



# Innovations in TV system design

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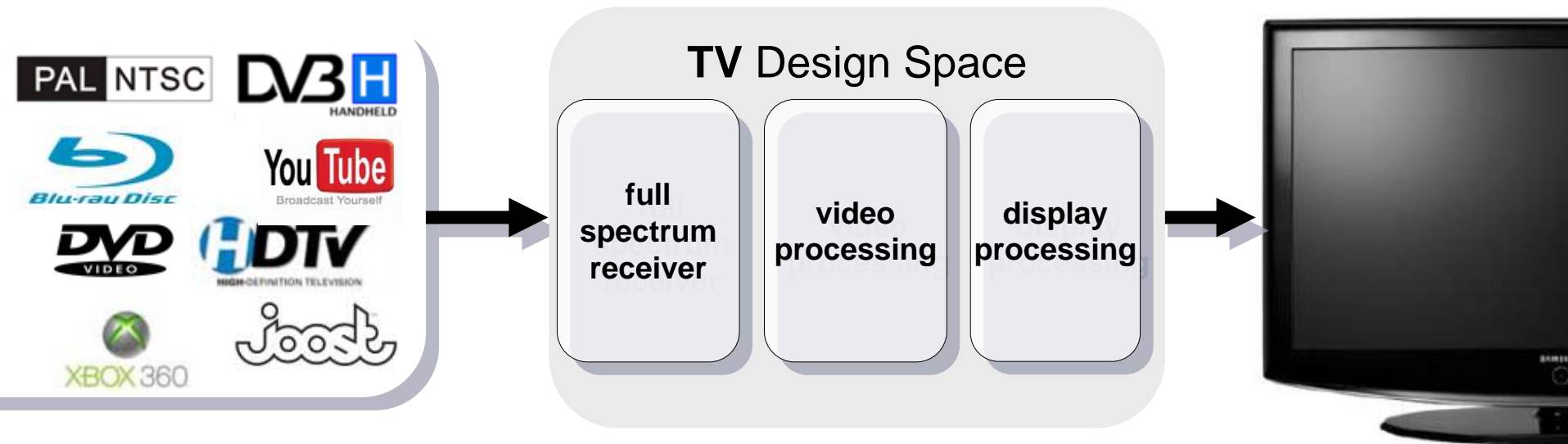


# The TV market challenges

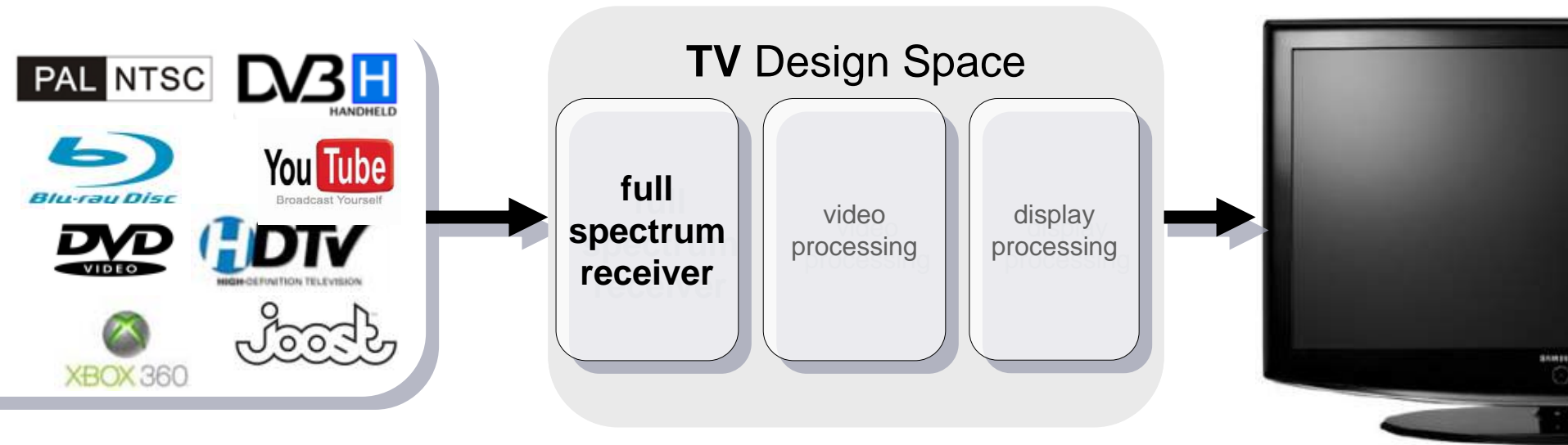
- ▶ More **content** from more **sources**
  - Analog signals: PAL, NTSC, ATSC
  - Digital signals: DVB-T(2), DVB-C, DVB-S(2), IP, HDMI
  - Local standards: DMB-T, AVS
  - Resolutions: personal content CIF/QVGA , MPEG2-SD to H.264HD
  
- ▶ Growing customer demand for **ultra picture quality**, **super slim panels** and **green power**



# NXP's video technologies bridge the gap between source and display



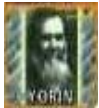
# Zooming in on Full Spectrum Receiver



# Full Spectrum Receiver functionality

## Yesterday

- Single channel
- Discrete tuner
- cost 1x
- Watch *or* record



## Today

- Dual channels
- 2 silicon tuners
- cost 0.4x
- Watch & record *or* PiP



## Tomorrow

- multiple, concurrent channels
- single IC receiver
- cost 0.2x
- Watch & record & PiP & Internet & widges & ...



# Example

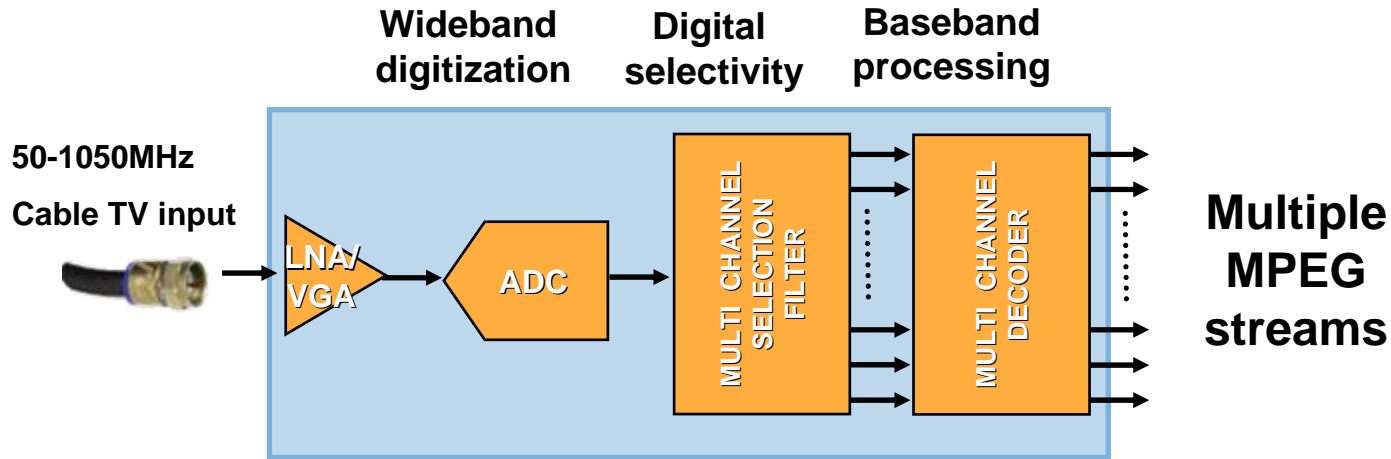
## Conventional multi-channel TV receiver

8 discrete tuners for PC applications



# Full Spectrum Receiver

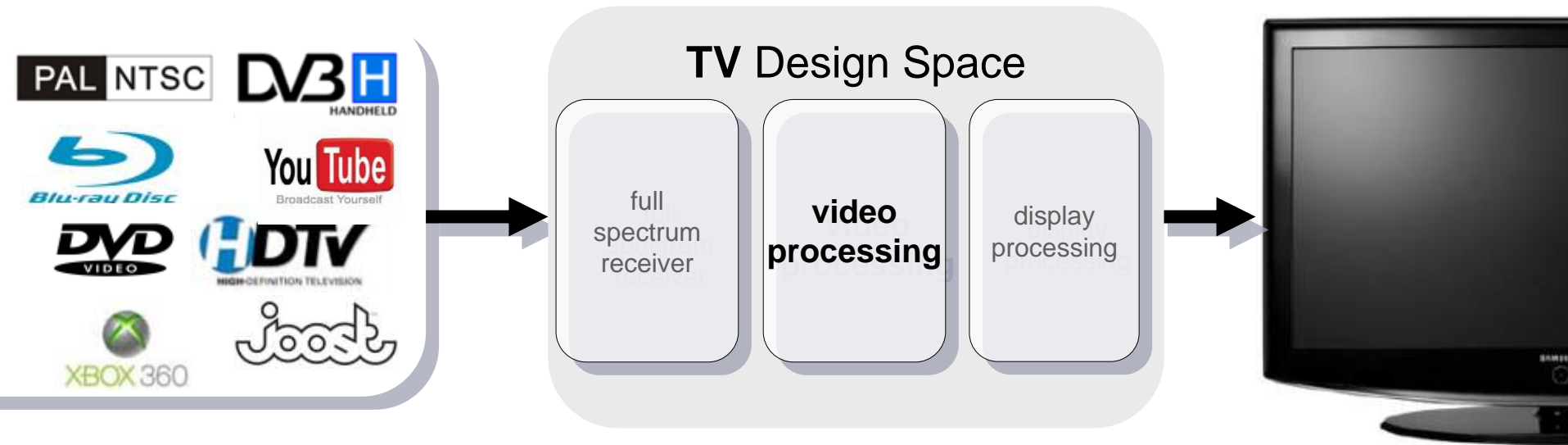
## Architecture



### NXP FSR™ features:

- ▶ **Software Radio** approach: one analog front-end, scalable and programmable digital tuners
- ▶ **LNA:** Wideband, low noise amplification with high linearity and reception quality independent of number of channels
- ▶ **ADC:** GHz signal digitization with 50-70dB dynamic range, power efficiency through Digital Correction Algorithms
- ▶ **IF/DSP:** Digital signal processing at GHz rates

# Zooming in on Video Processing



# At the display side, rapid innovation is occurring



**OLED**



**3D-TV**



**200 / 240Hz**

- ▶ More pixels: from HD to UltraHD (QuadHD)
- ▶ More frames: from 120Hz to 240Hz
- ▶ More colors: wide gamut and multi-primary
- ▶ ..... and finally 3D is starting to appear in the market

# Result is a clear challenge in picture quality ...

Example: internet playback of YouTube on HD LCD-TV

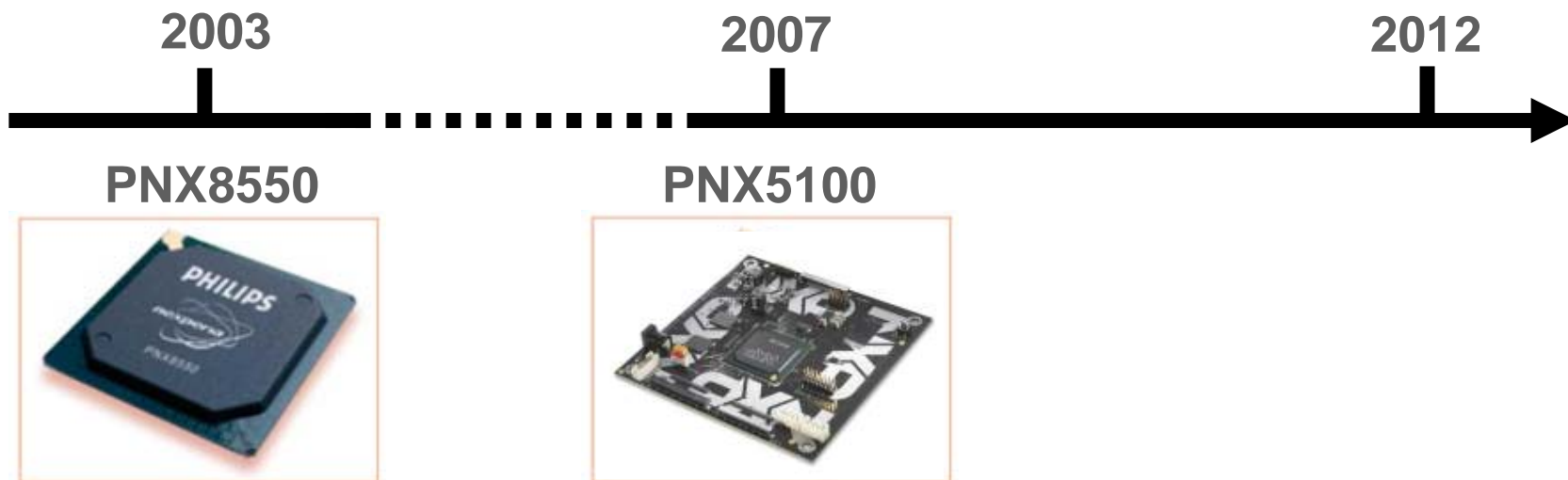


- QVGA 320 x 240  
15 frames/second

- full-HD 1920 x 1080  
120 frames/second

- ▶ For every 1 original pixel, 215 pixels have to be interpolated

# ... and drives requirements for efficient high quality video processing



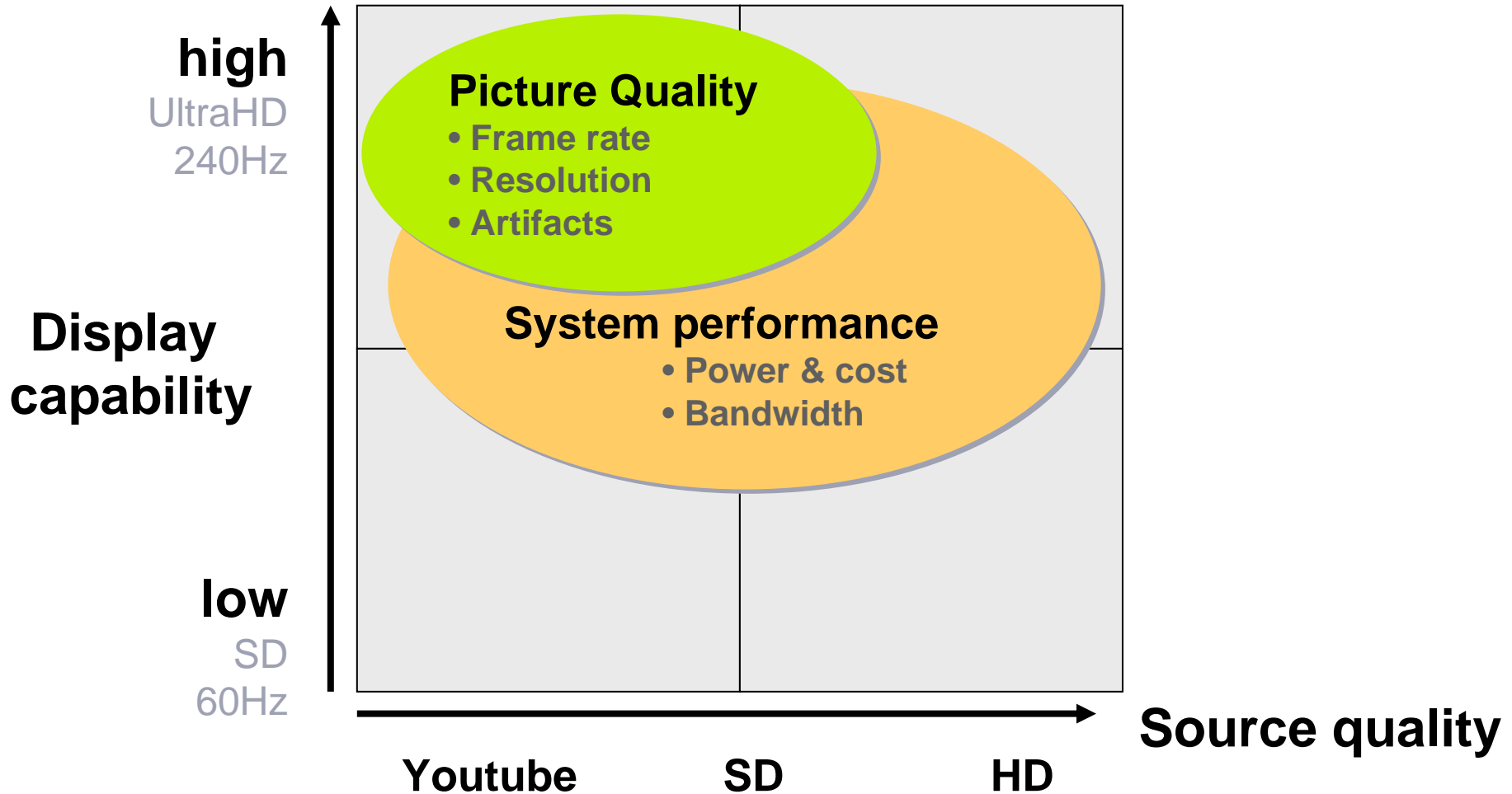
## Frame rate conversion

- SD: 720 x 576, 8-bit
- 60 frames/second
- **380 Mcycles/second**

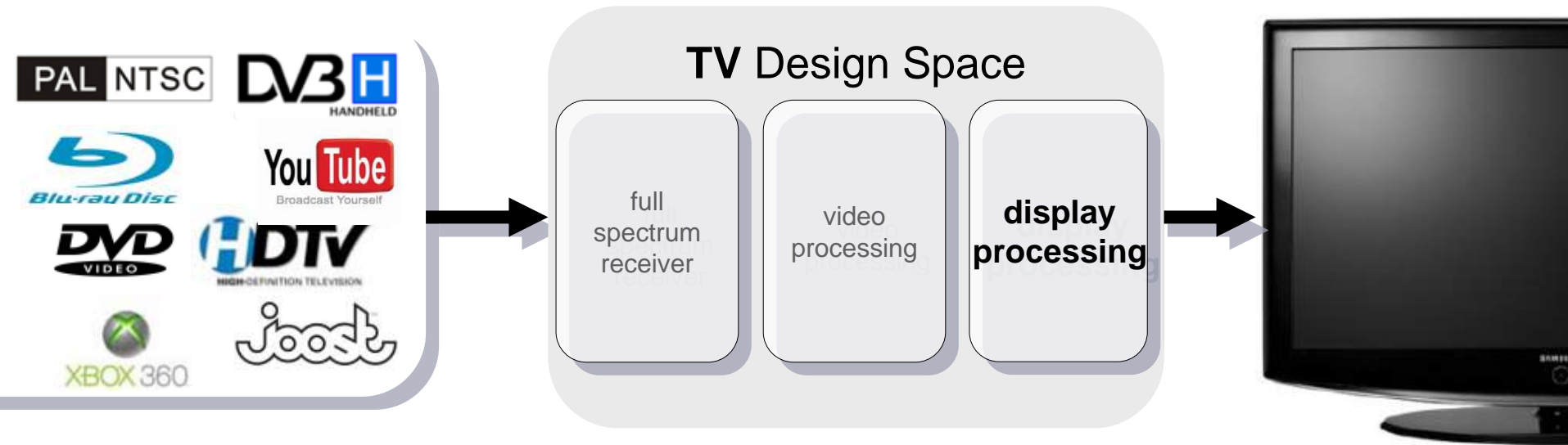
- HD: 1920 x 1080, 10-bit
- 120 frames/second
- **4750 Mcycles/second?**
- Improved architecture
- **680 Mcycles/second**

- UltraHD: 3840 x 2160, 12-bit
- 240 frames/seconds
- **6528 Mcycles/second?**

# Video processing innovation challenges

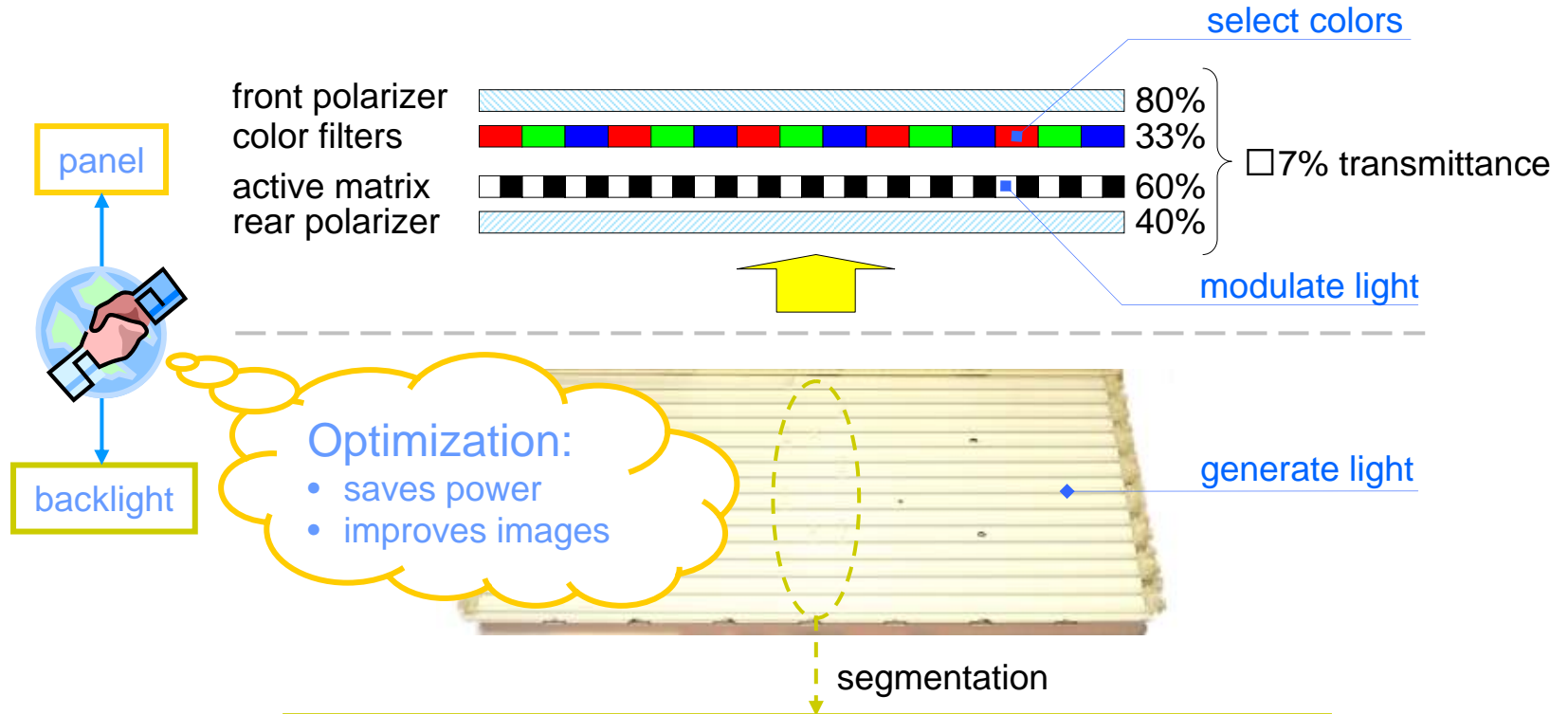


# Zooming in on Display Processing



# LCD display characteristics

intrinsic poor power efficiency



Optimization:  
• saves power  
• improves images

Backlight segments can be controlled individually:

- brightness
- color (RGB)
- exposure (timing and duration)



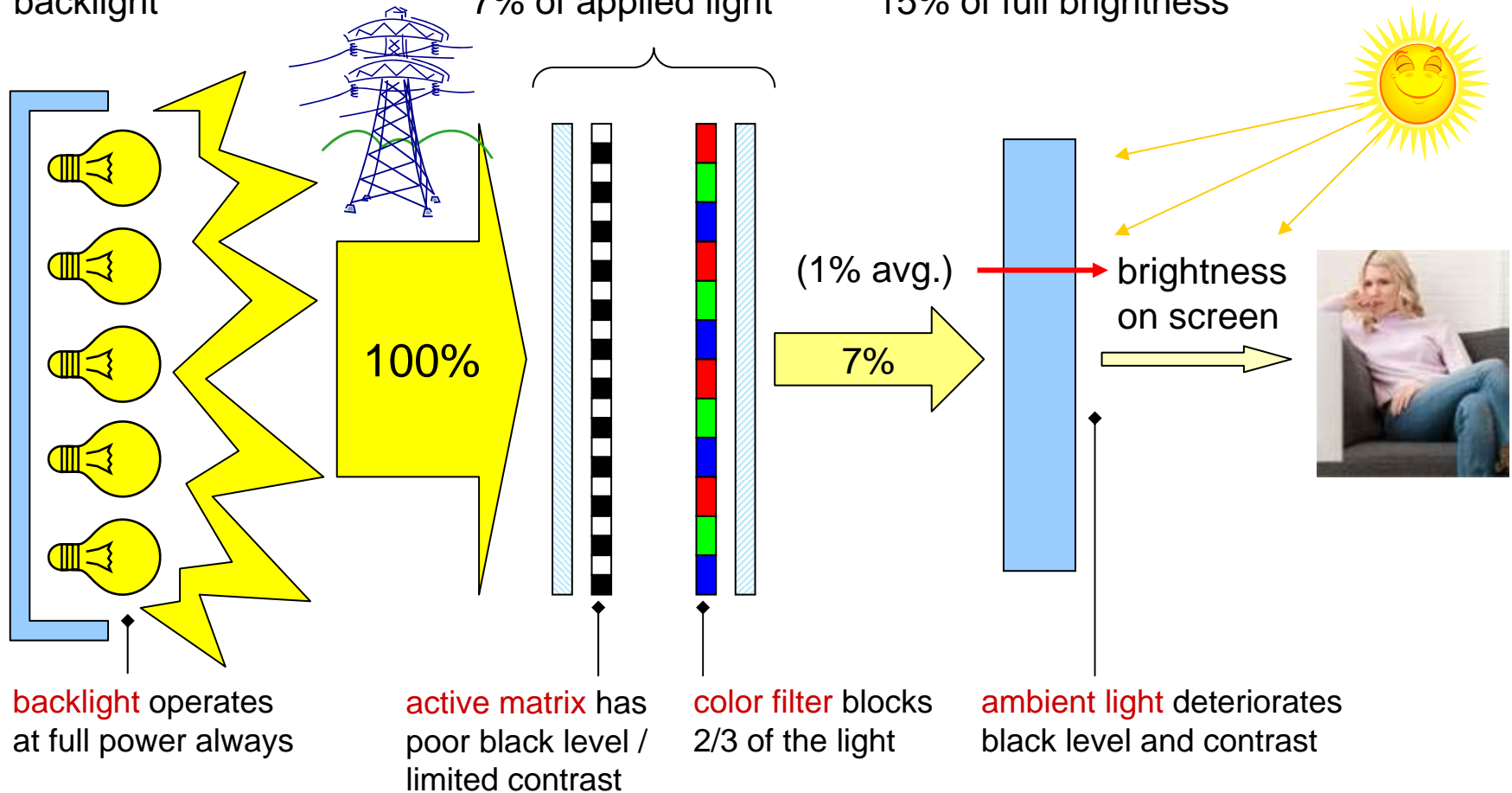
# Power Reference: non-dimmed backlight

42" CCFL backlight □ 180W @500 cd/m<sup>2</sup>

non dimmed  
backlight

panel transmittance is  
7% of applied light

Natural scene average is  
15% of full brightness



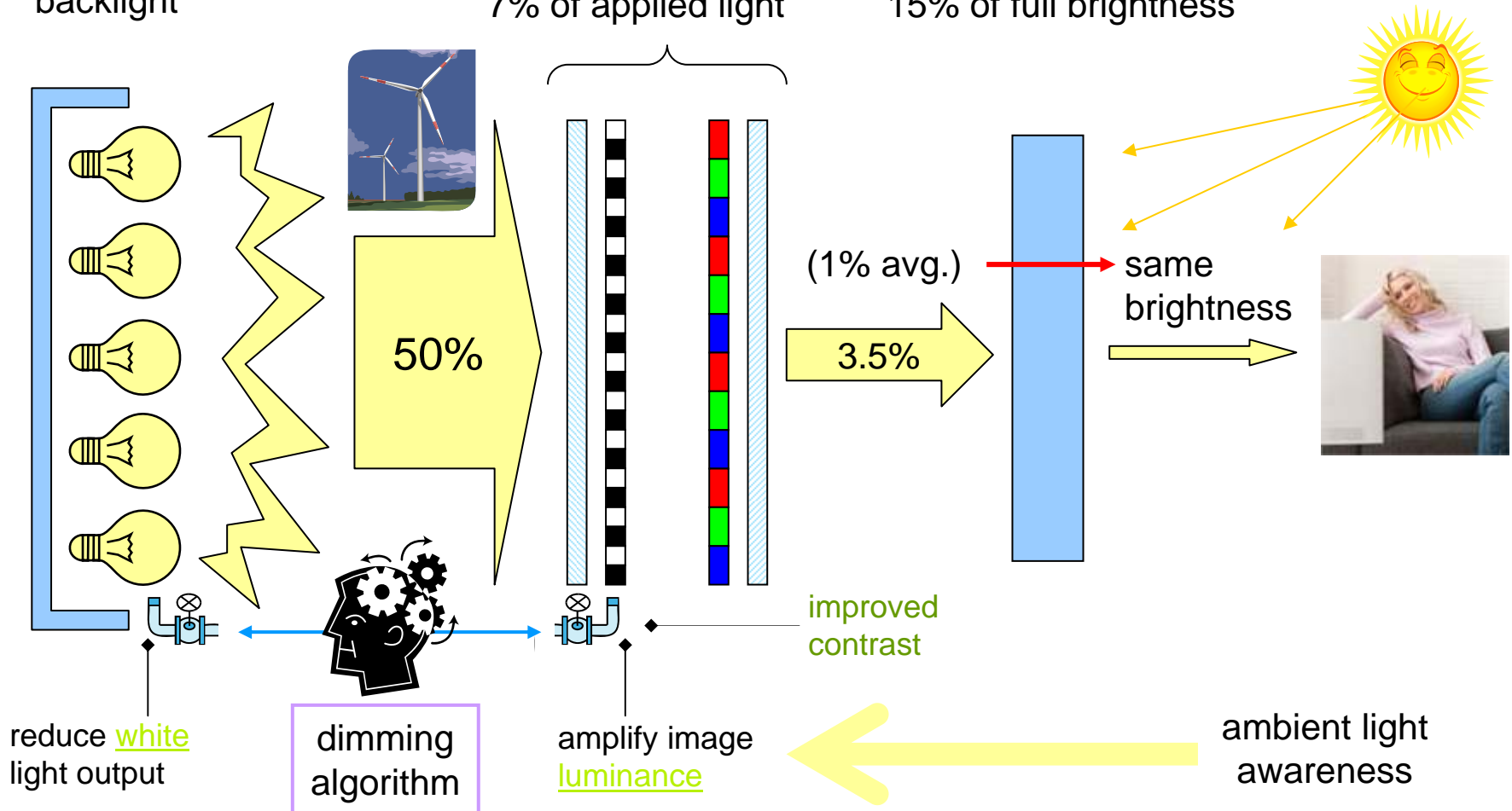
# The first step: White Dimming

Power efficiency gain = 2x

dimmed  
backlight

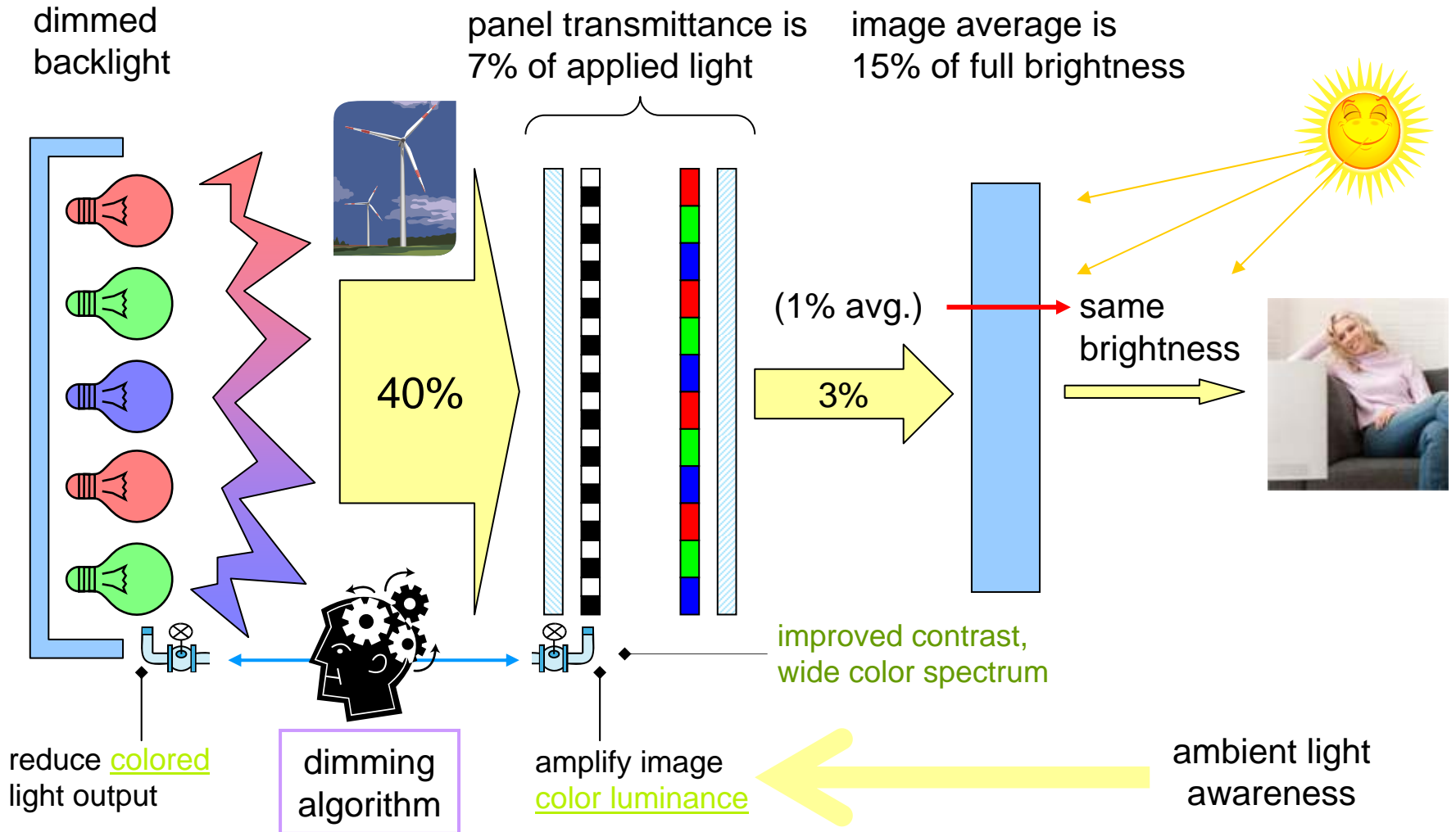
panel transmittance is  
7% of applied light

image average is  
15% of full brightness



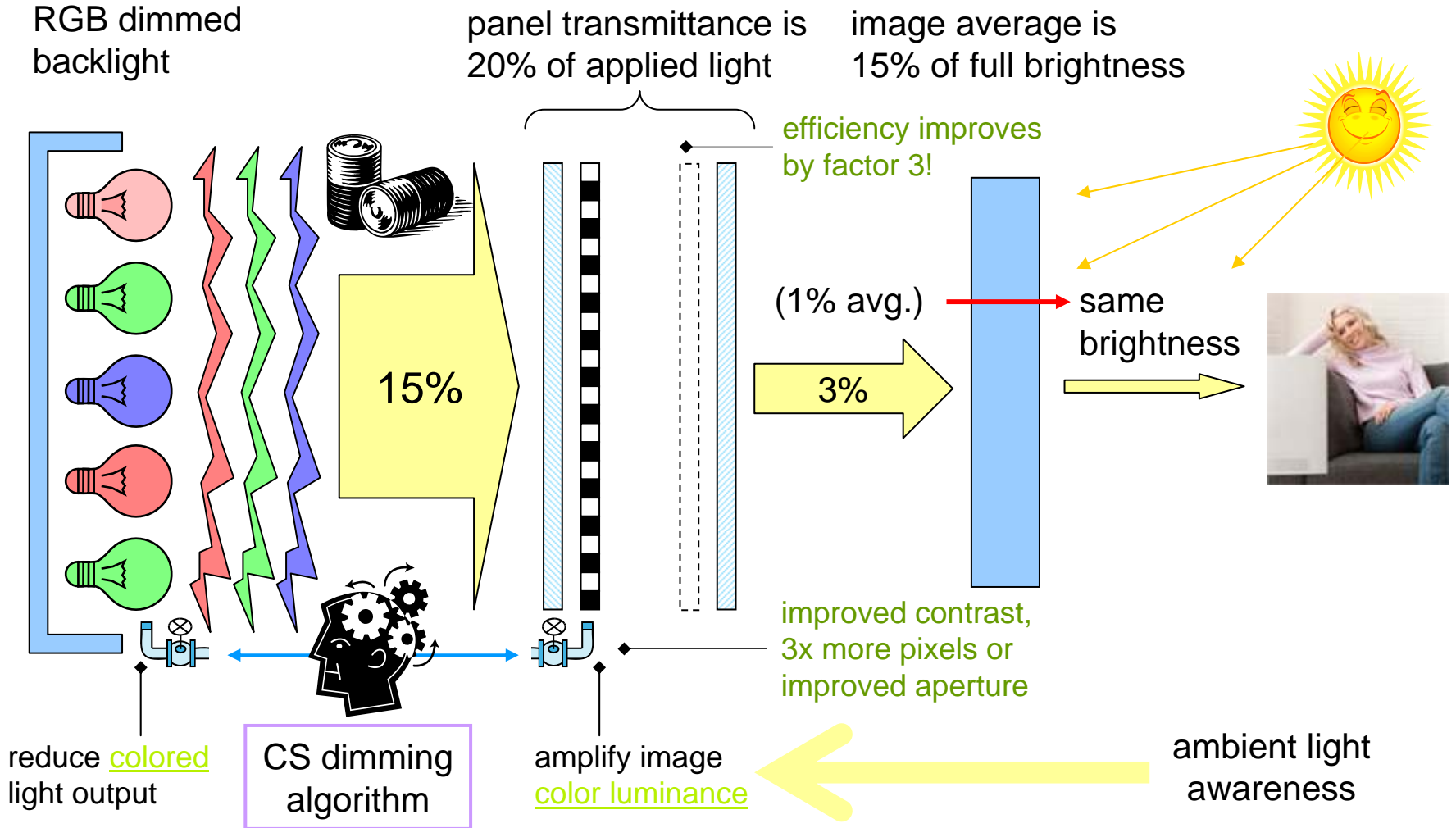
# The second step: Color Dimming

Power efficiency gain  $(2 \times 1.25) = \underline{2.5x}$

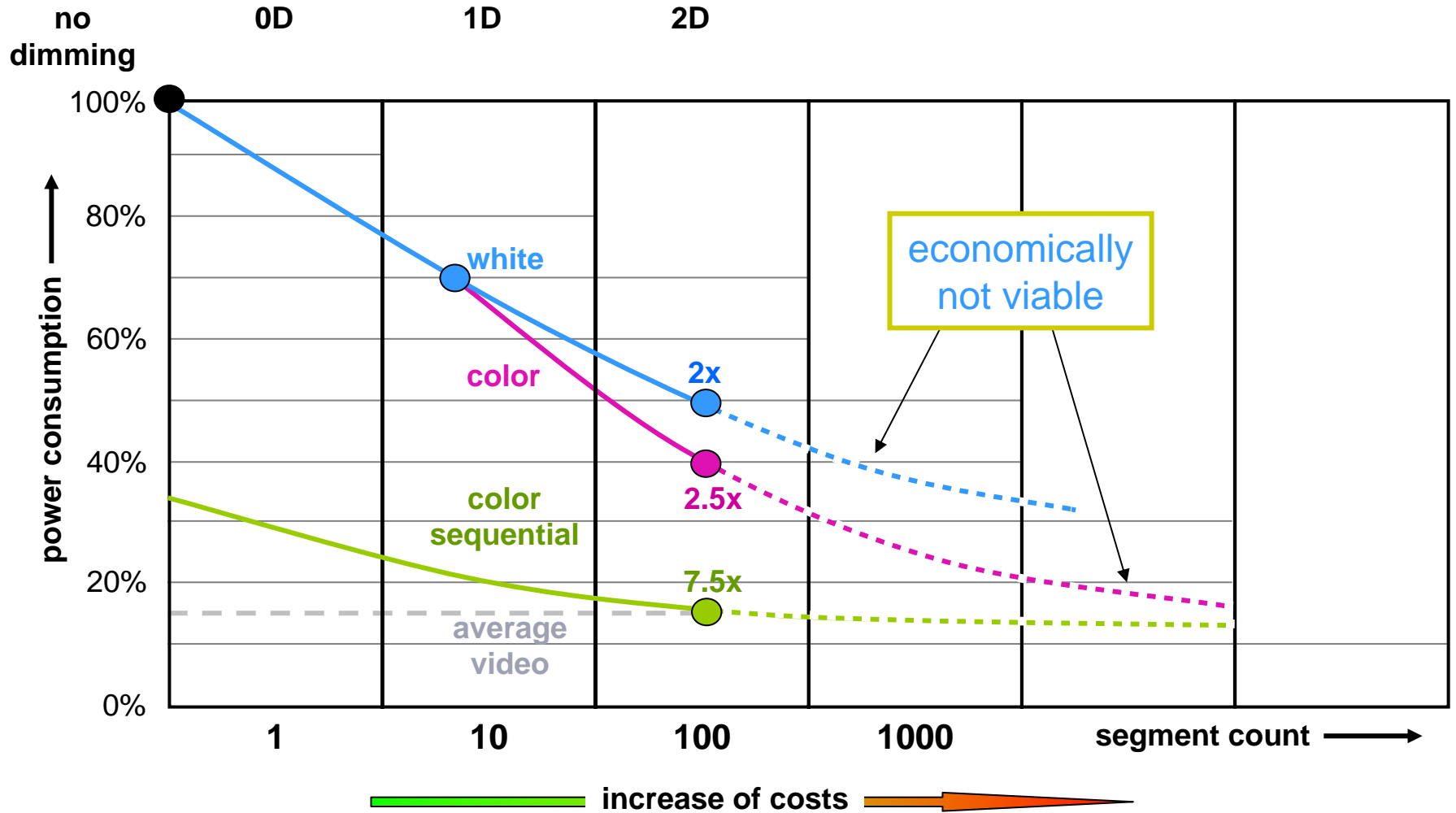


# The third step: Color Sequential Dimming

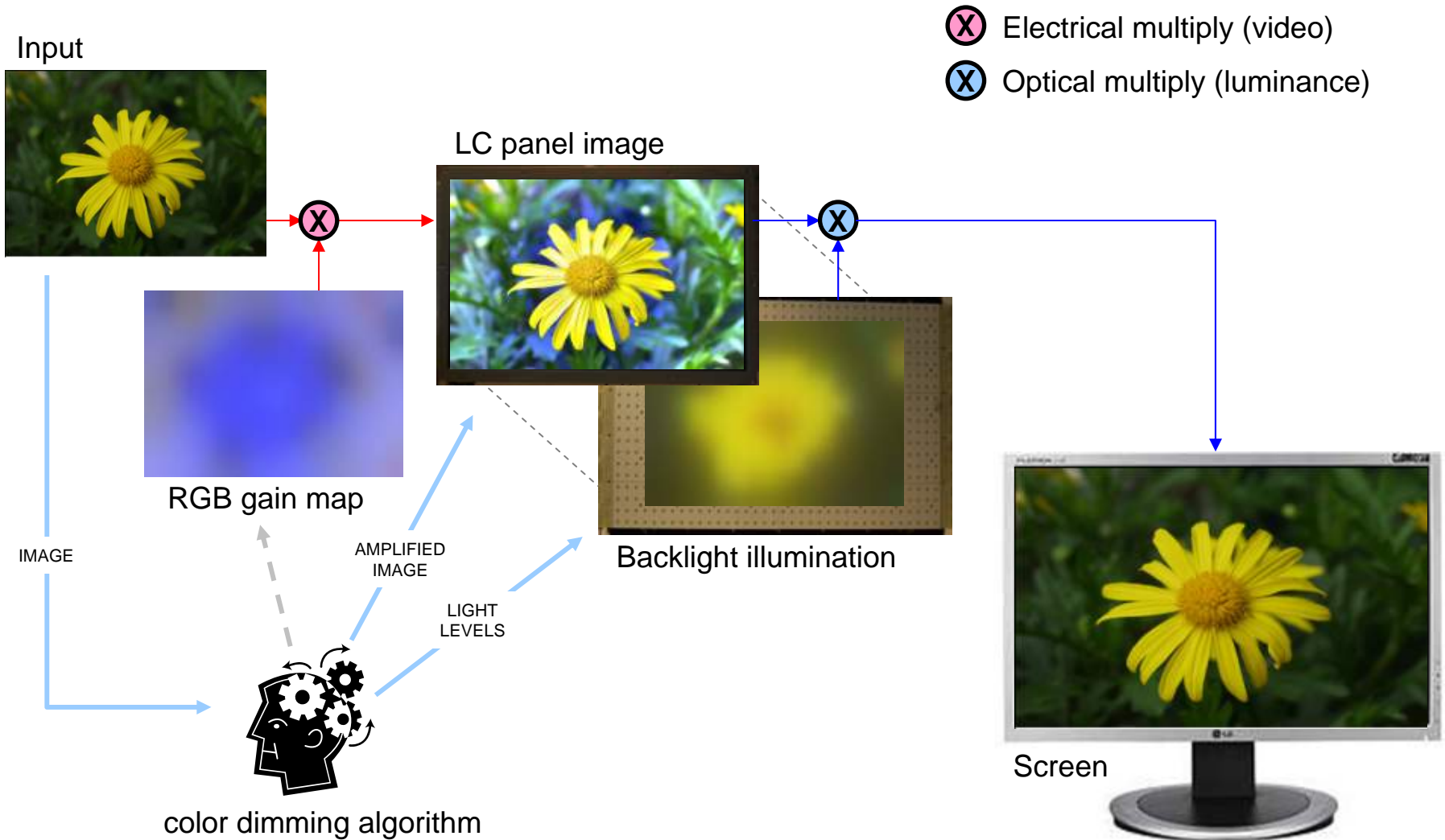
Power efficiency gain  $(2.5 \times 3) = \underline{7.5x}$



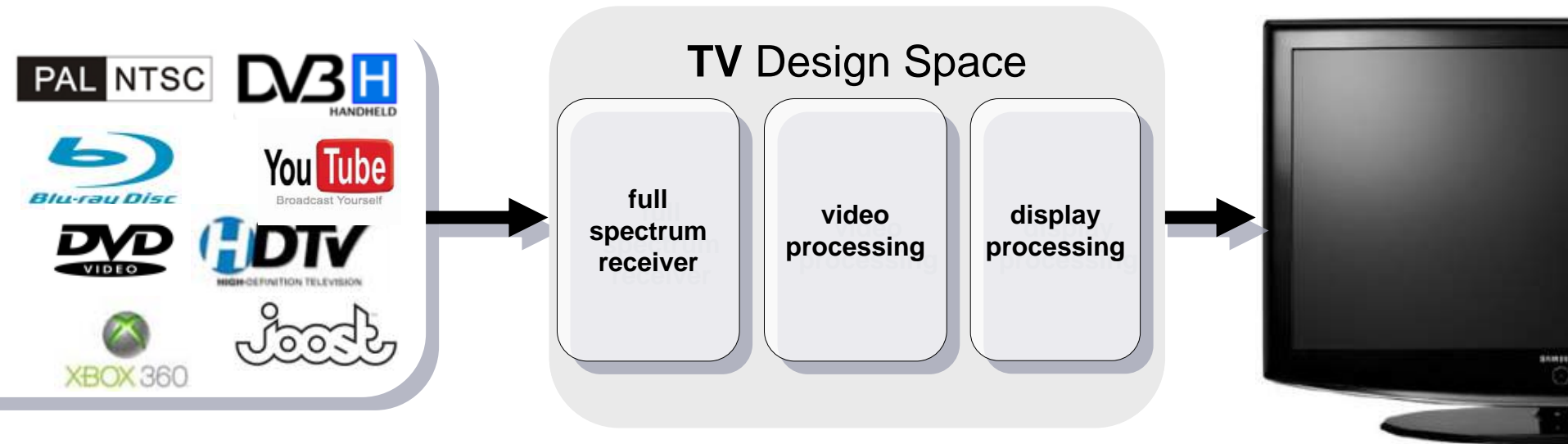
# Comparison dimming methods



# Illustration: 2D Colour dimming



# NXP innovates in the full TV design space



- ▶ End-to-end optimization requires joint innovation with the key value-chain players

**THANKS FOR YOUR ATTENTION**