



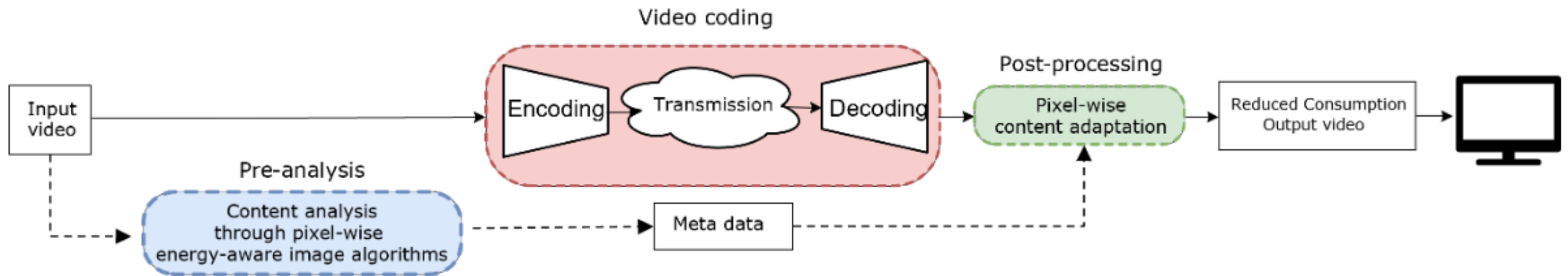
# JVET-AD0121

**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.



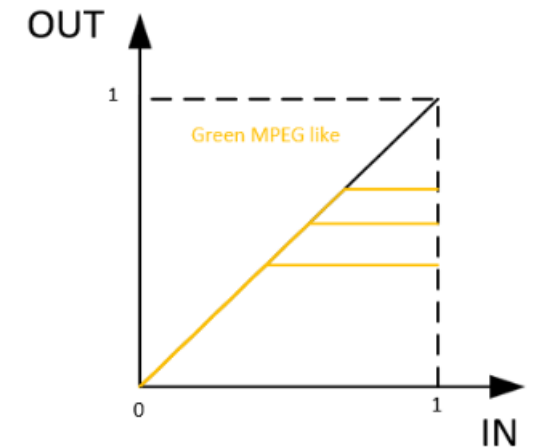
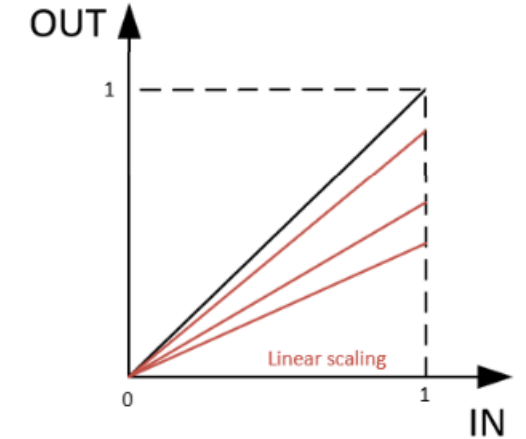
[AHG9: Attenuation Map Information SEI for reducing energy consumption of displays](#)

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

- During the JVET 29<sup>th</sup> 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]



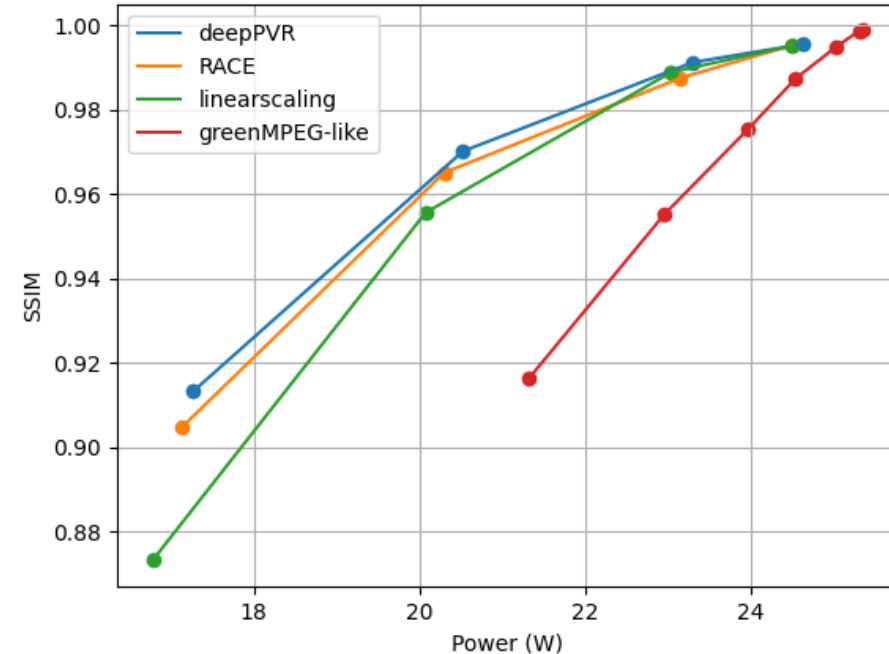
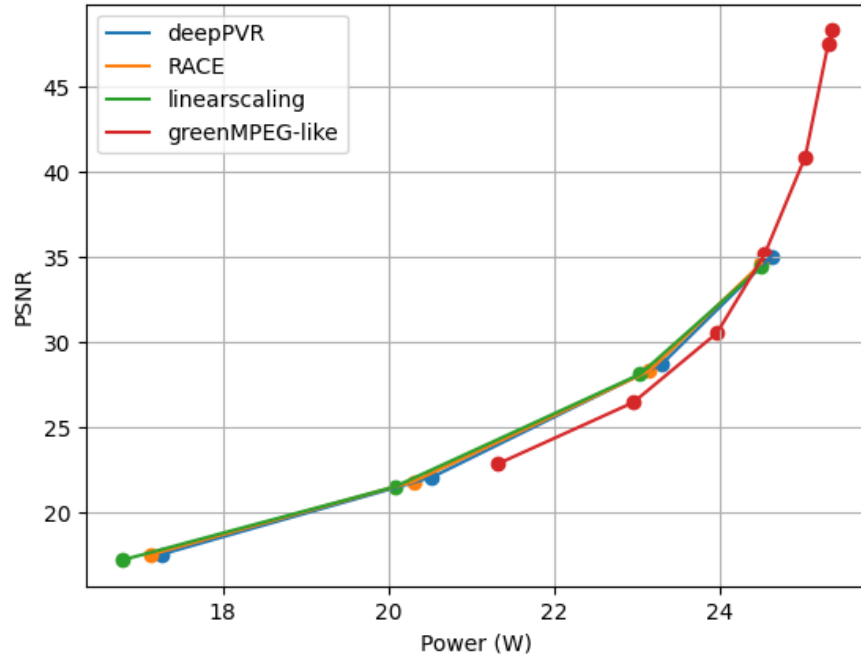
[Nugroho, 2022] Nugroho, Kuntoro Adi, and Shanq-Jang Ruan. "R-ACE Network for OLED Image Power Saving." *2022 IEEE 4th Global Conference on Life Sciences and Technologies (LifeTech)*. IEEE, 2022.

[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)

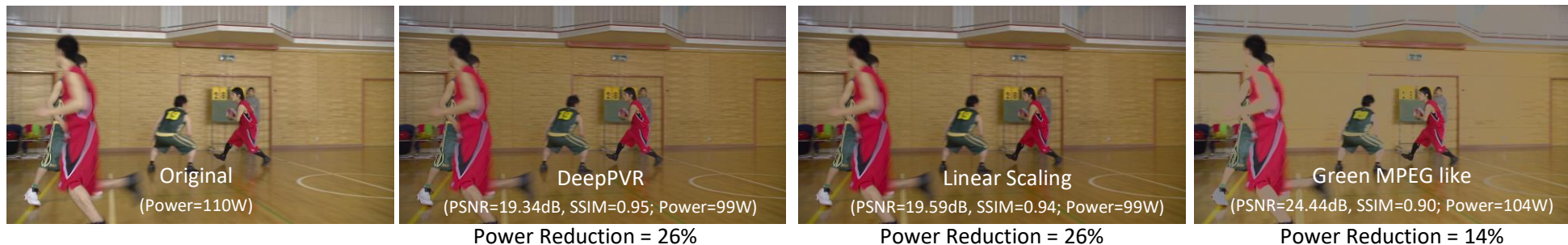
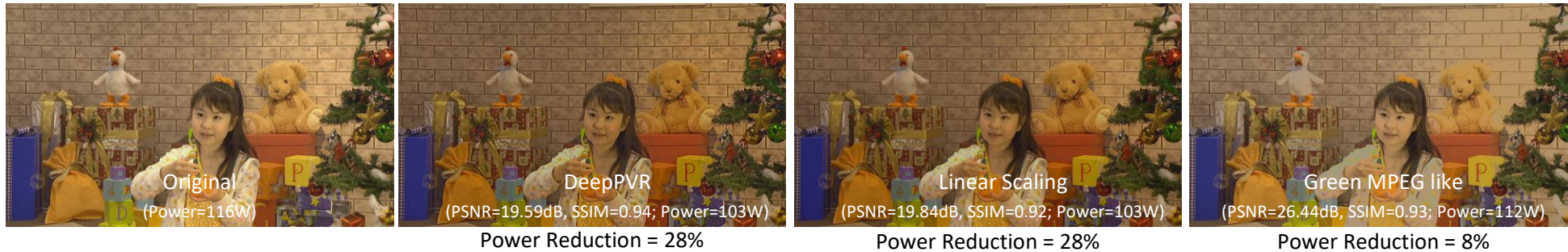
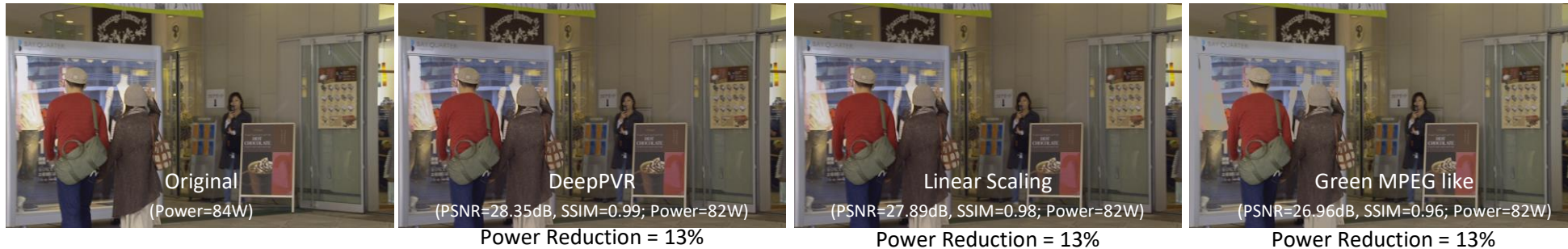
- Test protocol:
  - 85 images extracted from 17 JVET sequences (five frames per sequence)
    - 2 sequences from class A
    - 6 sequences from class B
    - 6 sequences from class C
    - 1 sequence from class D
    - 2 sequences from class E
  - 4 rates of power reduction: 10%, 20%, 40% and 60%.
  - PSNR and SSIM
  - Power consumption measured on OLED SONY KD-55AF9 (55'', HD). The static power consumption is 59W.
- Total of measurement:  $85 * 4 \text{ rates} * 4 \text{ methods} + 85 = 1445$

# 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

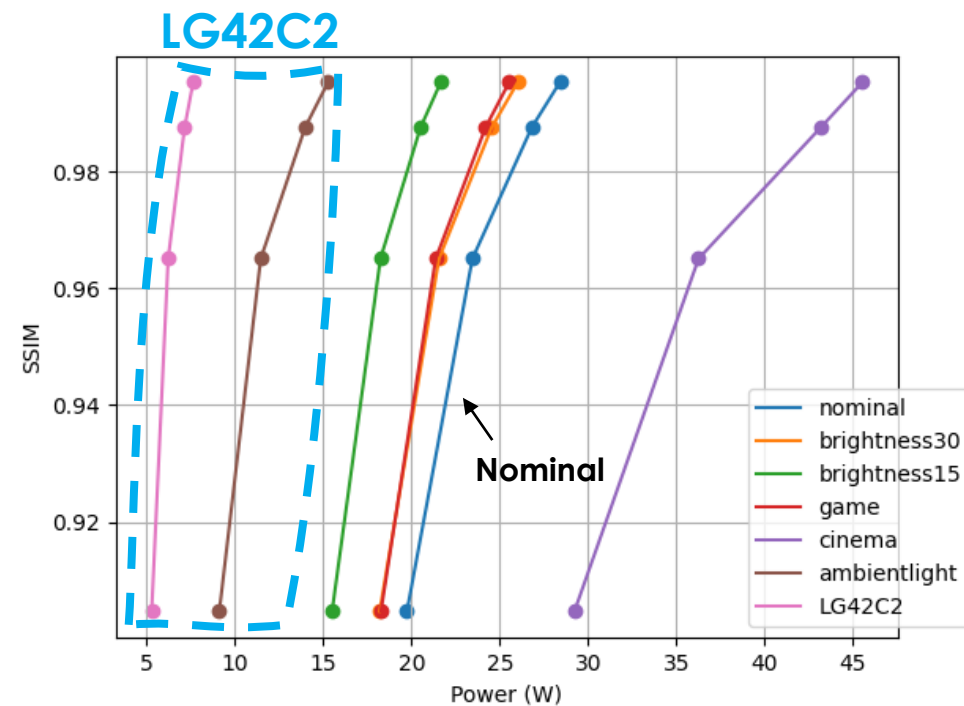
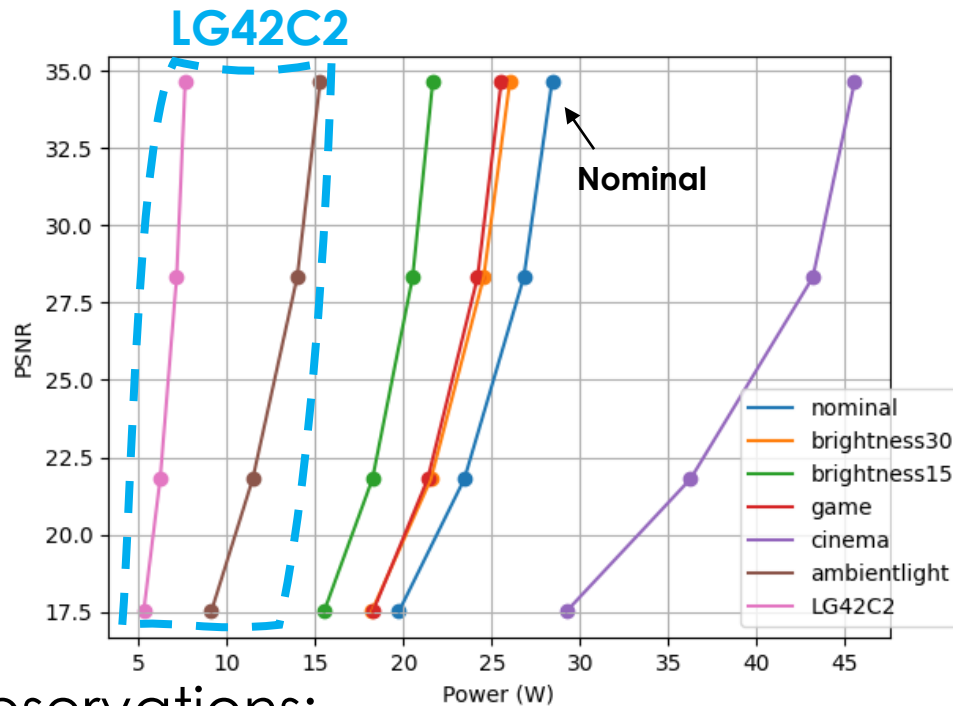
**Linear scaling introduces blur and reduces the contrast, details are less sharp than DeepPVR's results**

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

- Test protocol:
  - 7 different settings
  - 85 images
  - R-ACE method
- Total of measurement:  $85 * 4 \text{ rates} * 1 \text{ method} + 85 * 7 = 935$

Mode	Description
nominal	SONY KD-55AF9 (55'', HD), all possible options set to OFF, picture mode STANDARD, maximal brightness (=50)
Brightness30	SONY KD-55AF9 (55'', HD), all possible options set to OFF, picture mode STANDARD, brightness=30
Brightness15	SONY KD-55AF9 (55'', HD), all possible options set to OFF, picture mode STANDARD, brightness=15
Cinema	SONY KD-55AF9 (55'', HD), all possible options set to OFF, picture mode CINEMA, maximal brightness (=50)
Game	SONY KD-55AF9 (55'', HD), 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

