



2020 3D Media Spatial Sound and Vision

D7.2 Emerging Standards for 3D Media

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1. Public Executive Summary

3D video is currently an active issue in many standardisation bodies. Most bodies mean stereoscopic 3D when talking about 3D video, but first organisations now also take more advanced representation formats including depth and occlusion maps into account.

SMPTE standardized a DCP (Digital Cinema Package) for 3D in 2008 specifying a single file format with dual tracks. The Task Force on 3D to the Home is currently working on the requirements for a 3D Home Master. The format will support glasses-based as well as non-glasses-based displays. The requirements as well as the future standard will influence the complete distribution chain for TV.

MPEG is working on a 3D Video (3DV) format. The standard will support an adaption of the content to different display types and sizes. Auto-stereoscopic displays as well as current stereoscopic displays will be supported in an efficient way.

The Media Annotation WG of the W3C is working on an ontology for media on the Web as well as an API for accessing this metadata. Since 3D cinema and video production will have to integrate metadata from many different sources the challenges are very similar.

The 3D@Home consortium works on speeding up the migration of 3D video to the living-room. By defining requirements and agreeing on technologies to be supported the group will influence future standardisation activities.

Many other bodies also have moved a first step towards 3D, including DVD & BDA as well as HDMI & DisplayPort and the EBU.

Partners of 2020 3D Media are already active in SMPTE, MPEG, W3C and 3D@Home. Those contributions will be continued and standardisation activities will be monitored. Depending on results of the technical work packages the contributions will be adapted.

2. Introduction

With the success of 3D-Cinema many standardisation bodies have started to add support for 3D. This report summarizes the current activities in 3D video standardisation. Section 3 provides an overview of activities carried out in SMPTE in DCI as well as in the Task Force 3D to the Home. Work currently done in MPEG is summarized in section 4. Section 5 provides an overview of related work in W3C. Current activities 3D@Home follow in section 6. Section 7 gives an overview of bodies where no partner of the consortium is active. Section 8 lists planned activities of 2020 3D Media partners.

3. SMPTE

3.1. DCI

The SMPTE standardization effort for Digital Cinema has started several years ago with the DC28 Committee who followed the DCI Group recommendation work from initial start to the final DCI 1.2 recommendation.

3-D support (noted this way to mean stereoscopic) was already included in the very first draft of DCI work based on the DLP Cinema capability to display left and right images in high speed sequential time mode using a single projector. Such a possibility allow the digital cinema playback server and the DLP Cinema projector to be a single configuration for both regular (2D) content and stereoscopic 3-D contents. Only the 3-D glasses setup need to be added according the various technologies now available (RealD, Xpand, Dolby, Masterimage).

The initial implementation of 3-D in the DCP (Digital Cinema Package) was mostly equivalent to a 48 frames per second content packaged as an MXF file in a format agreed by a group of the industry called the MXF Interop Group (Avica, Dolby, Doremi, Kodak, GDC, EVS..). This initial file format for 3-D was used by the first stereoscopic features produced by Hollywood in 2005, 2006, 2007 (Chicken Little 3-D, Monster House 3-D...)

In 2008, through the standardization work of SMPTE DC28, a specific DCP file format for 3-D was elaborated following the ballot of two proposals : one as a single file format with dual tracks developed by Doremi and the second as a dual file format developed by Dolby.

The single file format supported by Doremi was finally the winner of the ballot and a new file packaging format was elaborated by SMPTE and become available during summer 2008.

3.2. Task Force on 3D to the Home

In August 2008 the Society of Motion Picture and Television Engineers (SMPTE) has established a *Task Force on 3D to the Home*. The task force is aimed to produce a report within six months which defines the issues and challenges relevant for bringing 3D into the living room, what minimal standards are needed and what evaluation criteria are relevant.

The work of an SMPTE task force is always based on a strict and fixed work statement. In this case the work was restricted to the stereoscopic 3D approach which is used in the cinema. That means that only formats which provide dedicated information for the left eye and for the right eye are under consideration. Nevertheless glasses-based as well as non-glasses-based 3D displays should be supported. At the end requirements for a *3D Home Master* (the name was chosen in analogy to the Digital Cinema Distribution Master) will be specified.

A substantial amount of use-cases was collected which cover all relevant technical issues but also very special needs for individual distribution channels. Depending on whether a particular use-case leads to special requirements in the 3D case and also depending on it's given priority it was defined as relevant for the groups work or not. The technical requirements for all relevant use-cases were defined in a next step. In particular the provision of depth maps as well as occlusion information and transparency maps is optionally possible. This ensures the support of auto stereoscopic (non glasses based) displays.

At the time when this deliverable is written the final report of the task force is not published yet. Because the technical details are still confidential they cannot be provided here.

The approach of 2020 3D Media in using depth maps as a key component for 3D, in particular work carried out in WP3, 4 and 5, goes far beyond the already established stereoscopic 3D approach used in 3D-Cinema today. To enable a depth-based workflow new standards will be needed beginning from the camera interface and ending at the display. The SMPTE task force is a very first step towards the support of depth information.

The work of the task force will be continued in a regular work group working title "Working Group on 3D Home Master" which will generate specifications for a 3D Home Master until end of 2010.

4. MPEG

MPEG has developed a suite of international standards to support 3D services and devices, and now initiates a new phase of standardization to be completed within the next two years.

- One objective is to enable stereo devices to cope with varying display types and sizes, and different viewing preferences. This includes the ability to vary the baseline distance for stereo video to adjust the depth perception, which could help to avoid fatigue and other viewing discomforts.
- MPEG also envisions that high-quality auto-stereoscopic displays will enter the consumer market in the next few years. Since it is difficult to directly provide all the necessary views due to production and transmission constraints, a new format is needed to enable the generation of many high-quality views from a limited amount of input data, e.g. stereo and depth.

The vision is a new 3D Video (3DV) format that goes beyond the capabilities of existing standards to enable both advanced stereoscopic display processing and improved support for auto-stereoscopic N-view displays, while enabling interoperable 3D services. This is illustrated in Fig. 1 and further details are described below.

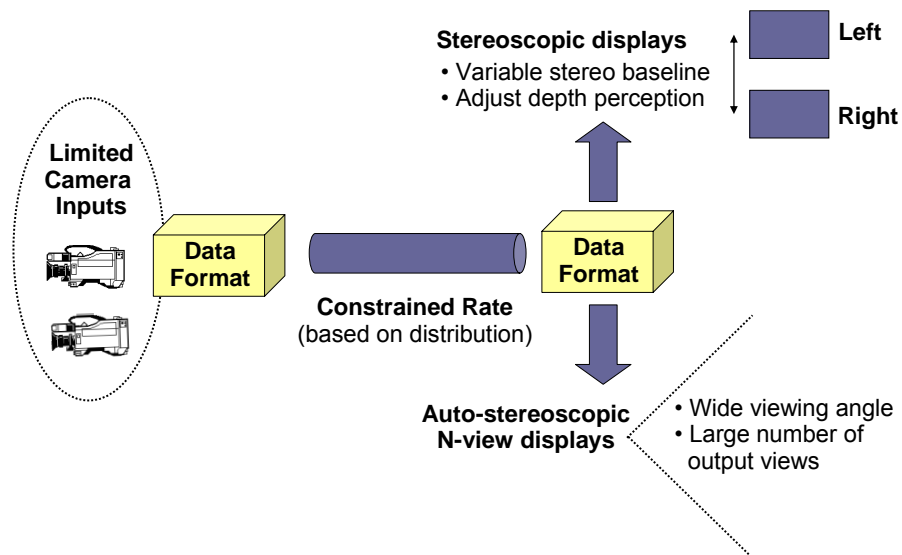


Fig. 1 Target of 3D Video format illustrating limited camera inputs and constrained rate transmission according to a distribution environment. The 3DV data format aims to be capable of rendering a large number of output views for auto-stereoscopic N-view displays and support advanced stereoscopic processing.

Due to limitations in the production environment, the 3DV data format is assumed to be based on limited camera inputs; stereo content is most likely, but more views might also be available. In order to support a wide range of auto-stereoscopic displays, it should be possible for a large number of views to be generated from this data format. Additionally, the rate required for transmitting the 3DV format should be fixed to the distribution constraints, i.e., there should not be an increase in the rate simply because the display requires a higher number of views to cover a larger viewing angle. In this way, the transmission rate and the number of output views are decoupled. Advanced stereoscopic processing that requires view generation at the display would also be supported by this format.

Compared to the existing coding formats, the 3DV format has several advantages in terms of bit rate and 3D rendering capabilities, which is also illustrated in Fig. 2.

- 2D+Depth, as specified by ISO/IEC 23002-3 (and also referred to as MPEG-C Part 3), supports the inclusion of depth for generation of an increased number of views. While it has the advantage of being backward compatible with legacy devices and is agnostic of coding formats, it is only capable of rendering a limited depth range since it does not directly handle occlusions. The 3DV format expects to enhance the 3D rendering capabilities beyond this format.
- Multiview Video Coding (MVC), as specified by ISO/IEC 14496-10 | ITU-T Recommendation H.264, supports the direct coding of multiple views and exploits inter-camera redundancy to reduce the bit rate. Although MVC is more efficient than simulcast, the rate of MVC encoded video is proportional to the number of views. The 3DV format expects to significantly reduce the bit rate needed to generate the required views at the receiver.

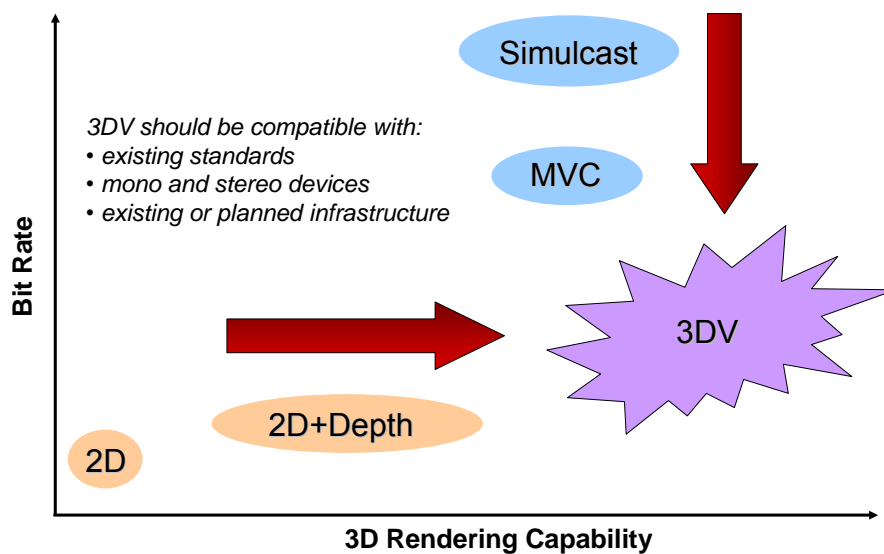


Fig. 2 Illustration of 3D rendering capability versus bit rate for different formats, where 3D Video aims to improve rendering capability of 2D+Depth format while reducing bit rate requirements relative to simulcast and MVC.

5. W3C

5.1. Introduction

The World Wide Web Consortium (W3C) has launched an activity called “Video in the Web” [W3V] with the goal of making video a “first class citizen” of the Web, i.e. provide means for accessing entire video items and spatial or temporal fragments and deploy video content together with metadata. The activity has started in August 2008 and is expected to produce final recommendations until January 2010. There are three W3C working groups related to this activity, namely Timed Text WG, Media Fragments WG and Media Annotations WG. JRS participates in the latter two.

The Media Fragments WG aims to define mechanisms for referencing spatial and/or temporal fragments of media using URI syntax. In the type of fragments considered the support for multiple visual and audio streams is explicitly considered [MFtype].

The task of the Media Annotation WG is to provide an ontology for media on the Web (with a focus on video) as well as an API for accessing this metadata. It is not intended to define another persistent format for audiovisual metadata but an ontology that can be mapped to several existing standards and formats.

5.2. Media Annotation WG ongoing activities

The Media Annotations WG has produced a first version of a requirements document for the ontology and API [MAreq], which takes the need to support various abstraction levels, granularities and degrees of formalisation into account. Using Dublin Core [DCES] and XMP [XMP] as input, a draft set of properties to be included in the ontology has been selected. Mapping to a wide range of formats and standards have been defined. JRS has contributed mappings to MPEG-7, SMPTE RP.210 and MXF DMS-1.

5.3. Relevance for 2020 3D Media

Although Web technologies are not in the scope of 2020 3D Media, there is a strong relation between the work done especially in the Media Annotation WG and tasks WP3T1 and WP3T2 concerning the definition of a metadata ontology integrating several existing standards and providing mappings to them. The challenges faced in supporting different source formats in a Web application and integrating metadata from different sources in the digital cinema production workflow are very similar.

Another overlap can be found in issues of deployment to a range of Web enabled clients and distribution of movie content to differently equipped cinemas or for broadcasting: Mechanisms for reducing metadata to a relevant subset must be in place, that keep items directly useful for the end user (e.g. some descriptive metadata) and needed for adaption in the final distribution stage.

5.4. References

[DCES] <http://dublincore.org/documents/dces/>

[MAreq] <http://www.w3.org/TR/2009/WD-media-annot-reqs-20090119/>

[MFtype] http://www.w3.org/2008/WebVideo/Fragments/wiki/Types_of_Fragment_Addresssing

[XMP] <http://www.adobe.com/devnet/xmp/pdfs/XMPSpecificationPart2.pdf>

[W3V] <http://www.w3.org/2008/WebVideo/>

6. 3D@Home

The 3D@Home Consortium is not a standardisation body itself but a group which was formed in 2008 to speed up the commercialization of 3D video into the homes. After one year the consortium consists of about 40 members covering the whole range of video and cinema production and distribution. The group is organized in four steering teams:

- ST1: Content creation & production
 - Develop guidelines for improving the quality of 3D content production
 - Define mastering methodologies for 3D content
 - Develop best practices for the workflow in 3D content creation
- ST2: Content storage, transmission & distribution
 - Prepare use cases and requirements for the specifications related to the uncompressed digital interface to 3D displays
 - Define and develop use cases for transmission of 3D content
 - Monitor and liaison with standards bodies for successful communication of efforts and ensure useful and complimentary work
- ST3: 3D promotion
- ST4: 3D displays

At the time this report is written 3D@Home finished the constitution phase and has started work for about 4 months. It can be expected that the consortium provides significant input to the standardisation bodies which are relevant for the group's goal.

The relevance for the work of 2020 3D Media is again in the support of advanced 3D representations like depth maps.

7. Other bodies already active in 3D

Many standardisation bodies around the world are currently working on standards for 3D. For those bodies where no 2020 partner is engaged this section will collect the material which is available for the general public.

ATSC – Advanced Television Systems Committee: US organization defining standards for digital television. Participated in the requirements definition of the SMPTE TF, no own 3D activities visible yet.

BDA – Blu-ray Disc Association: Several companies like Philips¹, Panasonic², Dolby³ and TDVision⁴ have announced to work on 3D standards for Blu-ray. The formats are not compatible to each other.

CEA - Consumer Electronics Association: 3D Video Discovery Group met first on October 22, 2008⁵. A 3D Task Force⁶ exists.

DVB - Digital Video Broadcasting: European organization working on the delivery of digital television. Liaison with SMPTE TF, no own 3D activities visible yet.

DVD-Forum approved Sensio 3D format as optional DVD extension in January 2009.

EBU – The European Broadcasting Union has⁷ started its 3D video related activities with a “3D TV Workshop” on April 30th 2009⁸, co-organised with the ITU and SMPTE. In the workshop experts discussed formats and technology related questions. Future workshops are planned.

EDCF – european digital cinema forum: The forum discusses key issues surrounding European Digital Cinema including 3D⁹.

HDMI - High-Definition Multimedia Interface: Support for Stereoscopic 3D is announced¹⁰ for version 1.4 being launched in the first half of 2009.

ITU – International Telecommunication Union: The ITU-R Study Group 6 is working on 3D Television issues¹¹.

VESA DisplayPort: Support for Stereoscopic 3D is announced¹² for version 1.2

¹ Philips 3D on Blu-ray <http://www.blu-ray.com/news/?id=1706>

² Panasonic 3D on Blu-ray <http://www.blu-ray.com/news/?id=2104>

³ Dolby 3D on Blu-ray <http://www.blu-ray.com/news/?id=2233>

⁴ TDVision 3D on Blu-ray <http://www.blu-ray.com/news/?id=1779>

⁵ CEA 3D Video Discovery Group

http://www.ce.org/Press/CurrentNews/press_release_detail.asp?id=11550

⁶ CEA 3D Task Force <http://www.ce.org/Standards/CommitteeDetails.aspx?Id=000011069866>

⁷ EBU 3D TV statement <http://tech.ebu.ch/3dtv>

⁸ EBU 3D TV workshop <http://tech.ebu.ch/events/3dtv09>

⁹ EDCF <http://www.edcf.net/3d.html>

¹⁰ HDMI http://www.hdmi.org/press/press_release.aspx?prid=93

¹¹ ITU-R <http://www.itu.int/ITU-R/information/docs/rsg6-news-01.doc>

¹² DisplayPort http://www.reghardware.co.uk/2009/01/13/displayport_1dot2_basics

8. Future 2020 3D Media activities

Several partners of the 2020 3D Media consortium are already active in standardisation bodies and plan 2020 related contributions. The following table lists these activities.

Body	Partner	Planned contribution
W3C MAWG	JRS	<p>Contribution to the formal modelling of the ontology, using experiences from the WP3T1 prototype implementation and getting feedback and input from other experts in the working group.</p> <p>Contribution to the reference implementation of the API, supporting the SMPTE metadata formats and MPEG-7 in the back end.</p> <p>With the specifications to be developed in D3.3 and D3.5 further contributions will be defined.</p>
MPEG	Fraunhofer	<p>D3.6 and D3.10 will provide a basis for video coding related inputs from 2020 3D Media. Co-chairing the MPEG AdHoc group on 3D Video Coding to develop a compact standard for supporting multi-view displays and stereo displays with varying baseline according to the vision and requirements.</p> <p>Support of the activities by evaluation experiments and provision of tests during the MPEG meetings.</p>
SMPTE	Fraunhofer	Participation in the “Working Group on 3D Home Master” contributing input on the usage of depth maps.
3D@Home	Thomson	Co-chairing steering team 2 “Content Storage, Transmission & Distribution”
	Fraunhofer	Contributions to steering team 1 “Content Creation & Production” and steering team 2 in the field of depth map creation from multiview and usage of depth maps.

9. Conclusions

Many standardisation bodies and companies are currently active in defining standards for 3D. This in particular holds for the distribution chain starting with a distribution master, including coding and going all the way down to the displays interfaces. For some parts companies managed to get their proprietary solution into an existing standard. Most bodies nevertheless prefer the adoption of open standards.

The whole development is very much influenced from the dominant stereoscopic 3D approach known from cinema. Nevertheless first bodies have recognized that standards which support all display technologies, including non-glasses-based approaches, are needed. Assuming that standards including depth information will be preferred in the future the complete upstream starting from multi-camera-rigs perhaps including active depth acquisition techniques as developed in WP4 are still not in the scope of current standardisation efforts.