Display Performance of 3D TV

China Electronics Standardization Institute

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CHINA ELECTRONICS STANDARDIZATION INSTITUTE

Outline

- Standardization in the 3D TV Industry Chain
- Standard Status of 3D TV
- Key performance parameter of 3D TV

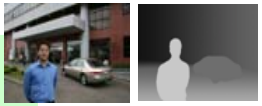
Standardization in industry chain

Content Gen. → Distribution → Display → Interaction

Content Sources
- *Dual-lens Cam*
- Single-lens Cam
- *2D/3D conversion*
- *Multi-camera Multi-view*

3D camera
3D video camera
3D content

Image with depth



Network or Storage

3D content format
3D encoding
3D video interface

MPEG, ISO, CIE
BDA
HDMI, WirelessHD

Depth ↑ m-view

3D Display
- Glasses Type:
  - *Micro-retarder*
  - Shutter glasses
- Multi-view Autostereo
  - *Barrier type*
  - *Lenticular type*
  - *Integrated 2D/3D*
- High Resolution Multi-view
  - *i-Screen*
  - Super multi-view
  - Time multiplexed

IEC, ICDM

3D display quality
Lifetime measurement for system/component

3D glasses measurement
3Dglasses specification

Interaction Engine
- *Gesture*
- Body Motion

Computer-human interface

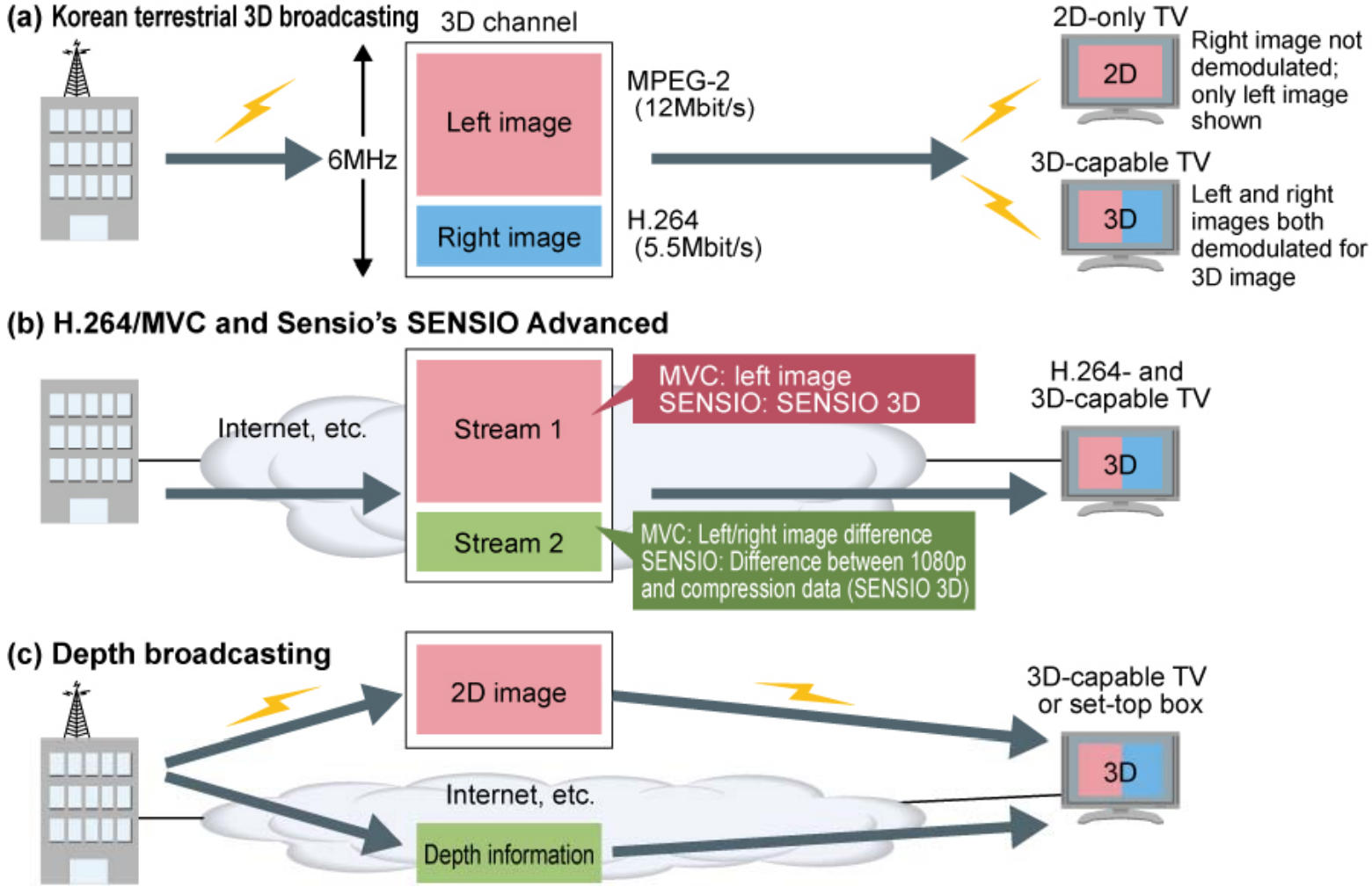
Measurement
Standardization
Human factor

3D monitor measurement
3D human factor
3D monitor specification
3D monitor vertification

SEMI
ICDM, IEC

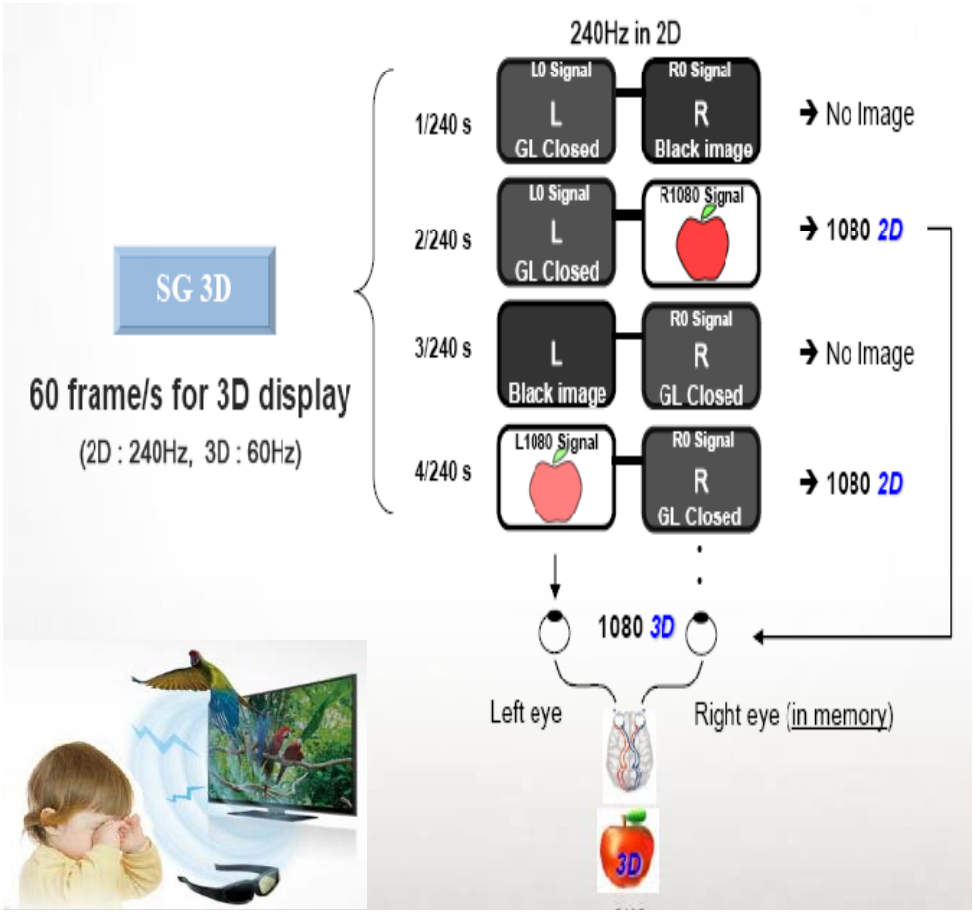
Standard status for 3D TV

- International standard is not established, whether signal encoding or transmission Interface
- Ex : The only video encoding standard is “Blue-ray 3D ”



Flicker

- Flicker: appears from brightness with more than 20 nits at 60Hz;
- Shutter glass: brightness difference with 60~70nits at 60Hz

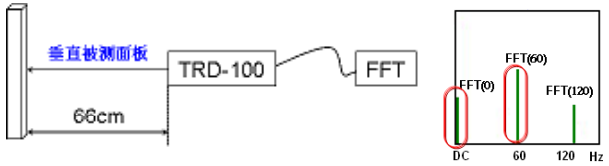


1. Pupil:

$$A = b_0 L_t^{b_1}$$

L_t :Total Light From Screen (cd/m^2)
b_0=12.45284, b_1=-0.16032

2. E_{obs}:



$$E_{obs\,n} = DC \times AMP_n$$

DC = (L_t – L_r) x A
L_t :Total Light From Screen (cd/m^2)
L_r: Light Reflected from Screen (cd/m^2)

$$AMP_n = \frac{2\times|FFT(\nu)_n|}{FFT(\nu)_0}$$

3. E_{pred}:

$$E_{pred\,n} \equiv ae\frac{nb}{T}$$

Screen diagonal	Predicted energy coefficients	
arc degrees	a	b
< 20	0,127 6	0,191 9
20 to 40	0,191 9	0,120 1
40 to 65	0,507 6	0,100 4
65	0,530 0	0,099 2

$E_{obs} \leq E_{pred}$ No flicker

Crosstalk

What is crosstalk?

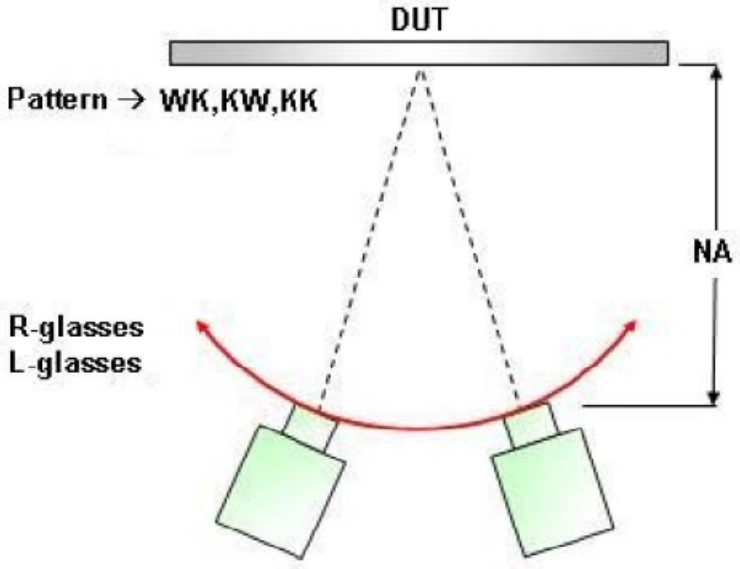
Incomplete isolation of left and right image channels so that one leaks into the other.

亮度 (nits)		Gray level for left eye j								
		0	32	64	96	128	160	192	224	255
Gray level for right eye i	0	**	**	**	**	**	**	**	**	**
	32	**	**	**	L_{j0}	**	**	Reference curve		
	64	**	**	**	**	**	**	**	**	**
	96	**	**	**	**	**	**	**	**	**
	128	**	**	**	**	**	**	**	**	**
	160	**	**	**	**	**	**	**	**	**
	192	**	**	**	**	**	**	**	**	**
	224	**	**	**	**	**	**	**	**	**
	255	**	**	**	**	**	**	**	**	**

L_{ij}

$$Crosstalk_{j,i} = \frac{L_L(j,i) - L_L(j,0)}{L_L(j,0)} \times 100\%$$

Viewing angle

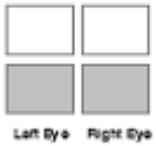
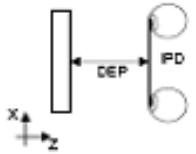
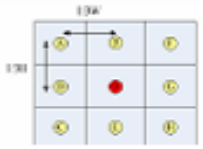
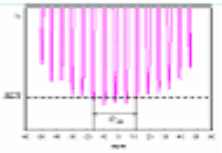


$$Crosstalk_L = \frac{L_L(W,K) - L_L(K,K)}{L_L(K,W) - L_L(K,K)}$$

$$Crosstalk_R = \frac{R_L(W,K) - R_L(K,K)}{R_L(K,W) - R_L(K,K)}$$

$$Crosstalk = \frac{Crosstalk_R + Crosstalk_L}{2}$$

All Optical parameter for 3D TV

No.	Item	measurement & calculation
1	3D luminance	- luminance meter set at the designated eye positions - measure the luminance at the display center $L_{3D} = \frac{L_{WWL} + L_{WWR}}{2}$ 
2	3D contrast ration	- luminance meter set at the designated eye positions - measure the luminance at the display center $C_{3DL} = \frac{L_{WWL}}{L_{BBL}}$ $C_{3DR} = \frac{L_{WWR}}{L_{BBR}}$ 
3	3D crosstalk	- luminance meter set at the designated eye positions - measure the luminance at the display center $SCT_L = \frac{L_{BWL} - L_{BBL}}{L_{WBL} - L_{BBL}}$ $SCT_R = \frac{L_{WBR} - L_{BBR}}{L_{BWR} - L_{BBR}}$ 
4	3D luminance uniformity	- luminance meter set at the designated eye positions - measure the luminance at the 9 points $U_L = \frac{L_{L\min}}{L_{L\max}} \times 100\%$ $U_R = \frac{L_{R\min}}{L_{R\max}} \times 100\%$ 
5	3D viewing angle	- luminance meter set at the designated eye positions - measure the luminance at the display center θ_{3DL} and θ_{3DR} for the left and right eyes 
6	3D color performance	- luminance meter set at the designated eye position - measurement the chroma at the display center $NTSC(\%) = A / A_{NTSC} \times 100\%$ 
7	3D flicker	- luminance meter set at the designated eye position - measurement the luminance at the display center - using the fast Fourier transform to obtain E_{obs} $A = b_0 L_t^{b_1}$ $DC = A \times c_0$ $E_{obs\,n}$ = DC × AMP_n 

Thanks !

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