

# **Burst transmission of I\_PCM blocks (JCTVC-H0051/ M22916)**

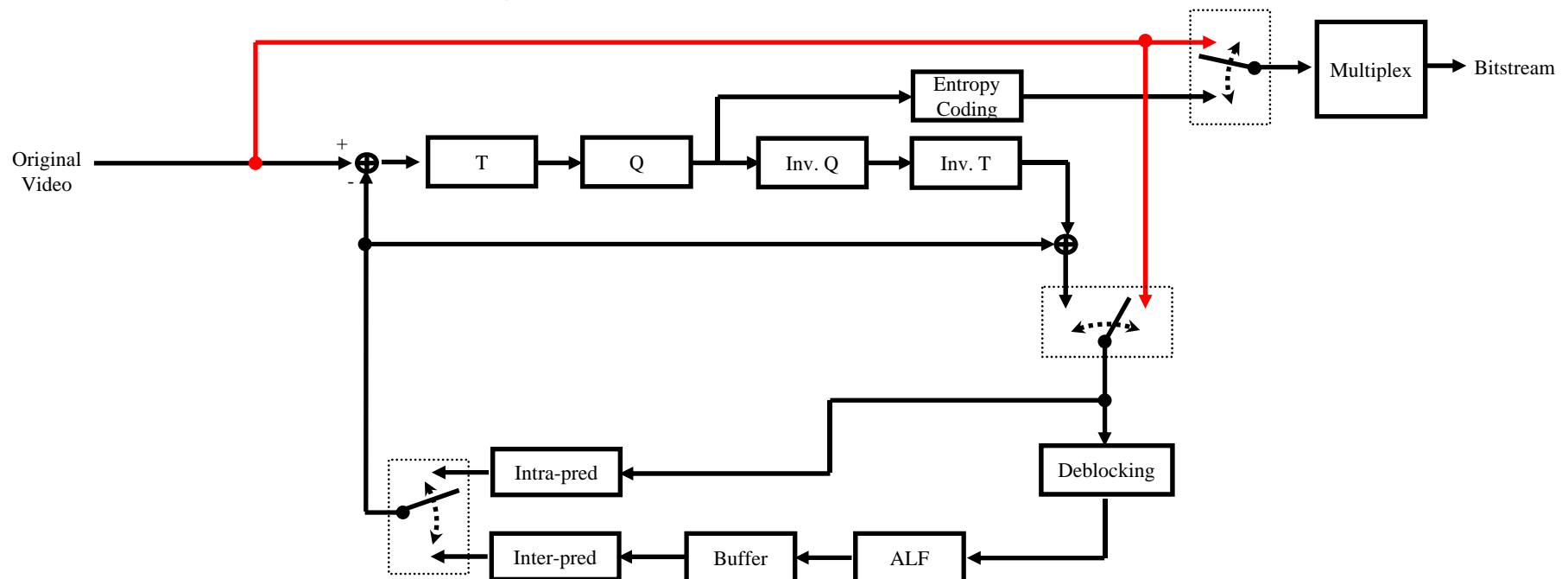
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# Summary

- Review of I\_PCM mode
- Proposal: Burst transmission of successive I\_PCM blocks
- Simulation results
  - No changes in BD-rates and negligible changes in enc/dec times for common test sequences using I\_PCM
  - 2.4% reduction in the header bitrates of loss-less coded video with negligible changes in enc/dec times
- Recommendation
  - Adopt Burst I\_PCM into HM-6.0

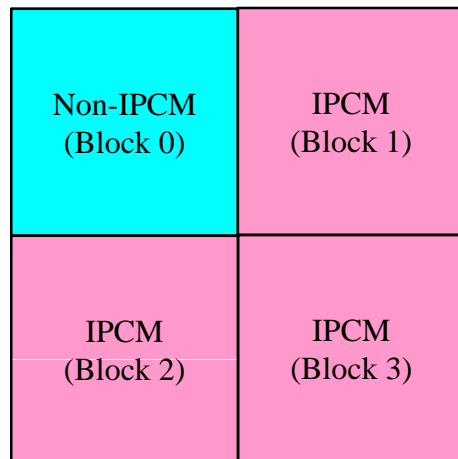
# Review of I\_PCM Mode

- Simple coding means: **No prediction, no transform, and no entropy-coding**
- Enable to accurately represent the anomalous picture content without significant data expansion

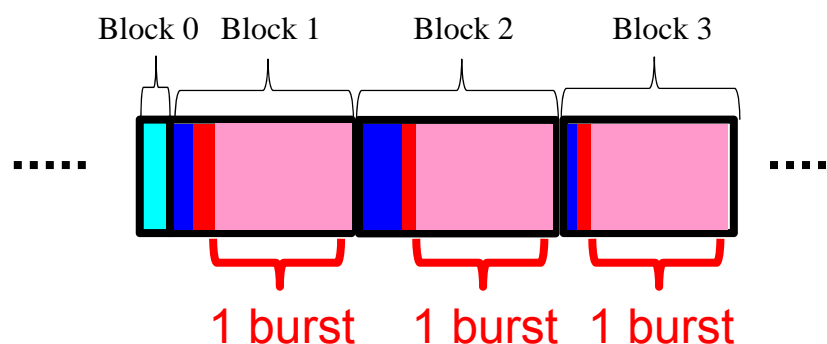


# Signaling Issue of Successive I\_PCM Blocks

- Transmission of PCM sample data of each of successive I\_PCM blocks is terminated.
  - Sub-optimal throughput of transmitting PCM sample data
  - Increase bits of side-information



(a)



■ `pred_type`, `pcm_flag`, etc.

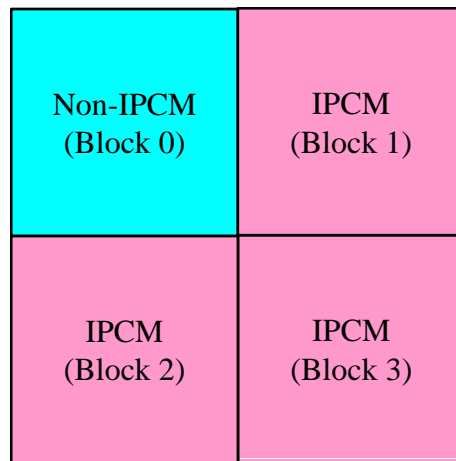
■ `pcm_alignment_zero_bit`

■ PCM sample data (luma/chroma)

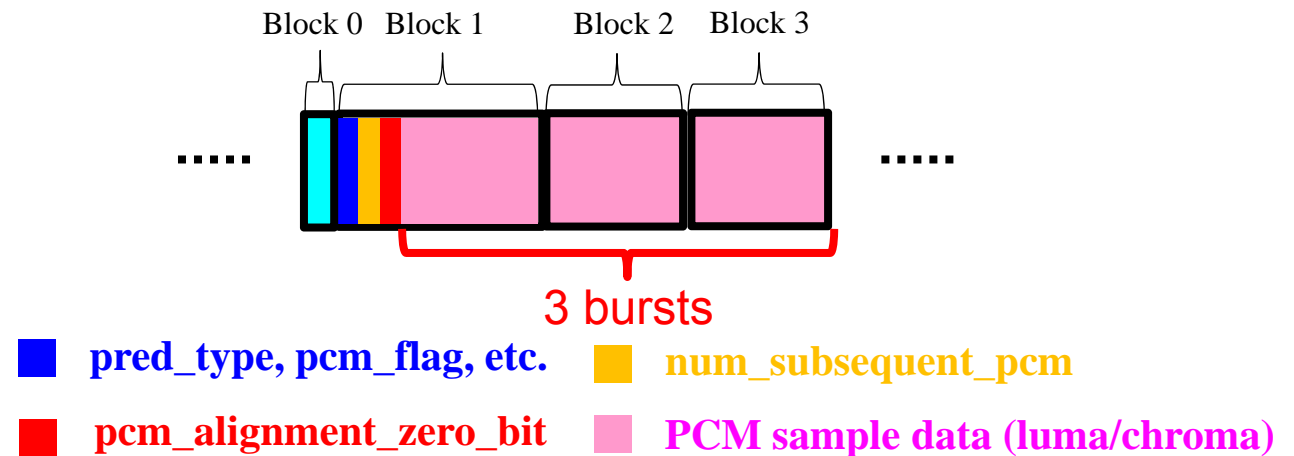
(b) HM bitstream of (a)

# Proposal: Burst I\_PCM Coding

- Signal the number of subsequently coded I-PCM blocks at the PU header of the first I\_PCM block
- PCM sample data of successive I\_PCM blocks follow the pcm\_alignment\_zero\_bit of the first I\_PCM block.
  - Optimal throughput of transmitting PCM sample data
  - Decrease bits of side-information



(a)



(b) Proposal's bitstream of (a)

# Definition of Subsequent I\_PCM Blocks

- Given the first I\_PCM block of a TB, successive I\_PCM blocks in the same depth of the TB that follow it.
  - The number is in the range of 0 to 3.
  - Easy to count the number of them because they are in the same depth of a TB
- The bit representation below is directly transmitted in a way similar to pcm\_alignment\_zero\_bit.
  - No changes of DecodeTerminate process for pcm\_flag / end\_of\_slice\_flag

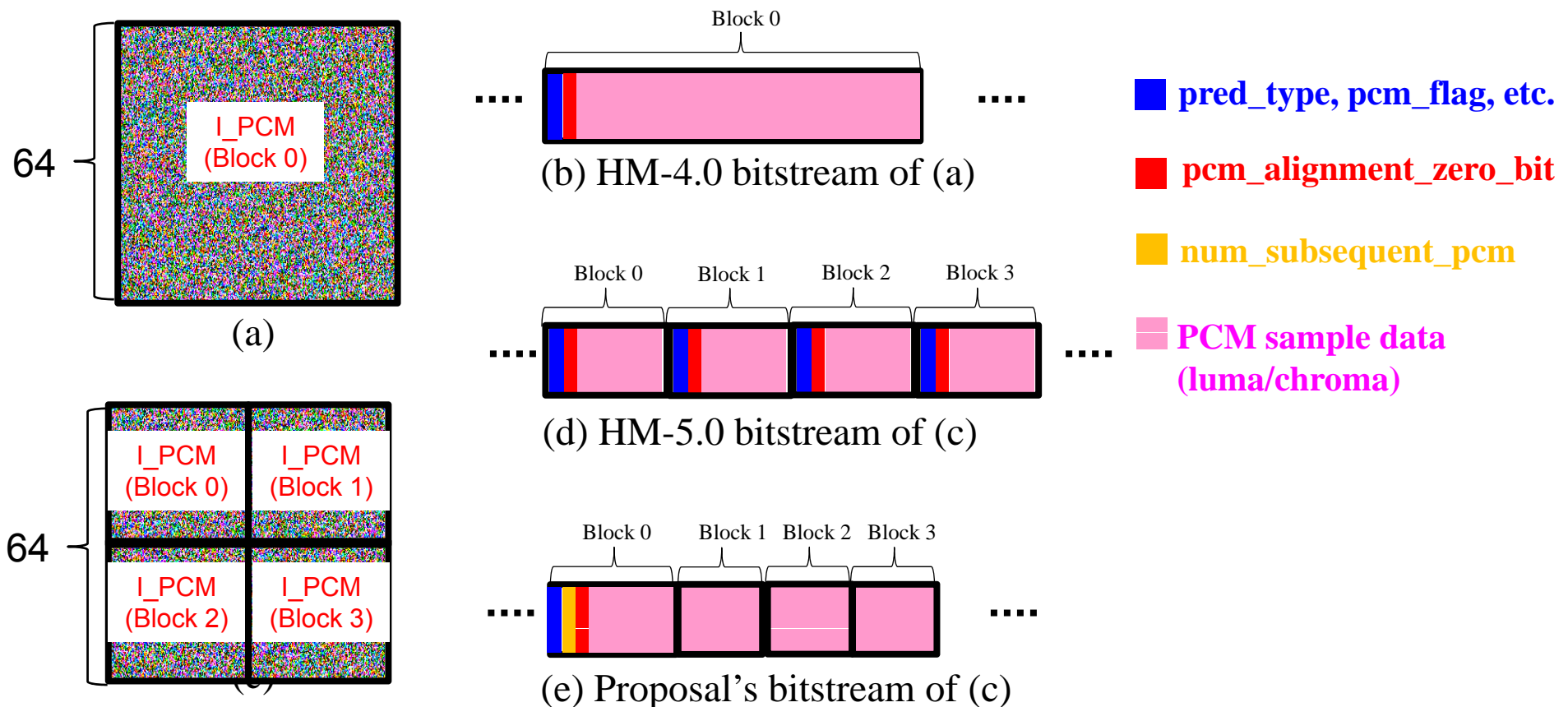
num_subsequent_pcm	Bit representation		
	1st	2nd	3rd
0	0		
1	1	0	
2	1	1	0
3	1	1	1

# Analysis of Proposal

- Two normative modifications to encoder/decoder
  - Write/read bits before pcm\_alignment\_zero\_bit
  - Skip coding/decoding of PU headers for I\_PCM blocks
- Freedom in encoder implementations
  - One can count # of I\_PCM blocks and signal it.
  - Another can skip counting # of I\_PCM blocks and transmit each of I\_PCM blocks separately as the current HM does

# Analysis of Proposal (Cont.)

- Enable to transmit 64x64 anomalous regions w/o termination associated with entropy coding
  - Significant improvement in transmission throughput of PCM sample data





# Simulation

- Two tests
  - Common test sequences with JCTVC-G1200 using I\_PCM (PCMEnabledFlag=1, PCMLog2MaxSize=5, and PCMLog2MinSize=3)
  - Synthesized test sequence with low QPs (0, 4, 8, and 12)



Synthesized sequence, *Sandstorms* (CIF 30Hz)

# Common Test Sequence Results

	All Intra HE			All Intra LC			All Intra HE-10		
	Y	U	V	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Enc Time[%]	101%			101%					
Dec Time[%]	101%			101%					
	Random Access HE			Random Access LC			Random Access HE-10		
	Y	U	V	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class E									
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Enc Time[%]	100%			100%			102%		
Dec Time[%]	100%			97%			101%		
	Low delay B HE			Low delay B LC			Low delay B HE-10		
	Y	U	V	Y	U	V	Y	U	V
Class A									
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Enc Time[%]	101%			101%					
Dec Time[%]	100%			101%					

- No changes in BD-rates since I\_PCM is not selected.

- Negligible changes in enc/dec times because of minor software modifications.

# Synthesized Test Sequence Results

HE RA results										
QP I-slice	HM-5.0-dev-highlevel-rev1712				JCTVC-H0051				Rate reduction %	
	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total	Header
0	37831.52	0.08	0.87	1336.16	37799.66	0.08	0.87	1304.30	0.08	2.38
4	37831.58	0.08	0.87	1336.22	37799.72	0.08	0.86	1304.36	0.08	2.38
8	37831.62	0.07	0.87	1336.26	37799.75	0.07	0.86	1304.39	0.08	2.38
12	37831.63	0.07	0.87	1336.27	37799.77	0.07	0.87	1304.41	0.08	2.38
									Ave rate reduction %	
									Total	Header
									0.08	2.38
									Ave time %	
									Enc T	Dec T
									100	99

Header = Compressed video – original video

LC RA results										
QP I-slice	HM-5.0-dev-highlevel-rev1712				JCTVC-H0051				Rate reduction %	
	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total	Header
0	37830.99	0.05	0.86	1335.63	37799.13	0.05	0.86	1303.77	0.08	2.39
4	37831.04	0.05	0.87	1335.68	37799.18	0.05	0.87	1303.82	0.08	2.39
8	37831.10	0.04	0.87	1335.74	37799.23	0.04	0.87	1303.87	0.08	2.39
12	37831.10	0.04	0.87	1335.74	37799.24	0.04	0.87	1303.88	0.08	2.39
									Ave rate reduction %	
									Total	Header
									0.08	2.39
									Ave time %	
									Enc T	Dec T
									100	100

- 2.4% (or 32kbps) reduction in the header bitrates by skipping coding of some PU headers of I\_PCM blocks.

# Additional Results for Synthesized Test Sequence (Proposal sets # of I\_PCM blocks to 1 always.)

HE RA results										
HM-5.0-dev-highlevel-rev1712					JCTVC-H0051 using serial mode encoding				Rate reduction %	
QP I-slice	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total	Header
0	37831.52	0.08	0.87	1336.16	37831.52	0.08	0.87	1336.16	0.00	0.00
4	37831.58	0.08	0.87	1336.22	37831.58	0.08	0.87	1336.22	0.00	0.00
8	37831.62	0.07	0.87	1336.26	37831.62	0.07	0.87	1336.26	0.00	0.00
12	37831.63	0.07	0.87	1336.27	37831.63	0.07	0.89	1336.27	0.00	0.00
									Ave rate reduction %	
									Total	Header
									0.00	0.00
									Ave time %	
									Enc T	Dec T
									100	100

LC RA results										
HM-5.0-dev-highlevel-rev1712					JCTVC-H0051 using serial mode encoding				Rate reduction %	
QP I-slice	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total kbps	Enc T[h]	Dec T [s]	Header kbps	Total	Header
0	37830.99	0.05	0.86	1335.63	37830.99	0.05	0.87	1335.63	0.00	0.00
4	37831.04	0.05	0.87	1335.68	37831.04	0.05	0.87	1335.68	0.00	0.00
8	37831.10	0.04	0.87	1335.74	37831.10	0.04	0.87	1335.74	0.00	0.00
12	37831.10	0.04	0.87	1335.74	37831.10	0.04	0.86	1335.74	0.00	0.00

- No changes in bitrates due to the presence of pcm\_alignment\_zero\_bit
- Simple encoder implementation is possible w/o affecting coding efficiency.

Ave rate reduction %	
Total	Header
0.00	0.00
Ave time %	
Enc T	Dec T
100	100

# Conclusions

- Review of I\_PCM mode
- Burst transmission of successive I\_PCM blocks
  - Significant improvement in transmission throughput of PCM sample data with some side-information reduction
  - Minor modification to the current HM design
  - Freedom in encoder implementations
- Simulation results
  - X-checked by Mitsubishi and Panasonic.
- Recommendation
  - Adopt Burst I\_PCM into HM-6.0

Empowered by Innovation

**NEC**

# Signaling of I\_PCM Block

- Presence of `pcm_flag=1` indicates that CU is I\_PCM block.
- `pcm_flag` syntax presents after CU/PU header parameters such as `split_coding_unit_flag`, `pred_type`, etc.
- `pcm_alignment_zero_bit` and PCM sample data follow it.

