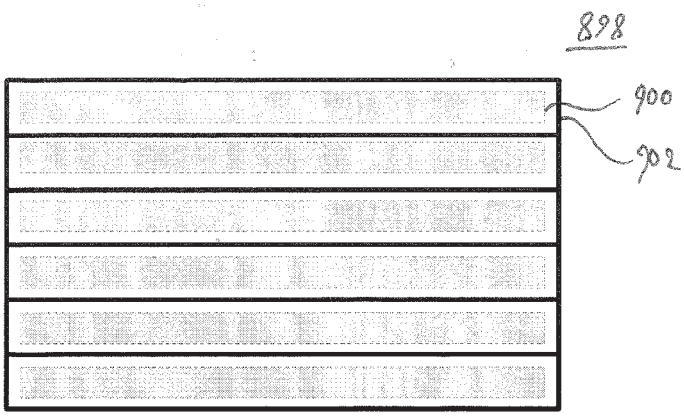


Fig.1

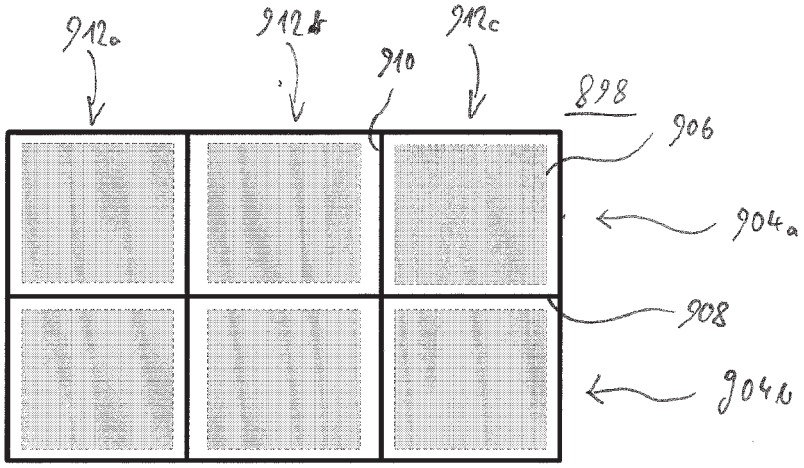


Fig.2

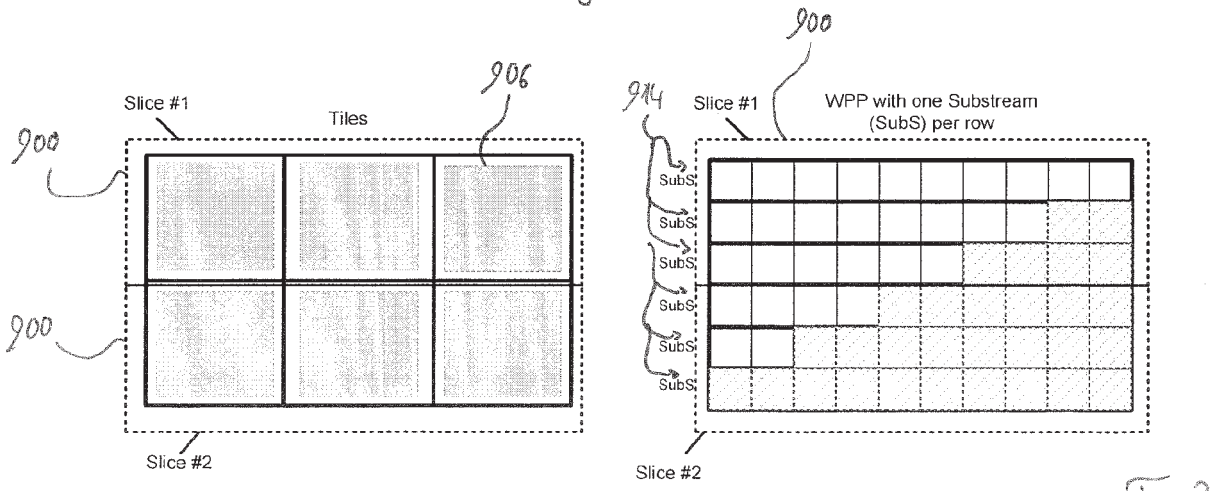


Fig.3

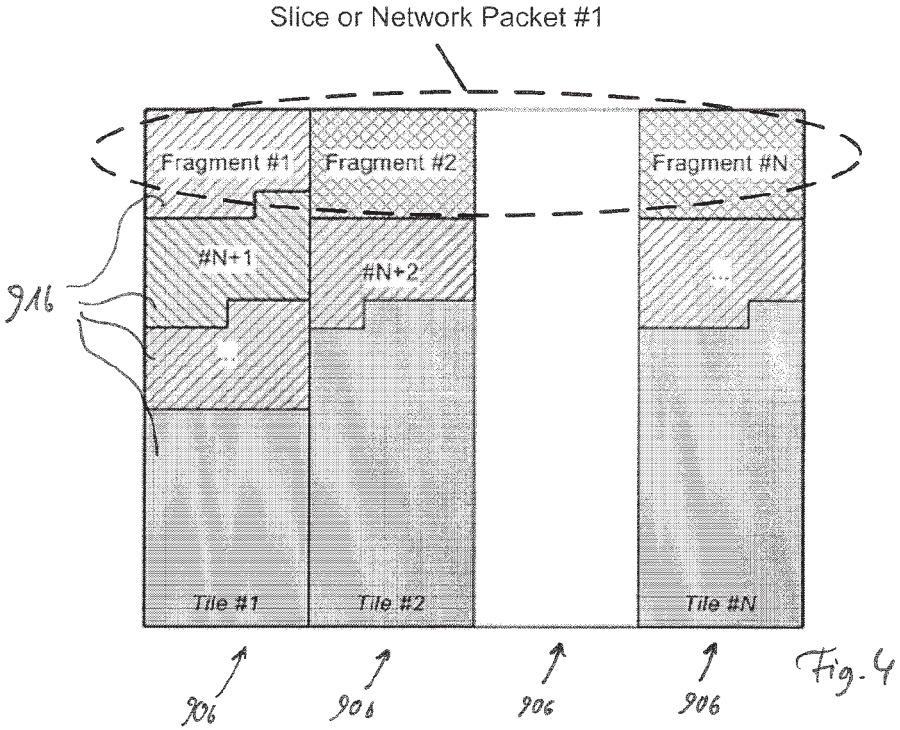

Slice or Network Packet #1
Fragment #1
Fragment #2
Fragment #N
#N+1
#N+2
...
916
Tile #1
Tile #2
Tile #N
906
906
906
906

Fig. 4

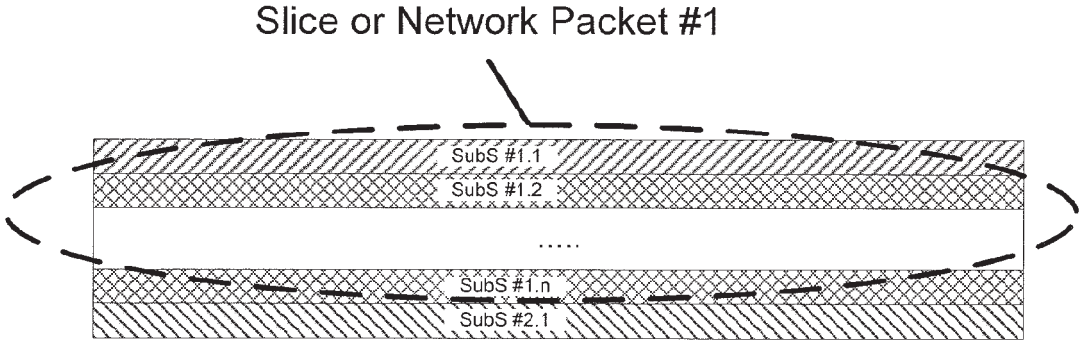

Slice or Network Packet #1
SubS #1.1
SubS #1.2
.....
SubS #1.n
SubS #2.1

Fig. 5

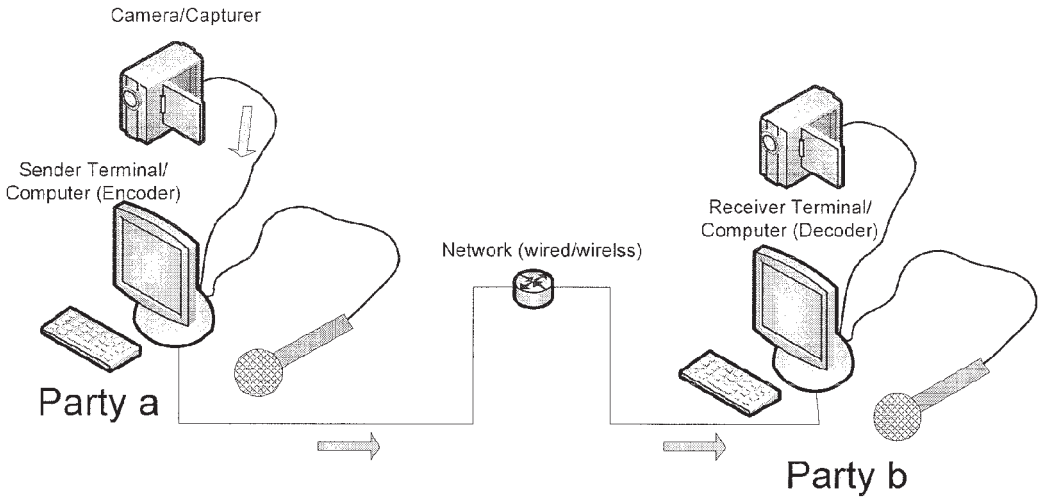


Fig.6

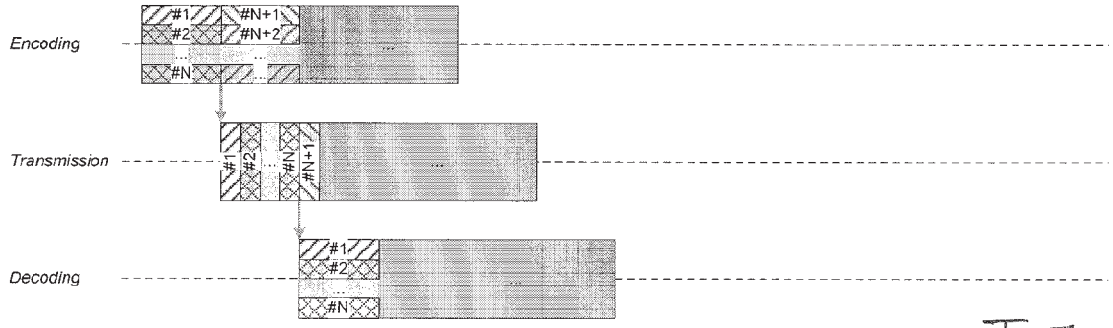


Fig.7

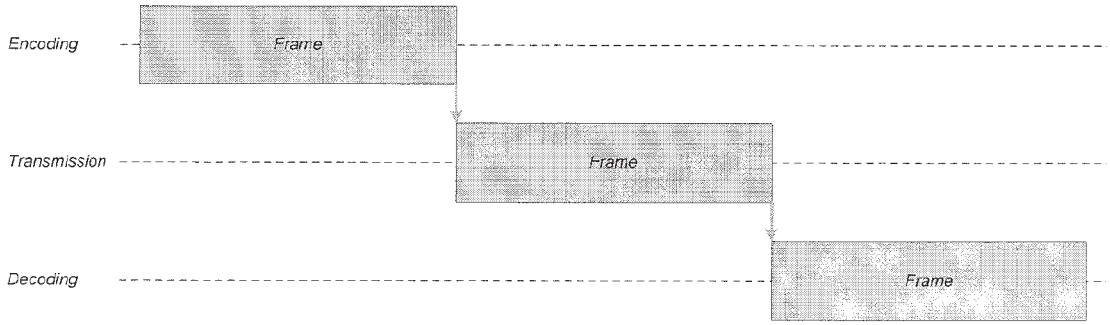


Fig.8

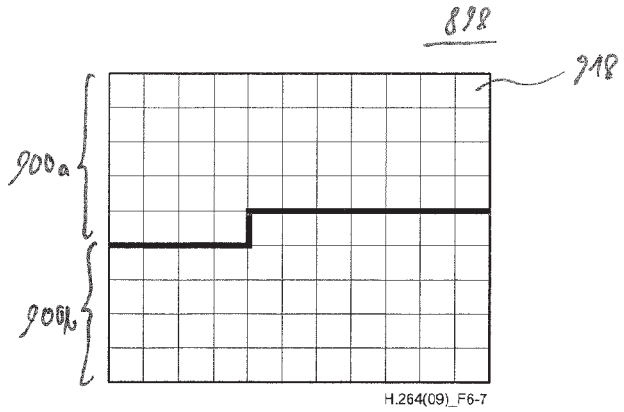

818
918
900a
900b
H.264(09)_F6-7

Fig. 9

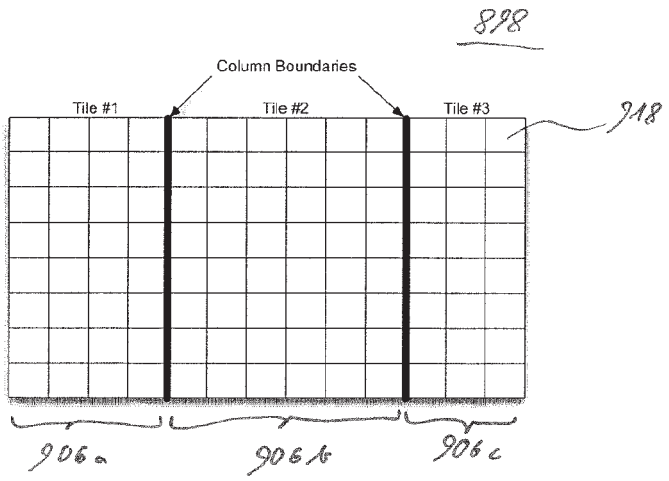

818
Column Boundaries
Tile #1
Tile #2
Tile #3
918
906a
906b
906c

Fig. 10

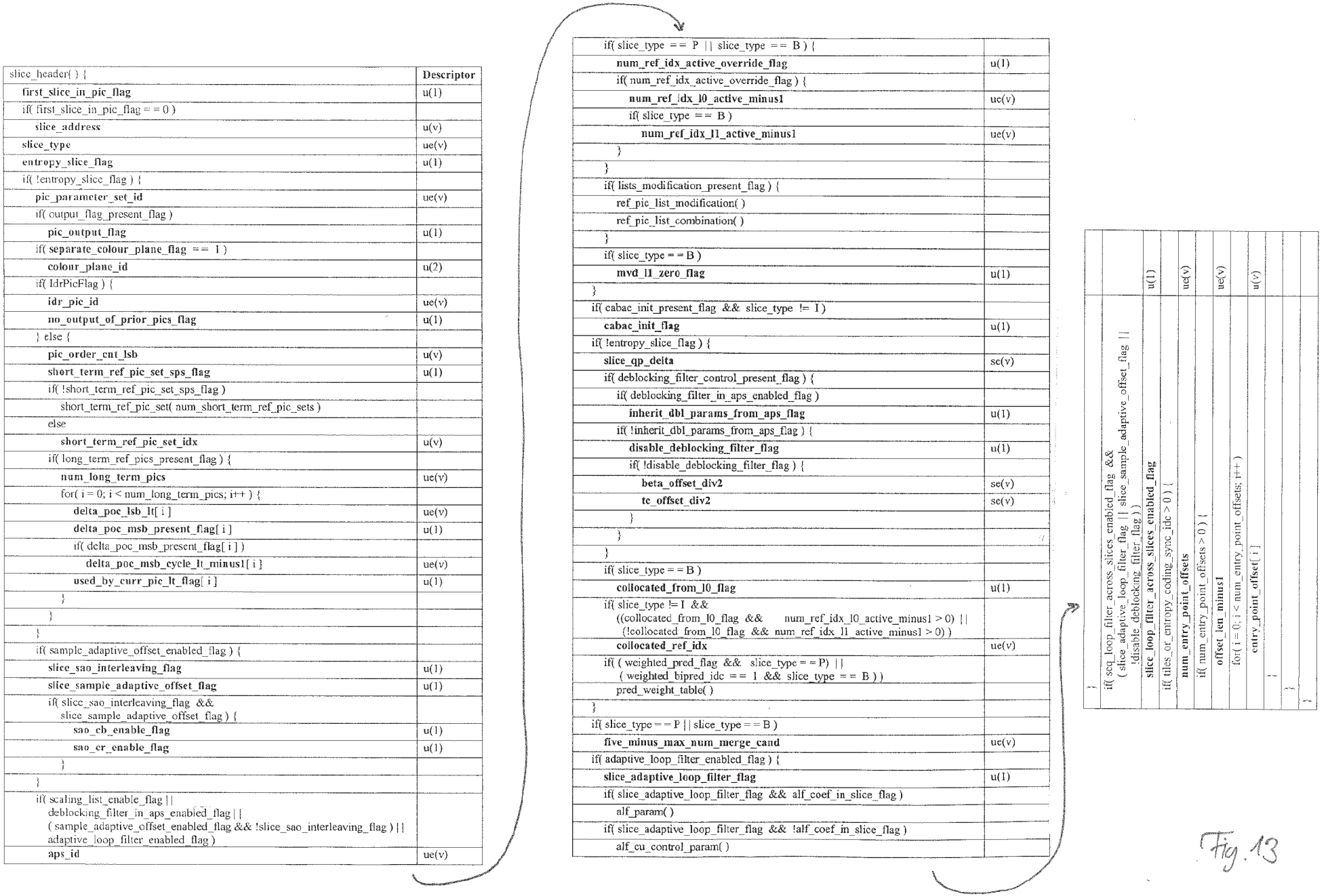
scaling_list_enable_flag	
chroma_pred_from_luma_enabled_flag	u(1)
deblocking_filter_in_aps_enabled_flag	u(1)
seq_loop_filter_across_slices_enabled_flag	u(1)
asymmetric_motion_partitions_enabled_flag	u(1)
non_square_quadtree_enabled_flag	u(1)
sample_adaptive_offset_enabled_flag	u(1)
adaptive_loop_filter_enabled_flag	u(1)
if(adaptive_loop_filter_enabled_flag)	
alf_coef_in_slice_flag	u(1)
if(pcm_enabled_flag)	
pcm_loop_filter_disable_flag	u(1)
temporal_id_nesting_flag	u(1)
if(log2_min_coding_block_size_minus3 = = 0)	
inter_4x4_enabled_flag	u(1)
num_short_term_ref_pic_sets	ue(v)
for(i = 0; i < num_short_term_ref_pic_sets; i++)	
short_term_ref_pic_set(i)	
long_term_ref_pics_present_flag	u(1)
tiles_or_entropy_coding_sync_idc	u(2)
if(tiles_or_entropy_coding_sync_idc = = 1) {	
num_tile_columns_minus1	ue(v)
num_tile_rows_minus1	ue(v)
uniform_spacing_flag	u(1)
if(!uniform_spacing_flag) {	
for(i = 0; i < num_tile_columns_minus1; i++)	
column_width[i]	ue(v)
for(i = 0; i < num_tile_rows_minus1; i++)	
row_height[i]	ue(v)
}	
loop_filter_across_tiles_enabled_flag	u(1)
}	
vui_parameters_present_flag	u(1)
if(vui_parameters_present_flag)	
vui_parameters( )	
sps_extension_flag	u(1)
if(sps_extension_flag)	
while(more_rbsp_data( ))	
sps_extension_data_flag	u(1)
rbsp_trailing_bits( )	
}	

seq_parameter_set_rbsp( ) {	Descriptor
profile_idc	u(8)
reserved_zero_8bits /* equal to 0 */	u(8)
level_idc	u(8)
seq_parameter_set_id	ue(v)
chroma_format_idc	ue(v)
if(chroma_format_idc = = 3)	
separate_colour_plane_flag	u(1)
max_temporal_layers_minus1	u(3)
pic_width_in_luma_samples	ue(v)
pic_height_in_luma_samples	ue(v)
pic_cropping_flag	u(1)
if(pic_cropping_flag) {	
pic_crop_left_offset	ue(v)
pic_crop_right_offset	ue(v)
pic_crop_top_offset	ue(v)
pic_crop_bottom_offset	ue(v)
}	
bit_depth_luma_minus8	ue(v)
bit_depth_chroma_minus8	ue(v)
pcm_enabled_flag	u(1)
if(pcm_enabled_flag) {	
pcm_bit_depth_luma_minus1	u(4)
pcm_bit_depth_chroma_minus1	u(4)
}	
qpprime_y_zero_transquant_bypass_flag	u(1)
log2_max_pic_order_cnt_lsb_minus4	ue(v)
for(i = 0; i <= max_temporal_layers_minus1; i++) {	
max_dec_pic_buffering[i]	ue(v)
num_reorder_pics[i]	ue(v)
max_latency_increase[i]	ue(v)
}	
restricted_ref_pic_lists_flag	u(1)
if(restricted_ref_pic_lists_flag)	
lists_modification_present_flag	u(1)
log2_min_coding_block_size_minus3	ue(v)
log2_diff_max_min_coding_block_size	ue(v)
log2_min_transform_block_size_minus2	ue(v)
log2_diff_max_min_transform_block_size	ue(v)
if(pcm_enabled_flag) {	
log2_min_pcm_coding_block_size_minus3	ue(v)
log2_diff_max_min_pcm_coding_block_size	ue(v)
}	
max_transform_hierarchy_depth_inter	ue(v)
max_transform_hierarchy_depth_intra	ue(v)

Fig. 11

pic_parameter_set_rbsp( ) {	Descriptor
pic_parameter_set_id	ue(v)
seq_parameter_set_id	ue(v)
sign_data_hiding_flag	u(1)
if(sign_data_hiding _flag)	
sign_hiding_threshold	u(4)
cabac_init_present_flag	u(1)
num_ref_idx_l0_default_active_minus1	ue(v)
num_ref_idx_l1_default_active_minus1	ue(v)
pic_init_qp_minus26	se(v)
constrained_intra_pred_flag	u(1)
enable_temporal_mvp_flag	u(1)
slice_granularity	u(2)
max_cu_qp_delta_depth	ue(v)
cb_qp_offset	se(v)
cr_qp_offset	se(v)
weighted_pred_flag	u(1)
weighted_bipred_idc	u(2)
output_flag_present_flag	u(1)
if(tiles_or_entropy_coding_sync_idc == 1) {	
tile_info_present_flag	u(1)
tile_control_present_flag	u(1)
if(tile_info_present_flag) {	
num_tile_columns_minus1	ue(v)
num_tile_rows_minus1	ue(v)
uniform_spacing_flag	u(1)
if(!uniform_spacing_flag) {	
for(i = 0; i < num_tile_columns_minus1; i++)	
column_width[i]	ue(v)
for(i = 0; i < num_tile_rows_minus1; i++)	
row_height[i]	ue(v)
}	
}	
if(tile_control_present_flag)	
loop_filter_across_tiles_enabled_flag	u(1)
} else if(tiles_or_entropy_coding_sync_idc == 2)	
num_substreams_minus1	ue(v)
deblocking_filter_control_present_flag	u(1)
if(slice_type = =P | | slice_type = = B)	
log2_parallel_merge_level_minus2	ue(v)
pps_extension_flag	u(1)
if(pps_extension_flag)	
while(more_rbsp_data( ))	
pps_extension_data_flag	u(1)
rbsp_trailing_bits( )	
}	

Fig. 12



slice_header( ) {	Descriptor
first_slice_in_pic_flag	u(1)
if(first_slice_in_pic_flag = = 0)	
slice_address	u(v)
slice_type	ue(v)
entropy_slice_flag	u(1)
if(!entropy_slice_flag) {	
pic_parameter_set_id	ue(v)
if(output_flag_present_flag)	
pic_output_flag	u(1)
if(separate_colour_plane_flag == 1)	
colour_plane_id	u(2)
if(IdrPicFlag) {	
idr_pic_id	ue(v)
no_output_of_prior_pics_flag	u(1)
} else {	
pic_order_cnt_lsb	u(v)
short_term_ref_pic_set_sps_flag	u(1)
if(!short_term_ref_pic_set_sps_flag)	
short_term_ref_pic_set(num_short_term_ref_pic_sets)	
else	
short_term_ref_pic_set_idx	u(v)
if(long_term_ref_pics_present_flag) {	
num_long_term_pics	ue(v)
for(i = 0; i < num_long_term_pics; i++) {	
delta_poc_lsb_lt[i]	ue(v)
delta_poc_msb_present_flag[i]	u(1)
if(delta_poc_msb_present_flag[i])	
delta_poc_msb_cycle_lt_minus1[i]	ue(v)
used_by_curr_pic_lt_flag[i]	u(1)
}	
}	
}	
if(sample_adaptive_offset_enabled_flag) {	
slice_sao_interleaving_flag	u(1)
slice_sample_adaptive_offset_flag	u(1)
if(slice_sao_interleaving_flag && slice_sample_adaptive_offset_flag) {	
sao_cb_enable_flag	u(1)
sao_cr_enable_flag	u(1)
}	
}	
if(scaling_list_enable_flag || deblocking_filter_in_aps_enabled_flag || (sample_adaptive_offset_enabled_flag && !slice_sao_interleaving_flag) || adaptive_loop_filter_enabled_flag)	
aps_id	ue(v)

if(slice_type == P || slice_type == B) {	
num_ref_idx_active_override_flag	u(1)
if(num_ref_idx_active_override_flag) {	
num_ref_idx_l0_active_minus1	ue(v)
if(slice_type == B)	
num_ref_idx_l1_active_minus1	ue(v)
}	
}	
if(lists_modification_present_flag) {	
ref_pic_list_modification( )	
ref_pic_list_combination( )	
}	
if(slice_type = = B)	
mvd_l1_zero_flag	u(1)
}	
if(cabac_init_present_flag && slice_type != I)	
cabac_init_flag	u(1)
if(!entropy_slice_flag) {	
slice_qp_delta	se(v)
if(deblocking_filter_control_present_flag) {	
if(deblocking_filter_in_aps_enabled_flag)	
inherit_dbl_params_from_aps_flag	u(1)
if(!inherit_dbl_params_from_aps_flag) {	
disable_deblocking_filter_flag	u(1)
if(!disable_deblocking_filter_flag) {	
beta_offset_div2	se(v)
tc_offset_div2	se(v)
}	
}	
}	
if(slice_type = = B)	
collocated_from_l0_flag	u(1)
if(slice_type != I && ((collocated_from_l0_flag && num_ref_idx_l0_active_minus1 > 0) || (!collocated_from_l0_flag && num_ref_idx_l1_active_minus1 > 0))	
collocated_ref_idx	ue(v)
if((weighted_pred_flag && slice_type = = P) || (weighted_bipred_idc == 1 && slice_type == B))	
pred_weight_table( )	
}	
if(slice_type = = P || slice_type = = B)	
five_minus_max_num_merge_cand	ue(v)
if(adaptive_loop_filter_enabled_flag) {	
slice_adaptive_loop_filter_flag	u(1)
if(slice_adaptive_loop_filter_flag && alf_coef_in_slice_flag)	
alf_param( )	
if(slice_adaptive_loop_filter_flag && !alf_coef_in_slice_flag)	
alf_cu_control_param( )	

}	
if(seq_loop_filter_across_slices_enabled_flag && (slice_adaptive_loop_filter_flag || slice_sample_adaptive_offset_flag || !disable_deblocking_filter_flag))	
slice_loop_filter_across_slices_enabled_flag	u(1)
if(tiles_or_entropy_coding_sync_idc > 0) {	
num_entry_point_offsets	ue(v)
if(num_entry_point_offsets > 0) {	
offset_len_minus1	ue(v)
for(i = 0; i < num_entry_point_offsets; i++)	
entry_point_offset[i]	u(v)
}	
}	
}	

Fig. 13

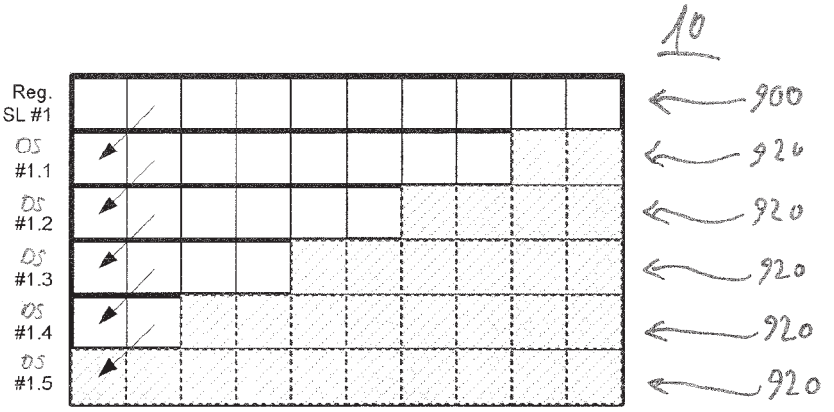
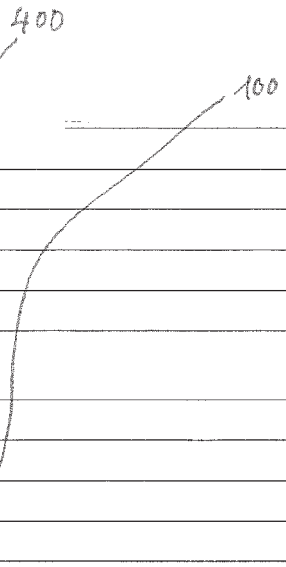


Fig. 14

pic_parameter_set_rbsp( ) {	Descriptor
.....	
dependent_slices_present_flag	u(1)
last_ctb_cabac_init_flg	u(1)
}	

Fig. 15



slice_header( ) {	Descriptor
first_slice_in_pic_flag	u(1)
if(first_slice_in_pic_flag = = 0)	
slice_address	u(v)
slice_type	ue(v)
~~**entropy_slice_flag**~~	~~u(1)~~
dependent_slice_flag	u(1)
~~if(!entropy_slice_flag) {~~	
if(!dependent_slice_flag){	
.....	
}else{	
no_cabac_reset_flag	u(1)
}	
....	
if(cabac_init_present_flag && slice_type != I && !no_cabac_reset_flag)	
cabac_init_flag	u(1)
....	
if(slice_type = = P || slice_type = = B)	
five_minus_max_num_merge_cand	ue(v)
if(adaptive_loop_filter_enabled_flag) {	
slice_adaptive_loop_filter_flag	u(1)
if(slice_adaptive_loop_filter_flag && alf_coef_in_slice_flag)	
alf_param( )	
if(slice_adaptive_loop_filter_flag && !alf_coef_in_slice_flag)	
alf_cu_control_param( )	
}	
if(seq_loop_filter_across_slices_enabled_flag && (slice_adaptive_loop_filter_flag || slice_sample_adaptive_offset_flag || !disable_deblocking_filter_flag))	
slice_loop_filter_across_slices_enabled_flag	u(1)
if(tiles_or_entropy_coding_sync_idc > 0) {	
num_entry_point_offsets	ue(v)
if(num_entry_point_offsets > 0) {	
offset_len_minus1	ue(v)
for(i = 0; i < num_entry_point_offsets; i++)	
entry_point_offset[i]	u(v)
}	
}	
}	

Fig. 16

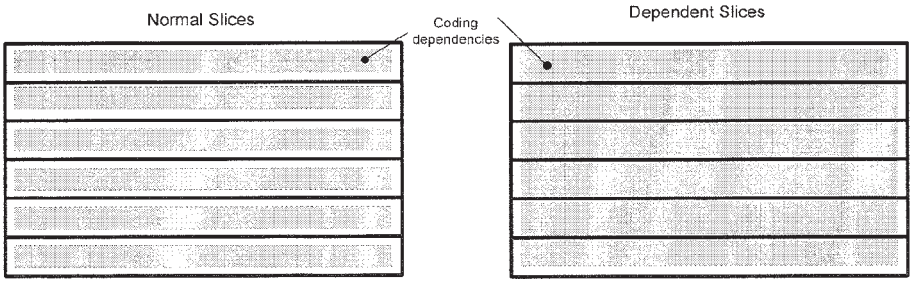


Fig. 17

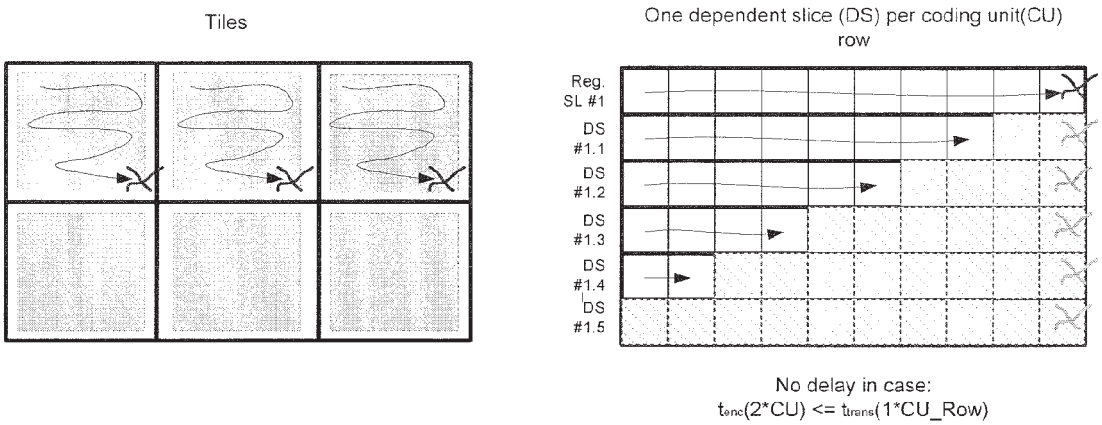


Fig. 18

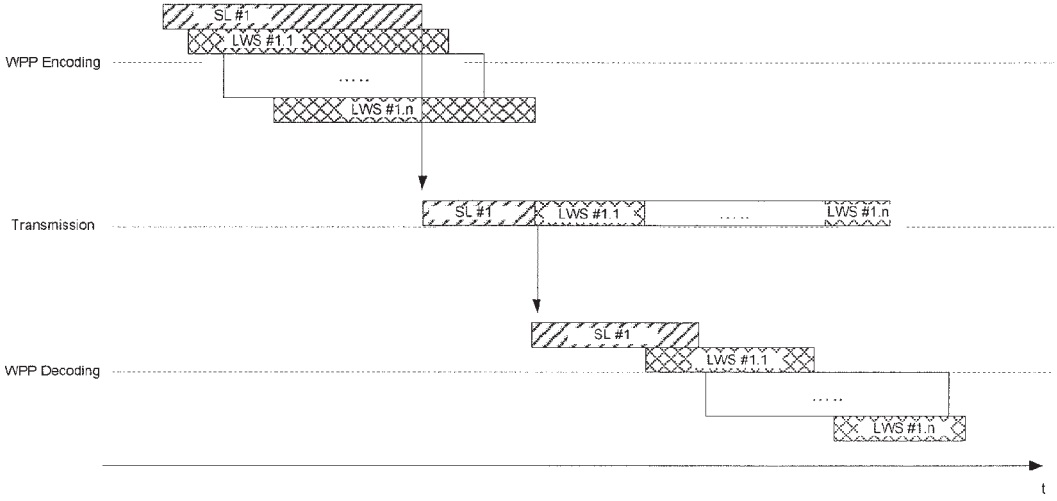


Fig. 19

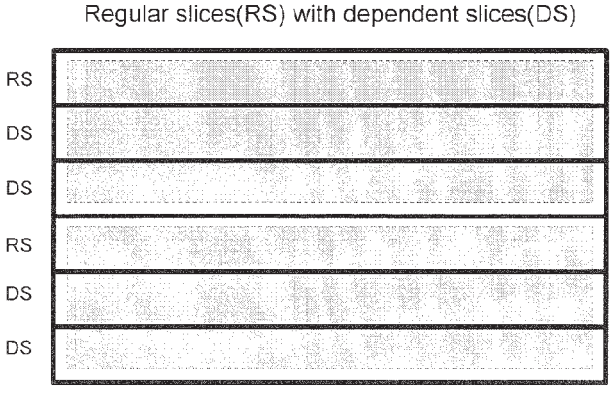
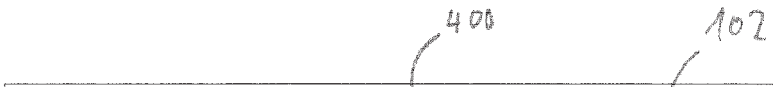


Fig. 20



slice_header( ) {	Descriptor
first_slice_in_pic_flag	u(1)
pic_parameter_set_id	ue(v)
if(!first_slice_in_pic_flag)	
slice_address	u(v)
if(dependent_slice_enabled_flag && !first_slice_in_pic_flag)	
dependent_slice_flag	u(1)
if(!dependent_slice_flag) {	
slice_type	ue(v)
if(output_flag_present_flag)	
pic_output_flag	u(1)
if(**separate_colour_plane_flag** == 1)	
colour_plane_id	u(2)
if(RapPicFlag) {	
rap_pic_id	ue(v)
no_output_of_prior_pics_flag	u(1)
}	
if(!IdrPicFlag) {	
...	
}	
if(tiles_or_entropy_coding_sync_idc == 1 || tiles_or_entropy_coding_sync_idc == 2) {	
num_entry_point_offsets	ue(v)
if(num_entry_point_offsets > 0) {	
offset_len_minus1	ue(v)
for(i = 0; i < num_entry_point_offsets; i++)	
entry_point_offset[i]	u(v)
}	
}	
if(slice_header_extension_present_flag) {	
slice_header_extension_length	ue(v)
for(i = 0; i < slice_header_extension_length; i++)	
slice_header_extension_data_byte	u(8)
}	
byte_alignment( )	
}	

Fig. 21

pic_parameter_set_rbsp( ) {	Descriptor
pic_parameter_set_id	ue(v)
seq_parameter_set_id	ue(v)
sign_data_hiding_flag	u(1)
if(sign_data_hiding _flag)	
sign_hiding_threshold	u(4)
cabac_init_present_flag	u(1)
num_ref_idx_l0_default_active_minus1	ue(v)
num_ref_idx_l1_default_active_minus1	ue(v)
[Ed. (BB): not present in HM software]	
pic_init_qp_minus26	se(v)
constrained_intra_pred_flag	u(1)
slice_granularity	u(2)
diff_cu_qp_delta_depth	ue(v)
cb_qp_offset	se(v)
cr_qp_offset	se(v)
weighted_pred_flag	u(1)
weighted_bipred_idc	u(2)
output_flag_present_flag	u(1)
transquant_bypass_enable_flag	u(1)
dependent_slice_enabled_flag	u(1)
tiles_or_entropy_coding_sync_idc	u(2)
if(tiles_or_entropy_coding_sync_idc == 1) {	
num_tile_columns_minus1	ue(v)
num_tile_rows_minus1	ue(v)
uniform_spacing_flag	u(1)
if(!uniform_spacing_flag) {	
for(i = 0; i < num_tile_columns_minus1; i++)	
column_width[i]	ue(v)
for(i = 0; i < num_tile_rows_minus1; i++)	
row_height[i]	ue(v)
}	
loop_filter_across_tiles_enabled_flag	u(1)
} else if(tiles_or_entropy_coding_sync_idc == 3)	
cabac_independent_flag	u(1)
...	
}	

Fig. 22

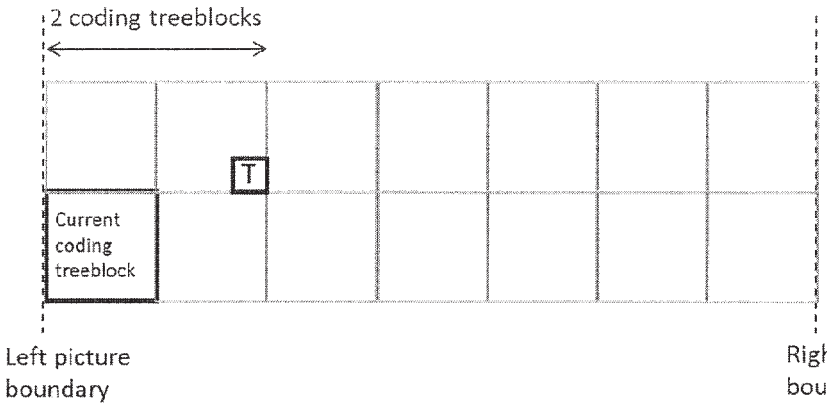

2 coding treeblocks
T
Current coding treeblock
Left picture boundary
Right picture boundary

Fig. 23

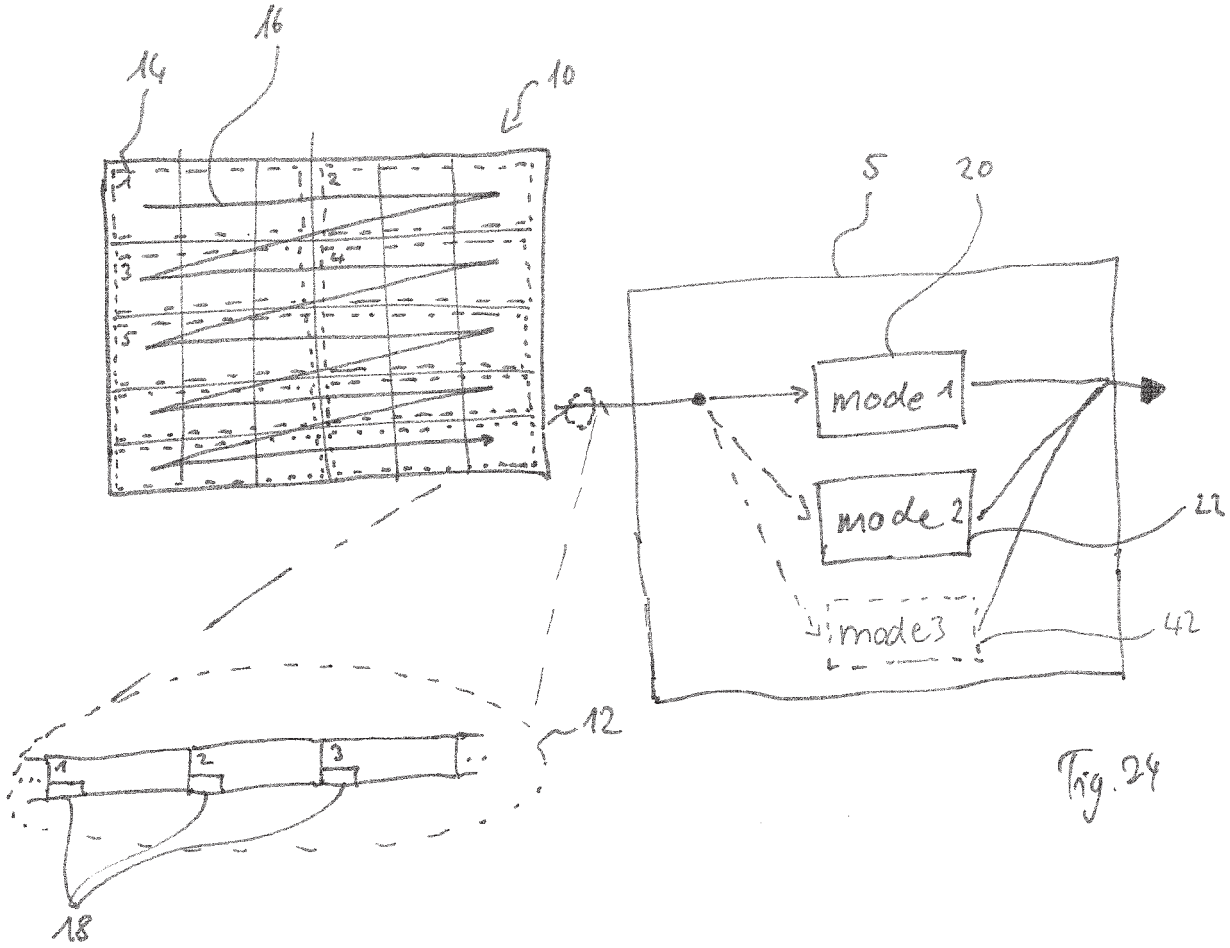

16
14
10
5
20
mode 1
mode 2
mode 3
22
42
12
18

Fig. 24

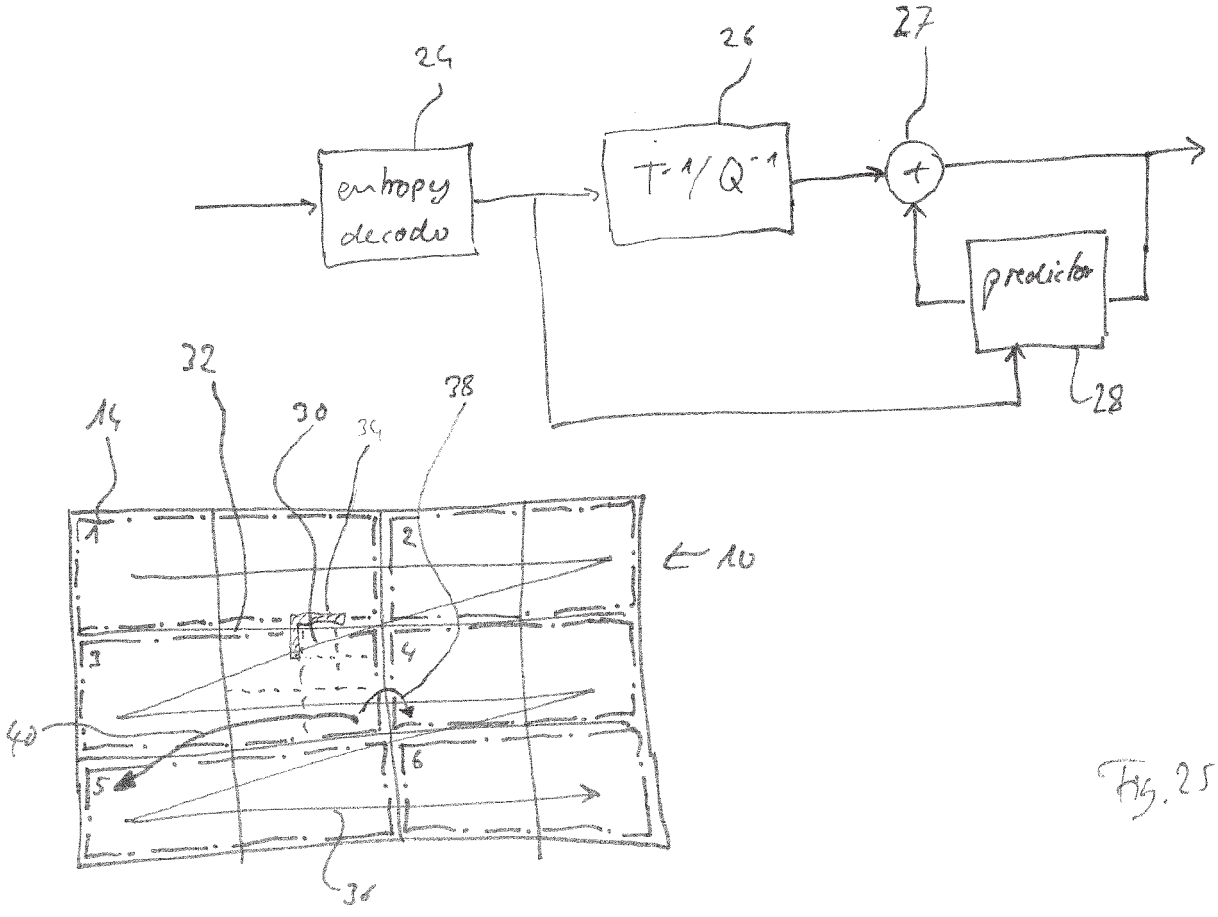

24
26
27
entropy decoder
T⁻¹/Q⁻¹
+
predictor
28
22
14
30
34
38
10
40
36

Fig. 25

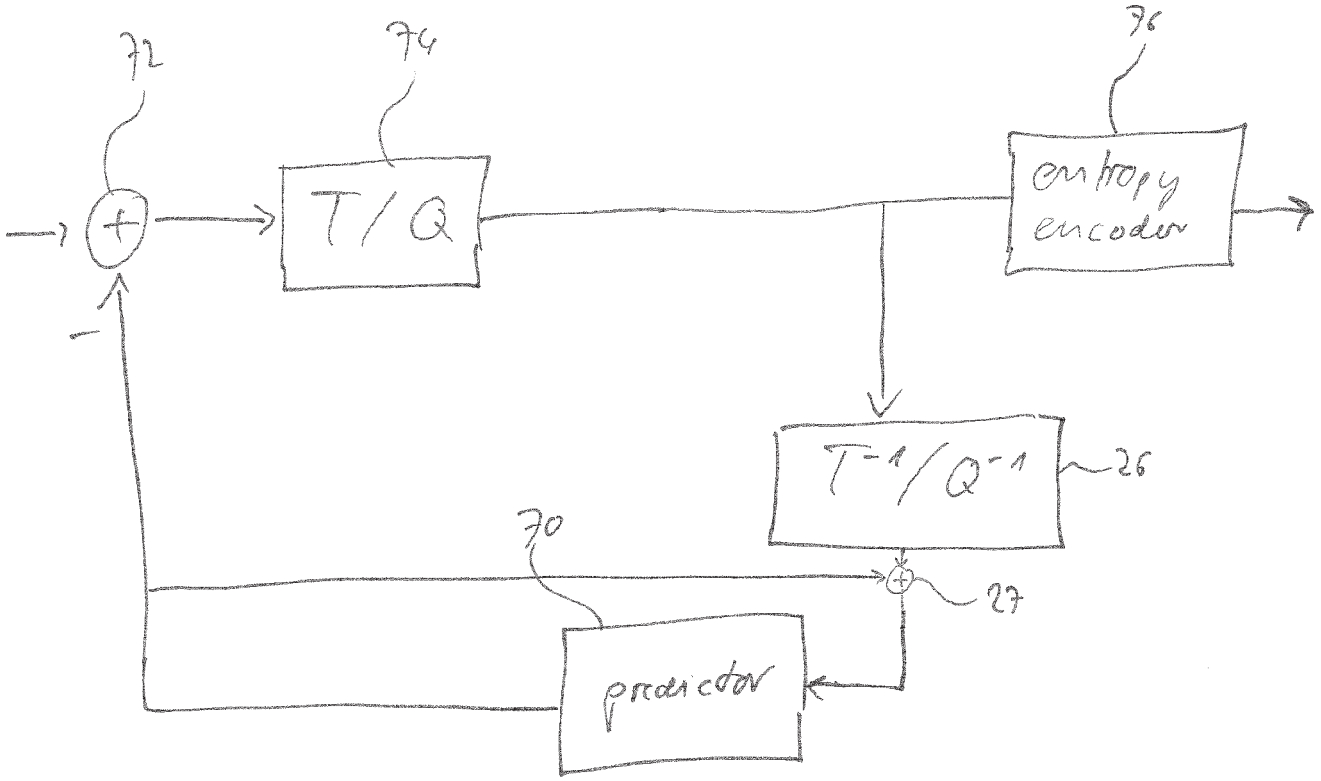


Fig. 26

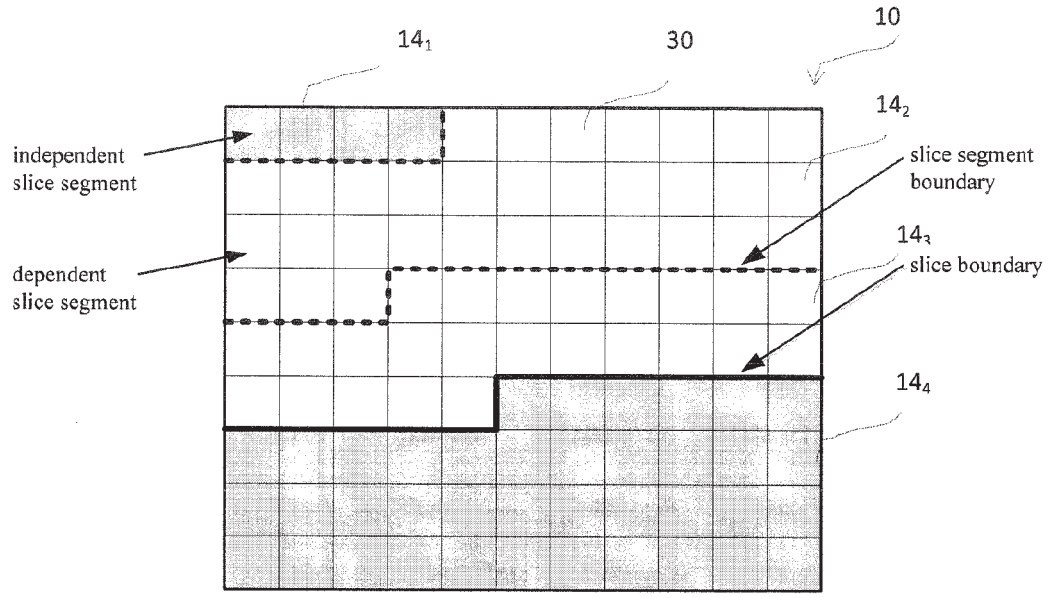


Fig. 27

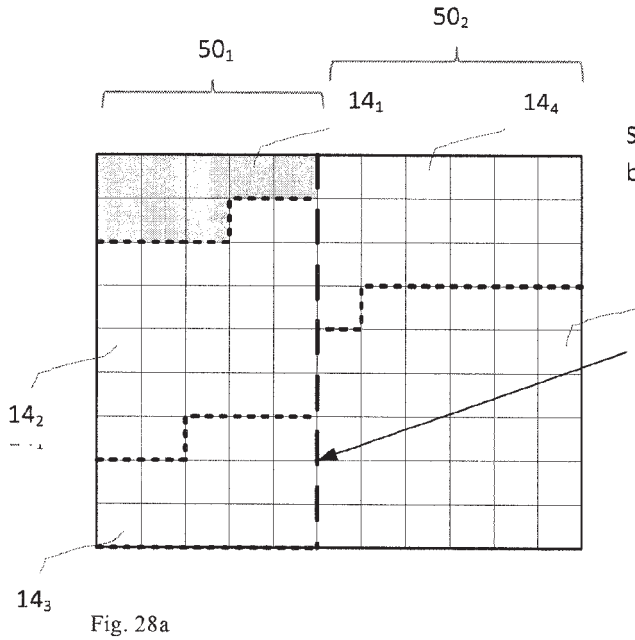


Fig. 28a

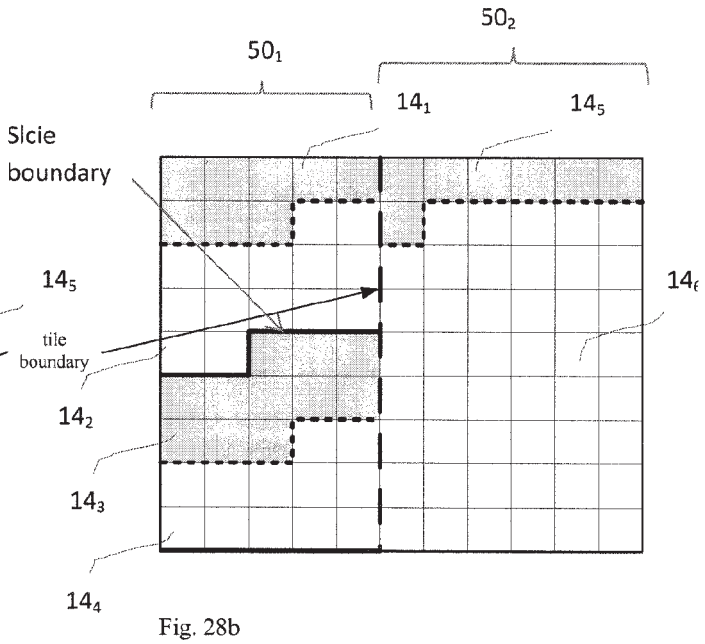


Fig. 28b

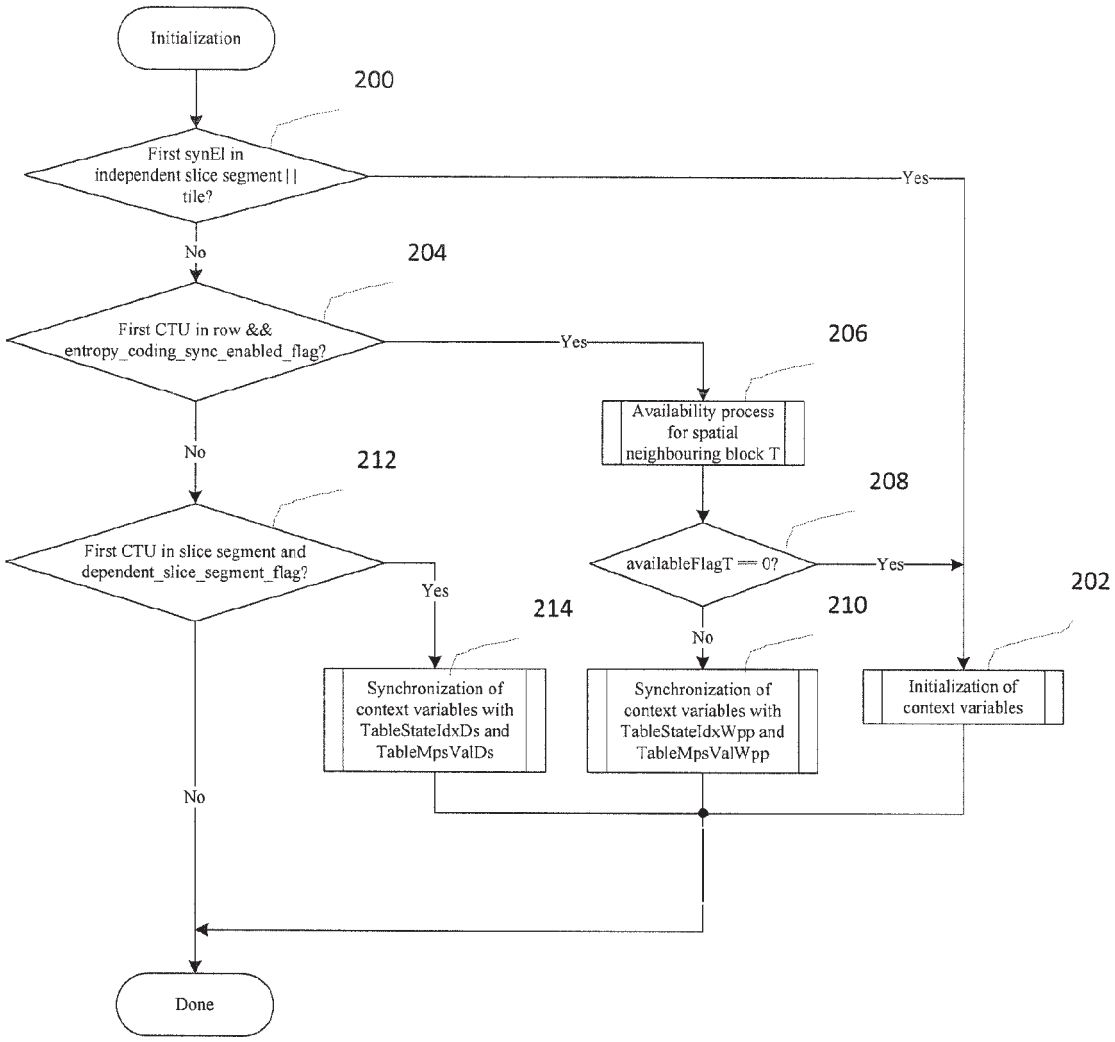

Initialization
200
First synEl in independent slice segment || tile?
Yes
No
204
First CTU in row && entropy_coding_sync_enabled_flag?
Yes
206
Availability process for spatial neighbouring block T
No
212
208
First CTU in slice segment and dependent_slice_segment_flag?
availableFlagT == 0?
Yes
202
Yes
214
210
No
Synchronization of context variables with TableStateIdxDs and TableMpsValDs
Synchronization of context variables with TableStateIdxWpp and TableMpsValWpp
Initialization of context variables
No
Done

Fig. 29

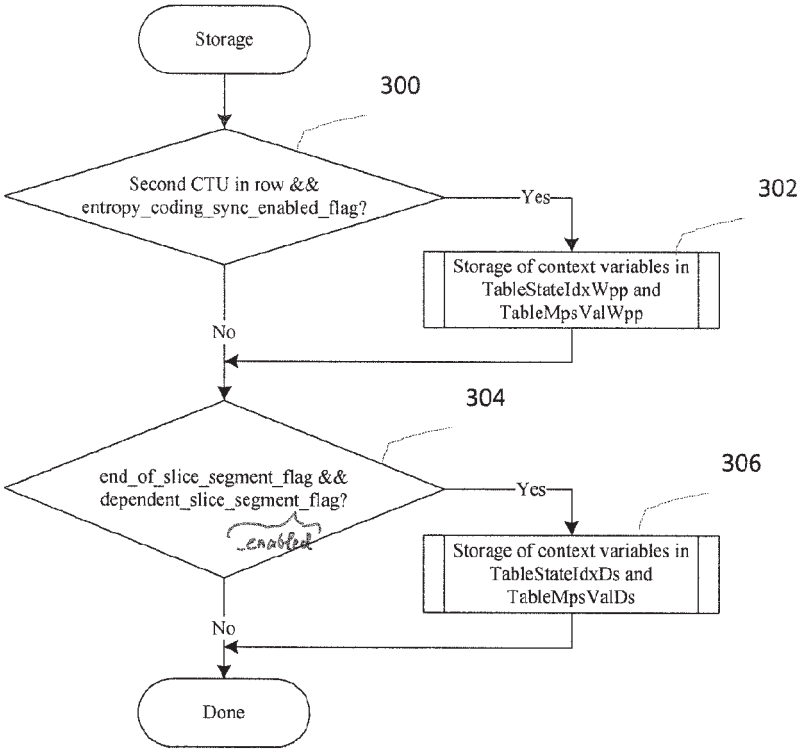

Storage
300
Second CTU in row &&
entropy_coding_sync_enabled_flag?
Yes
302
Storage of context variables in
TableStateIdxWpp and
TableMpsValWpp
No
304
end_of_slice_segment_flag &&
dependent_slice_segment_flag?
enabled
Yes
306
Storage of context variables in
TableStateIdxDs and
TableMpsValDs
No
Done

Fig. 30

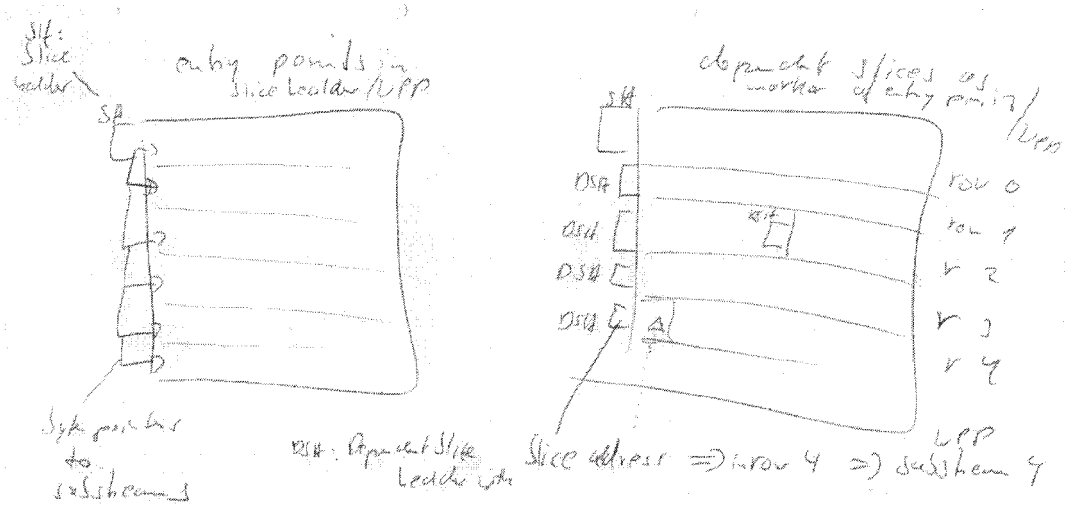

SH: Slice header
entry points in slice header/UPP
SH
dependent slices as marker of entry points/UPP
SH
DSH
DSH
DSH
DSH
row 0
row 1
r 2
r 3
r 4
UPP
DSH: Dependent slice header with slice address => in row 4 => substream 4

Fig. 31