JPEG 2000
“J2K”

For Contribution
Quality HD Transport

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JPEG2000 – Agenda

- Basic technical description of JPEG 2000
- Practical applications of JPEG 2000 for broadcasters
- Technical infrastructure requirements
- JPEG-2000 in comparison to MPEG-2 and MPEG-4
- Interoperability of various JPEG-2000 codecs
- Future potential JPEG 2000 applications for broadcasters
- Background of Evertz' involvement with JPEG2000

Basic technical understanding of JPEG 2000.

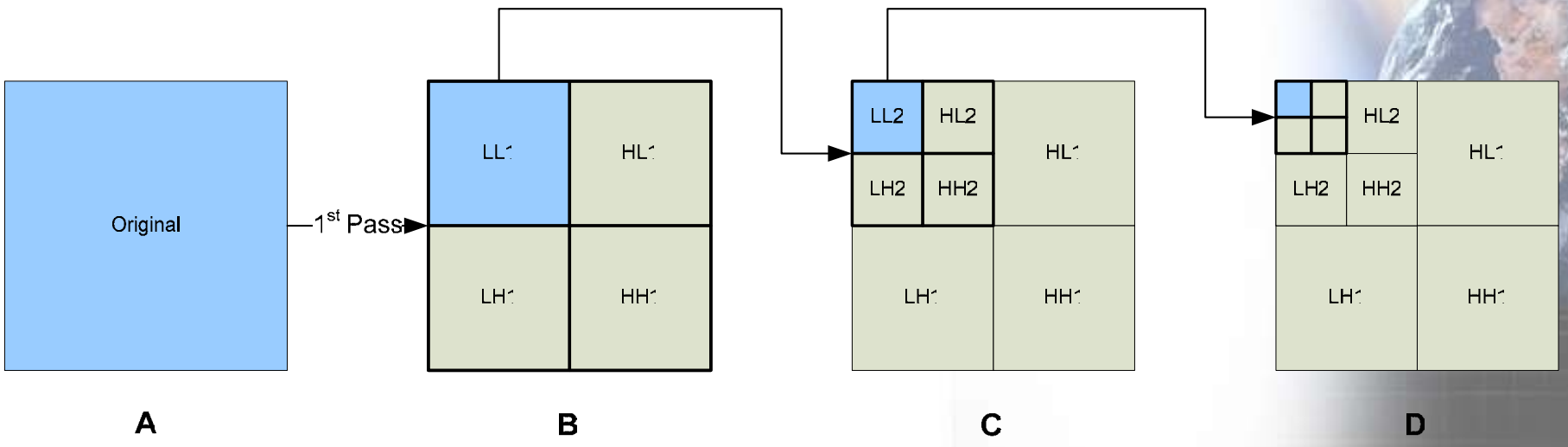
What is JPEG 2000?

- State of the art compression technology based on Wavelet Technology
- Overall goals:
  - Better compression quality than original DCT (Discrete Cosine Transform) based JPEG
    - Softer artifacts
  - Scalability, extract multiple resolution images from a single high resolution master
  - Support near lossless and lossless compression
  - Low delay encode-decode

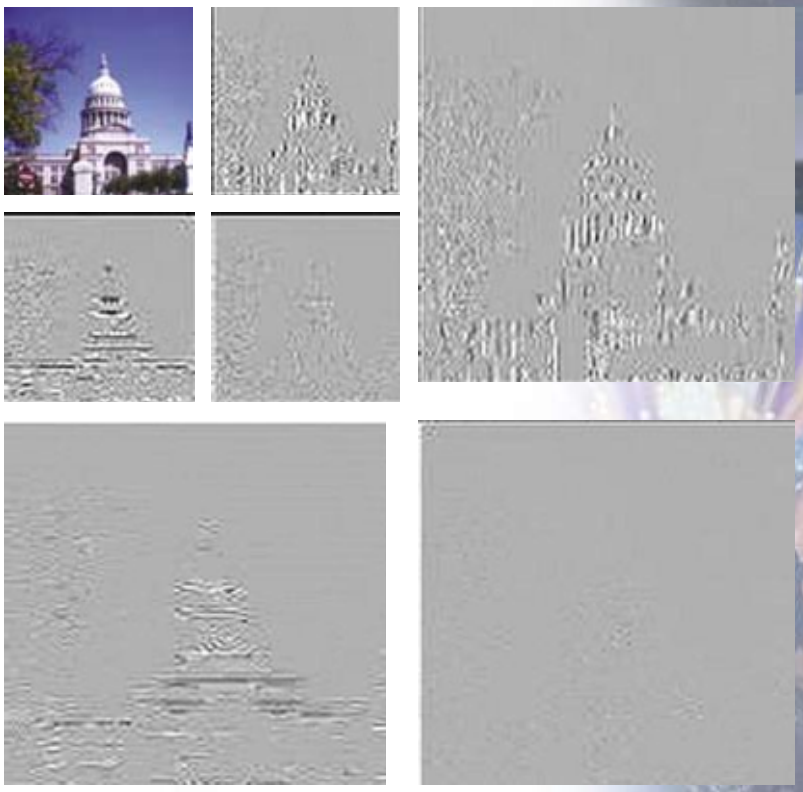
Basic technical understanding of JPEG 2000.

Wavelet transforms image into wavelet co-efficient sub-bands and resolutions

General Process
-Image is sent to a set of wavelet filters
-Pixel information is transformed into wavelet coefficients
-These are then grouped into several sub-bands which describe H and V frequencies
-Lower frequencies remain in first transform level
-Higher frequencies contained in higher transform levels



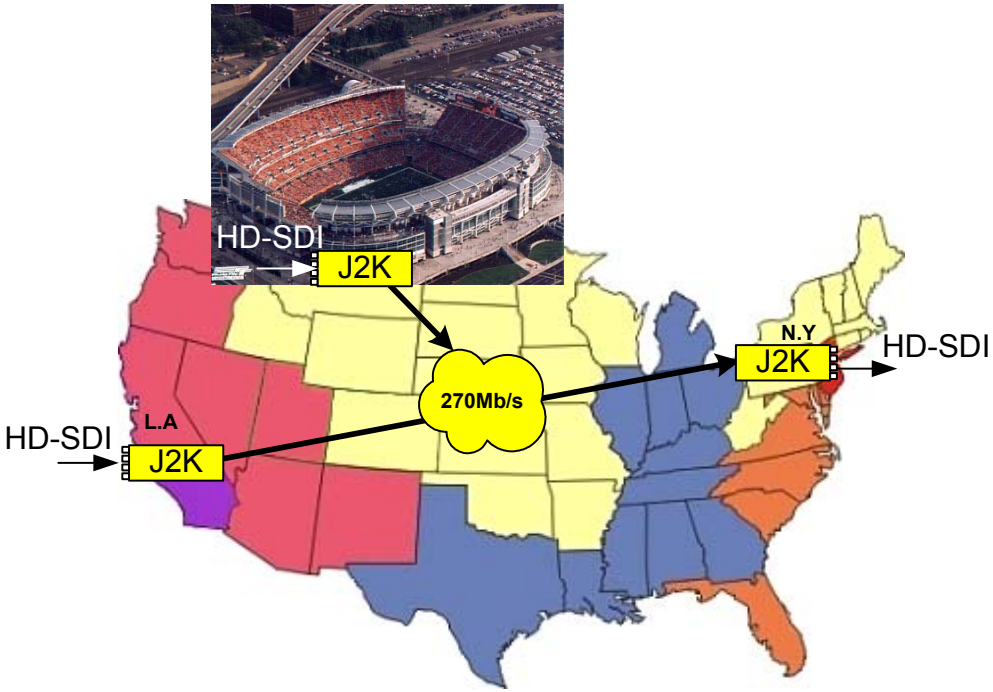
Basic technical understanding of JPEG 2000.



*Analog Dialogue 38-09, September (2004)

Practical applications of JPEG 2000 for broadcasters

- Accepted by Digital Cinema Initiatives (DCI)
- Used by broadcasters worldwide for contribution
  - HD acquisition
  - Sports or high revenue live shows
  - Hollywood for film shooting reviews
  - Low delay applications (e.g. 2-way interviews)



Major National Telecom Carriers

Technical requirements for infrastructure

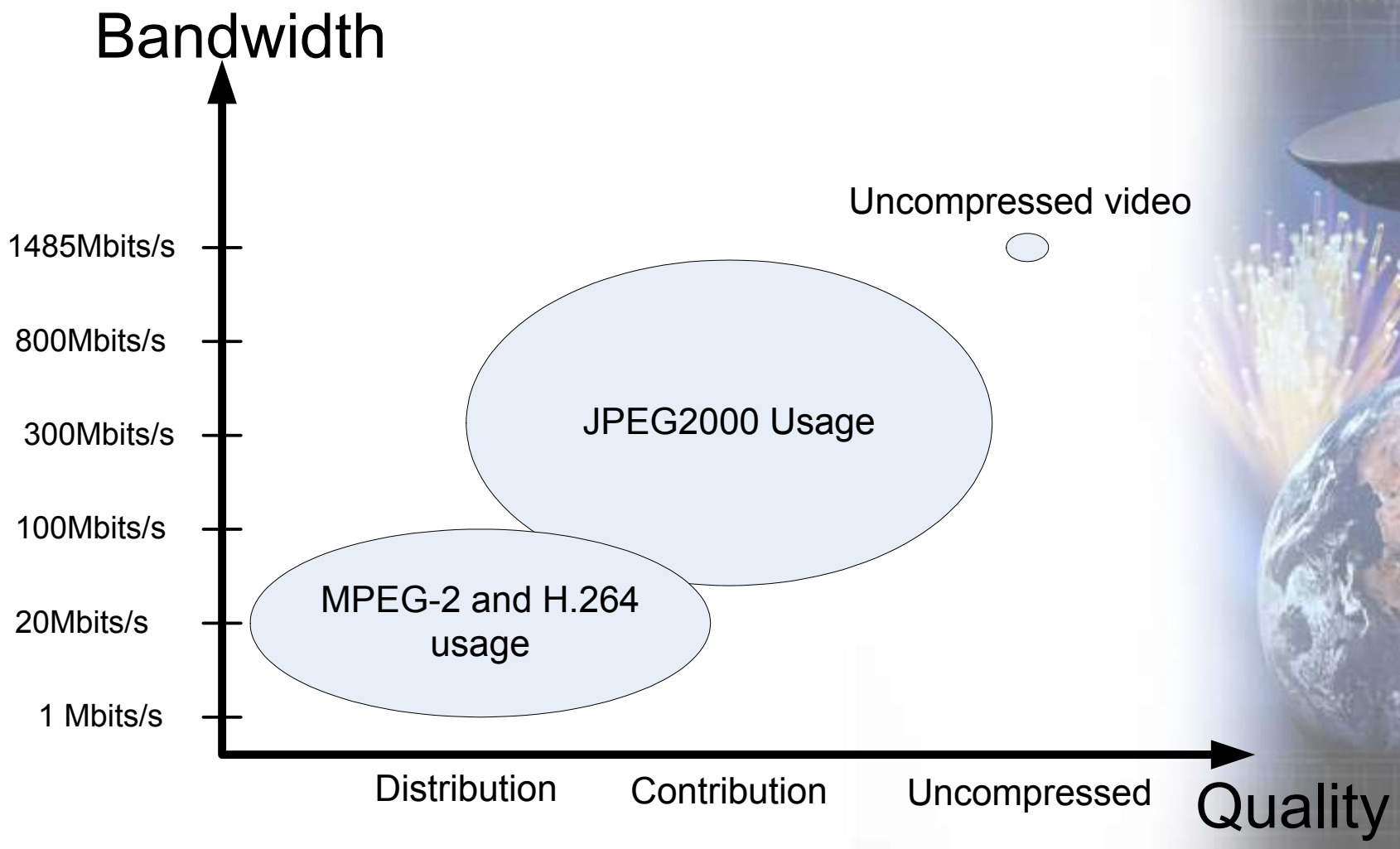
- JPEG2000 requires high bandwidth for contribution applications:
  - HD requires120Mb/s + for visually lossless quality
  - HD requires 300-500 Mb/s + for near lossless quality
- What transport media do the service providers have available?
  - Can't practically use Satellite:
    Typical DVB-S2 full transponder bandwidth is 72Mbits/s
  - Most of applications for J2K use terrestrial connections
    - Dark fiber
    - SONET or SDH networks
    - IP over MPLS
- Framing of the JPEG2000 bitstream for transport
  - HD 1.5 Gb/s compressed to 270 Mb/s (Using SDI links)
  - HD 1.5 Gb/s compressed over ASI transport stream
  - HD 1.5 Gb/s compressed over IP

JPEG 2000 – Comparing with MPEG-2 and H.264

	MPEG-2 encoding	H.264 encoding	JPEG2000
Inter frame coding	Yes	Yes	No
Transform base	DCT	DCT	Wavelets
Bit depth	8	8/10 (upcoming)	10
Encoder/Decoder design complexity	Asymetrical	Asymetrical	Symetrical
Low bitrate thumbnail	No	No	Yes
Technology Licensing	Yes	Yes	No
HD Contribution Bitrate	45-100	20-80	120-600Mbits/s
Typical Enc-Dec delay	200-300ms	300-800ms	sub 150ms
Physical Interface	ASI/IP	ASI/IP	ASI/SDI/IP
Cost	$$	$$$	$

- JPEG2000:
  - High bandwidth / High quality
  - Lower delay
  - No Licensing Costs which makes J2K cost effective

JPEG 2000 – Comparing with MPEG-2 and H.264



Interoperability of various JPEG-2000 codecs

- Most JPEG2000 products support:
  - Broadcast JPEG2000 Profile (ISO/IEC 15444-1Amendment 4).
  - At the raw bitstream level, most equipment use the same technology
- Current transport interface:
  - SDI, SDTI, ASI, IP are all standardized and can be carried over multiple networks

BUT…

- The encapsulation of the raw bitstream into a transport stream or over IP is NOT YET standardized
- Today, the encoder and the decoder must be from the same vendor to ensure compatibility
- Standardization efforts:
  - **SMPTE** and **VIDTRAN** are working on standardizing the encapsulation of the J2K raw bitstream over transport streams and IP
  - **JPEG2000 alliance** was formed to promote the use of JPEG2000 and also to test and verify interoperability (www.jpeg2000alliance.com)

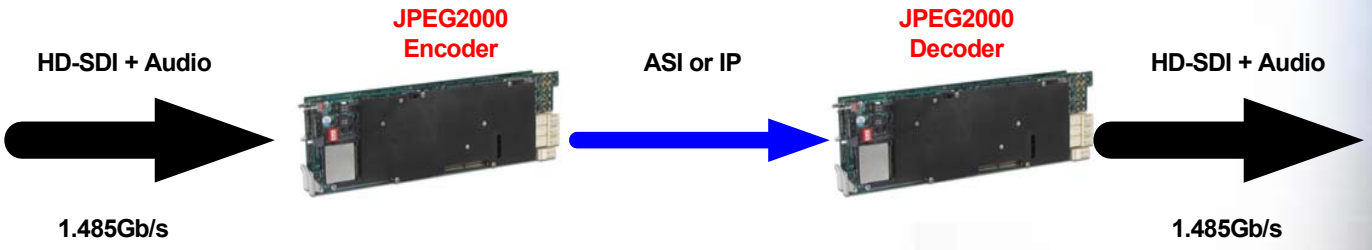
The Future for JPEG2000 in broadcast is bright:

- Application trends for broadcast:
  - Continued HD deployment worldwide
  - 3G (1080P 50-60Hz) contribution
  - 3D contribution (over 3G or 2x 1.5Gb/s links)
  - Archiving of content into servers

- Technology trends for broadcast:
  - Standardization of the Transport layer
  - JPEG2000 bitrate increased to 200-600Mbits/s for higher quality near loss less transmission
  - Other resolutions like 4Kx4K or 8Kx8K

JPEG2000 – Evertz involvement with JPEG2000

- Evertz has been providing JPEG2000 codecs for the last 5 years
- Thousands of encoders and decoders sold and in used today
- Evertz JPEG2000 Contribution Codecs:
    - 4:2:2, 10-bit processing
    - Compress SDI and HD-SDI to ASI or IP
    - 4 Groups of AES Audio
    - Full VANC support



JPEG2000 – Conclusion

- JPEG2000 makes sense in high quality contribution applications
- JPEG2000 doesn't replace MPEG-2 or H.264 but is complementary for high bitrate / high quality applications
- JPEG2000 will develop and grow in contribution and archiving applications especially when interoperability is achieved

Questions and comments?

Thank You