

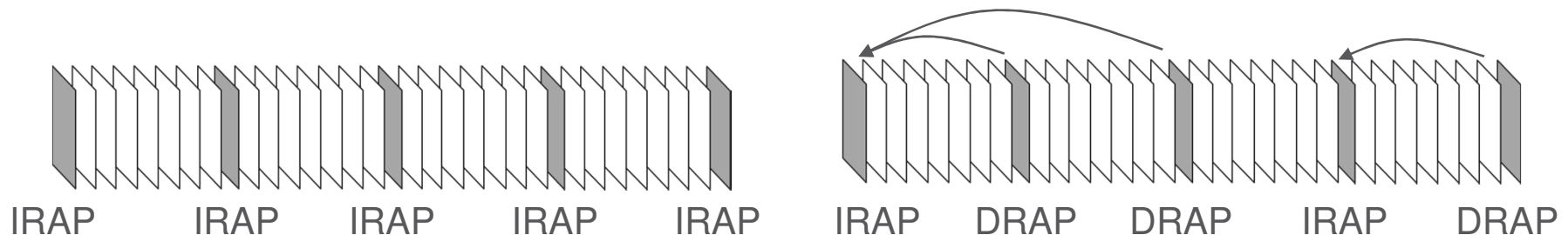
# JCTVC-S0095: HLS: DEPENDENT RAP INDICATION SEI MESSAGE

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# ONE SLIDE SUMMARY



- › Random access is provided in HEVC using periodic IRAP pictures
- › IRAP pictures are expensive to encode
- › Proposal: A dependent RAP (DRAP) picture SEI indication
  - DRAP is allowed to use the previous IRAP for prediction to reduce the bit cost
  - DRAP SEI guarantee that random access is possible given that IRAP is available



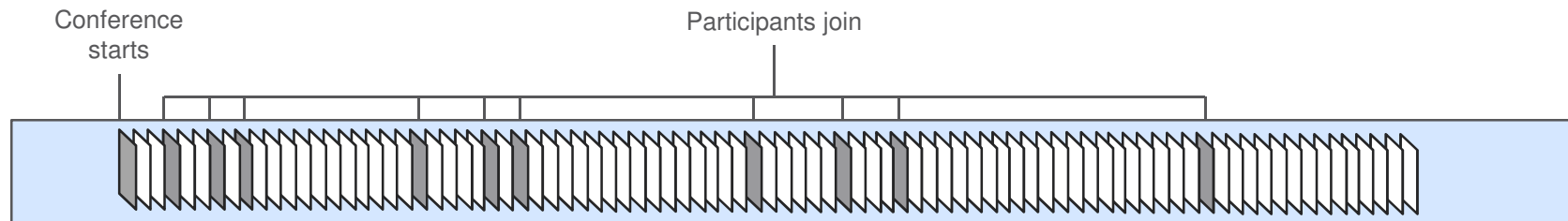
- › Example BD results
  - Anchor: IRAP every 32th picture
  - Test: First encoded picture IRAP, then DRAP every 32th picture

HEVC v1 RA test set	-9.5%
SCC YUV444 RA test set	-17.2%

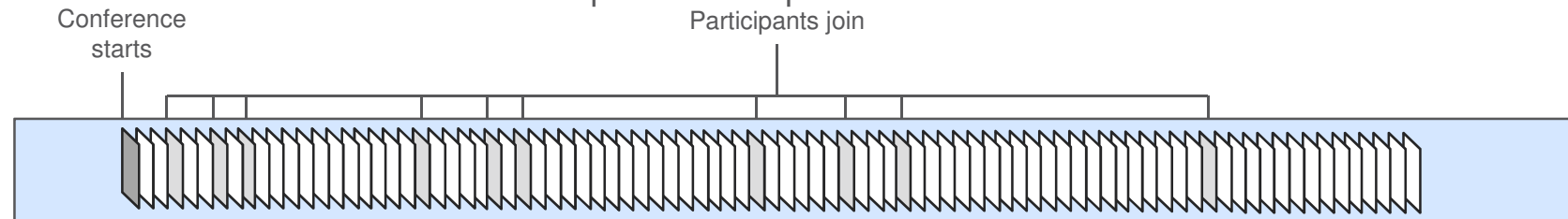
# USE CASE A: MASSIVE VIDEO CONFERENCE



- › Massive video conference (one to many) without DRAP
  - Each time a new participant joins, the conference server request an expensive IRAP from the sender



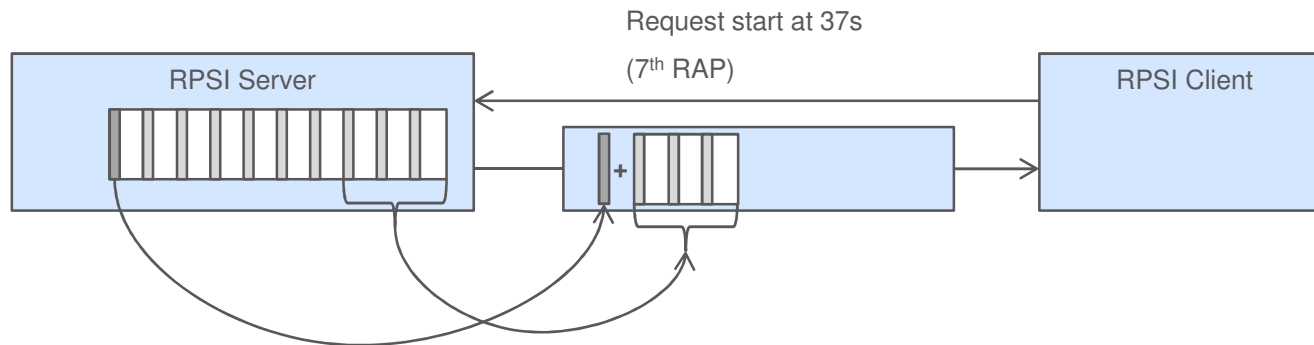
- › Massive video conference (one to many) with DRAP
  - When a new participant joins, the conference server sends the previous IRAP by unicast to that participant.
  - The conference server then request an inexpensive DRAP (Dependent RAP) from the sender



# USE CASE B: SERVER-CONTROLLED STREAMING



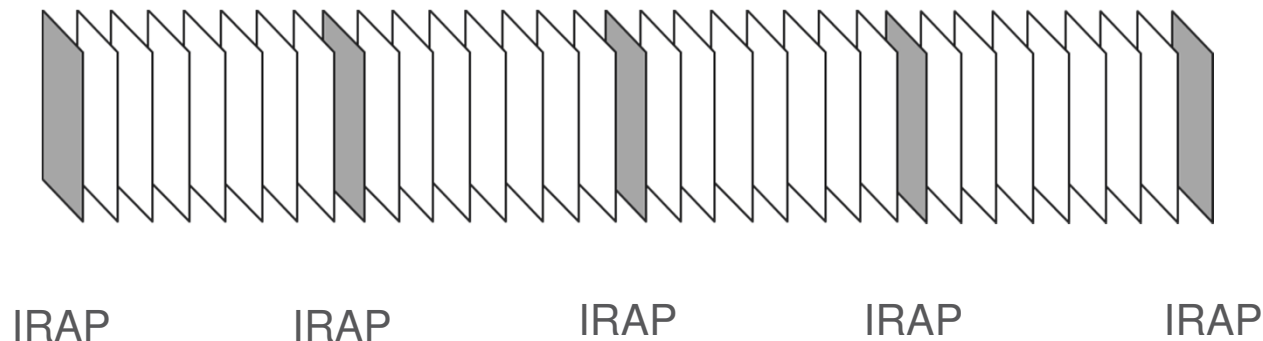
- › In this example the client requests a specific position in a stream to be delivered from the server (e.g. by using the PLAY request with a range value in RTSP).
- › The server will on-the-fly construct the stream to be delivered by concatenating the previous IRAP picture with the DRAP picture that corresponds to the start of the requested range.



# BACKGROUND



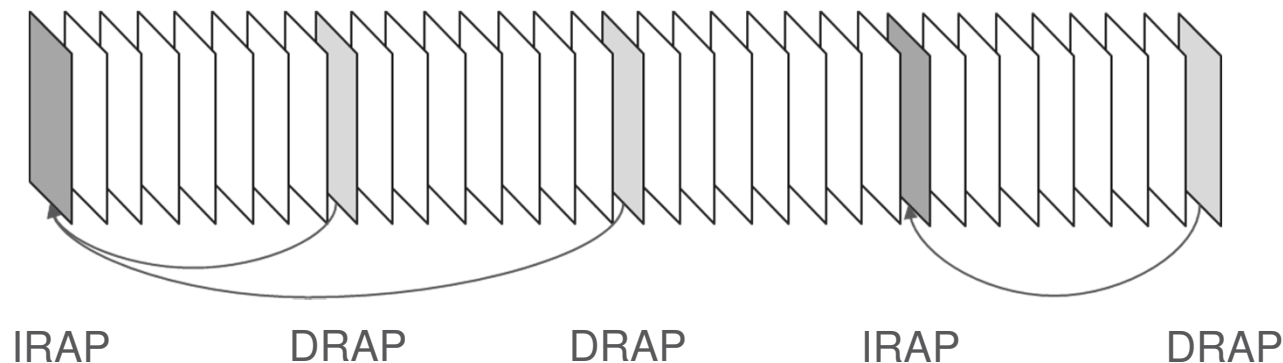
- › This is a follow-up contribution of JCTVC-R0059
- › Random access is provided in HEVC using periodic IRAP pictures
- › IRAP pictures are generally much more expensive to encode than inter predicted pictures
- › This is in particular true for static content



# PROPOSAL



- › It is proposed to introduce a Dependent Random Access Point (DRAP) picture with the following properties
  - The DRAP picture may not include any picture in RefPicSetStCurrBefore, RefPicSetStCurrAfter, or RefPicSetLtCurr except its associated IRAP picture.
  - The DRAP picture shall be a TRAIL\_R picture with temporal id equal to 0 and layer id equal to 0
  - Any picture that follow the DRAP picture in output order and decoding order shall not include, in its RPS, any picture that precedes the DRAP picture in output order or decoding order with the exception of the IRAP picture associated with the DRAP picture
- › It is proposed to indicate a DRAP through a Dependent RAP SEI message



# USE CASE 1: SEARCHING IN STATIC VIDEO CONTENT



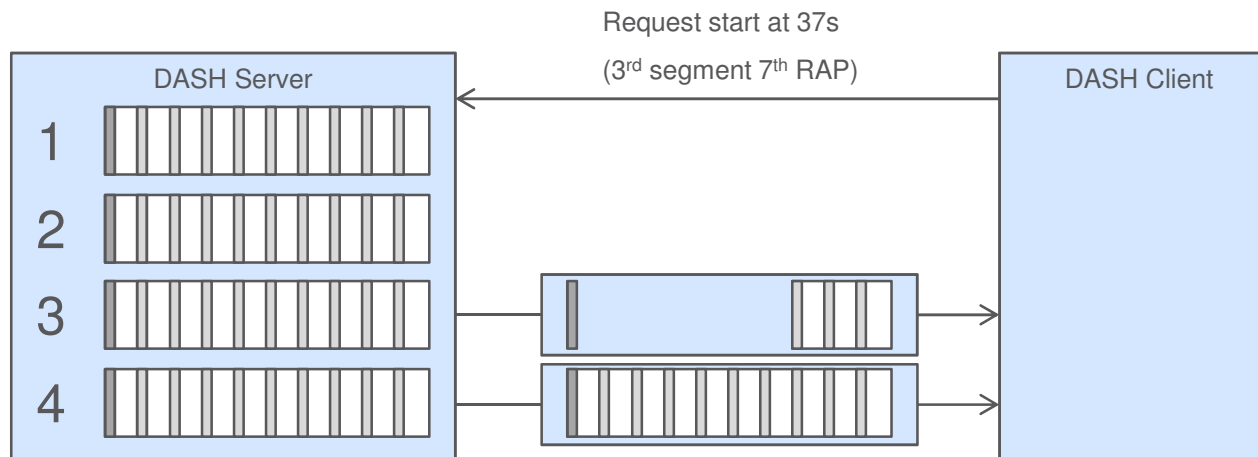
- › Video services that typically have very static content include:
  - Surveillance video
  - Screen sharing (as communication tool or for monitoring of other computers, e.g. servers)
- › For these services it may be useful to store the video material where the stored material preferably should be easy 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



# 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

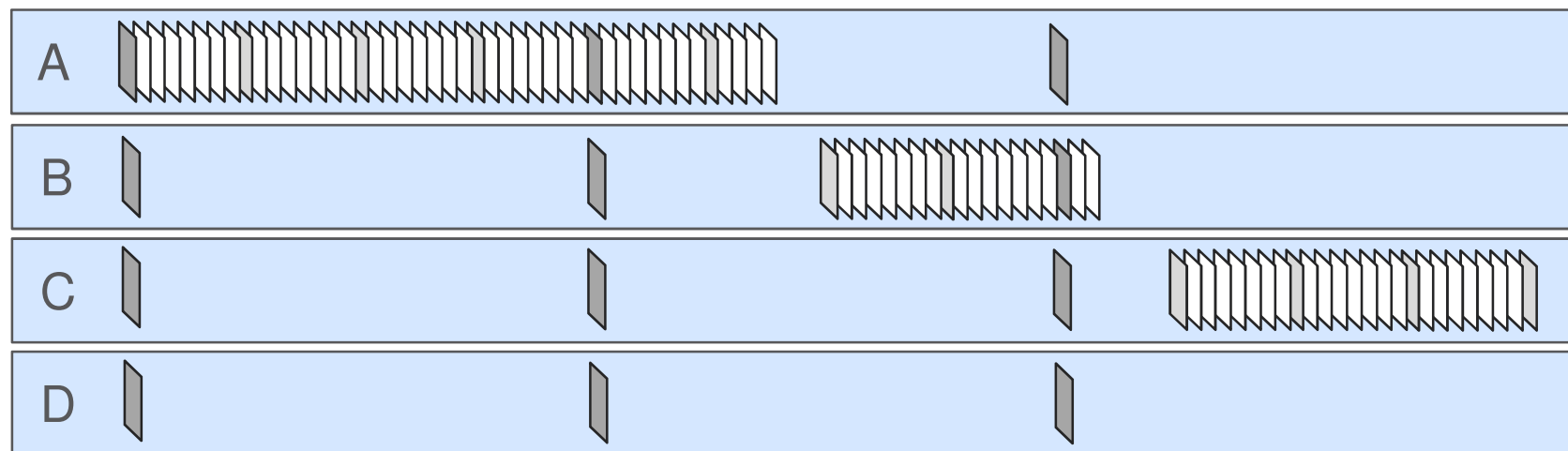




# USE CASE 3: FASTER CHANNEL SWITCHING FOR BROADCASTED SERVICES



- › 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 MPEG DASH USE CASE

- › Test setup
  - HM-14.0+Rext-7.0+SCM-1.0 modified to use long-term pictures
  - Anchor: IRAP period 32
  - Test: DRAP period 32 (reference only to the first IDR picture)
- › Results
  - BD Y -9.5% for HEVC v1 RA test set
  - BD Y -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.

# SIMULATION RESULTS

## FAST CHANNEL SWITCHING

- › Test setup
  - HM-15.0+Rext-8.0+SCM-2.0rc1 modified to use long-term pictures
  - Anchor: IRAP period 64
  - Test 1: IRAP period 8
  - Test 2: IRAP period 64, DRAP period 8
- › Results
  - Bitrate overhead 67.7% and 131.3% for test 1 compared to anchor
  - Bitrate overhead 17.1% and 28.1% for test 2 compared to anchor

Sequence	IRAP 8	IRAP 64, DRAP 8
	BD Y	BD Y
BQSquare_416x240_60	96.5%	23.9%
RaceHorses_416x240_30	17.1%	8.3%
BasketballPass_416x240_50	13.9%	3.9%
BlowingBubbles_416x240_50	61.9%	20.8%
BQMall_832x480_60	45.9%	16.2%
PartyScene_832x480_50	62.2%	13.5%
RaceHorses_832x480_30	17.6%	10.8%
BasketballDrill_832x480_50	46.5%	5.1%
Kimono1_1920x1080_24	25.5%	13.3%
ParkScene_1920x1080_24	62.6%	20.1%
Cactus_1920x1080_50	59.9%	15.7%
BQTerrace_1920x1080_60	99.4%	33.3%
BasketballDrive_1920x1080_50	18.7%	9.0%
Traffic_2560x1600_30_crop2	96.7%	21.6%
PeopleOnStreet_2560x1600_30_crop	14.2%	4.7%
SteamLocomotiveTrain_2560x1600_60_10bit_crop	63.2%	22.7%
Nebuta_2560x1600_60_10bit_crop	20.6%	11.6%
BasketballDrillText_832x480_50	52.0%	7.1%
ChinaSpeed_1024x768_30	44.7%	6.1%
SlideEditing_1280x720_30	444.3%	54.3%
SlideShow_1280x720_20	58.9%	37.8%
<b>Average</b>	<b>67.7%</b>	<b>17.1%</b>

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

Sequence	IRAP 8	IRAP 64, DRAP 8
	BD Y	BD Y
sc_flyingGraphics_1920x1080_60_8bit_444_yuv	6.4%	3.5%
sc_desktop_1920x1080_60_8bit_444_yuv	220.7%	17.9%
sc_console_1920x1080_60_8bit_444_yuv	37.1%	12.5%
sc_web_browsing_1280x720_30_300_8bit_444_yuv	270.3%	90.0%
sc_map_1280x720_60_8bit_444_yuv	207.2%	47.4%
sc_programming_1280x720_60_8bit_444_yuv	77.7%	14.8%
sc_SlideShow_1280x720_20_8bit_500_444_yuv	62.2%	39.8%
Basketball_Screen_2560x1440_60p_8b444_yuv	263.8%	5.7%
MissionControlClip2_2560x1440_60p_8b444_yuv	138.0%	49.2%
MissionControlClip3_1920x1080_60p_8b444_yuv	273.0%	26.9%
sc_robot_1280x720_30_8bit_300_444_yuv	72.5%	21.0%
EBURainFruits_1920x1080_50_10bit_444_yuv	64.0%	32.6%
Kimono1_1920x1080_24_10bit_444_yuv	13.9%	4.6%
<b>Average</b>	<b>131.3%</b>	<b>28.1%</b>

**BD rates for the SCC YUV444 test set.**

# PROPOSED TEXT



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

## D.2.30 Dependent RAP indication SEI message syntax

<code>dependent_rap_indication( payloadSize ) {</code>	<b>Descriptor</b>
<code>}</code>	

## D.3.30 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 following pictures.

The picture associated with the dependent RAP indication SEI message is referred to as a DRAP picture. The DRAP picture shall be a TRAIL\_R picture with TemporalId equal to 0 and nuh\_layer\_id equal to 0. The DRAP picture may not include any picture in RefPicSetStCurrBefore, RefPicSetStCurrAfter, or RefPicSetLtCurr except its associated IRAP picture.

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 that are unavailable in the decoded picture buffer.

Any picture that follow the DRAP picture in output order and decoding order shall not include, in its RPS, any picture that precedes the DRAP picture in output order or decoding order with the exception of the IRAP picture associated with the DRAP picture.

# CONCLUSION



- › It is proposed to introduce the Dependent Random Access Point (DRAP) picture with the following properties
  - The DRAP picture may not include any picture in RefPicSetStCurrBefore, RefPicSetStCurrAfter, or RefPicSetLtCurr except its associated IRAP picture.
  - The DRAP picture shall be a TRAIL\_R picture with temporal id equal to 0 and layer id equal to 0
  - Any picture that follow the DRAP picture in output order and decoding order shall not include, in its RPS, any picture that precedes the DRAP picture in output order or decoding order with the exception of the IRAP picture associated with the DRAP picture
- › It is proposed to indicate a DRAP through a Dependent RAP SEI message and include the SEI message in the HEVC base specification without any restrictions on which profiles and/or extensions it applies to



**ERICSSON**

# USE CASE C: FAST CHANNEL SWITCHING FOR IPTV BROADCASTED SERVICES



- › When a user determines to switch channel the previous IRAP for the new channel is sent to the user via very fast unicast
- › The received IRAP picture is decoded and used to decode the next DRAP picture followed by the other pictures in the stream
- › This may enable more frequent RAP points and faster channel switch

