EBU **TECHNICAL**

Summary of conclusions

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Options for production and display

The 3DTV toolbox – the results of the 3D TV NoE (Levent Onural, Uni. Bilkent)

- Overview on research on 3DTV, on history, principals and requirements on a 3DTV end-to-end chain
- Stereoscopy, auto-stereoscopy, multi-view auto-stereoscopy, integral imaging, holography (or kind of is the future)
- Long term: overall requirement is to create a physical duplicate of 3D light
  - Issues and comparative analysis of the different approaches
  - Motion sickness as a main reason for the failure of market penetration (to date)
- Decouple the capture technology and format from the display/presentation device
- Capture technologies variants and display/presentation variants
- Coding variants and standards activities (stereo, multiview, video&depth, 3D mesh) – remember 3D images are highly redundant
- Delivery aspects: analogue broadcast, digital broadcasts (sport events....)
- Overview on the various bodies in the 3D world and the EC founded projects
- Short term: end-to-end – commercialisation with usually stereoscopic technology
- Medium term: auto-stereoscopic (Multiview)
- Long term: realistic or ultra realistic (holographic type)

Options for production and display

Production aspects of plana-stereoscopic 3D TV (Colin Smith, ITV)

- Technical and Commercial issues for 3DTV
- Broadcasters are charged with the transition to HDTV – Is this in conflict with 3D? No, 3D it is an evolution and 3D will start with glasses (accepted or not?)
- 1st generation of 3DTV: extension with HDTV, glasses, HQ 3D AND 2D experience
- Even if you are not interested in 3DTV, the standards work will affected you
- Many different commercial interests – by the way: what is the business model?
- We still have not enough HDTV (and 1080p50 is on the horizon). 3DTV content gap.
- Suggest a button for the user to decide on 3DTV or 2dHDTV (Hybrid channels?)
- Critical: 2D backwards compatibility
- Evolution to glass free diplays
- Factors for affecting production: Live or non-live, test material needed, final assets, for FTA it is vital to have 2D backwards compatibility (less for PayTV)
- 3DTV production grammar is specific for each genre and requires special skills (different from 2D)
- Consumer domain issues – with the activities of the DVD forum, the BluRay developments

Options for production and display

3D TV situation for CE manufactures (Brian Markwalker CEA)

- US Market research on “3D Gaining Momentum”
- 17+ Feature films, Games, 3D@CES2009 (consumer tech)
- US: 2Mio 3D ready TVs, but few are used in 3D mode
  (various display vendors incl. nVidia 3Kit)
- HDMI announced next version to handle 3D
- BluRay suggested working on 3D
- 3D@home consortium
- CEA market research: high interest in action/adventure, nature wildlife, sport,.....
  “if one had a recent 3D experience, more inclined to 3DTV, when it is done well”
- Broad range of CEA standards activities brainstorming resulted in 3D Task Force.
  - focus on interoperability in the consumer domain
  - focus on CEA 861 to support the carriage of 3D (question on formats)
  - Investigate the need of standars for 3D glasses including interfaces,signalling, setup, etc.
  - Investigate the need to document terminology that conveys interoperabiliyt to the consumer
  - Authors comment: what is 3D Ready?
- Future work: Task Force is working on various topics
- CEA 3D Technzone for CES 2010
- Standards are desperately needed

Options for production and display

Human visual perception relevant to 3D TV (Wa James Tam, CRC)

- Shown the deficiencies of 3DTV
- Disparities (Uncrossed disparities, Crossed Disparities)
- Stereo deficiency: who can benefit from 3D?
- Number of experiments have been conducted:
  - Inter-ocular averaging: asymmetrical coding
  - Subjective image quality evaluations (Left/Right, blocking, scene cut)
  - OMotion visual impact and motion in depth
  - Conversion techniques (2D to 3D)
  - Well: yes
- Do we have the right standards in place for subjective tests, and test material, and reference displays and viewing conditions?
  ITU R has working tasks.....

What is the role of standards bodies?

- **It’s all about the right timing.....when you make standards**
  - It all about the right standards
  - It all about the IPRs behind the standards ;-)
  - It is all about the standards in not being to late

What is the role of standards bodies?

3D Activities in the DVB project (David Daniels, BSkyB)

- DVB has started a project on 3D
- Driven by commercial requirements first, so please communicate them
- Example technical work: Signalling, Metadata, Video codecs, subtiteling, CC, compatible 3D content
- BSKYB – The Vision
  - ➢ want a simple, cost effective way to deliver stereo to the home, need screens in the home
  - ➢ shot test content and will make further content
  - ➢ Discribed the issues with particular production gramars
  - ➢ Objective is to deliver 3D to the home that makes viewers NOT sick
  - ➢ Simple solutions (e.g. not sure about left/right with a really good production) that do not confusions to the customer (same glasses like in the cinema, see a passive glass solution as first generation with polarised displays)

What is the role of standards bodies?

Report on the SMPTE Task Force on 3D TV (W. Zou, SMPTE)

- Has finalised and published its report with 3D terminology
- what is a 3d home master for various distribution channels
- end to end system diagram
- The home master: uncompressed/unencrypted image format or file derived from the 3S source master; Specific requirements for the home master (2d backward compatible, metadata, evaluation criteria and so forth)
- 90 uses cases defined in various applications in the value chain
- Issues and challenges: evolving displays technologies, production techniques and psychophysical characteristics.
- Recommendations to SMPTE for further work
- Establish liaison with other organisations
- Whenever you udate exsiting standards have 3D in mind
- SMPTE will form a technology group for real standards work in due process (the 3D home master, packaging for delivery)

What is the role of standards bodies?

- **ITU-R activities in 3D TV (Paul Gardiner-Sony, V. Baroncini, FUB)**
  - Reviewing and gather information on what is going on in the world on 3DTV
  - Current ITU-R question 128/6 (2008)
  - What are the requirements, image viewing, systems currently exist or are under development, and what image capture and recoding would be suitable?
  - Working document in development “Requirements for 3DTV broadcasting systems and steps to a recommendation for a fist generation systems”
  - Identify topics for the development recommendations of 1st generation systems.

Private conclusions

- 1st Generation for early adopters and to commercialise: Glass based, too many options on the market. CE will drive to sell (content gap?). Risk of consumer irritation. 2nd Generation autostereoscopic; 3rd Generation: True 3D
- Need to structure standards work on what is needed in content creation, distribution and the consumer domain and set this to the right time frame
- Very little talk about business perspectives/ opportunities?
- How to test 3DTV subjectively/objectively - test material – what makes us sick and what not (guidelines)?
- What immediate standards are needed?
- There are many activities –> usually consolidation time is coming soon; who is linking the different forums?

Questions and comments

- It is important to consider backward compatibility for 3DTV standards developments.
- What are the issues within the gaming community (are they the drivers) ?
- What is happening in BluRay forum (where is the 3D image processing happening?)?
- What are the required bit-rates in distributions?

What tools are available for picture coding?

- **MPEG developments in multi-view video coding and 3D video (Jens Rainer Ohm, RWTH)**
  - MVC standards developments and final standards
  - Multiview high part of AVC (no interlaced)
  - Stereo-High: final spec expected 07-10/2009 (with interlaced)
  - Exploration activity in MPEG to allow large number of views from a sparse view set
  - MPEG-C part 3 2D plus depth information
  - Quality deteriorates with depth encoding
  - Need for better compression algorithms agnostic to capture, render and display
  - Subjective evaluation is necessary
  - Liaison activities required between different bodies

What tools are available for picture coding?

- **3D4You (Ralf Tanger, HHI)**
  - Overview in displays and upcoming movie releases was given.
  - What 3D format is needed to drive all the different displays?
    - Video and depth
    - Layered depth video (LDV) – Philips format as a candidate of the 3D4You project
    - Depth enhances stereo
    - multiple video plus depth
  - Capture of generic 3D format with 2 regular HD cameras plus two satellite cameras.
  - Stressed that a distribution format must be display agonistic
  - Full chain has to be considered
  - Computer vision solutions can be used for format conversions

What tools are available for picture coding?

- **Sensio system and its application for broadcsting (Richard LaBerge – Sensio)**
  - NO FEEDBACK RECEIVED ON SUMMARY (UPDATE IN DUE TIME)

What tools are available for picture coding?

- **Issues in broadcasting delivery of 3D (Walt Husak, Dolby)**
  - 3D cinema productions are 2-4x 2D costs, quickly covered in theaters
  - Television: additional costs are not so easily covered.
  - Initially 3DTV is event driven
  - Should use current delivery structure, STB and so forth
  - Worksflows to be preserved
  - Do we need 3d to 2d compatibility
  - Pros and cons and common characteristics of each method discussed
  - 2D compatible require increase of bandwidth 60-80%
  - Frame compatibe systems can be used know, resolution be added later. Consumer needs new displays.
  - 2D compatible systems require bit-rate!!
  - The problem is not technology but economics
  - Many questions..... (want full res and new equipment, or affordable and new equipment later)

What are the emerging future technologies?

3DTV based on integral method (F. Okano, NHK)

- 3nd Generation technology
- Technology without glasses, “allows long hours watching in wide angle directions”
- works with a lens array at pick-up device and display device
- number of factors impact the achievable resolution of the image
- requires extremely high resolution image (UHDTV)
- not yet commercially available, but prototype with low res has been demonstrated
- 2 books ;-)
- very high bit rate in the base-band 10TB?

What are the emerging future technologies?

3DTV based on holoscopic imaging (Amar Aggoun, Brunel Uni)

- 3nd Generation technology
- Technology without glasses watching in free angles and follows the principle of the “fly eye”.
- Works with micro-lens arrays at pick-up device and display device (i.e. on a LCD)
- Similar like the integral method
- Not yet commercially available
- UK - Prometheus project
- 3D Holoscopic image compression can benefit from huge redundancy in the source signal
- Display technologies are on the horizon with high resolution.

What conclusions and actions can we derive from the day – comments or even more questions.....

1. Define a glossary of terms (see SMPTE report pay 20$)
2. Define the different technology generations (Action: David)
3. Define common ground for 3D frame based formats and 3D-2D backwards compatible formats
4. Classic business – technology arguments; consequences of using sub-optimal technology (quality wise)? What is the impact of having a large established legacy situation based on Gen1. – will it bock future systems?
5. Will there be a world 3D only? – unlikely on the short medium term!
6. Can we define best practises for 3D productions (incl. cost issues and backwards compatibility to 2D)?
7. Define time scales for what do we want to achieve at what time (Action ?)
8. Define a landscape on which standards body is doing what
9. Some rules and requirements to avoid poisoning the water technologies
10. On the long term – how can 3DTV be broadcasted (Action: Report by ITU-R 6C)
11. What constitutes a “3D ready display”
12. Liaison request to the BluRay forum on their time frame (Action ITU-R)
13. Urgent standardisation of 3D testing and test content (any documents available)

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