

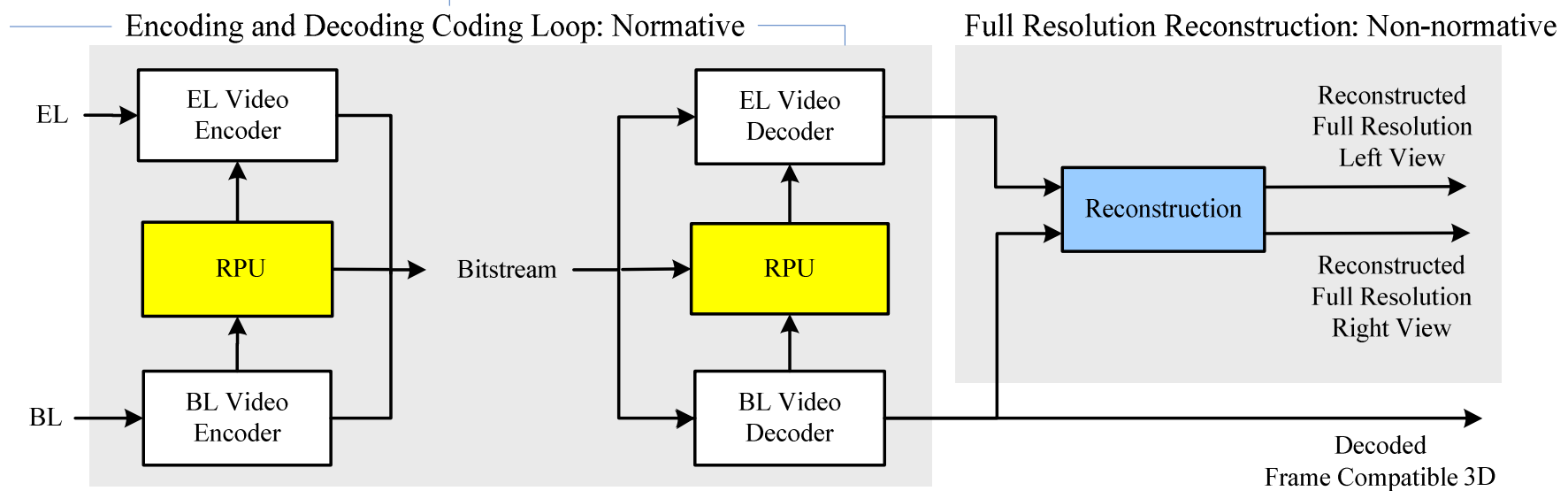
# JCT3V-C0037: Unification of Upsampling Filters in MFC

P. Yin, H. Ganapathy,  
T. Lu, T. Chen, W. Husak



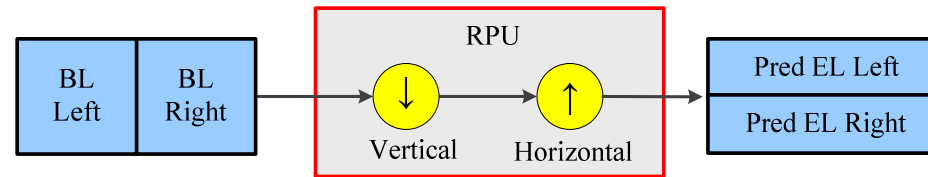
# Introduction: MFC WorkFlow

- MFC workflow: Encoding => Decoding => Reconstruction

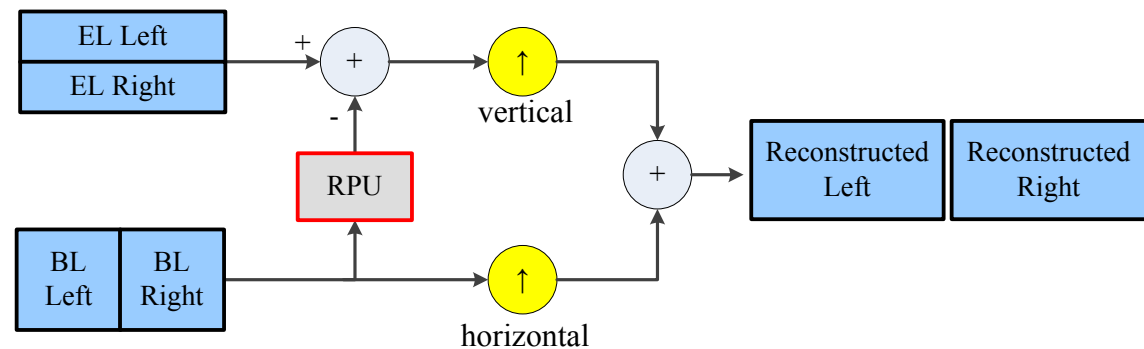


# Introduction: Filters in MFC

- In the RPU:
  - (vertical) downsampling + (horizontal) upsampling.
  - These filters are normative in the coding loop.



- In the Reconstruction:
  - (vertical / horizontal) upsampling
  - This filter is non-normative but recommended.



# Introduction: Current Working Draft

- Filters specified in the MFC working draft (N13137) are based on M27249
  - RPU downsampling and upsampling filters are normative and reconstruction upsampling filter is recommended.
  - RPU upsampling filter (4-tap) and full resolution reconstruction upsampling filter (6-tap) are different in software.
- Proposal: unify upsampling filters in RPU and full resolution reconstruction**

Doc. No.	RPU Downsampling Filter	RPU Upsampling Filter	Reconstruction Upsampling Filter
<b>M26661 (CfP bitstream)</b>	OM_RPU_DOWN_F1 (9-tap)	OM_RPU_UP_F0 (6-tap)	OM_RPU_UP_F0 (6-tap)
<b>M27249 (simplification)</b>	OM_RPU_DOWN_F0 (5-tap)	OM_RPU_UP_F1 (4-tap)	OM_RPU_UP_F0 (6-tap)
<b>This Proposal</b>	OM_RPU_DOWN_F0 (5-tap)	OM_RPU_UP_F0 (6-tap)	OM_RPU_UP_F0 (6-tap)

# Simulation:

- Follow test condition in MFC CfP
- CfP submission results (M26661) are used as anchor for BDRate and BDPSNR computation

- 2 Test Cases:

Test case 1 (Proposal) : unify the upsampling filter to be RPU\_OM\_UP\_F0 (6-tap) for both RPU and Recon.

	25% overhead		50% overhead	
	BDRate(%)	BDPSNR(dB)	BDRate(%)	BDPSNR(dB)
Billiards	-0.02	0.00	0.27	-0.01
NewsRoom	-0.42	0.01	-0.48	0.01
Amelia	0.14	0.00	0.37	-0.01
LivingRoomQuestion	0.54	-0.01	1.55	-0.04
Avg.	0.06	0.00	0.43	-0.01

Test case 2: unify the upsampling filter to be RPU\_OM\_UP\_F1 (4-tap) for both RPU and Recon.

	25% overhead		50% overhead	
	BDRate(%)	BDPSNR(dB)	BDRate(%)	BDPSNR(dB)
Billiards	1.08	-0.03	1.56	-0.05
NewsRoom	1.75	-0.05	1.99	-0.06
Amelia	3.37	-0.05	4.00	-0.06
LivingRoomQuestion	2.94	-0.08	4.16	-0.11
Avg.	2.28	-0.05	2.93	-0.07

## Conclusion

**Recommends the RPU\_OM\_UP\_F0 (6-tap) to be the upsampling filter used in both RPU and Reconstruction**

## Crosscheck: JCT3V-C0040

- We would like to thank InterDigital Communications, LLC for crosschecking the encoded bitstreams.
- Acknowledgement:
  - We would like to thank Fons Bruls from Philips for pointing out the issue of using different upsampling filters.

# Attachment

- Specification text with the suggested change. (All changes relative to JCT3V-C0038 are highlighted in yellow).
- Two excel files containing all the simulation results.
- Updated MFC software source code and software manual.
  - Software aligned with WD except OM\_RPU\_UP\_F0 is used instead of OM\_RPU\_UP\_F1.
  - PAFF and MBAFF are now supported in MFC software.



# Supplemental Results



# Additional Results

- M27249 are used as an anchor :
  - OM\_RPU\_UP\_F1 (4-tap) used for RPU upsampling and OM\_RPU\_UP\_F0 (6-tap) used for reconstruction

Proposal vs. M27249

	25% overhead		50% overhead	
	BD rate	BD PSNR	BD rate	BD PSNR
Billiards	0.21	-0.01	0.40	-0.01
NewsRoom	-0.20	0.01	-0.22	0.01
Amelia	-0.07	0.00	-0.03	0.00
LivingRoomQuestion	-0.08	0.00	0.04	0.00
Avg.	-0.04	0.00	0.05	0.00