

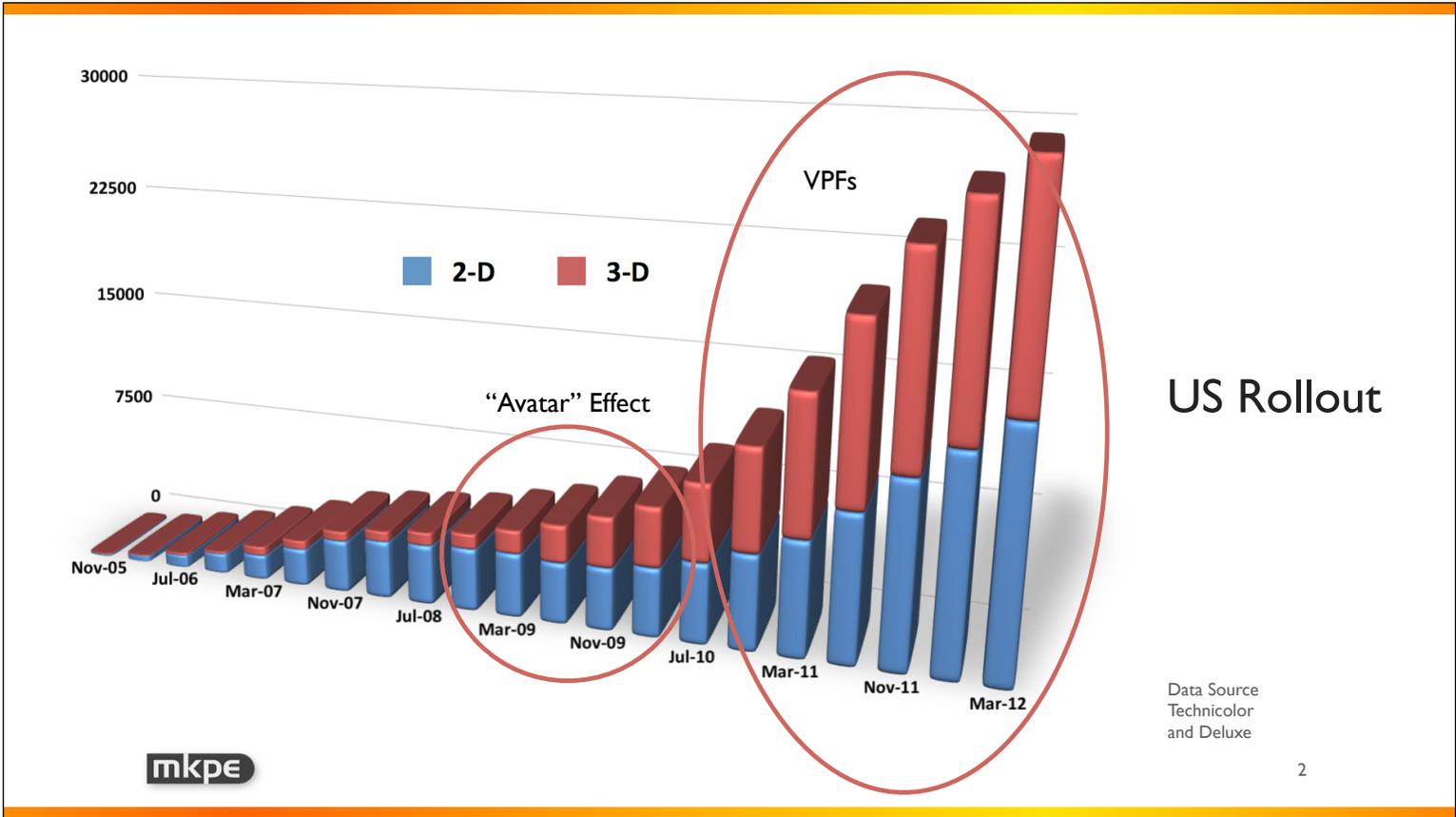


Beyond the Digital Turning Point: The Next Steps in Cinema

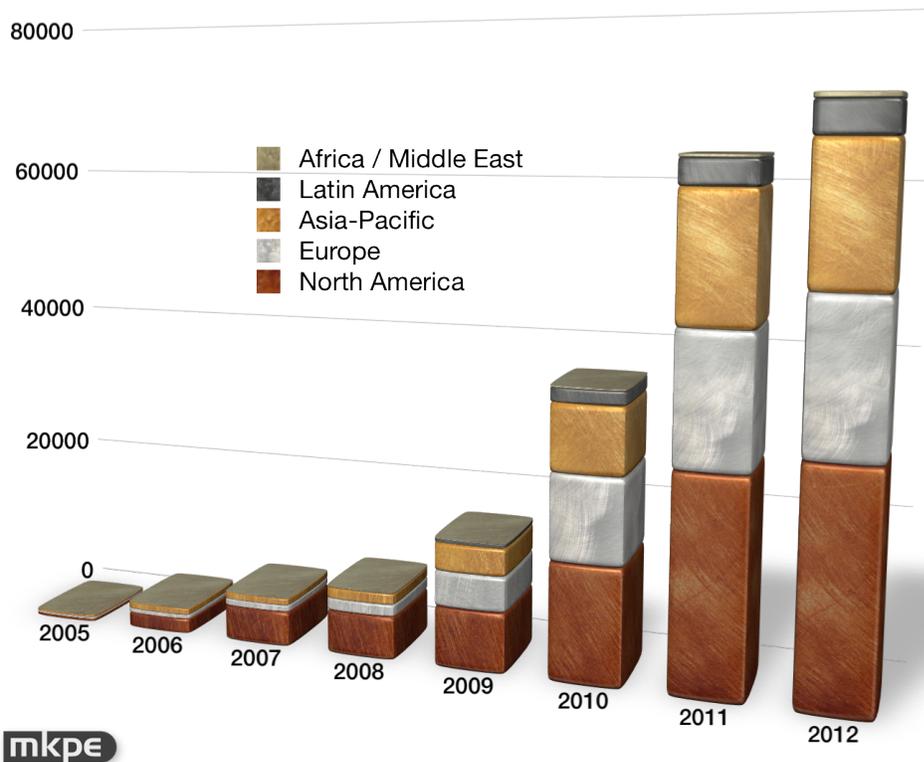
Michael Karagosian
30 August 2012



I'm Michael Karagosian, president of MKPE Consulting in Los Angeles. We have been engaged in business and technology development in entertainment for nearly 25 years, and have played an active role in the development and rollout of digital cinema for the past 12 years.



As of the end of March, approximately 28,000 digital projectors were installed in US cinemas. About 50% of these are 3-D. However, the 2-D digital screen count is growing. You can see in this chart how this tremendous growth was seeded by 3-D with the “Avatar” effect in 2009. This effect occurred around the world, leaving a mixed footprint of 2-D film and 3-D digital systems. To encourage 100% adoption of digital projection, a flood of virtual print fee deals were entered by studios, most of which were direct-to-exhibitor deals. These deals require exhibitors to rollout quickly to maximize the benefit of the subsidy, and this is what has fueled the rapid acceleration of digital cinema around the world.

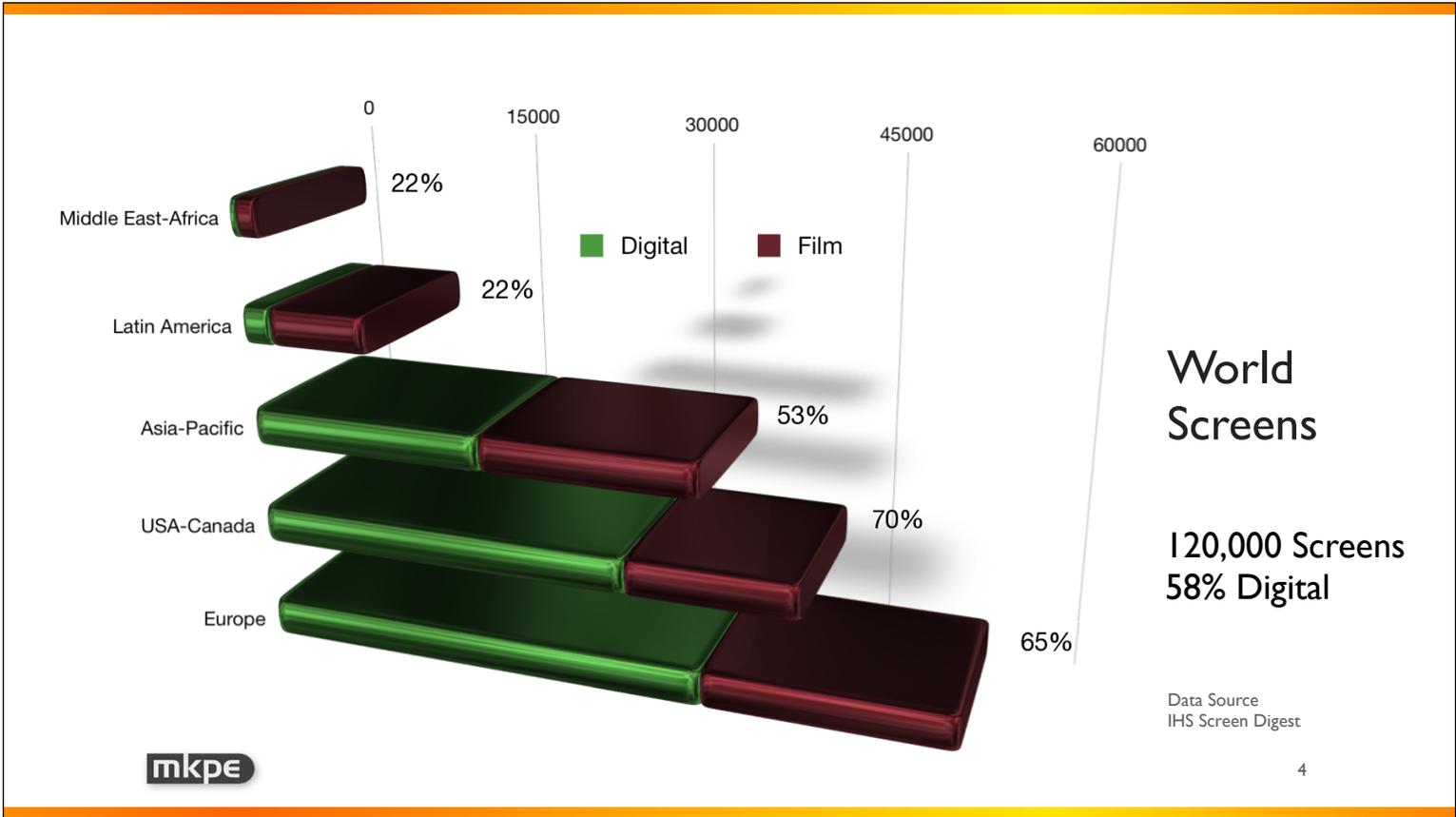


World Rollout

Data Source
IHS Screen Digest
and Deluxe

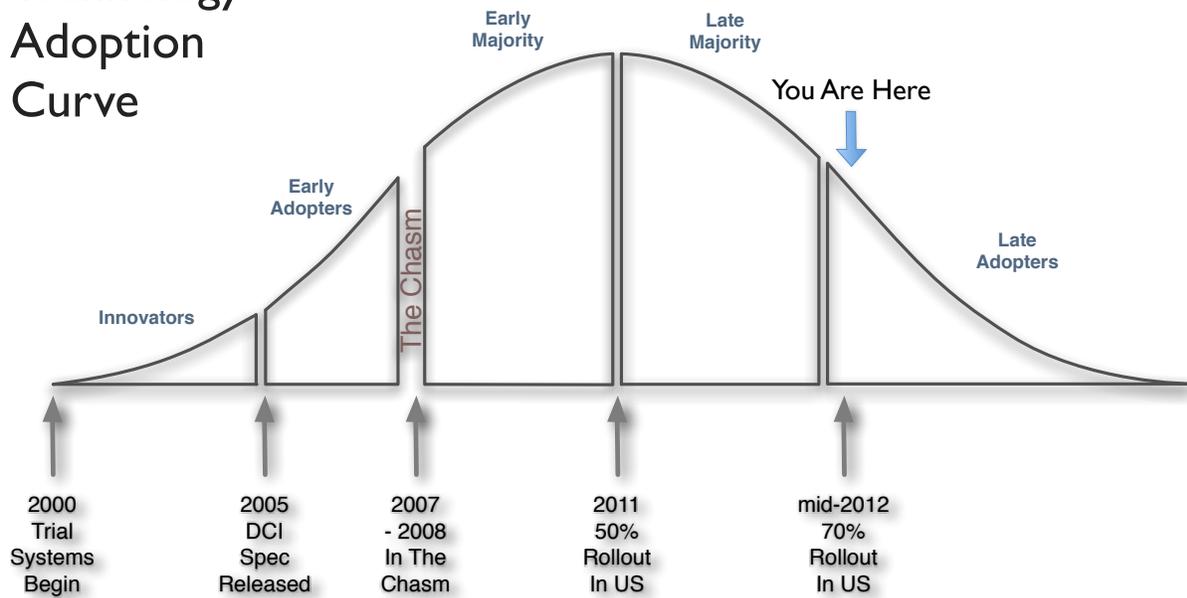
Worldwide, 70,000 digital projectors have been installed. The counts are:
 30,000 US and Canada
 19,000 Europe
 17,500 Asia-Pacific
 2,500 Latin America

Notice that the growth in worldwide digital screens began to accelerate in 2009, due to the “Avatar” effect.

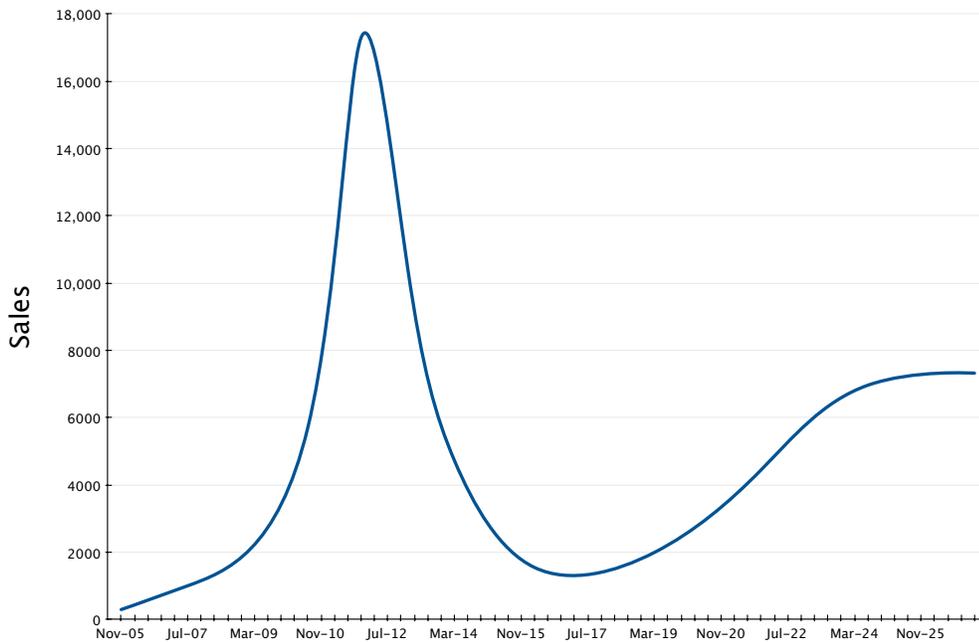


There are around 120,000 cinema screens around the world, and over 60% of these are now digital. The percentages shown indicate the degree of digital conversion for each region.

Technology Adoption Curve



The technology adoption curve gives us insight into the nature of the cinema sale today. Late adopters have a very different temperament than early adopters, and examine the cost of ownership in far more detail. Savvy manufacturers know how to sell to this different breed of customer. If you're an exhibitor in the market for equipment, then cost of ownership is an area to explore.



Digital
Cinema
Projector
Unit Sales
Curve



Manufacturers are no doubt thrilled about the robust sales now taking place. But we're in a sales bubble, and it'll burst in another year or two. In 2015, unit sales could drop to pre-2009 levels. The challenge for manufacturers is that the replacement cycle for projectors is unlikely to begin driving new sales until 2020. And they have a remedy for this.

Be Ready For New Features!

Higher Frame Rates

Improved Workflow

Lower Cost Equipment

Higher Brightness Projectors

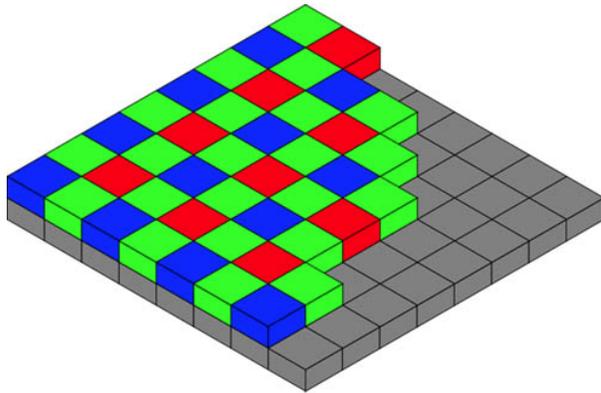
They're going to encourage you to replace that old projector early by offering you new features.

2K, 4K, and HFR



Doug Trumbull

Let's talk about those features. I'll start with resolution and high frame rates.



Bayer pattern in digital cameras

4K is not always
equal to 4K

Even in the professional world, there is a numbers game with cameras. When you hear that movies are now being shot in 4K, that may not always be exactly true. A camera with a Bayer patterned imaging element will produce an image with a lower line count. Still, a cinematographer is wise to reach for the highest resolution camera available. High resolution cameras provide the director with more choices in post production. A shot can be reframed in post without losing quality when presented on a 2K projector.

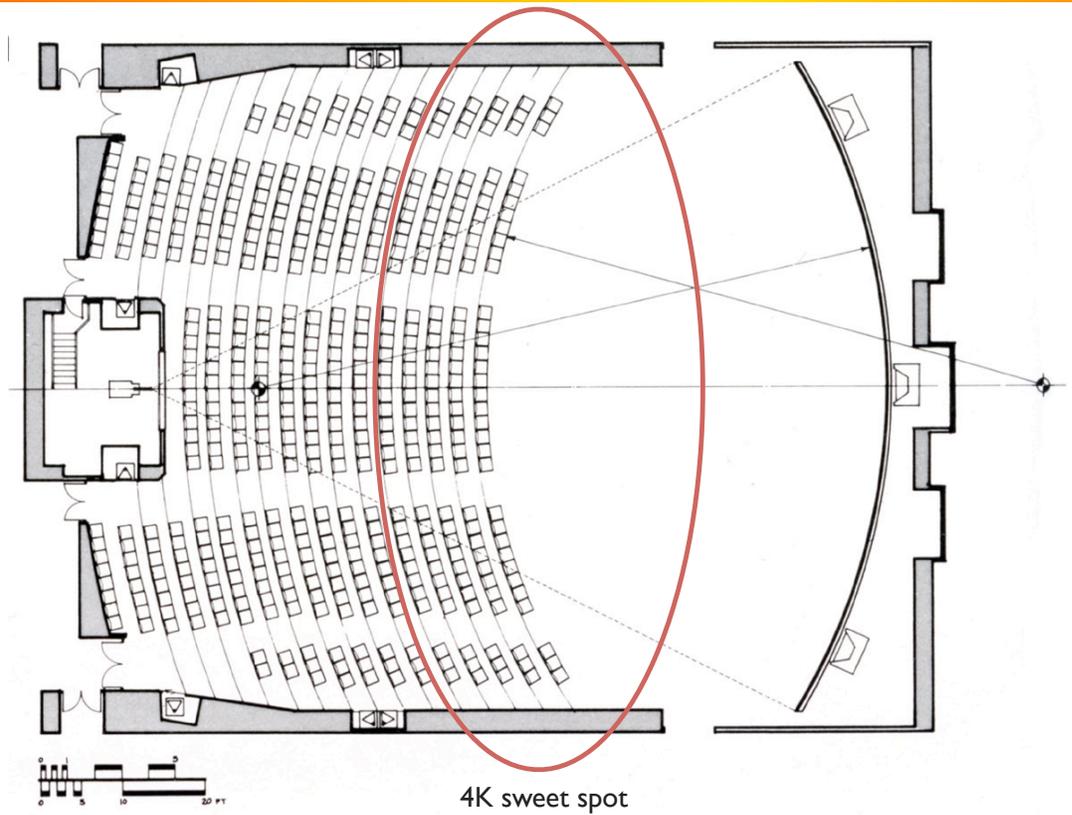


Sony 4K with 3D lens

Sometimes 4K is
less than 2K

Not all 4K projectors are used as 4K projectors. The dual lens arrangement used on this projector will project an image that is less than 2K.

Can you
sell 4K?



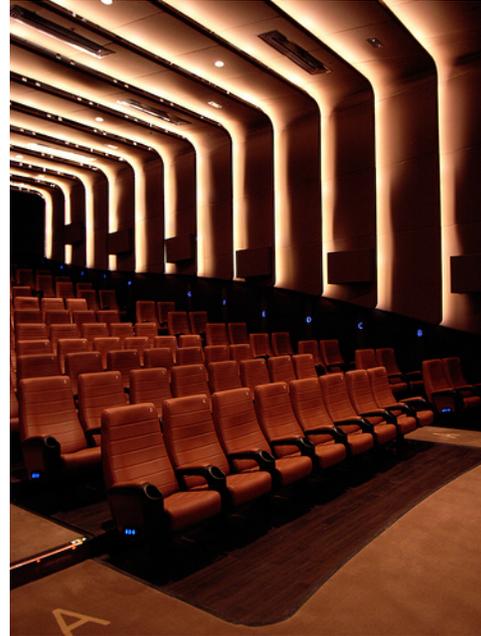
The bigger problem with 4K in the cinema is that it can't be appreciated from all seats. 4K resolution can only be viewed from the front rows, and these aren't the seats that your audience is willing to pay more for.

In contrast:

3-D pictures can be seen from every seat.

3-D sound can be heard from every seat (more or less).

High Frame Rate pictures can be seen from every seat.



2K-2D / 120 fps

2K-3D / 60 fps/e

2K-3D / 48 fps/e

2K-3D / 24 fps/e

2K-2D / 24 fps

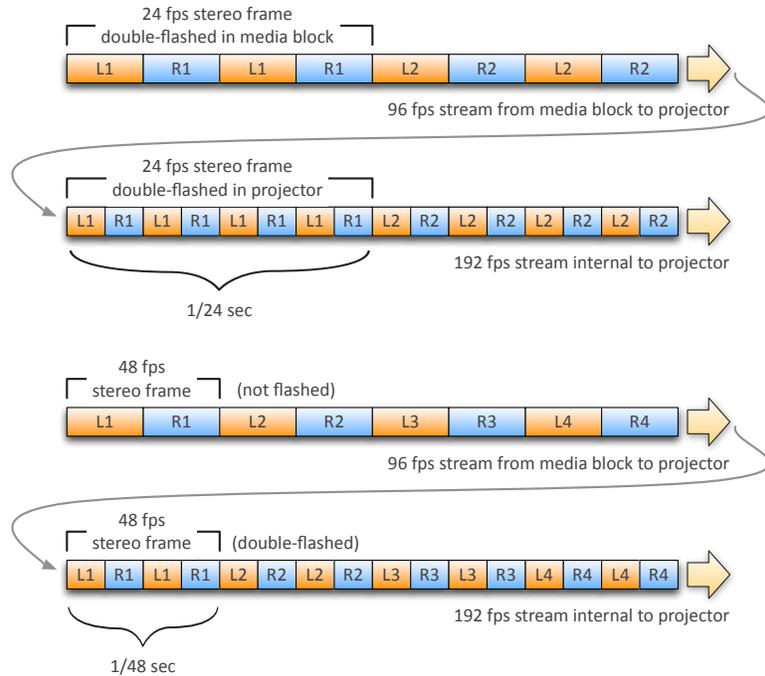
4K-2D / 30 fps

4K-2D / 24 fps

Higher
Frame Rates
(HFR)
Provides a
Rich
Environment
for Creatives

When we talk about higher frame rates in digital projection, we're only talking about 2K. But for most directors and cinematographers, this is enough.

HFR isn't
easy to play
...yet



Stereo 24 and 48 fps content projected at 192 fps



When trying to play a 3-D HFR trailer in a playlist that contains lower frame rate trailers, you will encounter problems. Not all 3-D add-on systems can synchronize immediately to a change in frame rate. A different scheme is now being explored where the media block always produces a 96fps stream, regardless of the frame rate of the content.

...and
HFR Today
may not be the
HFR of
Tomorrow



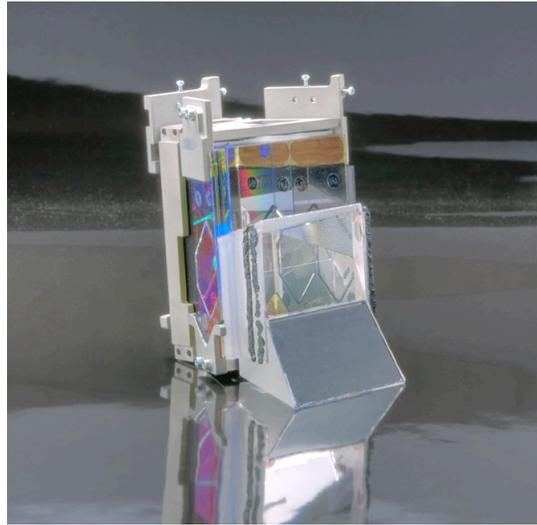
**TC-21DC SG Higher Frame Rates for
3D and 2D D-Cinema Applications**

*Work in progress: Study
compression bit rates required of
JPEG 2000 with higher frame rate
content.*



The DCI spec calls for a minimum compression bit rate of 250 Mbps. Integrated media blocks (IMBs) today peak at 500 Mbps - which is just enough for the 48 fps/e HFR version of "Hobbit". I co-chair the SMPTE HFR Study Group, along with cinematographers David Stump (ASC) and Kommer Kleijn (SBC). We are in the planning process for tests that will determine how future HFR media blocks should be designed.

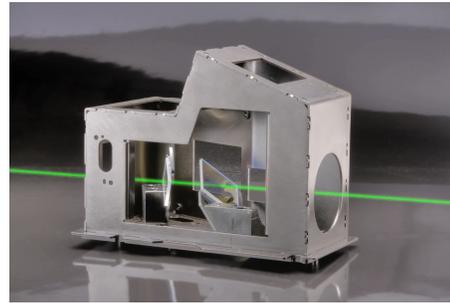
Illuminators, Low Cost Projectors, & Sound



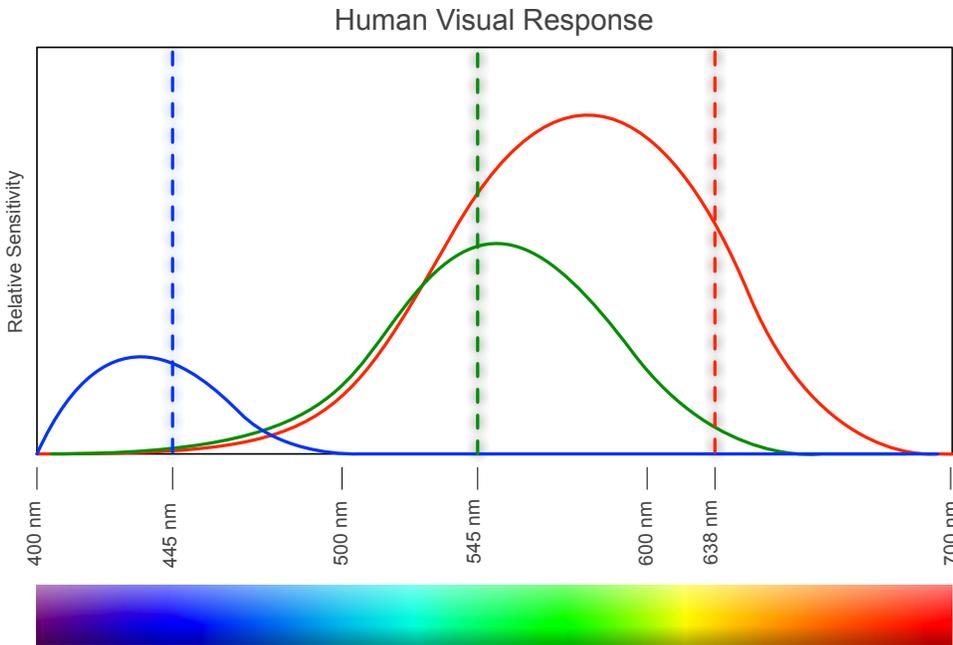
Other areas where features will be pushed is in illuminators, lower cost projectors, and 3-D sound.

Laser Illumination

- ☑ Regulatory
- ☑ Capex vs Opex (~8 year payoff)
- ☑ Speckle
- ☑ Metamerism



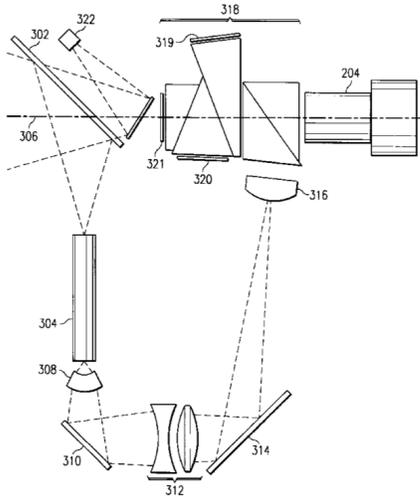
Laser illuminators have several hurdles to cross before they are commercially practical. The one you hear about least is metamerism.



Laser Metamerism

Metamerism is an effect where different people will see color differently when viewing the same projected image. We don't experience metamerism with xenon lamps, as they emit a full spectrum of light. The graph shows the sensitivity of the human eye for red, green, and blue primaries. The filters for R, G, and B in a digital projector provide a broad spectrum per primary, but laser projector primaries are quite narrow, as shown by the dashed lines. The narrowness in spectrum for laser primaries results in metamerism.

Lower Cost Projectors

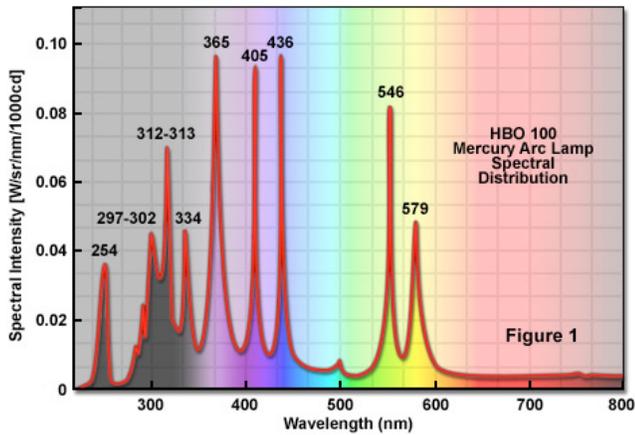


mkpe

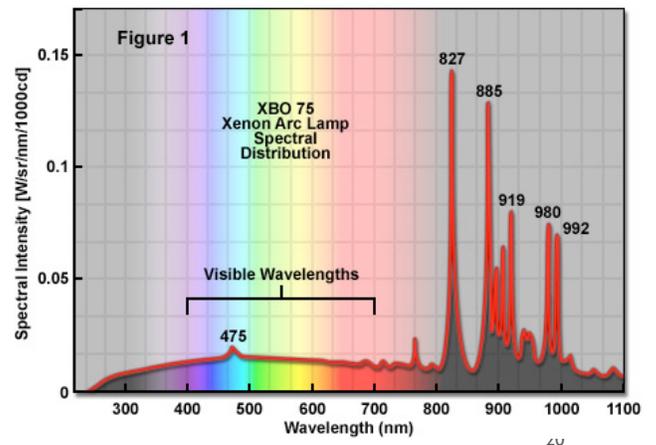
19

Low cost projectors require low cost optics. Texas Instruments recently announced the availability later this year of a new, smaller .7" DLP 2K imaging array. While the chip will presumably cost less than the .98" or 1.2" versions, the bigger cost savings will be in the smaller optics needed in the projector. Limiting the projector to lower light power will also reduce the cost of the glass used.

Combined with an Integrated Media Block, a complete projection solution could be offered that is DCI Compliant and less costly for smaller cinemas than current products on the market. Such products could be on the market within a year.



High Pressure
Mercury Arc
(courtesy of Zeiss)



Xenon Arc
(courtesy of Zeiss)

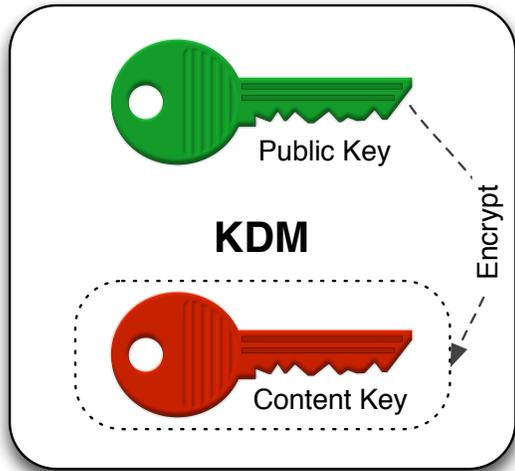
mkpe

At least one manufacturer is peddling high pressure mercury arc lamps in a lower cost projector. Mercury arc lamps do not have the smooth visible spectrum of xenon lamps, and are difficult to filter to an acceptable viewing quality. When viewing such projectors, look for the color cast at different light levels. Different color casts can occur at different light levels.

3-D Sound



For the past 12 years, the industry focused on achieving digital projection with a quality level that matched that of film. Now it's audio's turn to shine. Audio in the cinema is undergoing a renaissance, with no less than 5 companies having announced new sound formats that surround the audience with sound in a hemispherical manner. Two weeks ago, Dolby announced its entry into this area, called Dolby Atmos. Competing formats are offered by Barco's Auro3D, IOSONO, and a new Korean company called Sonic Tier. Unless standards are pursued, each format could require a different distribution package, further multiplying the number of versions of inventory required for each movie.



Security Key Management

mkpe

There are other areas that need improvement. An estimated .5M KDMs are distributed each week. No standardized solution now exists. Content management issues also exist, but solutions for content management won't be effective until security key management is fully automated.

Uniformity in Accessibility

- Uniform distribution
- Uniform interoperability

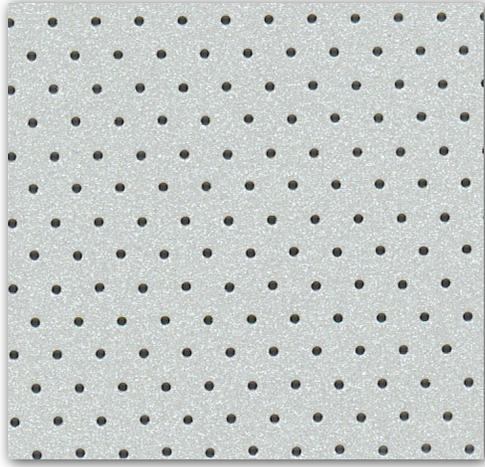


photo by Dutch photographers Ilse Leenders and Maurits Gisen



Accessibility standards now exist for cinema, but only for digital cinema.

Next Generation Screens?



Are those perforations really necessary?

The one area that remains untouched is that of the screen. Perforated screens lose light and have been known to cause moire patterns in some digital cinemas, by beating with the pixel pattern of the projector. The challenge is to make a screen that is acoustically transparent, but highly reflective to light.

Which brand attracts audience?

 DOLBY



IMAX
T H E A T R E

realD



XPAND 3D
BEYOND IMAGINATION

 DOLBY ATMOS



DLP
CINEMA[®]
TEXAS INSTRUMENTS



Manufacturers want exhibitors to buy their latest products, but the biggest problem they face is the limited ways in which exhibitors can monetize new technologies.

Michael Karagosian
MKPE Consulting LLC
Calabasas, CA USA
michael.karagosian@mkpe.com
mkpereport.com
mkpe.com



You can keep up on the latest analysis of digital cinema by subscribing to mkpeReport at <http://mkpeReport.com>. A special rate is available online for a limited time.