



# **JCTVC-M0080**

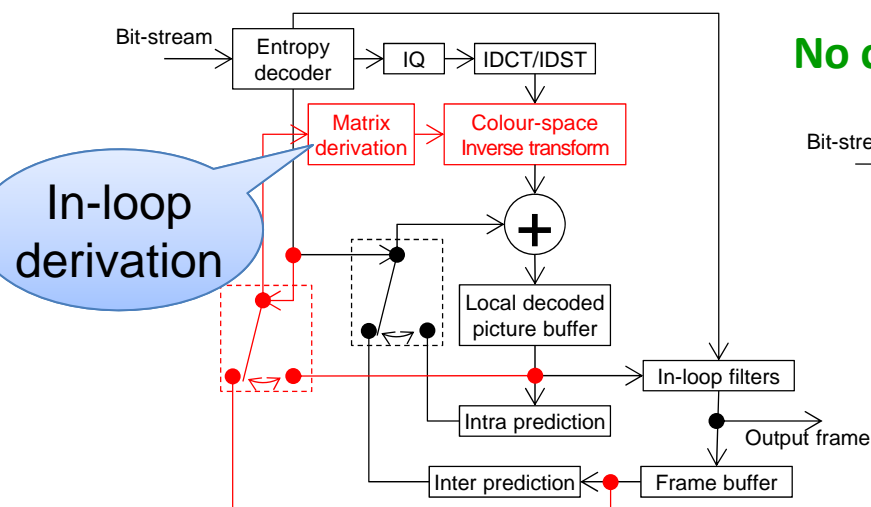
## **AHG7: Post filter for colour-space transformation**

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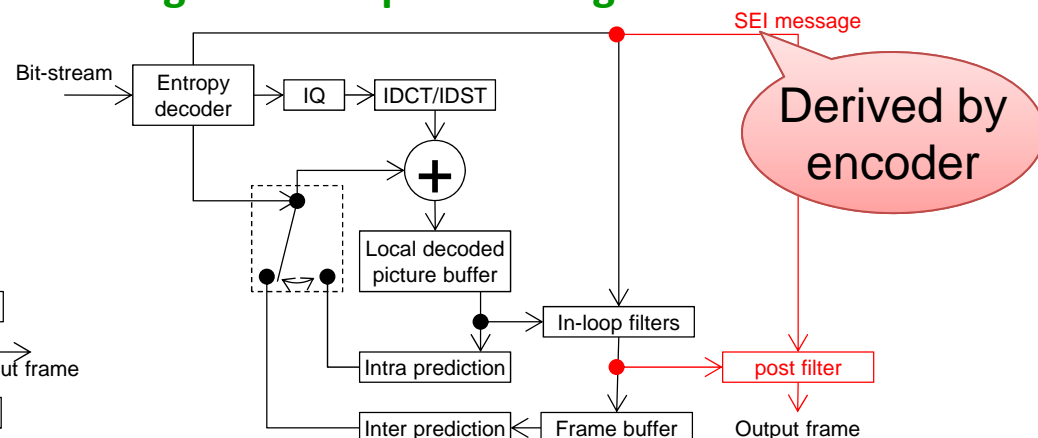
# CONCEPT

- **JCTVC-L0371 (proposed by KDDI)**
  - In-loop colour-space transformation for 4:4:4 sequences
- **JCTVC-M0048** [ proposed by FastVDO LLC  
RCE1: Adaptive Color Transforms for Range Extensions ]
  - Pre/post transformation using prepared 6 matrixes
- **Proposal (more flexible transformation)**
  - Pre/post transformation for RGB sequences
  - PCA in encoder derives the matrix for transformation



JCTVC-L0371

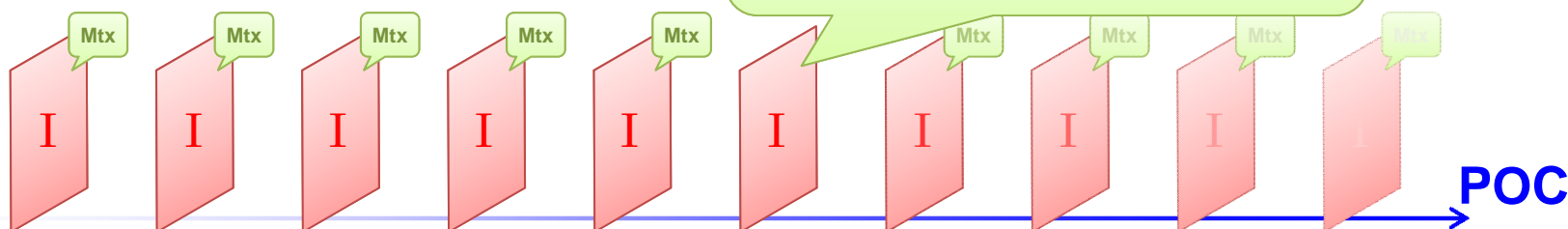
No change in in-loop block diagram



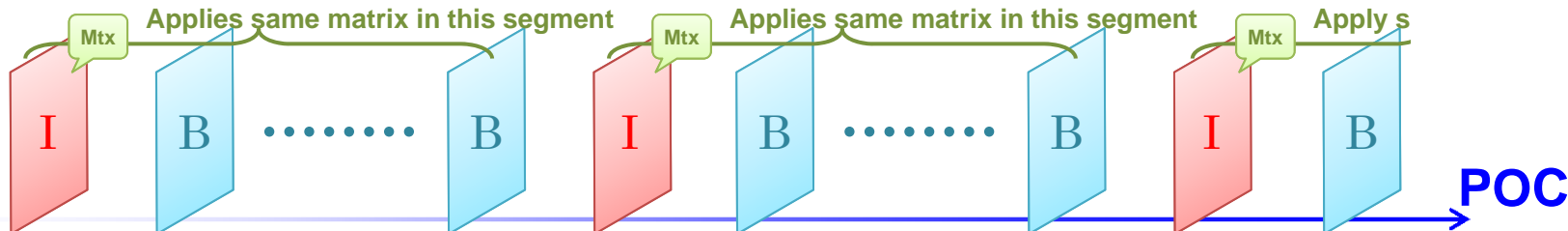
Proposal

# UPDATE FOR THE TRANS. MATRIX

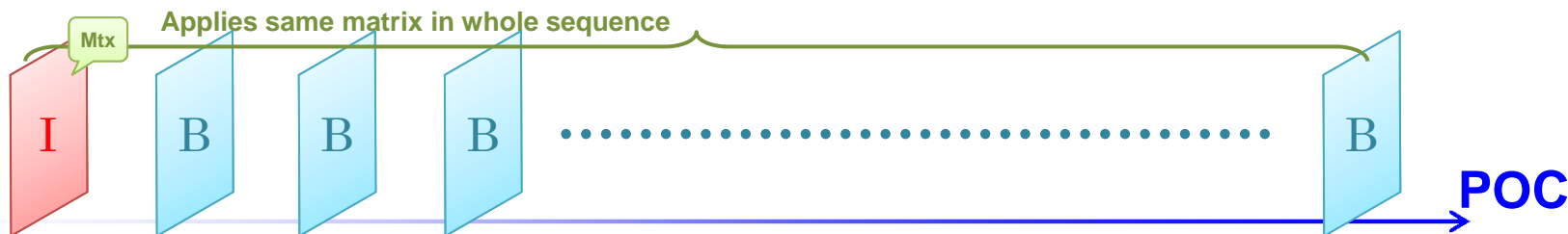
- All Intra (each frame)



- Random Access (each interval of I-frame on closed GOP)



- Low delay B (whole sequence)



# EXPERIMENTAL RESULTS (INTRA)

	All Intra Main-tier				All Intra High-tier				All Intra Super-High-tier			
	G	B	R	GBR	G	B	R	GBR	G	B	R	GBR
Traffic	-34.8%	-16.0%	-37.9%	-26.8%	-26.2%	-8.5%	-31.3%	-18.6%	-17.2%	-2.6%	-24.4%	-11.6%
Kimono	-27.1%	-11.2%	-27.8%	-20.7%	-10.1%	18.0%	-16.3%	4.8%	9.1%	19.3%	0.3%	11.6%
EBULupoCandlelight	-42.9%	-39.3%	-40.3%	-40.7%	-42.4%	-33.7%	-41.7%	-38.6%	-39.8%	-22.3%	-41.8%	-32.6%
EBURainFruits	-49.1%	-34.5%	-45.5%	-42.6%	-46.0%	-30.2%	-41.7%	-38.5%	-41.5%	-23.3%	-37.1%	-32.6%
VenueVu	-27.0%	-24.0%	-25.8%	-25.4%	-23.3%	-20.7%	-22.1%	-21.9%	-18.8%	-16.8%	-18.1%	-17.9%
DucksAndLegs	-14.2%	10.2%	-13.1%	0.2%	13.7%	14.7%	11.1%	14.2%	28.5%	17.5%	22.5%	22.3%
OldTownCross	-28.3%	-2.2%	-25.8%	-15.2%	-3.8%	3.9%	-8.1%	-1.5%	3.1%	1.4%	-0.8%	1.2%
ParkScene	-23.6%	-13.5%	-21.6%	-19.2%	-15.8%	0.8%	-14.8%	-7.8%	-2.4%	3.9%	-6.0%	-0.7%
Overall	-30.9%	-16.3%	-29.7%	-23.8%	-19.2%	-7.0%	-20.6%	-13.5%	-9.9%	-2.9%	-13.2%	-7.5%
	-30.2%	-16.5%	-28.0%	-22.1%	-18.4%	-10.4%	-20.8%	-13.6%	-11.2%	-3.1%	-14.1%	-8.0%
Enc Time[%]	89.9%				89.7%				90.4%			
Dec Time[%]	90.4% / 83.3%				87.0% / 80.9%				85.0% / 80.0%			

- EncTime includes run-time for matrix derivation and pre filtering
- DecTime includes run-time for post filtering
  - Red values denote DecTime without post filtering



# EXPERIMENTAL RESULTS (INTER)

Closed GOP	Random Access Main-tier				Random Access High-tier			
	G	B	R	GBR	G	B	R	GBR
Traffic	-40.4%	-13.9%	-42.7%	-29.2%	-34.8%	0.0%	-38.7%	-18.8%
Kimono	-32.9%	-35.9%	-35.2%	-35.7%	-33.6%	5.0%	-37.7%	-20.0%
EBULupoCandlelight	-37.5%	-35.1%	-36.3%	-36.2%	-42.9%	-36.9%	-43.3%	-40.9%
EBURainFruits	-46.0%	-30.0%	-46.8%	-40.5%	-47.9%	-29.3%	-47.9%	-40.9%
VenueVu	-22.8%	-22.3%	-25.2%	-24.3%	-21.8%	-21.2%	-23.7%	-23.0%
DucksAndLegs	-36.2%	2.4%	-35.1%	-26.7%	-8.2%	42.8%	-5.2%	15.1%
OldTownCross	-40.3%	-28.8%	-52.7%	-46.7%	-9.3%	16.2%	-15.8%	-4.1%
ParkScene	-25.2%	-24.5%	-27.4%	-26.4%	-25.5%	1.9%	-28.6%	-18.2%
Overall	-35.2%	-23.5%	-37.7%	-33.2%	-28.0%	-2.7%	-30.1%	-18.8%
	-34.8%	-15.2%	-38.1%	-32.8%	-20.4%	-15.4%	-25.5%	-11.7%
Enc Time[%]	84.4%				80.3%			
Dec Time[%]	99.4% / 85.2%				90.6% / 79.7%			

	Low delay B Main-tier				Low delay B High-tier			
	G	B	R	GBR	G	B	R	GBR
Traffic	-45.2%	-11.2%	-48.7%	-31.5%	-39.0%	5.1%	-45.4%	-19.8%
Kimono	-33.8%	-32.2%	-33.7%	-33.7%	-40.1%	15.3%	-42.0%	-15.9%
EBULupoCandlelight	-34.7%	-31.5%	-32.6%	-32.4%	-46.5%	-32.6%	-45.0%	-40.4%
EBURainFruits	-46.9%	-26.9%	-44.7%	-39.2%	-50.0%	-25.1%	-46.5%	-40.0%
VenueVu	-23.8%	-20.8%	-24.3%	-23.7%	-22.6%	-20.0%	-23.0%	-22.6%
DucksAndLegs	-46.9%	8.5%	-44.7%	-27.8%	-12.7%	42.8%	-6.3%	16.2%
OldTownCross	-55.0%	-29.3%	-58.0%	-51.8%	-21.2%	14.8%	-16.4%	-7.6%
ParkScene	-27.9%	-22.4%	-27.8%	-26.8%	-32.5%	8.1%	-31.6%	-17.9%
Overall	-39.3%	-20.7%	-39.3%	-33.4%	-33.1%	1.1%	-32.0%	-18.5%
	-39.0%	-5.1%	-39.7%	-32.3%	-21.6%	-6.3%	-28.1%	-15.8%
Enc Time[%]	85.2%				82.3%			
Dec Time[%]	93.8% / 77.8%				85.9% / 74.2%			

# CONCLUSION

- Proposed post filter for colour-space transformation
  - Average gains calculated by GBR BD-rate:

	Main-tier	High-tier	Super-high-tier
All Intra	23.8%	13.5%	7.5%
Random Access	33.2%	18.8%	N/A
Low delay B	33.4%	18.5%	N/A

- Average run-time saving:
  - Enc: 9.6-19.7% (with matrix derivation and pre filtering)
  - Dec: 0.6-15.0% (with post filtering), **14.8-25.8%** (without post filtering)
- Cross-checked by KDDI (JCTVC-M0408)
- Features:
  - Maintains channel independency in in-loop process
  - No change in in-loop block diagram for encoder/decoder
  - Generates suitable transformation matrix for particular sequences