


Issue 2 • September 2006

 **B•K•S•T•S The Moving Image Society**

# TDP

## TRAINING FOR DIGITAL PROJECTION

A REFERENCE GUIDE  
TO DIGITAL CINEMA

**CELEBRATING  
75 YEARS**  
of service to our industry



**BKSTS  
THE MOVING  
IMAGE SOCIETY  
1931 - 2006**



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**A supplement to Cinema Technology  
The leading specialist publication for cinema industry professionals**

**BKSTS****THE MOVING IMAGE SOCIETY**

The Society exists to encourage, sustain, educate, train and provide a focus for all those who are creatively or technologically involved in the business of providing moving images and associated sound in any form and through any media. The BKSTS works to maintain standards and to encourage the pursuit of excellence in all aspects of moving image and associated sound technology, in the UK and throughout the world. The Society is independent of all governments and commercial organisations.



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*Enquiries regarding Sponsor Membership of the BKSTS should be addressed to:*

**Wendy Laybourn**, Director, BKSTS - Moving Image Society,  
G Block, Suite 104, Pinewood Studios, Iver Heath, Bucks SL0 0NH, UK  
T: +44 (0)1753 656656 F: +44 (0)1753 657016 e: info@bksts.com www.bksts.com

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**Publisher BKSTS - The Moving Image Society**

Pinewood Studios, Iver Heath, Bucks SL0 0NH, UK

T: +44 (0)1753 656656 F: +44 (0)1753 657016 e: info@bksts.com www.bksts.com

**Editorial Jim Slater, Managing Editor**

17 Winterslow Road, Porton, Salisbury, Wiltshire, SP4 0LW, UK

T: +44 (0) 1980 610544 F: +44 (0) 1980 590611 e: Jim.Slater@SlaterElectronics.com

**Advertising****Bob Cavanagh, Advertising Manager**

Kelsall, Potterne Road, Devizes, Wiltshire, SN10 5DD, UK

T/F: +44 (0) 1380 724 357 M: 07854 235280 e: visionplus@onetel.com

**Design / Production****Bob Cavanagh,**

Visionplus, Kelsall, Potterne Road, Devizes, Wiltshire, SN10 5DD, UK

T/F: +44 (0) 1380 724 357 e: visionplus@onetel.com

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**On the cover:**

*A Barco DP100 Digital Cinema projector with a complete  
Dolby Digital Cinema installation, at the Odeon Cinema,  
Wimbledon. The equipment includes Disney Digital Cinema  
3-D facilities, and was installed by Bell Theatre Systems.*

# Digital newsreel...Digital newsreel...Digital newsreel...

## DSN - PHASE 2 ROLLOUT BEGINS

As TDP went to Press the following new screens had been added to the Digital Screen Network since we listed the first fifty in the previous issue.

Arts Picturehouse Cambridge Screen 1  
Arts Picturehouse Cambridge Screen 2  
Cineworld Birmingham Broad Street Screen 10  
Cineworld Birmingham Broad Street Screen 12  
Cineworld Braintree Screen 2  
Cineworld Burton on Trent Screen 4  
Cineworld Ipswich Screen 1  
Cineworld West India Quay Screen 3  
Parkway Cinema Cleethorpes Screen 3  
Pictureville Bradford Screen 1

## 50TH MOVIE SHOWN ON UKFC DIGITAL SCREEN NETWORK

On July 7th 2006, Momentum Pictures' 'District 13' had the distinction of opening as the 50th feature film to have been shown on the UK Film Council's Digital Screen Network. This digital cinema landmark reflects the growing popularity of the UK Digital Screen Network and demonstrates the proven reliability of digital content preparation and distribution. Since the beginning of the rollout in October 2005, over 11,000 digital shows have been played on the network.

Recent titles shown on the DSN include: The Wild (Buena Vista), Hard Candy (Lionsgate), Over the Hedge (UIP), Cave of the Yellow Dog (Tartan Films), A Throw of the Dice (BFI), Adrift (Pathé), Walmart – The High Cost of Low Price (Tartan), Time to Leave/Le Temps Qui Reste (Artificial Eye), Wah-Wah (Lionsgate), 36 Quai des Orfèvres (Tartan Films) and Love and Hate (Verve Pictures). Upcoming titles



include Pirates of the Caribbean: Dead Man's Chest (Buena Vista), Viva Zapatero (Dogwoof Pictures) and Awesome; I F\*\*kin' Shot That! (Revolver). Pictured above: Byambasuren Davaa on the set of Tartan Films' 'The Cave of the Yellow Dog', released 30 June 2006 and shown on the DSN. Photo Courtesy Tartan Films, Image.net

## JPEG 2000 UPGRADE FOR DSN SITES

Arts Alliance Media (AAM) reached another European digital cinema milestone in June with the announcement that all 50 of the QuVIS servers that it had installed as Phase 1 of the UK Film Council's Digital Screen Network (DSN) have been upgraded to be JPEG2000 compatible. Following this upgrade, the first of a series that will take place as DCI (Digital Cinema Initiatives) standards are formalised, the first JPEG2000 feature release to play on the DSN in JPEG2000 compression format, using MXF packaging and security keys, the format recommended by the DCI, was Disney's 'The Wild'.

## DCI MOVE FORWARD WITH COMPLIANCE TEST PROCEDURE

Digital Cinema Initiatives, LLC (DCI) has the role of establishing and documenting voluntary specifications for an open architecture for digital cinema

that ensures a uniform and high level of technical performance, reliability and quality control. DCI has signed an agreement with the Fraunhofer Institute in Erlangen, Germany to collaborate and jointly produce a certification test plan comprised of test procedures and data to validate compliance with the Digital Cinema system, and is now requesting manufacturers of digital cinema servers and projectors to provide their equipment to the Fraunhofer Institute to be used in the validation of the DCI Certification Test Procedures. The aim is that comprehensive test procedures will establish a certification benchmark for digital cinema projectors, servers, and associated equipment.

Development of the test procedures and data is expected to take place over a four-month period, followed by a three-month period of testing and validation. Once complete, the procedures and data will enable equipment manufacturers to validate their compliance with the Specification and promote interoperability between key digital cinema theatrical equipment components. DCI hopes to encourage an established process to test Specification compliance in order to gain certification of digital cinema equipment. Prospective equipment suppliers must note:

1. No test data whatsoever will be made available to the public, to DCI, or to the individual members comprising DCI.
2. Test data applicable to the specific equipment manufacturer may be made available to that equipment supplier subject to agreement directly with the Fraunhofer Institute.
3. Any testing will not be the basis for any claims of "DCI Compliance." All manufacturers must agree in writing prior to testing that the results of the testing will not be used in any way to represent the suitability of their equipment for any purpose.
4. All equipment shipping,

customs fees, etc. will be borne by the manufacturer.

5. All scheduling is planned to be made and coordinated by the Fraunhofer Institute.
6. For equipment to be considered it must:
  - (a) Have been in commercial service using "JPEG2000 InterOp"; that is, be able to decrypt and display JPEG2000 codestreams in addition to meeting other current industry commercial interoperability requirements,
  - (b) Have FIPS 140-2 Certification in process, and
  - (c) Have a reasonable expectation of being fully DCI Compliant.
7. Equipment provided may or may not be utilized for testing. The resulting certification test plan should promote the worldwide interchangeability of digital movies, just as 35mm film has done over the last hundred years.

## DOLBY JPEG 2000 DIGITAL CINEMA MASTERING FACILITY OPENS

Dolby Laboratories claims that the first European JPEG 2000 digital cinema encode was completed by its European mastering team at Wootton Bassett. Buena Vista International's *Secuestro Express* was mastered, duplicated, and securely distributed by Dolby for commercial release in selected cinemas on the UK Film Council Digital Screen Network, and Dolby provided 24-hour technical support to the cinemas showing the JPEG 2000 movie. The digital cinema mastering facility in Dolby's European headquarters is now fully equipped to master movies in both JPEG 2000 and MPEG compression formats, to securely encrypt and package these movies, and to produce copies for distribution with secure playback key creation and management. The facility, matching that available in

Dolby's Los Angeles office, boasts a state-of-the-art 60-seat screening room for full quality control of all digitally mastered content in a correctly aligned cinema environment.

Dolby is now mastering and distributing digital cinema movies to cinema screens throughout Europe for servers from a variety of manufacturers, utilizing the international standards currently in discussion with the DCI for digital cinema. Graham Edmondson, Film Marketing Manager, Dolby Laboratories, said that this first JPEG 2000 mastering for the UK Film Council Digital Screen Network demonstrates the company's broader commitment to the JPEG 2000 standards, as they gear up to support the industry in its forthcoming transition to meeting Digital Cinema Initiatives specifications. Dolby's digital cinema mastering service in Europe has got off to a great start with the mastering for Secuestro Express, and this highlights just how important open standards are in the business. The Dolby® Digital Cinema system is installed in more than 160 cinemas in 12 countries worldwide including, most recently, new installations in Iceland. More than 40 digital movies have been presented using Dolby Digital Cinema, among them recent and current presentations of Mission: Impossible III, Over the Hedge, Cars, and Pirates of the Caribbean: Dead Man's Chest.

[www.dolby.com](http://www.dolby.com)

## WORLD'S BRIGHTEST SAYS NEC

NEC is claiming that its STARUS NC2500S is the world's brightest DLP Cinema® projector. Designed for multiplexes with large screens 49 feet wide and larger, it delivers 2K (2048 x 1080) resolution and high contrast images (2000:1), and is easy to operate, extremely user friendly, and requires minimal maintenance.

• Contrast ratios of 2000:1 from DMD chips from Texas Instruments.



- STARUS NC2500S digital cinema projectors faithfully reproduce black and white digital cinema and hi-vision input sources, as well as input sources requiring superior colour reproduction and wide gradation.
- One-touch Operation and Memory Functions. There are buttons for the selection of eight stored signals, and a memory functions for lens position and lamp output. The display of different aspect ratios is simplified through pre-set lens shift position, zoom and focus, while maintaining constant screen brightness.
- There is a built-in Web Server, and the projectors can be accessed and controlled from any web browser.
- 3D Presentation using a single projector.
- Minimal Maintenance. The DMD has custom shielding to protect the projectors from dust, oil and smoke.
- Auto Lamp Brightness Control minimises fluctuations that occur during the lifetime of the lamp. The brightness level will not decrease as the lamp is consumed, and the lamp performance is optimised to ensure the brightest and most uniform image possible for the life of the lamp.
- Optional Touch Screen Control
- Compatibility with most standard film projector lamps
- Lamp Replacement can be done simply from the back of the projector, even in a cramped space.

[www.necam.com](http://www.necam.com)

## SONY 4K PROJECTORS FOR NORWEGIAN RESEARCH PROJECT

Sony's new SXR4K ultra high resolution projectors are being used as part of Norway's Digital Interoperability in Cinemas (NORDIC) project. The SRX-R110CE is the latest addition to the Sony CineAlta range of digital cinema equipment and is claimed to be the only projector designed to meet DCI specifications for 4K resolution. Media Block servers will also be installed with each projector as part of an overall digital cinema solution.

Headed by Unique Digital, the largest European provider of digital cinema advertising, NORDIC will pave the way for digital migration in Norway's cinemas and involves leading players in the industry, including the Trondheim-based Norwegian University of Science and Technology. It will look at the impact of moving from 35mm film to file-based distribution and will consider everything from audience response through to operational issues in a multi-screen environment.

Digital cinema development in Norway mirrors a global movie industry migration to digital file-based distribution in line with the standards laid down by the DCI (Digital Cinema Initiatives) consortium. This move brings with it numerous advantages, both for the viewing public and for the industry.

Electronic delivery replaces the costly reproduction and shipping of 35mm film prints. This means they can reach cinemas faster and more cost-effectively, reducing the need for staggered distribution that can result in late film releases in Europe and Asia. Digital files are always duplicated at optimum quality, eliminating



the picture deterioration suffered during film print reproduction. In addition, there is no loss through physical wear and tear because they are distributed electronically.

Faster, more cost-effective digital distribution will also enable cinemas to include a wider range of foreign language and specialist films as well as screen documentaries, pop concerts and sports events. Finally, file encryption means that access to films is also more secure, minimizing the film piracy that costs the industry billions of dollars per year.

Sony claims that the launch of its ultra high resolution projectors is the final piece of the overall digital cinema picture, bringing the benefits of digital technology, already seen in the field of content creation and distribution, to movie projection, giving an unsurpassed viewing experience. Developed 'in accordance with DCI-guidelines', the SRX-R110CE projectors to be installed in cinemas in Oslo, Bergen, Trondheim and Stavanger incorporate silicon reflective display (SXR4K) imaging devices to provide 4K resolution, four times the resolution of 2K high definition television. The high contrast ratio of greater than 1800:1 and brightness of 10,000 lumens, achieved by the use of and twin xenon lamps and a gamma curve of 2.6 should ensure crisp, clear images, and provide high-quality colour tonal reproduction.

The projectors will be supplied with digital content by a dedicated Sony Media Block server as part of a complete digital cinema presentation system.

The NORDIC trial will last for 12 months and involves multiple technology partners. Unique are working closely with Sony to establish a clear path for the rollout of digital cinema across Norway, and Kevin Wakeford, Head of Digital Cinema Business at Sony, who is well-known to many Image Technology readers from his time in the TV business, says that Sony will continue working with the cinema industry to develop solutions for the future.

## NEW KINOTON DIGITAL CINEMA PROJECTORS

Kinoton has introduced a new range of DCP Digital Cinema Projectors. These feature 2K DLP Cinema® components supplied by Barco, and the DCP Digital Cinema Projectors have been especially designed to combine superior light efficiency and image quality with reliability, flexibility and unique suitability in daily use. Their compact design and different design options help to accommodate the DCP projectors in virtually any projection room, whether or not they are used in addition to the existing film projectors. The DCP 70 Projectors (shown here) are the "all-in-one" version, with the 2K DLP Cinema® projection unit, lamphouse, electronic rectifier and cooling system and standard lens mount with (optional) anamorphic lens holder all integrated in one compact console. DCP 70 Digital Cinema Projectors are available as the DCP 70 S for Xenon bulbs up to 3000 W and for screens up to 18 metres / 59 ft. The DCP 70 L is for Xenon bulbs up to 7000 W and for screens up to 25 metres / 82 ft. The DCP 30 Digital Cinema Projectors provide all the features of the DCP 70 projectors, but with a separate console containing the power and cooling system as well as the equipment rack. Their two-part design simplifies transportation and offers additional installation flexibility as the projector head can be mounted separately from the console. DCP 30 Digital Cinema Projectors are available



as the DCP 30 S for Xenon bulbs up to 3000 W and for screens up to 18 metres / 59 ft. The DCP 30 L is for Xenon bulbs up to 7000 W and for screens up to 25 metres / 82 ft.

[www.kinoton.com](http://www.kinoton.com)

## 150 MORE 3D SCREENS FOR REAL D

REAL D, a leader in the delivery of premium digital 3-D experiences, and Cinemark USA, Inc., a major theatrical exhibitor with cinemas in 33 states in the United States and internationally in 13 countries, mainly in Mexico, South and Central America, have announced a landmark deal to equip up to 150 Cinemark Theatres with REAL D Cinema systems for the exhibition of digital 3-D content. Once completed, this deal will enable Cinemark to offer its customers more REAL D Cinema screens than any other exhibitor, positioning Cinemark as the undisputed leader in digital 3 D cinema. This deployment brings the total number of committed REAL D Cinema screens to more than 350 worldwide, the world's largest 3D cinematic footprint. Cinemark feels it is important to bringing REAL D Cinema to audiences on a massive scale, and on completion of this deployment, at least one screen in every Cinemark market could be REAL D Cinema enabled. The rollout has already begun, and 17 screens were installed in time for the REAL D Cinema presentation of Columbia Pictures' MONSTER HOUSE.

[www.REALD.com](http://www.REALD.com)

## 1000 DIGITAL SCREENS FOR CHRISTIE

Christie has announced the installation of its 1,000th Digital Cinema projector, a major milestone in the exhibition community, illustrating the rapid adoption of Digital Cinema that is transforming the movie-viewing experience. The accomplishment includes installations in the United

Kingdom, Germany, Switzerland, Italy, France, the Netherlands, Norway, Spain, Austria, Bulgaria, Africa, Canada, Asia and as of June 30th, more than 500 completed installations in the United States under the Christie/AIX plan in collaboration with Access Integrated Technologies, Inc.

The milestone occurred in the United States at Carmike Cinemas, Inc., the third-largest exhibitor in the U.S., which is using Christie DLP Cinema® projectors exclusively towards its goal of digitising 100% of its screens. Christie, meanwhile, at its current rate of worldwide installations, expects to increase its market share and reach the historic 2,000th installation milestone by the end of 2006 – effectively doubling its current record and further solidifying its leadership in the industry. Christie is especially proud to be the first to reach this milestone because it was only last year that they introduced their innovative Digital Cinema business plan, which has proved to be a very practical solution for the adoption of the technology which has led to the dramatic acceleration in the pace of global installations. Christie were the first licensee of Texas Instruments' revolutionary 3-Chip DLP™ Cinema technology, so it seems only fitting that they should also be the first to break the significant 1,000 screen record.

[www.christiedigital.com](http://www.christiedigital.com)

## BIG CHINESE ORDER FOR BARCO

Digital cinema pioneer Barco and Guangdong Dadi Digital Cinema China Ltd have signed an agreement to roll out digital cinema across Guangdong province in China. Dadi Digital Cinemas will deploy up to 300 digital projectors, of which 100 are ordered today and will be installed over the next 18 months. Guangdong is China's most populous province with over 90 million inhabitants. Guangdong, which borders the Special Administrative Region of Hong Kong, often takes a leading

role in technology deployment and is seen by China watchers as the province where one has to prove a high tech product before taking it across the mainland. With this first large scale commercial roll-out, China, already the world's 2nd largest digital cinema market, has now taken a decisive step towards full digitalization of its over 10,000 cinemas. Like with many other technologies China is leapfrogging the rest of the world.

Barco, which has enjoyed almost 100% market share in digital cinema in China over the last 2 years, strengthens its position in the Chinese market with this agreement. Over the last years Barco has been working closely with China's CFG, Sino-I and Dadi Digital Cinemas to develop its series of 2k digital cinema projectors, based on DLP Cinema™ technology of Texas Instruments. The new agreement also involves the build out of a 24/7 support network and Network Operations Centers. Dadi digital cinemas is aiming to build the first fully DCI compliant digital cinema chain and speed up the digital cinema development in China, working with Barco, who will be expanding its offices in Guangdong province to support the rollout. With 300 staff in Greater China today Barco is clearly the most committed player in the China market, having gone beyond simple sales and distribution and started full R&D and manufacturing at its Changping facilities. Barco expects to continue to build on this local strength in the years to come.

## DTS DIGITAL CINEMA ENCODER™

The DTS Digital Cinema Encoder™ provides "Constant Quality" encoding for D-Cinema presentation, using JPEG2000 image compression with DTS Variable Bit Rate™ (DTS-VBR) encoding, to produce the highest quality images for D-Cinema, with file sizes up to 50 percent smaller than competing systems. The DTS encoder was

developed in conjunction with Dr. Michael Marcellin, an expert in JPEG2000 image coding technologies and an advisor to Digital Cinema Initiatives. The DTS Digital Cinema Encoder can achieve any desired bit rate or distribution file size, while maintaining constant image quality compliant with DCI standards. Encodes are optimized through the use of a DTS-VBR implementation of JPEG2000, which makes the most efficient use of the available bit budget, and produces the highest quality images for D-Cinema exhibition. Complex or difficult frames are encoded with a higher bit rate, and easy frames are encoded at a lower bit rate to maintain quality, optimizing the image quality of the entire motion picture or individual reels. By comparison, competing systems employ Constant Bit Rate encoding (CBR), simply assigning a fixed maximum bit rate for each frame, often with mixed results, particularly in frames containing complex moving images. D-Cinema duplication time and distribution costs are important factors in its commercial success, and DTS claims that in tests a digital film encoded at 150 Mbps using VBR encoding produced the same quality as a digital film encoded at 250 Mbps using CBR encoding, and that the VBR could be reduced still further while maintaining the highest quality images. VBR encoding gives excellent temporal rate control with no image lag or flicker, which is essential for films that contain fast action. CBR encoding has virtually no temporal rate control for film frames with motion, resulting in possible image distortion. The DTS Digital Cinema Encoder also provides efficient encoding of extra materials, such as replacement frames or watermarked frames. It supports 2k and 4k resolutions, and is scalable for higher or lower resolutions. The encoding system is available either as part of a turn-key hardware solution, or as a custom software installation.

## KODAK TO EXPAND GLOBAL DIGITAL CINEMA 3D INSTALLATIONS

Kodak Digital Cinema is helping to deliver the screams being heard from Columbia Pictures' animated "Monster House" now playing in 3-D. Over the past several weeks, Kodak installation teams have been at work in nine states and Canada, and soon they'll be in Australia and Singapore, providing fully networked digital cinema 3-D systems on 27 multiplex screens of eight different exhibition chains.

"Monster House" opened in the US and Canada at the end of July; it opens in other parts of the world later this year. Most Kodak installations will be in advance of the release.

This is the next stage in a market-tested model Kodak initiated six months ago to roll out digital 3-D cinema, beginning with multiple screens throughout Australia. The company is handling all installation, service and support and providing packaging, preparation, and delivery of all feature content for the Kodak systems. This system includes Barco's highly-reliable cinema projectors and the industry-leading REAL D Cinema system, all driven by Kodak's fully networked Digital Cinema Operating System (DCOS).

"We designed our system from the exhibitor's point of view," says Bob Mayson, general manager and vice president, Kodak Digital Motion Imaging. "This is a great 3-D solution, but it goes far beyond that to handle a full cinema presentation, from digital pre-show through studio feature. It's complete, flexible, and ready for exhibitors' needs on a worldwide basis."

In fact, the Kodak-prepared and -delivered hard drives containing "Monster House" in 3-D also have several trailers in 2-D. "They play seamlessly," Mayson says. "Our system can handle any mix of 2-D and 3-D, in either MPEG or JPEG, with a pre-show or not."

## DTS TO WORK WITH AVICA TO EXTEND ITS REACH INTO DIGITAL CINEMA

DTS has entered into an exclusive licensing agreement with Avica Technology Corporation, a well-known name in the digital cinema market. The agreement provides DTS with exclusive global rights to exploit Avica's suite of technologies, products and services, and is expected to enable DTS to make better use of its existing technologies, including the recently completed acquisition of the Digital Booking Systems software, to position itself more aggressively in the emerging Digital Cinema market. The agreement with Avica is expected to significantly accelerate DTS' entry into the digital cinema market, and the addition of Avica's technology and product suite to DTS' existing cinema and digital images offerings will provide solutions for content creators, distributors and exhibitors as the world adopts digital content distribution and exhibition platforms.

## NO MORE SILVER SCREENS AS DOLBY® DIGITAL CINEMA ADOPTS NEW 3-D TECHNOLOGY

Dolby Laboratories has signed an agreement with Infitec GmbH, a German-based provider of virtual reality 3-D technologies, to develop a new 3-D system specifically for digital cinema. The new 3-D technology will provide exhibitors with a 3-D solution for digital cinema that offers superb quality as well as operational flexibility, with a system that is easily integrated into any Dolby® Digital Cinema system. Infitec's developments in 3-D technology will enable the



system to project a 3-D image directly on to the exhibitors' existing white screens, without the need for a special silver screen. Currently, this is possible only by using expensive, battery-powered glasses. Dolby's solution will eliminate the need for battery-powered glasses but will use the lightweight, comfortable glasses to which audiences are becoming accustomed.

Recent 3-D digital movie releases have demonstrated considerable audience demand, and Tim Partridge from Dolby says that per-screen attendances for 3-D digital screens have been more than double those of traditional showings, which is why the company believes that combining the 3-D experience with the Dolby Digital Cinema solution will be a win-win proposition for exhibitors and moviegoers.

Dolby's new 3-D technology is expected to be available in spring 2007.

*Photo Credit: Sony Pictures Imageworks*

*Copyright: © 2006 Columbia Pictures Industries, Inc.*

*Courtesy: PA PicSelect*

## BKSTS AT IBC

This year's IBC at Amsterdam's RAI Convention Centre 7 - 12 September, promises to be the biggest yet for cinema, and particularly digital interested parties, with whole day sessions dedicated to latest, and future, developments. Visit the IBC web site - [www.ibc.org](http://www.ibc.org) - to register and see the latest schedule. BKSTS will be there - **stand number 8.296** - with the full package of wall charts, and there are some new ones, help and advice and much more. For details visit:

[www.bksts.com](http://www.bksts.com)  
[info@bksts.com](mailto:info@bksts.com)

# Training for digital projection takes off



The National Film Theatre in London will be the base for a major new programme aimed at training projectionists to work with digital material of all kinds, not just cinema films.

**The National Film Theatre Technical Department has been successful with its Skill-set application to provide digital cinema multimedia box training to approximately 400 projectionists across the UK. This training initiative follows on from the work of the Digital Test Bed (DTB), which has been testing digital cinema technology through industry events and seminars as well as a public programme at the National Film Theatre for the past three years. This new training initiative is a direct response to the roll out of the UK Film Council's Digital Screen Network (DSN) and the recognition that thorough training for projectionists in screening all sources of digital content is vital if the DSN is to be a success.**

Following the announcement of the UK Film Council's Digital Screen Network (DSN) the DTB identified a skills gap that would need to be addressed if cinemas

wished to use the multimedia box which comes as part of the DSN equipment package. The multimedia box allows cinemas to exhibit a variety of formats outside the remit of the DSN. This would enable them to screen alternative content for live shows, education events, film festivals, corporate hires and other revenue generating activities. This training initiative dovetails with the training provided by Arts Alliance Media, the organization charged with the roll out of the DSN. It is important to note that the Arts Alliance training for the DSN does not cover the multimedia box, so cinemas wishing to screen digital content outside of the DSN will need to ensure that their projectionists are trained in this area.

The specially created training course is designed to help projectionists deal with the wide variety of alternative digital content that they are likely to be asked to project. With well over 10,000

possible combinations of physical, sound and image format, they will need to know how to identify each format and what to do to present it in the best possible way.

#### **The Course**

Starting with an explanation of the basic principles of video and audio formats, the two-day course will focus on the practical aspects of projecting from both digital and analogue sources. The initial lecture-style presentation will be followed by a series of workshops where small groups of students will practice setting-up and projecting typical examples of content using representative projectors, sound and ancillary equipment. One of the workshops will be conducted as a "surgery" where attendees can get detailed answers to questions on their particular site environment or get further information on any aspect of digital cinema.

#### **The Trainers**

The trainers, some of whom are

projectionists themselves, are very aware that this will be a steep learning curve for many of the trainees so the emphasis of the training will be to ensure that students feel comfortable and confident with this new technology. Course numbers will be kept low to allow each delegate plenty of time to work with the equipment and get answers to their questions.

#### **The Programme**

This £200K training programme will run for 18 months from early December 2006 and will be located mainly at the NFT. Depending on the numbers per region, the course is also very likely to go on tour.

Richard Boyd, Project Manager for this new initiative is delighted that his team will be enabled to take its work at the DTB to the next level and to be able to continue working with the BKSTS. The NFT team will be working with many of their old DTB friends including Christie, Quvis

*A 'multimedia box', such as the one which the NFT projectionist training scheme will be highlighting, allows cinemas to exhibit a variety of different video and audio formats, from Powerpoint presentations to features shot on a wide range of formats. The Christie Cine-IPM 2K, in use at the NFT, contains an image processor that converts analogue or digital signals for use with Digital Cinema projectors, allowing them to display virtually any standard of content, including broadcast television, satellite, and HDTV sources. Christie's Cine-IPM 2K offers image scaling, image processing and reformatting capabilities for both standard and HD sources, and has a range of remote control features.*





and Rex Beckett of Dcineco, who will be the Lead-Trainer and consultant for the course.

The course will be certificated and this will be administered by the BKSTS in consultation with the course designer and the Cinema Exhibitors Association.

Richard Boyd and Sarah Trigg, the Project Co-coordinator, are now working towards securing additional partners for the project as well as raising funds for the Hardship Fund, which can help with expenses for projectionists who may have to stay overnight. This will be a very high profile training programme with a visible industry presence over the next two years and there are many opportunities for manufacturers, service providers and other industry organisations to get involved.

### The Digital Test Bed

The Digital Test Bed was born out of the need for an independent and neutral testing facility for exploring the new digital technology that is affecting cinema exhibition and filmmaking. The inspiration came out of the industry co-operation that resulted in the road-show 'Celluloid or Silicon?', which toured London, Glasgow, Cardiff, Bradford and Belfast in Nov-Dec 2000. There was also a call for a UK/European equivalent to the Digital Cinema Lab, set up by the Entertainment Technology Center in Hollywood, California. These two elements came together in the DTB.

The Test Bed was funded by the Department of Trade and Industry (DTI), with support from the British Film Institute (BFI) and the members of the film and technology industry who have contributed their equipment and/or time and expertise. This has included Christie, Barco, Quvis, TI, ScreenDigest, DTS, JVC, Dolby, Digital Projection, Panastereo and Snell&Wilcox – among others. The NFT was seen as an ideal location to house the DTB because of its history, impartiality and high level of cinema expertise, as well as connections with the British and international film industries.

The DTB also extends the BFI/NFT remit by enabling the screening of new forms of film

originated in digital in its premiere cinema complex on London's South Bank.

The DTB has been the main UK and European facility for exploring the digital distribution and exhibition of film. Its aim has been to act as a neutral research laboratory in the search for universal standards and compatible technology solutions. The test bed has hosted seminars, training sessions, interactive forums and special demonstrations and, working closely with the BKSTS, has been able to host events covering most areas of the UK film industry's technical workforce. Some of the most memorable events include the Charles Poynton Colour seminar (picture above), FIRST archive conference, the first Digital Cinema 3D demo in the UK for the post production community and the Special Effects conference. Over three years the DTB has had over 4000 delegates pass through its doors.

The primary objective of the DTB up until now has been to test and explore every aspect of the emerging technology of digital creation, distribution and exhibition of film, as well as other forms of 'content'. While digital filmmaking and digital projection are nothing new, there was, and still is, considerable work to be done in areas such as standardisation, training and education.

There are also new areas, such as interactivity, that are only in the early stages of development.

### Audience Reactions

The subject of the audiences' response to digital display had also only been marginally explored and, through the Digital Futures programme at the NFT, the DTB has been able to gather audience feedback on digital screenings. The feedback has thrown up some interesting and somewhat surprising results as the response from the "discerning" NFT audience has been overwhelmingly positive over the period of the research (3 years). The NFT has been fortunate in that it was able to launch this digital programme with the three restored and digitised Warner classics *Casablanca*, *Singing in the Rain* and *The Adventures of Robin Hood*.

Without the support of organisations such as Warners, Disney, UIP and of course the BFI Archive, the work of the DTB would have been almost impossible as until now digital content was limited. The Digital Futures programme screened content from a variety of sources and restoration programmes and has demonstrated the potential and pitfalls of digital cinema exhibition. It has become clear that content screened digitally will only look as good as the source material allows. Having said this, even when some screenings were not what we would consider technically excellent, audiences were delighted to be able to see films on the big screen that had previously been unavailable due to the poor quality of the prints.

The DTB has worked with creatives, cinema exhibitors, technology providers and, not least, audiences to help make the transition from 35mm film for cinema display to digital projection an improved experience that benefits all parties.

### The Technology

Although the funding from the DTI has now expired the equipment is still in place and available for use on a project by project basis. The DTB is equipped with some of the most advanced technology used for digital distribution, storage and projection.

At present we have a Barco DP100 projector in NFT3 and a Christie CP2000 in NFT1 (part of the UKFC DSN). Through the DTB we have also hosted demonstrations of new projection technologies including 4K projection. The DTB is comprehensively equipped for preparing digital content for projection with a good selection of servers, tape players, format converters and monitoring. The range of equipment includes delays and other digital audio processing to ensure that soundtracks can be prepared with the same care as images.

### To Get Involved....

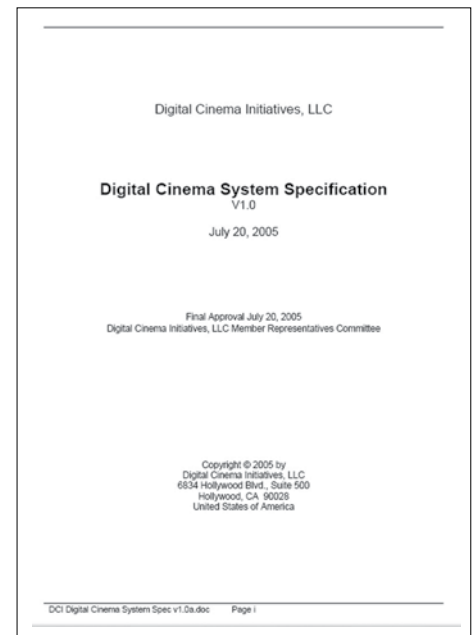
For details on the course or becoming involved in the initiative please contact sarah.trigg@bfi.org in the first instance.

*Sarah Trigg, Rex Becket & Richard Boyd*

Cinema technology leaders have expressed great concern about the use of phrases such as “DCI-compliant” and “DCI standard” at the recent SMPTE and ITEA conferences: there is no “DCI standard” – and there is no such thing as a “DCI-compliant” product.

# In need of digital cinema standards

Dave Schnuelle, Director, Image Technology, Dolby Laboratories, tells us that in spite of the many current claims of ‘DCI Compliance’, there is still a long way to go before the standardisation of Digital Cinema is complete.



In 1956 Cole Porter wrote a song called *Stereophonic Sound*, a satirical overview of the necessary ingredients for a successful motion picture in the 1950s. It humorously describes the negative effects of not incorporating Hollywood’s latest technology into a production. Looking for inspiration for his composition, Porter made lists of technology used in filmmaking, identifying four different sound formats, eight different picture formats and ten different color processes. If Porter were writing the song today he could include digital cinema on his list.

While there has been increasing adoption of digital cinema worldwide, the mass deployment depends on standards. The incorporation of digital image processing into digital cinema projectors has led some to believe they can manipulate the image at will in the theatre. In the last few years we have seen ten different combinations of color gamut, white point, dynamic range, and various combinations of pixels to make three different Cinemascope formats for the projector. Cole Porter would be proud of the technology innovations, but none of this data can be communicated seamlessly to the projector today. And if all the pieces for projection don’t work right together, exhibitors will have one messed up picture on the screen. Hence the need for standards.

That standards process is the only way we have of avoiding interoperability

chaos. The release of the Digital Cinema Initiatives (DCI) Specifications has been widely misconstrued to mean that industry standards are done and that equipment manufacturers should immediately be making equipment that complies with those standards. However, the DCI Specifications are not standards, but recommendations for the Society of Motion Picture and Television Engineers (SMPTE), which is charged with setting the industry standards. The DCI Specifications are incomplete from a standards viewpoint as they simply don’t say enough to build equipment from them alone. The specifications are user requirements, not standards. As the DCI group itself said, “the Specifications are intended to guide the Society of Motion Picture and Television Engineers (SMPTE) in its standards work.”

Take the MXF packaging format as an example. The DCI specification describes an overview of the file packaging format in half a dozen pages, not even mentioning which type of MXF is to be used. The SMPTE documents for packaging derived from the DCI specification now run to over 200 pages with over a dozen SMPTE Standards and Recommended Practices. The entire suite of digital cinema documents going through the SMPTE standards process numbers over 35 to date, with not a single one of them finished and published.

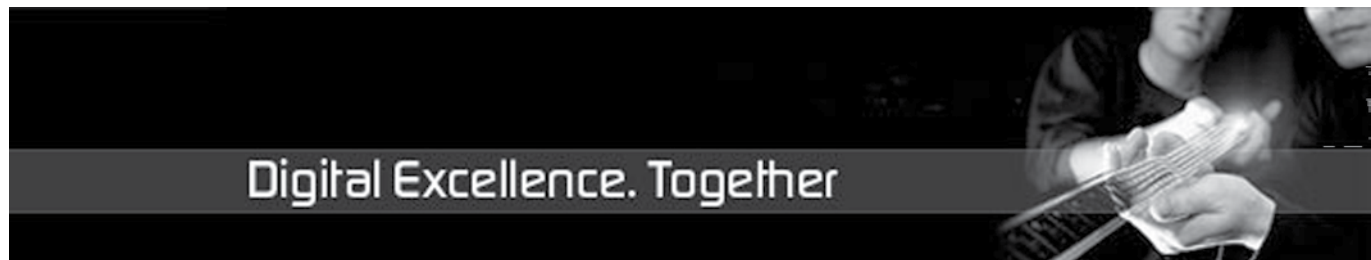
Cinema technology leaders have expressed

great concern about the use of phrases such as “DCI-compliant” and “DCI standard” at the recent SMPTE and ITEA conferences: there is no “DCI standard” – and there is no such thing as a “DCI-compliant” product. Theatre owners should be confident that the products they buy will be able to play all content, regardless of the mastering source. At this time, the term “DCI-compliant” does not provide any assurance of that. To fill that void, manufacturers of D-Cinema equipment, in conjunction with theatre owners and studio content owners, have begun to explore means by which we will be able to certify that our equipment meets the SMPTE Standards when they are completed, and the other compliance points dictated by the DCI Specifications.

It is expected that the various SMPTE Digital Cinema Standards and Recommended Practices will be published over the next year. During that time manufacturers will engage in interoperability discussions and file exchanges to test interchange. There is general consensus that the standards work and compliance efforts will allow an effective single standard at the beginning of 2007. Overall, it is most important that as an industry we work together to ensure that digital cinema technology is ready for mass rollout so moviegoers around the world can enjoy the best that technology has to offer.

*Dave Schnuelle*

Barco's latest Digital Cinema Day at BAFTA brought together a team of speakers from Bell Theatre Services, Disney, Dolby and Technicolor to talk about how we are finally starting to see a sizeable rollout of digital projectors in cinemas around the world, and how the final pieces of the digital Cinema jigsaw are slotting into place. Each of the companies involved has its own special area to cover and, of course, its own agenda, but Barco brought them together to speak under the overall theme of 'Digital Excellence - Together'.



# Barco digital cinema day

The basic message 'We're getting ready - are you?' was used as a way of explaining to the wide range of people in the audience what each of the companies involved is doing to push forward its part of the Digital Cinema market, so as to enable everyone from producers to exhibition staff to understand what this would mean for their next film, and what the implications are in the near future.

**ROD WHEELER** from *Barco Digital Cinema* opened the proceedings with an excellent clip from Disney's 'The Chronicles of Narnia: The Lion, The Witch and the Wardrobe', which not only showed the wonderful images which digital cinema can provide, but which managed to convey a moving story within a very short time - a perfect example of the cinematographers art being complemented by the best of modern cinema display technology. Rod explained how the

last twelve months had seen immense strides in Digital Cinema, and said that those who need to understand the technologies had moved on to work practically on the more complex areas of packaging, encryption, key management, etc. The aim of the day was to provide a snapshot of where the industry stands, and to examine what is possible and what is not. He provided a model of the complete Digital Cinema Chain from acquisition to exhibition and related these areas to the technologies involved in each area, discussing post-production, commercials and the integration of digital projection within the existing cinema business.

**TOM COTTON** from *Technicolor Digital Cinema* spoke about the work of the company in the development of end-to-end distribution technology and support services for the delivery of digital cinema to cinemas worldwide. TDC provides a complete range of capabilities to serve the emerging digital distribution needs for the motion picture industry based on open standards that cover all of the stages for taking a movie from a studio master to the digital projection sys-



tem. This includes compressing, encrypting, and transferring the master onto deliverable media, delivering the content to the cinema, either by physical media or via satellite, for storage, scheduling and playback, and the installation and service of digital cinema playback systems. Tom described the rollout model, with agreements in place in the US with Columbia, Dreamworks, and 20th Century Fox, and said that TDC is committed to installing some 5000 digital screens in North America, with the finance provided by Technicolor. Full rollout will begin when the current beta-tests are complete and their lessons have been absorbed - 2007 is their planned kick-off year. The beta tests involve a combination of 2K and 4K projectors, with 180 screens using 60 of each projec-





Graham Edmundson

Laurence Claydon

tor/ server combination, and it will require over three months to obtain some statistically valid figures. TDC have a similar target in mind for Europe, with between 3000 and 5000 digital screens envisaged.

Key principles of the planned rollout include:

- Minimise disturbance to existing business models
- Ensure that there are no 'gatekeepers' - TDC believes that it is vital for all service providers to be able to access all screens.
- Core technologies must be based on existing digital standards.
- Cost-effectiveness. Thousands of screens will bring the benefits of scale to the business.
- Every partner must commit to the project for the same length of time

Tom gave a brief 'status report' about the digital cinema business. As far as digital content is concerned, TDC have so far managed more than 100 digital releases, representing more than 285,000 digital presentations in North America. Equipment prices are dropping, with projectors and storage devices and systems falling in price, and satellite distribution should become cost-effective once thousands of cinemas are involved. Although the detailed specifications for Digital Cinema now exist on paper, much hard work needs to be undertaken to make these work in practice. The quality of 2K images appears acceptable, and the introduction of JPEG 2000 is going ahead well.

The new business models being explored by TDC will be applied first to the large US market, but the European models are seen as a greater challenge. Current issues facing the industry include:

- The networked environment is much more complex than a stand-alone situation.
- The migration to full DCI compliance.
- Interoperability issues.
- Monitoring, maintenance.
- Can I get digital content onto my screen?

Such issues highlight the importance of working with a solution provider like Technicolor Digital Cinema, who will look after the overall project, both technically and financially. This provides a single point of ac-

countability, with the service provider being responsible for everything, from the initial planning to the installation and the ongoing operation, as well as for collecting the 'virtual print fees' that will allow the cinema exhibition industry to carry on much as it does today, with Digital Cinema not changing existing business relationships. The two biggest US service providers are committed to 9000 digital screens, and this gives them much buying power and influence. 5000 digital screens will be sufficient to make a fully dedicated digital distribution network financially viable, since the huge costs will be split across a wide base.

Tom's key message to the industry was 'DO IT RIGHT, RATHER THAN FAST'. He said that we have been in business for about 100 years, so there is no need to rush to digital - getting it right is far more important. Before Digital Cinema is rolled out world-wide it must be at least as reliable as 35mm film, and TEST, TEST, TEST was his other key message. There are still interoperability issues to be sorted out, and a solution provider can use its independence to test that all the equipment works together and interoperably.

Answering a question from the audience about whether 2K would be the 'end-point' for Digital Cinema, Tom said that he thought that in the US theatre owners would definitely want to have one or two 4K projectors in their main screen, to provide a big marketing advantage over what viewers will be able to get with the equivalent of 2K HDTV at home. Tom's presentation ended with a stunning Tom Cruise clip from UIP's *Mission Impossible III*, shown via BAFTA's resident Barco 2K projector.

**GRAHAM EDMONDSON** from *Dolby Digital Cinema*, another solution provider, said that he wouldn't be talking about audio, but about Digital Cinema in the Real World. At what he described as 'the end of the beginning stage' of Digital Cinema, it was now necessary to take the next step, and to work together with the industry to move Digital Cinema forward. He spoke of the potential problems of security and distribution, and, claiming that Rod had told him to 'make

his presentation entertaining for a change', somehow contrived to drag four only partially-willing volunteers onto the stage to play their roles in what could only be described as a digital pantomime. The four enacted the various parts of the cinema distribution chain, including the projectionist at the cinema, the film distributor, the technical boffin in the laboratory, and, surprise, surprise, Rod dressed as a pirate!

The panto (pictured above) worked well in illustrating the various routes available to pirates and highlighted the most important links to ensure security throughout the process. Graham used boxes and chains to demonstrate physical security, and gave examples of multiple security management systems and how 128 bit digital encryption systems would remain difficult to crack. He went on to describe a few security 'myths', including the one that putting the 'media block', the secure part of the Digital Cinema system, into the projector is more secure than having it connected via a cable. Graham said that this is false, because an encrypted link is equally secure, and far less trouble to sort out when something goes wrong than when everything is within the projector.

He explained why computer hard drives are the only real option for transporting digital movies for the next few years, and pointed out that there can be incompatibilities between such drives. DCI specifies Gigabit Ethernet drives, but these are only just available on the market, although they can be expected to become more widespread fairly quickly. Graham spoke of the need for a secure key-delivery system, and explained the pros and cons of the current options, including CD-ROM, USB drive, and Hard Drive, saying that the long-term need is for an electronic connection directly into the media-block. He spoke of many practical issues affecting the early Digital Cinema systems, and said that these would be resolved during 2006-7. He finished with a brilliant digital clip from *Charlie and the Chocolate Factory*.

**LAURENCE CLAYDON** from *Bell Theatre Services* then provided an excellent technical presentation about important issues affecting the post-production and cinema ex-

hibition areas, basically examining how the DCI specifications will affect those working in each sector.

He began by explaining the difficult subject of 'colour space', saying that current digital projectors provide RGB P3 colour space whereas we shall shortly have the DCI specified X'Y'Z'. Laurence explained why this was chosen and why it was necessary for Digital cinema., saying that as time goes on every device in the chain, from camera to projector will store information about X'Y'Z', which will mean that we don't throw away any valuable colour information and that we don't tie ourselves to current display devices.

Laurence then spoke about the differences in the processes that are used if you must grade images for both film and for Digital cinema, but using the same basic image data. Even for image framing purposes 2K scanning and 2K Digital Cinema are not the same thing. He highlighted a potential problem with colour temperatures, since the digital white point is usually taken as 6300K whereas the SMPTE 196M standard recommendation for film is for 5400K.

He felt that the most relevant current issues for exhibitors are to do with DCI compliance, and that cinemas need to be able to answer the question 'are we ready to go?' This breaks down into three other questions:

- Can the equipment that I am choosing for my cinema eventually be made DCI compliant?
- Am I going to be able to get digital content for my projectors?
- Can I replace my 35mm equipment outright, making life much simpler?

Consider that at the moment many ads and trailers are not available in digital form, and you need everything to be available digitally before you can throw out your 35mm kit.

Laurence said that the answer to these questions right now has to be 'NEARLY'.

He stressed that in spite of what some manufacturers and exhibitors are claiming, the latest systems are not yet DCI compliant - using JPEG200 does not equal DCI compliance. Secure Media Blocks are an essential part of a DCI compliant system, and are not likely to be available until November of this year. Other essential parts of a DCI compliant system include:

- FIPS (Federal Information processing Standards) standards for encoding data and for encryption.



- Key management systems.
- MXF Packaging.
- Watermarking
- Reliability (including hot-swappable storage)
- Subtitling

Looking to the near future, Laurence said that it would be possible and very good to use the new technologies to integrate booking management systems with theatre management systems and the data stored on the server, and to check that the encryption keys have arrived. It is possible to control the signage on the foyer screens, to track customer behaviour, and there is also the promise of being able to provide more dynamic on-screen advertising. He advised all cinema owners looking to buy new equipment to ask what extra systems can be linked in, and whether the system can take a show playlist and automatically carry out all the auxiliary functions required. Summing up his presentation about the application of new technologies to cinema systems, he once again said 'WE ARE NEARLY THERE!'

**HOWARD LUKK Executive Director, Production Technology at Walt Disney Studios** began his presentation with a clip from the soon to be released 'Cars', and gave a lively talk describing what is happening in the USA, telling us some of the 'war stories' about the problems that the digital cinema pioneers had experienced as they installed their first fifty digital systems. Digital Keys can be a major problem, and some hold-overs after the first showing periods have proved difficult to accomplish administratively. There needs to be a simple way of arranging for a weekly key re-issue when required.

He spoke of the importance of getting all the technical details right when building a Digital Cinema system., and reminded the audience that the DCI Spec is in fact a requirements document, and does not tell

you how to build a Digital Cinema system. It is also important to realise that the SMPTE specs are still subject to adjustment. Howard described Disney's participation in DCI, SMPTE, and ISO TC36, and stressed again that much of this work is still ongoing.

Howard showed the often problematic results of scanning different picture areas for film use and for Digital Cinema, highlighting the areas that need to be protected. He said that Disney are considering proposing a 'projectable image' standard which would make for better framing of Super 35 and 1.85 'flat' images when used to provide Digital Cinema images. After praising the Digital Cinema distribution format being used by Disney, providing MXF interoperability, he announced that as from January 1 2007 all Disney content will be distributed in DCI compliant form only.

Howard dismissed several 'Digital Cinema myths', including the one that you no longer need quality control when using Digital Cinema - he said that all the checks that you did for film you must do for Digital Cinema, and he highlighted the need to QC the DCM.

He said that you mustn't assume that electronic delivery is foolproof - upgrades can and do provide problems and are rarely seamless, so it is necessary to check that all is well long before the showing. Another myth, that once a projector is aligned everything is OK thereafter, was also dismissed - Howard said that there are lots of different colour spaces used on different movies, and lots of TI colour space files. He said that the digital projector certainly needs to be checked before showing the Disney 'Cars' movie. Trailers provide the worst situation, and need extra careful checking, as every studio does different trailers for different formats. When 2K trailers are shown along with 4k movies, then audio issues can then occur. Effectively you sometimes need to reboot the server when changing between 2K and 4K.

Howard showed a graph of the rollout of Digital Cinemas, indicating a recent sharp upward trend, and showing that more digital screens are being introduced per location. He said that during the year there had been a general move from the use of MPEG2 compression to JPEG 2000, and emphasised what earlier speakers had said, by stating that the number one myth is that JPEG 2000 means the same as DCI compliant. Howard said that the various tests for DCI compliance are still being worked out by the Fraunhofer Institute, and that anyone

'...in spite of what some manufacturers and exhibitors are claiming, the latest systems are not yet DCI compliant - using JPEG200 does not equal DCI compliance.'

## 'Storage requirements can be massive - a two-hour 4K movie produces nearly 7 TeraBytes of data which needs to be processed and transferred from DCDM to DCP'

who claims at the current time to have either kit or content that is fully DCI compliant is just not telling the truth!

In answer to a question from David Pope of DTS about a possible move to 4K, Howard said that Disney do see advantages in 4K, but the sheer economics, time and cost make it impracticable at the moment, although 4K will eventually come. There are no practical and reliable 4K projectors yet, and the costs of post-producing material in 4K are significant.

The last speaker of the day was **RICHARD WELSH from Dolby Digital** production services, who gave an excellent talk describing the practicalities of Digital Cinema mastering, explaining the many different steps in progressing from the source material to the package that actually goes out to cinemas, including the video, the audio, and the extras that are needed. He began with a much-needed translation of many of the acronyms that might otherwise have left his presentation unfathomable to all but the cognoscenti. The main ones affecting Richard's presentation were:

- DSM - Digital Source Master, a digital master created in postproduction from which different versions and duplication masters may be created.
- DCDM - Digital Cinema Distribution Master. A master set of files that have not been compressed, encrypted, or packaged for Digital Cinema distribution. The DCDM contains essentially all of the elements required to provide a Digital Cinema (DC) presentation, and Richard additionally called this 'what you want the customer to see'.
- DCP - Digital Cinema Package, the set of files that are the result of the encoding, encryption and packaging process.
- DCDM\* - Digital Cinema Distribution Master\*. When the DCP is unpackaged, decrypted and decompressed, it is referred to as the DCDM\*. The DCDM\* is visually indistinguishable from the original DCDM. Richard explained the processes that take

place in moving from the DSM to the DCDM; some changes can be made in post-production, with some artistic input too. He gave lots of detail about creating the DCP, and the number of possible options seems massive. The DCP is made by a content preparation facility, and Richard said that the current processes are fairly complex and often inefficient - he said that there is a need to be able to go back through the post-production business to make the process of conversion to DC more efficient. He stressed that quality control and checking of the DCP is absolutely vital.

Storage requirements can be massive - a two-hour 4K movie produces nearly 7 TeraBytes of data which needs to be processed and transferred from DCDM to DCP. Transport is a big problem. Using Firewire this could take 37.5 hours, using SCSI or SATA drives could take 6 hours - there has to be a better way. Richard suggested that it might be beneficial to do the JPEG2000 compression of the DCDM in the image post production facility. He explained how image, sound, subtitles, audio description and auxiliary data are brought together to form the DCP, and then gave some 'warts and all' examples of problems that can currently occur with Digital Cinema. As has been highlighted elsewhere, Richard told of the practical problems of using 2K trailers with 4K movies - if you want the audio to be contiguous, you end up having to do a server reboot between the 2K and 4K sections, which doesn't make for a smooth cinema show! There are also problems if you try to do active pixel area changes, and Richard said that interoperability is still not at the level it needs to be, and all those working in the different areas of digital cinema need to work together to provide a system that will eventually be seamless.

He showed an interesting clip from *Secuestro Express* that had been shot on DV-CAM and finished on HD, explaining how Dolby had made the DCP, and the problems that had arisen, saying that the workflow

had been far from smooth. Richard said that the experiences he had described illustrate what is currently happening in the real world of Digital Cinema, and that there is a significant need to develop and improve the mastering and packaging processes that are currently in use.

Richard answered a number of practical questions from the audience, including an interesting one about the introduction of 'padding' or 'blanking' into image sequences.

Rod Wheeler then summed up the proceedings, saying that there had been three clear messages from the afternoon's speakers:

- **Digital Cinema is here to stay, and is unstoppable.**
- **There remain a whole host of technical and perhaps artistic issues to be resolved, and it is vital that these are sorted out quickly.**
- **Collaboration is happening between many of the companies and people wanting to see that DC has a great future, and we can see that it is happening by the way that companies had come together to provide the day's presentations.**

After thanking all those who had contributed to the success of the event, Rod said that the proof of the pudding is that going to the cinema to watch a Digital Cinema show is the very best way to watch movies, and he ended by showing another superb digital clip from Disney's 'Narnia.'

Another excellent 'Barco at BAFTA' occasion, which provided a lot of useful technical information, some honest opinions of the current state of the art in Digital Cinema, and a lot of food for thought. The drinks and canapés afterwards kept the discussions going, and I came away feeling that there is still much for all of us to learn about the revolutionary developments in Digital Cinema that are happening 'here and now'.

*Jim Slater*



The cinema industry is very sensitive to the phenomenon of piracy. Billions of dollars are lost each year due to the pirate distribution of movies through DVD, through the Internet or through any other means.



by  
Xavier Varians  
of Octalis

# Protecting content

The digitalisation of movies may potentially offer new opportunities for pirates. A digital copy is identical to the original. The digital form of the content simplifies pirate lives, as they only need computers to reproduce and distribute the content multiple times.

Two main piracy sources are directly damaging to the theatrical exhibition industry: the theft of content before or during its theatrical release window and the camcording of a movie off a theatre screen. Both are very damaging because pirate copies can be available before or during the theatrical release window, cutting down revenues early in the movie's life.

Let us first focus on the description of the mechanisms and tools that can be used to avoid or combat piracy related to the theatrical distribution and exhibition, so as to detail how such systems are built and their main forms of deployment, with most detail given for the parts that will be standardized. This is not a cryptography course or a guide on how to build a content protection system, but a simplified description in order to be accessible to a large audience.

Content protection is a hot topic in Digital Cinema. It has technical and business implications. A content protection system can be very constraining for some business entities, modifying the business balance between distributors and exhibitors. Such discussions are still under way and have been evolving tremendously over the past 5 years, but are not the subject of this article and will be solved by the business entities themselves, the studios, distributors and exhibitors, not by any security expert.

## Protecting digital movies

Security, or more precisely, content protection in digital cinema is often associated with the prevention of piracy. A movie protection system has various purposes:

- Preventing the theft of high-quality content,
- Controlling the access to content,
- Enforcing business usages.

The first purpose is clearly the most important one. Preventing movie theft is mandatory, especially during (or before) the first weeks of its release window. The consequence of content theft is often the distribution of pirate versions of the movie on DVD or through the Internet.

The second purpose is collateral to the first one. Protecting content has to be coupled with a system that allows authorised users to access the content, and the system must be designed

in such a way it does not affect business usages significantly. The two first purposes form the basics of a security system. The third purpose is integrated by solutions exploiting the presence of the security system to help enforce or control the application of business usages or contracts.

Those purposes are detailed below:

### Preventing content theft

One of the first things studios, distributors or exhibitors want to avoid is the possible theft of high-value content that can then be burned on pirate DVD or distributed on the Internet. Theft can arise at very different stages of the content value chain. Depending on the content nature, two types of solutions can be used:

- Digital content encryption and adequate management of encryption keys can prevent digital content from being used. This is the purpose of most encryption or content protection solutions today.
- Analogue content theft is an issue in theatres. Camcorder defeat technologies and fingerprinting will respectively prevent a pirate from recording the movie from screen with a digital camera and will enable the origin of the piracy to be traced in the context of a forensic enquiry.

Those two types of solution are mandatory in digital cinema. The first type protects high-quality digital content from theft from the point where the content is produced up to the point where it is decoded for the projection. The second type takes charge of the content protection as soon as it has been played on a projector, where content is easily accessible for a pirate equipped with a camcorder.

### Controlling the access to content

#### Setting Conditions for gaining access to content

A content protection system must not only be able to protect content against theft, but must also give authorised users access to content. Distinguishing an authorised user from an unauthorised one is mandatory, as pirates will often try to access content, not by breaking its protection directly, but by trying to appear to the system as an authorised user.

Controlling access to content in its simplest form will define who (or which device) will be able to access the content. Most content protection systems today also include the capability to define the conditions required to allow access to the content. These systems are often

called Digital Rights Management (DRM) systems. A Digital Right is indeed a description of the conditions under which the content can be accessed. Example of such conditions are:

- a limited time window for accessing the content (e.g. three weeks),
- a minimum requirement on some device capabilities,
- a maximum number of accesses (absolute or per time window)
- the satisfying of some pre-conditions evaluated by the system.

The number or type of conditions is infinite. Practically, this number is limited, as business users have to specify for each set of conditions - some of them possibly in contradiction with each others - if the content can be accessed or not. This definition of the access policy is far from trivial.

### Auditing the access to content

Another way to control the access to content is to record every access to this content. Content protection systems often integrate logging capabilities. A log is a record of the operations (content playout, rights modifications, etc.) performed on the system and the important system parameters (time, user performing the operation, etc.). Audits are the result of the analysis of logs into a more usable form. Auditing those logs enables rights owners to know who accessed the content and when. Logging clearly does not prevent piracy. Combined, however, with 'fingerprinting' or 'watermarking' techniques, audit mechanisms can play a deterrent role, as it is then possible to track the origin of a pirated copy.

Often, the auditing mechanism is combined with the DRM system, and their interaction produces two advantages:

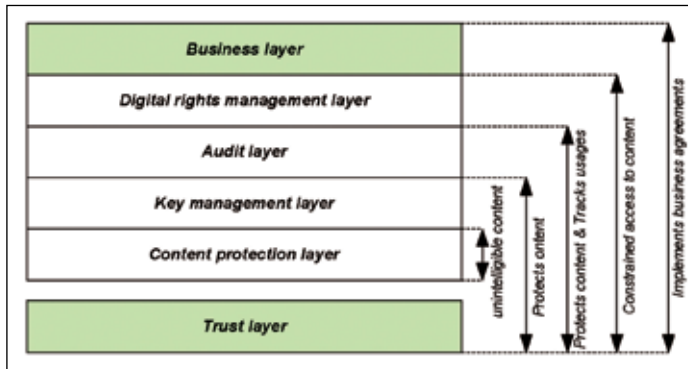
- the capability to define access rights based on audit information, for example so that a projection is authorised only if the previous projection was completed without interruption.
- the capability to detect tampering with the content protection system, by comparing the profile of the authorised accesses with the accesses that have been actually monitored.

Most DRM systems today integrate local or global logging features.

### Balance between audits and constraints

The two previous sections demonstrated two very different policies regarding the protection of content in a business environment:

- The first one defines constraining rights to



access the content. It is impossible to access the content in specific conditions if the user did not receive the rights to do it. This policy has the advantage of preventing unauthorised access to the content and then reducing the risk of piracy.

- The second one defines a secure logging and auditing system that enables content owners to check if the content was accessed according to the business agreements. This policy has the advantage of being more business-friendly, as users have a lot of freedom to access the content, within the legal agreements.

The Digital Cinema world is actually balancing between those two policies, the result being a mix of the two approaches. Studios and distributors have a preference for the first one, as they have better control of the use of the content. Exhibitors prefer the second one, as they have more flexibility to project their movies, and the risk of a black screen due to an issue in the transmission of specific projection rights is reduced.

This balance is a very sensitive subject in the Digital Cinema market. During the short history of Digital Cinema, the pendulum swung first towards the Constraint-Tight side, then went to the Audit-Only side, and is now oscillating between the two. Regardless of what is defined today, the future of the equilibrium will heavily depend on the way the business models evolve in Digital Cinema. A content protection system will be good for the digital cinema market only if it can support this ever-evolving move between the aforementioned policies.

#### Enforcement of business usages

As soon as it is possible to define conditions on how the content can be accessed, and to control afterwards the actual access to the content, the full support of business agreements is no longer far away. As a consequence, some security systems also enforce or support business usages. Digital cinema is a business environment governed by oral or written contracts. Those contracts relate to the usage of the content itself, but also to some additional conditions. An integrated security solution may also include the supervision of the respect of the terms of a particular contract. While those elements are not directly related to the content,

to provide full audit information while others may not have to do this. Or the same distributor may agree that an exhibitor benefits from a "No black screen policy" for its movies, while another distributor may not accept it. A third example is the capability for some theatres to pull projection licences from a distribution server automatically, while others may have to wait for the distributor to explicitly send them projection licences.

#### Elements of a security system

Generally a content protection system can be split into layers, each with a specific purpose. The diagram shows an overview of those layers, focusing on the purpose of the layers and how they interact together to provide a complete content protection system. Except for the trust layer, which is pervasive to any system, all the other layers add a fundamental functionality to the system and need the layers that are below it. Every security system implements all the layers, but with some systems some of the layers appear in only a rudimentary form.

#### Physical security

Although discussion of anti-piracy measures often focuses on encryption measures, these techniques form only part of the overall solution. Inside the digital cinema playback system, the movie data cannot always remain encrypted, as it must be decrypted before the image can be decompressed ready for display. Although once decoded, the valuable image data is encrypted again before it is output from the playback system to the projector, other methods are needed to protect the data whilst it is being processed inside the playback system.

To prevent a pirate from opening the lid of the equipment and stealing the unprotected movie data inside, physical security can be used to prevent access to any parts of the circuit where value movie data is processed. Physical security stops a pirate from physically reaching the relevant parts of the circuit - for example by making it impossible to access the pins of the processing chips or the tracks carrying signals on the circuit board. Physical security measures can also include logging of attempts to disassemble or otherwise attack the unit. Current discussions suggest that in the future some major movie distributors may expect physical

it indirectly influences the way the content is distributed or accessed. For this reason, security systems sometimes implement tools to model parts of those business agreements. For example, a distributor may require some exhibitors

security in addition to encryption in order to protect movie content from piracy.

#### Design of a movie protection system

Detailing how to build a digital cinema protection system is too complex to cover here, and we have already seen that security is far more than a technical issue. However, some insights are provided below.

Encrypting a movie is equivalent to putting it in a safe box, locked with a padlock. Only people (theatres) having the padlock key are able to access the movie. Today, standardized encryption algorithms like AES can be used as a digital padlock. They are recognized as being unbreakable, provided the length of the key is larger than 128 bits. This does not solve the problem, however. Instead of finding a way to securely distribute a movie to theatres, we now have the problem of securely distributing a movie key to theatres. Back to the beginning? No. The main difference is that a key is far smaller than a full digital movie.

For small packets of data, powerful - but slow - cryptographic algorithms like RSA can be used to securely distribute movie keys to theatres. Unlike AES, those algorithms are asymmetric and enable to establish secure communications between entities that do not share the same secret upfront.

Once you are able to distribute movie keys, you then have to add digital rights to those keys. Digital rights must be authenticated, protected and tightly attached to content keys. Cryptography provides tools to protect, sign, prevent modification and check the safe reception of the digital rights. The same tools can also be used to protect and sign audit trails.

#### The need for Trust

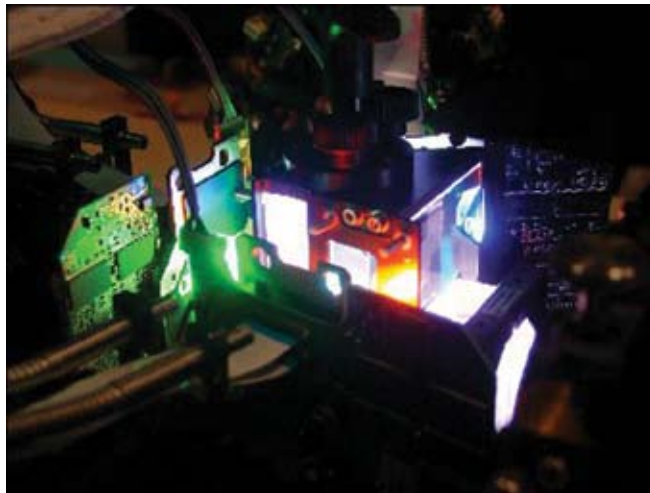
Now have we finished? No. One thing is lacking: trust. When you sign a contract with another person, you have to be sure it is the right person that signs the contract. Otherwise, the contract has no value. In the same way, to be sure that the keys you are using are actually tied to the right theatre (or projector), you need a trust infrastructure. This trust infrastructure can be based on people, on a certification authority, on shared secrets or on any other means that enable to establish this trust.

Now that you trust the person you are talking to, you can protect a content for this person only, define rights describing how to use the content, sign it and securely send it to the recipient. You have a security system!

This article oversimplifies the design of a security system. Actually this process must be executed in a very rigorous way in order to avoid creating a security hole due to a design flaw, and this requires security experts because only one error may open a fatal hole in the whole system.

*Thanks to the European Digital Cinema Forum for permission to reprint this article from their Guide for Early Adopters.*

# Practical digital projection



Rod Wheeler, Business Manager for Barco Digital Cinema UK, explains that there is far more to digital projection than pushing a button and watching the movie appear!

**The conversion to Digital is inevitable – at least that seems to be the general consensus. However whilst the ability to present high quality images on screen is now accepted, all parties involved also agree that there are a number of commercial and operational hurdles to finalise.**

With over 70 years of experience in creating high quality imaging products, the last seven of which have focused on Digital Cinema, Barco understands that the real challenge is not just providing a great looking picture on a screen; commercial pressures mean that running costs and reliability in a range of operating conditions mean the difference between a viable business case and an expensive failure.

Since the introduction of Digital Light Processing™ (DLP®) technology devised by Texas Instruments (TI), Barco has led the market in developing a range of projectors that will one day replace the incumbent 35mm film projection – itself an elegant and robust technology that has stood the test of time. In doing so Barco has worked closely with exhibitors and the film post production industry to ensure that the best modes of operation and working practices that are in use today for presenting theatrical content, can be integrated with new digital distribution



methods and alternative content models.

The design of the D-Cine Premiere range of 2K DCI compliant projectors has drawn on extensive R&D experience Barco has gained from the earliest variations of DMD, having started with 1.3K devices.

Coupled to this the same engineers and product managers work on solutions for similar projection and imaging sectors including events, staging and presentation where on-run costs and reliability are vitally important. The key features are a rugged/robust design to achieve reliability coupled with modularity of components to achieve low service and maintenance costs, supported by a unique set of software management tools.

### Rugged Design

The core of the D-Cine Premiere projector is a strong cast aluminium chassis that ensures that all the critical components from the lamp house, through the optical base, light processing path through to the digital video circuit boards and the lens assembly are held in a stable and secure environment. Ironically the very stillness of an image projected digitally means that the slightest mis-alignment or vibration is magnified on the large screen – a factor that is often masked in existing 35mm film projection where by design individual film frames are being “pulled” into the film gate 24 times a second.

Experience has shown Barco that if you put a complex electronic device such as a Digital Micro-mirror Device (DMD™) chip into a harsh and often dusty operating environment a gradual degradation of the image quality is inevitable. This is due to tiny dust and grease particles being attracted to the critical optical elements mainly through electrostatic forces.

Even if every effort is made to filter out these dust and grease particles a small percent-

age will get through. If you then add a heat source (from a high wattage xenon lamp) it is clear that some of this material could become baked-on, often irreversibly.

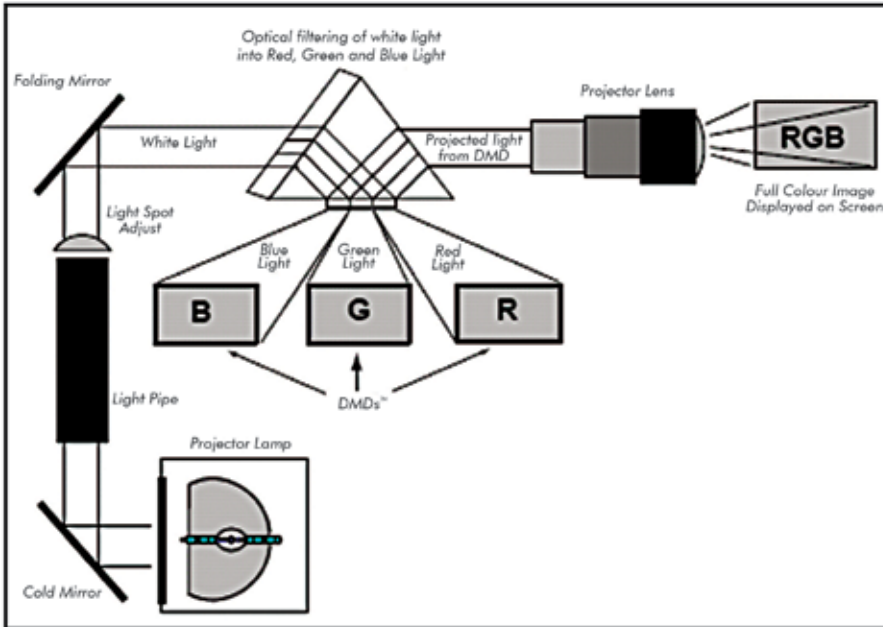
Barco's solution is to manufacture the critical elements in a “clean room” (below left) and then hermetically seal the entire “Light engine”. This ensures that no dust particles can enter the system whatever the operating environment, whilst still providing the necessary cooling.

### Convergence

One practical application that is effected by this design approach relates to convergence, and for the purposes of this article we will take a look at this in more detail.

In a 2K 3-chip DLP® projector the white light from the Xenon lamp is split into the primary colours Red, Green and Blue and each colour is directed towards its own DMD™ chip. The modulated light reflected back from each DMD™ chip is then recombined (additive mixing) before passing through the prime lens onto the screen. Convergence describes the accuracy at which the 3 matrices of tiny pixels overlay when they hit the screen. Convergence can be identified by projecting a white cross-hatch test image and looking at the edges of the pixels when in focus – red or blue fringing indicates poor convergence.

A 2K DMD™ is a true digital light modulator and utilizes 2211840 moving aluminium mirrors, with each one representing a pixel in the final projected image. Each mirror is suspended over address electrodes by a torsion hinge between two posts. Depending on the voltage polarity applied, each mirror will either tilt to the left or to the right. When light is applied to the complete DMD™, only the light redirected from a mirror tilting to the left is projected.



During the manufacturing phase it is necessary to set the convergence and this will normally suffice for the lifetime of the projector. However it may be required to make adjustments on-site during installation or during routine maintenance - a task which should always be carried out by a qualified engineer.

Even with the sealed light engine design Barco realised it is vital to be able to adjust convergence and has devised a simple and fast procedure to achieve this.

First a specially designed test pattern is projected onto the screen (see figures below). From this the engineer can identify which sides of the screen are out of convergence by looking at the vertical and horizontal Red, Green and Blue indicator pixels. The test pattern also tells the engineer which of the 6 alignment screws to adjust. Only adjustments to the Red and Green DMD's are required since the Blue DMD is set as a reference.

Adjustment can be made to shift the Red and Green DMDs vertically and horizontally. Adjustment of one side only causes a rotation. A typical procedure is as follows;

1. Load Convergence test pattern
2. Identify which side and colours (R or G) need adjustment. (A small engineer's scope looking through the porthole can be used)
3. Converging the RED pattern onto the Blue pattern
  - a. Start with aligning the RED DMD in the vertical directions [1] and [2] and then proceed with the horizontal direction [3]
  - b. To translate RED vertically in the Y - direction, turn both [1] and [2] anti-clockwise.
  - c. To translate RED horizontally in the X + direction, turn [3] clockwise.
  - d. To translate RED horizontally in the X - direction, turn [3] anti-clockwise.
  - e. To rotate RED, turn [1] anti-clockwise or

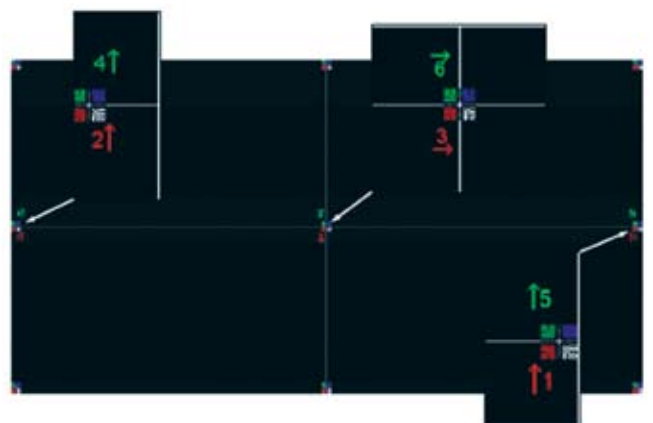
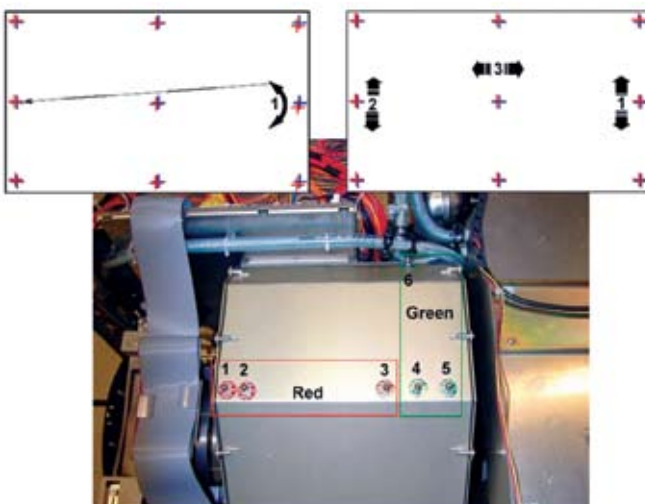
- clockwise
4. Converging the GREEN pattern onto the Blue pattern
  - a. Align the GREEN DMD in the vertical directions [4] and [5] and then proceed with the horizontal direction [6].
  - b. To translate GREEN vertically in the Y + direction, turn both [4] and [5] clockwise. Turn screws in equal increments.
  - c. To translate GREEN vertically in the Y - direction, turn both [4] and [5] anti-clockwise. Turn screws in equal increments.
  - d. To translate GREEN horizontally in the X + direction, turn [6] clockwise.
  - e. To translate GREEN horizontally in the X - direction, turn [6] anti-clockwise.
  - f. To rotate GREEN, turn [5] anti-clockwise or clockwise

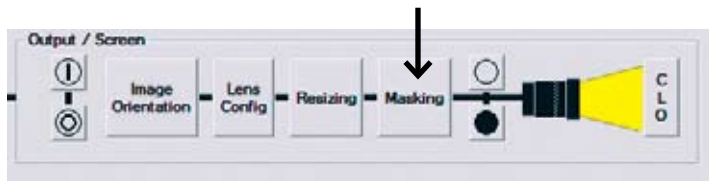
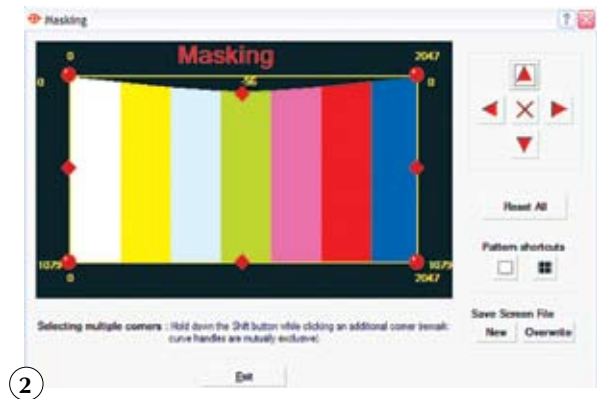
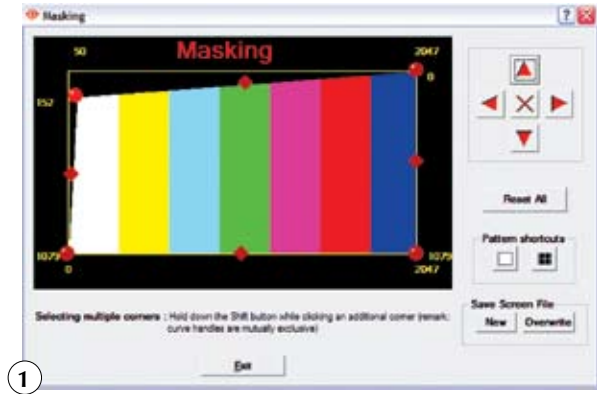
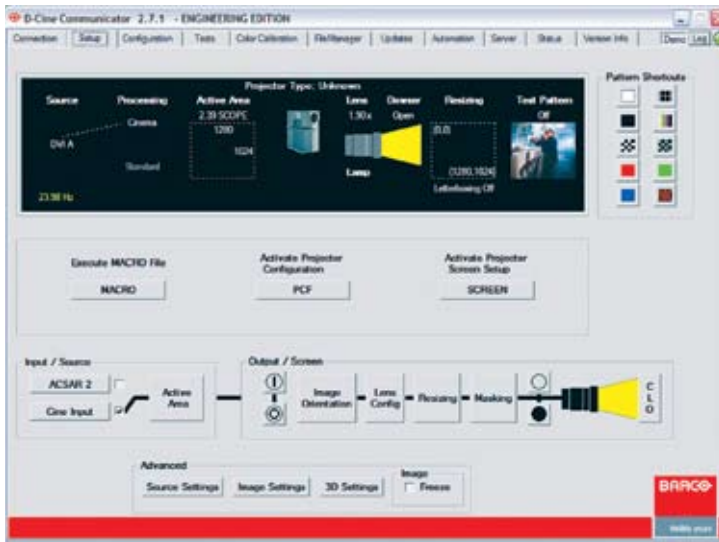
**Modularity**

"The Show must go on" – and to ensure that downtime is minimised from an operators point of view the key components of the D Cine Premiere are built into the rugged chassis in a modular form and the lamp is powered by a redundant supply (Dual in the case of the DP90 and triple for the DP100).

For ease of maintenance and service the lamphouse, digital video processing boards, alternative content input modules and of course lens can all be removed and replaced in a matter of minutes by a trained operator. The sealed light engine can also be removed as one unit quickly but this does require more specific training.

Barco envisage that larger operators will stock sufficient spare parts for easy accessibility within their own organisation with engineering resource provided "in-house" or through their normal service partners. Smaller operators will contract direct with an approved cinema service company who will carry sufficient spares and react within the same timescales provided for 35mm operation.





**D-Cine Communicator Software**

From the outset Barco developed a set of software tools and diagnostics that have been made available in a range of flavours to suit the needs of operators, projectionists, engineers and post facilities technicians.

The tools are bundled into a clear Graphical User Interface (GUI) known as D-Cine Communicator and allow access to all elements of the projector set-up and maintenance.

Organised into groups of controls accessible under separate tabs, the main set-up and control page is shown above.

For instance to set up or alter the screen masking for a given cinema the Masking button is clicked on the main setup page (above).

This takes the operator/engineer to the Masking page and from here it is possible to trim the image on screen with pixel width accuracy. Both top and bottom sides can be moved either in a perpendicular fashion or at any desired angle. In addition it is possible to create smooth curves.

In the example (top right - 1) the left side and top have been trimmed to remove key-stone error created by off-axis installation.

The example (top right 2) shows the top has been curved to match the screen. Note that by definition masking trims the projected image as individual pixels are "switched off". Any image value intended for those pixels will not be displayed. In all cases the masking setup can be saved to a specific named file relevant to that cinema screen and screen masking for a given aspect ratio content. E.g. screen1\_185, screen1\_235 etc

**Constant Light Output**

Another feature specific to the D-Cine Premier projector is the ability to automatically adjust the lamp power over time thus compensating for the inevitable decay in light output associated with all Xenon lamps.

First a full white test pattern is displayed on screen and a brightness reading at the centre is taken using a meter reading foot lamberts (reflected light).

In the light output page, CLO mode is selected and the reading taken from the meter is entered in the box relevant to the lens



type currently in use.

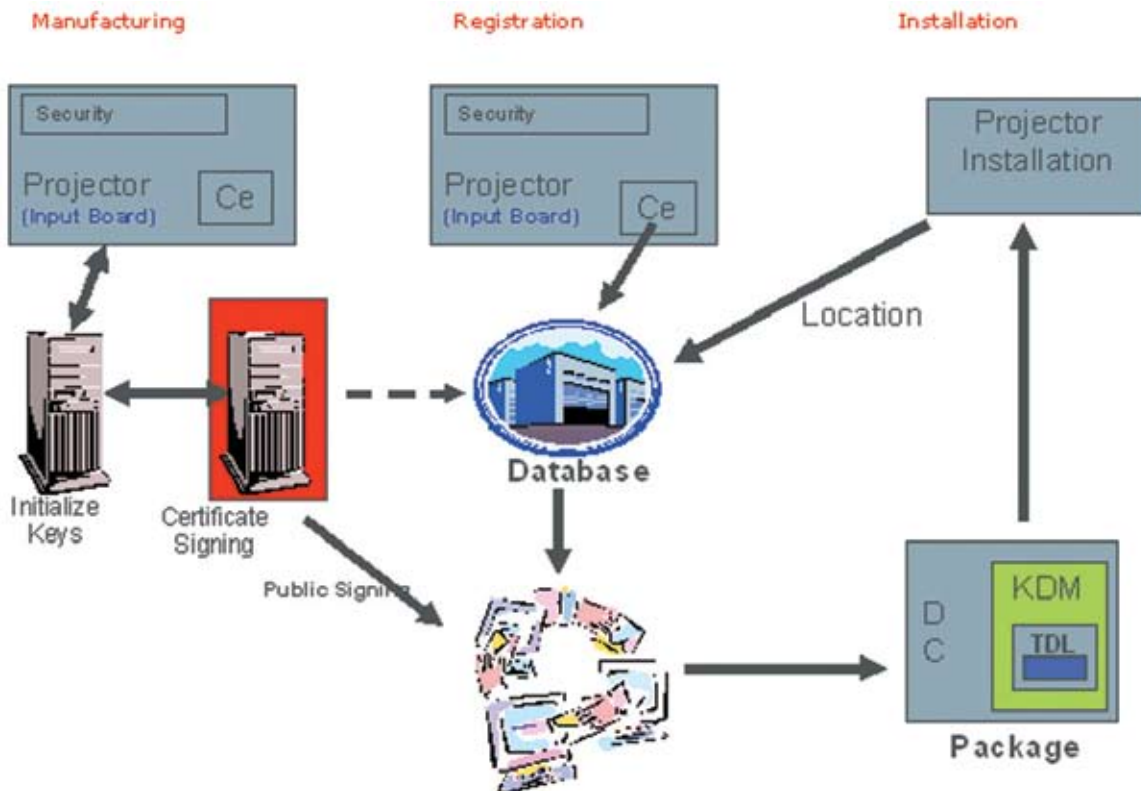
By clicking on the Calibrate button the value read by the internal feedback sensor within the projector is stored. As the light output collected from the lamp reduces over time (due to the change in arc position and shape), the CLO electronically controls the redundant power supply output to maintain the correct light output.

**DCI Compliance**

Digital Cinema Initiatives, LLC (DCI) was created in March 2002, as a joint venture of Disney, Fox, MGM, Paramount, Sony Pictures Entertainment, Universal and Warner Bros. Studios. From the outset Barco has been committed to developing a projection solution that complies with all the recommendations proposed by DCI. Despite the first release version (1.0) being issued in September 2005, some of the elements, especially those relating to image compression and digital security, are based on new technologies which are only now becoming available. From the projector perspective there are two different elements to consider:

**1) Hardware:**

For DCI compliance the physical security needed to be increased and therefore a new TI input board is required which contains a secure chip with a private key embedded in the silicon. This board is certified and has to



be mounted in a tamper proof environment or at least have the ability to audit access to the board.

In addition for DCI compliance every system per screen needs to be identified from a trusted device list which is part of the key for playing the film content. Before playing the film the system will check the projector serial number, TI board keys and server keys to confirm that system is allowed to play the film.

Barco have created a hardware upgrade kit for all projectors shipped prior to April 2006. This kit includes the new TI board, new back plane and micro switches to secure the electronics. This work needs to be carried out by an approved dealer or trained engineer.

**2) Software:**

TI release 9,2 is the software version in use up until March 2006 and supports Cinelink

1 (otherwise known as standard cinelink).

TI release 10,0 has been in production since April 2006, and is available for download from the Barco Partnerzone. This version supports Cinelink 2 with 128bit AES encryption but not with secure Transport Layer Security (TLS - a cryptographic protocol that provides secure communications on the Internet and is a successor to Secure Socket Layer (SSL) communication).

TI release 11.0, which will be available from TI and Barco in October 2006, supports Cinelink2 with secure TLS communication, which is required by DCI to exchange private keys between server and projector.

This means that Barco DC projectors shipping today are hardware DCI compliant, and can be made fully DCI compliant when the latest TI software is made available.

Finally all the site information needs to be entered into a web database, including the

serial number and screen location. This data will then be available for distributors to create keys.

**The Future**

Barco are committed to a fully digital cinema world and will continue to collaborate with all parties involved in making it a reality – thereby helping to unleash the promised benefits that digital production and distribution will bring to the next generation of film lovers.

**Note: The technical information supplied in this article is in no way intended to replace Barco training material.**

Thanks to Chris Colpaert, Senior Product Manager DC, for his help with the preparation of this article.

Rod Wheeler

## TDP - Ideal for the Digital Cinema Advertiser

Training for Digital projection is published four times a year alongside Cinema Technology, the Leading Specialist Publication for Cinema Industry Professionals. It is distributed to all UK cinema multiples and independents and many throughout Europe and the rest of the world - some 55 Countries worldwide. TDP is designed as a reference guide to digital cinema, intended to be filed and kept, and so is an ideal, precisely-targetted advertising medium for companies involved with all aspects of Digital Cinema.

We also welcome editorial contributions on technical and training aspects of Digital Cinema.

Contact Bob Cavanagh      e-mail: visionplus@onetel.com      Tel+44 (0) 1380 724357



# More 'Hands-on' with **CHRISTIE** digital projectors

As discussed in the previous TDP, film projectionists have had years of experience with all the tasks that their daily work involves, and what many of them need to know is exactly what differences a change to digital projection will make to them. Both film projectors and digital projectors use similar basic elements, a light source and power supply, a film or digital imaging head, and an optical system. In this second of a hands-on practical series from Christie, we look at the need to keep an eye on the projector's electrical system.



**Cinema Technology readers are professionals, so, as in all work on all projection equipment, will realise the importance of taking all the usual safety precautions, so we shan't labour these here, but just remind you that digital projectors are basically no different, so remember a few things that you know already:**

- Never look directly into the projector lens or at the lamp - this can cause permanent eye damage.
- To protect yourself from ultraviolet radiation keep all projector housings intact during operation.
- Keep hands, clothes and all combustible material away from the concentrated light beam of the lamp.
- Position all cables where they cannot contact hot surfaces or be pulled or tripped over.
- Check that power supply and pedestal voltages are within the specified voltage range, and don't use the projector if there are problems.

Always disconnect from the mains before opening any enclosure, checking that ALL supplies are disconnected via the relevant wall, ceiling or floor breakers.

#### **Electrical checks and maintenance on a digital cinema projector**

After every 500 hours of operation, or every 60 days, whichever comes first, you should check the contact surfaces of the projector for cleanliness and ensure that the electrical and lamp connections are tight. Note that the lamp housing door should not be opened without wearing the correct protective clothing, and the Christie Protective clothing safety kit #598900-095 includes the protective latex lab gloves used by the operator in the pictures, as well as a double layer acetate face shield and a quilted ballistic nylon jacket or welders jacket. Even when you are not changing the lamp and just checking that the connections are in good condition, this kit should be worn.

Ensure the projector is fully disconnected from any power supply before commencing

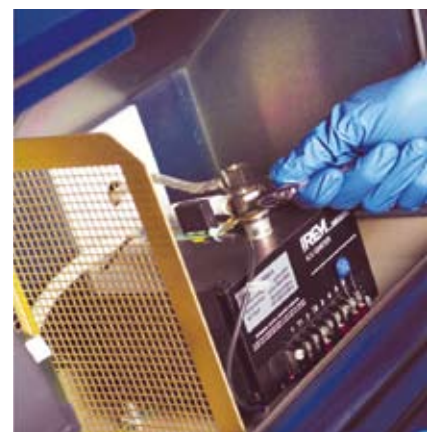
maintenance. The anode and cathode connector connect to both the power supply and the Xenon lamp. The connectors to the power supply can be located on the operators side of the projector, as shown in the pictures).

It is important to clean all electrical contact surfaces to prevent the development of high contact resistance from overheated connectors.

The connectors to the anode and cathode connectors to the lamp can be found in the self-contained lamp housing, on the opposite side of the projector.

Thanks to Christie for their help in the preparation of this article, but do note that this is intended purely to give those projectionists who haven't yet had the chance to get 'hands-on' experience of digital cinema projectors some idea of what the new technologies are likely to involve them in, and should not be regarded as a substitute for using Christie's operating and maintenance manuals.

[www.christiedigital.com](http://www.christiedigital.com)



# International deployment of digital cinema



Jason Power, Marketing Development Manager of Dolby looks at some of the different technical issues being addressed and the solutions that need to be implemented as Digital Cinema begins its worldwide rollout.

Digital Cinema promises to bring improved efficiency, greater control to both studios and exhibitors, and more movies to audiences worldwide. However, as any international operator knows, different geographical audiences and markets have different requirements and business models and modus operandi must be flexible and adaptable.

Dolby is committed to rolling out digital cinema globally and so far has more than 160 Dolby Digital Cinema systems installed worldwide. Having rolled out multiple new cinema technologies in the industry for more than 30 years and across 61 countries, Dolby understands first-hand the unique challenges posed when introducing new cinema technologies and standards internationally.

Not only must the international production community provide digital releases in appropriate local versions, but varying business practices and technical specifications must be taken into account. Thus the development of the Dolby Digital Cinema system built on past experience to ensure that it could fit in any theatre and be used by any projectionist throughout the world – and in addition, the company has considered ways

to smooth the acceptance of digital cinema as a viable new way of working and doing business internationally.

## The Importance of Standards

One of the biggest requirements for a smooth roll-out and successful implementation of digital cinema worldwide is the acceptance of and adherence to standards. Whilst no digital cinema player can be said to be fully “DCI-compliant” today, it’s important to trust your equipment supplier to provide you with the updates you will need in the long term to ensure you continue to receive a steady flow of digital content. Dolby believes that digital cinema can only take off if there is true interoperability of digital movie files, or ‘packages’, between servers from different manufacturers. This is why, as we start to deploy JPEG 2000, Dolby continues to work with SMPTE and other industry bodies to turn the DCI requirements into the detailed standards documents that are needed to ensure interoperability.

## Security Issues

The industry initially has focused on the picture quality for digital cinema with the JPEG

2000 specification. However in looking at the DCI specification security plays a larger role that has not yet been fully discussed publicly. Security issues are of the utmost importance as digital content is pristine and a high-commodity target for pirates. The DCI specification calls for all content to include encryption technology to protect it during distribution.

As all of the digital content is encrypted or “locked,” in order for exhibitors to access it, they need a “key.” The DCI specification details that a key must be sent separately from the digital content. Each key is assigned to an exhibitor and contains the rights they have for each digital movie. After the exhibitor has the digital movie file, they receive the key which will enable them to verify they have permission to access the movie. Without the correct key, no one can access the digital file.

Once the content is unlocked it is then stored in a digital cinema server. The DCI specification outlines a high level of physical anti-piracy protection for the physical digital cinema server requiring certification of the Federal Information Processing Standard (FIPS).





Photo taken at the Sambíóin Kringlunni cinema complex in Reykjavik (the first Dolby Digital Cinema installation in Iceland), where a special private screening of Disney's 'Cars', digitally mastered by Dolby, successfully took place on April 28 2006.

As a final security measure for when the content is being played on the server, the DCI recommends a secret code called a "watermark" be embedded in the movie. As the movie plays, the code is presented on the screen, without the audience noticing, and can be detected in pirated videotaped copies helping to trace where copies originated.

#### Digital Subtitles

Digital cinema actually makes it easier to prepare the multiple subtitled versions of major international movie releases, as well as subtitles for the hearing impaired, than the process for film. Different versions of the movie packaged with different subtitles can be created on a computer, as opposed to the time consuming and expensive process of printing multiple different sets of film reels, or the complexity of using a separate subtitle projection system. But the additional cost of creating different language digital cinema versions does pose a challenge during the transition period where both film and digital releases are needed. Until there is greater worldwide adoption, only a few digital systems might be installed in a specific territory and it may be difficult for distributors to justify the cost of a local language digital release. At a practical level, we have tried to make local releases as feasible as possible – by creating innovative ways of mastering that speed creation of new versions.

However, digital cinema is already giving some further flexibility with foreign language versions. For example, it is easier to update or change subtitling if there are last minute issues. For a recent release, a studio decided the Japanese subtitles for one of its movies needed to be in a different font

and size to make it easier for moviegoers to read. Dolby was able to create a new set of subtitles in its Burbank mastering facility, run a complete quality control review of the image, and then email the new file to Japan where it was loaded onto the Dolby Digital Cinema system and played back. This only took a few hours, which would not have been an option with film and could have led to delays in the release or unsatisfied moviegoers.

#### Key Management

Managing and distributing security keys, provided by the studios to exhibitors, is a new part of the digital cinema process everywhere. Without an authorized key for the digital movie, it will not play on exhibitors' digital cinema systems. This is part of the added security digital cinema enables to protect against piracy – but requires both exhibitors and distributors to ensure that both the movie package and a current security key are provided and loaded on to the playback system. If a booking for a movie is extended, a new key is often needed – unlike film, once you have the digital movie 'print' you cannot play it indefinitely. This has been a new concept for distributor sales staff and cinema projection staff, but over the last 12 months, we have seen this gradually become accepted into operational processes at both ends of the chain.

In practice today, not all cinemas have the same ways of accepting keys. Ideally, it might happen directly into the digital cinema server over a network connection, but not all theatres internationally have this possibility. Currently Dolby is delivering keys by CDROM, by email or on USB memory sticks as is most convenient for the exhibitor.

It may sound obvious, but when sending keys internationally, you have to consider the different time zones. To give the distributor greater control of the viewing window, especially for special screenings in advance of release like premieres, a key can define when a movie can be played down to the minute. For a four or six week movie run, this is unlikely to be needed as a key can last for days or weeks. However, there are instances when a key only lasts for one day, such as a festival or press screening, so if the time on the key is not set to the correct local time of the theatre there is the possibility the movie will not start on-time or even stop before the movie ends.

#### Business Models

The international market is far from homogenous. Globally there may be many business models, ranging from third party financiers charging virtual-prints-fees (VPF) to direct sales, which are being considered. In Europe, many parties are watching the development of US-based VPF models, where costs are shared between the exhibitor and the distributor via a third party. However, although some European exhibitors seem ready to move forward with digital cinema they are evaluating the various options.

Over the past year Dolby has worked to prove the viability of digital cinema as a technology and business model, and we have learned a great deal of what needs to be addressed for the international market. With more than 120,000 screens worldwide, these lessons are critical for the industry to embrace before we can truly expect widespread adoption.

# Digital cinema glossary

## Part 2

Like many new technologies, digital cinema can sometimes seem to have a language all of its own.

Part 2 of this short guide from Dolby explains some of the key new terms used to describe the operation, performance, and features of digital cinema equipment.

### HD-SDI

High-Definition Serial Digital Interface. A standard interconnection for carrying high resolution image data. Often used for connecting digital cinema playback systems to digital cinema projectors.

### Image Decoder

The portion of the digital cinema playback system that decodes the image compression. Some designs use dedicated silicon chips to do this, but these can only decode one image format and are therefore difficult to upgrade. Other designs use re-programmable or modular hardware.

### JPEG2000

An image compression technology developed for a broad range of applications. A specific new type of JPEG2000 has been identified by DCI for future use in digital cinema, so it is important that any digital cinema playback system has a clear upgrade path.

### Interoperability

Compatibility between different manufacturers' digital cinema systems. A vital industry requirement is the ability to replay a common digital movie file on playback systems from multiple manufacturers. A standard format has already been proposed but only some manufacturers are actively supporting this in the field.

### Key

A mathematical code that is used to decrypt (unlock) encrypted content. In digital cinema, it forms part of the playback license that enables playback of the movie.

### License

Also known as a Key Delivery Message (KDM). A standardised method of delivering security keys to digital cinema playback systems. The license contains the key necessary to decrypt a movie in a given cinema, plus information about how it may be used. Licenses are often distributed on USB memory sticks, but can also be carried on CD-ROMs, over a network, or even on the removable hard drive together with the content.

### Link Encryption

A local form of encryption used to secure the valuable image data as it passes from the playback system to the projector.

### Mastering

The process of creating the master digital cinema file package containing all the movie images, audio, subtitles, and any additional information. Mastering is performed on

behalf of the movie distributor at a suitable mastering facility. Encryption is also applied at this stage. The file package is then ready for duplication on to removable hard disks or transfer via satellite or cable for distribution to cinemas.

### MPEG-2

An image compression technology with a wide range of applications. High quality MPEG-2 encoding is currently used for digital cinema releases.

### MXF

Material Exchange Format. The open file format proposed for the interchange of movie file packages between digital cinema systems from different manufacturers. Only some manufacturers have so far demonstrated support for this in the field.

### Projector Configuration File

A method of storing various projector settings, including aspect ratio and colour space. Individual projector configuration files may in future be distributed with specific movie releases.

### Physical Security

Inside the digital cinema system, the movie data cannot always be encrypted, as it must be decrypted before the image can be decompressed. To prevent a pirate from opening the lid of the equipment and stealing the unprotected movie data inside, physical security can be used to prevent access to any parts of the circuit where valuable movie data is processed. Very few digital cinema playback systems currently offer physical security, even though it is required in the latest DCI draft specifications.

### RAID

Redundant Array of Independent Disks. Used in some digital cinema systems to enable very high-quality movie data to be played back reliably by storing the data across multiple hard drives. Hard drives contain moving parts and have a finite lifetime, so RAIDs can be used to ensure that a hard drive can fail completely, yet show playback will still continue unaffected.

### Redundant Power Supplies

Dual power supplies used on some digital cinema equipment to ensure that the show remains on screen, even if one power supply fails.

### Resiliency

The ability of equipment to withstand a non-ideal operational environment. This

is important for digital cinema equipment, as projection booths often have non-ideal electrical, ventilation, or operational characteristics.

### Server

See digital cinema playback system.

### SMPTE

An international body creating standards for the motion picture and television industries.

### Show

A term referring to a complete digital cinema presentation. This could include movie trailers, cinema advertising, and feature films. A show is assembled on the digital cinema playback system by selecting the desired pieces of content, called clips, and setting the running order. On some systems, shows can be scheduled for automatic playback at specific times, or can be triggered externally by an existing automation system.

### UPS

Uninterruptible Power Supply. A power conditioning device that is required for digital cinema playback systems with insufficient on-board electrical protection.

### User Interface

The way in which a user can control a device. Digital cinema playback systems sometimes offer different controls optimised for different uses – for example, illuminated keys for use by the projectionist during a show, plus a screen and mouse for setup of shows.

*Thanks to Dolby Digital Cinema for providing this glossary.*



# It's About Choice

## CHRISTIE CP Series (CP2000-X illustrated) 2K DLP™ DIGITAL CINEMA PROJECTOR

If you are considering D-Cinema for your theatre and haven't spoken to Christie yet, ask yourself this;

- Does my provider hold its own DLP Cinema™ license and look to meet DCI compliancy?
- Is my provider truly independent of OEM ties and in full control of the support they offer?
- Does my provider develop its own systems for Film cinema, E-Cinema and D-Cinema?
- Has my provider got real-world experience of a large-scale deployment of D-Cinema?
- Has my provider got real-world experience of a large-scale deployment of D-Cinema?
- Is my provider the digital projection supplier for the UK Film Council's DSN?
- Has my provider been responsible for more than 80% of UK Digital Cinema installs to date?
- Does my provider have a proven NOC to deliver remote monitoring and on-site response?
- Has my provider got more than 75 years experience designing systems for public cinema?

Don't make a rash decision. Please give Christie a call, we offer FREE consultation - without obligation.

**It's About Choice - be confident you made the right one.**



Visit the Christie Digital website for full Digital Cinema Projector details:  
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ViewPoint  
200 Ashville Way  
Wokingham  
Berkshire, U.K.  
RG41 2PL

PH: +44 (0) 118 977 8000  
FX: +44 (0) 118 977 8100  
[sales-europe@christiedigital.com](mailto:sales-europe@christiedigital.com)

