

JVET-N0496

AHG12: Rectangular tile group address signaling



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Background – Rectangular tile groups in VVC



- Rectangular tile groups were adopted at the last JVET meeting
- The position and size of a tile group is signaled using two tile indices, one for the top-left corner and one for the bottom-right corner
- For the first tile group, the top-left tile index is not signaled but inferred to be equal to 0

<code>pic_parameter_set_rbsp() {</code>	Descriptor
<code>...</code>	
<code> single_tile_per_tile_group_flag</code>	<code>u(1)</code>
<code> if(!single_tile_per_tile_group_flag)</code>	
<code> rect_tile_group_flag</code>	<code>u(1)</code>
<code> if(rect_tile_group_flag && !single_tile_per_tile_group_flag) {</code>	
<code> num_tile_groups_in_pic_minus1</code>	<code>ue(v)</code>
<code> for(i = 0; i <= num_tile_groups_in_pic_minus1; i++) {</code>	
<code> if(i > 0)</code>	
<code> top_left_tile_idx[i]</code>	<code>u(v)</code>
<code> bottom_right_tile_idx[i]</code>	<code>u(v)</code>
<code> }</code>	
<code> }</code>	
<code> ...</code>	
<code>}</code>	

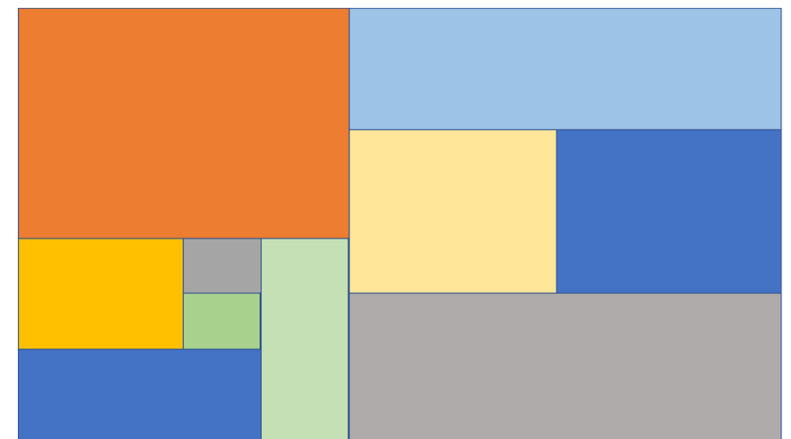
Background – Notes from Marrakesh



JVET-M00853-v2 adds the support of rectangular tile groups in addition to the existing raster scan ordered tile groups, and enables extraction of MCTSs without changing VLC NAL units.

Decision: Adopted, with constraints as follows:

- the tiles in a tile group need to be in raster-scan order.
- the tile groups need to be in increasing address order (see below: dark orange, then light blue, then pale yellow, then dark blue, then light orange, ...)
- The tile group shapes shall be such that each tile, when decoded, shall have its entire left boundary and entire top boundary consisting of a picture boundary or previously decoded tile(s). In other words, the light yellow and light green tiles in the figure below are not allowed.



The following tile group picture was drawn for illustration and discussion purposes regarding the above constraints (an accidental *homage* to Piet Mondrian).

Proposal



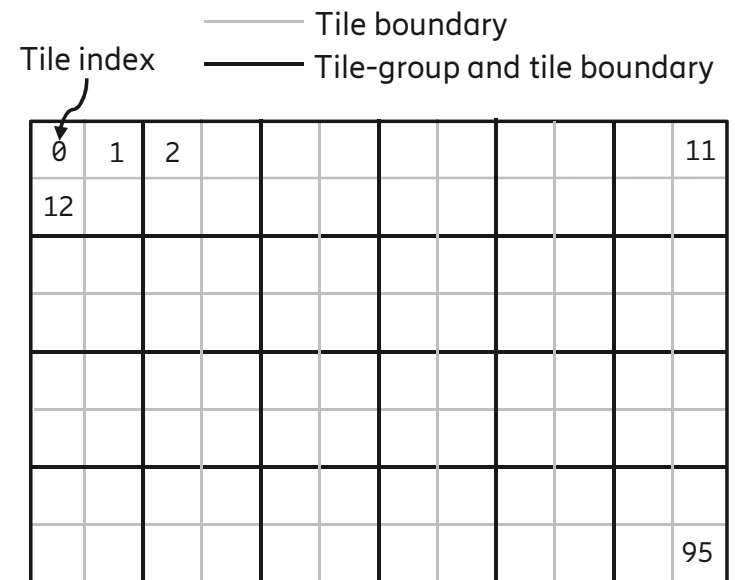
- The signaling of `top_left_tile_idx[i]` is redundant
- We propose to remove the `top_left_tile_idx[i]` code word and instead derive the value of it as equal to the first tile index in raster scan order that is not yet included in any tile group
- The change would almost cut the number of bits spent on tile indices in half

pic_parameter_set_rbsp() {	Descriptor
...	
single_tile_per_tile_group_flag	u(1)
if(!single_tile_per_tile_group_flag)	
rect_tile_group_flag	u(1)
if(rect_tile_group_flag && !single_tile_per_tile_group_flag) {	
num_tile_groups_in_pic_minus1	ue(v)
for(i = 0; i <= num_tile_groups_in_pic_minus1; i++) {	
if(i > 0)	-
top_left_tile_idx[i]	u(v)
bottom_right_tile_idx[i]	u(v)
}	
}	
...	
}	

Example



- The CE12 testing conditions specify two test cases with 24 and 96 tile groups
- For a 24 tile group case with 96 tiles the code word lengths would be 7 bits
 - In the VVC draft, that would result in $24 \times 2 \times 7 - 7 = 327$ bits
 - For the proposal, that would result in $24 \times 7 = 168$ bits



Exemplary tile grouping structure

Proposal - semantics



top_left_tile_idx[i] specifies the tile index of the tile located at the top-left corner of the i-th tile group. The value of **top_left_tile_idx[i]** shall not be equal to the value of **top_left_tile_idx[j]** for any i not equal to j. When not present, the value of **top_left_tile_idx[i]** is inferred to be equal to i. The length of the **top_left_tile_idx[i]** syntax element is $\text{Ceil}(\text{Log2}(\text{NumTilesInPic}))$ bits.

bottom_right_tile_idx[i] specifies the tile index of the tile located at the bottom-right corner of the i-th tile group. When **single_tile_per_tile_group_flag** is equal to 1 **bottom_right_tile_idx[i]** is inferred to be equal to **top_left_tile_idx[i]**. When not present, the value of **bottom_right_tile_idx[i]** is inferred to be equal to i. The length of the **bottom_right_tile_idx[i]** syntax element is $\text{Ceil}(\text{Log2}(\text{NumTilesInPic}))$ bits.

The variable **NumTilesInTileGroup[i]**, which specifies the number of tiles in the i-th tile group, and related variables, are derived as follows:

```
if( i == 0 )
    for( j = 0; j <= num_tiles_minus1; j++ )
        TileInTileGroupFlag[ j ] = 0
for( j = 0; j <= num_tiles_minus1; j++ )
    if( TileInTileGroupFlag[ j ] == 0 )
        break
top_left_tile_idx[ i ] = j
deltaTileIdx = bottom_right_tile_idx[ i ] - top_left_tile_idx[ i ]
NumTileRowsInTileGroupMinus1[ i ] = deltaTileIdx / ( num_tile_columns_minus1 + 1 )
NumTileColumnsInTileGroupMinus1[ i ] = deltaTileIdx % ( num_tile_columns_minus1 + 1 )
NumTilesInTileGroup[ i ] = ( NumTileRowsInTileGroupMinus1[ i ] + 1 ) *
    ( NumTileColumnsInTileGroupMinus1[ i ] + 1 )
for( y = 0; y <= NumTileRowsInTileGroupMinus1[ i ]; y++ )
    for( x = 0; x <= NumTileColumnsInTileGroupMinus1[ i ]; x++ )
        TileInTileGroupFlag[ top_left_tile_idx[ i ] + y * ( num_tile_columns_minus1 + 1 ) + x ] = 1
```

Note - It can be noted that it might be beneficial to replace **NumTileRowsInTileGroupMinus1** and **NumTileColumnsInTileGroupMinus1** by **NumTileRowsInTileGroup** and **NumTileColumnsInTileGroup** and change the derivation of them and the associated semantics in the VVC draft, but that would be purely editorial.

