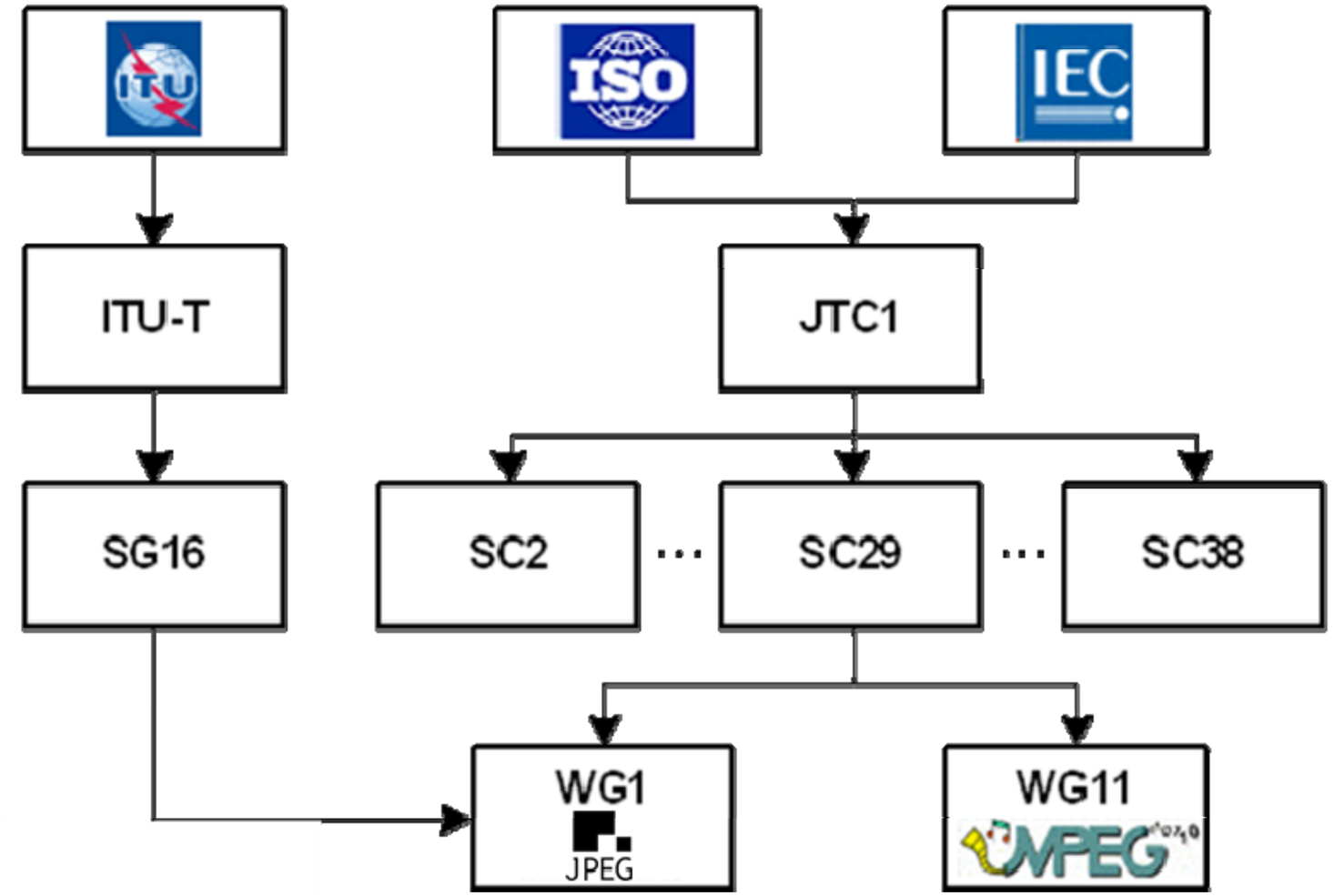
JPEG Pleno

Activities and Status Report

Walt Husak
Dolby Labs

What is JPEG?



- Joint Photographic Experts Group
  - ISO/IEC
  - ITU-T
- Informally known as JPEG
  - WG1 in official communications

Current JPEG Image Standards

JPEG-1

JPEG 2000

JPEG XR

JPEG XT

HDR

HDR Layer

SDR Layer

HDR Display

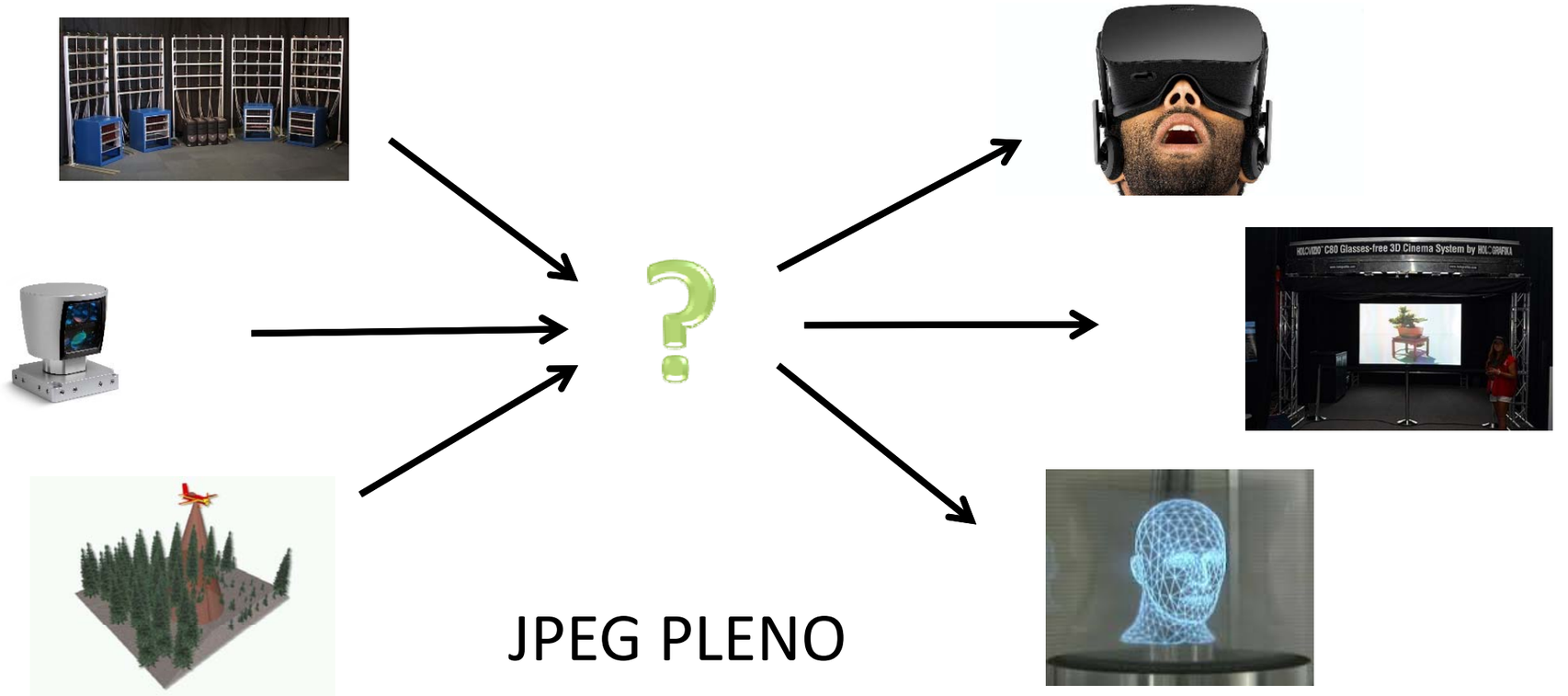
SDR Display

Functionally backward compatible with JPEG-1

Current Work

JPEG XS

Current Work



Future Work

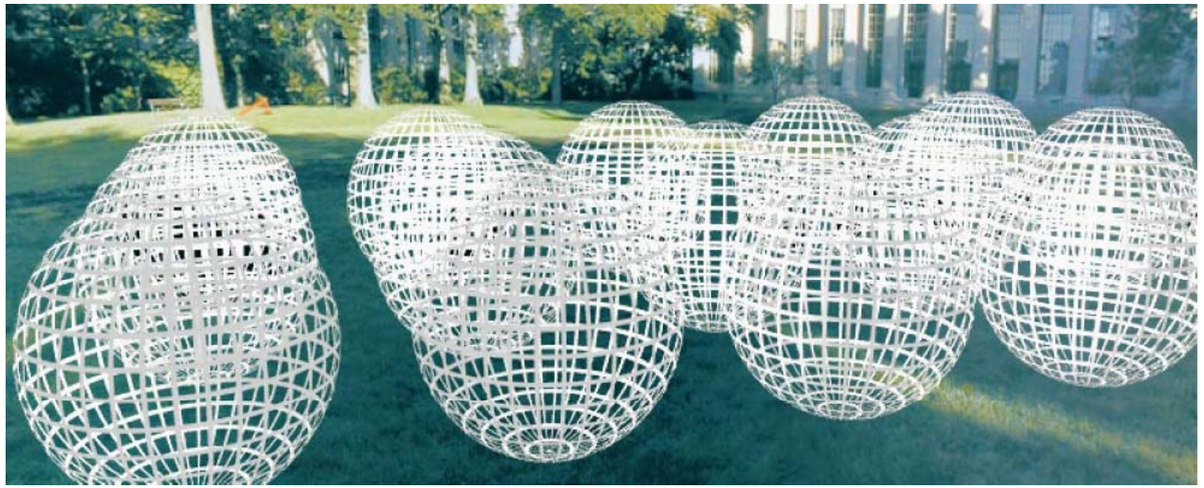
- HT-J2K
  - High Throughput JPEG2000
  - Simplifies the codec for faster encode and decode
- Next Generation Image Coding
  - Exploration of high efficiency planar image coding
  - Early stages of the project
- JPEG 360
  - Navigable representation of an object or environment
  - Developing use cases and requirements

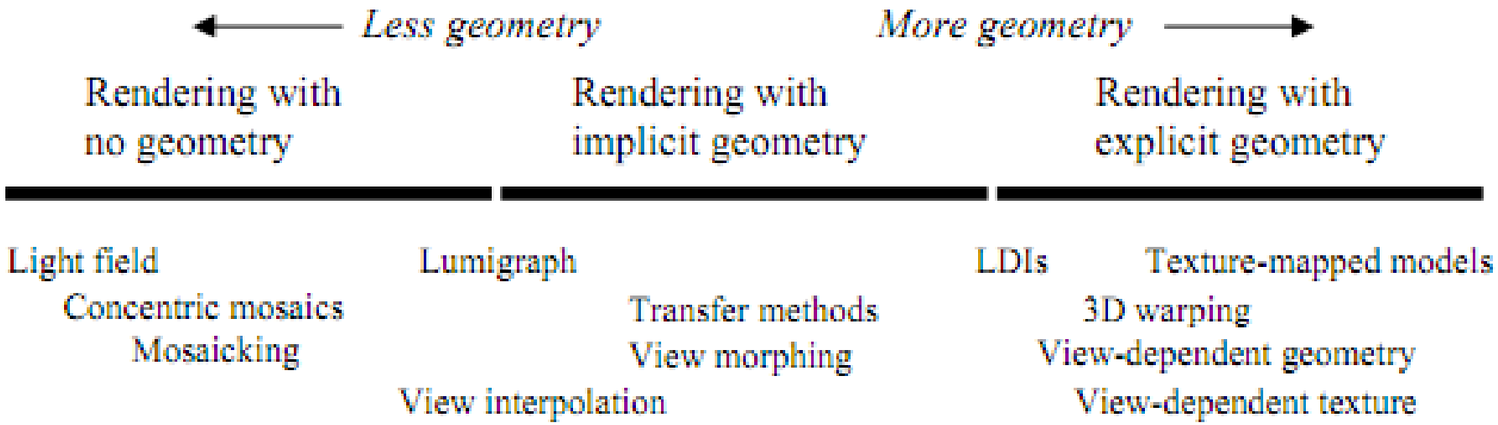
JPEG and Hollywood

- 2004 – DCI selects JPEG2000 as the D-Cinema Image Codec
- 2005 – ISO/IEC 15444-1 AMD1 published
- 2008 – Studios requests Broadcast Profiles
- 2010 – ISO/IEC 15444-1 AMD3 published
- 2012 – SMPTE requests IMF Profiles
- 2014 – ISO/IEC 15444-1 AMD7 published
- 2015 – Newest revision published with comprehensive support for Hollywood-centric applications

Plenoptic representation

- 7D function $P_f(x,y,z,\theta,\phi,\lambda,t)$
  - spatial position (x, y, z)
  - viewing direction (θ,ϕ)
  - wavelength (λ)
  - time (t)

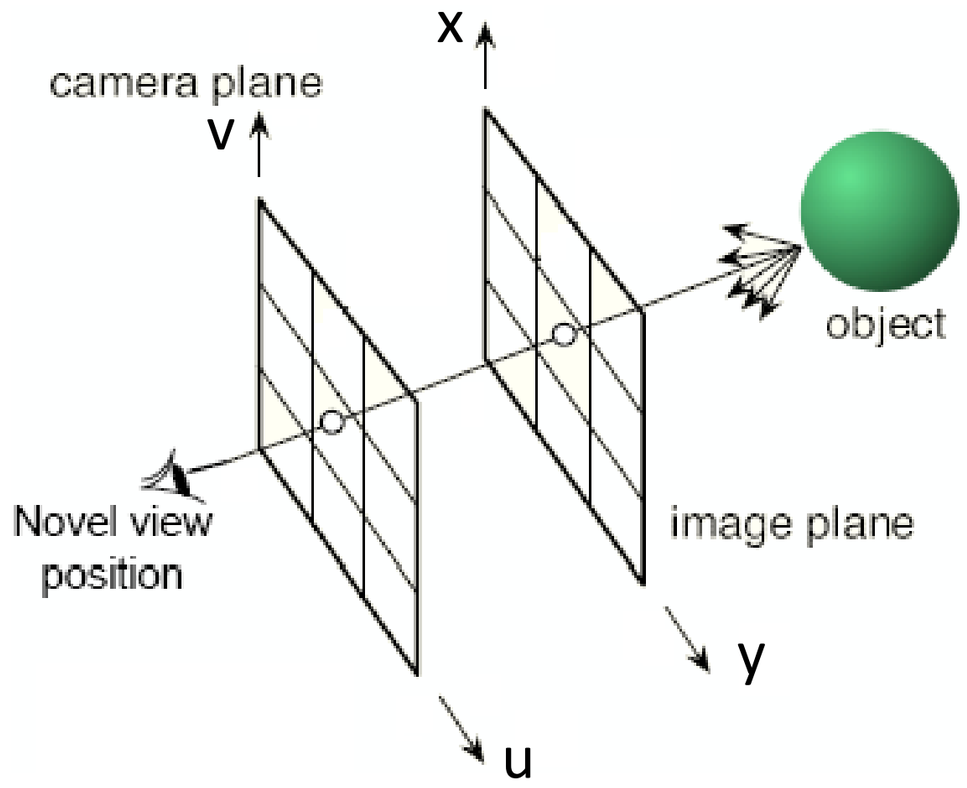




Simplification of plenoptic function

4D light field

- λ represented by R, G, and B components
- Static scene (no t)
- Assume intensity constant along a ray of light



JPEG Pleno timeline

Date	Stage
06/16	First version of the Call for Proposals
10/16	Second version of the Call for Proposals on Light Field Coding Technologies
01/17	Final version of the Call for Proposals on Light Field Coding Technologies
04/17	Anchor Evaluation Results
05/17	Submission deadline for responses to CfP
07/17	Responses evaluation results available

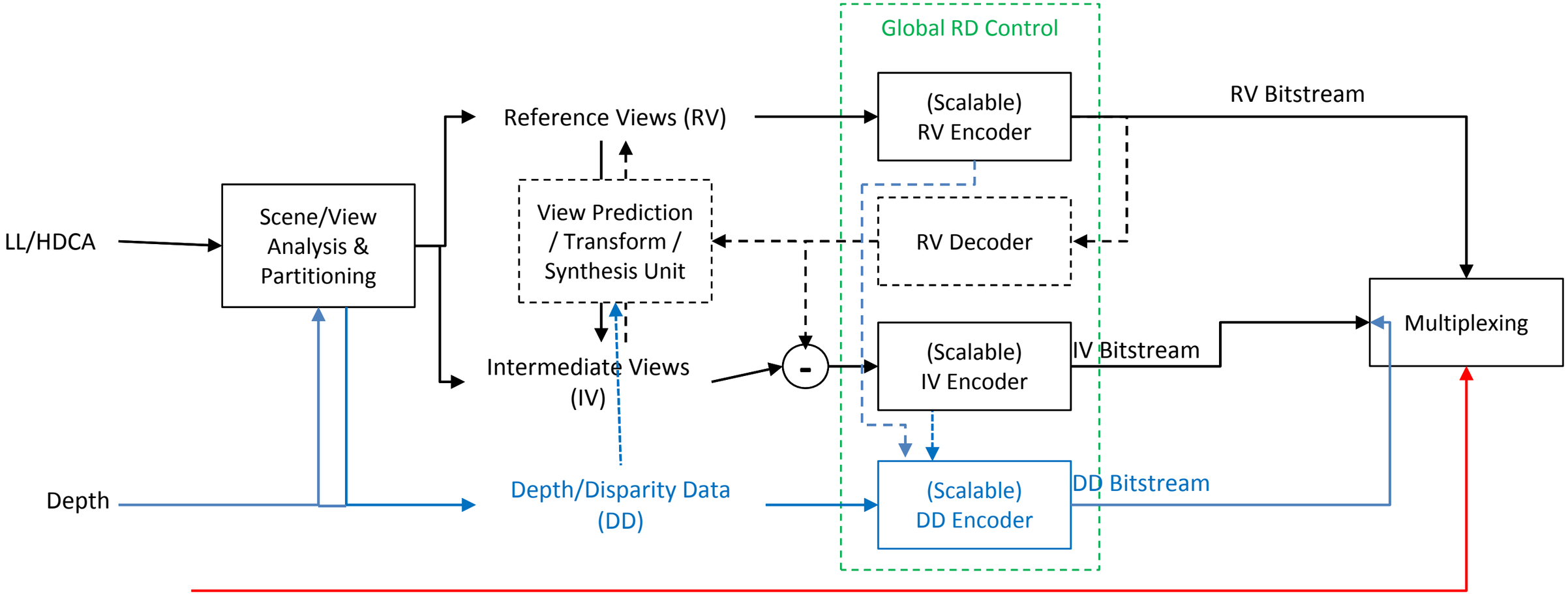
JPEG Pleno timeline

Date	Stage
06/16	First version of the Call for Proposals
10/16	Second version of the Call for Proposals on Light Field Coding Technologies
01/17	Final version of the Call for Proposals on Light Field Coding Technologies
04/17	Anchor Evaluation Results
05/17	Submission deadline for responses to CfP
07/17	Responses evaluation results available
10/17	Working draft 1 (WD) and core experiments
01/18	Working draft 2 (WD) and core experiments
04/18	Committee Draft (CD) and validations
10/18	DIS
01/19	IS

JPEG Pleno Light Fields AHG

Subgroup	Coding and Analysis
Status	Public
Name	**Ad Hoc Group on JPEG Pleno - Light Field**
Chair	Peter Schelkens (Peter.Schelkens@vub.ac.be)
Co-chair	Zahir Alpaslan (zahir@ostendo.com)
Mandates/ Objectives	• Run core experiments as defined during 76th JPEG meeting • Cross check results of the above core experiments • Design software interface for software modules for next set of core experiments
Deliverables	• JPEG Pleno Core Experiment Report
Meetings	• Regular teleconference meeting(s) will be held when appropriate and after consultation of the JPEG Pleno AHG members and eventual additional test labs. • AHG Meeting on 2017-10-21, 22 in Macau, CN
How to join	E-mail reflector: jpeg-pleno@listserv.uni-stuttgart.de In order to subscribe to the mailing list, please follow the link: https://listserv.uni-stuttgart.de/mailman/listinfo/jpeg-pleno and follow the steps of the e-mail being received.

Generic JPEG PLENO LF architecture



Core Experiments

- Descriptions in output document:
  - wg1n76032 “C&A Core Experiments for JPEG Pleno”

- CE1 Scene/View Analysis & Partitioning
- CE2 View Prediction, Transform & Synthesis
- CE3 Depth/Disparity Representation & Coding
- CE4 Texture Coding (RV + IV) → Postponed until next meeting

Core Experiments

Deadlines

- Conference call on details of core experiments: August 7, 2017
- Finalized experiment details broadcast: August 14, 2017
- TUT provides software: August 14, 2017, all participants will receive email with software
- Final Software: September 20, 2017
- Tool for Angular Consistency: September 30, 2017
- Participants email their results: October 06, 2017
- Final Report: October 20, 2017

Core Experiment #1

CE1 Scene/View Analysis & Partitioning

- Goal: Assess the impact of the reference view selection on the overall performance (eventual goal). TUT software will be modified to accept rectified sub aperture images as input reference images.
- Test Data: Scene and camera metadata, lenslet input images (same set as the CfP at minimum)
- Evaluation Criteria:
  - Sampling of the reference views chosen
  - Rate distortion, PSNR and SSIM, on lenslet rectified sub aperture views produced by the matlab script, bitrates should cover existing range at minimum
- Output: Report the reference view locations, PSNR, SSIM, encoded files

Core Experiment #2

CE2 View Prediction, Transform & Synthesis

- Goal: Identify technology to efficiently represent the reference views and intermediate views utilizing prediction, transform and/or view synthesis approaches. (Note: some approaches might implicitly involve depth information as well)

- Test Data: Reference views, depth data, lenslet, HDCA (33x11 sampling), Reference views are predetermined:
  - Checkerboard: Black squares references starting from top left;
  - 4 corner views + center as references

- Evaluation Criteria
  - Computational efficiency
  - PSNR and SSIM of the intermediate views
  - angular consistency (see: http://www.sciencedirect.com/science/article/pii/S0923596516300674)

- Output: Report all evaluation criteria measurements and provide intermediate views generated.

Core Experiment #3

CE3 Depth/Disparity Representation & Coding

- Goal: Evaluate different strategies for depth/disparity information representation and coding.
- Test Data: Rectified LL sub aperture images /HDCA (33x11).
- Evaluation criteria
  - Average end point error (method/tool to be finalized by August 14, 2017)
  - Size of the coded bitstream
- Output: Encoded and original depth data for all the views, and report the results of evaluation criteria, suggested depth estimation tool

Core Experiment #4

CE4 Texture Coding (RV + IV) → This experiment will be postponed until next meeting.

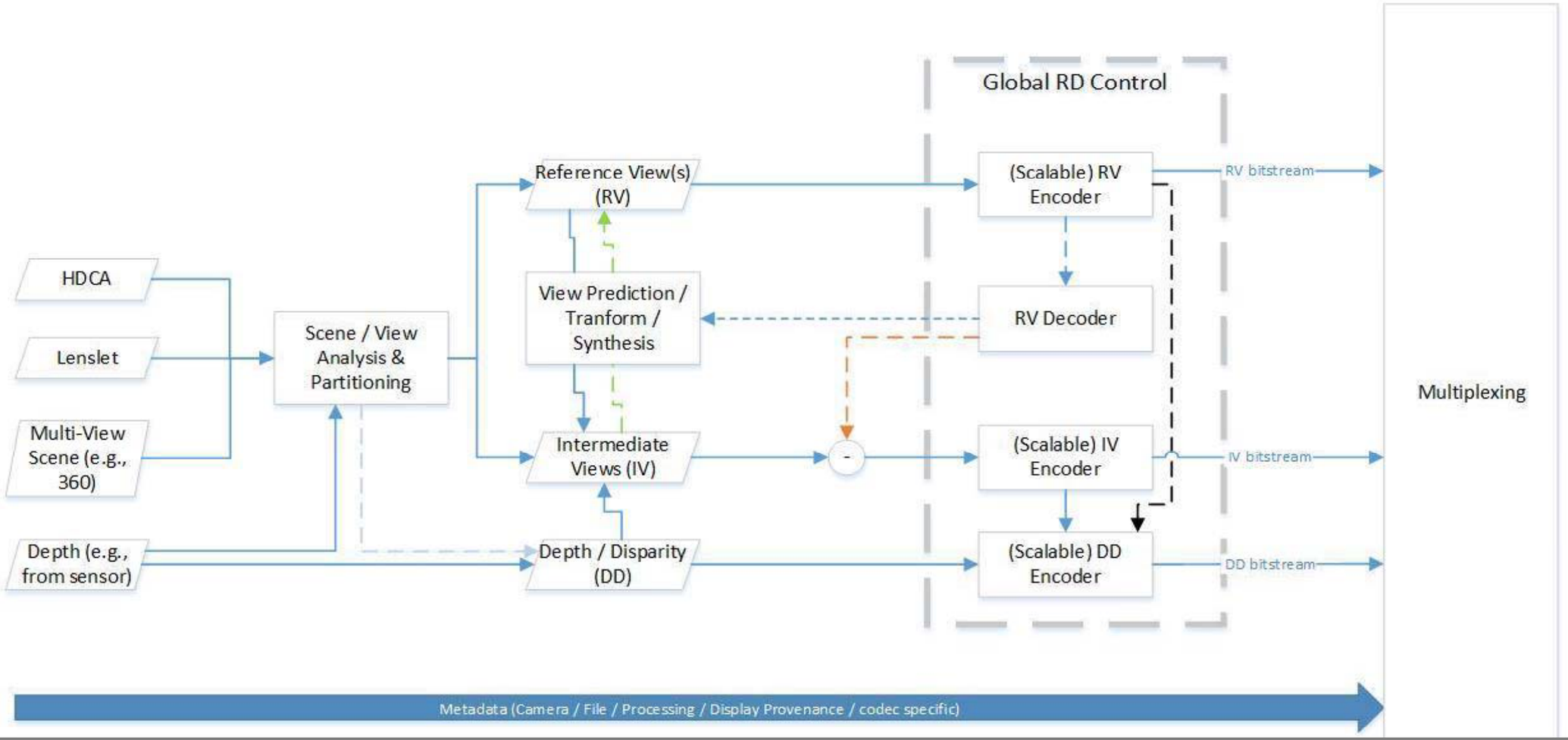
- Goal: Evaluate various proposed coding strategies for texture data in terms rate distortion performance and impact on functionality requirements. This set of experiments will focus only on RV. IV will be performed after the next meeting.

- Test data: Input data LL/HDCA (33x11), RV, IV, Decoded RV, Residual IV. Reference views shou predetermined. A- Checkerboard : black squares references starting from top left; B- 4 corner views + center are references.

- Evaluation criteria
  - Functionality Criteria as identified in CfP
  - Rate distortion performance
  - PSNR, SSIM, angular consistency

- Output: Encoded texture data, and report the results of evaluation criteria, list of the functionalty enabled by the encoding method

Updated Architecture Drawing



JPEG PLENO Software AHG

Subgroup	Coding and Analysis
Status	Moderated
Name	**Ad Hoc Group on JPEG Pleno Software**
Chair	Andy Kuzma (andy.kuzma@intel.com)
Co-chair	Peter Schelkens (Peter.Schelkens@vub.ac.be)
Mandates/ Objectives	• Work with contributors to develop a modular framework for the Generic JPEG Pleno Light Field Architecture that isolates the top-level architecture functional blocks in order to support core experiments.
Deliverables	• Updated testbench from TUT. • Core experiments successfully run on framework.
Meetings	• Conference meetings (will be announced following the procedure described in WG1 AHGs rules)
How to join	E-mail reflector: jpeg-pleno@listserv.uni-stuttgart.de In order to subscribe to the mailing list, please follow the link: https://listserv.uni-stuttgart.de/mailman/listinfo/jpeg-pleno and follow the steps of the e-mail being received.

Software framework

- Potential input file formats
  - RGB and 16-bit PPM until next meeting
    - Open EXR will be a replacement starting in next meeting
  - Depth in 16-bit floating point Open EXR (max supported by Open EXR)
- Encoded files will be in binary format (CfP format)
- Output of each block goes into a box container
  - Spec: 19566-1, JPEG SYSTEMS. WG1-N70007 , Brussels, 70th JPEG meeting.
  - SVAP, VPSU, RVEN, IVEN, DDEN, META
- Programming Language: C++

Next Steps

- Next meeting is 77th JPEG meeting October 23rd – 27th in Macau, CN
- Complete Core Experiments 1-3
  - Begin CE4
- Report on CEs and software development at the 77th meeting
- Report on other PLENO AHGs:
  - AHG on JPEG PLENO – Holography
    - Test is important
  - AHG on JPEG PLENO – Point Clouds
    - Test is important
- Solicit input on interchange and testing

Conclusions

- JPEG PLENO is proceeding with a test model and software framework for light fields
- JPEG is soliciting input for effective criteria for subjective test methods
  - Viewing subjects from the community are always welcome
- JPEG is prepared to hold Ad Hoc Group and JPEG parent meetings in convenient locations to the user community

Participation in JPEG PLENO

- Joining JPEG
  - US National Body (USNB)
  - Email to wjh@dolby.com

- Participate through liaisons

- Face-to-Face AHG meetings

JPEG Pleno

Reinventing the world of imaging

Walt Husak Dolby Labs wjh@dolby.com