JPEG

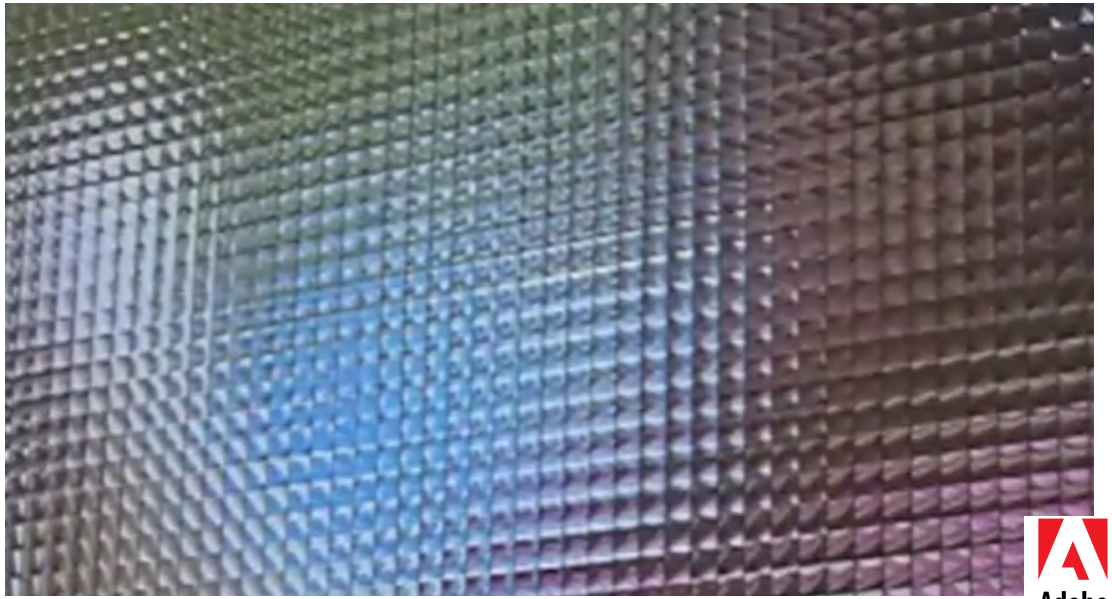
JPEG Standards

‘Are we prepared for the next disruptive evolution in digital imaging markets?’

Prof. Peter Schelkens

Spokesman of the JPEG Committee

Digital Photography



DIGITIZATION = FACT

- The analog to digital transition was disruptive
- 3B+ pictures/day uploaded on social media
- 400B+ pictures/year on digital cams

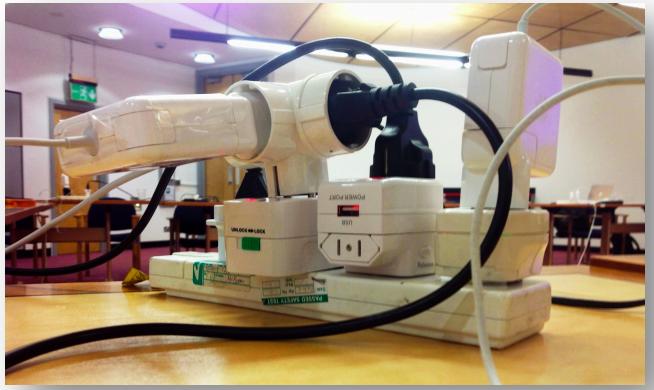
NEXT DISRUPTION IS UPCOMING

- Images become CUBES

GROWTH POTENTIAL (CAGR) 3.8 %

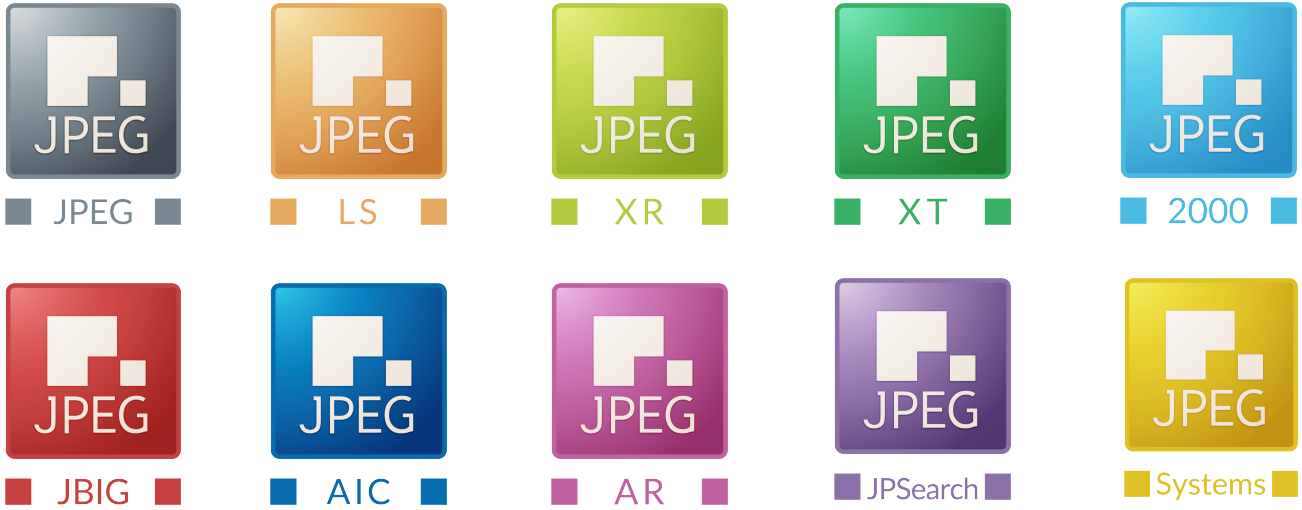
MARKET SIZE (2016) 82.5 B€

JPEG Committee

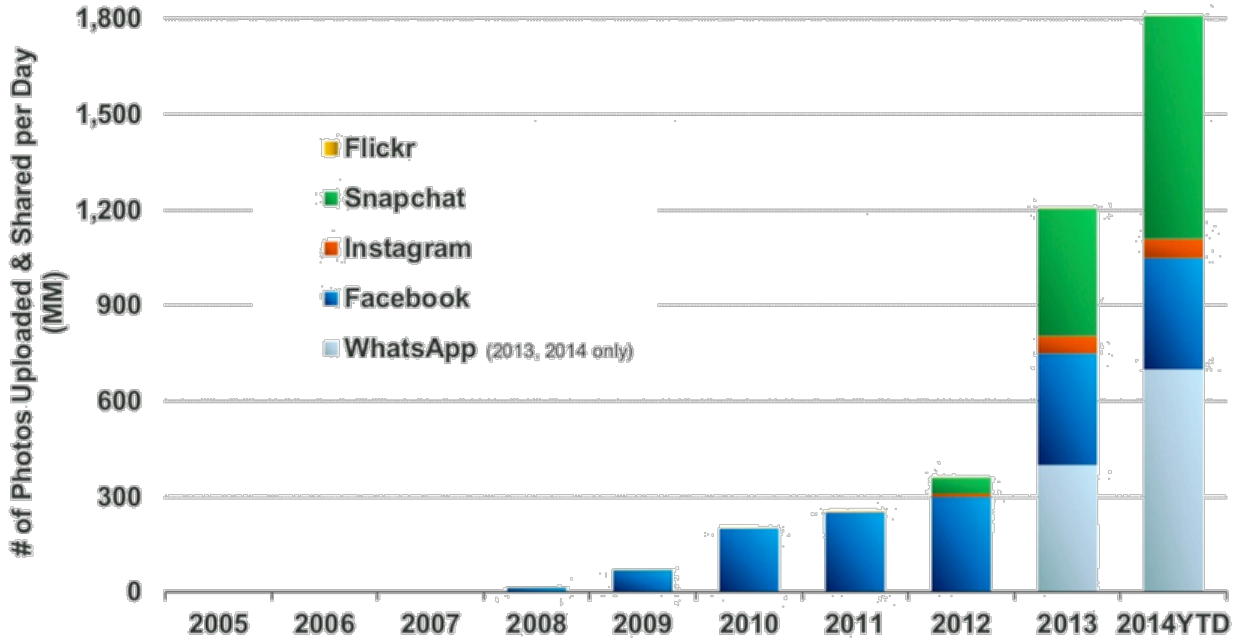


- Joint Photographic Experts Group
  - ISO/IEC JTC1/SC29/WG1
  - ITU-T SG16
- Standardization = Assuring INTEROPERABILITY

JPEG Family of Standards



JPEG's still growing ecosystem



Source: KPCB 2014 Internet Trends, estimates based on publicly disclosed company data.

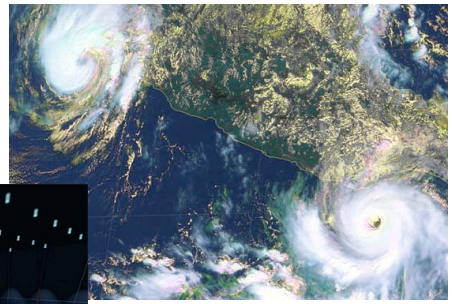
1995-96 Technology and Engineering Emmy award (together with MPEG-2)

JPEG 2000 hits professional markets

DICOM
Digital Imaging and Communications in Medicine

DCI
Digital Cinema Initiatives, LLC

VSF
VIDEO SERVICES FORUM



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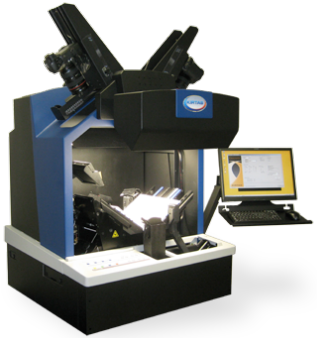
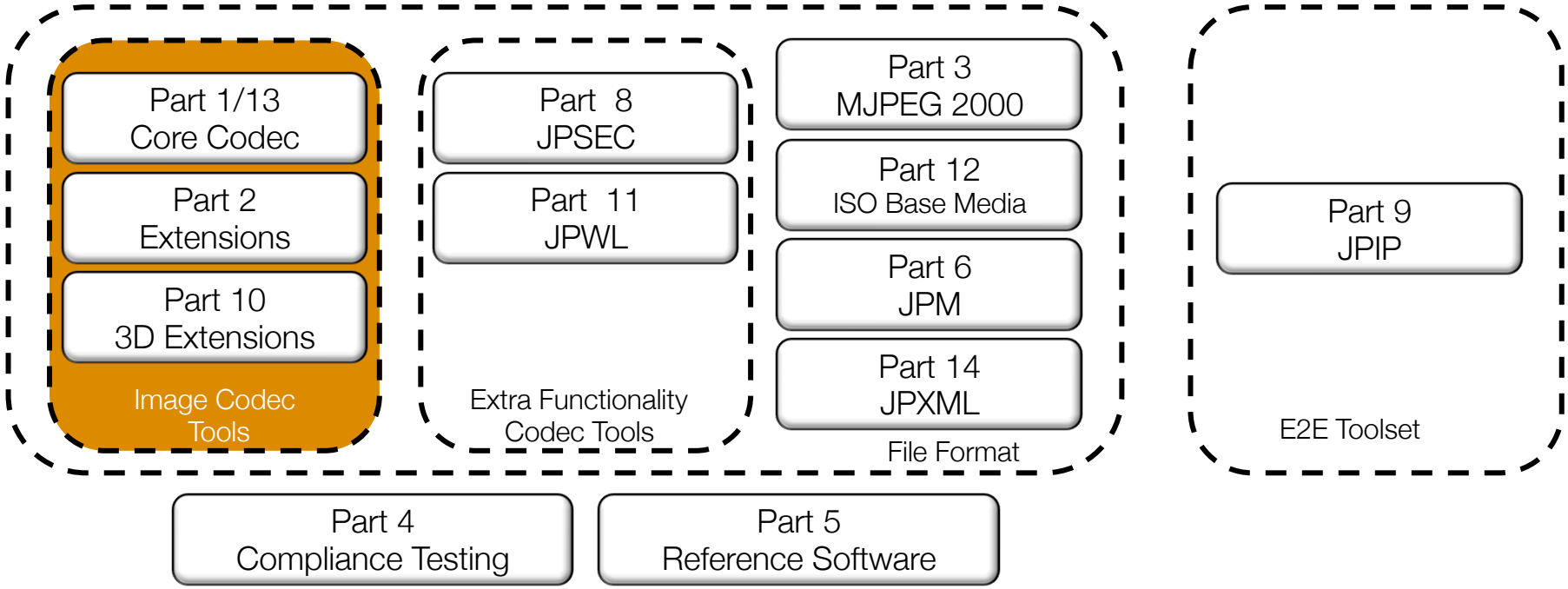


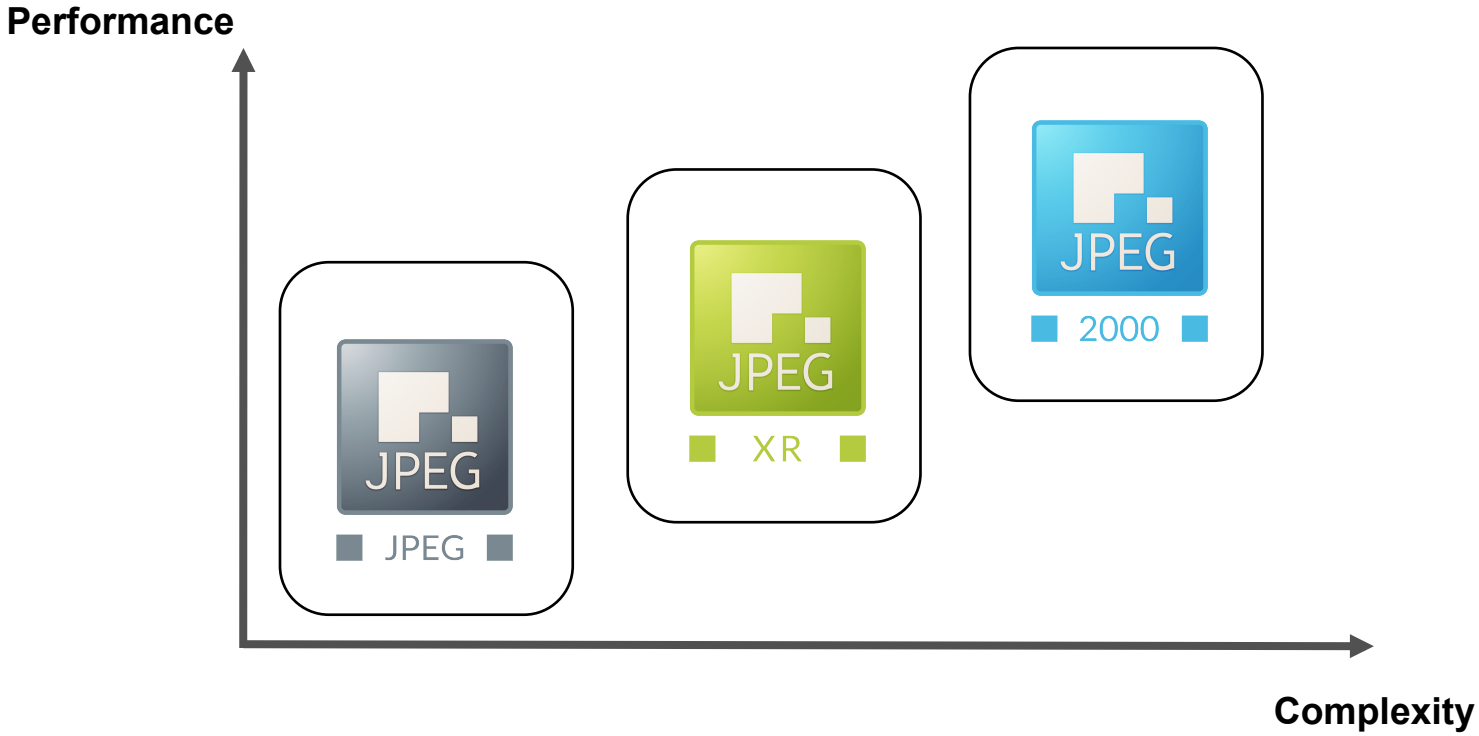
2015 Technology and Engineering Emmy award (JPEG 2000 interoperability)

JPEG 2000

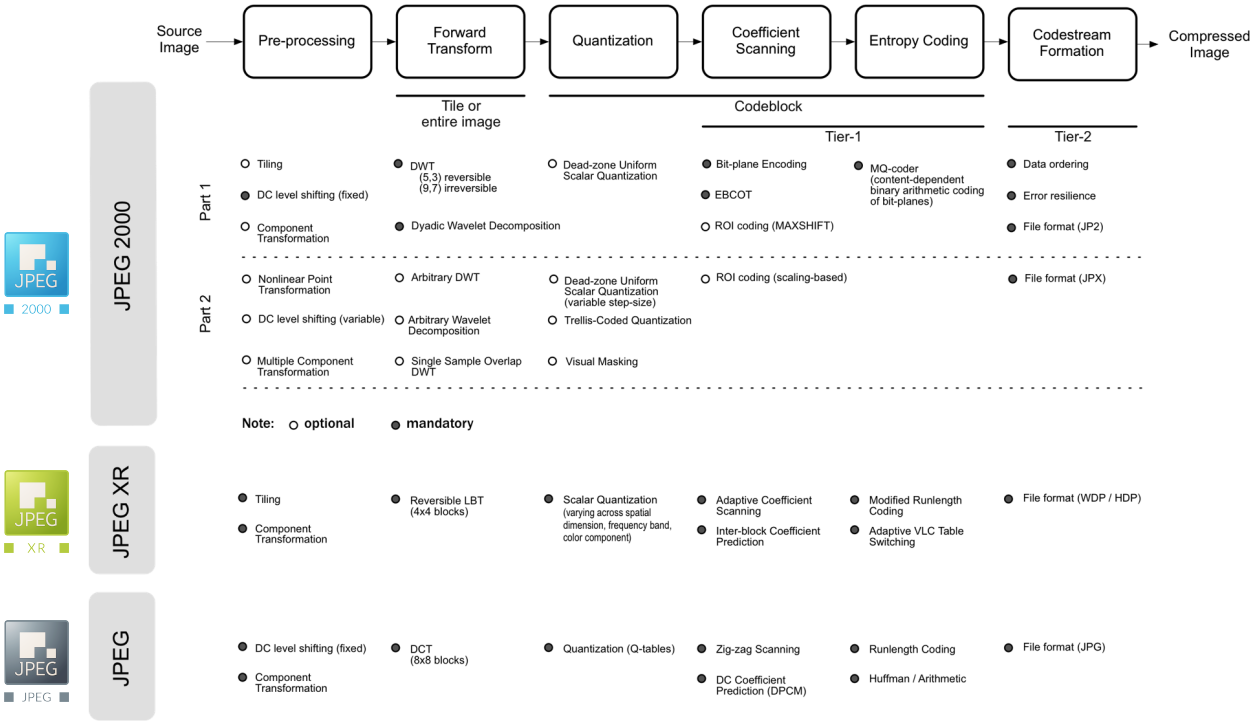
JPEG 2000 framework



JPEG XR bridges gap

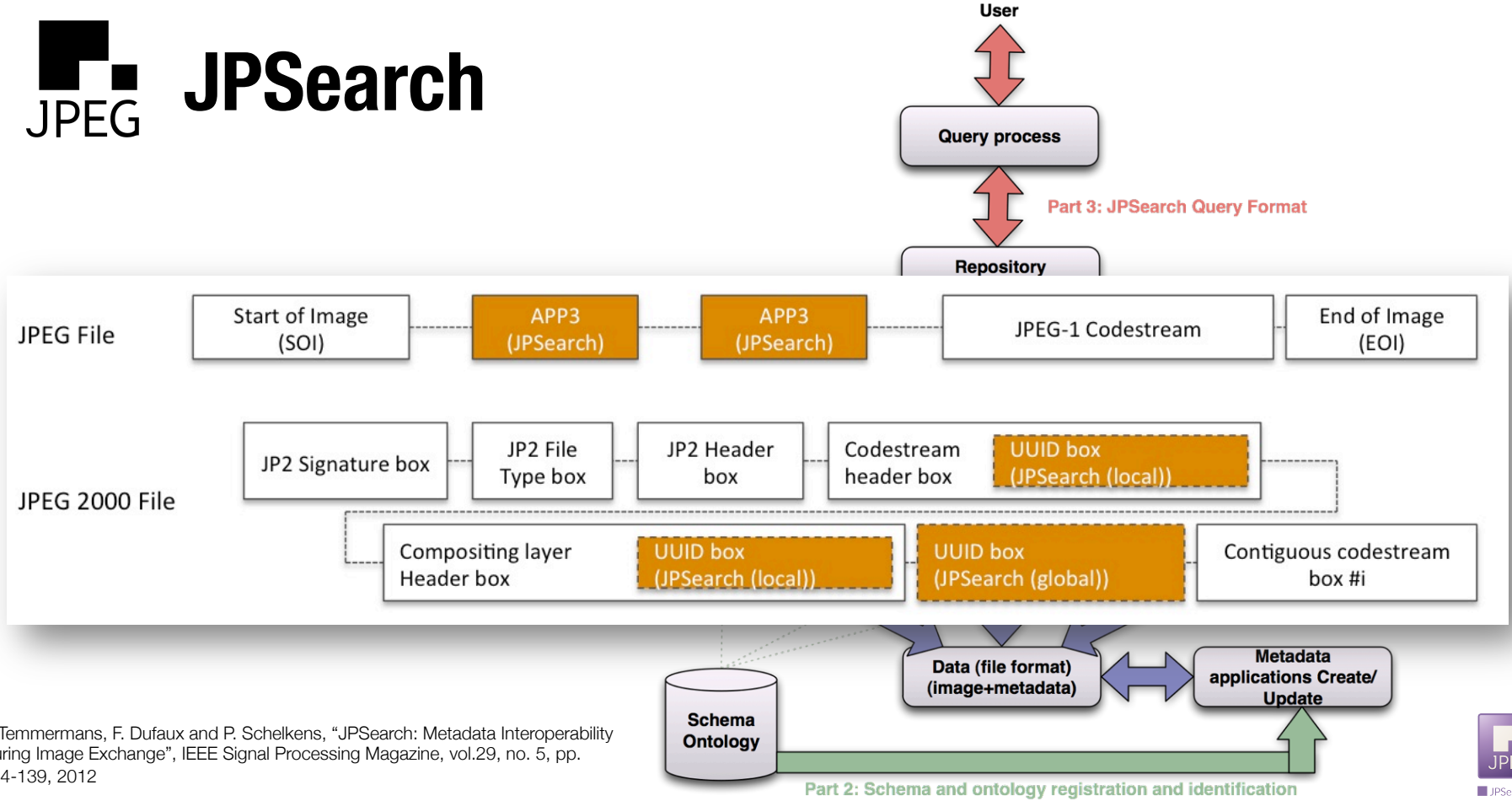


JPEG vs JPEG 2000 vs JPEG XR



JPEG XR not widely used

JPSearch



F. Temmermans, F. Dufaux and P. Schelkens, "JPSearch: Metadata Interoperability During Image Exchange", IEEE Signal Processing Magazine, vol.29, no. 5, pp. 134-139, 2012

Standards in Progress

- Advanced Image Coding (AIC)
  - Evaluation methodologies and metrics
- JPEG AR
  - Image exchange in Augmented Reality
- JPEG Systems
  - Consolidated system layer structure
- JPEG XT
  - JPEG forward/backward compatible HDR compression

Advanced Image Coding (AIC)

- Advanced Image Coding
  - Part 1: Guidelines for codec evaluation
  - Part 2: Evaluation procedure for assessing visually lossless coding

- Call for information issued in February 2015 to receive information on next generation still image compression with superior compression efficiency, as well as other useful features in future multimedia applications

- PCS2015 Feature Event - Evaluation of current and future image compression technologies

- For further information see www.jpeg.org and www.pcs2015.org

JPEG XT design principles

- Exif and JFIF use APP marker of JPEG
  - Reserved for application segments

APP marker (0 to 15)	Format
APP0	JFIF, JFXX
APP1	Exif
APP2	ICC Profile
APP3	JPSearch Part2
APP14	Adobe

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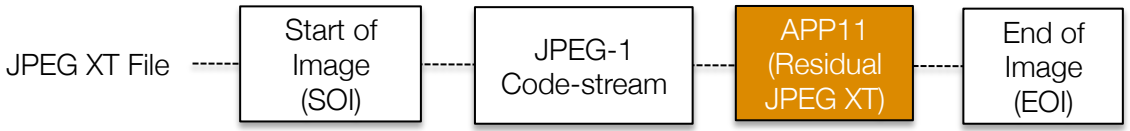
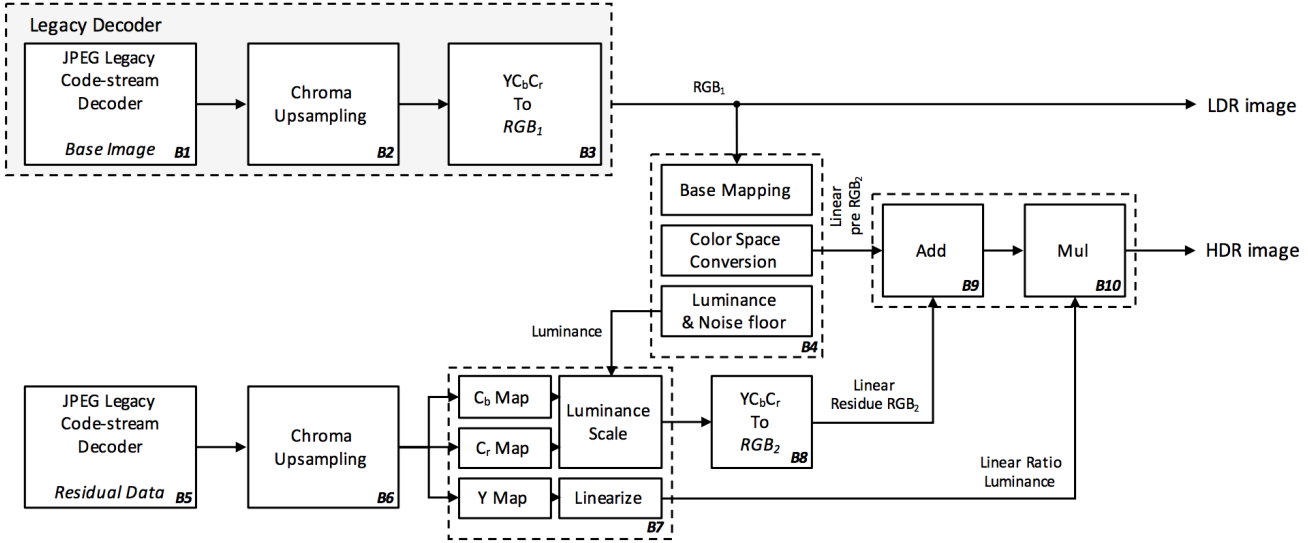


JPEG XT design principles

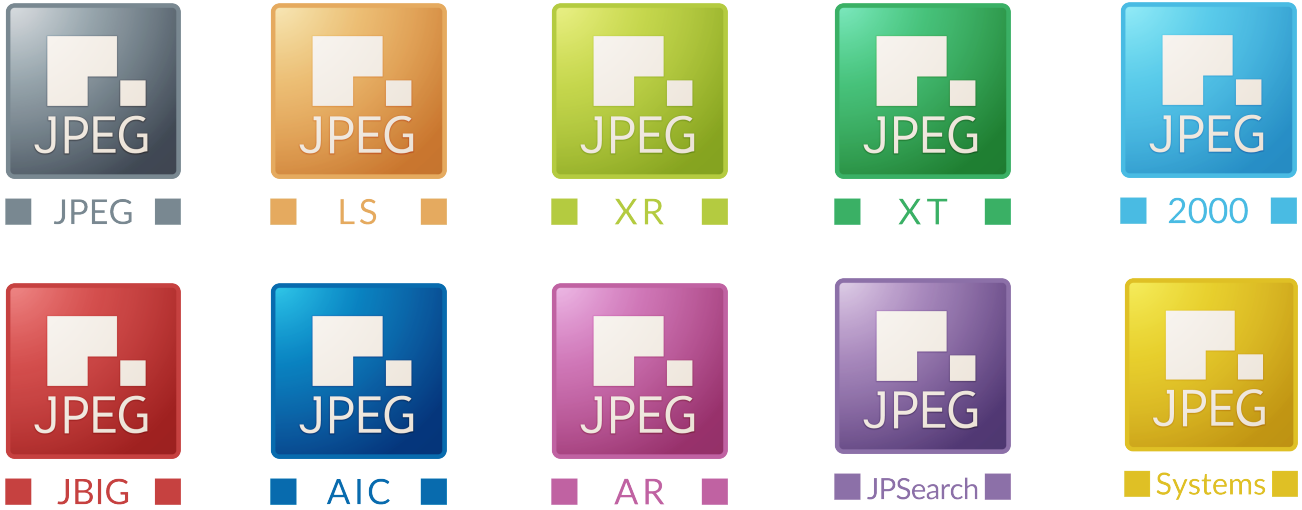
- Two-layer coding, with **base layer a legacy JPEG coded LDR** and enhancement layer the residual to produce the HDR
- Enhancement layer uses a maximum of JPEG Legacy coding tools



JPEG XT status

Part	Title	WD	CD	DIS	FDIS	IS
1	Core Coding System	13/01	13/07	14/01	-	**14/10**
2	Coding of High Dynamic Range Images	13/10	14/01	14/04	-	**14/10**
3	Box File Format	14/05	**14/07**	15/06	-	16/02
4	Conformance Testing	**15/02**	15/06	16/02	-	16/06
5	Reference Software	**14/07**	15/06	16/02	-	16/06
6	IDR Integer Coding	14/05	**14/07**	15/06	-	16/06
7	HDR Floating-Point Coding	14/05	**14/07**	15/06	-	16/02
8	Lossless and Near-lossless Coding	14/07	**15/02**	15/06	-	16/02
9	Alpha Channel Coding	14/10	**15/02**	15/06	-	16/02

Questions?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AR
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JPSearch
JPEG
Systems

JPEG

JPEG Markets

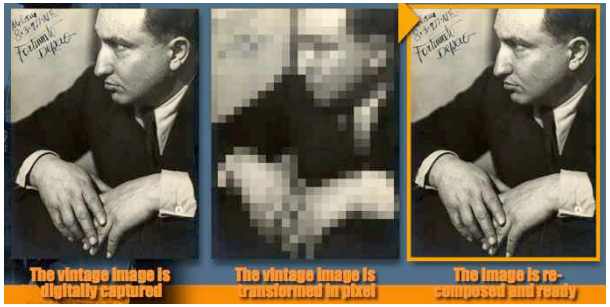
Andrea de Polo

CulturalHeritageConsulting

Content

- JPEG today
- JPEG in the commercial sector
- JPEG in the research sector
- JPEG and “our” save-our-memory plans
- JPEG tomorrow

JPEG Today



- The JPEG standard made its debut in 1992, and since then it has become the most widely used lossy compression format for digital images.
- Over a trillion pictures have been created in JPEG format and this trend continues. Millions of images are shared every day among friends and family via e-mails, photo-hosting Web sites and the enormously popular social networking sites, like Facebook and Flickr, where users can even instantly upload photos taken with their mobile phone cameras. Digital photos are also widely printed at homes or through commercial printing services.

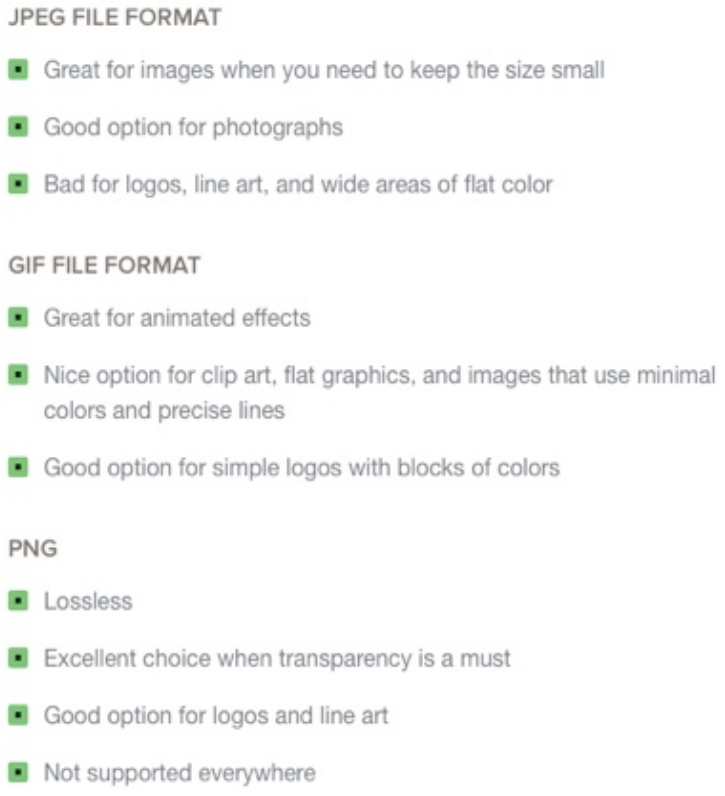
JPEG in the Commercial Sector

- According to Facebook, over 200M images are uploaded online/daily
- According to 1.000memories.com every year over 400 billion pictures are taken

- According to e.g. Infotrends, Statista over 75% of online content is provided in JPEG format

JPEG in the Commercial Sector

- JPEG and TIFF widely used
- RAW popular among photographers
- JPEG 2000 used in medical, archival, broadcasting, security & movie industries



JPEG in the Research Sector

- JPEG today is still very active and popular among research community
- Several parts of JPEG have been adapted recently and annual meetings (next in Warsaw on June 24-26th) aim to measure the progression in the advances in the various JPEG components covering various aspects such as: data security, IPR and licensing, personal privacy, file optimization, backward compatibility, file optimization, data integrity, metadata, etc.

JPEG and “our” save-our-memory plans

Interoperability / Harvesting / Integration into existing ecosystems

- JPEG is a de-facto standard in digital photography. Most digital cameras can produce JPEGs, and many can only produce files in JPEG format.
- JPEG format is a source of data that can be used for the purpose of detecting forged images and some forensic analysis to criminal-cases. In that stored a technical information is called “Metadata “. These Metadata tags contain information about quantization of matrixes, Huffman code tables of full image.
- JPEG tags contain important information about the photo including shooting conditions and parameters such as light levels, shutter speed information, make or model of the camera and lens, lens focal length, flash usage, color profile information, geospatial information.

JPEG and “our” save-our-memory plans

Interoperability / Harvesting / Integration into existing ecosystems

- The basic analysis methods verify the validity of Exif tags in the first place in an attempt to find information. Exif tags added in post processing by certain editing tools, check for capture date vs. date of last modification.
- TIFF, JPEG, JPEG 2000 are all considered popular and widely accepted for long term preservation….. However, it is always VERY important to consider in your ecosystem a workflow that fully supports and preserves your existing metadata (more info on this can be find at IPTC-Photo Metadata group).

JPEG

JPEG & TIFF Compared:
The chart below outlines the pros and cons of each format.

JPEG		TIFF	
Pros	**Cons**	**Pros**	**Cons**
Smaller File Size: JPEG uses lossy compresion to reduce file size making use on the Internet or creating backup CDs less hassle.			Large File Size: TIFFfiles are much larger than JPEGs making them harder to upload or email.
	Lossy Compresion: Lossy means with data loss. JPEG compression does discard some image data based on the amount of compression used.	No Compression: Our TIFF files do not get compressed. This means 100% of the data captured during scanning is retained.	
Supported by most software and photo sharing websites.			Not supported by most photo sharing websites but is supported by most software.
	High Quality but not the absolute best.	Absolute best quality!	
	Not as good a choice for editing: JPEG files use lossy compression. If you plan to edit a photo and then re-save it you will lose some quality each time.	Better if you plan to edit: Because TIFF files don't use compression they do not degrade in quality each time the photo is edited.	

JPEG Tomorrow

- JPEG is working on new features while maximizing backward/forward compatibility.
- New tools and settings like HDR, geo-references and metadata support are considered.
- New software appears in the market: i.e. JpegMini Pro, Topaz DeJpeg, Jpegger, Lossless Photo Squeezer, Advanced Jpeg Compressor (AJC), ImageOptim, Radical Image Optimization Tool, Png Gauntlet, Kraken.io, EWWW Image Optimizer, WP Smush Pro, BPG…
- JPEG standard consortium is there to watch what is available in the market, encourage exchange of information, promote cooperation among users and service providers in order to build for the future always a better and widely accepted solution.

More information

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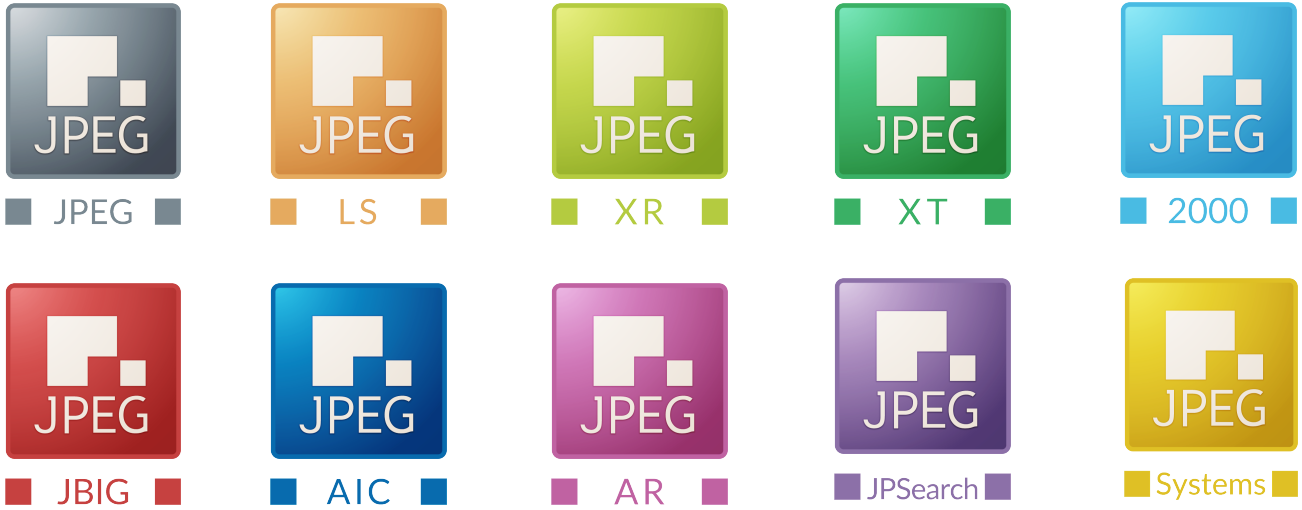
Questions?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Systems

JPEG

JPEG Standards (cnt'd)

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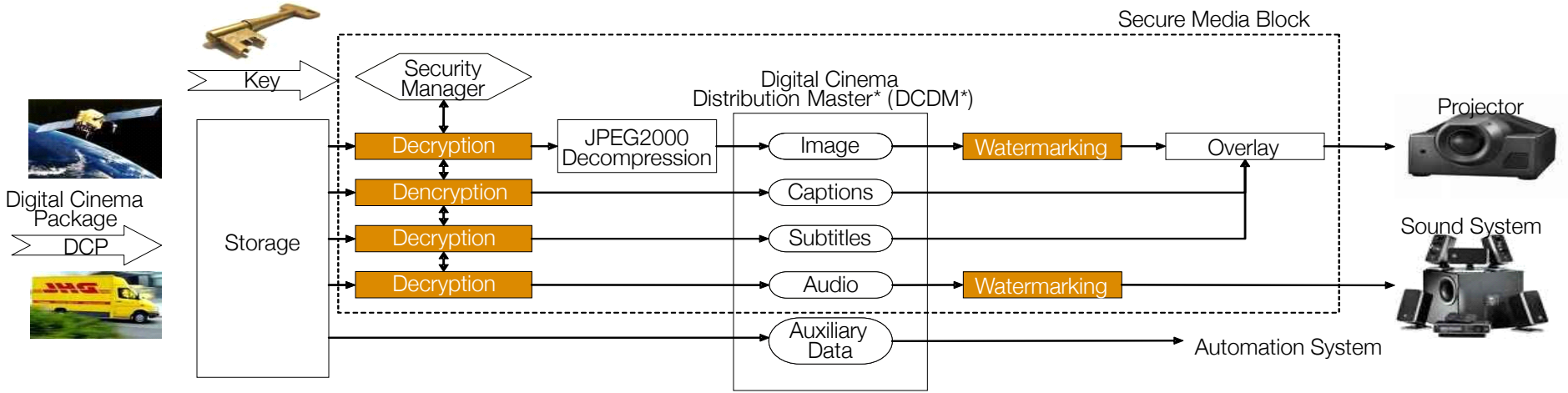
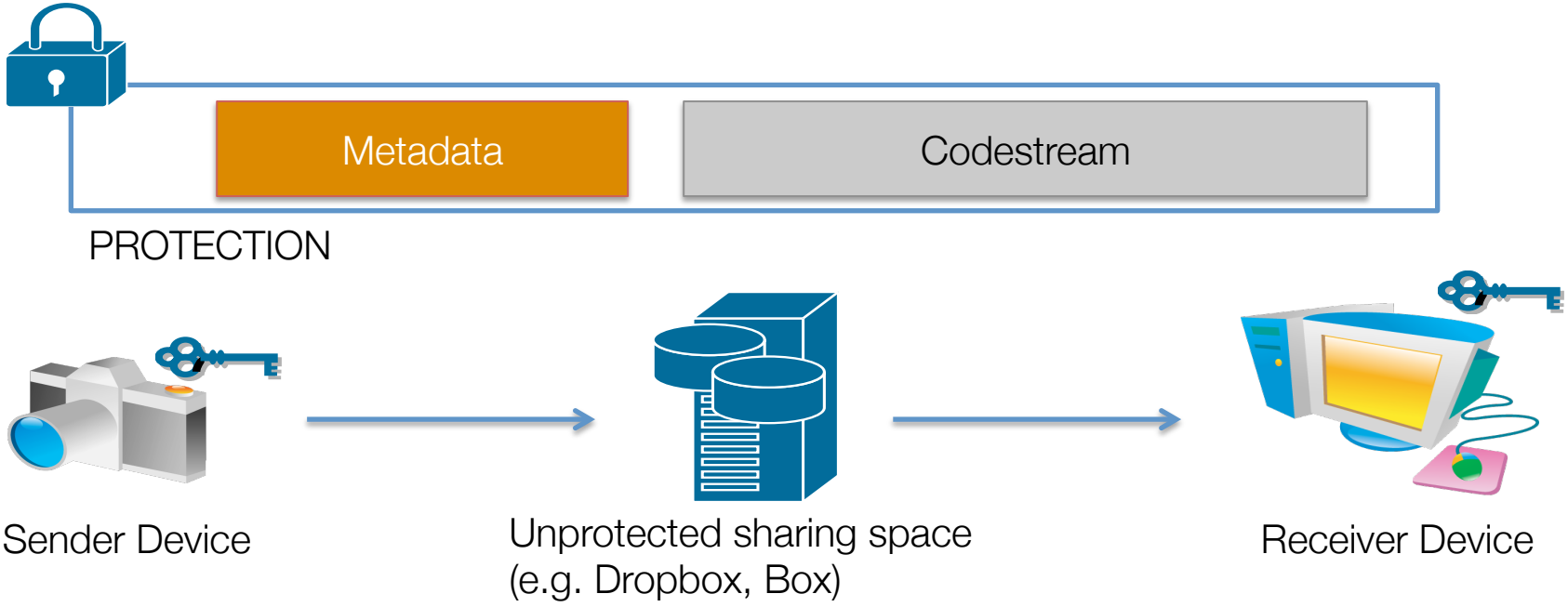
JPEG Privacy JPSEC/DCI Legacy



A. Bohó, G. Van Wallendael, A. Dooms, J. De Cock, G. Braeckman, P. Schelkens, B. Preneel and R. Van De Walle, "End-to-End Security for Video Distribution", *IEEE Signal Processing Magazine*, issue Signal Processing in the Encrypted Domain, vol.30, no. 2, pp.97-107, 2013

JPEG Privacy

- Solutions to provide privacy protection to legacy JPEG



JPEG Privacy

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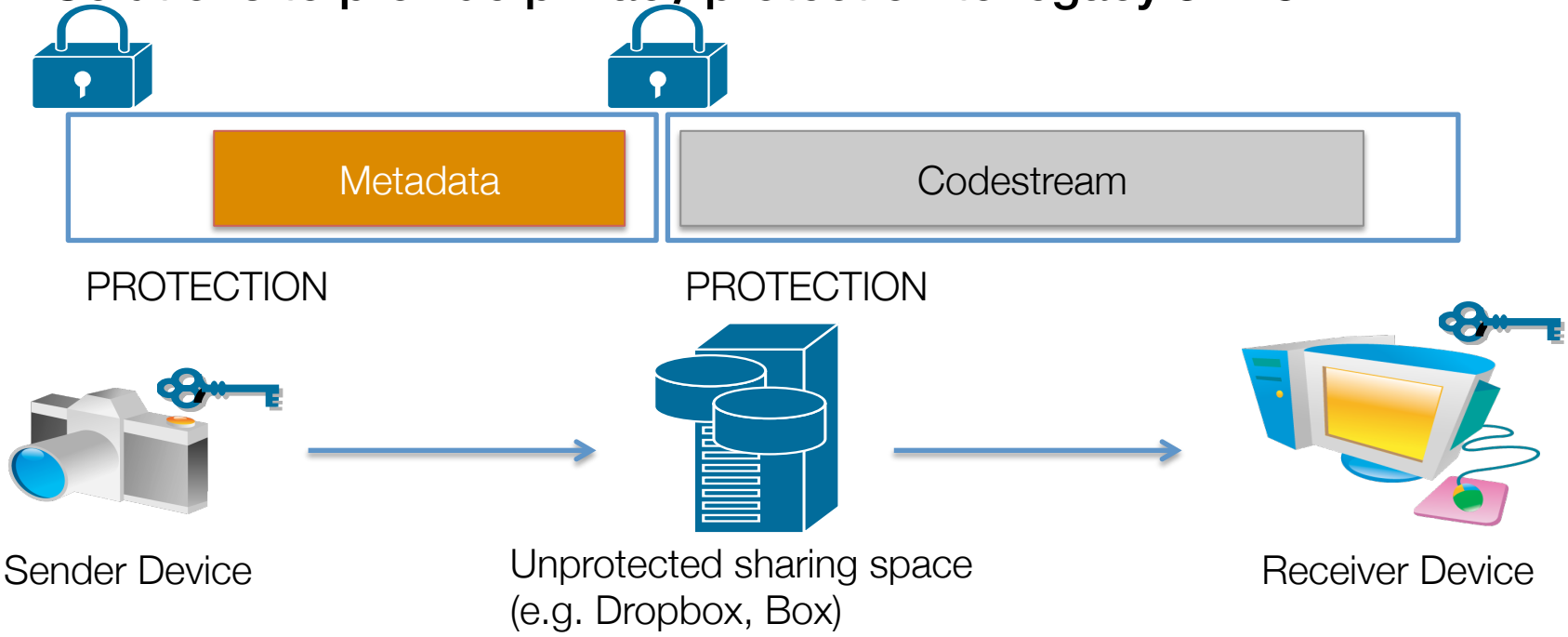


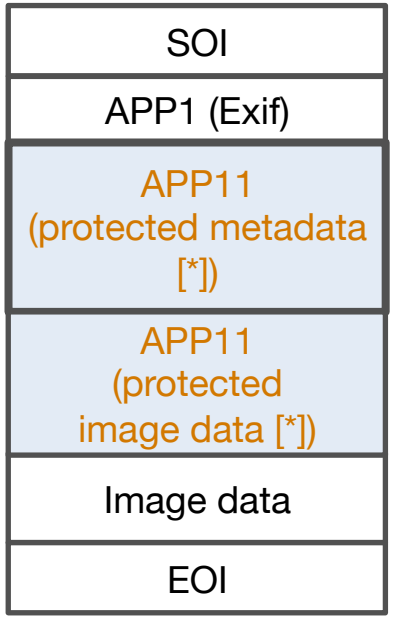
JPEG Privacy Metadata Protection

- Exif and JFIF use APP marker of JPEG
  - Reserved for application segments

APP marker (0 to 15)	Format
APP0	JFIF, JFXX
APP1	Exif
APP2	ICC Profile
APP3	JPSearch Part2
APP14	Adobe

WG1N5725

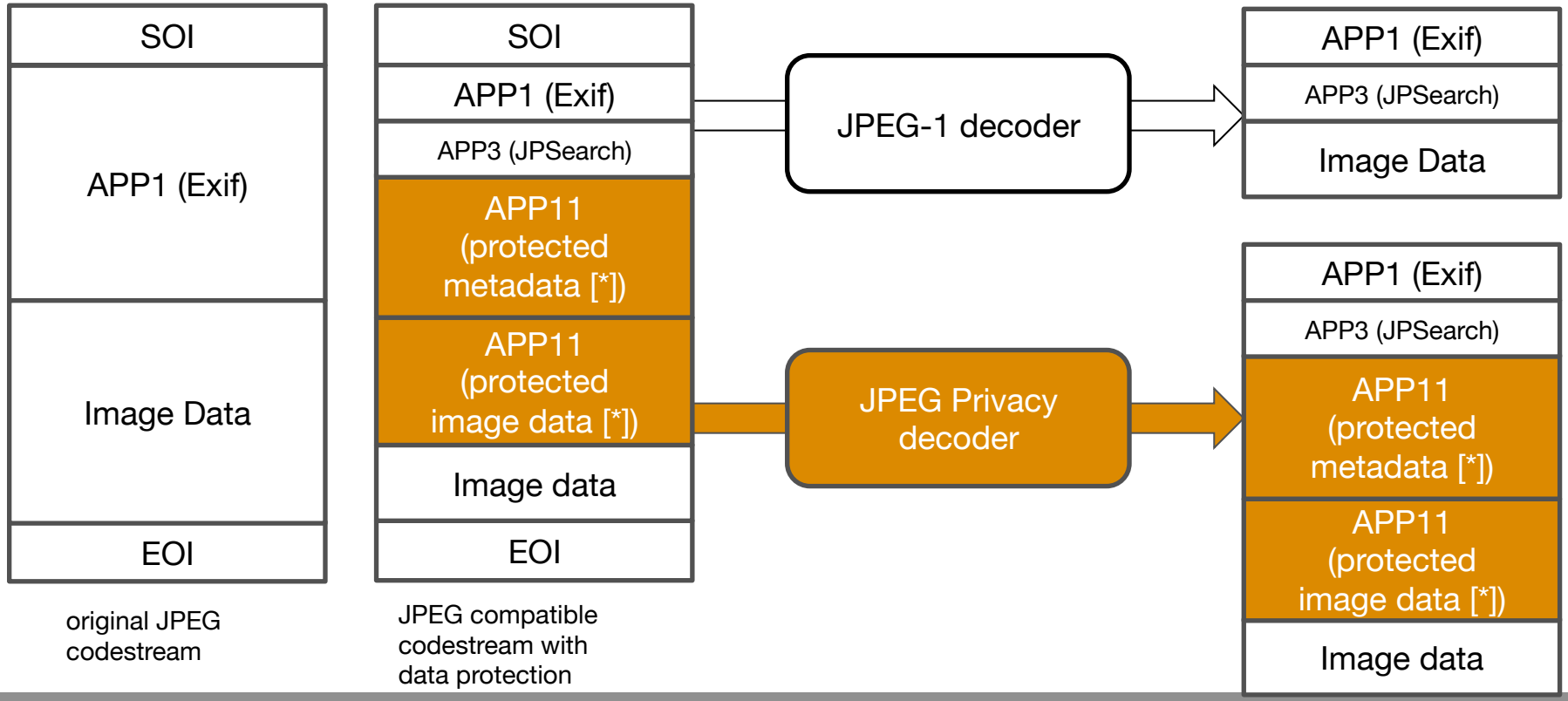
JPEG Privacy App11



JPEG compatible codestream with data protection

- Protected Exif information (described in Box-format)
- Protection methods (refer to JPSEC)
  - Cipher
  - Digital signature
  - Hash function
  - Encryption Tool Registration Authority (like JPSEC-RA)
- Default tools and additional tools (refer to JPSEC)
- Protected image data contains partial DCT coefficients to overwrite the non-protected data (min. region = 8x8 DCT block)

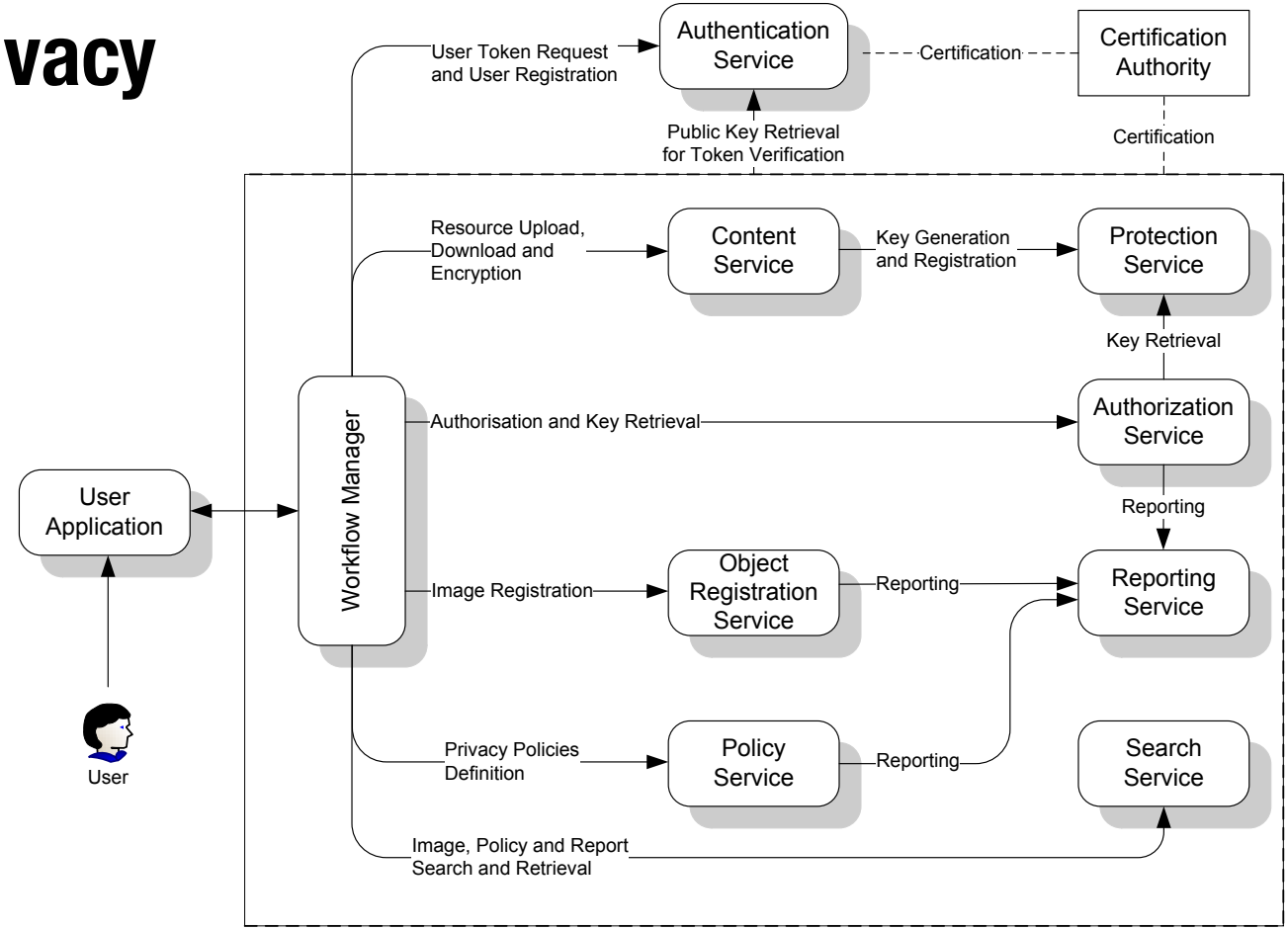
JPEG Privacy App11



JPEG Privacy

- “A JPEG image repository with controlled access”.
- Features:
  - Access control to specific images is defined with rules (privacy policies).
  - Policies are defined either by the service provider or by the image owner.
- Policies define conditional access to information on
  - User: individual, group, location, role, …
  - Context: date and time, number of accesses, action (view, download, …), …
  - Image: quality, geolocation, author, date, semantic information (using e.g. RDF), …
  - Action: read, update, delete, …

JPEG Privacy
MIPAMS



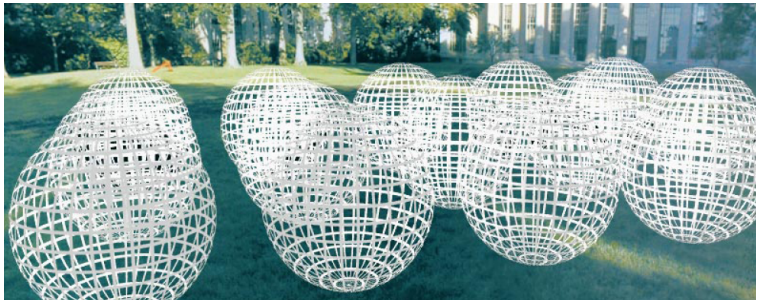
http://dmag.ac.upc.edu/mipams/

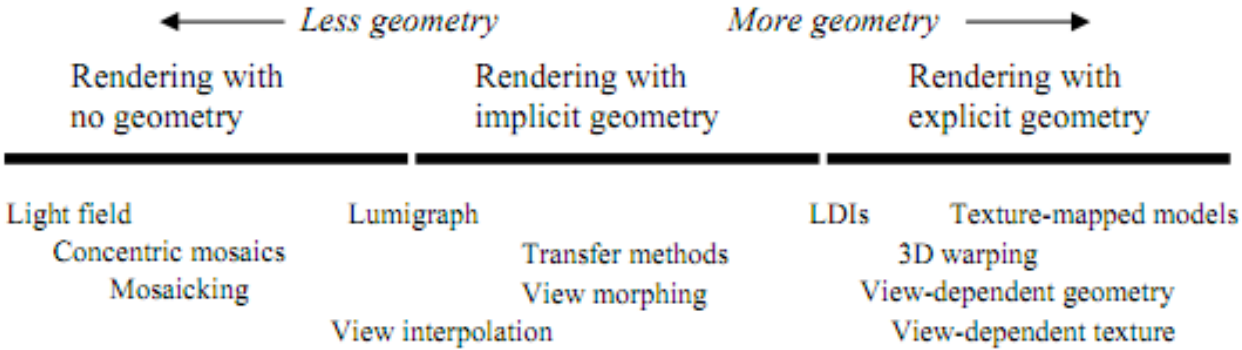
On the Horizon

JPEG PLENO targets a standard framework for the representation and exchange of new imaging modalities such as light-field, point-cloud and holographic imaging.

On the Horizon

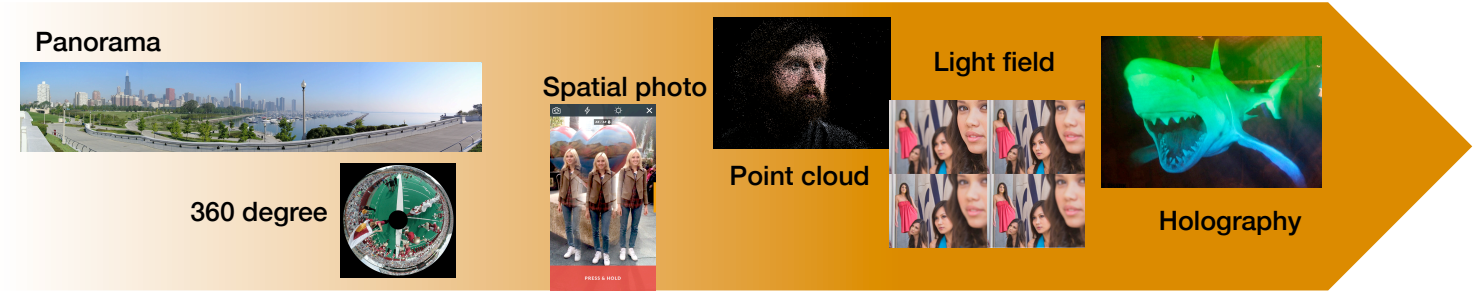
- 7D function P(a,q,l,t,x,y,z)
  - view point
  - wavelength
  - time





JPEG PLENO design principles

- One or limited number of representation models
- Well defined, specific and useful milestones
- Backward compatible with legacy JPEG

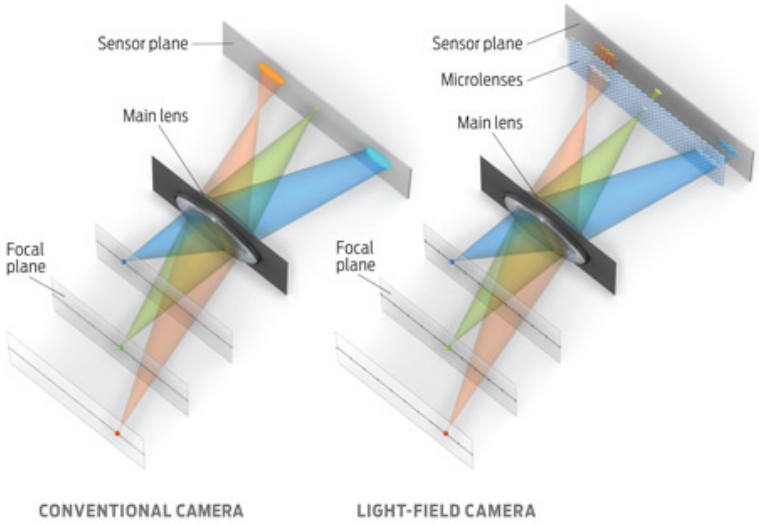


Spatial Photography

- Motion parallax

Point-cloud Photography

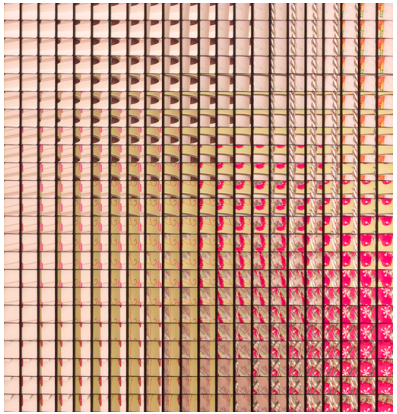
Light-field Photography



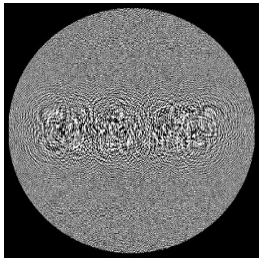
Light-field Photography

LYTRO

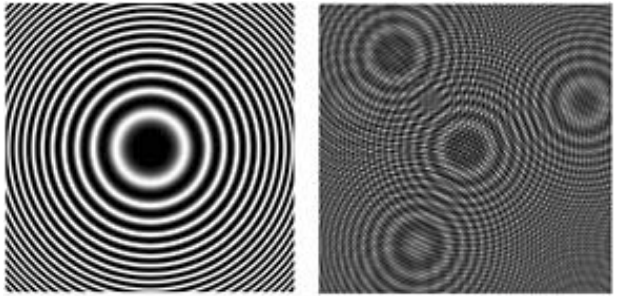
Holography



LIGHT-FIELD
Rays with position + orientation



HOLOGRAM
Interference = superposition of waves



JPEG PLENO Challenges

Scientific

- Source coding technologies
- Image analysis and reconstruction algorithms
- Image restoration
- Better understanding of human visual system

Technology

- Advanced (plenoptic) lenses
- Higher resolution sensors
- Higher dynamic range sensors
- Advanced (3D) printing
- Storage and distribution
- QoE tools
- IPR

Business

- Images move from static entities to dynamic givens
- Classical printing industry is not prepared to adequately address this evolution
- IPR

JPEG PLENO Workshop

Warsaw, Poland – June 23rd, 2015 – Marriott Hotel Warsaw

14:00 Touradj Ebrahimi (JPEG Convenor - EPFL): "*JPEG PLENO - Introduction and Scope*"

Light-fields

14:15 Christian Perwaß (Raytrix GmbH, Germany): "*Metrically Calibrated Multi-focus Plenoptic Camera and its Applications*"

14:40 Joachim Keinert (Fraunhofer IIS, Germany): "*Lightfield media production using camera arrays - use cases and requirements*"

14:55 Peter Kovacs (Holografika, Hungary): "*Light Field Displays*"

15:20 Atanas Gotchev (Tampere University of Technology): "*Content creation for light-field displays*"

15:35 Roger Olsson (Mid Sweden University): "*Objective evaluation and SotA compression solutions for plenoptic image content*"

15:50 Discussion on compression of light field data (Requirements, use cases, technologies)

Point-clouds

16:30 Rufael Mekuria (CWI Netherlands): "*Point Cloud Compression*"

16:45 Discussion on compression of point cloud data (Requirements, use cases, technologies)

Holography

16:55 Małgorzata Kujawinska (Warsaw University of technology): "*Holographic capturing and rendering systems, suitable data representations for phase and amplitude*"

17:10 Frederic Dufaux (TELECOM ParisTech, France): "*Digital Holography Compression*"

17:35 Discussion on compression of holographic data (Requirements, use cases, technologies)

17:50 Conclusions

Conclusions

- JPEG standard is further nurtured
- IPR and privacy extensions in preparation
- New imaging modalities are being addressed
- Open calls to contribute to new standardization efforts in
  - Still Image Coding
  - JPEG PLENO
  - JPEG Privacy
    - Workshop planned at 70th ISO/IEC JTC1/SC29/WG1 (JPEG) Meeting – Lucca, Italy – October 19, 2015 - October 23, 2015

More information

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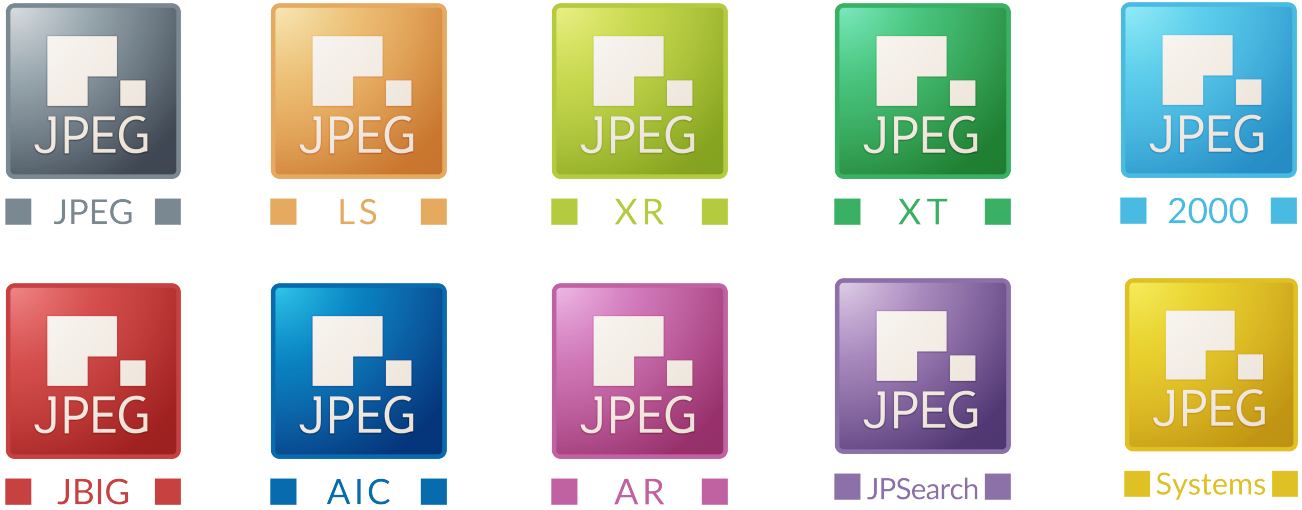
David Blinder, Tim Bruylants, Jamie Delgago, Touradj Ebrahimi, Philippe Hanhart, Takaaki Ishikawa, Martin Rerabek, Thomas Richter, Peter Schelkens, Frederik Temmermans

Questions?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