



REDEFINING MOBILITY

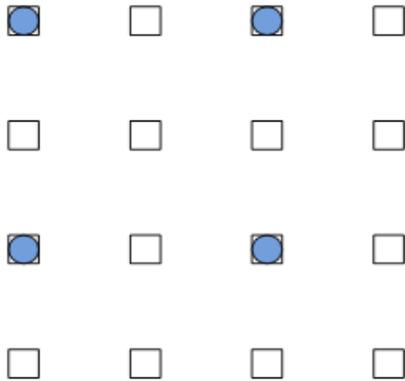


## On phase alignment of up-sampling process in SHVC

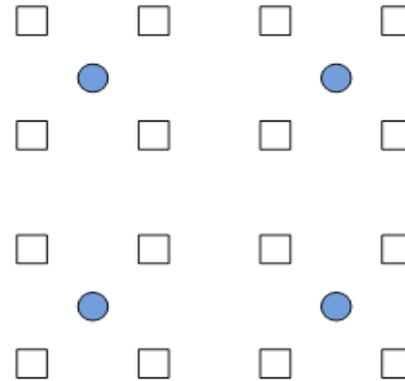
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# Sample grid location of BL and EL pictures

- SHVC: zero-position aligned
- Common up-sampling process: central-position aligned
  - Scaling module in commercial products
    - Mobile, TV, Camera, Display, etal
  - Commercial software
    - Matlab, Photoshop



Zero-position aligned



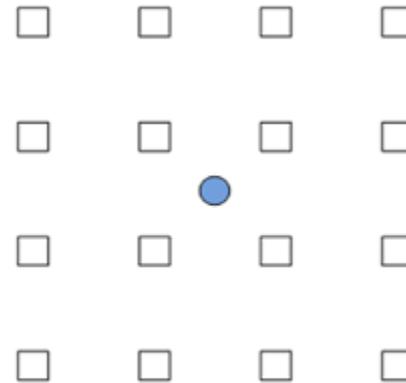
Central-position aligned

# Suggestion

- SHVC shall support central-position aligned sequences as input
  - To be able to use the *widely deployed down-sampling modules* as part of a SHVC encoder
  - To use the input resource generated by the *current down-sampler used in industrial product*
  - To be able to transcode *the existing HEVC simulcast bitstream* without re-encoding the base layer



Zero-position aligned



Central-position aligned

# Coding performance

- Central-aligned vs Zero-aligned input with proper up-sampling process
  - Central-aligned shows average **0.3%** BD rate loss

Configuration	Y	Cb	Cr
AI 2x	0.4%	0.2%	0.1%
AI 1.5x	0.4%	0.1%	0.1%
RA 2x	0.4%	0.3%	0.2%
RA 1.5x	0.3%	0.2%	0.0%
LD-B 2x	0.4%	0.3%	0.4%
LD-B 1.5x	0.2%	-0.1%	-0.3%
<b>AVG.</b>	<b>0.3%</b>	<b>0.2%</b>	<b>0.1%</b>

- Current SHVC (zero-phase up-sampling) applied on central-aligned sequences
  - Average **6.8%** BD rate loss

Configuration	Y	Cb	Cr
AI 2x	-9.4%	-10.9%	-10.9%
AI 1.5x	-8.3%	-10.2%	-10.2%
RA 2x	-6.6%	-4.1%	-3.9%
RA 1.5x	-6.0%	-5.1%	-4.6%
LD-B 2x	-4.8%	-2.7%	-2.6%
LD-B 1.5x	-5.9%	-4.9%	-4.4%
<b>AVG.</b>	<b>-6.8%</b>	<b>-6.3%</b>	<b>-6.1%</b>

# Proposed solution

- Signal a flag to indicate which sample alignment schemes is used, accordingly the matched phase derivation is used in up-sampling process,

$$xRef16 = ( ( ( xP - offsetX ) * ScaleFactorX + addX + ( 1 \ll 11 ) ) \gg 12 ) - ( phaseX \ll 2 )$$

$$yRef16 = ( ( ( yP - offsetY ) * ScaleFactorY + addY + ( 1 \ll 11 ) ) \gg 12 ) - ( phaseY \ll 2 )$$

- Complexity of reference layer sample location derivation
  - One add operations (0 or 4) for each pixel when calculated online
  - No complexity when Look Up Table (LUT) is used
  -
- Benefits
  - To be able to use the *widely deployed down-sampling modules* as part of a SHVC encoder
  - To use the input resource generated by the *current down-sampler used in industrial product*
  - To be able to transcode *the existing HEVC simulcast bitstream* without re-encoding the base layer
  - The coding gain of zero-position aligned scheme