|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  10th Meeting: Stockholm, SE, 11–20 July 2012 | Document: JCTVC-J0198 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **Frame packing arrangement SEI message modification** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Marco Arena,  RAI  Paola Sunna,  RAI | Email:  Email: | [marco.arena@rai.it](mailto:marco.arena@rai.it)  [p.sunna@rai.it](mailto:p.sunna@rai.it) |
| *Source:* | RAI | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Abstract

Frame packing stereo 3D coding using frame-packing arrangement SEI is already supported in the current draft. However, due to the geometrical layout of the composite frame that contains both the left and the right views, one issue is compatibility with 3D decoders while maintaining 2D service compatibility.

Document JCTVC-I\_Notes\_dD suggested to use the cropping window for 2D compatibility in order to avoid 2D receivers to pay attention to the SEI message.

This contribution is releted to JCTVC I0072 presented at the 9th JCT-VC Geneva meeting. That document asked for a technical solution to provide compatibility between stereo 3D and 2D receivers when frame packing arrangement is used. In order to answer this request, this proposal suggests two alternative solutions that modify the frame packing arrangement SEI message..

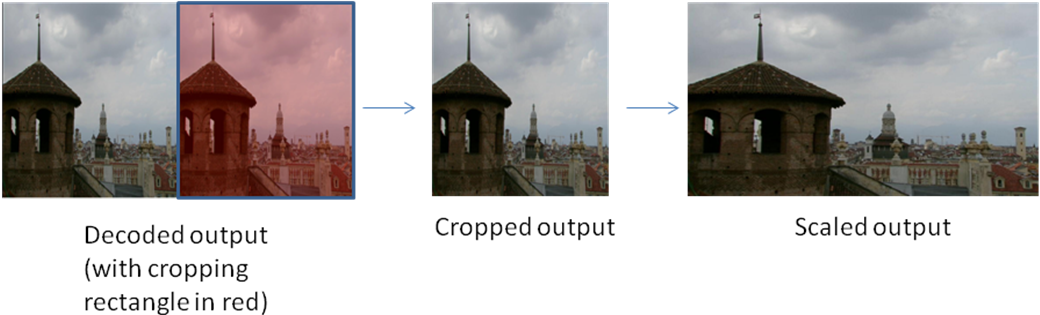
# Introduction

Frame packing stereo 3D coding using frame-packing arrangement SEI is the key technology that is being adopted in the first generation of 3DTV broadcasting services.

Squeezing the Left and Right images in a single High Definition frame allows the service provider to reuse part of the existing production infrastructure and the whole of the existing distribution infrastructure. This is becoming even more relevant since the possibility for a second digital dividend (UHF 700 MHz band) already prospected at ITU WRC-12 after 2015 is making RF spectrum resources even more precious.

The current HEVC design already supports frame packing arrangement SEI referencing the syntax table and the semantics specified in Rec. ITU-T H.264 | ISO/IEC 14496-10, however one issue is compatibility among receivers. As the matter of facts, due to the geometrical layout of the composite frame that contains both the left and the right views, the resulting video will not be service (meaning backwards or 2D) compatible: HD decoders will be able to decompress the video, but 2D receivers will display the composite picture and not, as it would be desirable, one of the two composing images.

If the input frame is a composite frame used for the distribution of 3D stereoscopic video (Side by Side or Top and Bottom Frame Compatible modes), the cropping rectangle can be used to delimit the area within the frame containing one of the two 2D views: as illustrated in the figure below, a 2D receiver, decoding such a video would only output the view contained within the cropping rectangle.



Therefore the output video, properly scaled, provides a 2D-compatible format.

3DTV receivers are required to ignore the cropping rectangle parameter when SEI frame packing arrangement messages indicate that a frame compatible format is being decoded, so as to be able to use also the part of the decoded picture outside the cropping rectangle bounds (needed to present the second view).

Since this feature is deemed to be a powerful tool, regional standardization bodies such as HD Forum Italia have decided to make its support mandatory for AVC receivers coming to the Italian market even though it is not fully conformant to the intended meaning of the AVC specification.

Document JCTVC-I\_Notes\_dD suggested to use the cropping window for 2D compatibility in order to avoid 2D receivers to pay attention to the SEI message.

Since there is no legacy of deployed HEVC decoders it may be inappropriate to copy SEI message from AVC, for this reason this contribution aims to modify the frame packing arrangement SEI message.

Two alternative methods are here proposed:

1. modifying "side-by-side" and "top-and-bottom" frame packing arrangements definition already included in HEVC
2. adding two new frame packing arrangement SEI messages which provides service (2D) compatibility to those already present in HEVC

# Text modification

The current draft applies the semantics specified in subclause D.2.25 of ITU-T Rec. H.264 | ISO/IEC 14496-10. The proposed modifications are highlighted in yellow.

## Method 1

* 1. SEI payload semantics
     1. Frame packing arrangement SEI message semantics

**frame\_packing\_arrangement\_type** indicates the type of packing arrangement of the frames as specified in the table below.

Table ‎2‑1: proposed modification to Table D-8 of the ISO/IEC 14496-10

|  |  |
| --- | --- |
| **Value** | **Interpretation** |
| 0 | Each component plane of the decoded frames contains a "checkerboard" based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-1. |
| 1 | Each component plane of the decoded frames contains a column based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-2. |
| 2 | Each component plane of the decoded frames contains a row based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-3. |
| 3 | Each component plane of the decoded frames contains a side-by-side packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-4 and Figure D-6. This frame packing arrangement may be made 2D compatible by suitable settings of the frame cropping parameter values in the SPS as exemplified in (2.16.X) and illustrated in figure D-X. |
| 4 | Each component plane of the decoded frames contains top-bottom packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-5. This frame packing arrangement may be made 2D compatible by suitable settings of the frame cropping parameter values in the SPS as exemplified in (2.16.Y) and illustrated in figure D-W. |
| 5 | The component planes of the decoded frames in output order form a temporal interleaving of alternating first and second constituent frames as illustrated in Figure D-7. |

When **frame\_packing\_arrangement\_type** is equal to 3 or 4 it is possible to set up the cropping rectangle on one of the two views to provide backward compatibility.

Assuming no padding specified, to enable a 2D decoder to seamlessly extract only one of the two views from the arrangement the frame cropping parameter in SPS may be set to the following values:

if ( **frame\_packing\_arrangement\_type** == 3 ) (2.16.X)

{

**pic\_crop\_right\_offset** = **PicWidthInSamplesL /** 2

**pic\_crop\_bottom\_offset** =0;

**pic\_crop\_top\_offset** = 0;

**pic\_crop\_left\_offset** = 0;

}

if ( **frame\_packing\_arrangement\_type** == 4 ) (2.16.Y)

{

**pic\_crop\_right\_offset** = 0;

**pic\_crop\_bottom\_offset** = **PicHeightInSamplesL** / 2;

**pic\_crop\_ top \_offset** = 0;

**pic\_crop\_left\_offset** = 0;

}

3D-aware decoders, should compute new cropping parameter as defined in (2.16.W) and (2.16.Z), regardless the presence of padding or other cropping information:

if ( **frame\_packing\_arrangement\_type** == 3 ) (2.16.W)

{

**PicCropRightOffset** = **PicWidthInSamplesL** %[**PicWidthInSamplesL - CropUnitX** \* (**pic\_crop\_right\_offset** + **pic\_crop\_left\_offset**) ];

**PicCropLeftOffset** = **pic\_crop\_bottom\_offset**;

**PicCropTopOffset** = 0;

**PicCropBottomOffset** = 0;

}

else if ( **frame\_packing\_arrangement\_type** == 4 ) (2.16.Z)

{

**PicCropRightOffset** = **pic\_crop\_right\_offset**;

**PicCropBottomOffset** = **PicHeightInSamplesL** %[**PicHeightInSamplesL** - **CropUnitY** \* (**pic\_crop\_bottom\_offset** + **pic\_crop\_top\_offset**)];

**PicCropTopOffset** = 0;

**PicCropLeftOffset** = 0;

}

The decoder should use the variables **PicCropLeftOffset, PicCropTopOffset, PicCropRightOffset, PicCropBottomOffset** to crop the output picture.

## Method 2

* 1. SEI payload semantics
     1. Frame packing arrangement SEI message semantics

**frame\_packing\_arrangement\_type** indicates the type of packing arrangement of the frames as specified in the table below.

Table ‎2‑2: proposed modification to Table D-8 of the ISO/IEC 14496-10

|  |  |
| --- | --- |
| **Value** | **Interpretation** |
| 0 | Each component plane of the decoded frames contains a "checkerboard" based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-1. |
| 1 | Each component plane of the decoded frames contains a column based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-2. |
| 2 | Each component plane of the decoded frames contains a row based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-3. |
| 3 | Each component plane of the decoded frames contains a side-by-side packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-4 and Figure D-6. |
| 4 | Each component plane of the decoded frames contains top-bottom packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-5. |
| 5 | The component planes of the decoded frames in output order form a temporal interleaving of alternating first and second constituent frames as illustrated in Figure D-7. |
| 6 | Each component plane of the decoded frames contains a side-by-side packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-4 and Figure D-6. This frame packing arrangement is intended to be made 2D compatible by suitable settings of the frame cropping parameter values in the SPS as exemplified in (2.16.X) and illustrated in figure D-X. |
| 7 | Each component plane of the decoded frames contains top-bottom packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-5. This frame packing arrangement is intended to be made 2D compatible by suitable settings of the frame cropping parameter values in the SPS as exemplified in (2.16.Y) and illustrated in figure D-W. |

When frame\_**packing\_arrangement\_type** is equal to 6 or 7 it is necessary to set up the cropping rectangle on one of the two views to provide backward compatibility.

Assuming no padding specified, to enable a 2D decoder to seamlessly extract only one of the two views from the arrangement the frame cropping parameter in SPS may be set to the following values:

if ( **frame\_packing\_arrangement\_type** == 6 ) (2.16.X)

{

**pic\_crop\_right\_offset** = **PicWidthInSamplesL /** 2

**pic\_crop\_bottom\_offset** =0;

**pic\_crop\_ top \_offset** = 0;

**pic\_crop\_left\_offset** = 0;

}

if ( **frame\_packing\_arrangement\_type** == 7 ) (2.16.Y)

{

**pic\_crop\_right\_offset** = 0;

**pic\_crop\_bottom\_offset** = **PicHeightInSamplesL** / 2;

**pic\_crop\_ top \_offset** = 0;

**pic\_crop\_left\_offset** = 0;

}

3D-aware decoders, should compute new cropping parameter as defined in (2.16.W) and (2.16.Z):

if ( **frame\_packing\_arrangement\_type** == 6 ) (2.16.W)

{

**PicCropRightOffset** = **PicWidthInSamplesL** -{**2** \*[ **PicWidthInSamplesL - CropUnitX** \* **(pic\_crop\_right\_offset** + **pic\_crop\_left\_offset**)]};

**PicCropBottomOffset** = **pic\_crop\_bottom\_offset**;

**PicCropTopOffset** = 0;

**PicCropLeftOffset** = 0;

}

else if ( **frame\_packing\_arrangement\_type** == 7 ) (2.16.Z)

{

**PicCropRightOffset** = **pic\_crop\_right\_offset**;

**PicCropBottomOffset** = **PicHeightInSamplesL** - **{2** \*[**PicHeightInSamplesL** - **CropUnitY** \* **(pic\_crop\_bottom\_offset** + **pic\_crop\_top\_offset**)]};

**PicCropTopOffset** = 0;

**PicCropLeftOffset** = 0;

}

The decoder should use the variables **PicCropLeftOffset, PicCropTopOffset, PicCropRightOffset, PicCropBottomOffset** to crop the output picture.

## Common to all methods

Figure D-X illustrates the 2D compatible rearrangement of the side by side arrangement scheme.

The cropping rectangle is depicted in dashed lines on the side by side frame packing arrangement.

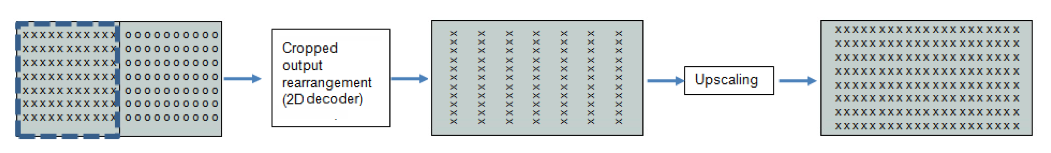


Figure D-X – 2D compatible rearrangement and upconversion of side-by-side packing arrangement

Figure D-Y illustrates the 3D rearrangement of the side by side arrangement scheme.

The new values of the cropping rectangle parameter are depicted in dashed lines on the side by side frame packing arrangement.

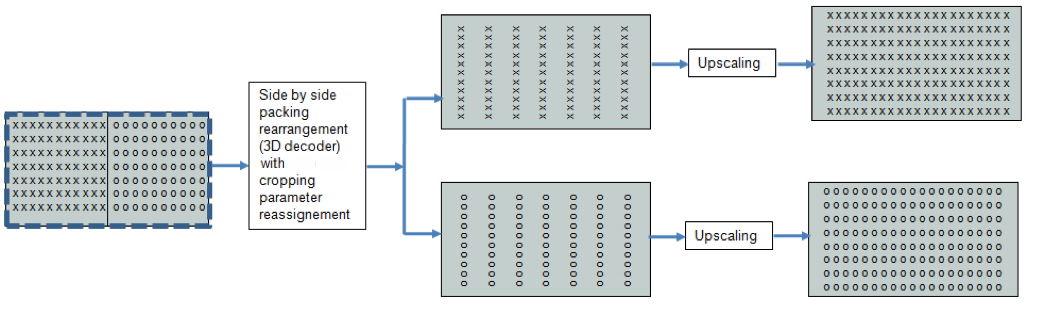


Figure D-Y – 3D rearrangement and upconversion of side-by-side packing arrangement

Figure D-W illustrates the 2D compatible rearrangement of the top and bottom arrangement scheme.

The cropping rectangle is depicted in dashed lines on the top and bottom frame packing arrangement.

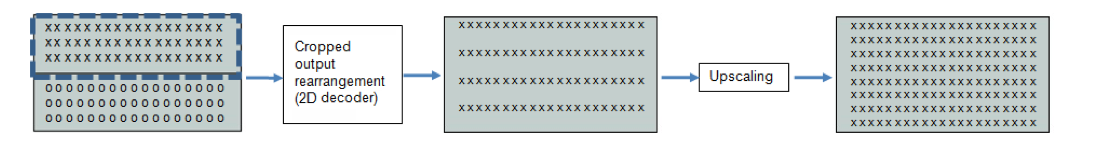


Figure D-W – 2D compatible rearrangement and upconversion of top and bottom packing arrangement

Figure D-Z illustrates the 3D rearrangement of the top-and-bottom arrangement scheme.

The new values of the cropping rectangle parameter are depicted in dashed lines on the side by side frame packing arrangement.

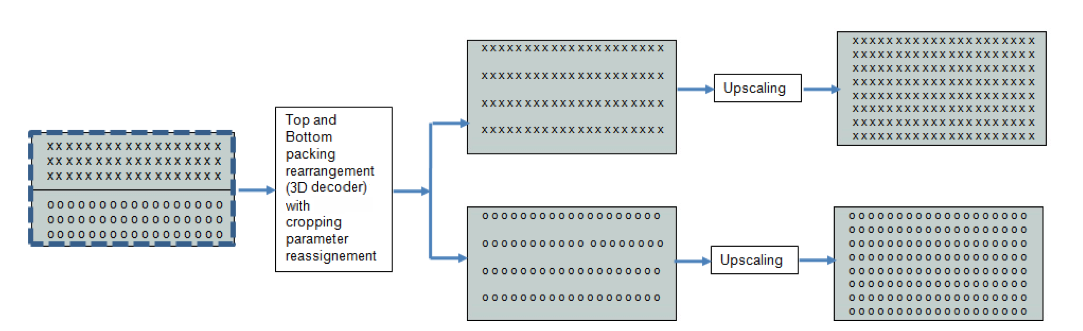


Figure D-Z – 3D rearrangement and upconversion of top-and-bottom packing arrangement

# Patent rights declaration(s)

**RAI does not have any current or pending patent rights relating to the technology described in this contribution.**