



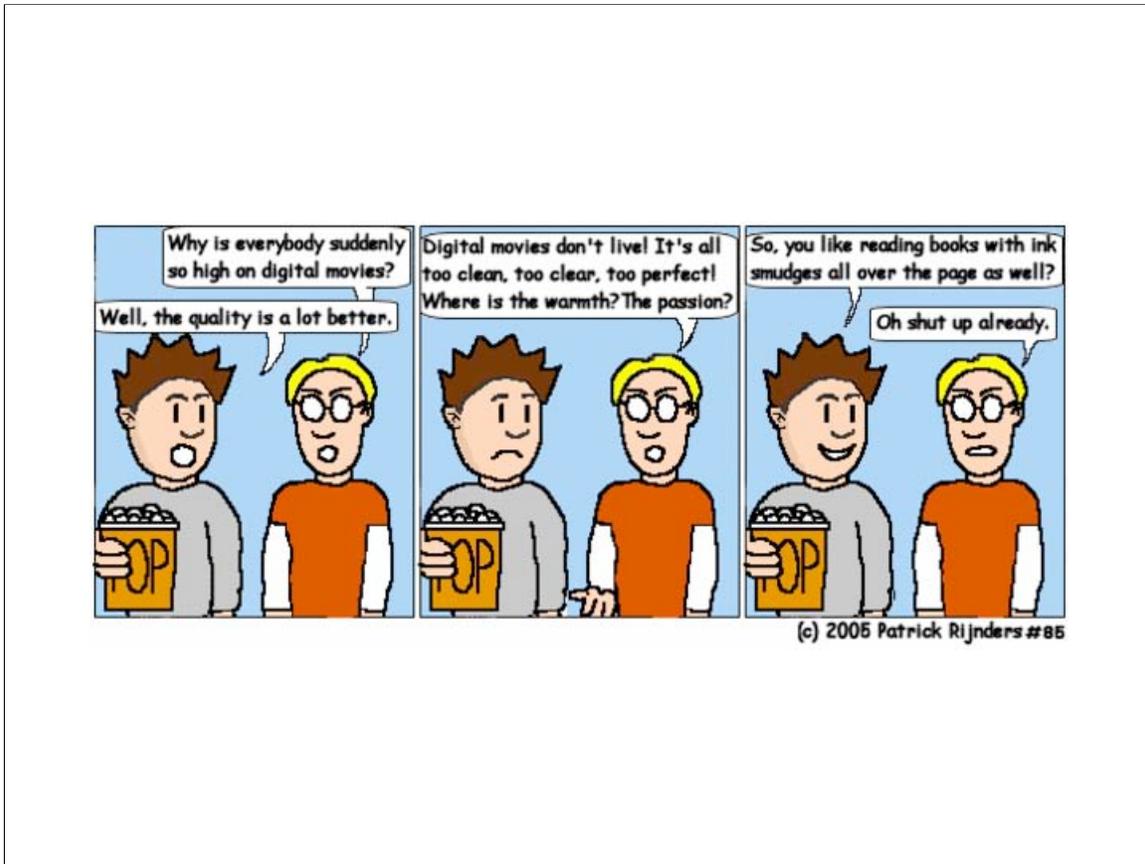
Universal Pictures D-Cinema: “Serenity” DCP and *Trailers*

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Good afternoon everyone! I’m Wade Hanniball and I work in Universal Pictures’ Technology Office.

Under Jerry Pierce’s tutelage, my responsibilities include the studio’s technical and operational implementation of d-cinema distribution. I work with teams in post production, marketing, distribution, exhibitor relations and IT - about 50 people so far - managing our digital-in-addition-to-film transition.

As a test of d-cinema workflow, using our feature “Serenity”, we prepared one of the first studio feature Digital Cinema Packages (a DCP) that followed as closely as possible the Digital Cinema Initiatives (DCI) Specification. I’m going to talk about that experience, but I’m also going to talk about *trailers* in a d-cinema world.



Universal is very supportive of digital cinema. Honestly, we hope to ultimately save millions of dollars a year with it.

We're a signatory to both the Christie/Access IT rollout and the Technicolor rollout.

Beginning in March, we expect to release 60-75% of our theatrical features in d-cinema for the remainder of 2006. In 2007 and thereafter, that will increase to 85-90%. We are committed.

DCI DCP

- Universal will release DCI DCPs (only)

- Image
 - JPEG 2000
 - X'Y'Z' color, 12 bit, 4:4:4
 - 2K container (2048x1080)
 - 24 and 48 fps progressive
- Audio
 - PCM, 48 kHz, 24 bit
 - 5.1
- Subtitles
 - .PNG (not Timed Text)
- AES Encryption
 - Image, Audio, (Subtitles?)
 - Key Delivery Messages (KDMs)
- MXF Packaging
 - Packaged by Reels
 - Single DCP with Multiple Composition Play Lists (CPLs)
- Forensic Marking
 - Image and Audio
- Logging & Report Data

What have we committed ourselves to deliver?

It should come as no surprise that we will deliver DCI DCPs.

What does that mean?

In truncated form, it means all these things and more. This list is an extraction from the DCI Specification to show what Universal views as important.

Initially, we thought there might need to be interim deliveries of MPEG d-cinema releases, but manufacturers are quickly incorporating JPEG2000, so Universal will move directly to 2K deliveries of JPEG2000 content.

We have no plans to support existing MPEG and 1.3K server/projector installations. We also have no plans for 4K image deliveries (nor 96 kHz audio for that matter).



With these requirements in mind, in August 2005 we spoke with a number of vendors about creating a DCI DCP of “Serenity”, a sci-fi action-adventure that was to open with traditional film prints on September 30th.

Creating a DCI DCP with Serenity was a test case and the d-cinema version was *not* released commercially. Its one and only public d-cinema screening was at the ETC Digital Cinema Lab on November 7th.

We found that most vendors were not ready to attempt a DCI DCP last August, many have that capability today. To their credit Fotokem and Doremi were ready to undertake this exercise and, with Christie providing projector capability, they were engaged to undertake the project. I’m indebted to Camille Rizko at Doremi, Paul Chapman & Bill Schultz at FotoKem, and Brian Claypool at Christie for a successful outcome.

The project was greenlit the last week of August and the necessary equipment was in place at FotoKem about September 6th. A deadline for completion was set at September 23rd, a little over two weeks later. (I hope I get two weeks to make feature DCPs, but I won’t count on it!)

“Serenity” DCP Processing

- Captured on Super 35mm
 - Scanned at 2048x1556 full aperture
- Released in “Scope” format
 - 1:2.39 aspect ratio
- Running time: 2 hours 23 seconds
- Processing done on a reel by reel basis
- DI DPX to TIFF to JPEG2000 conversion

What was done?

Serenity was a scope feature, captured on Super35. FotoKem had done the Digital Intermediate, scanning the Super35 at full aperture, 2048x1556.

FotoKem designed a hardware & software pipeline for making the conversion into XYZ color space. Accessing the DI 10-bit .DPX files, a custom 3-D Color Look-Up Table was applied, and a conversion was made to 16-bit TIFF containing the 12-bit XYZ data.

FotoKem then delivered those approximately 132,000 TIFF files, each representing one frame, to the Doremi Mastering Station. There they were converted to JPEG2000 files and wrapped with the audio into an encrypted Media eXchange Format (MXF) file, thus creating the DCP.

“Serenity” DCP Results

- 2048x872 (1:2.35) picture in 2048x1080 container
 - Error: should have been 2048x858 (1:2.39) release format
- JPEG2000 VBR encoding
 - 190 Mb/s average, 220 Mb/s peak
- Added second 5.1 French language soundtrack
- Added PNG Spanish subtitles (1700x125)
- Total DCP package size: 186 GB
- Single DCP, Multiple CPLs
 - Image with 5.1 English audio
 - Image with 5.1 English audio and Spanish subtitles
 - Image with 5.1 French audio, etc.

The final outcome?

A 2048x872 picture in a 2048x1080 container. (My mistake, it should have been 2048x858. Camera aperture vs. projector aperture strikes again. But what’s a few pixels among friends?)

The JPEG2000 was variable bit rate encoded averaging 190 megabits/second, with peaks of 220 megabits/second. We had no reason to constrain the encoding, but similar qualitative results could probably be reached at lower rates.

After meeting the September 23rd deadline with image and English audio, we added a French soundtrack and Spanish subtitles to more closely approximate a North American distribution DCP. It’s worth noting that Universal will provide PNG subtitles and not timed text subtitles.

“Serenity” DCP Interoperability

- Encrypted DCI DCP and KDM provided to:
- Access IT
- Christie Digital
- Dolby Labs
- Doremi Labs
- Eastman Kodak
- Fotokem
- Grass Valley / Technicolor
- NEC
- QuVis
- Sony Electronics
- Texas Instruments

Which leads me to another primary reason for creating the Serenity DCI DCP - interoperability testing between manufacturers.

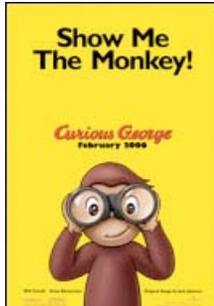
The encrypted Serenity DCI DCP and a Key Delivery Message has been provided as test material to a dozen companies with a single purpose in mind - can you play it?

And I'm pleased to say, they can. (Mostly. PNGs can be pesky.)

There have been some glitches and gotchas in obtaining this interoperability - bad headers and bad certificates come to mind - but after minimal finger-pointing and verification, these manufacturers are able to playback the various Serenity CPLs. This bodes well for having DCI DCP interchange match the interoperability performance of 35mm film.

That's the news on our Serenity DCP.

Universal's DCI DCP Trailers



Now please indulge me while I go off-topic of the Serenity DCP to talk about d-cinema trailers. We've been seriously working d-cinema trailer issues at Universal and have a few ideas to share.

Trailers are an interesting d-cinema challenge. They're a microcosm of all the DCI fulfillment concerns, with some unique twists.

They have to go everywhere, generally to all theaters, just in case an exhibitor wants to use yours. They're short, but there's lots of them, for each feature usually a teaser, then a trailer, then another trailer, then maybe another - trailers highlighting reviews or awards, etc.

Unlike features, Universal will not encrypt its trailers. We want them to be readily usable at any time without the need for a key delivery.

And if you think the turnaround time for a feature DCP is going to be hard, wait until you try trailers. Two weeks? Try two days!

1.85 & 2.39 Trailers

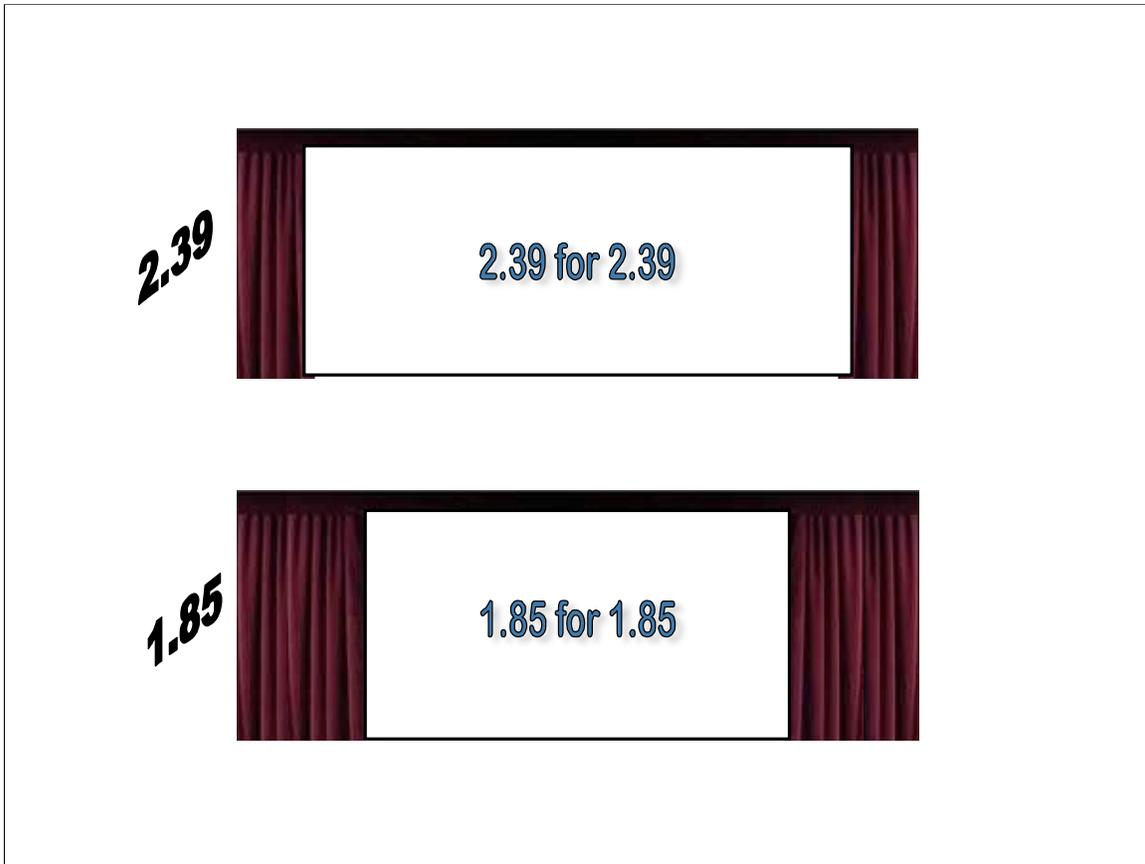
TITLE	FEATURE ASPECT RATIO	TRAILER 1.85 VERSION	TRAILER 2.39 VERSION
THE INSIDE MAN	2.35	2.39 FOR 1.85	2.39 FOR 2.39
CURIOUS GEORGE	1.85	1.85 FOR 1.85	1.85 FOR 2.39

Trailers have to be played in front of features that are flat or scope, so two versions of each trailer must be created, a 1.85 version and a 2.39 version.

A few examples will help make this point clearer.

The Inside Man is a 2.35 feature, so the 2.39 trailer is straightforward. But those same 2.39 feature elements have to be used to make a 1.85 trailer suitable for attaching to a 1.85 feature. I call that “2.39 for 1.85”.

Curious George is a 1.85 feature, so the reverse occurs. The 1.85 trailer is straightforward, but the 1.85 feature elements are used to make a 2.39 trailer suitable for attaching to a 2.39 feature. Call that “1.85 for 2.39”.



Let's visualize this.

Here's a representation of a theater masked for 1.85 and 2.39 presentation, in this case using common height.

The 2.39 for 2.39 and the 1.85 for 1.85 trailers are matches to the screen aspect ratios. No problem there.



But what about the 1.85 for 2.39's and the 2.39 for 1.85's? Well, how are they made to work in film today? By using letterboxing and pillarboxing. And the same will work in d-cinema, but there's an issue to be aware of: the numbers. And standardizing those numbers.




- 2K DCP Container
 - 2048x1080
- 2.39 Feature Trailers:
 - 2.39 for 2.39 @ 2048x858
 - 1.85 for 2.39 @ 1588x858
- 1.85 Feature Trailers:
 - 1.85 for 1.85 @ 1998x1080
 - 2.39 for 1.85 @ 1998x836

In d-cinema, we want to maximize the utilization of the projector imager, which for 2K is 2048x1080. (I'm only giving 2K math.)

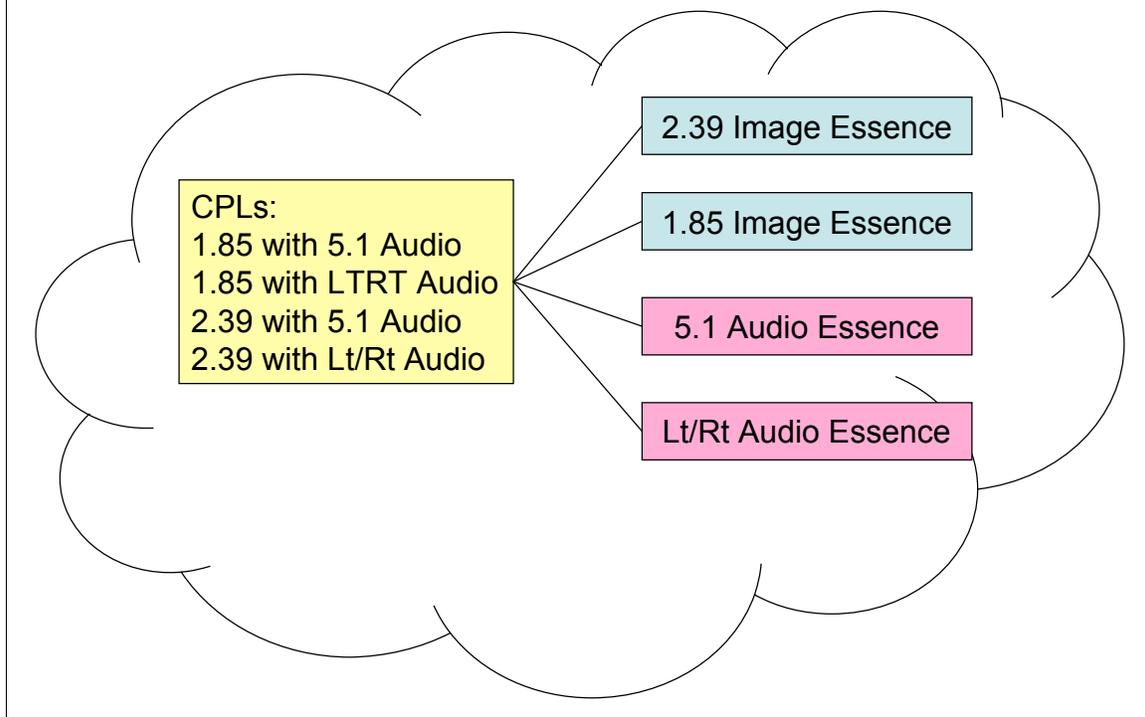
Well, 2048x1080 is neither a 2.39 nor a 1.85 aspect ratio, it's 1.89629 something.

In practice, 2.39 maximizes utilization in the horizontal (**2048**x858) and 1.85 in the vertical (1998x**1080**).

The 1.85 for 2.39 and the 2.39 for 1.85 trailers have to fit within these maximum utilization numbers. Hence, 1588x858 (accommodating the pillarboxing) and 1998x836 (accommodating the letterboxing).

It's Universal's intent to standardize on these numbers for our trailers.

Universal's DCI DCP Trailers



Using the foregoing numbers, Universal is packaging a trailer in a single DCP that contains both of the appropriate 2.39 and 1.85 images, a single matching 5.1 audio for both, as well as a single matching LT/RT audio. There will be four CPLs to call out the four possible versions an exhibitor might wish to utilize.

We've made a few. When we're lucky, the DCP fits on a recordable DVD-5. Or you might have to go to recordable DVD-9.

We think this is a useful and efficient approach to trailer DCP packaging. It's our current plan for distributing DCI DCP Trailers. We thought you might like to know.

That's my presentation. Thank you for your attention.