

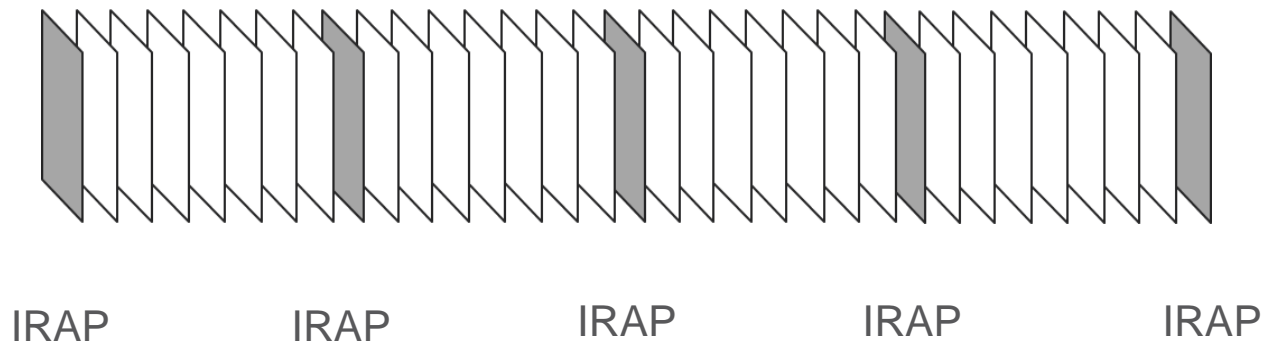
# JCTVC-R0059: HLS: DEPENDENT RAP INDICATION SEI MESSAGE

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# PROBLEM



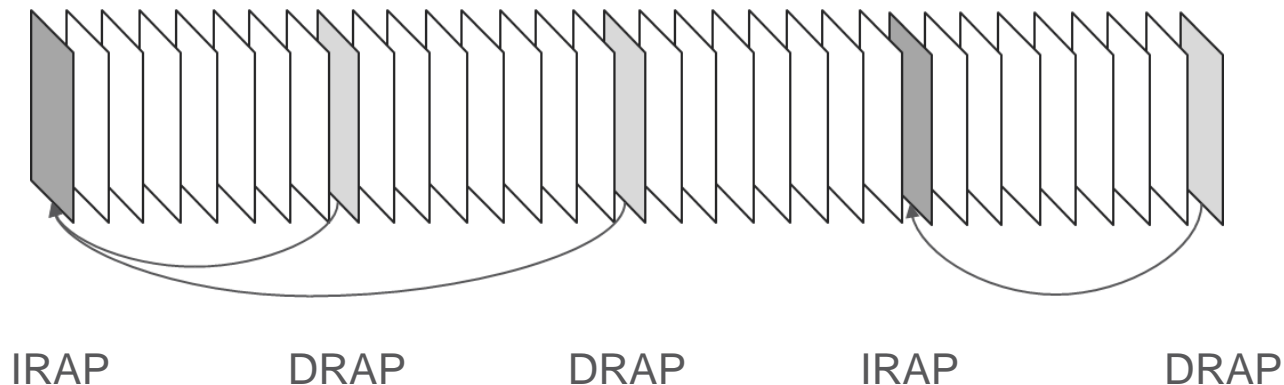
- › Random access and video refresh are provided in HEVC using periodic IRAP pictures
- › A problem is that IRAP pictures tend to be much more expensive to encode than inter pictures
- › This is in particular true for static content



# PROPOSAL



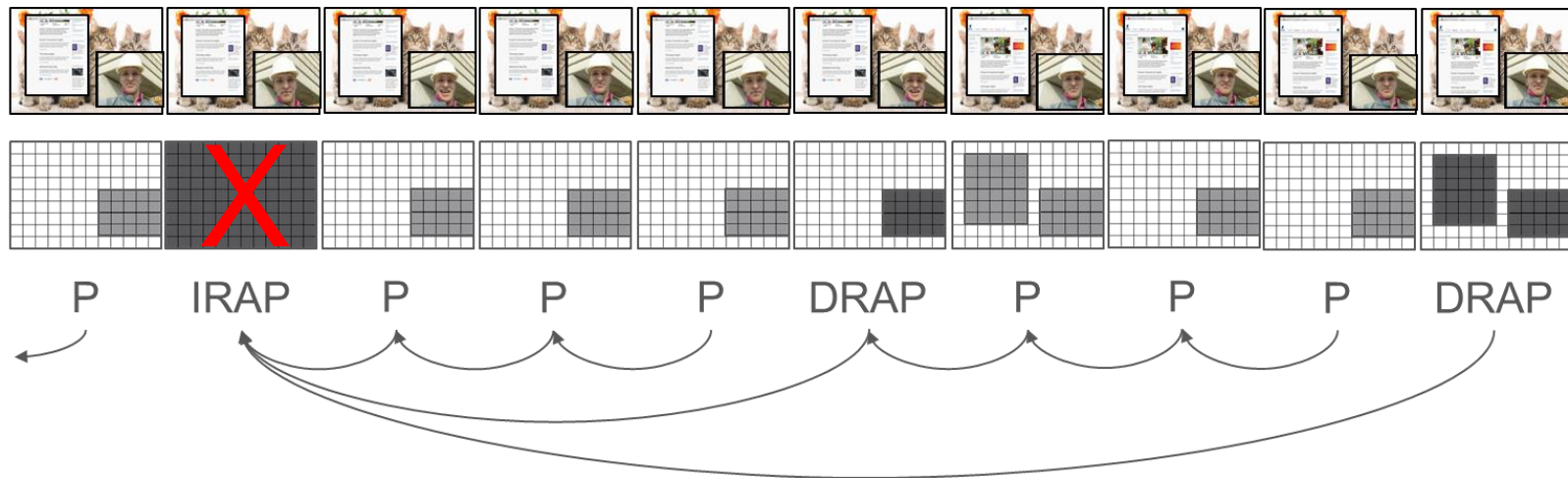
- › It is proposed to introduce the Dependent Random Access Point (DRAP) picture
- › A DRAP picture has the following properties
  - It may only reference the previous IRAP picture
  - It is a TRAIL\_R picture with temporal id 0
  - Prediction across the DRAP is not allowed except for by other DRAPs
- › It is proposed to indicate a DRAP through a Dependent RAP SEI message



# PROPOSAL CONT'D



- › A broken link flag may be set in the SEI message to indicate that pictures preceding the DRAP picture may contain undesirable visual artifacts
- › A flag may also be set in the SEI message to indicate that a DRAP picture only contains intra or skip blocks
  - Decreases decoding complexity when using DRAP picture as RAP
  - Improves error robustness



# USE CASE 1: SEARCHING IN STATIC VIDEO CONTENT



- › Video services that typically have very static content include:
  - Surveillance video
  - Screen sharing (as communication tool or for monitoring of other computers, e.g. servers)
- › For these services it may be useful to store the video material where the stored material preferably should be easy to navigate and search
- › For static content IRAP pictures may be very expensive to encode compared to inter pictures
- › By using DRAP pictures for most of the IRAP pictures compression efficiency is improved and the material may still be easily searched
  - Example: Use DRAP pictures every second and IRAP pictures every 60 seconds



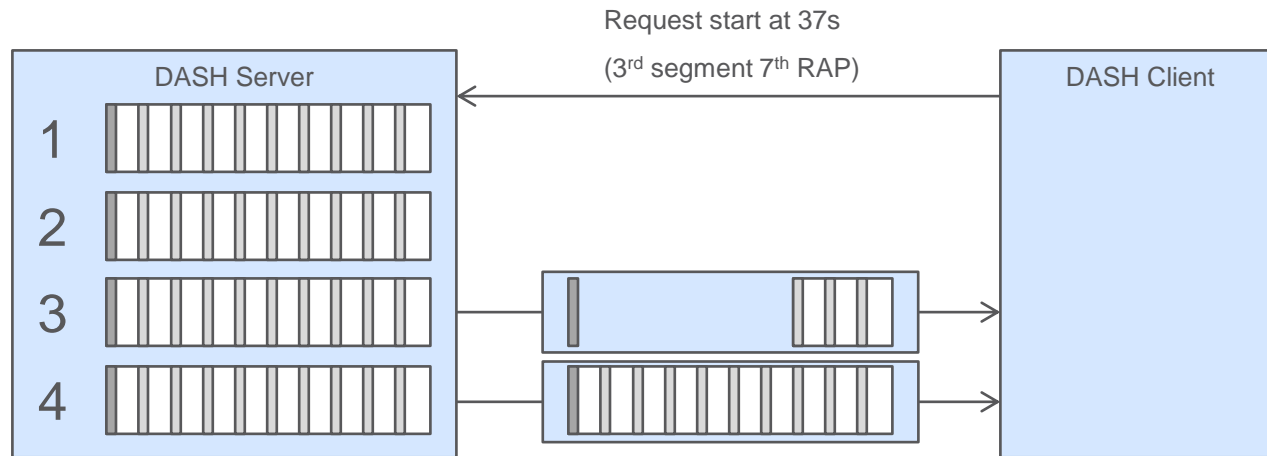
IRAP

IRAP

# USE CASE 2: MPEG-DASH



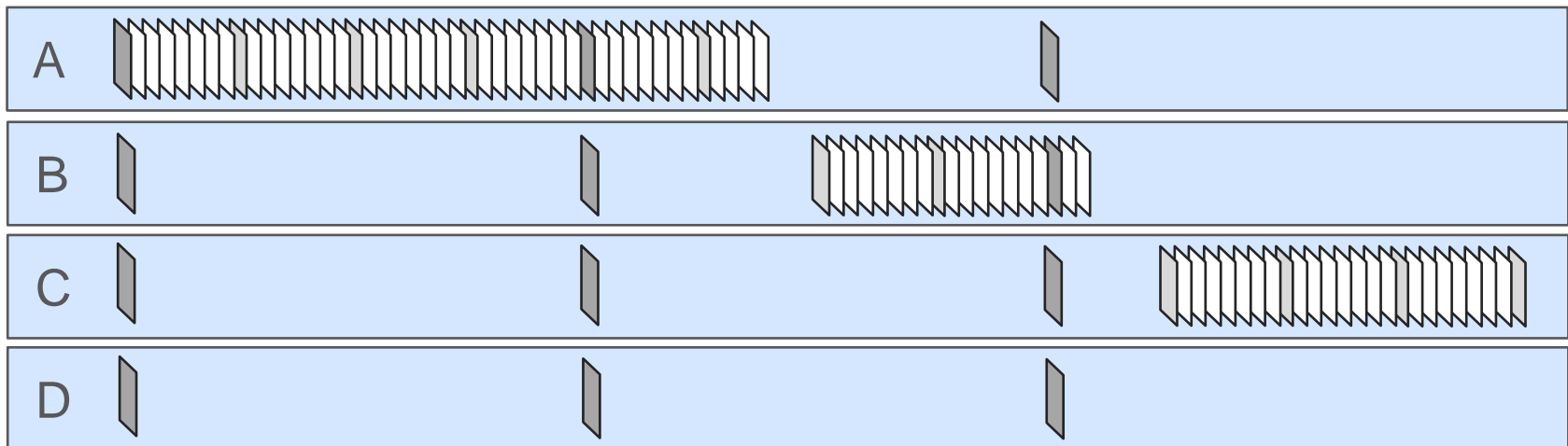
- › MPEG-DASH segments may be 10 seconds long with IRAP pictures every second to allow random access
- › To save bits all IRAP pictures in a segment except the first one may instead be coded as DRAP pictures
- › When the client requests to start in the middle of a segment only the DRAP at the specified position and its associated IRAP picture needs to be transmitted, followed by the remaining pictures



# USE CASE 3: FASTER CHANNEL SWITCHING FOR BROADCASTED SERVICES



- › A receiver with multiple tuners, decodes one channel
- › At the same time the receiver stores the last IRAP pictures for some other channels
- › When a user determines to switch channel the stored IRAP picture for that channel is decoded and used to decode the next DRAP picture followed by the other pictures in the stream



# SIMULATION RESULTS

## › Test setup

- HM-14.0+Rext-7.0+SCM-1.0 modified to use long-term pictures
- Anchor: CRA pictures every 32nd picture
- Test: DRAP pictures every 32nd picture referencing only the first IDR picture

## › Results

- BD Y gain 9.5% for HEVC version 1 RA test set
- BD Y gain 17.2% for SCC YUV444 RA test set

Sequence	BD Y	BD U	BD V
Traffic_2560x1600_30_crop2	-19.21	-17.63	-16.31
PeopleOnStreet_2560x1600_30_crop	-2.68	-1.37	-2.34
Nebuta_2560x1600_60_10bit_crop	-4.15	5.33	8.25
SteamLocomotiveTrain_2560x1600_60_10bit_crop	-9.39	-2.76	-5.66
Kimono1_1920x1080_24	-1.23	1.79	4.60
ParkScene_1920x1080_24	-5.82	-1.31	0.94
Cactus_1920x1080_50	-16.73	-17.01	-11.92
BasketballDrive_1920x1080_50	-2.01	1.80	1.25
BQTerrace_1920x1080_60	-16.36	-2.84	-10.49
BasketballDrill_832x480_50	-16.40	-15.62	-15.75
BQMall_832x480_60	-4.73	-0.05	-0.94
PartyScene_832x480_50	-5.00	0.28	0.32
RaceHorses_832x480_30	-2.37	0.89	1.49
BasketballPass_416x240_50	-1.31	1.27	0.00
BQSquare_416x240_60	-6.57	-0.23	1.12
BlowingBubbles_416x240_50	-1.98	3.35	2.66
RaceHorses_416x240_30	-1.38	1.86	1.64
BasketballDrillText_832x480_50	-17.03	-16.30	-16.25
ChinaSpeed_1024x768_30	-11.70	-9.42	-10.02
SlideEditing_1280x720_30	-55.90	-54.50	-54.97
SlideShow_1280x720_20	1.78	8.12	7.19
<b>Average</b>	<b>-9.53</b>	<b>-5.44</b>	<b>-5.49</b>

Table 1 BD rates for the HEVC version 1 test set.

Sequence	BD Y	BD U	BD V
sc_flyingGraphics_1920x1080_60_8bit_444_yuv	-1.19	-0.45	-0.44
sc_desktop_1920x1080_60_8bit_444_yuv	-38.64	-38.58	-38.61
sc_console_1920x1080_60_8bit_444_yuv	-7.94	-7.38	-7.13
sc_web_browsing_1280x720_30_300_8bit_444_yuv	-25.56	-24.38	-25.43
sc_map_1280x720_60_8bit_444_yuv	-17.08	-15.89	-14.23
sc_programming_1280x720_60_8bit_444_yuv	-10.49	-10.31	-10.50
sc_SlideShow_1280x720_20_8bit_500_444_yuv	1.63	3.55	3.96
Basketball_Screen_2560x1440_60p_8b444_yuv	-57.68	-57.65	-57.64
MissionControlClip2_2560x1440_60p_8b444_yuv	-10.90	-8.72	-8.03
MissionControlClip3_1920x1080_60p_8b444_yuv	-40.91	-40.26	-39.99
sc_robot_1280x720_30_8bit_300_444_yuv	-8.83	-7.59	-6.42
EBURainFruits_1920x1080_50_10bit_444_yuv	-3.46	1.54	1.52
Kimono1_1920x1080_24_10bit_444_yuv	-2.10	-2.47	-0.74
<b>Average</b>	<b>-17.17</b>	<b>-16.05</b>	<b>-15.67</b>

Table 2 BD rates for the SCC YUV444 test set.



# PROPOSED SYNTAX



- › It is proposed to insert the following text into the HEVC base specification

## D.2.25 Dependent RAP indication SEI message syntax

dependent_rap_indication(payloadSize) {	Descriptor
broken_link_flag	u(1)
only_skip_or_intra_blocks_flag	u(1)
referenced_irap_picture_poc_delta_idc	ue(v)
}	

# PROPOSED SEMANTICS



## D.3.25 Dependent RAP indication SEI message semantics

The dependent RAP indication SEI message assists a decoder in determining what parts of a bitstream need to be decoded in order to achieve correct decoding of the picture associated with the dependent RAP indication SEI message and the pictures that follow it in output order.

The picture associated with the dependent RAP indication SEI message is referred to as the DRAP picture. The DRAP picture shall be a TRAIL\_R picture with TemporalId equal to 0. The DRAP picture may use its associated IRAP picture for reference but shall not use any other picture for reference.

When performing random access at the DRAP picture the value of pic\_output\_flag should be inferred to be equal to 0 for all pictures that precede the DRAP picture in output order. Decoded pictures preceding the DRAP picture in output order may contain references to pictures unavailable in the decoded picture buffer.

Pictures that follow the DRAP picture in output order shall not use for reference any picture that precedes the DRAP picture in output order or decoding order with the exception that other, subsequent DRAP pictures may also use the associated IRAP picture for reference.

**broken\_link\_flag** indicates the presence or absence of a broken link in the NAL unit stream at the location of the dependent RAP indication SEI message and is assigned further semantics as follows:

- If broken\_link\_flag is equal to 1, pictures produced by starting the decoding process at the location of a previous IRAP access unit may contain undesirable visual artefacts to the extent that decoded pictures preceding the access unit associated with the dependent RAP indication should not be displayed.
- Otherwise (broken\_link\_flag is equal to 0), no indication is given regarding any potential presence of visual artefacts.

**only\_skip\_or\_intra\_blocks\_flag** indicates whether the DRAP picture contains only intra coded blocks or blocks with cu\_skip\_flag set to 1 according to:

- If only\_skip\_or\_intra\_blocks\_flag equals 1, the DRAP picture shall only contain intra coded blocks or blocks with cu\_skip\_flag set to 1.
- Otherwise, if only\_skip\_or\_intra\_blocks\_flag equals 0, the DRAP picture may contain blocks other than intra coded blocks or blocks with cu\_skip\_flag set to 1.

**referenced\_irap\_picture\_poc\_delta\_idc**, when greater than zero, specifies the difference between the PicOrderCntVal of the DRAP picture and the PicOrderCntVal of the IRAP picture referenced by the DRAP picture. If referenced\_irap\_picture\_poc\_delta\_idc equals 0, the difference between the PicOrderCntVal of the DRAP picture and the PicOrderCntVal of the IRAP picture referenced by the DRAP picture is unspecified.

# CONCLUSION

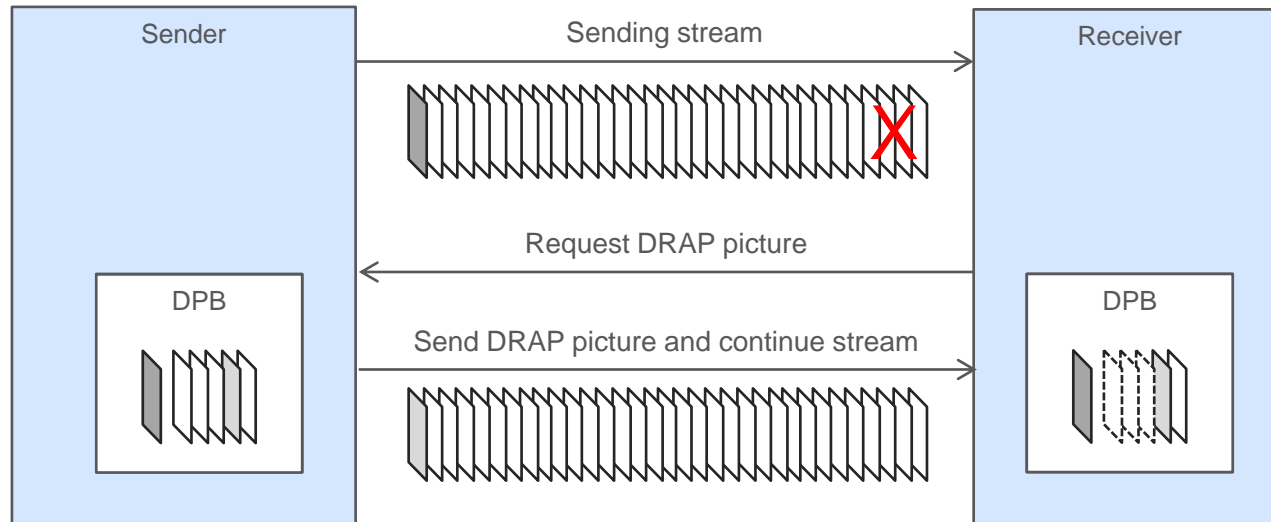


- › A new dependent RAP indication SEI message has been proposed that indicates the presence of a DRAP picture
  - A DRAP picture may only reference the previous IRAP picture
  - Two flags are signaled in the SEI message, `broken_link_flag` and `only_skip_or_intra_blocks_flag`
  
- › It is proposed to include the SEI message in the HEVC base specification



**ERICSSON**

# USE CASE 4: CONVERSATIONAL VIDEO WITH FEEDBACK CHANNEL



- › A sender streams video to a receiver. The IRAP picture is stored as a long term picture in the DPB
- › If a picture is lost, the receiver may request a DRAP picture for refresh
- › If broken link flag is set to 1, the receiver discards the pictures before the DRAP picture in the output buffer