Quantel White
Paper

The DI business
model

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Digital Intermediate is one of the fastest growing areas of Post.

When any fundamentally new way of working is introduced, the process of adoption takes time. Until recently, the film industry debated 'why use DI?' and there were many misconceptions and unfounded doubts about DI. This phase of the discussion is almost over.

Now the debate is 'how should we use DI?' The fact that the debate has moved from 'why' to 'how' is a natural progression.

This paper has been put together to help illuminate the current phase of the DI debate for those thinking of becoming involved in DI. It is based on the real world experiences of film makers, post houses and laboratories that are already using DI. It's not a technical theory of DI, but discusses how practical issues about DI relate to making it a successful business.

Detailed technical information on DI can be found in the Quantel Digital Fact Book and Quantel Guide to Digital Intermediate at http://www.quantel.com/DFB

Quantel has been involved in digital film since the early 90s and today enjoys market leadership in DI. This market leadership is thanks to the quality of the work produced by a huge range of Quantel iQ equipped DI facilities, from small specialist post houses to multi national film laboratories, around the world. Quantel is working with leading DI facilities such as Centro, Cinecitta, Company 3, Deluxe, Duran, Fotokem, Peter Jackson's Film Unit, George Lucas's ILM, Modern Video Film, MPC and One Post to drive the DI revolution forward.

iQ has helped in many ways on hundreds of movies - everything from low budget independents like the Oscar winning The Fog of War all the way to recent big budget blockbusters like Bad Boys 2, Once upon a time in Mexico, I Robot, Collateral, King Arthur, Star Wars and Troy. If you are involved in DI at any level or are thinking of becoming involved, I hope you find this white paper useful. If you wish to share information or have any questions, please feel free to contact me at mark.horton@quantel.com

What do we mean by DI?

DI is sometimes incorrectly understood as the digital assembly and colour correction of movies. Companies that set up their DI business in the early days of the technology primarily on the basis of colour correction have either left the business or have changed their approach. Relying on a single customer for a single large payment on a single project - or on a single revenue stream - puts a DI house in a weak negotiating position. True DI workflows encompass several or all parts of the digital film pipeline, starting with pre-visualisation, on through assembly, colour grading, clean-up, effects, titles and mastering, with trailers, promotions DVD creation and extras as related areas.

While digital colour correction of movies is an important part of DI, any company or any manufacturer who has focused on that alone is exposed to the usual dangers of over specialisation, as some have already found to their cost. That's why leading DI houses have worked together with Quantel to build workflow business models based around a more comprehensive DI approach. True DI allows the film maker economies on the whole film project and allows DI houses multiple revenue streams from each project:

Production budgets (e.g. previs, on set digital services),

Post Production budgets (scanning, clean up, color grading, effects, titles)

Marketing budgets (trailers, teasers, electronic press kits)

Distribution budgets (mastering and versioning, subtitling, DVD creation)

True DI as a business model has other benefits for Post houses and Laboratories:
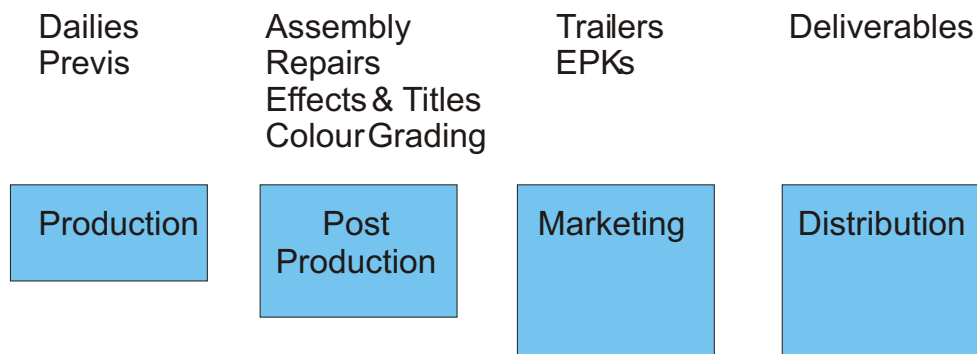
It's a robust growth business

DI activity can leverage other group services (film processing, duplication)

DI activity can leverage other in house skills (VFX, editorial)

Infrastructure and expertise requirements limit competition

Potential investors see more potential cash flow and more spreading of risk

True DI has a 'best fit' of chargeable services for which a DI house can be paid from the different film budgets. Relative budget levels vary depending on the type of movie but there is always money allocated to marketing and distribution potentially available to a DI house, especially the lucrative deliverables market:

Dailies Previs	Assembly Repairs Effects & Titles Colour Grading	Trailers EPKs	Deliverables
Production	Post Production	Marketing	Distribution

How are companies moving into DI?

Film Laboratories are now offering DI as a natural extension of their chemical/optical services. DI can 'feed' the existing Lab film printing business and also position the Lab for future digital projection services. Where the Lab is part of a group that includes DVD or duplication services, there is also an excellent tie in.

For Post houses there are a several strategies for moving into DI. Some Post houses have been offering services to film makers since their beginning - anything from screening dailies to digital effects. DI is a logical next step, especially for post houses with VFX skills that already produce substantial digital content for movies. Now they can offer a full package of digital services.

Post houses with colour correction expertise are offering sophisticated digital colour correction to film makers as an alternative to the simple colour correction possible in optical laboratory colour grading. Post houses with links to independent film makers can offer low cost, good quality movie post production based on Super 16 or HD acquisition.

There are many other strategies, with companies who originally offered titles, trailers or even audio successfully extending their services. DI is likely to become 'the' approach for all post production, requiring more than just colour correction from the systems involved. Why invest in one business when you could potentially be investing in many?

What is the best way of doing DI?

This sounds like a simple question but, as we have seen, there are several routes to moving into DI and therefore important differences. The background of the company moving into DI, its client base, people and existing equipment are all important factors. So, beware of anyone offering simplistic solutions to DI before they take the time to find out what you are trying to do. Technology booms inevitably attract new entrants with little or no experience. You may see statements like this:

"{Insert product name here} is an amazing machine… There have been over {insert number} sold in {insert city}. Add a few seats of {insert other product or products} to a {insert storage architecture} and you have a serious DI setup"

The politest thing to say about such statements is that there is no 'best way' of doing DI. It depends on what you are trying to do. There are however many wrong ways of doing DI as some have already found to their cost. A better question to ask 'what kinds of things do I need to consider if I want to offer DI'. The business decision needs to drive the equipment decision:

> Do I want to invest in scanning in or recording out or can I create a partnership?

Do I want to create a business relationship with a specific laboratory?

How many of the DI services (previs, colour correction, clean up, assembly, titles, effects, trailers, mastering, deliverables) do I want to offer?

How many DI projects do I want to make per year?

Will clients attend sessions or do I need to provide in house producers?

How will I be charging clients, especially for changes?

Will my clients start using digital acquisition and if so which formats?

Will my colourists come from Laboratory or Post backgrounds?

If I purchase equipment for DI do I also want to use it in other applications?

What existing equipment I have can be re purposed?

Once these and similar questions are considered, the next thing to consider is people.

The DI Human Factor

The relationship between a DI facility and its clients is critical to the success of the business. Clients will be excited to use DI but may also have reservations or misunderstandings about the DI process.

For a Post house, operating a DI facility is unlike traditional commercials, because of the much longer project time scales, the much higher levels of project management needed and the difficulty of charging by the hour. Colourists especially find that some clients need careful guiding through DI. The colourist wants the client to get the best result but the range of freedom that DI provides comes with a time/price dimension.

For a Laboratory, unlike traditional colour timing the film maker now has virtually unlimited possibilities to change colour and even has last minute editorial and effects tools immediately to hand.

Everybody wants the film maker to go away happy, so the client's expectations must be understood and the equipment and infrastructure must be able to deliver on time and on budget.

Proxies and long rendering times are a bad thing for client relations. Some DI systems use proxies and long rendering purely because they lack the ability not to. There are several major issues with proxies and long rendering that can impact the DI business model.

Proxies are bad because they can't show you what you are actually getting. There may be dead pixels, flicker or render errors that are not shown on the proxy. In the worst case (and this has happened more than once) errors aren't spotted until after the film out - or later. This is an embarrassment for the client and a financial disaster for the DI house. iQ doesn't use proxies - it doesn't need to and our customers don't want it to.

Long rendering times are bad because they slow down workflow in general and can mean an additional quality control cycle. Increasingly, many DI clients attend bookings. Naturally they therefore want to see the result shot during the session and sign off on a particular shot or sequence. If they have to come back later in the day or on a subsequent day to check the render, there may be requests for creative or technical changes. This causes client management issues for the DI house.

iQ's high processing speed and rich tool set allows client and artists to get to 'sign off' quickly. Additionally iQ's ability to work with external Pandora and daVinci real time colour correctors gives DI houses the option of totally render free working and provides a working environment familiar to Post colourists and their clients.

Acquisition & delivery formats for DI

While film remains the major acquisition format for DI, digital capture is increasingly important. A successful DI house therefore needs to service clients with both kinds of projects.

For film, LUT (look up table) tools should be comprehensive, offering both user defined and third party LUTs - Kodak and Arri are good examples of the latter. LUTs provide accuracy for judging film out colourimetry (and can show out of gamut warnings) but it's also important to judge digital projection characteristics and also how a project will look in HD and SD. Clients need to be confident that what they are seeing is what they will be getting. Quantel has extensive past & current experience in film and video colourimetry and with working with film scanner & recorder characteristics. Some manufacturers now launching DI products lack experience in one or more of these areas.

When working with digitally captured formats, a good DI operation needs the ability to work quickly and without compromising the material. Specifically this means handling HDCam and Varicam YCrCb (YUV) colour space correctly without clipping into an RGB cube, maintaining HDCam SR's RGB data without unnecessary transcoding to YUV, using Varicam's variable frame rate technology, handling RGB LOG FilmStream from Viper and working directly with MCF files from Tornado.

Also clients from time to time may want to use standard definition material - and they will want to do it at best possible quality, ideally without lengthy conversion times.

All DI systems on the market, except iQ, lack at least one (and in some cases several) of these capabilities.

DI houses should be able handle RGB, YUV, Log and Lin, progressive and interlaced, 8 and 10 bit without time or quality problems. This is exactly why iQ's resolution co-existence technology was developed. Shooting digitally will increase and it is important to the DI business model to be able to say 'yes' to new projects whatever the formats used.

Film Capture		Digital projection
	DI	
Digital Capture		Film Projection
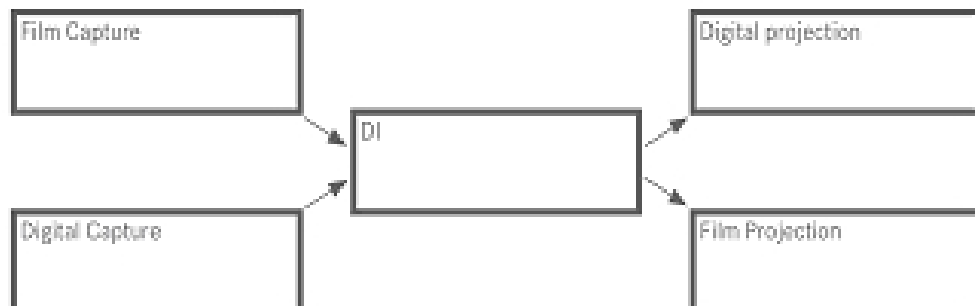
Technology architecture and DI

Having looked at the critical factors for DI success - the range of services to be offered, client interaction and choices offered, the final issue is technology choices.

Very early DI houses used what few tools were available at the time - either repurposed VFX systems or early 'virtual telecines'. Although movies were made, capital costs were very high, workflow was very poor and profits were negligible.

iQ changed that situation. Most DI houses with iQ do the bulk of the DI image processing on the iQ itself using iQ's own previsualisation, conforming, colour correction, titling and mastering tools. Increasingly iQ is also used to perform day to day effects without the need to tie up other compositing resources. Third party systems such as scanners, telecines, offline, 3D, SAN or NAS systems and desktop compositing packages work via background networking with the iQ, contributing to the 'Master Timeline' of the movie.

The iQ Master Timeline holds all elements of the movie and enables editorial, effects and grading changes to be executed easily. New timelines can be derived from the Master Timeline for directors cut's, language versions, airline versions, trailers, DVD extras etc. without the making moving and managing media and metadata hassles of transferring between distributed systems.

This way of team working using the iQ gives DI post houses significant business advantages. Client changes can be accommodated relatively easily and a whole range of chargeable derivatives can be made efficiently.

However, today the choice of DI tools is very wide. Just as, in recent history, everyone seemed to be making a PC based non linear editor, now everyone seems to be making a software based colour corrector. New DI software based colour correctors are appearing at a rate of about one a month. Typically these systems use a bits and pieces 'off the shelf' construction - software package, third party operating system, third party platform, third party control panel and third party discs.

A few of these products will survive and go on to perform a useful long term role in DI. However, true DI is about more than colour correction. This white paper isn't intended as a detailed technical discussion on DI but it's worth while considering how well such systems might fit into the DI business model.

iQ is sometimes used alongside such software colour correction systems to provide a central 'hub' supplying the missing tools (such as editorial, paint, effects and titling) and the missing horsepower (especially for multi format mastering). iQ's unique Resolution Co ExistenceTM & Dynamic RoundingTM technology also helps eliminate some of the issues with software based colour correctors in handling mixed format material, especially YUV, interlaced (few handle this correctly) and low bit depth sources. iQ of course has world class colour correction of its own - QColor. Often it's the case that the iQ is brought in to support a previous purchase of a software based system.

Workflow and DI

The latest phase of the technology debate in DI is around storage architecture and how to best handle the very large amounts of data involved in DI. Several kinds of DI architecture under discussion today propose 'eliminating local storage'. Instead, a number of effects, color correction and editing packages would work directly on a SAN which is responsible both for storage and 2K playback. The theoretical benefit is reducing time moving media between systems & reducing storage costs.

Storage architecture and workflow are important topics in DI and this is an area deserving serious attention. So, what criteria does any storage architecture need to meet to best support the DI business model?

We have seen the importance of client confidence and quality control. Use of Proxies needs to be avoided. SANs alone could be used for 2k playback if they could play full length movies non stop at 2k totally reliably, irrespective of fragmentation & level of user access. Any playback issues would otherwise impact client confidence and require some other device to be used.

If the SAN went off-line, work on the systems connected to it would need to be able to carry on (SANs are especially vulnerable to viruses if many systems are connected) otherwise productivity would be disrupted.

The SAN and any local storage on the connected workstations need to be RAID protected and have hot swappable discs (to avoid project disruption or even loss). Using RAID 0 (no protection) anywhere is risky. The greater the number of RAID 0 discs the more likely a failure.

DI projects often go through multiple changes and revisions so sophisticated clip management would be necessary to allow media deletion and version control between all the different connected vendor systems without accidents.

Versioning and deliverables are an important part of the DI business model. To avoid lengthy rendering times (and filling up discs with copies) the SAN would need to be able to mix formats without rendering and change formats on output on the fly. If this were not practical, additional equipment purchases would be required.

Metadata used in projects should where possible use an AAF data model. AAF is a cross industry technology created to alleviate the interoperability issues our industry and its clients suffer. As well as having widespread manufacturer membership, the AAF Association also numbers AOL/Time Warner, Ascent Media, E! Entertainment, the BBC and Fox amongst its supporters. A great deal of DI is collaborative and studios frequently have their own metadata requirements for project material. Interoperability and AAF based workflow will become an important topic in DI.

As clients increasingly use digital acquisition, the overall workflow through the system would need to accommodate RGB, YUV, progressive, interlaced, low bit depth, mixed frame rate and mixed resolution work without time and disc consuming conversions.

There are systems coming on the market looking to offer a multiple workstation/single point of SAN storage model but none meets all the criteria above. In fact some systems actually use local unprotected storage attached to individual workstations for rehearsal modes and require media movement between these and the SAN.

Currently available systems require a 'mix and match' collection of workstations typically from different vendors. This raises several questions:

First, there are practical workflow questions associated with metadata. When editorial changes inevitably happen, how do the various systems from different vendors update each other? How easily can deliverables and versions be made? What metadata is being used between systems - is it AAF (which iQ uses) or is it closed, restricting future purchasing options and possibly failing to meet future studio requirements?

Secondly, there are the practical questions of ownership. How many systems from how many vendors are actually needed to make the workflow efficient? Who takes overall service responsibility? How are software revisions between vendors handled to ensure continued compatibility?

Today, iQ is also used with SANs or other high volume external storage but in a way that more closely matches DI business requirements.

The high performance storage on iQ is used for material you need right now. It is fully RAID protected, has hot swappable drives (so work continues uninterrupted) requires no manual clip management (as it uses Frame MagicTM) doesn't use proxies, doesn't need defragging or consolidating and can easily handle mixed format projects through Quantel's Resolution Co-ExistenceTM technology. Low bit depth material is handled through Quantel's patented Dynamic RoundingTM technology. The iQ local storage is open to access by external systems and applications via QXML and sophisticated system to system background workflow is supported.

SAN or NAS storage systems are typically used for material you need sometime soon and data tape is used for long term archive. Any data movements take place in the background, allowing iQ to keep working and can be very fast (currently up to 2K at 22 FPS to and from some SANs). Quantel's 'Black Tagging' system allows incoming clips on the network to be inserted into a timeline before they have fully arrived and the iQ 'Master Timeline' means that anything from previz, test 3D renders, animatics, SD, HD and film resolution material can be played on the fly as they arrive without further conversion.

Once a project is locked down, the iQ can then easily produce a wide range of deliverables the client requires, including those requiring changes, without the need to export to external systems and without the need to produce unnecessary multiple images on the discs. Once a film is assembled cleaned and color corrected, doing the versioning for deliverables is very profitable for an iQ equipped DI house and very convenient for the client. The cost of deliverables is already factored into the film making process and clients new to DI are more accustomed to paying for them as for all the changes they may create along the road to getting there. Even a locked down project can of course get 'unlocked' so iQ's Match Settings technology copes with this eventuality.

This is a proven methodology today and it makes iQ ideally placed to make best use of emerging SAN and other storage technology in the future.

Non DI work in the DI business model

Last but not least, any DI house wants to maintain optimal use of resources. Film projects are very cyclical - like London buses you often wait for one for ages then three turn up at the same time. This can lead to 'boom and bust' cash flow. As we have seen, true DI allows the DI house - with the right equipment - to potentially offer lots of services at different points of the film's progress, from previz through colour grading, to trailer making and deliverables.

The range of services can be extended further. With the right equipment and workflow management, a well organised DI operation in a market with a limited number of films to be serviced can also offer restoration work, HD long form services and general post production between film projects. In this case, it is important that the people - and the equipment - have the ability to work on conventional post production projects. Investors like this approach as it has regular cash flow and efficient asset utilisation. Significantly the DI house also isn't over reliant on a single payment from a single customer which can otherwise give a weak negotiating position.

DI in conclusion

Building a DI business model that works always starts with the question 'what are we trying to do?' before asking anything else. Successful DI businesses like many other enterprises, are based on a combination of business acumen, people handling skills, infrastructure and technical expertise.

Quantel DI systems are found everywhere from small post houses making occasional movies to the very largest film laboratories. Go to any cinema today and the chances are some or most of the films have been helped to the screen by our customers. Our business model has been developed together with our customers - it works because it takes into account the differing needs of different people.

The growth of DI has been remarkable - just to give a quick example, at the time of writing this report, my local cinemas near Quantel were showing I Robot (DI on iQ at Modern Video Film), Troy (DI of 2 reels on iQ at MPC), Thunderbirds (DI deliverables on iQ at LipSync) Collateral (DI on iQ at Company 3), King Arthur (DI on iQ at One Post). Premieres of Wimbledon (DI on iQ at MPC) Code 46 (DI on iQ at MPC) and Man on Fire (DI on iQ at Company 3) were taking place. George Lucas's remastered THX 1138 (DI on iQ at ILM) was also being premiered and the restored and remastered Star Wars trilogy (DI on iQ at ILM) had just been re released on DVD in my local stores.

I hope you have found this report useful.

If you'd like to find out more about DI technical information the direct link is
http://www.quantel.com/domisphere/infopool.nsf/html/DIGuideIntro

If you wish to contact me the link is

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