JPEG Family of Image Coding Standards: Retrospective and New Developments

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ITU-T VICA Workshop
22-23 July 2005, ITU Headquarter, Geneva

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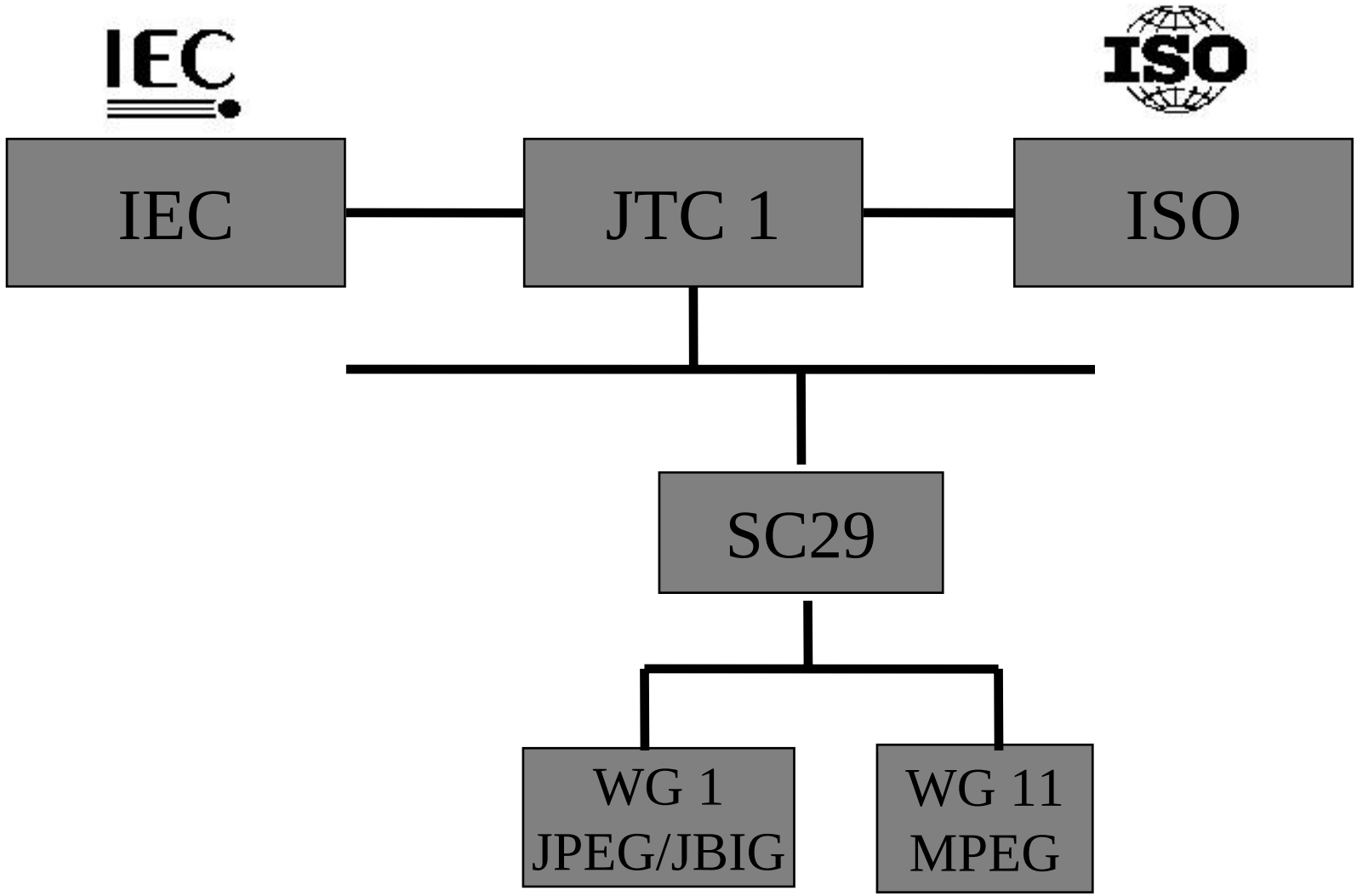
Organizations



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JPEG (*Joint Photographic Experts Group*)

"Digital Compression and Coding of Continuous-tone Still Images"

- Joint ISO/IEC and ITU-T
- Published in 4 Parts:
  - ISO/IEC 10918-1 | ITU-T T.81 : *Requirements and guidelines*
  - ISO/IEC 10918-2 | ITU-T T.83 : *Compliance testing*
  - ISO/IEC 10918-3 | ITU-T T.84: *Extensions*
  - ISO/IEC 10918-4 | ITU-T T.86: *Registration of JPEG Parameters, Profiles, Tags, Colour Spaces, APPn Markers Compression Types, and Registration Authorities (REGAUT)*

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JPEG derived industry standards

- *JPEG File Interchange Format* - JFIF
  <xxxxxx.jpg>
  <xxxxxx.jpe>

- TIFF *Tagged Image File Format*

- JP2 *JPEG 2000*
- JPM *JPEG 2000 Compound Document*

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Motivation for JPEG 2000

- Address areas where JPEG does not produce the best quality/performance
- Provide capabilities to markets that currently do not use compression
- Provide an open system approach to imaging applications

JPEG Application Paradigm

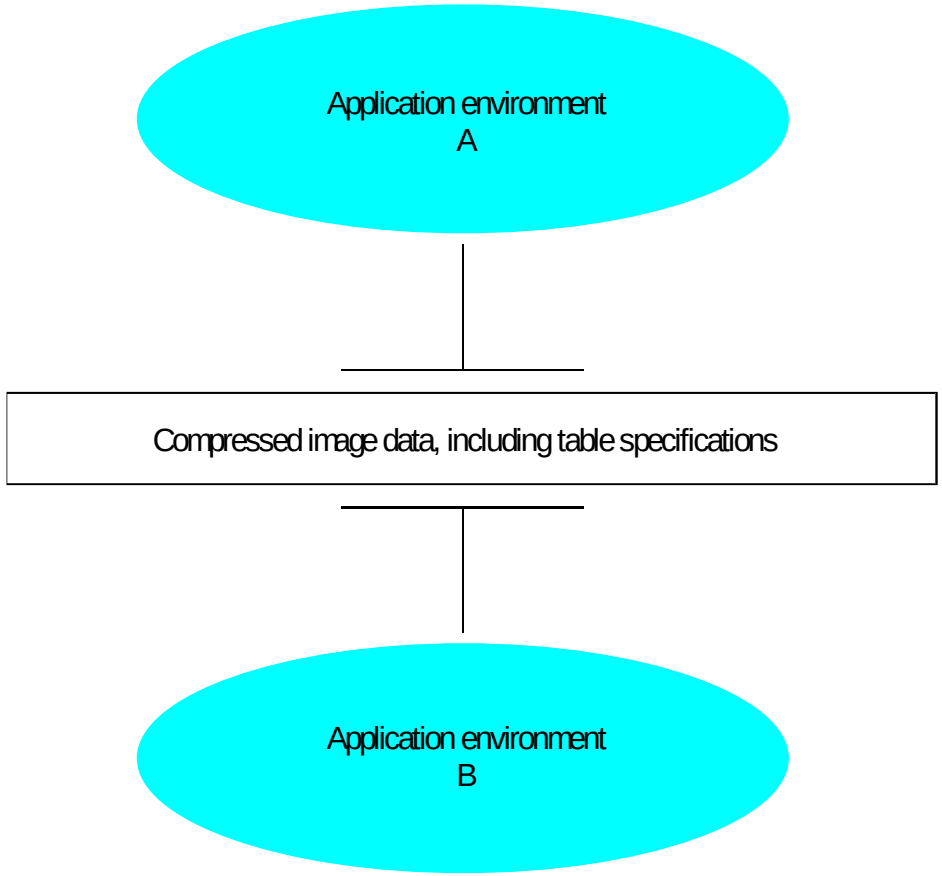
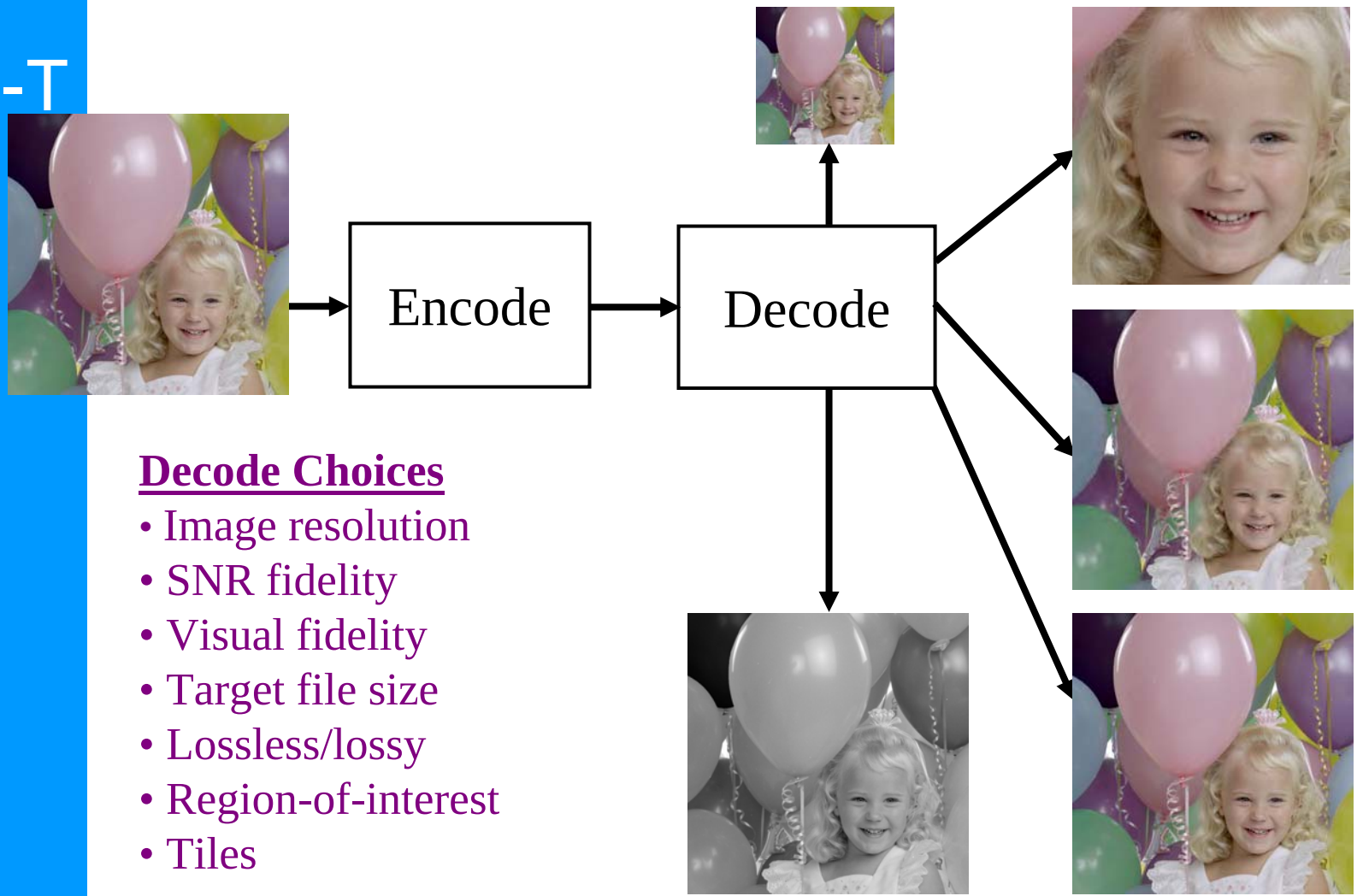


Figure 3 – Interchange format for compressed image data

JPEG2000 Application Paradigm



Decode Choices

- Image resolution
- SNR fidelity
- Visual fidelity
- Target file size
- Lossless/lossy
- Region-of-interest
- Tiles

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Key Technologies in JPEG 2000

- **Discrete Wavelet Transform (DWT)**
  - Multi-resolution image representation
  - Compression efficiency
  - Good energy compaction
  - Decorrelate image across larger scale
  - Integer DWT for lossy to lossless compression
  - Efficient computation techniques

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Key Technologies in JPEG 2000

- **Embedded coding**
  - Embedded scalar quantization: SNR scalability
  - Independent embedded blocks
  - Bit-plane encoding
  - Arithmetic coding: MQ coder from JBIG2
  - Flexible organization
  - Error resilience
  - Efficient compression

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JPEG 2000: Image Coding System

JPEG 2000 Part 1: Core Coding System
ISO 15444-1 (2000), ITU-T T.800

JPEG 2000 Part 2: Extensions
ISO 15444-2, ITU-T T.801

JPEG 2000 Part 3: Motion JPEG 2000 (15444-3)

JPEG 2000 Part 4: Conformance Testing (15444-4)

JPEG 2000 Part 5: Reference Software (15444-5)

JPEG 2000 Part 6: Compound Image File Format (15444-5)

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JPEG 2000: New Parts

JPEG 2000 Part 8: JPSEC
Image Security

JPEG 2000 Part 9: JPIP
Interactivity tools: APIs and Protocols

JPEG 2000 Part 10: JP3D
Three Dimension Data

JPEG 2000 Part 11: JPWL
Wireless Applications

JPEG 2000 Part 12: ISO Media Format

JPEG 2000 Part 13: Entry Level Encoder

Commercial Software, IP, and Silicon

June 2004:

JPEG 2000 Software

DSPG@UVic
Digital Signal Processing Group

JPEG 2000 Firmware

JPEG 2000 Silicon

Commercial Products Supporting JPEG 2000

June 2004

Non-native software

Standards Organization

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ISO International Organization for Standardization

ITU

NISO

ANSI American National Standards Institute

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY

DICOM
Digital Imaging and Communications in Medicine

NATO OTAN

DCI Digital Cinema Initiatives, LLC

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JPEG New Project: JPSearch

ISO 24800: Image Search

1. JPSearch metadata fields and storage formats
2. Specification of compliant system behavior in response to a query
3. Specification of compliant system behavior during a federated query
4. Specification of compliant system behavior during collection export
5. Specification of compliant system behavior for metadata generation
6. Specification of compliant system behavior while editing an image or collection of images, or merging collections of images

Call for proposal at 36th WG1 Geneva Meeting, July 18-22, 2005

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JPEG 2000 Websites

- JPEG website (general information, WG1 documents)

  http://www.jpeg.org

- JJ2000 (software, tutorial, general information)

  http://jj2000.epfl.ch

- JasPer (C implementation of JPEG 2000)

  http://www.jpeg.org/software

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In Summary...

- JPEG 2000 is a triumph of innovations, teamwork and good execution
- JPEG 2000 Reference Software and Compliance Testing are readily available to help developers and users community
- New Parts: JPSEC, JPIP, JP3D, JPWL
- Future directions: JPSearch

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Acknowledgments

- Over 100 experts from 17 national bodies, over 60 organizations
- Adobe, Aerospace, AlgoVision, Analog Devices, Apple, Aware, Booz Allen, Canon, Elysium, Ericsson, Fraunhofer, Fujifilm, HP, IBM, Image Power, Kodak, Los Alamos, LuraTech, Microsoft, Mitre, Mitsubishi, Motorola, NEC, NetImage, Nokia, Oki, Philips, Picture Element, Ricoh, SACD, SAIC, Sharp, Sony, TI, Xilinx, Yahoo!, Xerox, Zoran, ...
- Univ. of New South Wales, Univ. of Arizona, EPFL, UBC, RPI, Tokyo Instit. Polytechnics, ...
- National Bodies: Australia, Belgian, China, Denmark, Finland, France, Germany, Israel, India, Italy, Japan, Korea, Portugal, Singapore, Spain, Sweden, Switzerland, UK, US