

JVET-P0179

Non-CE5: ALF as a post-filter

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Application concept

To reuse ALF engine as a post-filter.

Current ALF

- Designed to improve PSNR.
- Calculate, select and signal filter on/off and filter coefficients based on lowest RD cost.

ALF as a post-filter

- Designed to customize subjective picture quality.
- User selects filter on/off and input filter coefficients based on user preferences (e.g. sharpening filter).

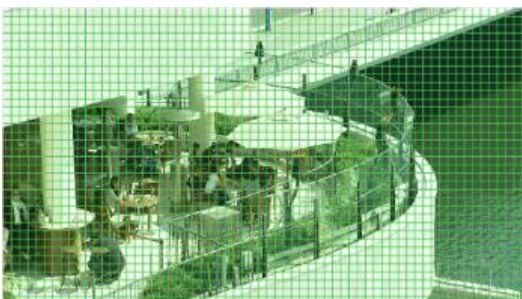
Application concept

Key advantages:

- Same ALF engine in VVC.
- CTU level filter on/off control.
- Signal up to 25 luma filters.



BQTerrace
with 64x64
CTU



BQTerrace
with 32x32
CTU



Class 0



Class 1



Class 2



Class 3



Class 4



Class 5



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Class 10



Class 11



Class 12



Class 13



Class 14



Class 15



Class 16



Class 17



Class 18



Class 19



Class 20



Class 21



Class 22



Class 23



Class 24

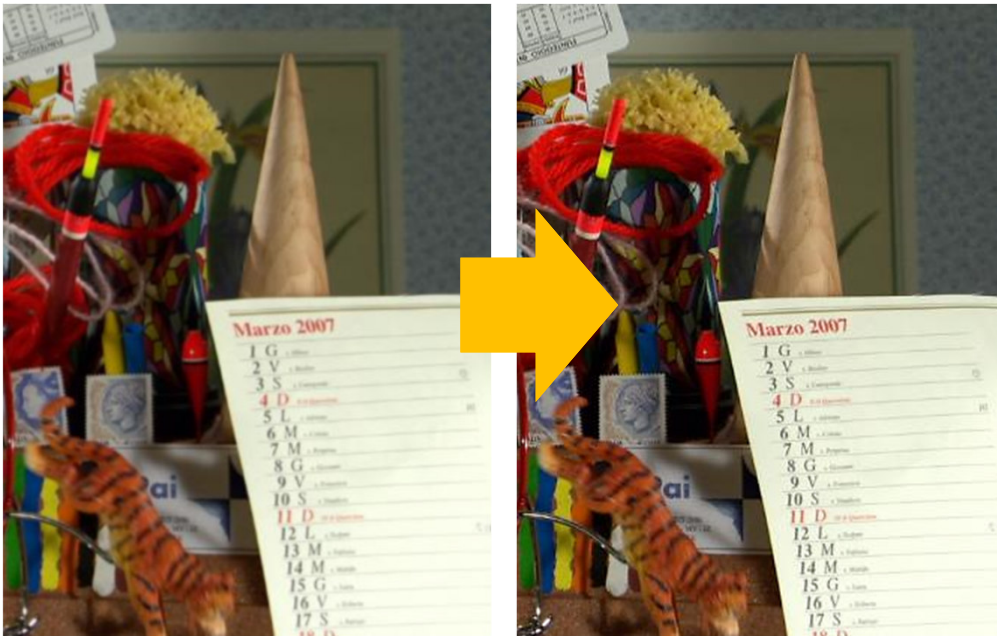
Application concept

To reuse ALF engine as a post-filter.

Target application:

- To allow video creator/publisher (artist) to create and deliver same customized filtering effects to consumer.

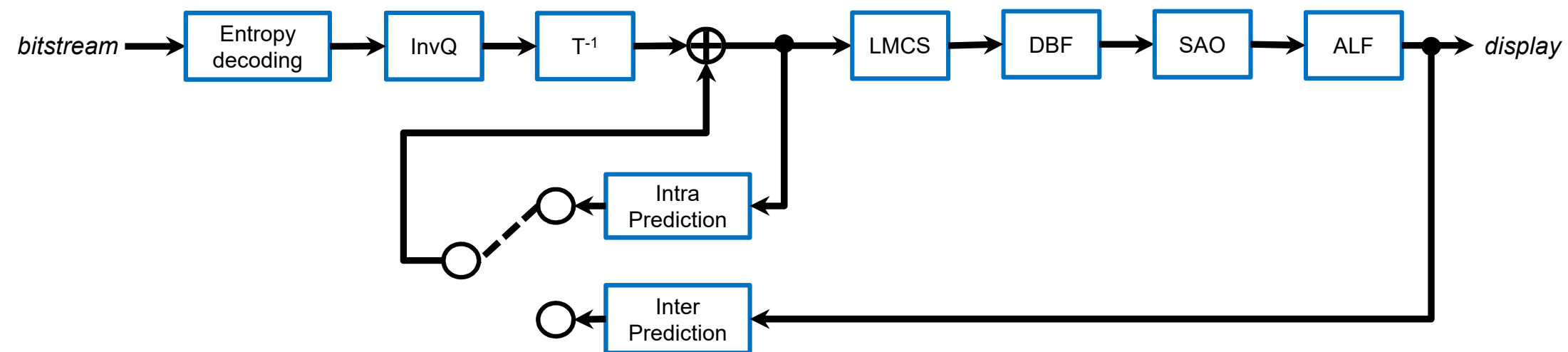
Sharpening using multiple customized filters



Sharpening ROI region

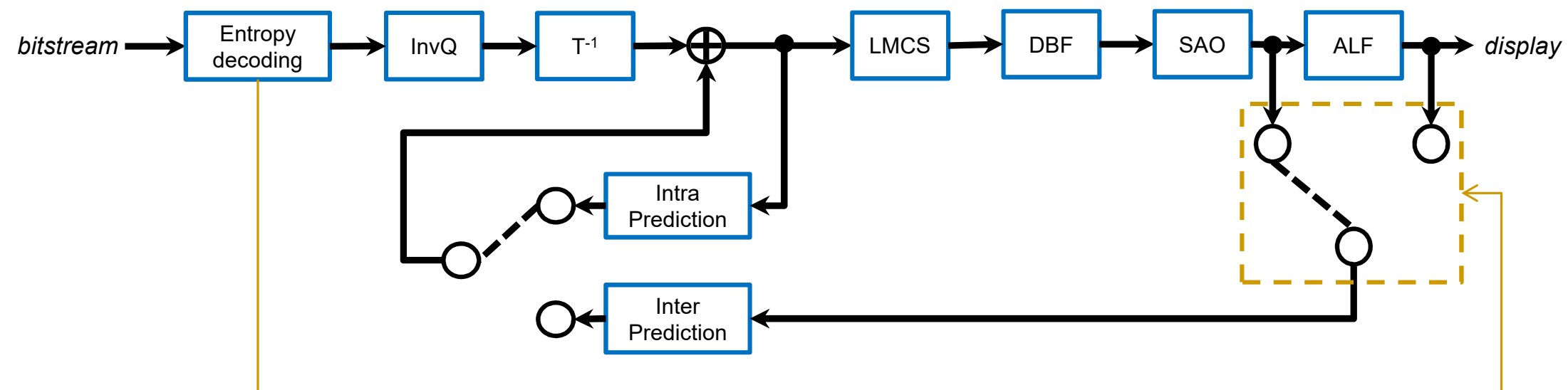


VTM6 Decoder Block Diagram



Proposal

Proposed Decoder Block Diagram



Comparisons

Pre-filter (before encoding)	HEVC post-filter	ALF as a post-filter (Proposed)
Separate module from codec	Separate module from HEVC	Built-in VVC
Determined by content provider, but typically: Picture level on/off No classification 1 set of filter	Picture level on/off	CTU level on/off
	No classification	4x4 level luma block classification
	1 set of filter for luma, 1 set of filter for Cb, 1 set of filter for Cr.	Up to 25 sets of luma filters, 1 set of filter for Cb, 1 set of filter for Cr.
NA	NA	Virtual boundary filtering
NA	NA	Additional buffer to store unfiltered pixels (before ALF)
Sharpening original source	At same bitrate, smaller QP used compared to pre-filter.	At same bitrate, smaller QP used compared to pre-filter.

Comparison

Pre-sharpening vs Post-sharpening (Proposed) vs ALF off

Pre-sharpening (before encoding)
RA @ QP32, 5.69Mbps



Post-filter (proposed)
RA @ QP27, 5.62Mbps



more details in
water area

before ALF filtering
RA @ QP27, 5.62Mbps



Comparison

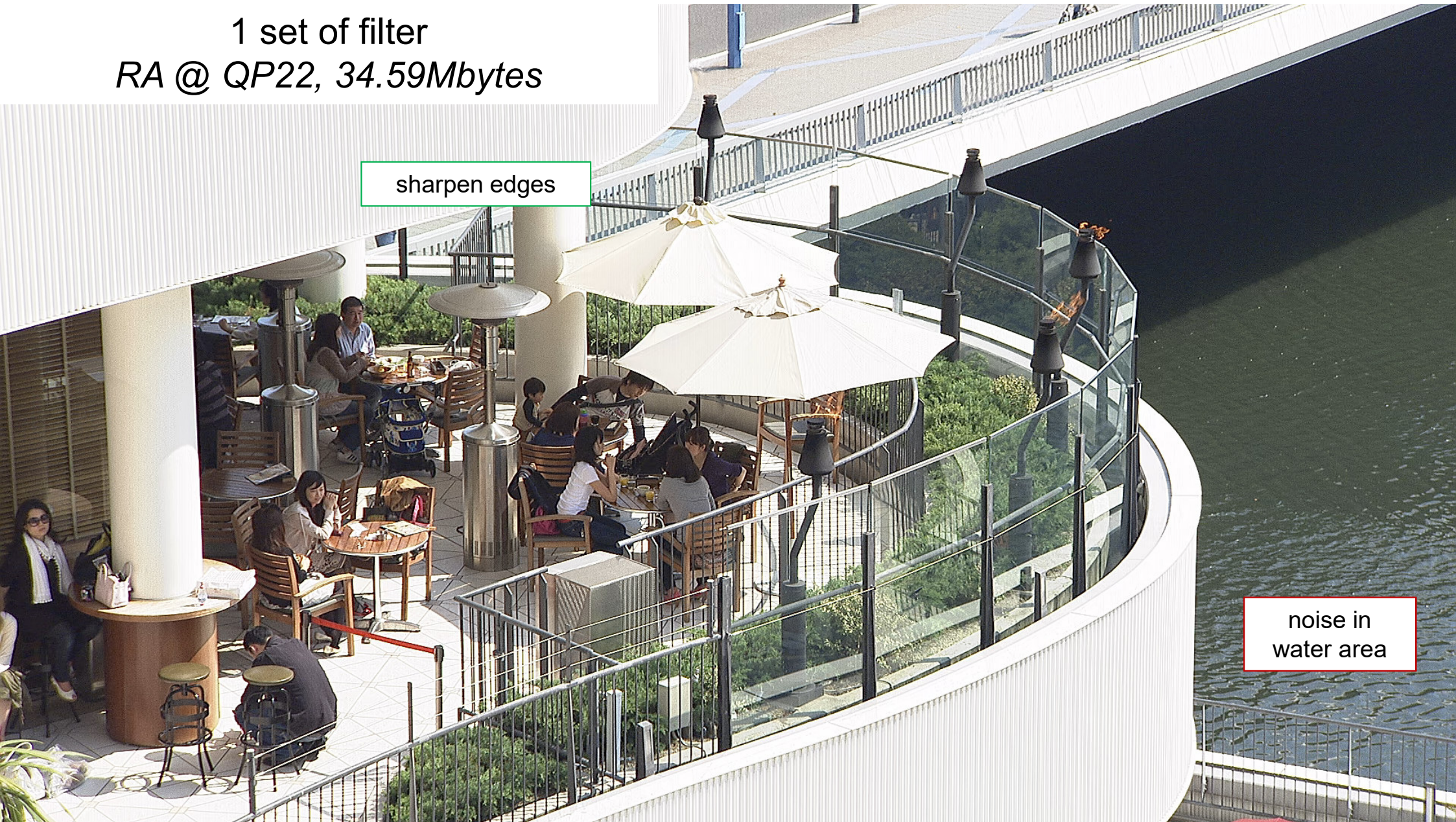
Post-sharpening

1 filter vs multiple filter (Proposed) vs ALF off

1 set of filter
RA @ QP22, 34.59Mbytes

sharpen edges

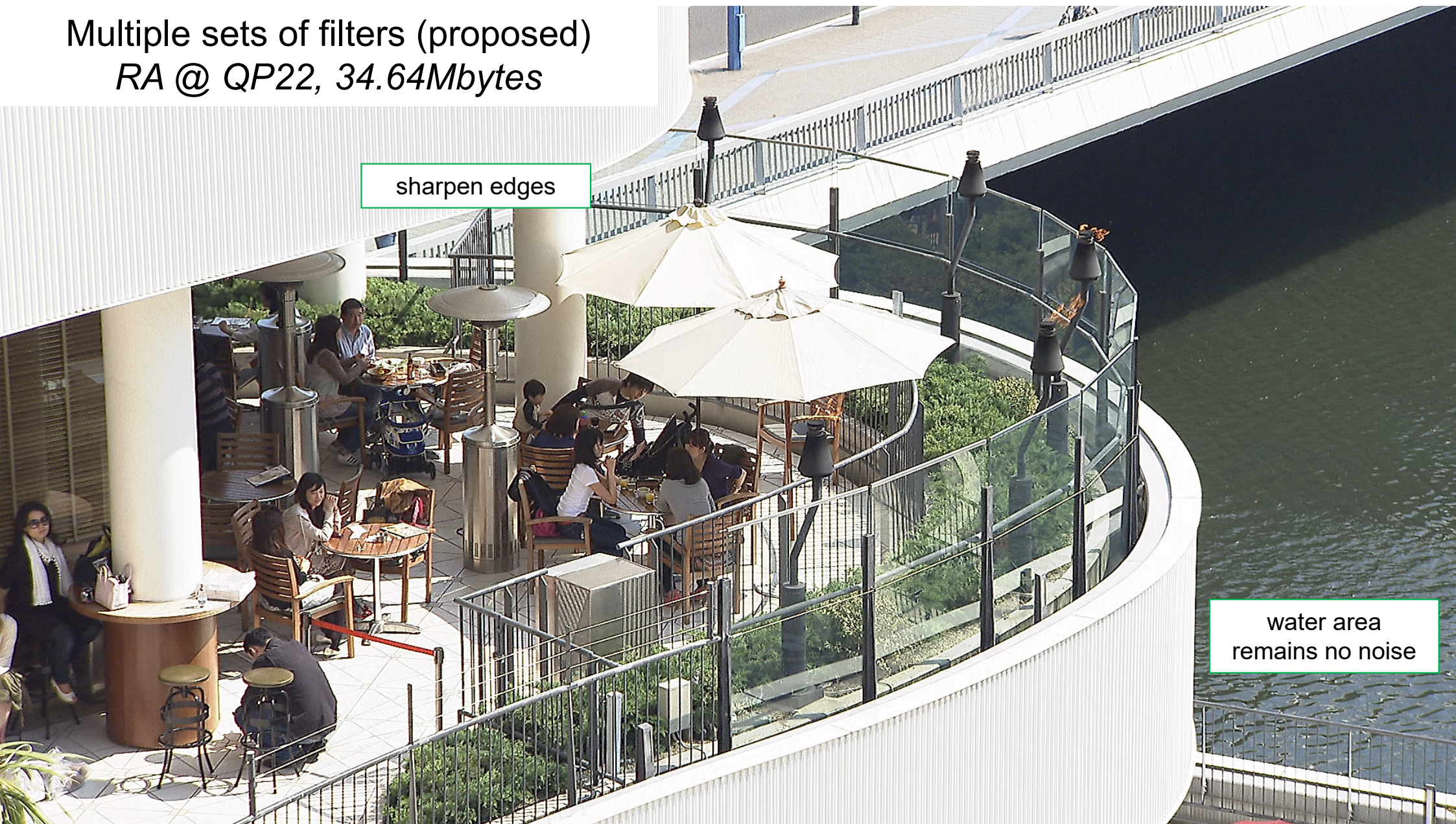
noise in
water area



Multiple sets of filters (proposed)
RA @ QP22, 34.64Mbytes

sharpen edges

water area
remains no noise



before ALF filtering
RA @ QP22, 34.64Mbytes



Proposed specification changes method 1

❑ Add a SPS flag

seq_parameter_set_rbsp() {	Descriptor
...	
sps_alf_enabled_flag	u(1)
if (sps_alf_enabled_flag)	
sps_alf_post_flag	u(1)
...	

sps_alf_post_flag equal to 0 specifies that the adaptive loop filter is functioning as an in-loop filter. **sps_alf_post_flag** equal to 1 specifies that the adaptive loop filter is functioning as a post-filter. When not present, the value of **sps_alf_post_flag** is inferred to be equal to 0.

Proposed specification changes method 2

❑ Add SEI syntax

D.2.xx Adaptive post-filter hint SEI message syntax

adaptive_post_filter_hint(payloadSize) {	Descriptor
alf_post_flag	u(1)
if(alf_post_flag)	
alf_data()	
}	
...	

D.3.xx Adaptive post-filter hint SEI message semantics

This SEI message provides the signal for adaptive loop filter to function as an in-loop filter or a post-filter. When post-filter function is selected, it can be used for customizing multiple filter to create different filtering effects.

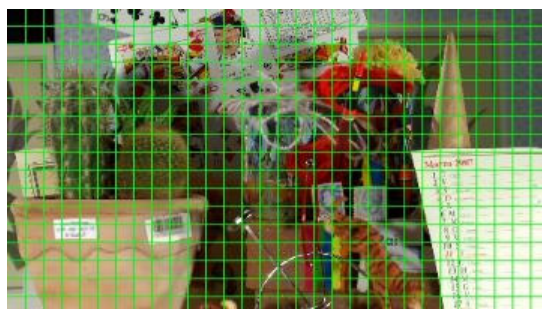
alf_post_flag equal to 0 specifies that the adaptive loop filter is functioning as an in-loop filter. **alf_post_flag** equal to 1 specifies that the adaptive loop filter is functioning as a post-filter. **alf_post_flag** can only be equal to 1 when **sps_alf_enabled_flag** of the bitstream is 0. When not present, the value of **alf_post_flag** is inferred to be equal to 0.

Conclusion

- An alternative use of ALF engine as a post-filter was proposed.
- There are no changes to existing ALF engine or its coefficient signalling.
- With this proposed change, a new channel of picture quality customization can be realized.

We propose to adopt using ALF as a post-filter into VVC specification.

Supplementary



Cactus with
64x64 CTU



Cactus with
32x32 CTU



Class 0



Class 1



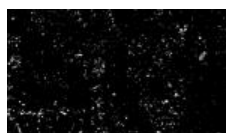
Class 2



Class 3



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Class 20



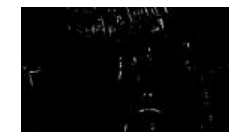
Class 21



Class 22

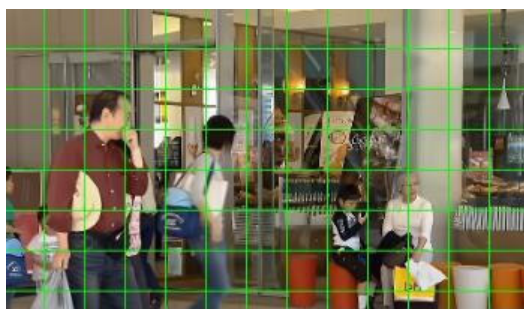


Class 23



Class 24

Supplementary



BQMall with
64x64 CTU



BQMall with
32x32 CTU



Class 0



Class 1



Class 2



Class 3



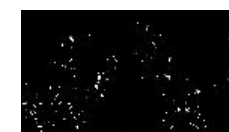
Class 4



Class 5



Class 6



Class 7



Class 8



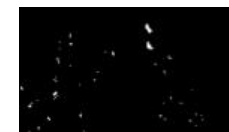
Class 9



Class 10



Class 11



Class 12



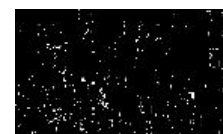
Class 13



Class 14



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Class 20



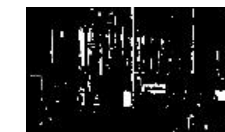
Class 21



Class 22



Class 23

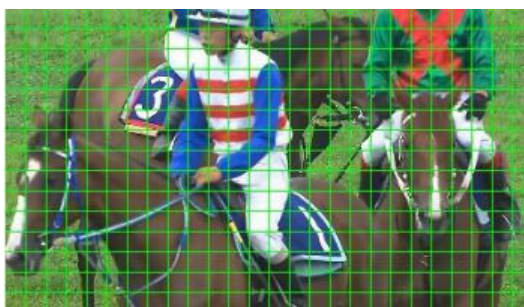


Class 24

Supplementary



RaceHorsesC
with 64x64
CTU



RaceHorsesC
with 32x32
CTU



Class 0



Class 1



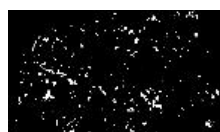
Class 2



Class 3



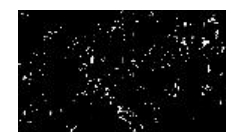
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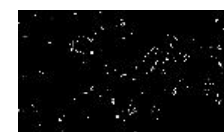
Class 5



Class 6



Class 7



Class 8



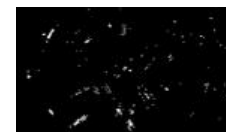
Class 9



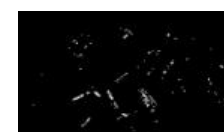
Class 10



Class 11



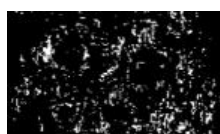
Class 12



Class 13



Class 14



Class 15



Class 16



Class 17



Class 18



Class 19



Class 20



Class 21



Class 22



Class 23



Class 24