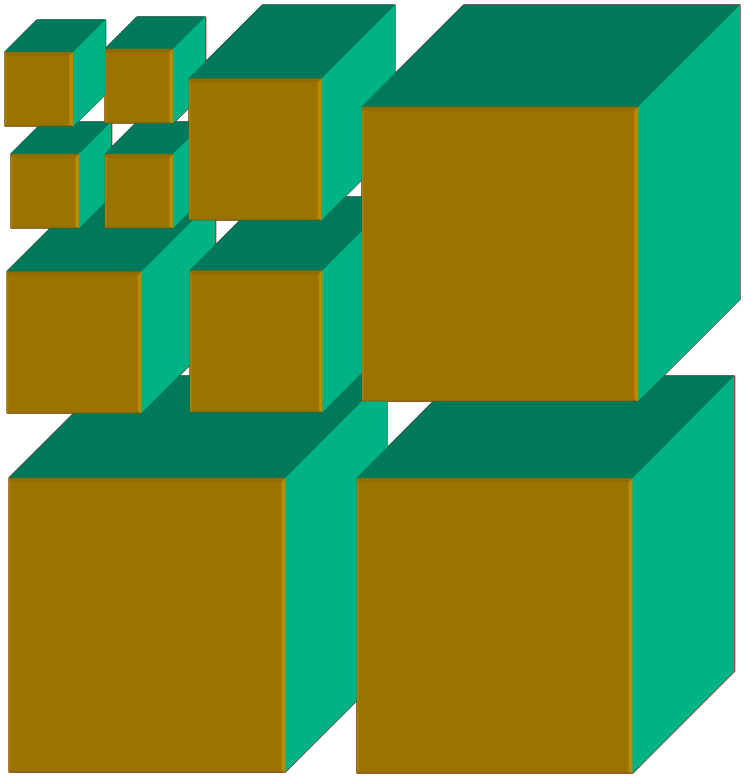
Multiple decompressions



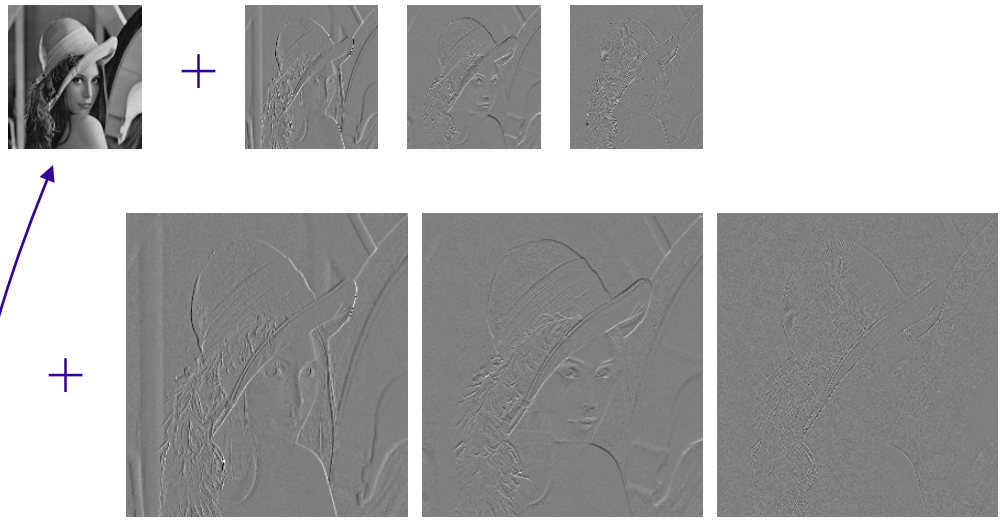
Progressive transmissions



Scalability : by resolution *(1)*

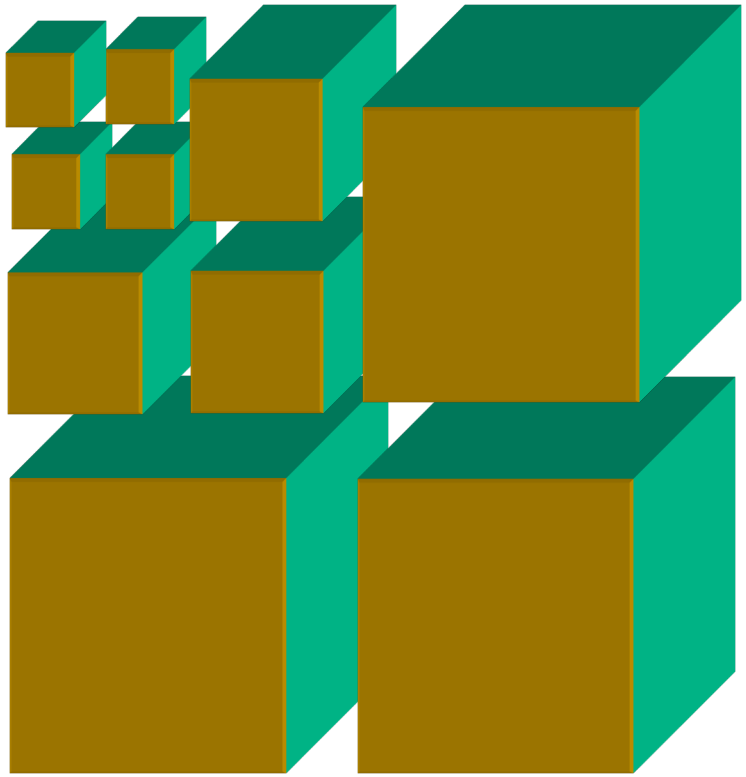


Scalability : by resolution *(2)*

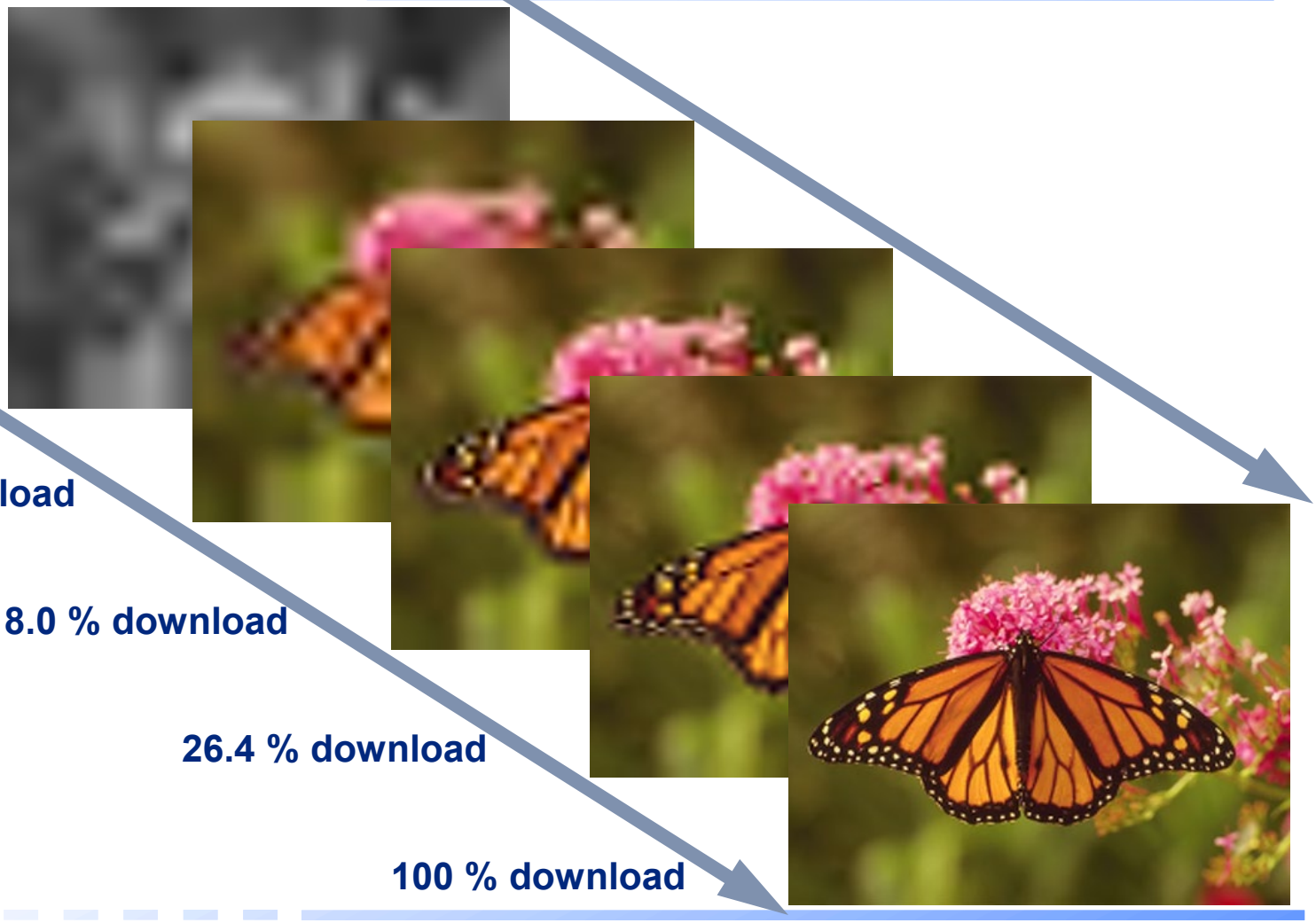


2.6 kBytes (1:100)

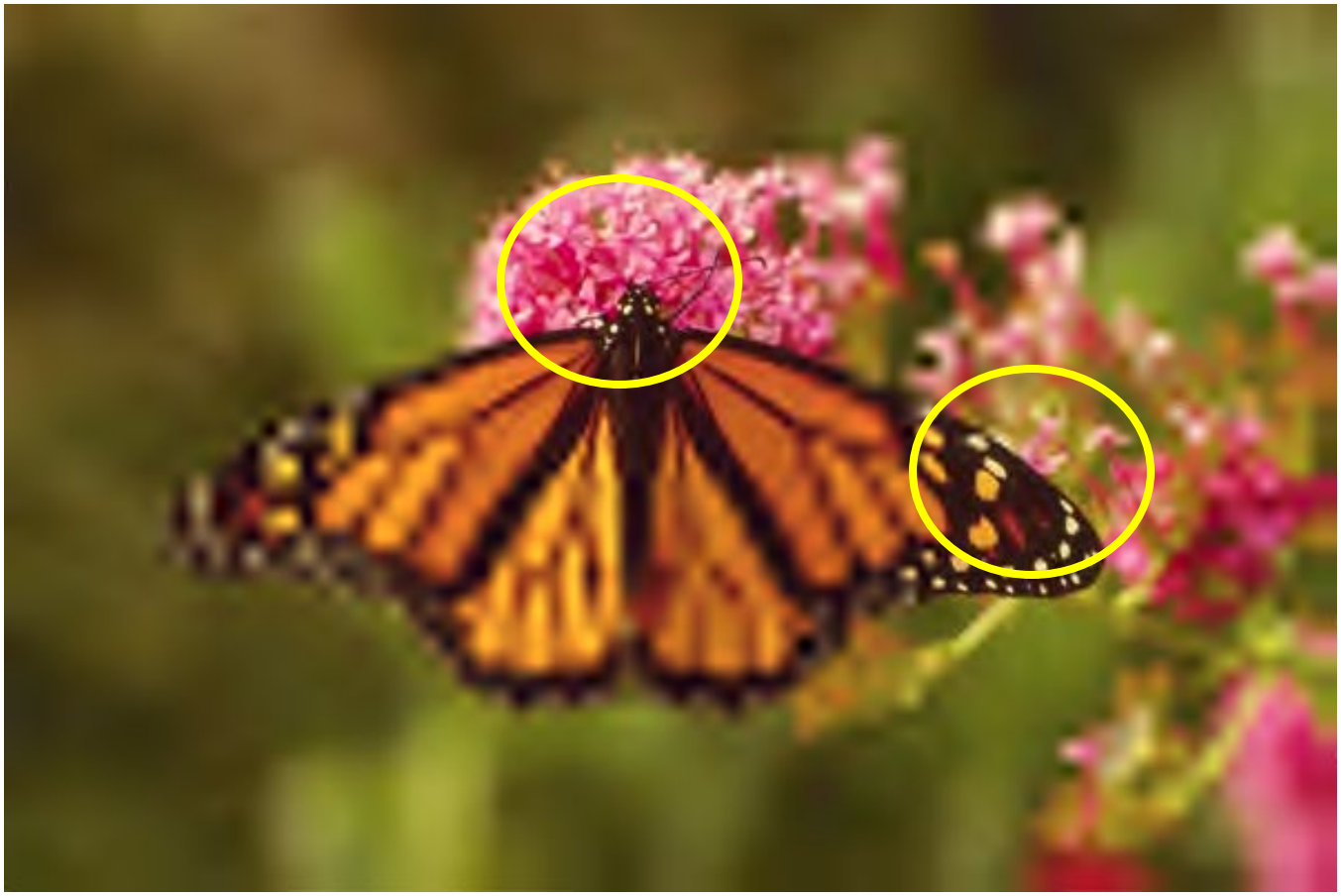
Scalability : by quality

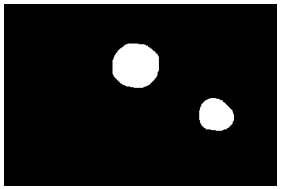


Scalability : by quality *(ctd)*



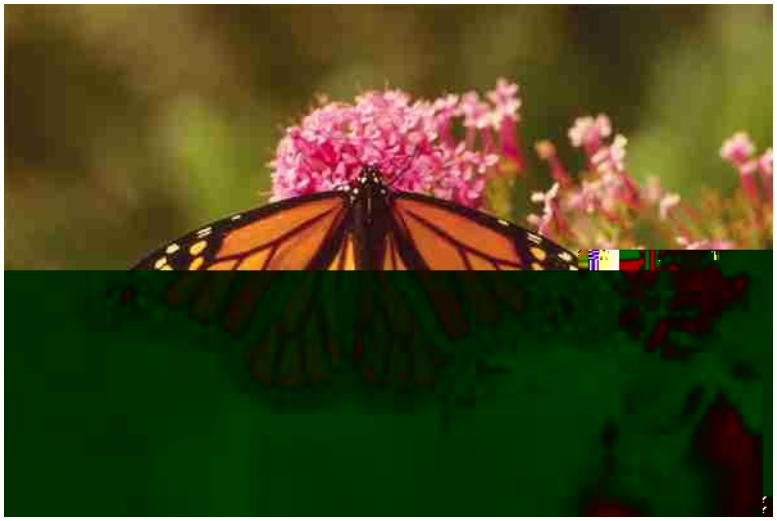
Region of Interest





Robustness to errors

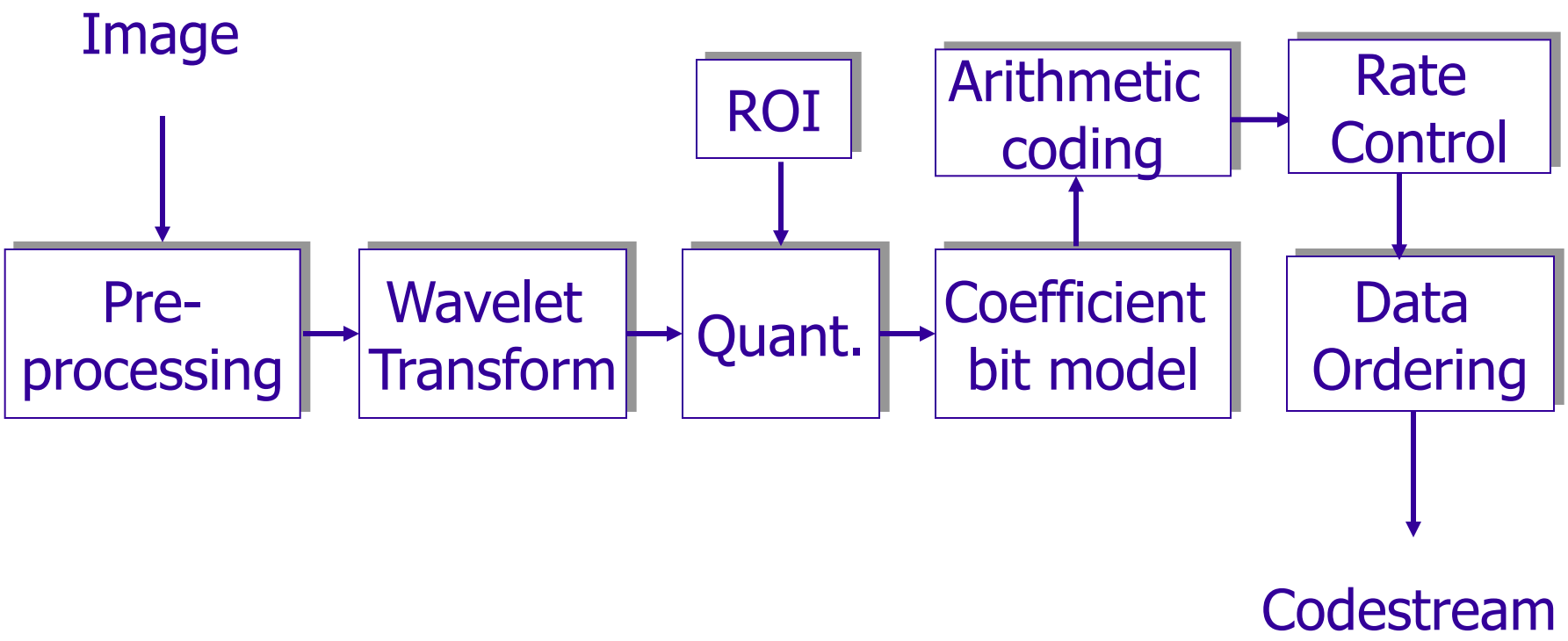
- Embedded error : 16 bytes set to 0 in the middle of the compressed file



JPEG

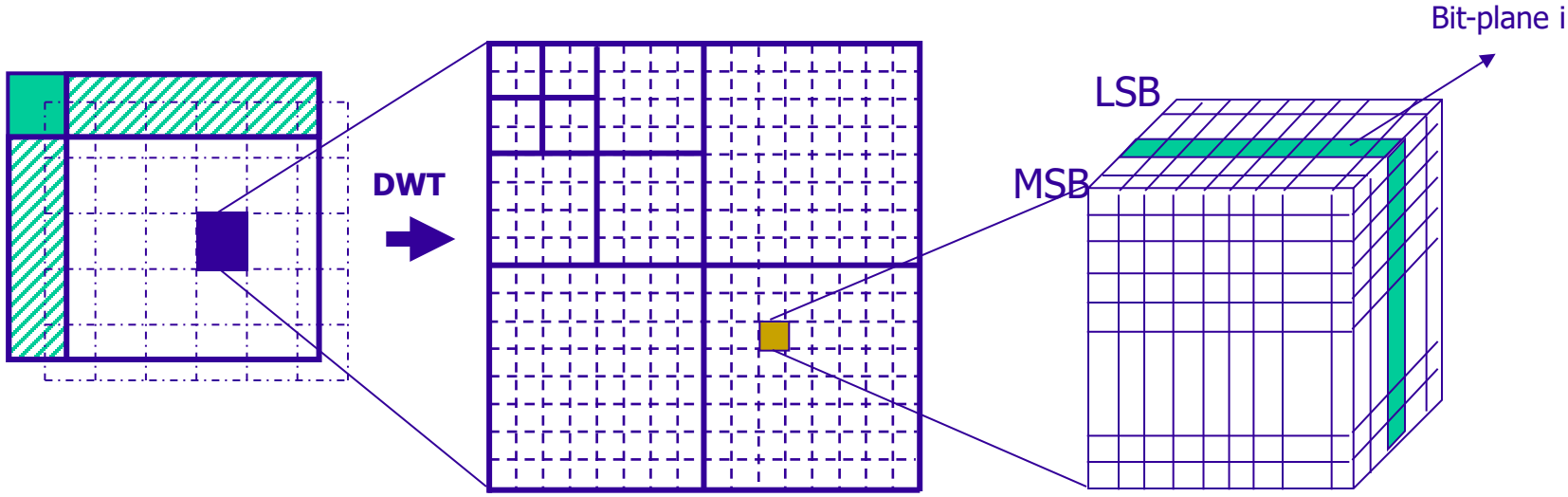
JPEG2000

JPEG 2000 Overview

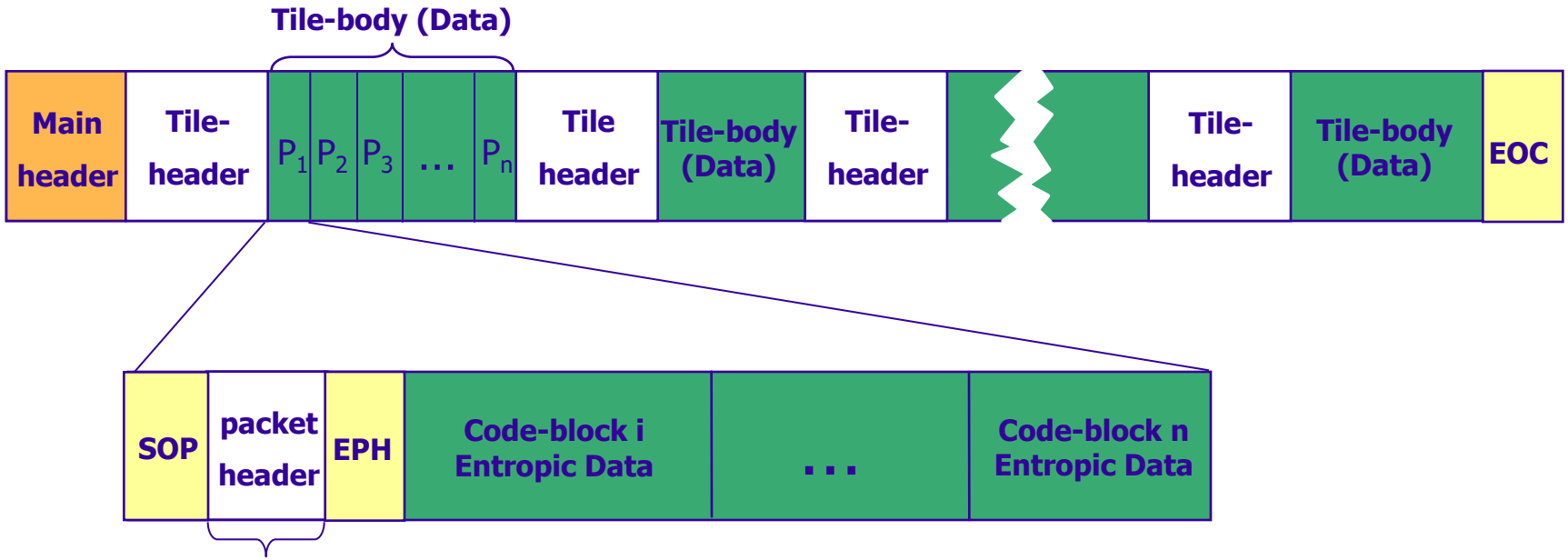


Useful Concepts

- ***Code-block :*** each sub-band from each tile-component is partitioned into code-blocks.
- ***Bit-plane :*** each code-block will be entropy-encoded independently bit-plane by bit-plane.



Data Ordering



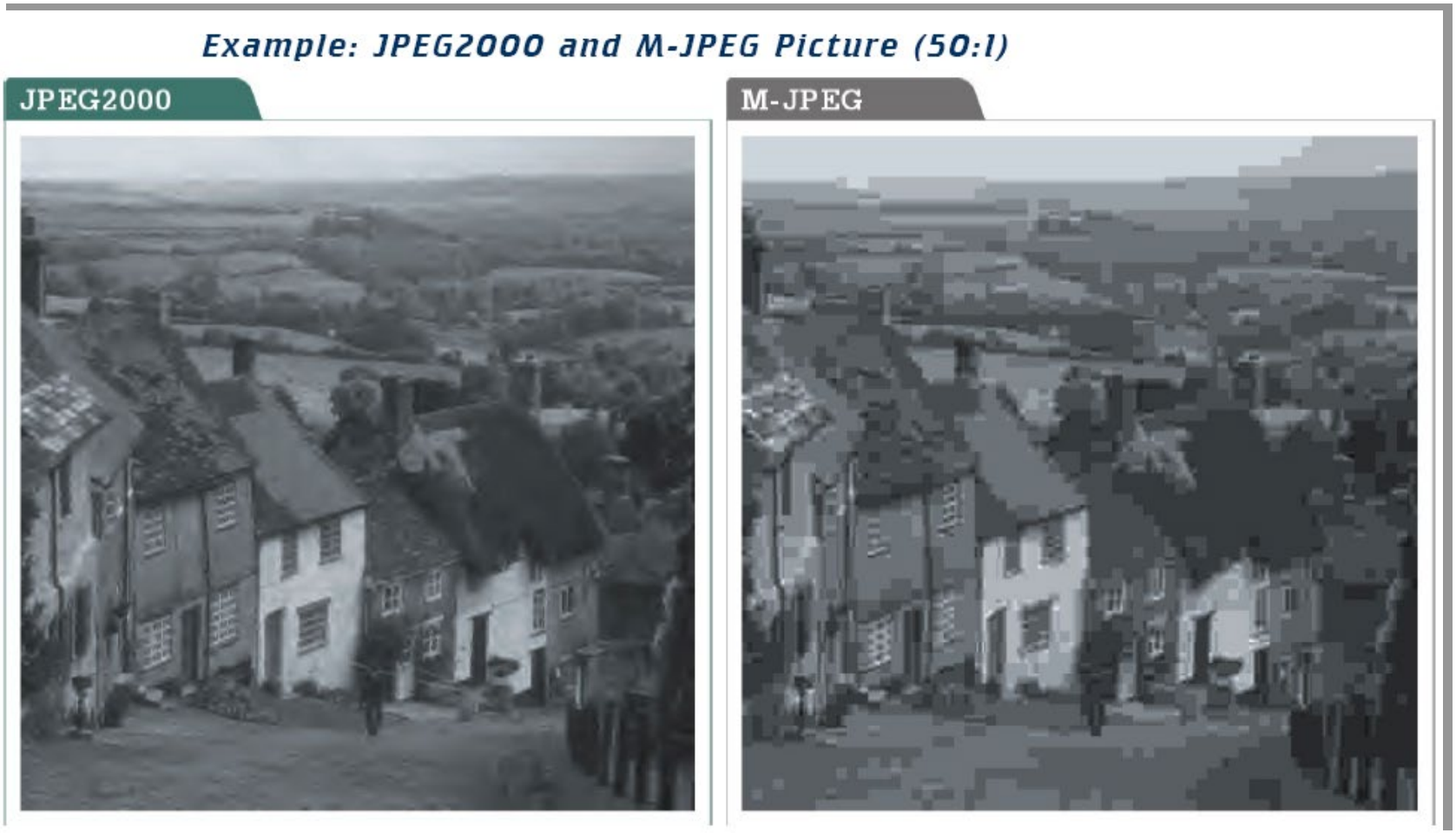
- Code block inclusion
- Zero bit plane information
- Number of coding passes
- Data length

Standardization Process

J2K parts under development :

- Part 8, JPSEC (*security aspects*)
- Part 9, JPIP (*interactive protocols and API*)
- Part 10, JP3D (*volumetric imaging*)
- Part 11, JPWL (*wireless applications*)

Compared side by side



Compared side by side

Error resilience examples

JPEG 2000 Handles High Bit Error Rates*

(Compression ratio of 80:1, BER of 10^{-4})

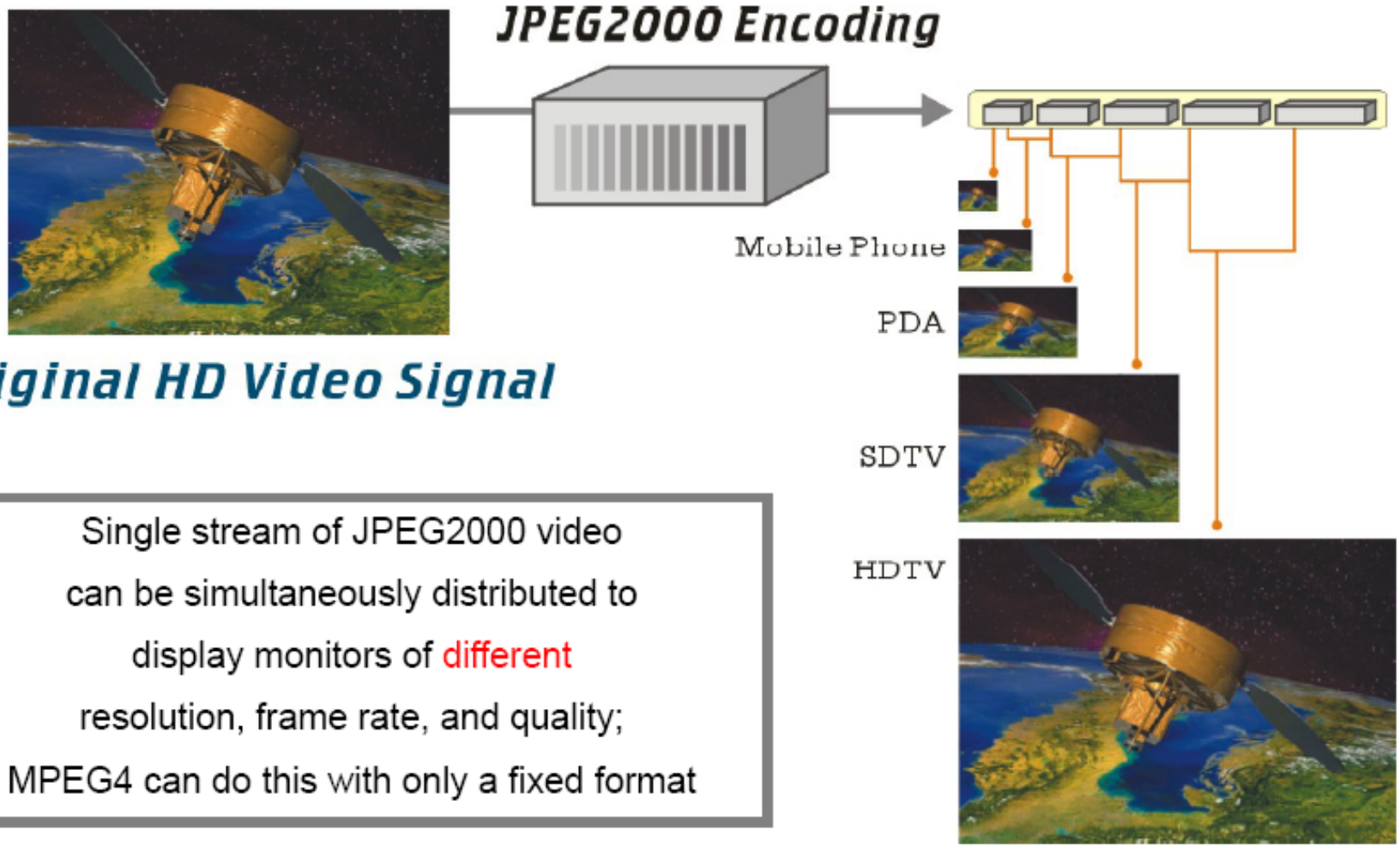
JPEG2000

Motion -JPEG

MPEG2

MPEG4

Multi-resolution example



Single stream of JPEG2000 video
can be simultaneously distributed to
display monitors of different
resolution, frame rate, and quality;
MPEG4 can do this with only a fixed format

Diagram courtesy of NHK (Japan Public Broadcasting)

OpenJPEG

- Open source JPEG 2000 coder and decoder
  - Implemented in C language
  - Developed at UCL

http://www.openjpeg.org/

Thank you !

And visit also :

www.twist-cluster.be
www.xdcinema.com
www.intopix.com
www.tele.ucl.ac.be
www.openjpeg.org

References

- ISO, JPEG 2000 International Standard
- Taubman, D. and Marcellin, M. (November 2001) *JPEG2000: Image compression fundamentals, standards and practice*, Boston, Kluwer Academic Publishers, 795 pgs.
- Taubman, High performance scalable image processing with EBCOT, *IEEE Trans. on Image processing*, July 2000.
- Rabbani, Joshi, An overview of the *JPEG2000 still image compression standard*, Signal processing: Image communication 17(2002) p 3-48.
- *Special issue on JPEG2000*, Signal Processing: Image Communication. Elsevier, Volume 17, Issue 1, January 2002