

On course for understanding DCPs



Jim Slater reports on a Skillset funded technical course at BFI

What is a DCP?

I remember that as part of an ongoing discussion on Digital Cinema the question 'What's a DCP?' was raised at a recent Cinema Technology Committee meeting by one of the members who knows far more about film-based cinema than I ever will. He was told that the Digital Cinema Package is the electronic equivalent of the reels of film that are traditionally delivered to cinemas - a set of files, usually delivered on a computer hard-drive, but that could equally well be received from a satellite dish, the files containing the pictures, sound, subtitles and audio descriptions necessary to show a movie. Now I obviously knew that, but not much more of the detail of DCPs, so was delighted when, purely by coincidence, I received an invitation to attend a Skillset-funded 'Digital Cinema Mastering Workshop' being held at the BFI.

This two day course on the theory and practice of the Digital Cinema Package had been arranged by BKSTS Member Peter Wilson, Chairman of the EDCF Technical Support Group, whose company **hddc - High Definition & Digital Cinema Ltd**, is involved with Digital Cinema standardisation and implementation around the world. Peter knows a good deal about most aspects of Digital Cinema and was therefore well-qualified to lead such a course, but he

had also managed to persuade a long-time colleague Jim Whittlesey, who is actually involved in the day to day mastering of Hollywood movies at DeLuxe, Hollywood, to act as joint lecturer. Jim's current practical experience and knowledge as a 'DCP Guru' was to prove invaluable throughout the course.

Theory and Practice

The idea of the course was to have the first day as a theoretical introduction to making and compiling DCPs - usually called 'mastering', with opportunities on the second day to actually get 'hands-on' experience of mastering DCPs. Since there are several companies in the market with DCP mastering hardware and software, Peter persuaded five of these to turn up with mastering equipment and specialised staff for what was to be a unique opportunity for the course members to try their hands at making a DCP for themselves.

The 'proof of the pudding' as to whether and what they had learned from the course, was to be a digital showing in the NFT's Studio cinema of the packages that the 'students' had actually created, with everyone else interestedly watching the results of their efforts. No pressure, then! The staff from Doremi, Dolby, Qube, Fraunhofer Institute and DVS played a full part, listening to the lectures on day one, and showing the course members how to create their own DCPs on the second 'hands-on' day.

I can't attempt to give anything like the vast amount of detailed information that we were presented with on the first day, but will just provide the outline, and tell you that the fact that we knew we were going to have put into practice on day two what

we learned on day one really did tend to concentrate the mind!

Throughout the day Peter and Jim presented a very well-balanced 'double act' (which was Abbott and which Costello I will leave to your imagination!) with each one talking about a few slides before handing over to the other speaker, dividing the topics according to their particular areas of expertise. The idea worked very well, and in the comfortable and 'intimate' surroundings of the BFI's well equipped Studio it was noticeable that the audience and speakers soon relaxed enough to be able ask and answer questions as the talks progressed, with all questions being answered directly and no question being regarded as 'dumb'. The technical facilities in the studio were very good, thanks to Richard Boyd and his team, and arrangements had been made to videotape the proceedings, a task done admirably by David Webb, which led to the room being well lit, with professionally arranged lights so that we could see the lecturers without spillover onto the screen.

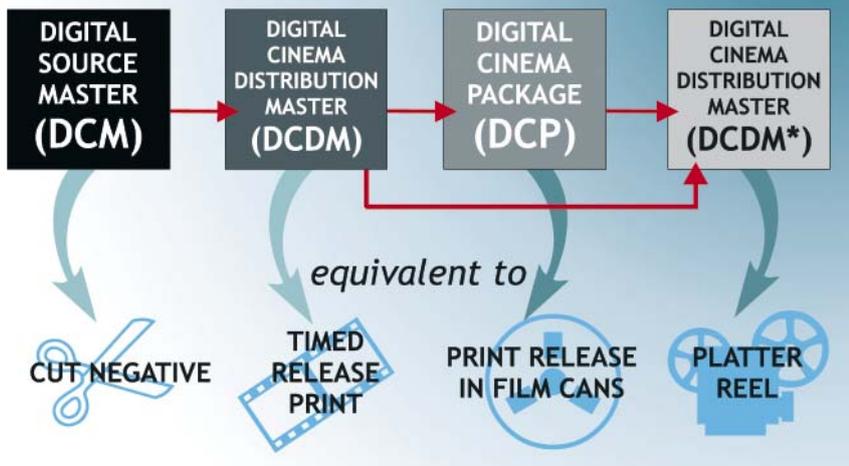
Nikie Piper, the Course Manager, who had done an efficient job in organising everything, welcomed each participant and handed out a course folder containing notes and a CD of the lecture slides. The audience mix was an interesting one. Apart from the company representatives, who were obviously experts, only a couple of those who had come on the course were actually involved in DCP mastering and needed to learn the skills - most of the others, including myself, were there because they wanted to know more about the process so as to be able to deal knowledgeably with other people in the digital cinema business when the topic of DCPs comes up.



Peter Wilson

Jim Whittlesey

SIMPLE FUNCTIONAL WORKFLOW



Workflow diagram showing how the Digital Cinema Package is effectively the electronic equivalent of the print release in film cans.

Learning the basics

We were given a summary of the history of Digital Cinema and a description of the role that Digital Cinema Initiatives (DCI) and SMPTE has been playing in standardisation in recent years, before Jim described the functional workflow of the DCinema process, showing how the DCP is the electronic equivalent of the print release in film cans. The packaging format is based on 'reels' which can be electronically spliced together to create a 'composition' which could include a feature, a trailer, a logo etc. Reels include parallel 'track files' containing image, sound, and subtitle elements, and the track files are bundled together into 'composition playlists'.

It was explained that Mainstream movies are no longer edited on Film, and the **Digital Intermediate** process was spelt out in detail. Other Digital Cinema basics were explained, and we were told how the picture elements must be checked for correct resolution and aspect ratio, correct colour space (XYZ) and correct first and last frames, and that sound elements must be checked for consistent bit depth and sample rate and correct channel assignment. The basics of the CIE colour space diagram were explained, and we were told how the XYZ colour space used in Digital Cinema can have a wide gamut suitable for both today's Xenon lamp sources and the even wider gamut laser-light sources of the future. It was interesting to learn that some 20% of the colour code values in the CIE diagram refer to light that we cannot actually see!

It is necessary to understand the many individual elements of Digital Cinema before tackling the ultimate goal of making a DCP,

so we were taken through many topics including the **DCDM** (Digital Cinema Distribution Master) and its image, audio and subtitle components, the Universally Unique Identifier (**UUID**), the anatomy of an **.mxf track file**, and the **JPEG 2000** compression system. The **CPL (Composition Play List)** is an XML document that defines how a movie is played, defines the order of play of the track files (Reels) and defines which portions of the track file are played. **XML** is a set of rules for encoding documents in machine-readable form, and we were shown how this is used to define the various elements that can appear in a DCP and their attributes.

The concept of the **MXF** standards developed by SMPTE for wrapping audio/video data into interoperable standardised file formats was discussed, and it was explained how this was adopted for use in Digital

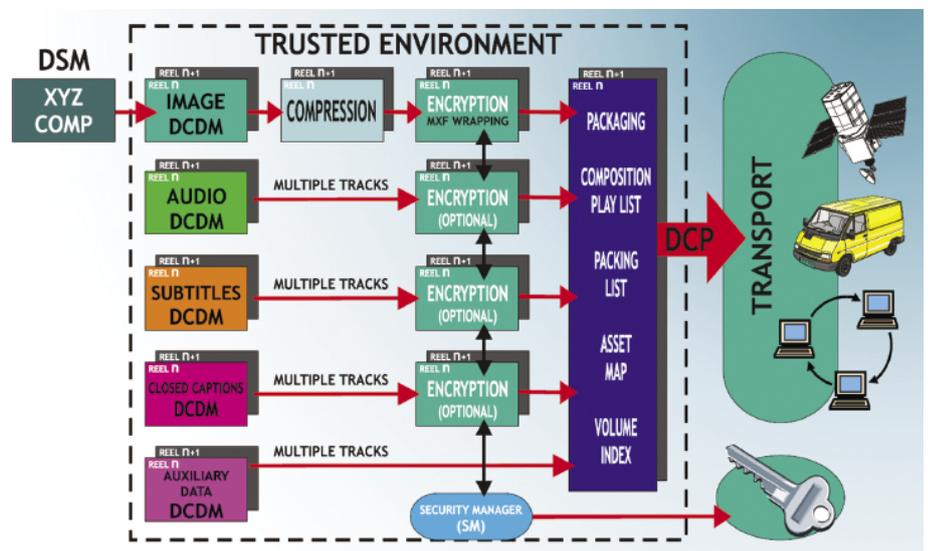


Cinema, with Peter managing to squeeze in his favourite illustration of how the different MXF wrapping layers work, using a Snickers bar with the various assets including biscuit, nougat and peanuts all wrapped in a chocolate layer before the bar is finally wrapped for despatch with a plastic security layer on the outside.

The importance of encryption and certification in Digital Cinema was explained, and we were shown how the all-important **Key Delivery Messages (KDMs)** can be generated in order to allow a specific DCP to be played out on a specific server at a particular cinema at a specified time, and how **watermarking** can be included if desired. Jim Whittlesey told how he had successfully tested the DCI watermarking system by camcording an in-house movie showing for a period of just over five minutes. It was encouraging to learn that when the resulting videotape was returned by the forensic security checking company it correctly provided him with the serial number of the server that had been used, together with all the technical details, including the time that the movie had been shown.

Putting it all together

All these preliminaries finally led to an understanding of how to put together a complete Digital Cinema Package (DCP), the set of files that is shipped to cinemas, containing all the files necessary for a feature film, a trailer or whatever, and we were shown that the package includes all MXF wrapped image and audio track files,



From Digital Source Master to Digital Cinema Package
The diagram shows the various steps involved in putting together a DCP ready for transport to a cinema

Digital Cinema Training



Peter Wilson and Jim Whittlesey put on a good 'double act' throughout the whole of the first day's lecture sessions.

Composition Playlists, a Packing List, an Asset map, and a Volume Index.

Throughout the day the in-depth technical explanations, inevitably sometimes a little 'heavy', were leavened by being interleaved with amusing personal stories from both lecturers about the practical aspects of digital cinema development that each had encountered along the way. This helped to develop a really friendly atmosphere within the whole group, leading to a natural interaction between lecturers and audience which overcame any reluctance to ask questions and developed a willingness to contribute practical experiences which helped everyone.

Day 2 - now let's see you do it!

When we gathered on Day 2 in one of the BFI teaching rooms it soon became obvious how much preparatory work had been put into the course by all concerned. Five separate sets of mastering equipment, hardware and software, had been put together around a huge conference table by the companies supporting the course, and we were divided into teams of three people and given five different tasks to undertake that would eventually result in each group making a DCP, which would be shown to the other groups in a grand finale at the end of the day. The five main tasks were:

- Make a DCP from the DCI StEM (Standard test and Evaluation Material) files that were provided. The JPEG 2000 compressed files were given to us as seven separate reels and we were also given .wav audio files conformed to suit. We had to calculate entry points and durations for each reel and put the whole package together.
- We were given a trailer in both flat and 'scope aspect ratios with leaders on both image and audio files, and asked to make a DCP containing both flat and scope Composition Play Lists.
- We were asked to make a DCP for a



Pictures of the course 'students' gathered around the five different mastering stations on the second day of the course, as they undertook the five practical tasks that had been set.

3D trailer, and to use the standard naming convention.

- A timed text subtitle track file had to be incorporated into a DCP of a trailer, and we had to change the original Chinese text of the subtitles to English.
- The final exercise gave us the chance to try out the JPEG 2000 compression system on each of the five different systems, so that we were able to compare the different user interfaces; again we used the STEM test material.

With a little help from our friends.!

Fortunately, we were not on our own, and in each case we were guided as to how to

undertake the five tasks by our devoted 'trainers', who were each very experienced in the art and craft of DCP mastering. **Lorna Lewis from Dolby, François Helt from Doremi, Claudia Roth from DVS, Susan Zacharia from QUBE and Alexander Schmidt from Fraunhofer** explained their different sets of mastering equipment and guided us through the various tasks, tuning their explanations to our different needs and helping us when we got 'stuck'! I was interested to find how different the various equipment packages were, and surprised to find that they varied in price from under £2000 to over £40,000. There was no question that the higher priced packages

provided more facilities and 'prettier', more user-friendly graphical user interfaces than the lowest cost package, but I was pleased to see that the lowest cost package would be within the budget of many a small cinema group, and this is important because it could enable them to assemble their own DCPs at a very modest cost, allowing independent cinemas to put together packages of locally-produced or art-house movies together with trailers and locally-produced advertisements for use with digital cinema projectors at film festivals or for local presentations, something that has so far been out of reach of those with modest budgets.

The proof of the pudding - just how well had we done?

It was with some degree of trepidation that late on the afternoon of the second day, having earlier handed over our DCPs (on USB memory sticks - no long epics here) to Brent Watson, in charge of technical logistics on the course, we all assembled in the BFI Studio cinema to see the results of our efforts.

The instructors began the rundown of the results, expressing their surprise and pleasure at how interested and involved all the students had been, especially considering that most of them were not in fact intending to take up mastering as a career, and they were kind enough to say that the results after just two days were actually very good. Brent, who had been given the job of ingesting our DCPs into the Christie Digital Cinema Projector, gave a slightly more realistic assessment when he reported that at first he had been unable to ingest some of our files. He explained that there had been problems with the UUIDs (Universally Unique Identifiers) on some of our packages, and that there were some other problems with the use of the standard Digital Cinema Naming Convention on others, but that, having seen what had happened he managed to persuade the digital cinema projector server to accept each of our pack-



The proof of the pudding - watching the final DCPs that the students had put together on the second day of the course - apart from a few tiny 'glitches' the DCPs played out without problems

ages. He also reported that even the DCP that had been encrypted with a KDM had worked properly first time. We then watched as each DCP was played out on screen, The main thing as far as I was concerned was that they all worked! A more critical analysis from our instructors highlighted that one clip had a problem in that it didn't show the subtitles - we had been told that a single error anywhere in the subtitle file could result in no subtitles at all showing. Another clip showed a small synchronisation error between sound and picture, and there was a question on another clip as to whether the surround sound was working. All in all, though, Peter and Jim said that they were pleased with the overall results and felt that with a lot more practice we could all go on to make quite reasonable DCP mastering engineers! I shall be sticking to my publishing, thank you, but I was interested to learn about the DCP mastering process, and to see that in fact there are numerous similarities between

making a DCP and preparing a modern magazine for publishing - QuarkXpress and Adobe Indesign publishing packages both require the assembly of a number of precisely tailored 'assets' - text files, fonts, pictures, colour swatches and settings and preferences before they will accept a document as being ready for sending to the printers, and both have 'pre-flight' checkers that highlight any potential problems, such as having included an RGB image instead of the required CMYK.

I enjoyed the course, as I am sure did all the others who took part, and I felt that providing training on this very new area of the cinema business was a very worthwhile use of the Skillset funding support. Look out for future courses from hddc. www.hddc.co.uk

Jim Slater