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Information technology — Coding of audio-visual objects —

Part 10: Advanced Video Coding

AMENDMENT 1: Multiview Video Coding

Technologies de l'information — Codage des objets audiovisuels —

Partie 10: Codage visuel avancé

AMENDEMENT 1: Codage vidéo multivues

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Information technology — Coding of audio-visual objects —

Part 10: Advanced Video Coding

AMENDMENT 1: Multiview Video Coding

In 0.6, add the following paragraph after the paragraph that starts with “Scalable video coding”:

Multiview video coding is specified in Annex H allowing the construction of bitstreams that represent multiple views. Similar to scalable video coding, bitstreams that represent multiple views may also contain sub-bitstreams that conform to this specification. For temporal bitstream scalability, i.e., the presence of a sub-bitstream with a smaller temporal sampling rate than the bitstream, complete access units are removed from the bitstream when deriving the sub-bitstream. In this case, high-level syntax and inter prediction reference pictures in the bitstream are constructed accordingly. For view bitstream scalability, i.e. the presence of a sub-bitstream with fewer views than the bitstream, NAL units are removed from the bitstream when deriving the sub-bitstream. In this case, inter-view prediction, i.e., the prediction of one view signal by data of another view signal, is typically used for efficient coding.

In 0.7, add the following paragraph after the paragraph that starts with “Annex G specifies”:

Annex H specifies multiview video coding (MVC). The reader is referred to Annex H for the entire decoding process for MVC, which is specified there with references being made to clauses 2-9 and Annexes A-E. Subclause H.10 specifies one profile for MVC (Multiview High).

In 7.3.1, NAL unit syntax, replace:

```
nal_unit_header_svc_extension() /* specified in Annex G */
```

with:

```
nal_unit_header_extension() /* specified in Annexes G and H */
```

In 7.3.2.1.1, Sequence parameter set data syntax, replace the syntax table with:

seq_parameter_set_data() {	C	Descriptor
profile_idc	0	u(8)
constraint_set0_flag	0	u(1)
constraint_set1_flag	0	u(1)
constraint_set2_flag	0	u(1)
constraint_set3_flag	0	u(1)
constraint_set4_flag	0	u(1)
reserved_zero_3bits /* equal to 0 */	0	u(3)
level_idc	0	u(8)
seq_parameter_set_id	0	ue(v)
if(profile_idc == 100 profile_idc == 110 profile_idc == 122 profile_idc == 244 profile_idc == 44 profile_idc == 83 profile_idc == 86 profile_idc == 118) {		
chroma_format_idc	0	ue(v)
if(chroma_format_idc == 3)		

separate_colour_plane_flag	0	u(1)
bit_depth_luma_minus8	0	ue(v)
bit_depth_chroma_minus8	0	ue(v)
qpprime_y_zero_transform_bypass_flag	0	u(1)
seq_scaling_matrix_present_flag	0	u(1)
if(seq_scaling_matrix_present_flag)		
for(i = 0; i < ((chroma_format_idc != 3) ? 8 : 12); i++) {		
seq_scaling_list_present_flag[i]	0	u(1)
if(seq_scaling_list_present_flag[i])		
if(i < 6)		
scaling_list(ScalingList4x4[i], 16, UseDefaultScalingMatrix4x4Flag[i])	0	
else		
scaling_list(ScalingList8x8[i - 6], 64, UseDefaultScalingMatrix8x8Flag[i - 6])	0	
}		
}		
log2_max_frame_num_minus4	0	ue(v)
pic_order_cnt_type	0	ue(v)
if(pic_order_cnt_type == 0)		
log2_max_pic_order_cnt_lsb_minus4	0	ue(v)
else if(pic_order_cnt_type == 1) {		
delta_pic_order_always_zero_flag	0	u(1)
offset_for_non_ref_pic	0	se(v)
offset_for_top_to_bottom_field	0	se(v)
num_ref_frames_in_pic_order_cnt_cycle	0	ue(v)
for(i = 0; i < num_ref_frames_in_pic_order_cnt_cycle; i++)		
offset_for_ref_frame[i]	0	se(v)
}		
max_num_ref_frames	0	ue(v)
gaps_in_frame_num_value_allowed_flag	0	u(1)
pic_width_in_mbs_minus1	0	ue(v)
pic_height_in_map_units_minus1	0	ue(v)
frame_mbs_only_flag	0	u(1)
if(!frame_mbs_only_flag)		
mb_adaptive_frame_field_flag	0	u(1)
direct_8x8_inference_flag	0	u(1)
frame_cropping_flag	0	u(1)
if(frame_cropping_flag) {		
frame_crop_left_offset	0	ue(v)
frame_crop_right_offset	0	ue(v)
frame_crop_top_offset	0	ue(v)
frame_crop_bottom_offset	0	ue(v)
}		
vui_parameters_present_flag	0	u(1)
if(vui_parameters_present_flag)		
vui_parameters()	0	
}		

In 7.3.3, Slice header syntax, replace the condition:

```
if( nal_unit_type == 5 )
```

with:

```
if( IdrPicFlag )
```

In 7.4.1, NAL unit semantics, make the following changes:

Replace the following paragraph:

For coded video sequences conforming to one or more of the profiles specified in Annex A that are decoded using the decoding process specified in clauses 2-9, VCL and non-VCL NAL units are specified in Table 7-1 in the column labelled "Annex A NAL unit type class". For coded video sequences conforming to one or more of the profiles specified in Annex G that are decoded using the decoding process specified in Annex G, VCL and non-VCL NAL units are specified in Table 7-1 in the column labelled "Annex G NAL unit type class". The entry "suffix dependent" for nal_unit_type equal to 14 is specified as follows.

with:

For coded video sequences conforming to one or more of the profiles specified in Annex A that are decoded using the decoding process specified in clauses 2-9, VCL and non-VCL NAL units are specified in Table 7-1 in the column labelled "Annex A NAL unit type class". For coded video sequences conforming to one or more of the profiles specified in Annex G that are decoded using the decoding process specified in Annex G or specified in Annex H that are decoded using the decoding process specified in Annex H, VCL and non-VCL NAL units are specified in Table 7-1 in the column labelled "Annex G and Annex H NAL unit type class". The entry "suffix dependent" for nal_unit_type equal to 14 is specified as follows.

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Replace Table 7-1 with:

Table 7-1 – NAL unit type codes, syntax element categories, and NAL unit type classes

nal_unit_type	Content of NAL unit and RBSP syntax structure	C	Annex A NAL unit type class	Annex G and Annex H NAL unit type class
0	Unspecified		non-VCL	non-VCL
1	Coded slice of a non-IDR picture slice_layer_without_partitioning_rbsp()	2, 3, 4	VCL	VCL
2	Coded slice data partition A slice_data_partition_a_layer_rbsp()	2	VCL	not applicable
3	Coded slice data partition B slice_data_partition_b_layer_rbsp()	3	VCL	not applicable
4	Coded slice data partition C slice_data_partition_c_layer_rbsp()	4	VCL	not applicable
5	Coded slice of an IDR picture slice_layer_without_partitioning_rbsp()	2, 3	VCL	VCL
6	Supplemental enhancement information (SEI) sei_rbsp()	5	non-VCL	non-VCL
7	Sequence parameter set seq_parameter_set_rbsp()	0	non-VCL	non-VCL
8	Picture parameter set pic_parameter_set_rbsp()	1	non-VCL	non-VCL
9	Access unit delimiter access_unit_delimiter_rbsp()	6	non-VCL	non-VCL
10	End of sequence end_of_seq_rbsp()	7	non-VCL	non-VCL
11	End of stream end_of_stream_rbsp()	8	non-VCL	non-VCL
12	Filler data filler_data_rbsp()	9	non-VCL	non-VCL
13	Sequence parameter set extension seq_parameter_set_extension_rbsp()	10	non-VCL	non-VCL
14	Prefix NAL unit prefix_nal_unit_rbsp() /* specified in Annex G and Annex H */	2	non-VCL	suffix dependent
15	Subset sequence parameter set subset_seq_parameter_set_rbsp() /* specified in Annex G and Annex H */	0	non-VCL	non-VCL
16..18	Reserved		non-VCL	non-VCL
19	Coded slice of an auxiliary coded picture without partitioning slice_layer_without_partitioning_rbsp()	2, 3, 4	non-VCL	non-VCL
20	Coded slice extension slice_layer_extension_rbsp() /* specified in Annex G and Annex H */	2, 3, 4	non-VCL	VCL
21..23	Reserved		non-VCL	non-VCL
24..31	Unspecified		non-VCL	non-VCL

In 7.4.2.1.1, *Sequence parameter set data semantics*, make the following changes:

Add the following text after the paragraph starting with “*constraint_set3_flag*”:

constraint_set4_flag equal to 1 indicates that the coded video sequence obeys all constraints specified in subclause H.10.1. **constraint_set4_flag** equal to 0 indicates that the coded video sequence may or may not obey all constraints specified in subclause H.10.1.

Replace:

reserved_zero_4bits shall be equal to 0. Other values of **reserved_zero_4bits** may be specified in the future by ITU-T | ISO/IEC. Decoders shall ignore the value of **reserved_zero_4bits**.

with:

reserved_zero_3bits shall be equal to 0. Other values of **reserved_zero_3bits** may be specified in the future by ITU-T | ISO/IEC. Decoders shall ignore the value of **reserved_zero_3bits**.

In C, *Hypothetical reference decoder*, replace:

For each picture in the bitstream, the variable **OutputFlag** for the decoded picture and, when applicable, the reference base picture is set as follows.

- If the coded video sequence containing the picture conforms to one or more of the profiles specified in Annex A and the decoding process specified in clauses 2-9 is used), **OutputFlag** is set equal to 1.
- Otherwise (the coded video sequence containing the picture conforms to a profile specified in Annex G and the decoding process specified in Annex G is used), the following applies:
 - For a reference base picture, **OutputFlag** is set equal to 0.
 - For a decoded picture, **OutputFlag** is set equal to the value of the **output_flag** syntax element of the target layer representation.

The operation of the CPB is specified in subclause C.1. The instantaneous decoder operation is specified in clauses 2-9 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A, or specified in Annex G when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G. The operation of the DPB is specified in subclause C.2. The output cropping is specified in subclause C.2.2.

HSS and HRD information concerning the number of enumerated delivery schedules and their associated bit rates and buffer sizes is specified in subclauses E.1.1, E.1.2, E.2.1 and E.2.2. The HRD is initialised as specified by the buffering period SEI message as specified in subclauses D.1.1 and D.2.1. The removal timing of access units from the CPB and output timing from the DPB are specified in the picture timing SEI message as specified in subclauses D.1.2 and D.2.2. All timing information relating to a specific access unit shall arrive prior to the CPB removal time of the access unit.

with:

For each picture in the bitstream, the variable **OutputFlag** for the decoded picture and, when applicable, the reference base picture, is set as follows.

- If the coded video sequence containing the picture conforms to one or more of the profiles specified in Annex A and the decoding process specified in clauses 2-9 is used), **OutputFlag** is set equal to 1.
- Otherwise if the coded video sequence containing the picture conforms to a profile specified in Annex G and the decoding process specified in Annex G is used, the following applies:
 - For a reference base picture, **OutputFlag** is set equal to 0.
 - For a decoded picture, **OutputFlag** is set equal to the value of the **output_flag** syntax element of the target layer representation.
- Otherwise (the coded video sequence containing the picture conforms to a profile specified in Annex H and the decoding process specified in Annex H is used), the following applies:
 - For the decoded view components of the target output views, **OutputFlag** is set equal to 1.
 - For the decoded view components of other views, **OutputFlag** is set to 0.

The operation of the CPB is specified in subclause C.1. The instantaneous decoder operation is specified in clauses 2-9 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A, or specified in Annex G when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G, or specified in Annex H when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H. The operation of the DPB is specified in subclause C.2. The output cropping is specified in subclause C.2.2.

HSS and HRD information concerning the number of enumerated delivery schedules and their associated bit rates and buffer sizes is specified in subclauses E.1.1, E.1.2, E.2.1 and E.2.2 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or specified in subclauses G.14.1 and G.14.2 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G, or specified in subclauses H.14.1 and H.14.2 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H. The HRD is initialised as specified by the buffering period SEI message as specified in subclauses D.1.1 and D.2.1. The removal timing of access units from the CPB and output timing from the DPB are specified in the picture timing SEI message as specified in subclauses D.1.2 and D.2.2. All timing information relating to a specific access unit shall arrive prior to the CPB removal time of the access unit.

In C.2, Operation of the decoded picture buffer (DPB), add the following text after the sentence, "When decoding a coded video sequence conforming to one or more of the profiles specified in Annex G":

When decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H, each of the frame buffers may contain a decoded frame view component, a decoded complementary field view component pair, or a single (non-paired) decoded field view component that is marked as "used for reference" (reference pictures) or is held for future output (reordered or delayed pictures).

In C.2.1, Decoding of gaps in frame_num and storage of "non-existing" frames, add the following paragraph at the start of the subclause:

When decoding a coded video sequence conforming to a profile specified in Annex H using the decoding process specified in Annex H, the following process in this subclause is repeatedly invoked for each view in increasing order of view order index, with "picture" being replaced by "view component", "frame" being replaced by "frame view component", and "field" being replaced by "field view component". During the invocation of the process for a particular view, only view components of the particular view may be removed from the DPB.

In C.2.2, Picture decoding and output, make the following changes:

Add the following text at the start of the subclause:

When the coded video sequence containing the picture conforms to a profile specified in Annex H and the decoding process specified in Annex H is used, the following applies:

- When at least one view component of picture *n* has OutputFlag equal to 1, it is considered that picture *n* has OutputFlag equal to 1.
- When at least one view component of picture *n* is output, it is considered that picture *n* is output.
- When at least one view component of picture *n* is stored in DPB, it is considered that picture *n* is stored in the DPB.

Replace:

NOTE – When the current picture is a reference picture it will be stored in the DPB.

with:

NOTE – When the current picture or a view component of the current picture has nal_ref_idc greater than 0, it will be stored in the DPB.

Replace:

When output, the picture shall be cropped, using the cropping rectangle specified in the active sequence parameter set for the picture.

with:

When the coded video sequence containing the picture conforms to a profile specified in Annex H and the decoding process specified in Annex H is used, and picture *n* is output, the view components of all the target output views in picture *n* are output at the same time instant and in increasing order of VOIdx.

When output, the picture or a view component of the picture shall be cropped, using the cropping rectangle specified in the active sequence parameter set for the picture or the view component.

In C.2.3 Removal of pictures from the DPB before possible insertion of the current picture, make the following changes:

Add the following at the start of the subclause:

When decoding a coded video sequence conforming to a profile specified in Annex H using the decoding process specified in Annex H, the following process in this subclause is repeatedly invoked for each view in view decoding order, with "picture" being replaced by "view component", "frame" being replaced by "frame view component", and "field" being replaced by "field view component". During the invocation of the process for a particular view, only view components of the particular view may be removed from the DPB.

Replace:

All reference pictures in the DPB are marked as "unused for reference" as specified in subclause 8.2.5.1 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or as specified in subclause G.8.2.4 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G.

with:

All reference pictures in the DPB are marked as "unused for reference" as specified in subclause 8.2.5.1 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or as specified in subclause G.8.2.4 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G, or as specified in subclause H.8.3 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H.

Replace:

Otherwise (the slice header of the current picture does not include `memory_management_control_operation` equal to 5), the decoded reference picture marking process specified in subclause 8.2.5 is invoked when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or the decoded reference picture marking process specified in subclause G.8.2.4 is invoked when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G.

with:

Otherwise (the slice header of the current picture does not include `memory_management_control_operation` equal to 5), the decoded reference picture marking process specified in subclause 8.2.5 is invoked when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or the decoded reference picture marking process specified in subclause G.8.2.4 is invoked when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G, or the decoded reference picture marking process specified in subclause H.8.3 is involved when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H.

In C.2.4 Current decoded picture marking and storage, add the following at the start of the subclause:

When decoding a coded video sequence conforming to a profile specified in Annex H using the decoding process specified in Annex H, the following process in this subclause is repeatedly invoked for each view in increasing order of view order index, with "picture" being replaced by "view component", "frame" being replaced by "frame view component", and "field" being replaced by "field view component". During the invocation of the process for a particular view, only view components of the particular view may be removed from the DPB.

In C.3, *Bitstream Conformance*, make the following changes:

Replace:

The nominal removal times of pictures from the CPB (starting from the second picture in decoding order), shall satisfy the constraints on $t_{r,n}(n)$ and $t_r(n)$ expressed in subclauses A.3.1 through A.3.3 for the profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, and they shall satisfy the constraints on $t_{r,n}(n)$ and $t_r(n)$ expressed in subclauses G.10.2.1 and G.10.2.2 for profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G.

with:

The nominal removal times of pictures from the CPB (starting from the second picture in decoding order), shall satisfy the constraints on $t_{r,n}(n)$ and $t_r(n)$ expressed in subclauses A.3.1 through A.3.3 for the profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, and they shall satisfy the constraints on $t_{r,n}(n)$ and $t_r(n)$ expressed in subclauses G.10.2.1 and G.10.2.2 for profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G, and they shall satisfy the constraints on $t_{r,n}(n)$ and $t_r(n)$ expressed in subclause H.10.2 for the profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H.

Replace:

The value of $\Delta_{to,dpb}(n)$ as given by Equation C-13, which is the difference between the output time of a picture and that of the first picture following it in output order and having OutputFlag equal to 1, shall satisfy the constraint expressed in subclause A.3.1 for the profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, and it shall satisfy the constraint expressed in subclause G.10.2.1 for profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G.

with:

The value of $\Delta_{to,dpb}(n)$ as given by Equation C-13, which is the difference between the output time of a picture and that of the first picture following it in output order and having OutputFlag equal to 1, shall satisfy the constraint expressed in subclause A.3.1 for the profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, and it shall satisfy the constraint expressed in subclause G.10.2.1 for profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G, and it shall satisfy the constraints expressed in subclauses H.10.2 for the profile and level specified in the bitstream when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H.

In C.4.1, *Operation of the output order DPB*, add the following text after the sentence starting with, "When decoding a coded video sequence conforming to one or more of the profiles specified in Annex G":

When decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H, each of the frame buffers may contain a decoded frame view component, a decoded complementary field view component pair, or a single (non-paired) decoded field view component that is marked as "used for reference" (reference pictures) or is held for future output (reordered or delayed pictures).

In C.4.2, *Decoding of gaps in frame_num and storage of "non-existing" pictures*, add the following at the start of the subclause:

When decoding a coded video sequence conforming to a profile specified in Annex H using the decoding process specified in Annex H, the following process in this subclause is repeatedly invoked for each view in increasing order of view order index, with "picture" being replaced by "view component", "frame" being replaced by "frame view component", and "field" being replaced by "field view component". During the invocation of the process for a particular view, only view components of the particular view may be removed from the DPB.

In C.4.4, Removal of pictures from the DPB before possible insertion of the current picture, make the following changes:

Add the following at the start of the subclause:

When decoding a coded video sequence conforming to a profile specified in Annex H using the decoding process specified in Annex H, the following process in this subclause is repeatedly invoked for each view in increasing order of view order index, with "picture" being replaced by "view component", "frame" being replaced by "frame view component", and "field" being replaced by "field view component". During the invocation of the process for a particular view, only view components of the particular view may be removed from the DPB.

Replace:

All reference pictures in the DPB are marked as "unused for reference" as specified in subclause 8.2.5 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or as specified in subclause G.8.2.4 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G.

with:

All reference pictures in the DPB are marked as "unused for reference" as specified in subclause 8.2.5 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or as specified in subclause G.8.2.4 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G, or as specified in subclause H.8.3 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H.

Replace:

Otherwise (the decoded picture is not an IDR picture), the decoded reference picture marking process is invoked as specified in subclause 8.2.5 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or as specified in subclause G.8.2.4 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G.

with:

Otherwise (the decoded picture is not an IDR picture), the decoded reference picture marking process is invoked as specified in subclause 8.2.5 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex A using the decoding process specified in clauses 2-9, or as specified in subclause G.8.2.4 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex G using the decoding process specified in Annex G, or as specified in subclause H.8.3 when decoding a coded video sequence conforming to one or more of the profiles specified in Annex H using the decoding process specified in Annex H.

In C.4.5, Current decoded picture marking and storage, add the following at the start of the subclause:

When decoding a coded video sequence conforming to a profile specified in Annex H using the decoding process specified in Annex H, the following process in this subclause is repeatedly invoked for each view in increasing order of view order index, with "picture" being replaced by "view component", "frame" being replaced by "frame view component", and "field" being replaced by "field view component". During the invocation of the process for a particular view, only view components of the particular view may be removed from the DPB.