EBU **TECHNICAL**

# FPDs in professional broadcast
## *which technology to replace the CRT ?*

**WBU ISOG Geneva 2009**

**Adi Kouadio**

Project Engineer EBU TECHNICAL

European Broadcasting Union

EBU·UER

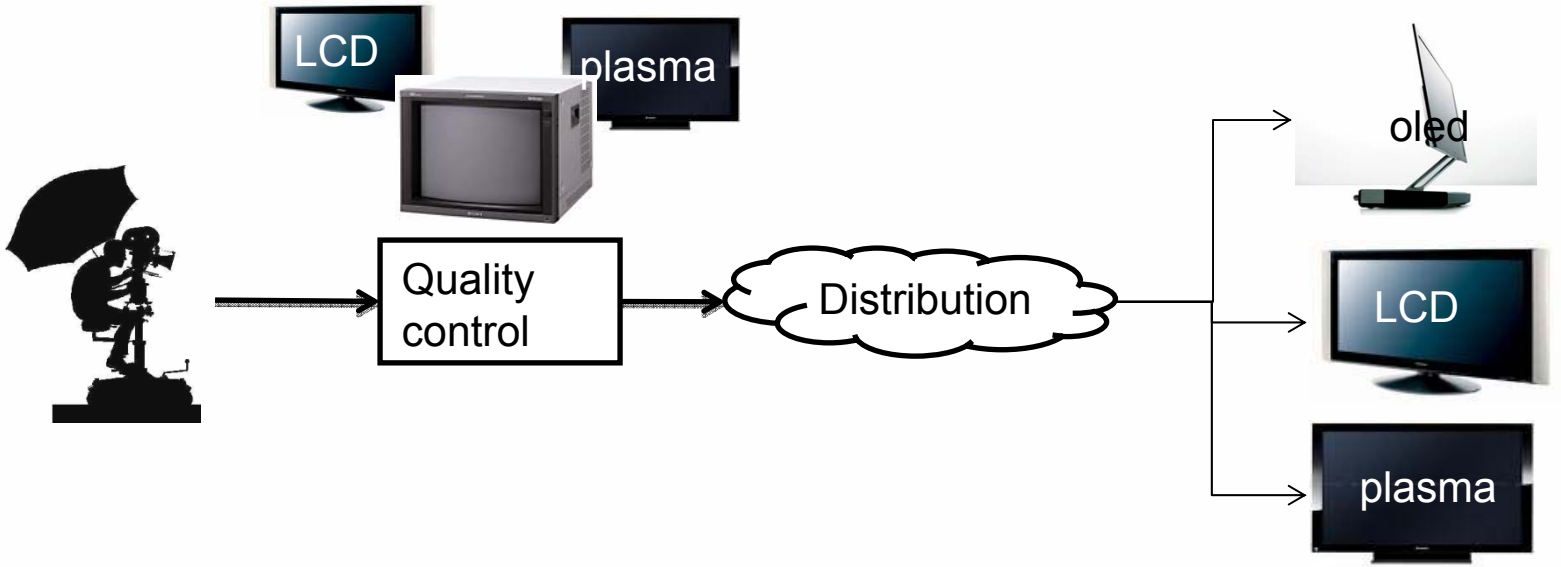
# Background

**CRT technology has ben reference for long.**

**Several candidate technologies to replace it:**

- LCDs, PDPs (Plasma) for the most widespread today
- OLEDs, FEDs upcoming in a near future.

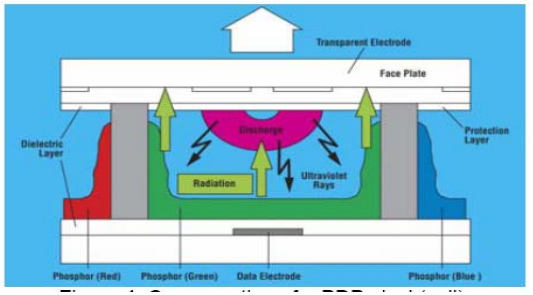
**→No more end to end perfect match of the display technology.**



# Potential replacement Technologies - Plasma LCD

**Plasma – Emissive display based on electric discharge on ionised gas in phosphors.**

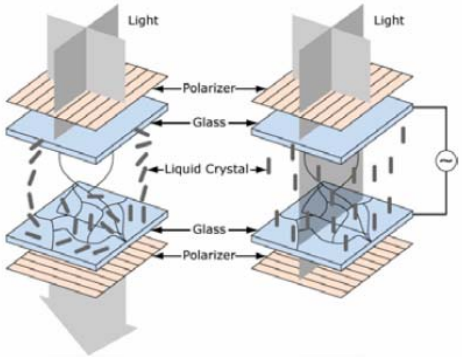
- Uses PWM - Pulse width modulation to provided different shades of grey.

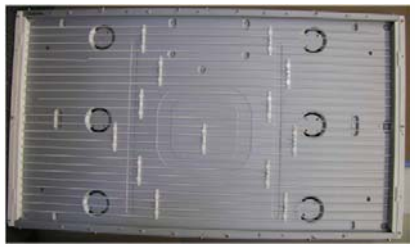



**Transmissive display type i.e. not self-generating light**

**Based on different backlight technologies**

- CCFL – cold cathode fluorescent tubes (most spread)
  - Contains mercury
- LED backlight
  - Advantages
    - Low power consumption
    - Provides wider color gamut
    - high contrast ratio (better blacks since led can be switched off locally)
  - Disadvantages
    - Differential aging (causing non-uniformity and white point drift)
    - uniformity

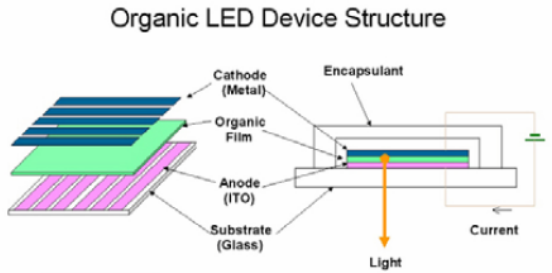


# Other Technologies – OLED / SED

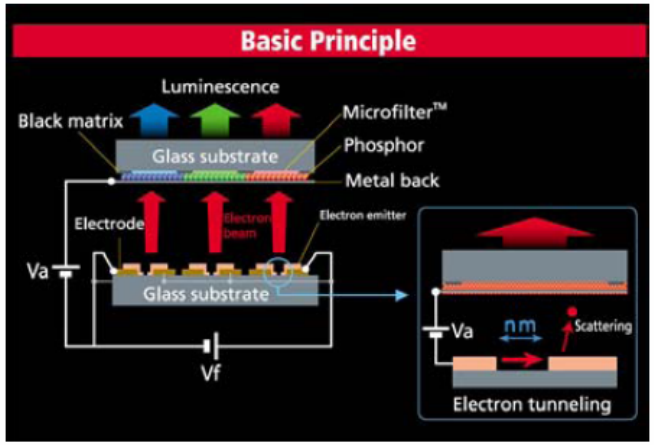
**OLED – Organic Light emitting Display – Emissive display emitting colored light from the organic layer when current flows.**

- Low power requirements
- Limited lifetime vs luminance
- Limited size resistance against water .




**FED / SED – Field Emissiondisplays**

- Low power requirements
- CRT Like color gamut due to phosphors
- Emitter electrode erosion, phosphor aging.
- No products yet



# EBU P/Display

**Created in 2006.**

**Chair : Richard Salmon (BBC)**

**Goal :**

- *Study the implications of using non-CRT Flat Panel Displays (FPDs) in the Television production environment.*

**Member organisation :**

- EBU, BBC, IRT, DR, NRK, ZDF,TSR, RTE, CBS, NHK, SMPTE etc...
- Special thanks to EBU members for their commitment.

(*All available freely on the EBU technical web site http://tech.ebu.ch* )

**Tech 3321**

- Guidelines for consumer flat panel displays.
  - *What should you require at least from a consumer display ...*

**Tech 3320 –** *(under revision)*

- User requirements for Video monitors in television production.
  - *Defining the relevant metrics and their values for A professional display*

**Tech 3325**

- Methods for the measurement of the performances of studio monitors.
  - *How to measure the predefined metrics in A STANDARD WAY ...*

**Tech 3325 – Test patterns (*as specified in Tech 3273*)**

# Tech 3320 – User requirements of production Monitors

*(Metrics...)*

**Identified relevant parameters :**

- Acoustic noise
- Achievable contrast
- **Black level**
  - **EBU 0.05 cd/m2 , ARIB 0.01 Cd/m2**
- Chromaticity
- **Colour gamut**
- Color temperature
- **Contrast ratio**
- **Delay time**
- **Gamma characteristic**
  - **EBU 2.35**
- **Grey scale reproduction**
- Image scaling, de-interlacing and overscan
- Image sticking
- Luminance ranges
- **Motion artefacts**
- Mura
- Pixels defects
- Ringing and handling of under and overshoots
- Screen resolution
- Screen size
- Signal interfaces
- Stability
- Streaking
- Treatment of illegal signals
- **Uniformity**
- **Viewing angle**
- White uniformity over the picture area.

# Tech 3320 – User requirement for production Monitors

**Professional monitors can be further categorised depending on the production application:**

- **GRADE 1** – High grade monitor aimed at visual quality evaluation of the image. Artefacts should not be unduly masked or inserted. State of the art display technology.
- **GRADE 2** – for tighter tolerance applications where no picture quality manipulation is required. (accuracy of colour reproduction and stability are core requirements)

  *e.g. control walls, edit suite monitors etc...*
- **GRADE 3** – observation/presence displays (professional interfaces, higher mechanical robustness, electromagnetic robustness )

  *e.g. Audio production, dialogue dubbing etc...*

***More in Tech 3320...***

# ...And their values

| | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| Luminance | **70 -100 cd/m²** | **70 – 200 cd/m²** | **70 - 250 (or 400) cd/m²** |
| Black Level | **≤ 0.1cd/m²** | **≤ 0.4cd/m²** | **≤ 0.7cd/m²** |
| Full screen contrast | **≥ 1000:1** | **≥ 500:1** | **≥ 300:1** |
| Simultaneous contrast | **≥ 200:1** | **≥ 100:1** | **≥ 100:1** |
| Colour temp of white point | **Default D65** | **Default D65 3200K opt.** | **Default D65 3200K opt.** |
| Delay time | **Not demanded** | **Short delay required** | **Short delay required** |
| Resolution | **At least as many pixels as input signal.** | **At least as many pixels as input signal.** | |

# Tech 3320 – *From a plasma point of view*

- **Black level**
  - *Very low  close to CRT*
- **Chromaticity**
  - *Close to CRT since using phosphors*
- **Colour gamut**
  - *Larger than required for BT. 709 due to phosphors*
- **Contrast ratio**
  - *Very high since emissive display*
- **Delay time**
- **Gamma characteristic**
  - *EBU requires 2.35*
- **Grey scale reproduction**
  - *PWM used to create shades of grey.*
- **Motion artefacts**
  - *Very low response time (<1ms) provides for better motion rendition.*
- **Screen resolution**
  - *Up to 1920x1080*
- **Screen size**
  - *From 42" to higher*
- **Uniformity**
- **Viewing angle**
  - *Large*
- White uniformity over the picture area.

# Tech 3320 – *From an LCD point of view*

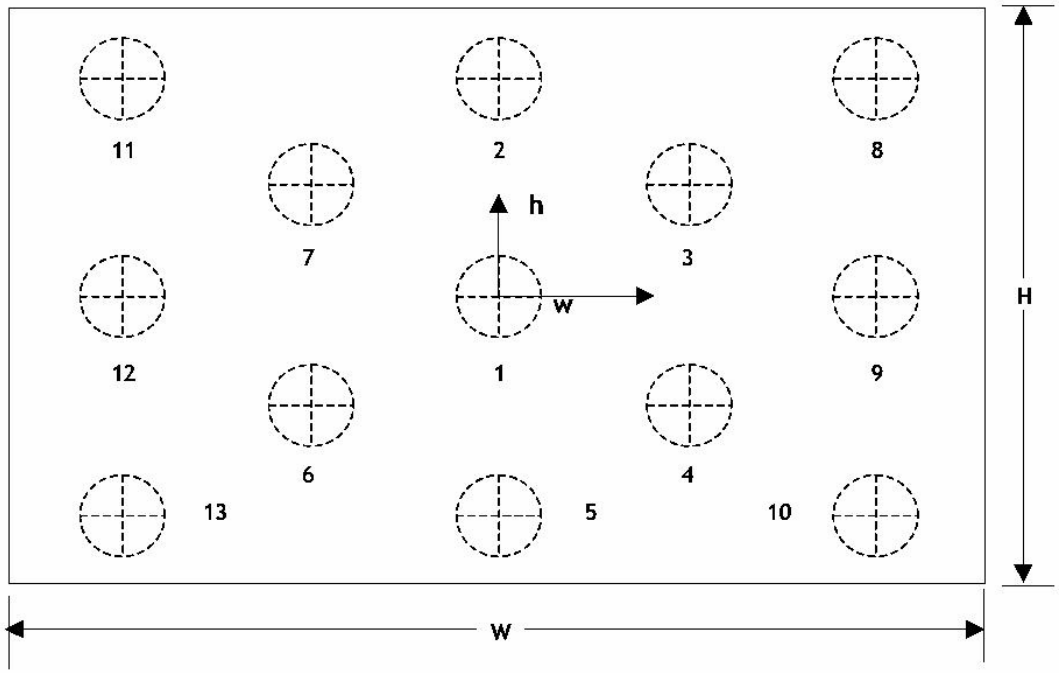
- **Black level**
  - *Varies with backlight and panel but not as low as plasmas. Improved with LED back light*
- **Chromaticity**
  - *Uses LUT and also depends on Backlight. More accurate with LEDs*
- **Colour gamut**
  - *Wider with LED Backlight (wider than BT 709)*
- **Contrast ratio**
  - *Very high since emissive display*
- **Grey scale reproduction**
  - *LUTs*
- **Motion artefacts**
  - *High response time provides for motion blur.Depends as well on LC switching time. Use of fast panels 100/120Hz*
- **Screen resolution**
  - *More than 1920x1080*
- **Screen size**
  - *No restrictions (up to 108")*
- **Uniformity**
  - *Need Real Time Control and adjust due to differential aging*
- **Viewing angle**
  - *Limited - Problem intrisic to LCD*
- **White uniformity over the picture area.**

# How to measure them... Tech 3325

**Based on 2 measurement methods**

- Spectro-radiometric : measuring the spectrum wavelength by wavelength.
- Tristimulus method : uses a tristimulus meter that modifies the light energy from the monitor using filters designed to replicate each of the colour matching functions.

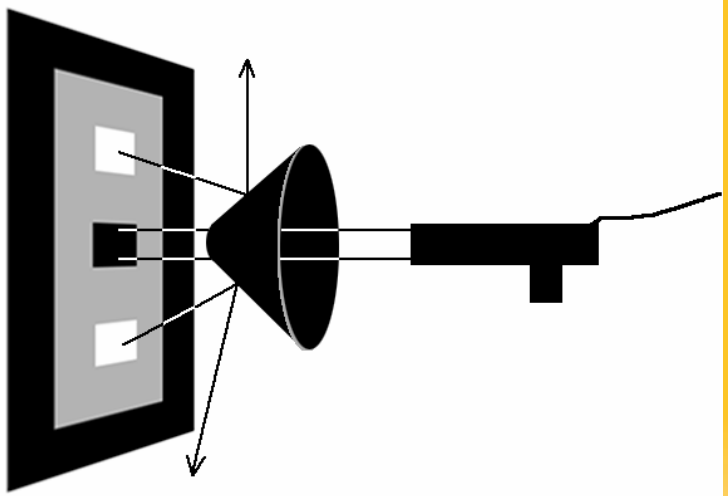
**Standardised measurement points are defined across the screen width (w) and height (h).**



# Tech 3325 – Measurement Methods for Studio FPDs...

**Measurement conditions overview :**

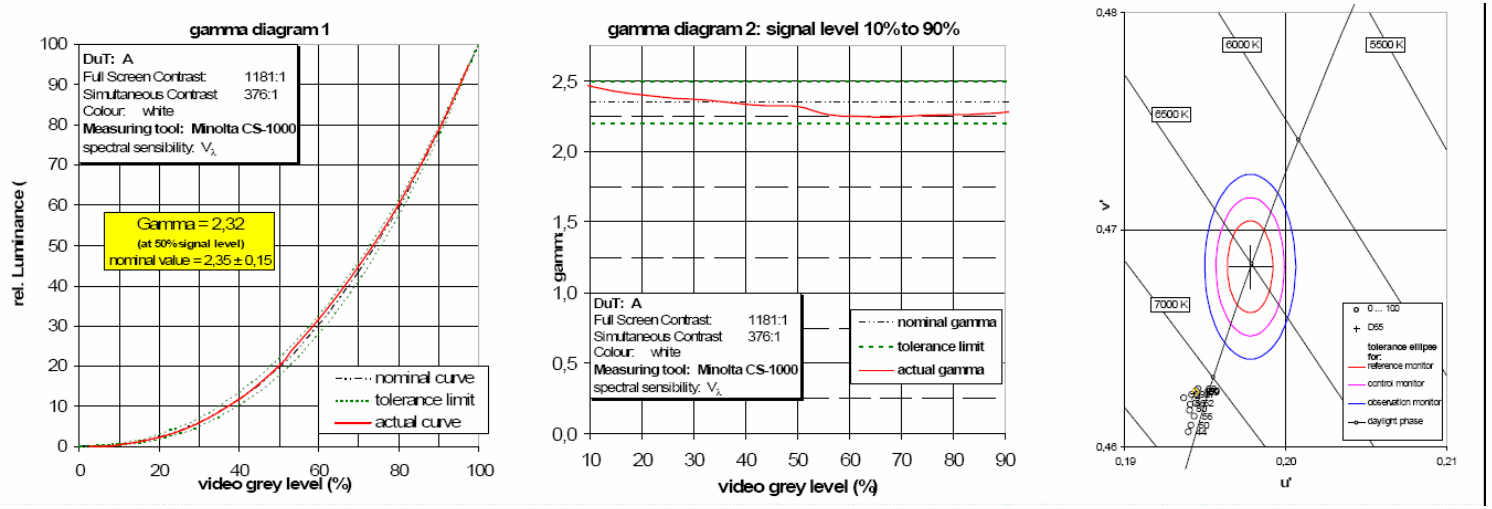
- Darkened room (1 Lux room brightness) [ VESA FPDM2 ].
- Measurement distance : 3 to 4 time picture height.
- No overscan
- Colour temperature : D65
- Peak white set to 80 cd/m2
- Balck level set using image format corresponding PLUGE test signal.[ITU-R BT 814-2]



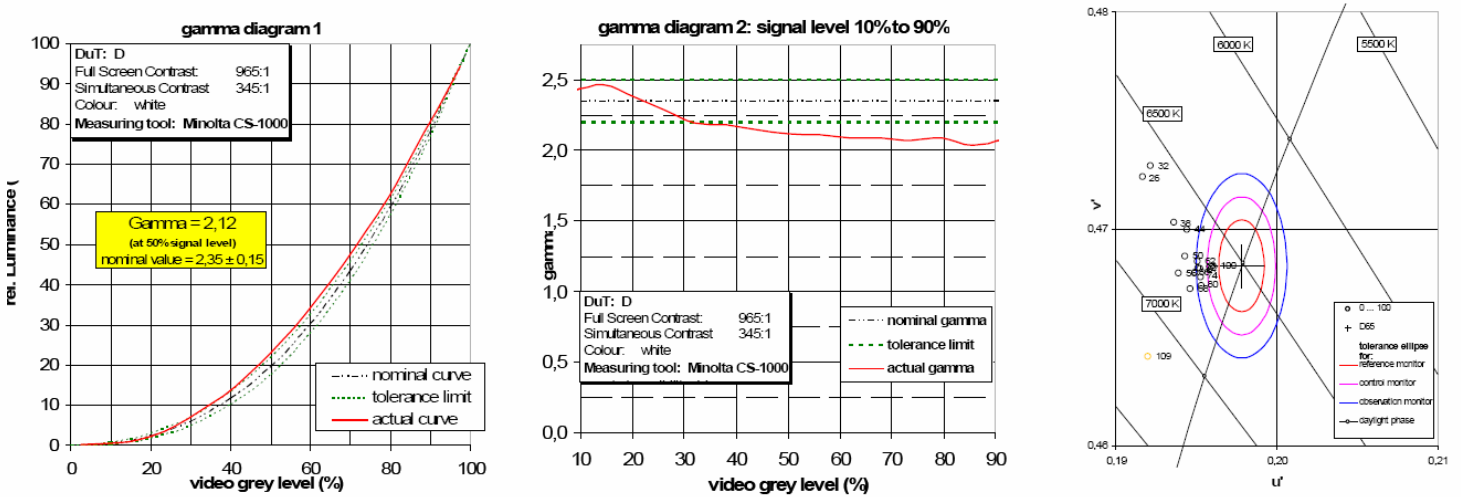
**Additional tuning particular to certain display technology might be necessary.**

**Results representation are also defined to establish standard method.**

# Measurements examples* – *Greyscale reproduction*



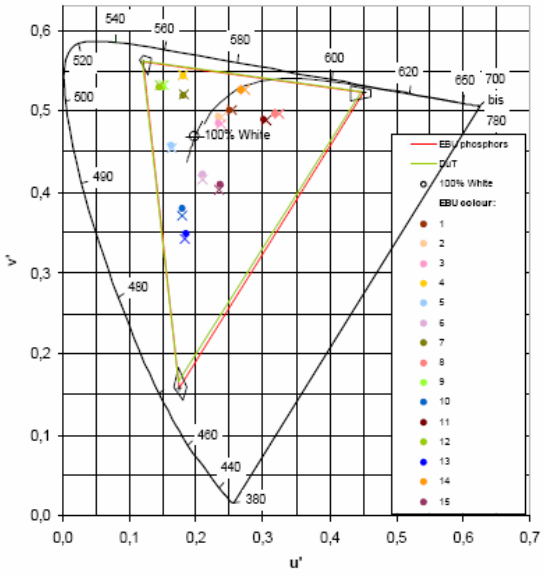

*Courtesy to IRT

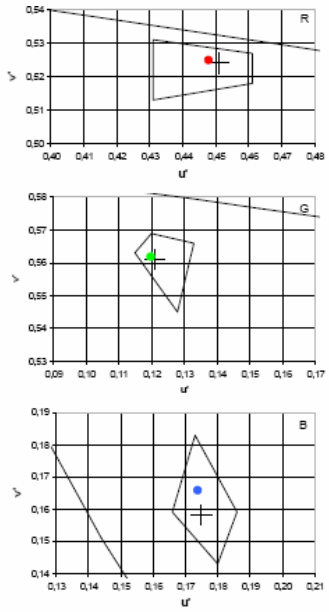


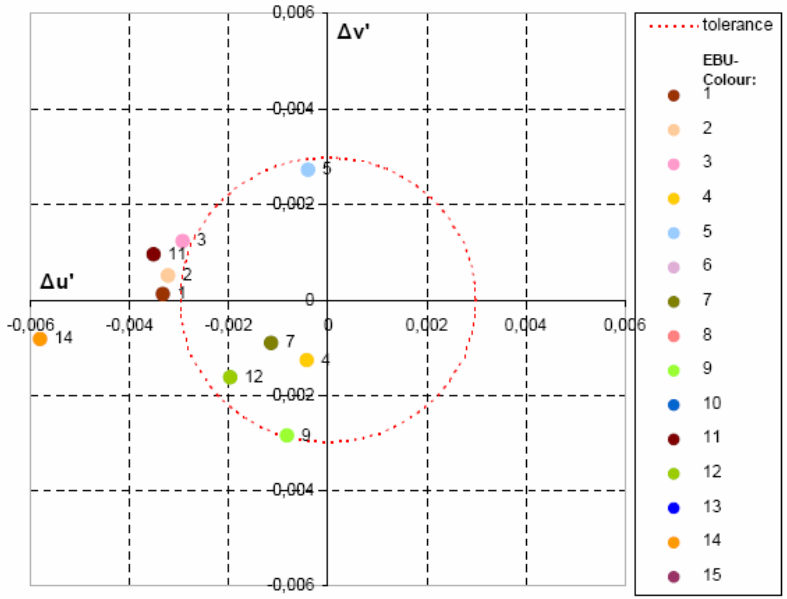
# Measurements examples – *EBU colour reproduction*

## Colour reproduction still need to be improved

- More displays have primaries in EBU tolerances ranges without matching the EBU colours tolerance range.




*Courtesy to IRT

# Conclusion

**For LCDs**

- Black Level, Fast Motion Rendition and Viewing angle are still an issue even if the use of LEDs overcomes color accruacy issues from CCFL.

**For Plasmas**

- Power consumption / heat and display size (below 42'') are still issues. However improvement such as Panasonic Neo PDP technology help reduce the power consumption of the panel.

**OLED and FED**

- Promising but not ready yet.

**From latest Measurement**

- It can be acknowledge that EBU color reproduction and gray scale reproduction are still an issue for most of the display even if color primaries are matched.
- **A CRT equivalent... Not today but may be later...**

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# Thank you

Kouadio@ebu.ch

http:// tech.ebu.ch

All documents are available on the publications sections

http:// www. smpte.org

http:// www. itu.int

http://icdm-sid.org/

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