DVB
COMMERCIAL REQUIREMENTS
FOR DVB 3D-TV

July 2010

1 Contents

2 Revision History

3 Summary

This document defines DVB 3D-TV commercial requirements for DVB members from the key industry groups. The requirements are specifically directed to the ability to provide a 3D-TV service utilising existing HDTV infrastructure.

There are in total 20 commercial requirements set out in this document covering the areas for digital TV reception that the industry members believe are needed to provide a user friendly, HDTV Frame Compatible TV service.

4 Introduction

Plano-stereoscopic imaging systems deliver two images (L, R) that are arranged to be seen simultaneously, or near simultaneously, by the left and right eyes. Special glasses are usually needed by the viewer. Viewers perceive increased depth in the picture, which becomes more like the natural binocular viewing experience.

CE Manufacturers have announced 3D-TV product launches during 2010. 2010 will see the widespread availability of 3D-TV enabled consumer electronics products. The following 3D-TV consumer configurations will be available to the public.

3D-TV connected to 3D Blu-ray Player for packaged media.
3D-TV connected to HD Games Console, e.g. PS3 and Xbox360, for 3D gaming.
3D-TV connected to HD STB for broadcast 3D-TV.
3D-TV receiving a 3D-TV broadcast directly via a built-in tuner and decoder

For the two broadcast scenarios above, initial requirements are for Pay-TV broadcasters to deliver 3D-TV services over existing HD broadcasting infrastructures, and to use existing receivers (with firmware upgrade, as required) to deliver 3D content to 3D-TV sets, via an HDMI or equivalent connection, if needed. As explained below, this is termed 'Frame Compatible' .

5 Scope of this document

The Scope of this document SHALL be to address "frame compatible" 3D-TV services over HD broadcast infrastructures up to the point of reception and decoding by a digital receiver. The document SHALL NOT address how the received and decoded content is displayed.

A number of DVB Members need a set of technical standards that will allow them to introduce 3D-TV broadcasting in 2010/11. They need the standards to be appropriate for a specific commercial environment, or 'use case', which is described below.

The standards that provide collectively 3D-TV system will make use of certain existing specifications in combination with new DVB specifications that are to be prepared by the DVB TM. This package of specifications is termed in this document, for convenience, the **DVB 3D-TV Specification**.

Other DVB members have expressed the potential need for a set of standards that are appropriate to a different set of commercial requirements. These commercial requirements are in the process of being discussed and agreed, and they are not considered in this document.

3D-TV displays need to provide the viewer with separate images for the Left and Right eyes (the L and R images). There are a number of ways of arranging this in the display. They involve, for instance, using active shuttered glasses or glasses with lenses with different polarization planes. The method used by the display for making the L and R images available in the display is not considered in this document, and is outside its scope. This is a matter for set makers.

6 The Use Case for DVB 3D-TV

The main commercial requirement for the 3D-TV Specification is that broadcasters can use an existing DVB HDTV broadcast channel, and viewers can use an existing or suitably adapted receiver to receive the 3D-TV content. Thus, the 3D-TV Specification can be considered to be a system that can be used with 'existing delivery and home infrastructure'. This does not, however, preclude its use in other commercial environments, or the later addition of enhancement signals.

For the 3D-TV Specification viewers will need to have available a 3D-TV display, in order to see the picture with depth as intended. This display is not the same as a conventional HD '2D' display (HD-ready or HD-ready 1080p), but can be used also as a conventional HD '2D' display. The proportion of HD displays which are capable of 3D-TV, and those which are only capable of 2D, will be determined by market forces.

The main implication for the requirement is that the L and R images must be arranged in a '**spatial multiplex**' such that the resulting signal can be processed by the STB substantially as a conventional HDTV signal. Following ITU and other terminology, this is termed a **Frame Compatible (FC) format**.

There are a range of **Frame Compatible** formats. They include the **Side by Side (SbS)** format, the **Top and Bottom (TaB)** format, and others. Initially the Frame Compatible format may be carried in its entirety from a set top box to a display via an HDMI or equivalent connector, and should therefore match the format needed by the HDMI or equivalent connection.

7 General Commercial Requirements

The DVB Ad hoc Group on Measurements should give consideration to future work in the area of test and measurement for DVB 3D-TV.

CR1. 3D-TV specifications shall provide “Frame Compatible” 3DTV Services over existing HDTV broadcast infrastructures.
Note: - 3D-TV specifications are likely to only require software/firmware upgrades to elements in the existing infrastructure

CR2. The 3D-TV specifications shall support the following Frame Compatible 3D formats / structures as specified in the HDMI Specification: -

a. 720p @ 50Hz Top-and-Bottom
b. 720p @ 59.94 / 60 Hz Top-and-Bottom
c. 1080i @ 50Hz Side-by-Side
d. 1080i @ 59.94 / 60 Hz Side-by-Side
e. 1080p @ 23.97 / 24 Hz Top-and-Bottom
f. 720p @ 50Hz Side-by-Side
g. 720p @ 59.94 / 60 Hz Side-by-Side
h. 1080p @ 23.97 / 24 Hz Side-by-Side

Note: - implementers shall be aware that only the mandatory frame compatible formats in the HDMI Specification, (a. through to e. above), are guaranteed to be supported by 3D-TV compatible receivers in the market in the short term.

CR3. The 3D-TV Specification should be extendible to support future frame compatible formats (see Annex 1) and phases of work to support “service compatible formats” and evolutions of 3D-TV technologies.

CR4. The 3D-TV Specification shall allow services which exclusively contain 3D-TV events / programmes and those that are a mix of 3D-TV and 2D events / programmes.
(Note: - the transition between 3D and 2D modes, and vice versa, should only take place during event / programme transitions).

Guidance note: - In situations where the programme duration is short, switching between 2D and 3D modes should be avoided.

CR5. Provision should be made for a 3D receiver to identify 3D events that are available, for which EPG listings of 3D-TV content can be included.

Cautionary note: - such provision should not adversely affect existing receivers.

CR6. The 3D-TV Specification shall address frame compatible 3D-TV Services over HD broadcast infrastructures up to the point of reception by the digital receiver. The 3D-TV specification shall not address how the 3D transmission is displayed nor any technologies, such as shutter glasses, used to achieve 3D viewing effect.

8 Quality of the L and R images

Informative note: The resolution and other quality factors associated with the L and R images should be the same. Research has shown that if viewers have equal quality acuity in each eye, reducing the quality in the image made available to one of them to some degree does not cause eye discomfort, and can be largely un-noticeable. Nevertheless, since all viewers do not have the same balance of acuities, the largest public interest is best served by providing equal quality images to each eye.

9 Graphics and Text display

Informative note: The mixture of graphics and video images can be grouped into four categories.

1. The first group includes all programme titles and programme credits, etc. that are intended to be viewed by all TV viewers. These are termed **'titles'** in this document. They are combined ('burned in') with the video of the programme, and are part of video broadcast signal. No separate technical standard's provision is needed for these. **No requirements are given in this document.**
2. The second group is termed here **'captions'**, and include text and visual elements that are intended to be optionally overlaid on the picture. These include subtitles for foreign language source material and those with hearing disabilities. The information needed to construct and display these is broadcast along with the video. The reconstruction of the composite image which includes the captions needs to be done in the receiving equipment.

There are standards for sub-titling already available for DVB broadcast systems, which can also be used for 3D-TV broadcasting. However, in addition, the receiver needs, at minimum, additional information to depth (z) position the caption[1]. The L and R pictures passed to the display from an external receiver (STB) in their anamorphic form would each need to have correctly positioned L and R versions of the captions mixed with them.

3. The third group includes multimedia generated within the receiver which serves as a service or programme guide. This is called here a **service guide**. This can provide displayed multimedia which is specific to the receiver, which combines the use of data preloaded into the receiver with data provided by the broadcast, in the form of service information (SI) elements such as 'now' and 'next'. If the broadcaster provides a 'caption position data block' continuously, such as that needed for captions above, this could also be used by the receiver to position a service guide.
4. The forth group includes **interactive multimedia** generated by applications and data which are broadcast, or preloaded in the receiver, and interpreted by an application programming interface in the receiver. If the broadcaster provides a 'caption position data block' continuously, such as that for captions above, this could also be used by the receiver to position interactive multimedia.

The requirements are as follows:

CR7. The 3DTV specification shall provide a mechanism for broadcasters to signal a position for DVB subtitles within a stereoscopic view.

CR8. The 3D-TV Specification shall use where possible, existing DVB subtitling specifications.

[1] For an existing receiver to make use of a 'caption position data block', it would need to be possible for the receiver to receive and install a software upgrade.

CR9. Extensions to existing DVB Subtitling for 3D-TV shall be selected on the basis of simplicity. The DVB 3D subtitling solution shall introduce minimum additional complexity to existing DVB subtitling implementations and shall be backward compatible.

CR10. The 3D-TV specification shall allow 3D subtitles to the equivalent quality level as that of 2D subtitles.

CR11. The 3D-TV Specification should provide a mechanism to guide a receiver to optimally position on screen graphics (EPG, Now/Next etc) within a stereoscopic view.

Default behaviours by convention for use in the absence of broadcast depth signalling information or receiver decode capability are needed. This should place captions so they are not obscured by an object in the scene.

10 Signalling

Since the 3DTV Specification is limited to frame compatible services it is envisaged that the primary task of DVB 3DTV shall be to signal the presence of 3D encoding in an HD frame. The first 3DTV broadcast services are likely to be directed to STBs connected to 3D-TVs via HDMI or equivalent interface. The latest version of HDMI, is likely to be the basis for 3D-TV connections between STB, Game Consoles and Blu-ray Players and the first generation 3D-TV Sets.

CR12. The 3D-TV Specification shall support signalling of all the formats specified by [CR 2].

CR 13. The 3D-TV specification signalling shall make provision for expansion to support the signalling of additional 3D encoding formats in the future.

CR14. The 3D-TV Specification shall not prohibit future deployment of 3D enabled Integrated Digital TV sets that will decode and display 3D transmissions directly “off air”.

CR15. Whilst it is not expected that legacy receivers can sensibly render 3DTV Specification transmissions, the 3DTV Specification shall not have an adverse effect on such legacy receivers.

CR16. It should be possible to signal that a 3D version of a 2D service or event is being simulcast, and vice-versa, together with information on where the simulcast can be found.

CR 17.It should be possible to include in the broadcast signal information about the pixel arrangement used to decimate the master HDTV full samples/line pictures to create the anamorphic version, if available.

Note 1:- Broadcasters shall be aware that not all pixel arrangement information can be passed on to TV displays via the HDMI interface using the current HDMI specification (see Reference 1).

Note 2:- Only horizontal sub-sampling can be guaranteed to be used by 3D-TVs based upon the current HDMI Specification.

CR18. Signalling should be capable of being inserted at the point of transmission and the point of packaging.

11 3D-TV Audio system

There are no specific additional requirements for audio for 3DTV.

CR 19. 3DTV Specification systems shall support the signalling of all existing DVB audio types and codecs specified for TV services.

12 Future 3D-TV systems

Guidance note: Future Specification receivers may provide normal 2D HD 'spectral occupancy' (horizontal, vertical, and diagonal resolution) L and R pictures to the display. This may be provided by means such as an extension of the Frame Compatible system and / or by a 2D Service Compatible system. Future Specification system may include the broadcasting of depth maps to assist the viewer to adjust stereo window position and depth range for maximum individual eye comfort.

CR 20. Nothing proposed in the signalling or distribution video formats for the 3D-TV Specification should prevent future expansion to support new 3D encoding technologies.

13 Conclusions

This document provides Commercial Requirements for a 3D-TV Frame Compatible Plano-Stereoscopic system.

14 Terminology

DVB 3D-TV: - The group of specifications that collectively define the 3D-TV system The 3D-TV specification that can be used with existing DVB-based digital HDTV broadcast or cable distribution infrastructures for the broadcast channel and currently used home receivers (set top boxes).

Plano-stereoscopic: - A 3D picture which uses two single pictures, L and R, displayed on single plane surface (the TV screen in the case of 3D-TV).
Natural binocular viewing: - The process of viewing with two eyes, as is done by most people.
Blu-ray Disk: - The high capacity disk packaged media system
Frame Compatible: - The arrangement of the L and R images in a spatial multiplex which results in an image which can be treated like a normal HDTV image by the receiver demodulator and video compression decoder.
Shuttered Glasses: - The type of 3D-TV glasses that are electronically synchronised with the 3D-TV display. The synchronisation is in relation to providing the appropriate left and right images.
Polarization planes: - An optical filter system used to direct the left and right eye images to the appropriate eye.
HD-ready, HD-ready 1080p: - Labels authorized by DIGITALEUROPE to classify HDTV TV displays.
SbS: - The arrangement of the Frame Compatible spatial multiplex such that the horizontally anamorphically compressed Left eye picture line is placed in a spatial multiplex to occupy the first half of the line and the anamorphically compressed Right eye picture line is placed in the spatial multiplex to occupy the second half of the line for transmission.
TaB: - The arrangement of the Frame Compatible spatial multiplex such that the vertically anamorphic Left eye picture is placed in the spatial multiplex to occupy the first (top) half of a single HD video frame and the Right eye picture is placed in the spatial multiplex to occupy the second (bottom) half of a single HD video frame.
HDMI: - The industrial consortium which includes major set makers, which has specified the form of the connector between an HDTV set top box and a display.
Titles: - Usually all forms of text and graphics that appear on top of a TV scene or another background.
Captions: - Usually text that provides written dialogue over the picture.
Service Guide: - Usually information on programme choice displayed on the screen, and often derived from 'Now' and 'Next' Service Information broadcast in the multiplex.
Interactive Multimedia: - Usually multimedia available to the viewer derived from broadcast information working with an applications programming interface in the receiver.
Simulcast: - Parallel broadcasting of the same programme, often in different forms/formats
Legacy receiver: - A receiver which is part of a (possibly large) population of receivers already purchased by the public.
Pixel arrangements: - The arrangement of horizontal and vertical image samples. This has an impact on vertical, horizontal, or diagonal resolution.

15 References

1. High Definition Multimedia Interface Specification Version 1.4a. March 4, 2010. http://www.hdmi.org/manufacturer/specification.aspx
2. ITU-R Doc 6/177 ‘Features of Three Dimensional Television (3D-TV) video systems for broadcasting’.

ANNEX

1. Additional frame compatible formats

Additional frame compatible formats have been proposed or may be proposed in order to improve picture quality, e.g. by providing a better balance between the V and H resolution, or offering other advantages such as “service compatibility”. As an example, one of these formats allows to insert two 720p L and R pictures within a 1080p composite frame (the “tile frame” described in doc. CM-3DTV0045 – see footnote).

The TM -3DTV should investigate the technical benefits of additional frame compatible formats and provide a report to the CM-3DTV, summarizing “pros and cons” of such formats to assist CM-3DTV to make an evaluation of whether additional formats should be added to the DVB-3DTV Specification

> Note: Formats that are not compatible with most of the existing H.264 set-top-boxes which do not support 1080p50 or 60, but could be compatible with the most recent 1080p-enabled set-top-boxes and chip-sets. The required bit rate is only slightly greater than that required for 1080i, as it has been shown by EBU studies.