

# HDR Overview

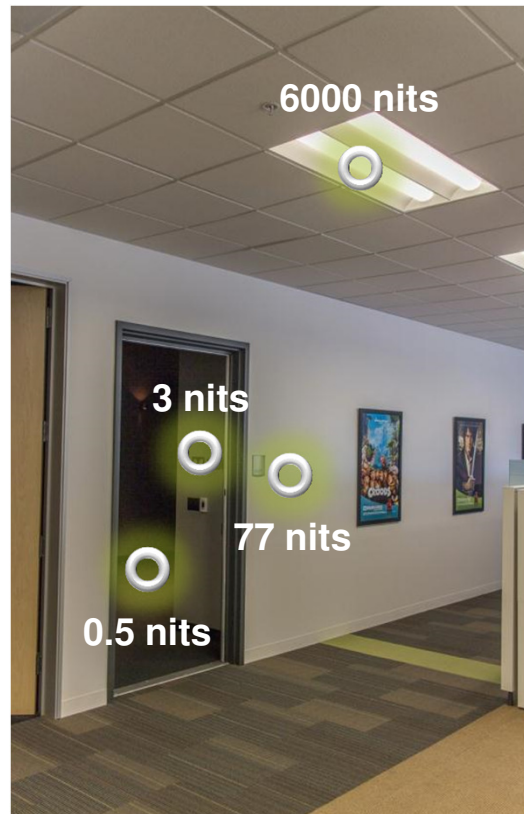
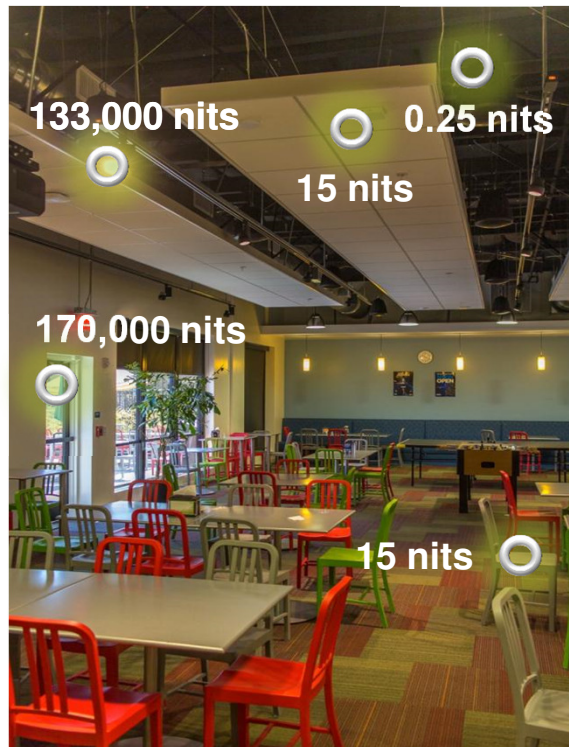
Walt Husak



 DOLBY.

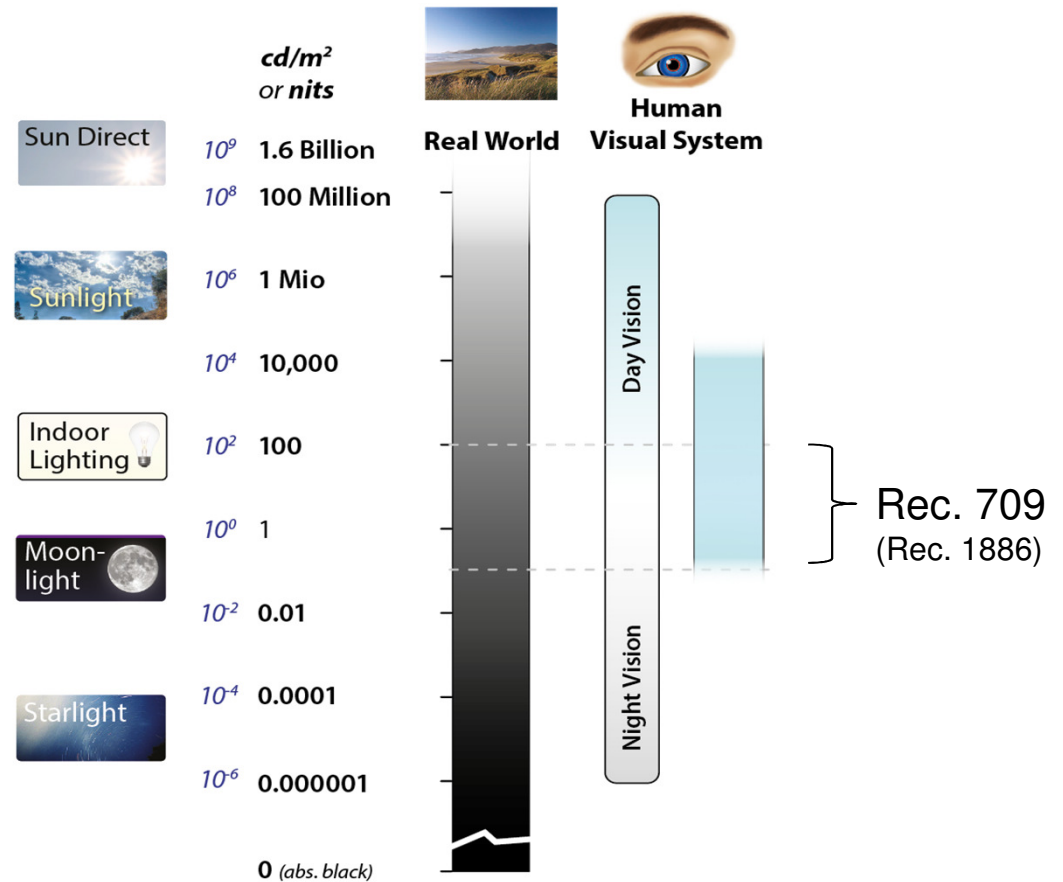
April 16, 2015

# The Real World



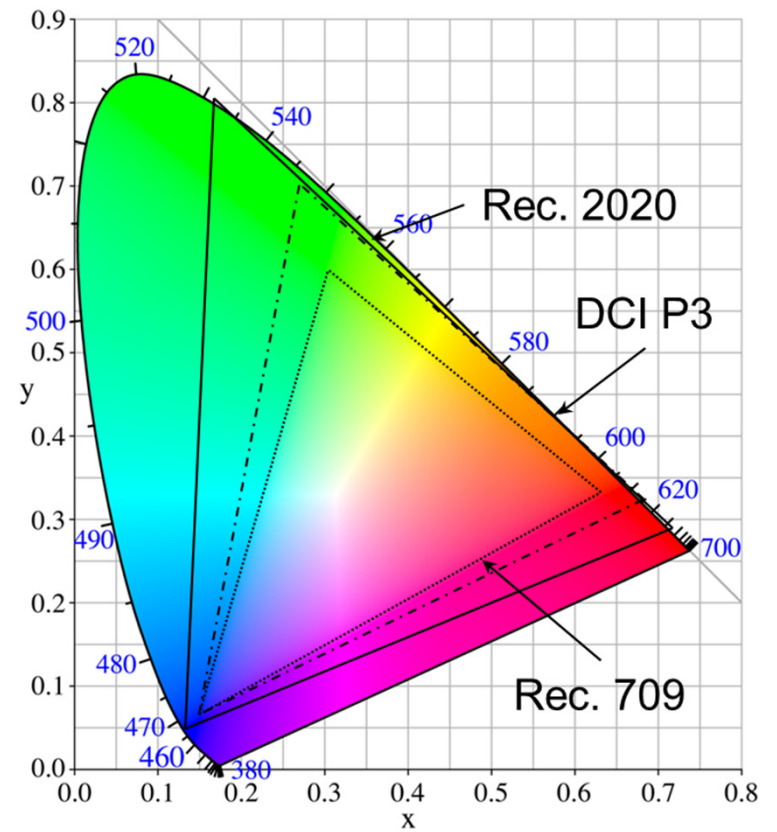
# Luminance

- Real World
  - >15 orders of magnitude
- The eye
  - 4 orders of magnitude
  - But adaptive
- Current TV
  - 3 orders of magnitude





# Color Gamut

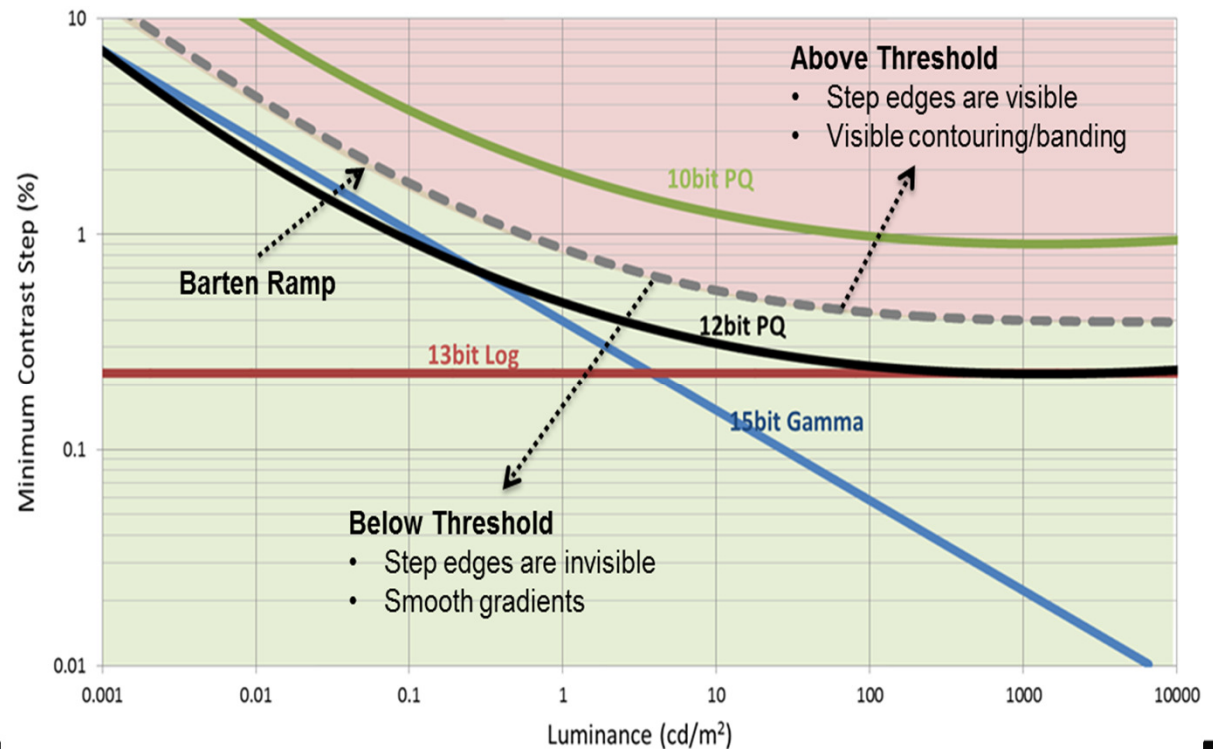


# What is HDR?

- High Dynamic Range (HDR)
  - Provides brighter highlights and deeper blacks
  - Average Picture Level (APL) is roughly the same as current TV
  - It is **NOT** just a brighter picture
- Wide Color Gamut (WCG)
  - Beyond current TV (Rec. 2020?)
  - Allows pictures with richer color sets
  - Dovetails well with HDR

# Contrast Sensitivity in the HVS

- Barten ramp  
– see Report  
ITU-R BT.2246-2
- 10bit PQ is above the  
Barten threshold -  
contouring can occur
- 12 bit PQ shows no  
visible contouring
- This HDR EOTF is  
defined in SMPTE  
Standard ST 2084



## Peak Brightness

Luminance Range	Dynamic Range (Stops)	Digital Code Words – 12bitPQ	Bit Depth Required
0.005nits to 100nits	14.3	2001 (49%)	11.0
0.005nits to 600nits (Dolby PRM4220)	16.9	2765 (68%)	11.4
0.005nits to 4000nits (Dolby Pulsar)	19.6	3603 (89%)	11.8
0.0nits to 10000nits (HDR PQ Signal)	20.9	4060 (100%)	12.0

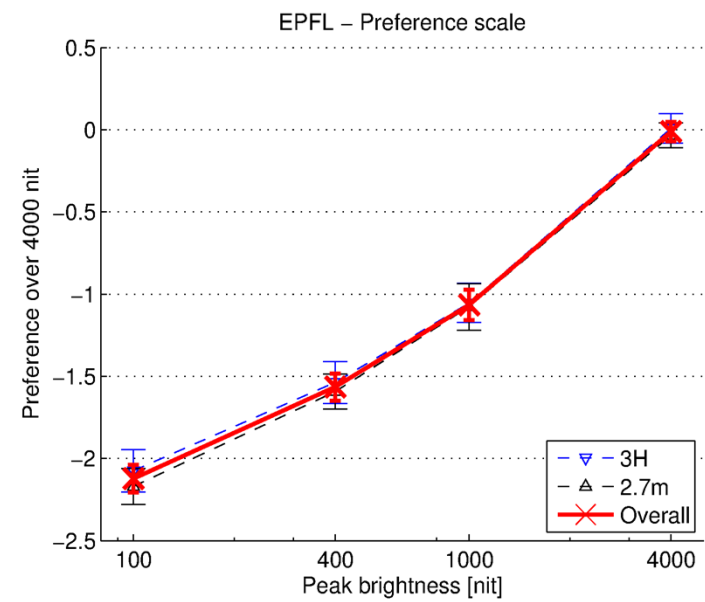
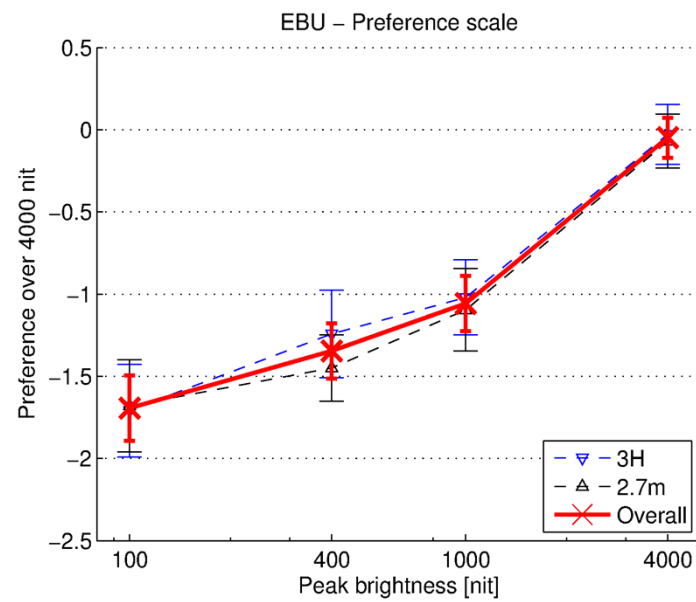
- Due to the sensitivity of the HVS, there is really no benefit in reducing the peak brightness.

## What do people prefer?

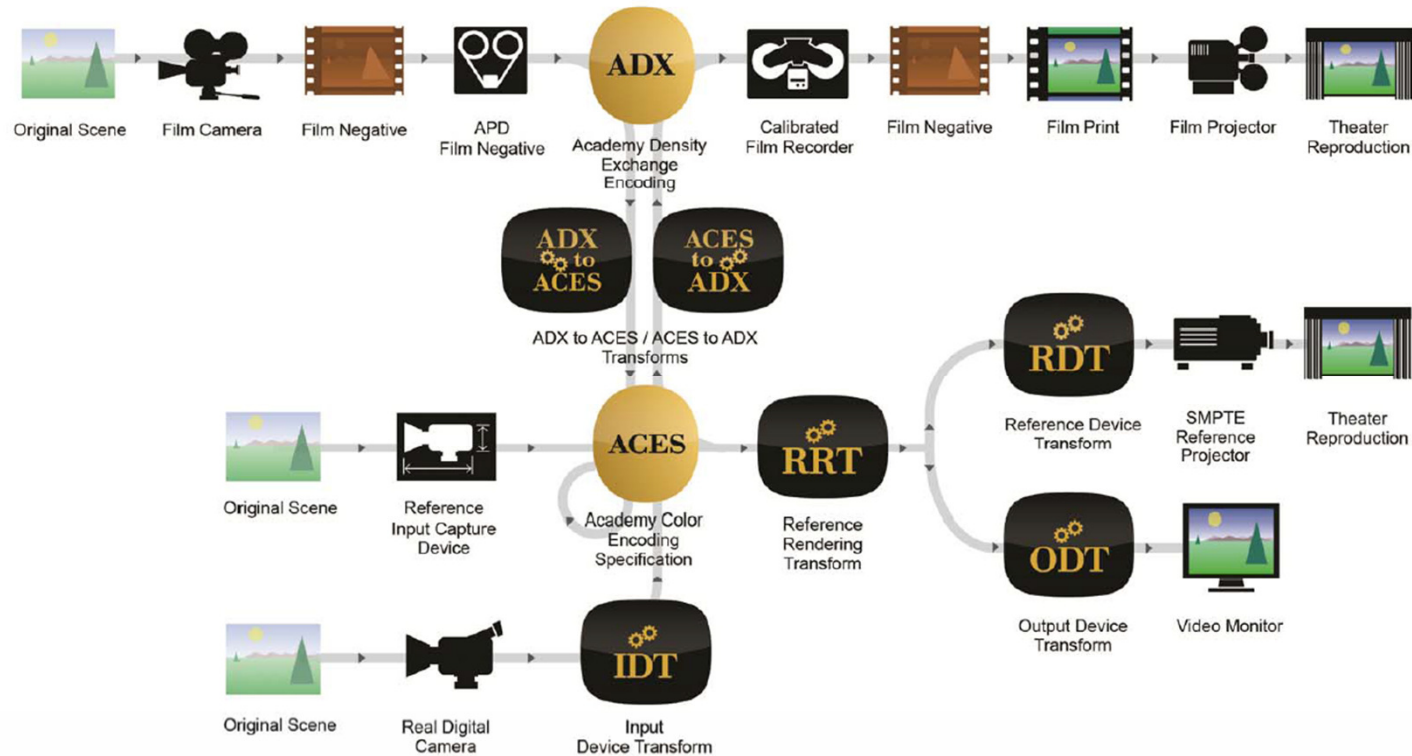
- Two tests completed last year by the EBU and EPFL
  - Expert viewers (broadcasters)
  - Non-experts (college students)
- Four peak luminance targets tested
  - 100, 400, 1000, 4000 nits
  - Content was remastered for peak luminance preserving average brightness (APL)
- Tested on a multipoint scale
  - Simulate the five point CCIR scale



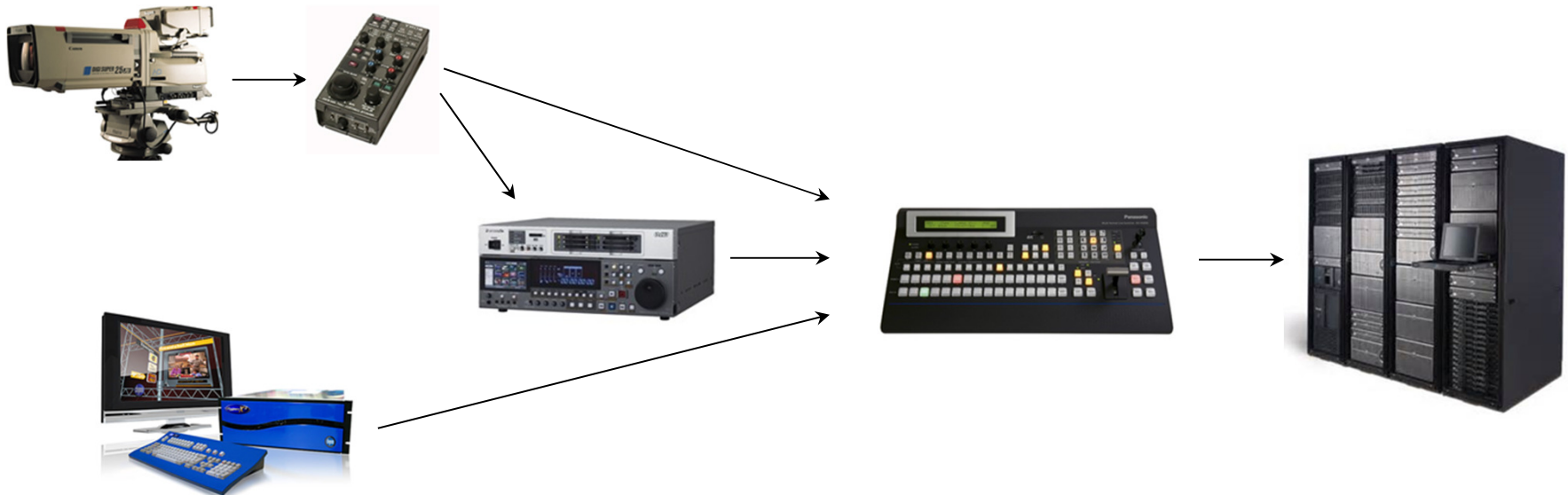
# User Preference Testing



# ACES System (Render at Device)



# Linear Production



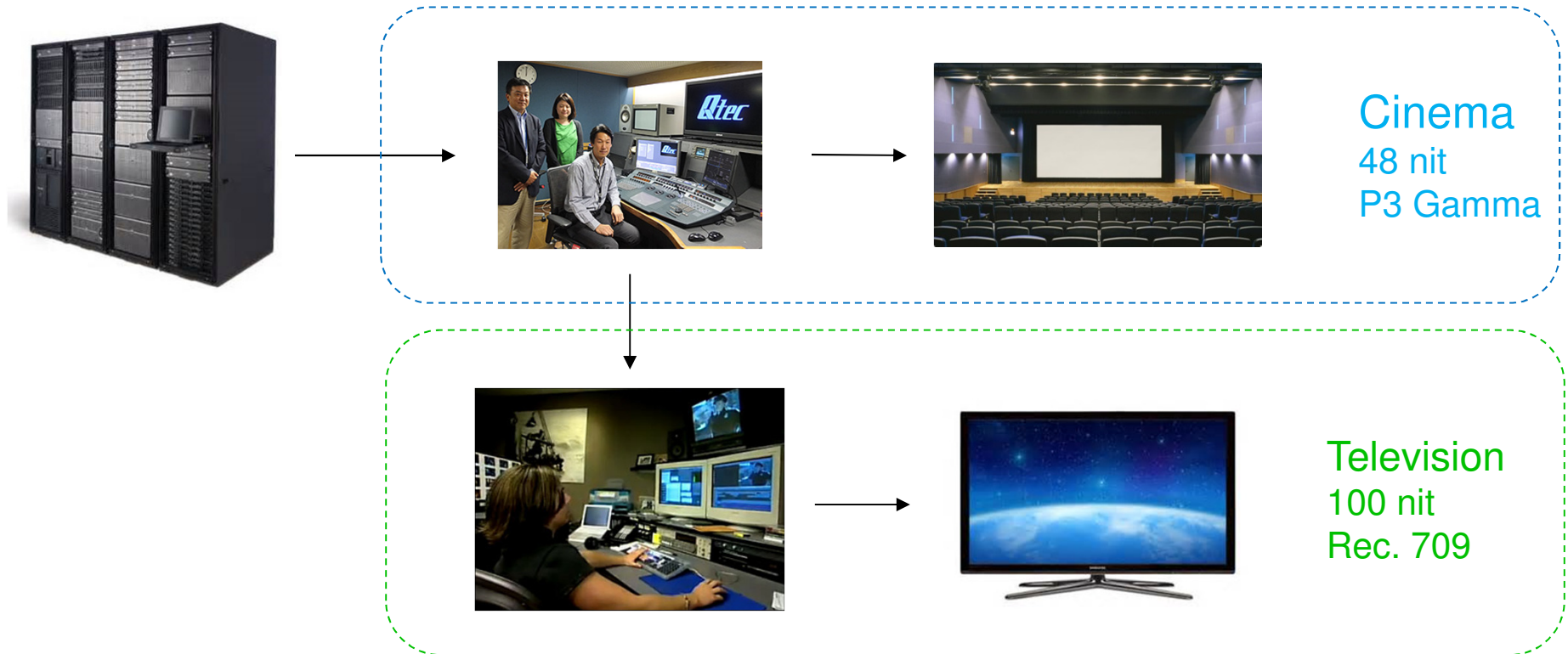
- Most production equipment already supports 10 bits
  - New EOTF available for HDR (SMPTE 2084)
  - Demonstrated functionality in existing equipment

# D-Cinema

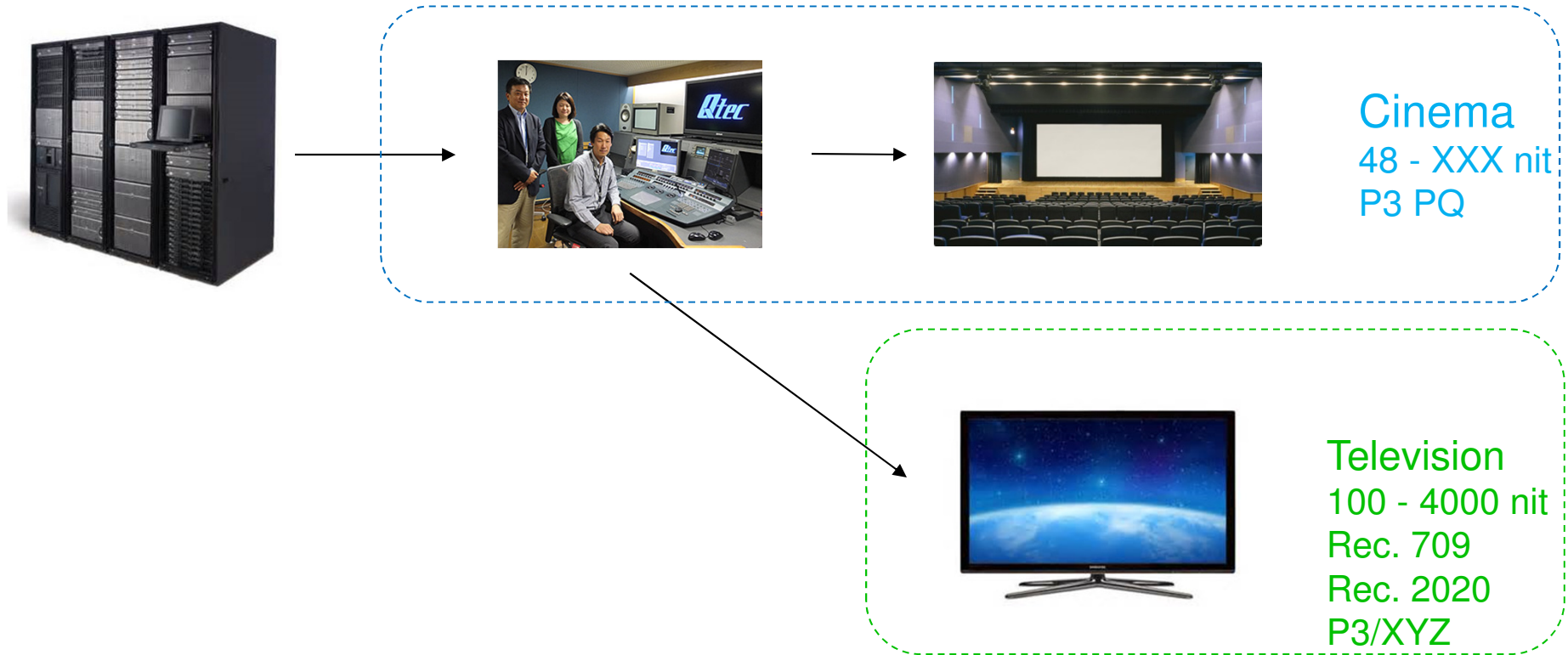
- Xenon based
  - Wider dynamic range
    - 12 bit Gamma 2.6 (48 nits)
  - Larger color gamut
    - P3 (larger than Bt.709)
- Laser based systems announced
  - Path to higher brightness (>100 nits)
  - Wider color gamut (true Bt.2020)



# Traditional Content Distribution

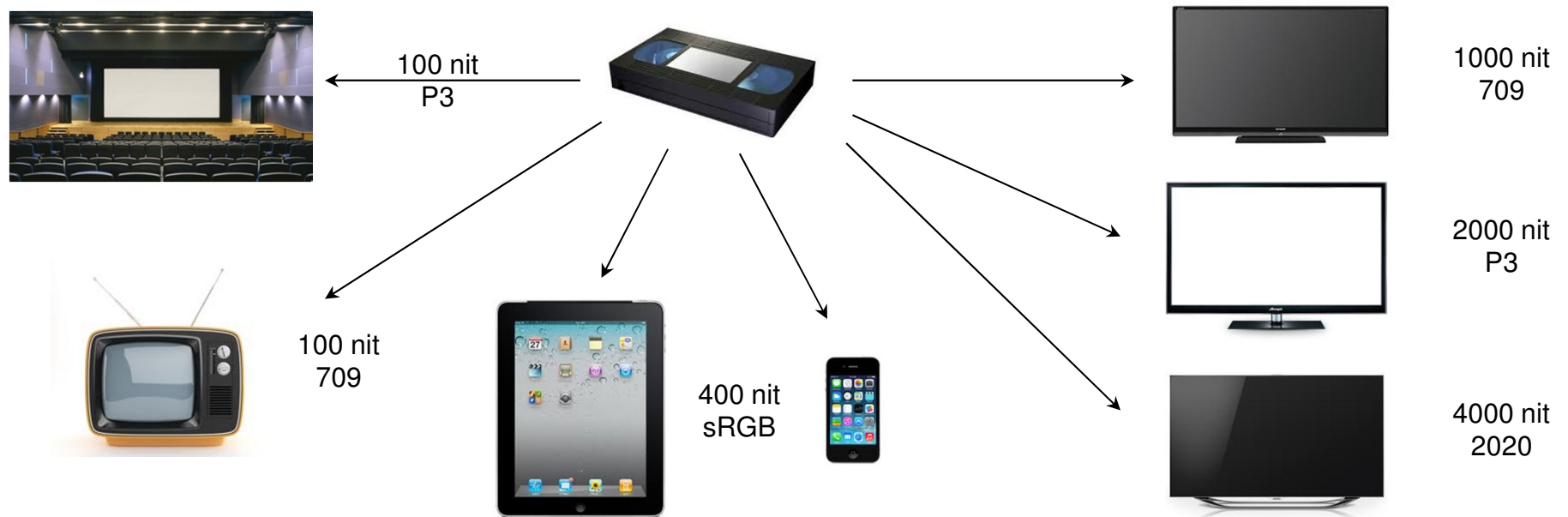


# Forward Looking Content Distribution





# Creative intent can be preserved to the display



- Single master feeds multiple render devices with different capabilities

## Distribution to the Home

- Streaming Services (OTT)
  - Will be much quicker due to flexibility in using company based systems
  - Content is typically offline productions which are typically quicker for new technologies
- Disc Based (Blu-Ray)
  - Quick deployment due to “closed” system
- Linear Broadcasting
  - Standards based with substantial inertia due to hardware platforms
  - Likely to take several years due to standards and product development

## Potential solutions

- Company sponsored solutions (example – Dolby Vision)
  - Uses existing MPEG codecs with additional communication
  - Multiple 8 bit codecs simulate 10/12 bits
  - Concerted ecosystem development effort (like Windows/iOS)
- Standards based (MPEG)
  - Modification of existing codecs (HEVC and/or AVC)
  - Ecosystem is similar to open source development (like Linux)
- Both will exist in the distribution channel
  - AC-3 and HE-AAC is a good example

## Summary

- HDR is an attractive value proposition
  - Allows the content creator a rich set of new tools
  - Consumers are reacting positively to HDR
- HDR ecosystem is maturing
  - Workflow development is well underway
  - Much of the content value chain can already support HDR
- Multiple solutions will exist
  - Different distribution modalities and deployment timelines

# Thank You

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