

JCTVC-E222

Slices Modification for HEVC

N.Ouedraogo, P.Onno, G.Laroche,
E.Francois, C.Gisquet

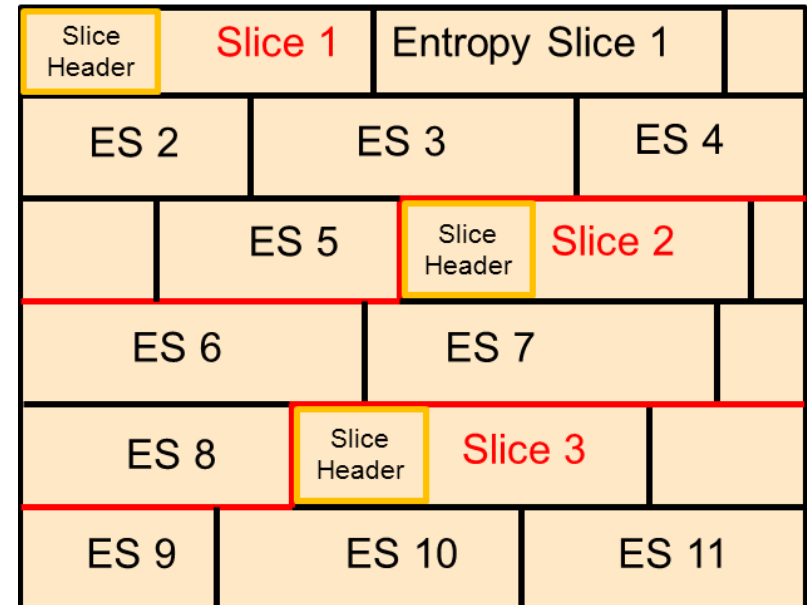
JCT-VC 5th Meeting, Geneva 16-23 March, 2011

Usage of slices in streaming context

- For RTP/UDP communication protocol, 3 main packetization approaches
 1. Single NAL unit (e.g. one slice) in one packet
 2. Multiple NAL units in one packet
 3. One NAL unit is fragmented in several consecutive packet
- Transmission errors on the network
 - To avoid using 3rd alternative which is very sensitive to packet loss
 - Clients adapt the size of one slice to the MTU size
 - Error propagation within one frame occurs
 - Inside the motion vector field and in reconstructed pixel blocks
 - Can be limited by breaking all coding dependencies at slice boundaries
- Thus slices are required for streaming
 - But slices increase overall bitrate

Current slices definition in HM2.0

- Entropy slice
 - guarantee independent entropy decoding and reduced bitrate increase in comparison of usual slices
- Slices
 - Limit error propagation at slice boundaries as they are independently coded
- Entropy slices and usual slices are differentiated by entropy_flag which controls the presence of slice headers parameters
 - Slice header indicates a coding dependencies break



Proposed Slices modifications

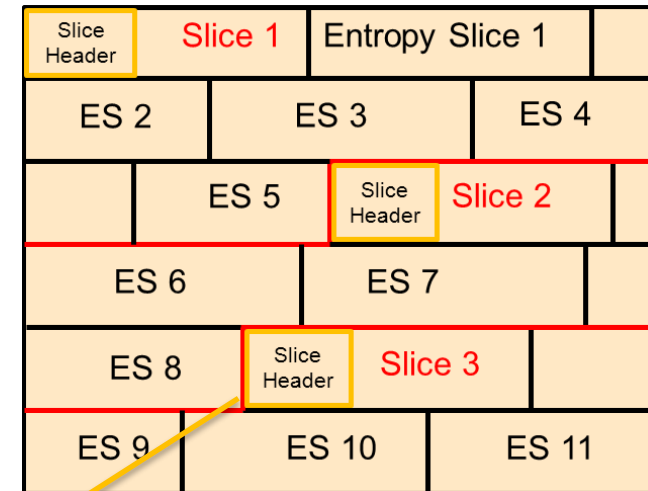
- Creation of a new **Slice Parameter Set** NALU:

- Basic principle

- Move current Slice parameters from Slice Header to this new NAL unit defined at picture level
- Slice Header syntax is reduced to only 2 parameters
 - address of first CU and CABAC context
- One Slice Parameter Set associated per frame

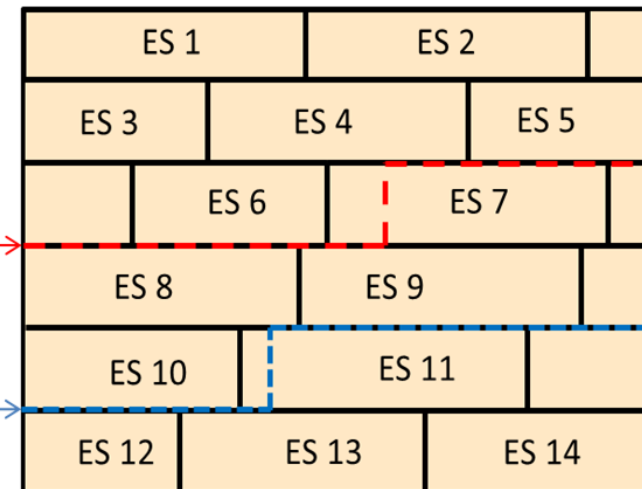
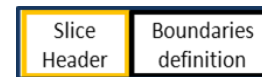
- Motivation

- Avoid redundant coding of slice parameters
- Coding gain is expected



HM2.0

Slice Parameter Set

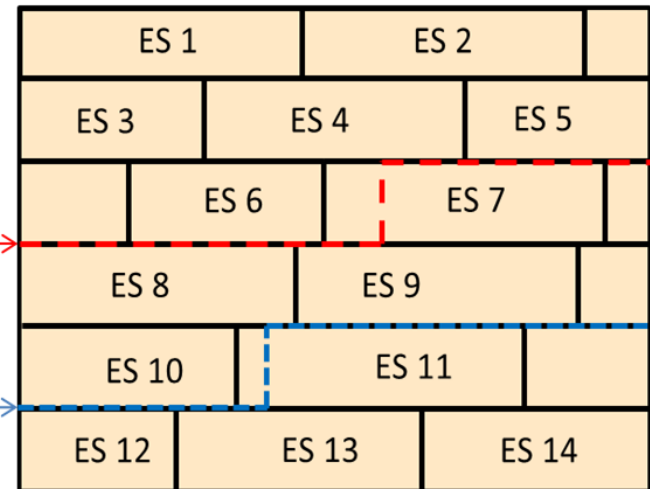


Proposal

Proposed Slices Modifications

- Define boundaries in this Slice Parameter Sets NAL unit
 - For Intra and inter prediction processes
 - Signaled by the LCU address
 - Can be defined independently of slice boundaries dedicated to entropy coding process
 - For Loop filter process
 - Signaled by the LCU address
 - Independent of other boundaries

Slice Parameter Set



Slice Parameter Set Syntax

Former slice header syntax

Inter/intra boundaries signalling syntax

Loop filter parameter and boundaries signalling

slice_parameter_set_rbsp()	Descriptor
pic_parameter_set_id	ue(v)
seq_parameter_set_id	ue(v)
frame_type	ue(v)
frame_num	u(v)
if(IdrPicFlag)	
idr_pic_id	ue(v)
pic_order_cnt_lsb	u(v)
if(frame_type == P frame_type == B) {	
num_ref_idx_active_override_flag	u(1)
if(num_ref_idx_active_override_flag) {	
num_ref_idx_0_active_minus1	ue(v)
if(slice_type == B)	
num_ref_idx_1_active_minus1	ue(v)
}	
}	
ref_pic_list_modification()	
ref_pic_list_combination()	
if(nal_ref_idc != 0)	
dec_ref_pic_marking()	
if(frame_type == B)	
collocated_from_0_flag	u(1)
num_recons_slices_minus1	ue(v)
for(i = 0; i < num_recons_slices_minus1; i++)	
recons_slice_index_offset_in_tb[i]	ue(v)
for(i = 0; i <= num_recons_slices_minus1; i++)	
recons_slice_qp_delta[i]	se(v)
num_loop_filter_slices_minus1	ue(v)
for(i = 0; i < num_loop_filter_slices_minus1; i++)	
lf_slice_index_offset_in_tb[i]	ue(v)
for(i = 0; i <= num_loop_filter_slices_minus1; i++) {	
alf_param()	
if(deblocking_filter_control_present_flag) {	
disable_deblocking_filter_idc	
if(disable_deblocking_filter_idc != 1) {	
slice_alpha_c0_offset_div2	
slice_beta_offset_div2	
}	
}	
rbbsp_trailing_bits()	
}	

Slice Syntax: few elements now

slice_layer_rbsp() {	Descriptor
first_tb_in_slice	ue(v)
if(entropy_coding_mode_flag && slice_type != I)	
cabac_init_idc	ue(v)
slice_data()	
rbp_slice_trailing_bits()	
}	

Virtual slices

- Boundaries defined in Slice Parameter Sets can be considered as definition of new virtual slices
 - Reconstruction slices that break all inter and intra prediction coding dependencies
 - Loop filter slices which break loop filter dependencies
 - Virtual slices since not physically corresponding to one NAL unit
 - Each virtual slices and slices are independently defined
- Slice Parameter Sets also defines coding parameters for each virtual slices
 - Reconstruction slices: Quantization parameters
 - Loop filter slices: Deblocking filter activation flag and ALF parameters

Benefits of the proposal for streaming

- Slices partitioning for network requirements and coding efficiency is separately defined
 - The slice partitioning process can be adapted to the application
 - Slices partitioning for network transport
 - Reconstruction virtual slices for error propagations limitation
 - Loop filter virtual slices for accurate loop filtering
 - Same partitioning as with slices and entropy slices is permitted
- Availability of Slice Parameters Sets prior to slice data enables
 - Identification of coding boundaries even in case of slice loss
 - Adaptation of error concealment and video quality estimation strategy
- Forward Error Correction can be applied only on parameter sets to retrieve most important coding parameters
 - Complex with usual slices and entropy slices

Benefits for coding performance

- Proposal defines independent partitions for main decoding processes
 - Flexible parallelization is thus allowed
 - Independent parallelization level for main decoding processes
 - Parallelization of syntax decoding process based on slices
 - Parallelization of pixel reconstruction process based on reconstruction slices
 - Parallelization of Loop filter process based on loop filter slices
 - Decoder may initialize its parallelization resources in accordance to Slice Parameter Sets
- Coding gain is expected
 - Remove redundant coding of slice header
 - Higher flexibility regarding inter slice dependencies for the reconstruction and loop filter processes

Conclusion

- Goal of this proposal
 - Introduce flexible and independent partitioning for the main decoding processes of HEVC codec.
- Main points of this proposal
 - Creation of a Slice Parameter Set NAL unit
 - Introduction of coding dependencies and filtering boundaries/parameters in the proposed Slice Parameter Set.
- Main advantages
 - One single Slice Parameter Sets improves the coding efficiency
 - Parallelization of the decoding process (entropy, reconstruction, loop filtering)
 - Forward Error Correction can also take advantage of this single Slice Parameter Sets NAL unit for reliable video streaming.
- Recommendation
 - We propose to further study this proposition in “Slice” Ad-Hoc Group or in a CE to further evaluate this proposal.