



International Telecommunication Union  
International Multimedia Telecommunications Consortium



# Time to Enhance JPEG-1

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# Outline



- o JPEG-1 parts
- o Enhancement to JPEG-1 (T.851)
- o Call for interested parties
- o Potential enhancements

# JPEG-1 parts

- o Part 1: ITU-T Rec. T.81 | ISO/IEC 10918-1  
Requirements and Guidelines
- o Part 2: ITU-T Rec. T.83 | ISO/IEC 10918-2  
Compliance tests
- o Part 3: ITU-T Rec. T.84 | ISO/IEC 10918-3  
Extensions
- o Part 4: ITU-T Rec. T.86(?) | ISO/IEC 10918-4  
Registration authority



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# Modes of JPEG-1



- o Baseline Sequential (DCT-based, Huffman)
- o Extended Sequential
- o Progressive
  1. Spectral selection
  2. Successive approximation
- o Hierarchical
  1. Change sizes by factors of 2
  2. Improve quality
- o Lossless (not DCT-based)

- o Huffman
  1. Fixed (example tables)
  2. Custom (2 pass adaptive)
- o Arithmetic coding
  1. QM-coding (1 pass adaptive)
  2. 3 patent holders (IBM, MEL, AT&T)
  3. \$5/15K each

# A.C. vs. Huffman coding

- o Both lossless entropy coders
- o Bit errors not allowed
- o Huffman coding
  1. Custom table optimal for integer bits/code
  2. Assumes static statistics over image
- o Arithmetic coding
  1. Adaptive FSM estimation of statistics
  2. Slower than Huffman coding (approx 2:1)
  3. Net 25% more CPU cycles in 1989



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# Enhancement to JPEG-1 T.851



- o Bit depth for DCT 8-16
  - o Q-15 coder \*
    1. Fee-free (IBM IP only)
    2. Based on JPEG 8 ver. 5.2 (1990)
    3. 5-20% compression improvements
    4. Successive approximation easier
  - o JPEG Extension (JPG) marker \*
    1. Replaces Start of Image (SOI) marker
    2. Allows for future extensions variations
- \* Likely to be in IJG code Dec. '06



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# T.851 open source software\*



- o Not ready last year
- o Mike Slattery, ASICNorth, provided
- o Originally a patch on IJG code
- o Now have IJG cooperation
- o Still waiting on independent validation
- o Guido Vollbeding appoint webmaster for ITU-T T.851 software website

\* Likely to be in IJG code Dec. '06



# Call for interested parties

- o Ad Hoc on Exploring Enhancements to JPEG-1
  1. SG16 WP3/Q23 (April 6-7, 2006)
  2. Joan L. Mitchell (IBM), chair
  3. Guido Vollbeding (IJG)
- o Recommended:
  1. Call be made for interested parties to attend the next SG16/WP3/Q23 meeting
  2. Understanding/exploring possible enhancements to JPEG-1.

- o Items
  1. With clear need
  2. With easy implementations
  3. Be added to T.851 as an annex within a year
- o Ongoing process
- o Future annexes in future years(?)

- o Discard rows/columns at top/left edges
  1. Needed for 90 degree rotations
  2. Image cropping off 8x8 block boundaries
- o Component registration
  1. Location of sub-sampled components
  2. MPEG-1: centered in 2x2 block
  3. MPEG-2: co-located H, centered V
- o Standardized IDCT(s) (lossless hierarchical)
  1. Waiting for results of MPEG contest
  2. Requirements relaxed

# Improvements to lossless

- o Quantization of lossless prediction
- o DC progressive
  1. Use 2-D lossless
  2. Use near lossless
- o More contexts for DC/Lossless A.C.
  1. Doubling contexts (25->49) gives 5% improvement
  2. No extra CPU cycles in inner loop



# Alternate scan orders\*



- o Along vertical/horizontal (not diagonal)

0	1	8	9	24	25	48	49
3	2	7	10	23	26	47	50
4	5	6	11	22	27	46	51
15	14	13	12	21	28	45	52
16	17	18	19	20	29	44	53
35	34	33	32	31	30	43	54
36	37	38	39	40	41	42	55
63	62	61	60	59	58	57	56

- o Custom scan order (LUT to decoder)

\* Will be implemented in IJG code Dec. '06

- o Specialized FDCT/IDCTs for scaling
- o Ex: specialized IDCTs
  1. Scale up 9x9,... 16x16
  2. Scale down 7x7,... 1x1
- o Alternate scan order assists
- o Lossless via DC
  1. Encoder 8x8 scaled up image, only DC
  2. Decoder scales down 8x8.

\* Will be implemented in IJG code Dec. '06

# Not a new competition

- o Looking for minor tweaks
- o JPEG-1 designed for minimum of 25 years
- o Reasonable to have some maintenance
- o ITU-T SG16/WP3/Q23 asking the question
  1. Need more company/country participation
  2. Won't happen if no interest
- o I'm willing to be the editor
  
- o Please help get the word out



# Q & A

