



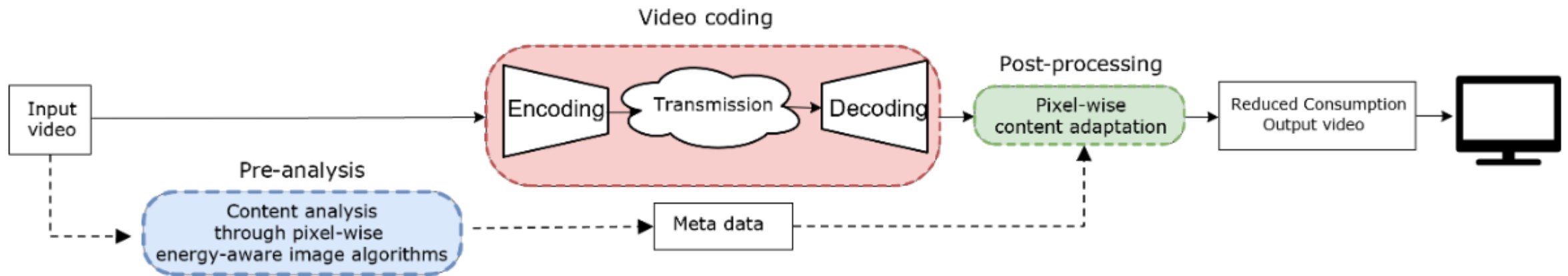
JVET-AD0121

AHG9: Attenuation Map Information SEI for reducing energy consumption of displays

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Follow-up of JVET-AC0122 (1/2)

- JVET-AC0122 proposed a **new framework for reducing the energy consumption of displays**:
 - new metadata for assisting with attenuating of the decoded video at the receiver side
 - new type of auxiliary pictures and associated Attenuation Map Information (AMI) SEI message.



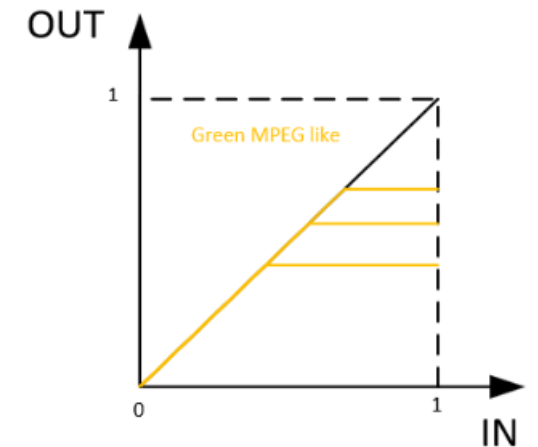
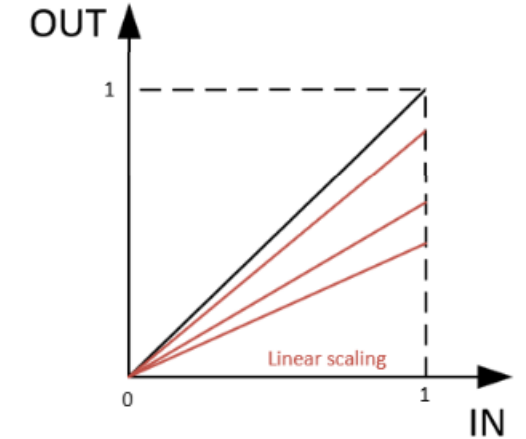
[AHG9: Attenuation Map Information SEI for reducing energy consumption of displays](#)

Follow-up of JVET-AC0122 (2/2)

- During the JVET 29th meeting, the group recommended to:
 - Compare **pixel-based methods** as proposed in the contribution with the approach in **Green metadata display adaptation**.
 - Assess the influence of **different screens** and **screen options** on the method.
 - Study whether the **existing auxiliary picture dedicated to alpha blending** may be used for the proposed use case.
 - Evaluate the **transmission cost** of attenuation map.

Comparison with Linear Scaling and Green MPEG-Like method (1/5)

- Four methods have been tested:
 - Two global methods:
 - Linear scaling of the luminance channel
 - Clipping the highlights to simulate the current Green Metadata solution
 - Two local deep-learning-based methods (pixel-wise attenuation map):
 - Third party implementation of the R-ACE network [Nugroho, 2022]
 - Light weight deep network inspired from R-ACE network, called DeepPVR [Le Meur et al., 2023]



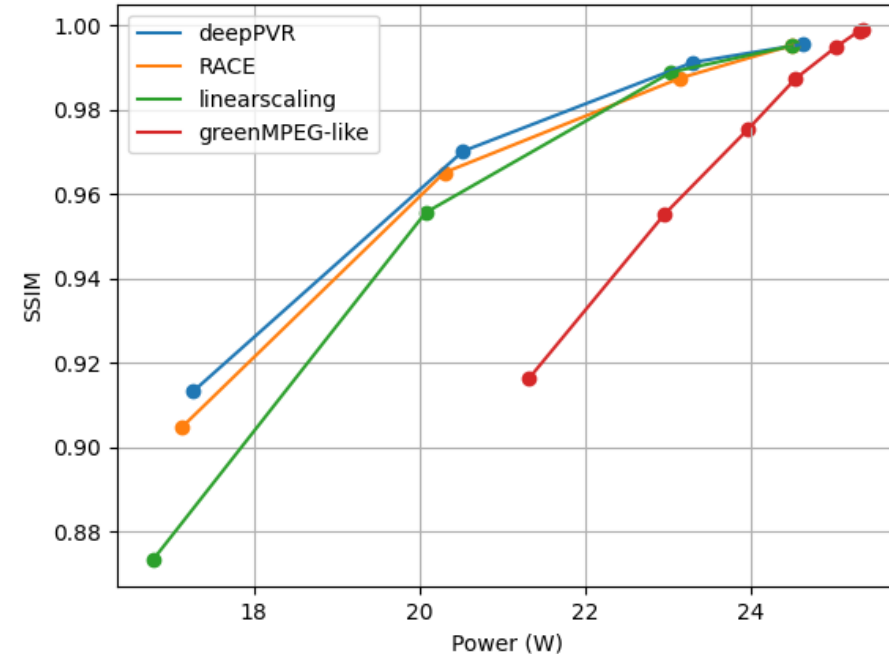
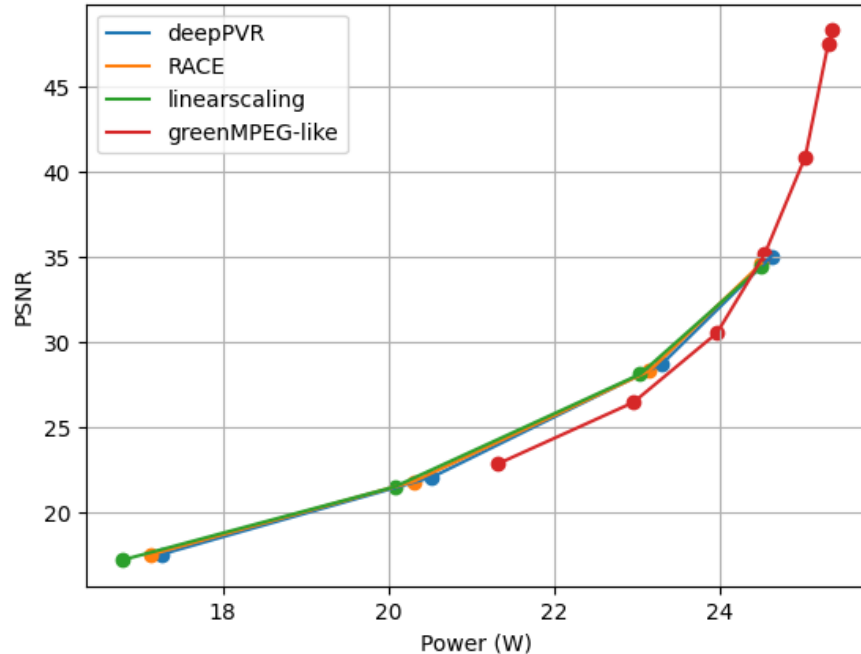
[Nugroho, 2022] Nugroho, Kuntoro Adi, and Shanq-Jang Ruan. "R-ACE Network for OLED Image Power Saving." *2022 IEEE 4th Global Conference on Life Sciences and Technologies (LifeTech)*. IEEE, 2022.

[Le Meur et al., 2023] Le Meur et al., Deep-learning-based energy aware images, submitted to ICIP 2023,

Comparison with Linear Scaling and Green MPEG-Like method (2/5)

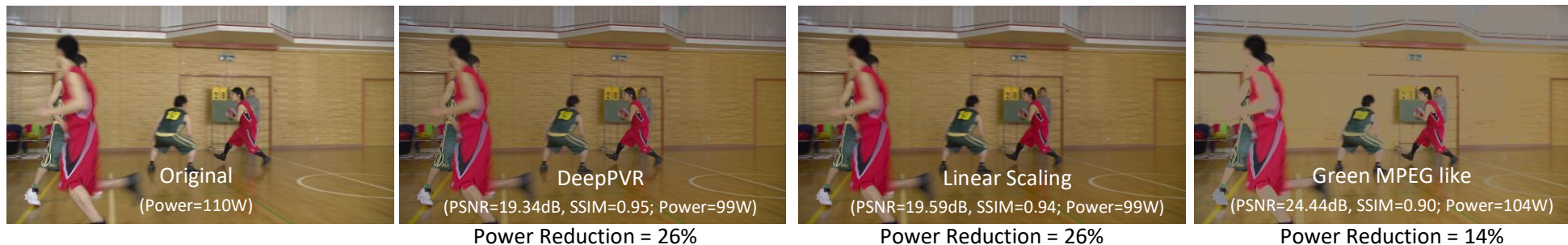
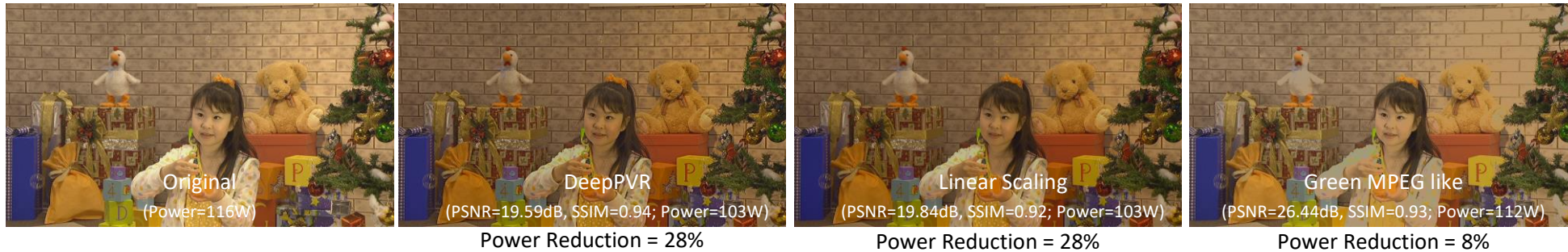
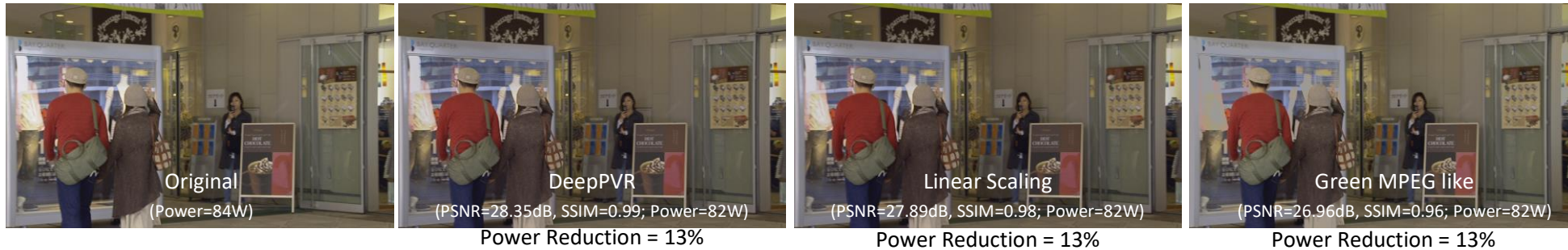
- Test protocol:
 - 85 images extracted from 17 JVET sequences (five frames per sequence)
 - 2 sequences from class A
 - 6 sequences from class B
 - 6 sequences from class C
 - 1 sequence from class D
 - 2 sequences from class E
 - 4 rates of power reduction: 10%, 20%, 40% and 60%.
 - PSNR and SSIM
 - Power consumption measured on OLED SONY KD-55AF9 (55'', 4K). The static power consumption is 59W.
- Total of measurement: $85 * 4 \text{ rates} * 3 \text{ methods} + 85 * 7 \text{ (Green MPEG)} + 85 = 1700$

Comparison with Linear Scaling and Green MPEG-Like method (3/5)



- Observations:
 - Green MPEG-like method provides the worst results (current standardized solution is not tailored for OLED screen);
 - Pixel-wise methods perform better than the linear scaling especially when the energy reduction rate is increasing;
 - DeepPVR is the best method so far.

Comparison with Linear Scaling and Green MPEG-Like method (4/5)



Observations:

- Bad visual quality for Green MPEG like method
- DeepPVR provides better visual results than linear scaling

Comparison with Linear Scaling and Green MPEG-Like method (5/5)



DeepPVR



Linear Scaling



DeepPVR



Linear Scaling



DeepPVR



Linear Scaling

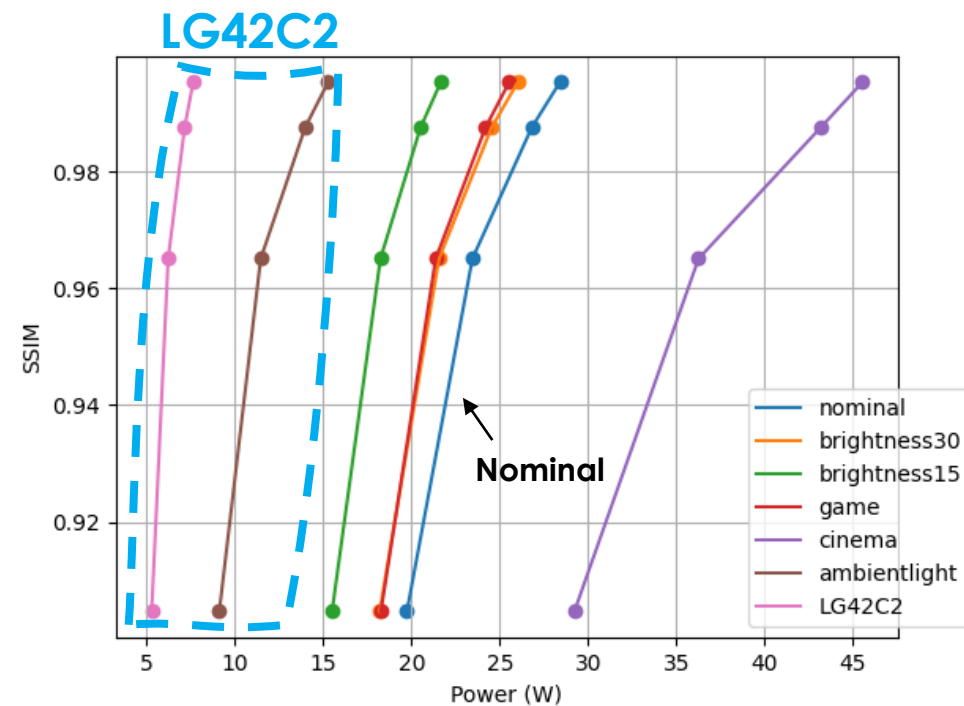
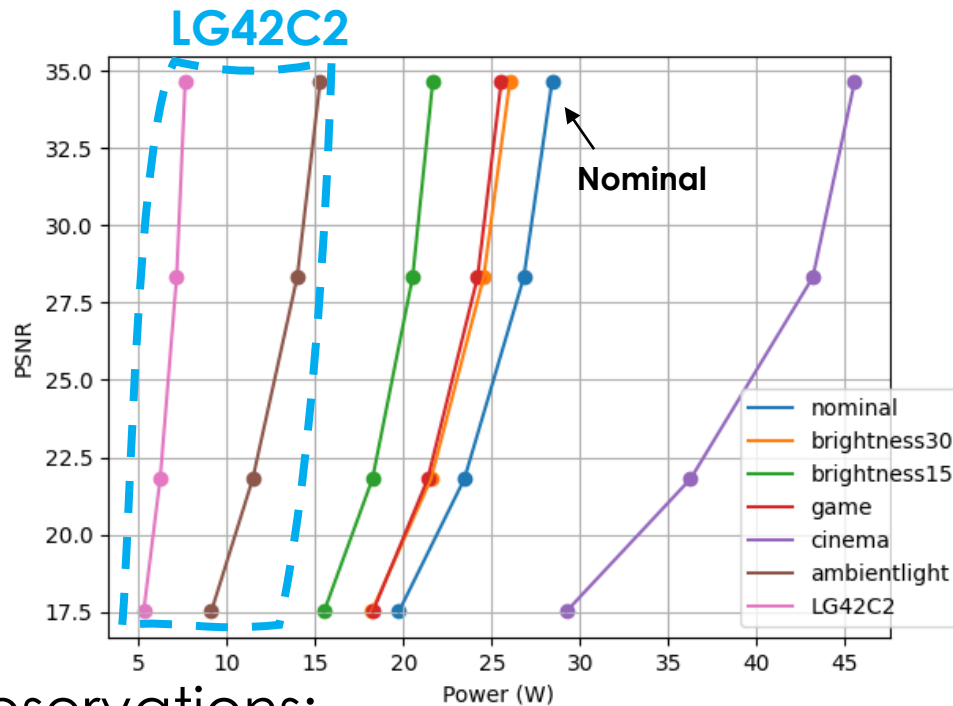
Linear scaling introduces blur and reduces the contrast, details are less sharp than DeepPVR's results

Does the TV setting influence the performances? (1/2)

- Test protocol:
 - 7 different settings
 - 85 images
 - R-ACE method
- Total of measurement: $85 * 4 \text{ rates} * 1 \text{ method} * 7 + 85 * 7 = 2975$

Mode	Description
nominal	SONY KD-55AF9 (55'', 4K), all possible options set to OFF, picture mode STANDARD, maximal brightness (=50)
Brightness30	SONY KD-55AF9 (55'', 4K), all possible options set to OFF, picture mode STANDARD, brightness=30
Brightness15	SONY KD-55AF9 (55'', 4K), all possible options set to OFF, picture mode STANDARD, brightness=15
Cinema	SONY KD-55AF9 (55'', 4K), all possible options set to OFF, picture mode CINEMA, maximal brightness (=50)
Game	SONY KD-55AF9 (55'', 4K), all possible options set to OFF, picture mode GAME, maximal brightness (=50)
LG42C2	LG 42C2 (42'', 4K), all possible options set to OFF, picture mode STANDARD, maximal brightness, no ambient light adaptation
LG42C2-ambientlight	LG 42C2 (42'', 4K), all possible options set to OFF, picture mode STANDARD, maximal brightness, ambient light adaptation

Does the TV setting influence the performances? (2/2)



- Observations:
 - Decreasing the brightness of the TV decreases, as expected, the energy consumption;
 - The most consuming mode is the cinema mode (more than 100W in average);
 - The set of chosen options or screens does not influence significantly the performance of the proposed attenuation process.

Using the auxiliary picture AUX_ALPHA (1/1)

- We can leverage the auxiliary picture of type AUX_ALPHA to carry the attenuation map;
- The ACI (Alpha Channel Information) SEI message can be used without any change in syntax and semantics:
 - **alpha_channel_use_idc should be equal to 3**
 - Note that the auxiliary pictures of type AUX_ALPHA has only one component.

Compression of the attenuation map sequence (1/1)

	Bit Rate (kbps)		VMAF between original video and original video+(compressed) attenuation map	
	10%	60%	10%	60%
Energy reduction	10%	60%	10%	60%
Original attenuation map without compression	--	--	88	24
Compressed attenuation map RA QP 32	70	313	87	22
Compressed attenuation map RA QP 37	43	180	89	23

Protocol:

- The first 32 frames of NTT_BQTerrace (1080p)
- DeepPVR
- Attenuation map in 420 in full resolution
- VTM encoder Version 17.2

• Observations:

- The bit rate required to transmit the full resolution attenuation map is moderate (between 43 to 313 kbps).
- The VMAF scores indicate that the quality of the resulting attenuated sequence is not significantly impacted. For higher QP, the quality is increasing (the attenuation values decrease to zeros).

Conclusion

- The proposed framework **performs better than the actual Green standard for OLED screens;**
- The **TV setting does not influence the results;**
- The attenuation map can be conveyed thanks the auxiliary picture of type **AUX_ALPHA** (with the associated limitation);
- **The cost to transmit attenuation map is moderate;**
- **The specific information for the Attenuation Map Information will be proposed to be specified in a new amendment of the Green metadata specification.**

Thanks 😊

This work has been achieved in the context of the project 3EMS-2 funded by the “Region Bretagne”, Rennes Métropole, and “Images et Réseaux”.

Use Case: one Attenuation Map (one component) applied on luma

