



# Archives and Digital Cinema

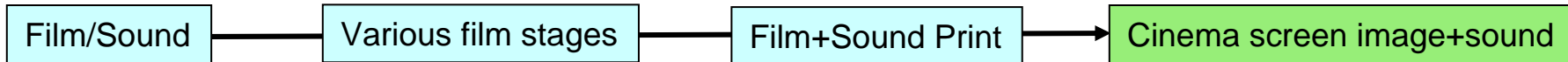


EDCine Brussels June 2009

Paul Read

# Digital projection of archive film

- Film production for the cinema has been much the same for nearly 100 years.



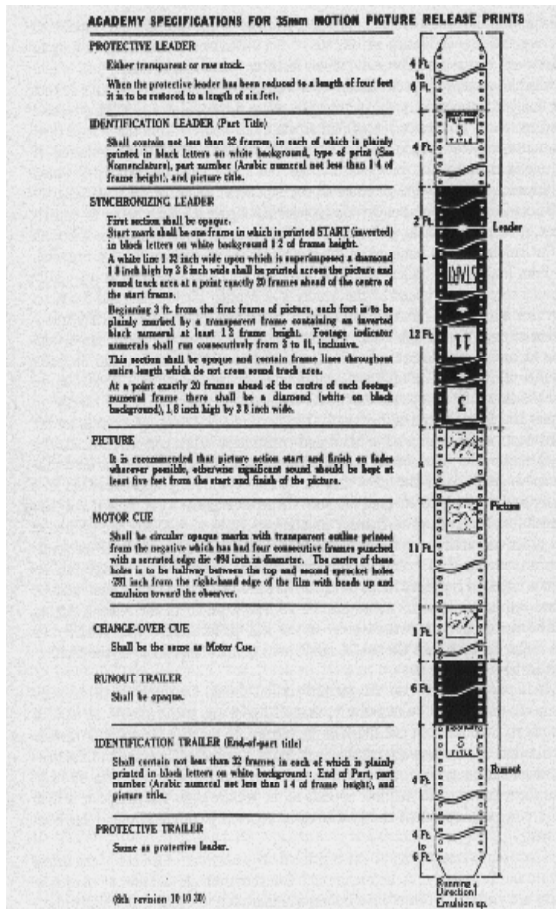
- Film is no longer widely used during post-production and has been replaced by the Digital intermediate process (*sound went that way many years ago*).



- Film may cease to be projected in cinemas within a few years.
- All cinema film will eventually be replaced entirely by digital media.
- It is expected that film will cease to be manufactured. Archives will no longer screen their films as they cannot be replaced (or will become very expensive).
- Digital projection offers a method of screening archive film programmes.

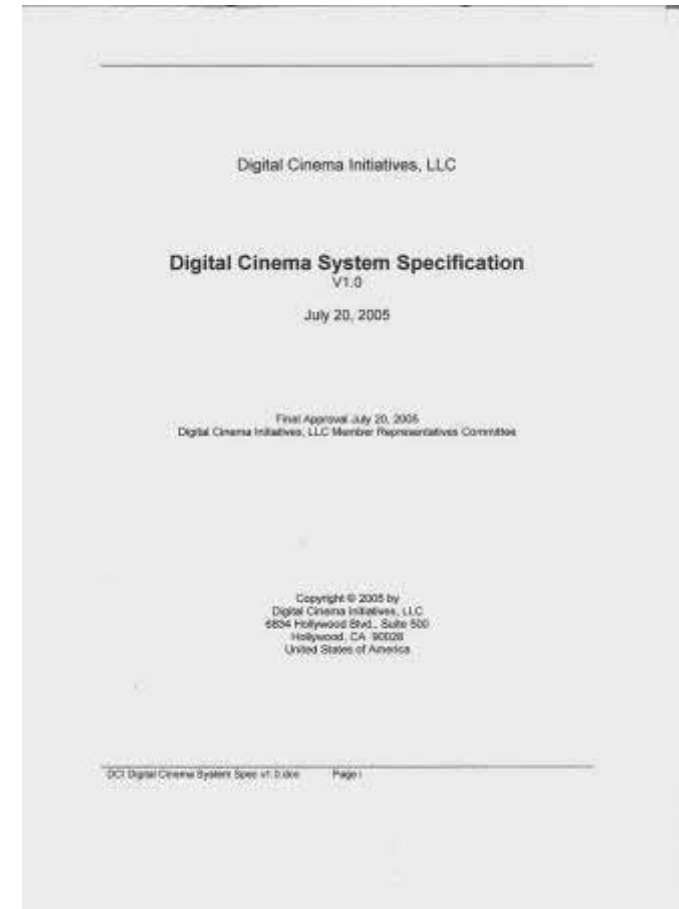


- Archives and cinematheques will always wish to screen films in the same way, and with the same visual impact, as they were seen originally.



**Two historic documents from the USA.**

**with a difference!**



**A page from the 1930 Academy of Motion Pictures Arts and Science document describing the “Academy leader” used to this day throughout the world.**

**However the Academy was actually describing something that was almost universal by that time already.**

**The front page of the 2005 Digital Cinema Initiatives specification for digital cinema, describes a system that did not yet exist for projection, using a file format that had not previously been used for projection – but had by November 2006.**

## **DIGITAL CINEMA TODAY**

- **Digital Cinema Initiative DCI was created by Disney, Fox, Paramount Sony Universal and Warner Bros in 2002.**
- **DCI's technical proposal as specification was published in 2005.**
  - It used open architecture**
  - Aimed for high quality**
  - Aimed for high security**
  - Aimed for access control by distributor**
- **SMPTE adopted the specification and is currently working towards a bunch of SMPTE Standards for Digital Cinema (3D is still active, 2D is done).**
- **Meanwhile servers and projectors were developed and marketed following the expected DCI and SMPTE specifications.**
- **SMPTE standard will be adopted by April 2010. Transitional phases are in process, a so called Interop J2K format is in the field today.**
- **ISO TC36 will adopt the SMPTE Standards within the next 2-3 years**

# SOME TECHNICAL SPECIFICATIONS

**IMAGE:**  
12bit  
XYZ colour space  
2048 x 1080 at 24 and 48fps  
4096 x 2160 at 48fps  
JPEG2000 compressed

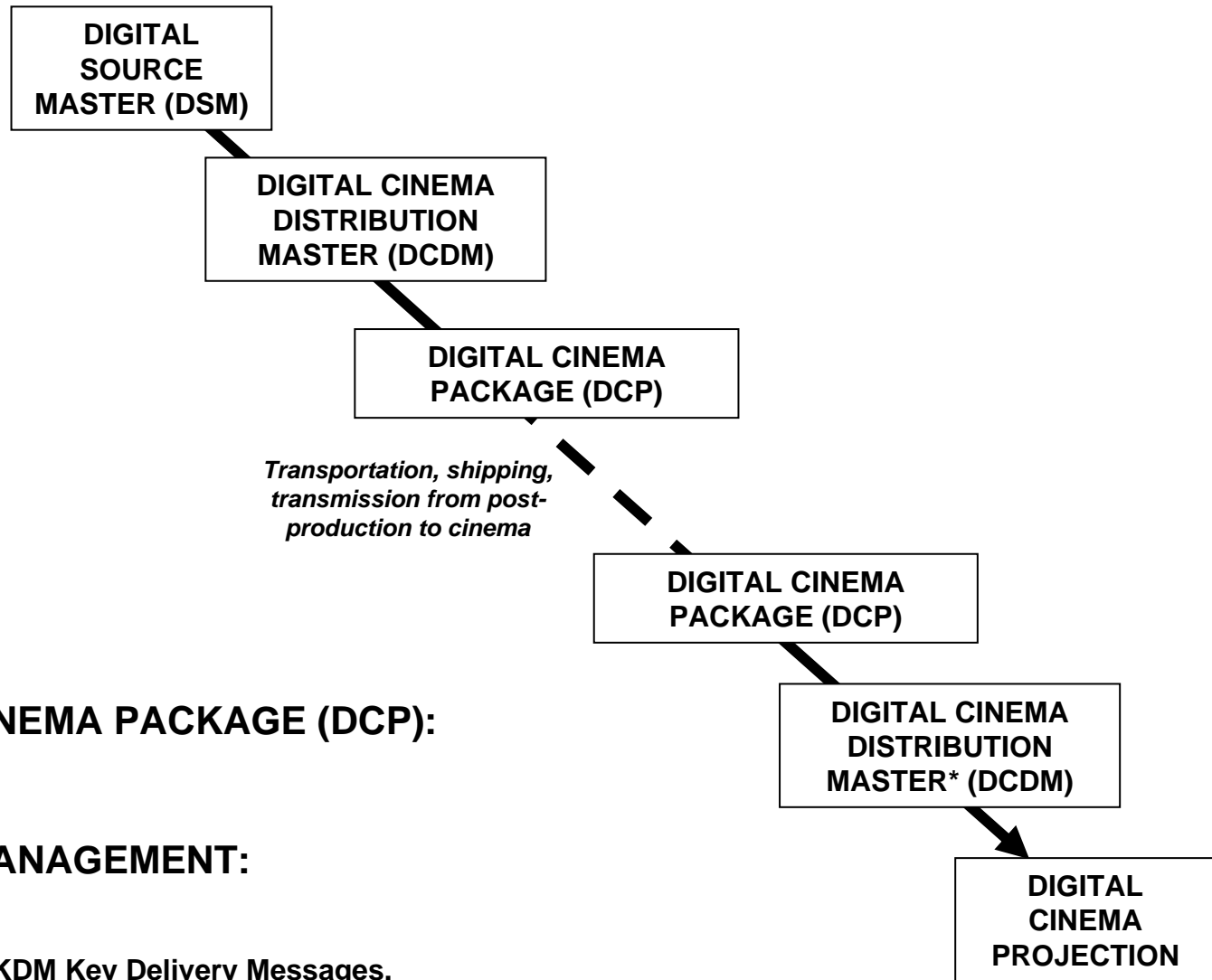
**SOUND:**  
Up to 16 channels  
24bit, 48 or 96Hz  
Uncompressed

## DIGITAL CINEMA PACKAGE (DCP):

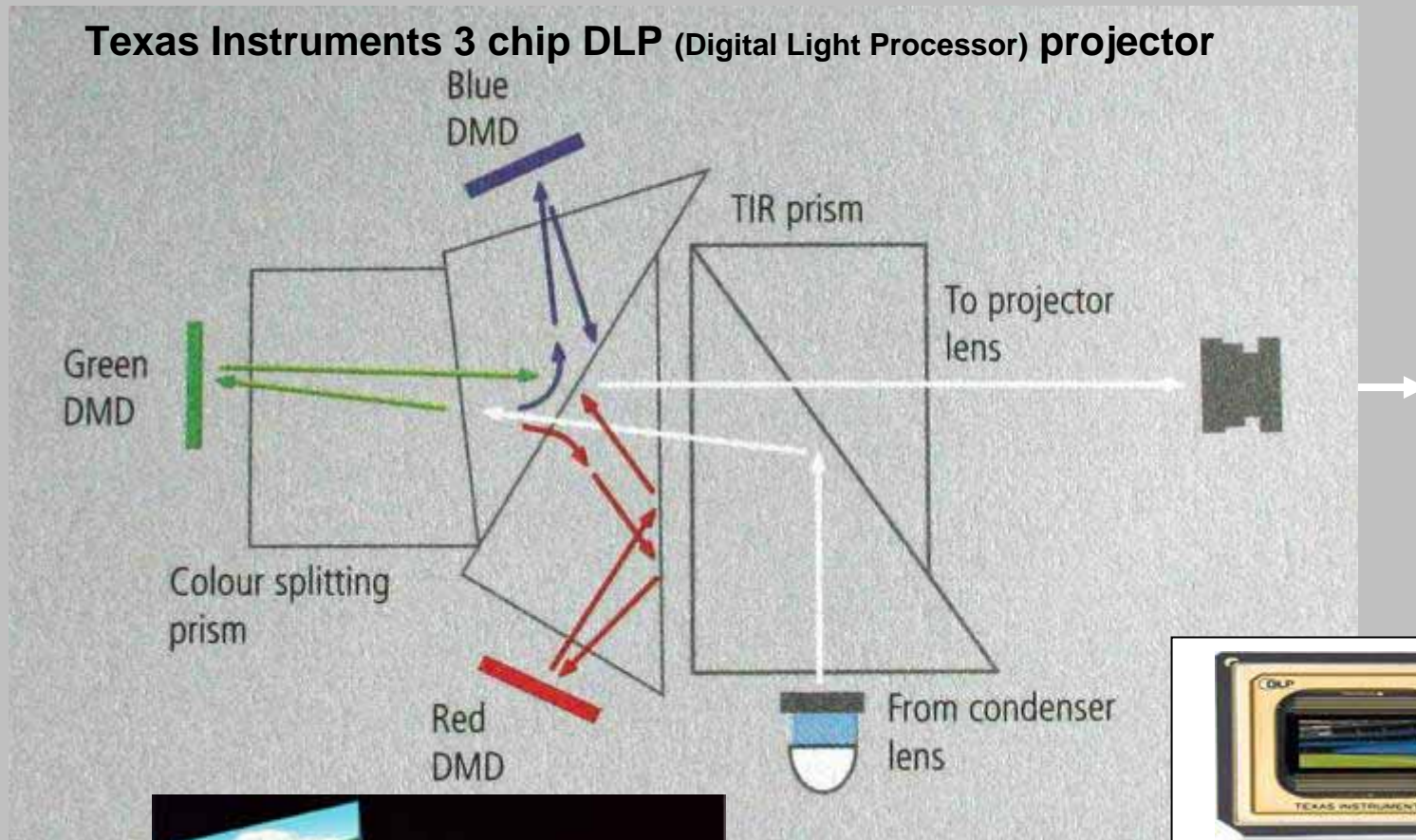
Created with MXF & XML

## ACCESS MANAGEMENT:

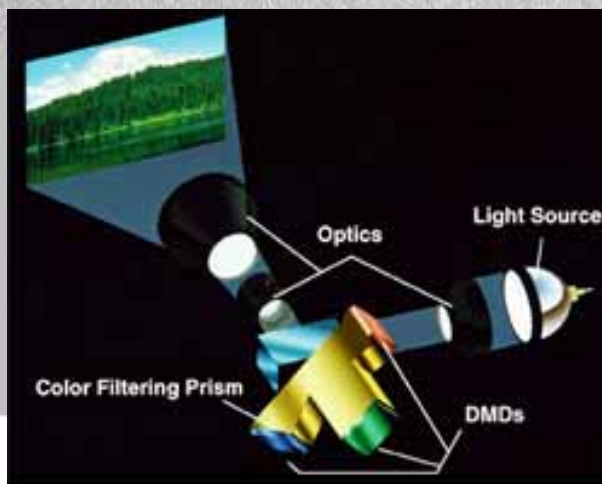
Optional encryption.  
Optional access control by KDM Key Delivery Messages.  
Optional access restriction to specific screens, dates, times and lifetime.



## Texas Instruments 3 chip DLP (Digital Light Processor) projector



**Texas Instruments DMD**  
(Digital Micro-Mirror Devices,  
2048x1080).



# WHAT IS A CINEMA **FILM** IMAGE?

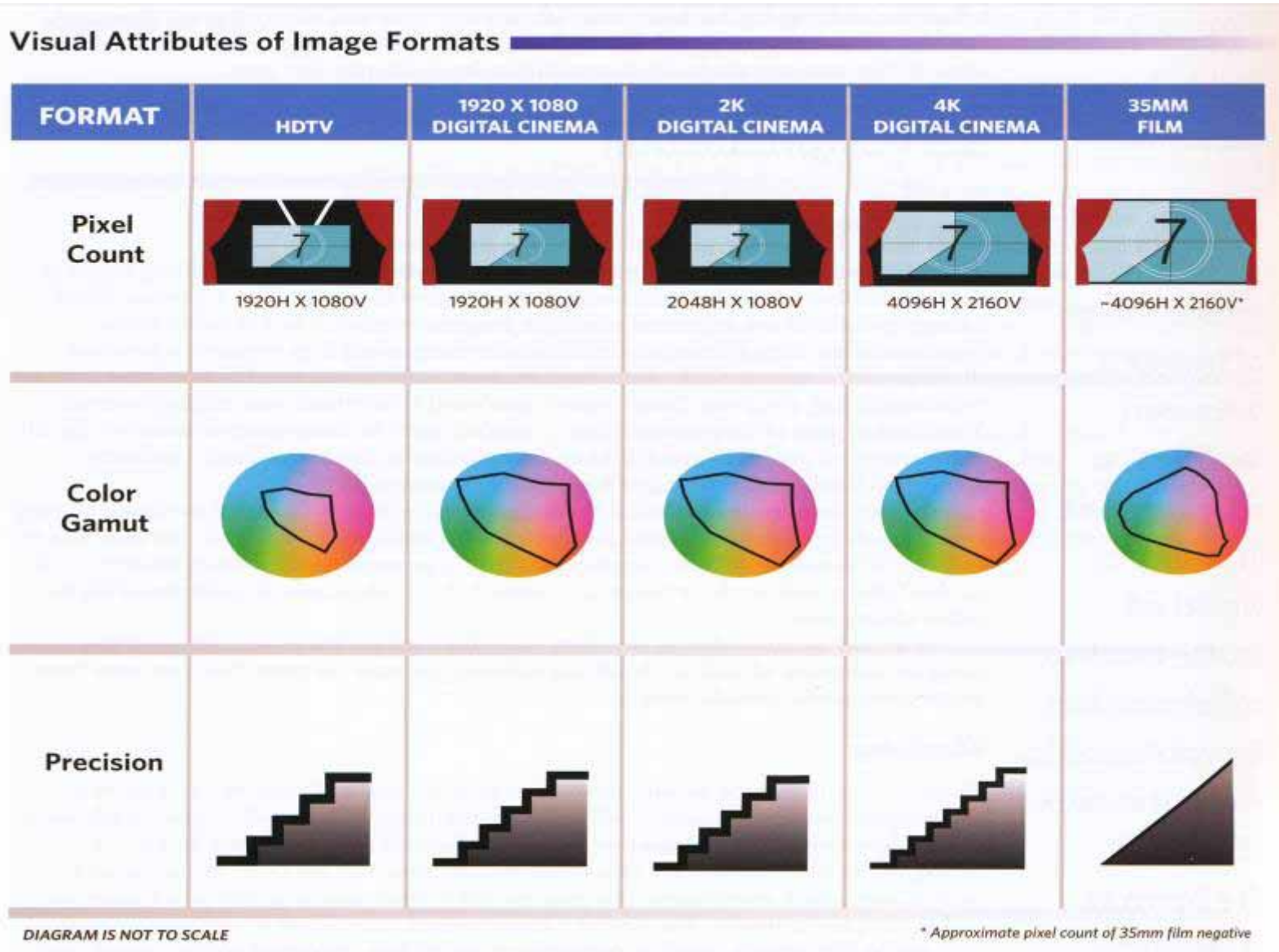
- 16, 18, 20, 16-24, 24, 25, 32, or 48 frames a second (& even 19 & 26fps!)
- Black interval between frames (up to 40% of screen time)
- Dark room
- Screen brightness range 1,000,000:1 (Density range 0.10 - 4.00)
- *And other characters*
- **The finest detail the eye can separate is 1second of arc  
(about 23M separate images across our normal field of view of 135 degrees)**
- **This roughly equals 3,000 pixels across a cinema screen seen from  
the “best seat” in a cinema**

## **Film archives' principles for film preservation, restoration and access in the cinema: historical accuracy and authenticity.**

- **“Sufficient” resolution to reproduce the film information.**
- **The “appearance” of film, colour gamut and brightness range.**
- **Original aspect ratios**
- **Traditional “common height” projection principles**
- **Original frame rates**



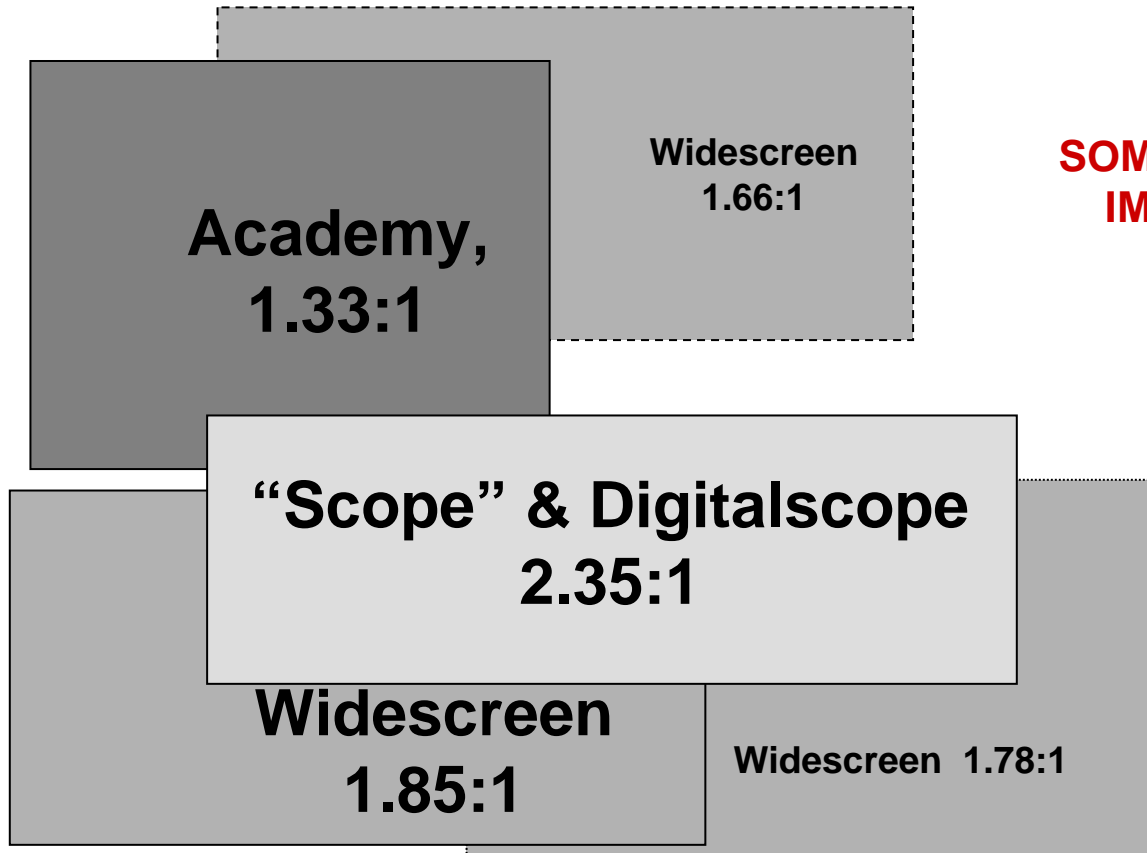
# COLOUR GAMUT



# BRIGHTNESS RANGE

- **B/W Film print density range: 4.20 equivalent to 14 stops.**
- **“Premier” colour film density range: 5.00 equivalent to 17 stops.**
- **No digital projector can achieve this....yet.**
- **Daylight brightness range may be 1,000,000:1 or equivalent to more than 20 stops, a film density range of more than 6.00....or even more.**

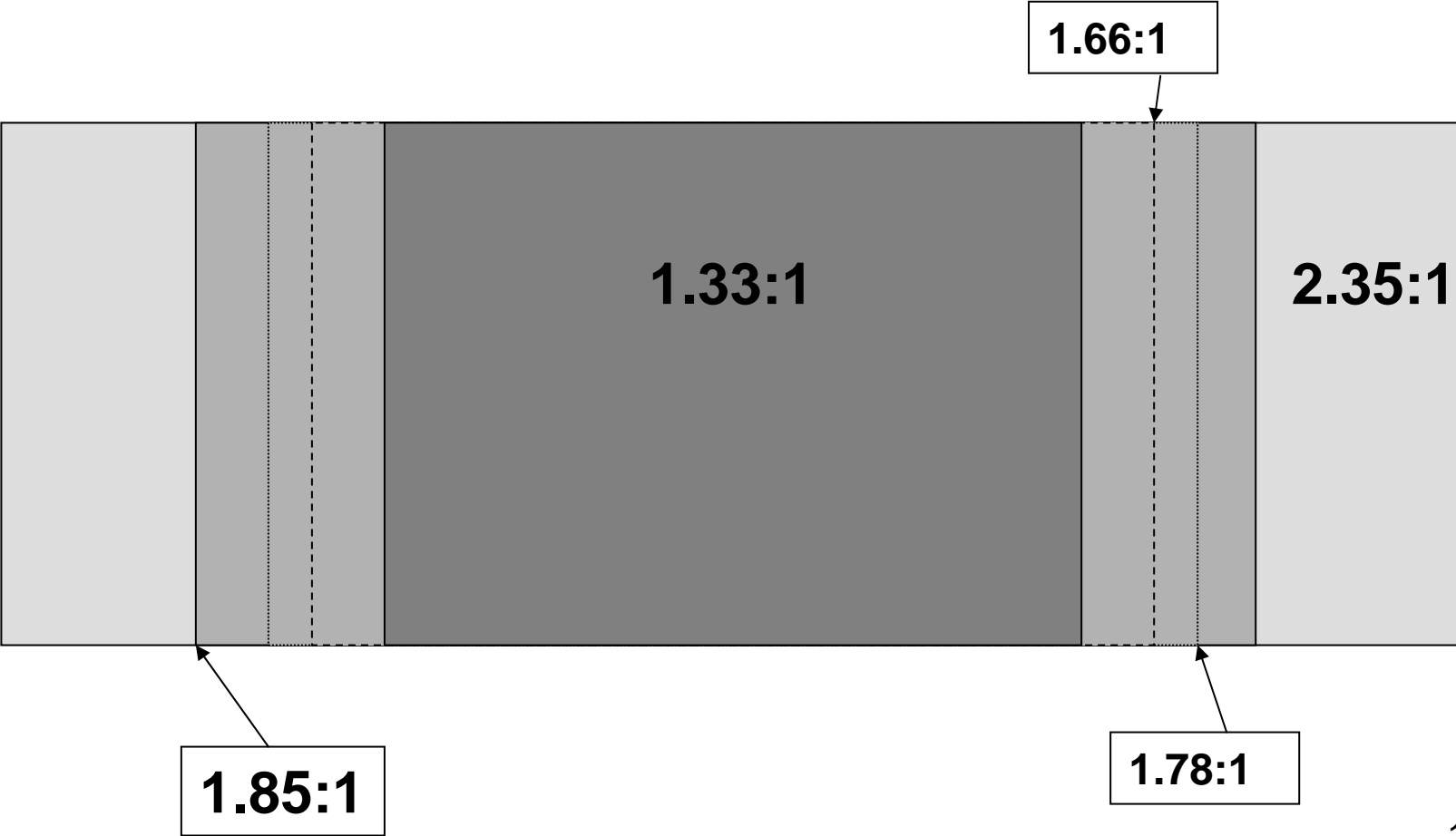
# Original Film Aspect Ratios



**SOME CINEMA FILM  
IMAGE ASPECT  
RATIOS**

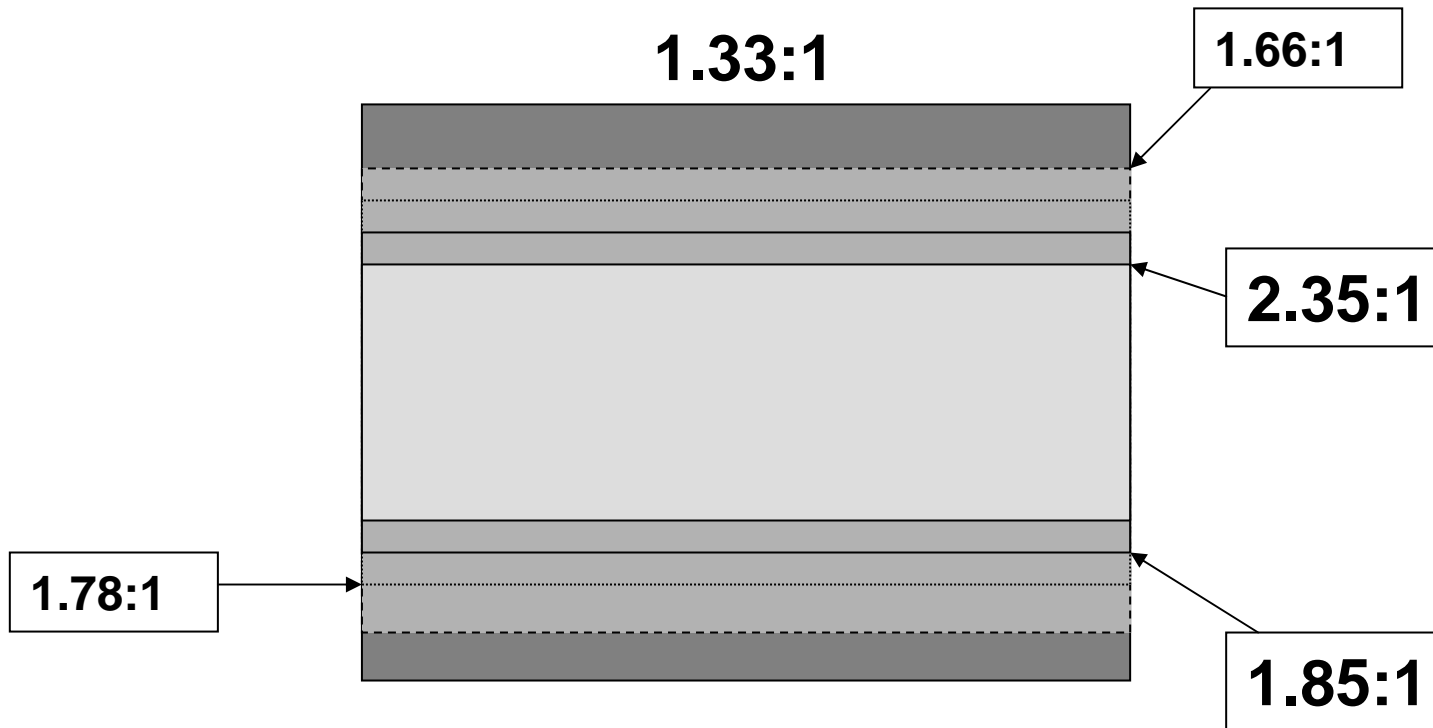
# PROJECTION CONDITIONS

“Common height” projection,  
the traditional cinema principle for multiple formats.



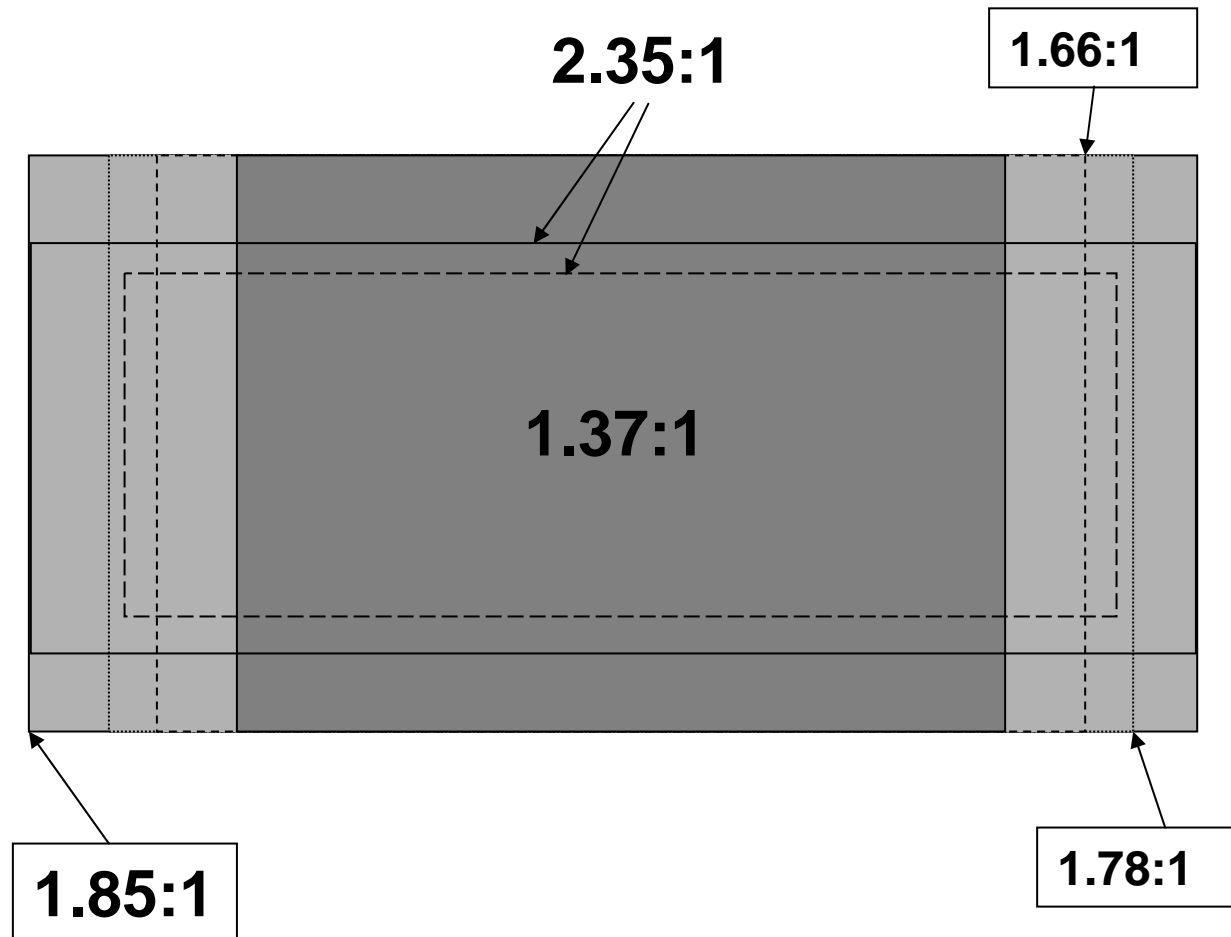
## PROJECTION CONDITIONS

“Common width” projection,  
not traditional - occasionally used where projection  
equipment or screen size is limited, but now in some  
modern multiplexes.



# PROJECTION CONDITIONS

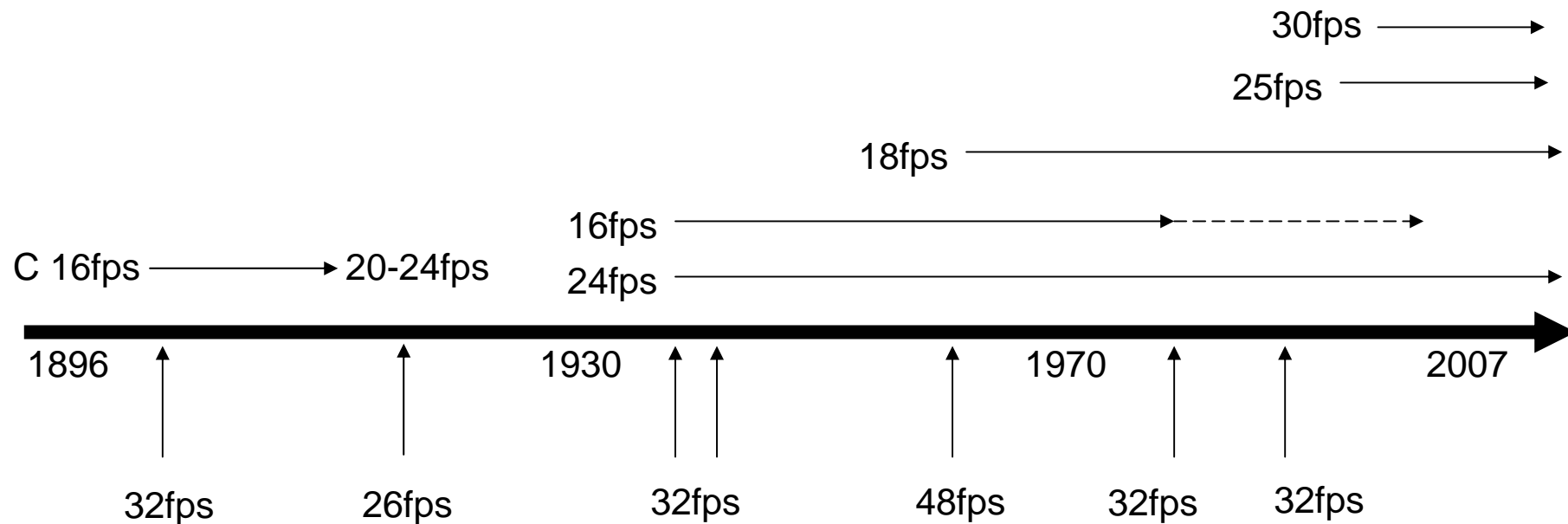
DCI proposals included and allowed, all with different resolutions:



# FRAME RATES

## Original film frame rates up to 2008

“Heritage” frame rates: 16, 18, 20, 22, 24, 20-24, 25, 30, 32, 40, 48, 60 fps (etc!)



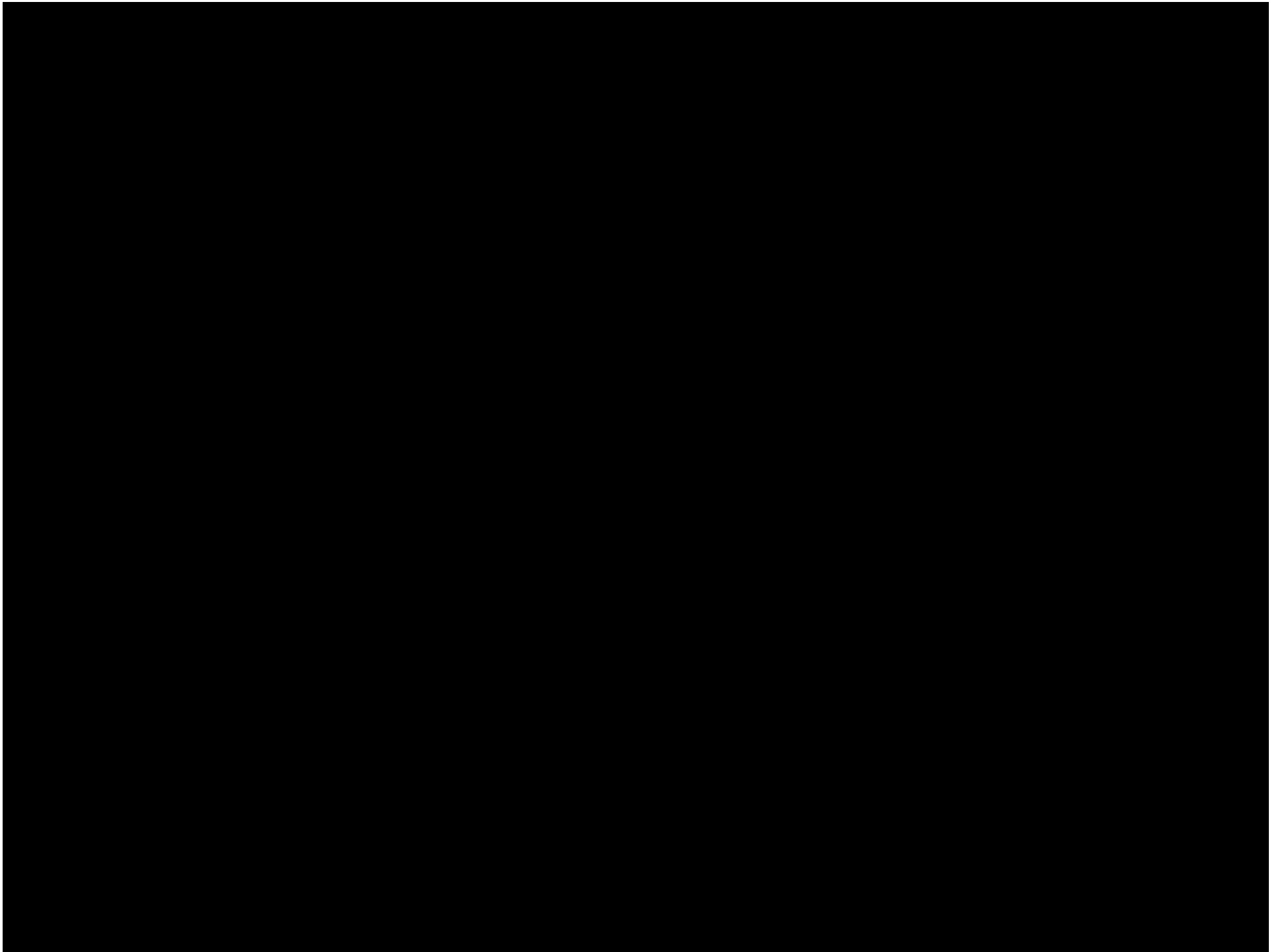
**March 2007:**

The FIAF Technical Commission presented a case to SMPTE to retain all heritage frame rates for digital cinema projection of content originating from archive film.

# Digital projection of archive film SUMMARY

- DCI in 2005 proposed a narrow specification that is unsuited to authentic projection of a wide range of archive film.
- However by June 2009, only two principle problems for film archives still exist in the SMPTE D-cinema standard:
  - The traditional screening practice for multiple format programmes in cinemas
  - Projection of lower than 24 frames per second film.





# digital test bed

at the national  
film theatre 



## DCI - cinema specification - SUMMARY.

- **Open access files format, JPEG2000.**
- **Projected resolutions of 2K or 4K (pixels per horizontal line) only.**
- **Fixed and restricted frame rates – to 24, or 48fps.**
- **1.85: 1 “native” Aspect Ratio – other aspect ratios fit inside this “frame”.**
- **‘Common width’ projection “preferred”.....?**
- **Encrypted digital cinema package (DCP), optional, but required by major US studios.**
- **KEY required to access DCP, optional, but required by major US studios.**
- **Limitation on “life” of DCP, optional, but required by major US studios.**
- **Invoicing mechanism inbuilt to DCP, optional, but required by major US studios.**
- **DCI → SMPTE → ASA → ISO**