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PRESTO
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AV Digitisation and Digital Preservation

TechWatch Report

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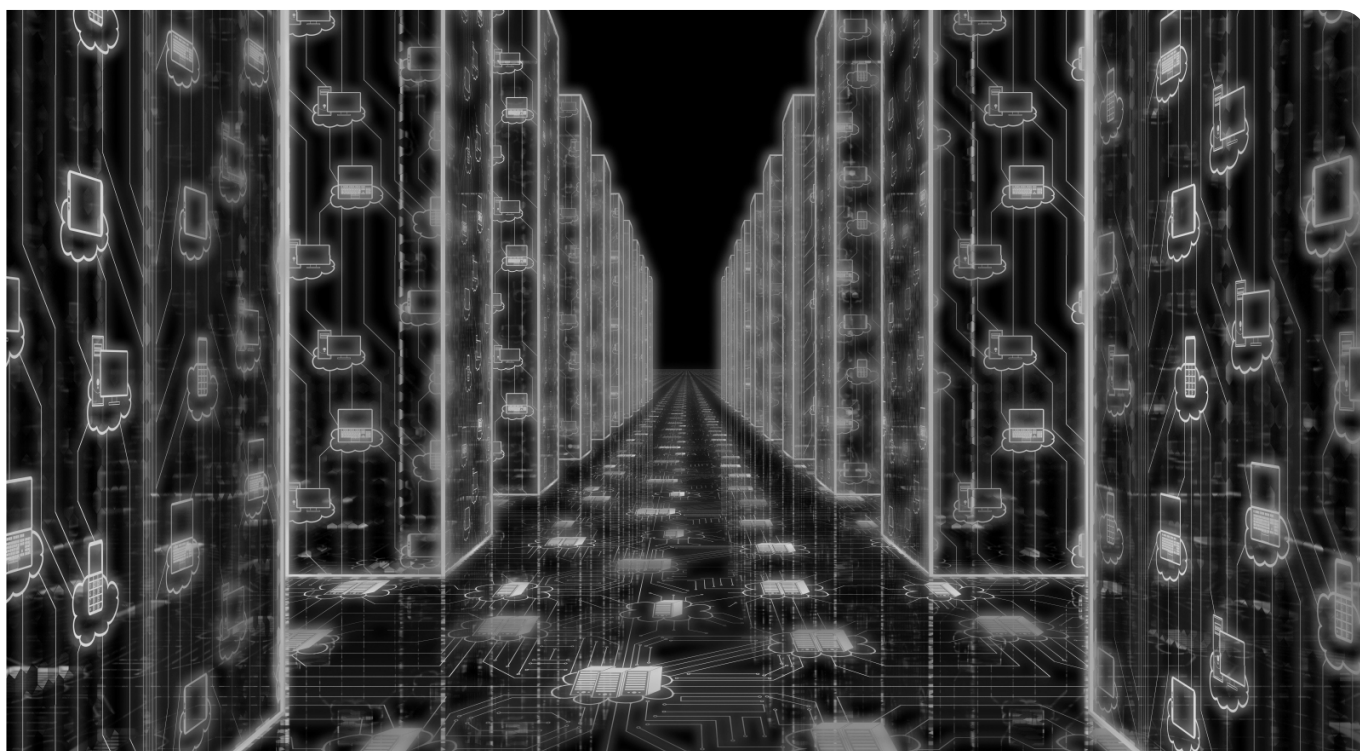
Contribution to this edition
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Foreword

Through the development of communities of practice during 2013, the Presto4U project has gathered information regarding the shape and scale of technical challenges faced by the audiovisual archiving community. In parallel, we have taken a deep dive into the technology supply side to gather information on products in the market today to see where research is heading that will hopefully solve the challenges that continue to exist.

This second TechWatch Report has been written by Members of PrestoCentre involved in the Presto4U project and was compiled through meetings they had with specialist technology vendors and researchers at the National Association of Broadcasters 2014 Convention (NAB). This TechWatch aims to provide audiovisual archive practitioners with a view of what is relevant, new and 'bleeding edge' in distinct areas of AV Digitisation and Archive technology.

This report is the second of three that will be published this year. The next report is planned late 2014 where we will take a look at the technology at IBC 2014 and how the tools reviewed in this and previous reports have matured over the year.

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1.   Workflow Management

There were two big themes at IBC. Or, to be more accurate, there were two themes, although neither of them was particularly big or original. Firstly there was 4k. Everyone is dealing in 4k, and no one is doing anything with 3D. Second theme is cloud. But of course, no one can quite agree on what they mean by cloud. Is it a local but large storage, or is it Amazon S3? There were also the glimmerings of the impact that high dynamic range (HDR) content capture and display will have. HDR screens from Warwick University were in evidence in the New Technology Park, but perhaps more significantly, Dolby were giving a first airing to their HDR workflow (meaning they have considered capture and production processing as well as a very impressive quantum-dot based display technology). And does this have any implications for archives? Well probably, yes, but in the longer term. We need to be aware that file sizes are continually increasing. High dynamic range means more bits-per-pixel, 4k means more pixels per image and more images per second. This will have a commensurate need for an increase in ingest times, storage demands and transfer loads, but inevitably investment in archive workflows and facilities will lag the demands that new formats put on them – as we will see, file transfer using "bunches of disks" will continue to be the only option available. We should not forget either that it is not only new formats that affect the viability of AV archives – formats which have failed to gain ground in the market place still need to be archived and be recoverable in the longer term. All three competing 3D technologies are still being used to shoot movies, even though, as Christie described, the numbers of movies shot in 3D, and the sizes of audiences prepared to watch them are both decreasing. Since 2010 the proportion of US movies made in 3D has dropped from 52% to 31%, and the proportion of audiences choosing to watch in 3D has dropped from 48% to 27% (64% to 46% amongst minors) [source deadline.com from MPAA data]. The new Christie laser projector may well push the Dolby 3D system to the top of the pack, but without an audience appetite to keep 3D in the mainstream we are likely to see some of the other formats disappear in the same way as did U-matic and laser discs, creating another headache for recovering archived productions in the future. And with Christopher Nolan (Inception and Batman) continuing to shoot on film rather than digital (he considers film a superior medium, even though the handling facilities are increasingly difficult to find) we still face the dilemma of which version to archive – is a digital workflow preserving the director's intention, should we preserve the 3D or 2D version, and which 3D format would we choose to preserve?

The main target of this part of the TechWatch was workflow solutions – to discover which companies out there have workflow products or developments that are going to be helpful to archive holders. The first thing to notice is that there are very few companies thinking about workflow solutions for archive applications as we know them. For most workflow and MAM providers at NAB their target is broadcast production and distribution. This is hardly surprising, since there is not a lot of money in archives, and as a target market they are mostly going to attract specialist companies who know the business. There is no evidence that new companies are entering the market place for the archive community, and conversely it is not obvious that the media asset management workflow tools being created are directly applicable to the needs of archives. Increasingly, production workflow providers are looking to 'the cloud' as a part of their solution (see for example Signiant and their forthcoming SkyDrop product or Dalet and their anticipated Amazon S3 tie-up). Some workflow providers are starting to open up their workflow products to non-proprietary third-party plug-ins, and are starting to get more involved with standards organisations as a means of keeping current and finding ways to incorporate standard interfaces into their solution (for example Cinegy of Munich), although many of the 'established' workflow providers still offer proprietary components or, like Signiant, deal only with accredited partner plug-in providers. We are also seeing a strong move towards software-only solutions, indicating that the workflow providers are moving away from the hardware components of transcode and storage and looking to 'license by seat' business models for shrink-wrapped software installations. Snell, for example, is developing its Momentum workflow product range to incorporate an increasing number of software devices (such as encoders, transcoders and QC tools) which might have been hardware in the past, but are now available and operational as software components. Several vendors indicated that they only provide the software, but that they 'recommend' the hardware specification that their workflow should run on, with the implication that they did not warranty the operation if their recommendation was not followed (there is, for example, different operational performance from Intel and AMD processors, so a recommendation for running on Intel processors might be made).

Interestingly, transport of content was raised by one experienced archive workflow provider. They maintained that, especially with very high bit-rate content (such as 4k) it still takes too long to transfer files into storage over the network, and in reality there are some high-capacity content owners

and producers shipping stacks of disks around the country in Transit vans, on the grounds that, in the right circumstances this can still be the highest bandwidth transfer mechanism, even though the Digital Production Partnership (DPP) are pressing for digital-only file transfer.

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We asked the question to each vendor we spoke to of whether they included a business analysis tool in their workflow solution. The responses ranged from a totally blank look ("what's that for?") to a couple of providers of tools who included a Business Process Model (BPM) module in the workflow that tracks costs and provides reports. It seems to be the specialist archive vendors who are more conscious of the need for this kind of facility, rather than the broadcast workflow providers, presumably because the dynamics of the two markets are very different. So companies like Crawford, Dalet and TMD, who are working directly with archives of AV content, often outside the traditional film & video space, are very conscious of the financial constraints which are faced by these organisations, and provide tools to help manage the finances and prioritisation of archives as well as those needed to track and monitor the content itself.

Good news from the show was the increasing awareness of the need to provide open interfaces of some sort for the inclusion of 3rd party components. This is part of the continuing shift from hardware to software thinking that is going on. Vendor 'lock-in' is less prevalent than it was, although there are still some large workflow provider companies following the proprietary thinking. This is of course a result of their own business models, and how they are looking to recover costs from their products. Providing a shrink-wrapped, closed product and an annual maintenance charge comes from a traditional product provision background, whilst the newer companies who are more comfortable in the software and IT

world seem to prefer the approach of licensing a customised workflow backbone with plug-ins for QC tools and software based conversion tools, either using standardised interfaces or published SOAP specifications, which is very much to the benefit of smaller, more budget-driven archives.

Something which is common to all the workflow products, whether proprietary or open, is the provision of a graphical user interface for constructing the workflow sequence. The sophistication of such interfaces means that it is easier for a non-IT specialist to view and modify the workflow without having to employ a consultant to do it for them, although a high level of expertise in the tools and operation of the workflow is still necessary, and close working with a supplier knowledgeable in the particular needs of archives and an experienced consultant is still the way forward for developing the most appropriate workflow solution for any particular archive need.

In summary there were a number of takeaways from this review of workflows and archives at NAB-14. Firstly, there are no unexpected changes in file sizes or formats on the horizon, but it is fair to say that the inexorable increase in file size will continue unabated. Even though 3D appears to be on the wane at present, its resurgence is surely only a couple of decades away in yet another form, and in the meantime the assets already produced in 3D stereoscopic format need to be preserved and accessible. Higher image resolutions, bits per pixel and higher frame rates are becoming a fact of life, driving the need for file storage capacity, transfer bandwidth and processing speeds, but the necessary technology developments continue to track some form of Moore's law, and there is no reason to believe that the technical needs will exceed technical capability, although inevitably there will be continuing technology updates needed by archives in order for them to manage new material.

Changes in the view of workflow provision are looking positive for archives, especially the smaller archives with limited budgets, although the big commercial providers are still focusing on production workflows and content producers with significant budget, using their partnership tie-ups with service and plug-in providers and proprietary components to maintain their commercial position. Nonetheless, there is an increasing number of companies offering software-only workflow solutions incorporating easy-to-use graphical interfaces to set up and structure the workflow that works for

your archive. There is a trend towards software only provision, with several solutions offering open interfaces and APIs – which means that quality control, monitoring, reporting, metadata management and external devices and plug-ins can all be used independently of the workflow provider, or can be specified as part of the deal. The more dedicated companies are very happy to offer a consultancy service, helping to build the best workflow for the archive as a service. Some providers talk about using commercial cloud services, and can offer interfaces to them (principally Amazon S3), although interfaces to 'private' or managed cloud services may make more sense for many archive owners. The final interesting addition to workflow solutions is the possibility of including business process tools in the workflow. This seems to be less of interest to the production workflow users, who simply want to get the job done, and so is less in evidence in the large proprietary solutions, but the means to track what is going through the system, how much it is costing and how long the processes are taking is a potential benefit that archives can take advantage of.

Overall, the future is looking positive for archives with specific needs who want to find a bespoke provider who can help design, supply and support a viable workflow option – so long as they avoid the large, proprietary 'out-of-the-box' solutions.

2. What's happening in Scanning?

The move to file based capture and workflows has had a major impact on the business landscape for all of the leading Scanner manufacturers in recent years. At a very high level this can be quickly observed at NAB as the main Scanner manufacturers have cut their cloth carefully this year, exhibiting from small stands with big changes to their companies, products and pricing strategy. Up to quite recently the Scanner market was a valuable high-end segment of the post-production hardware business. All of the biggest and best post-houses in the world invested high six figure sums in acquiring and running their scanners, the machines were always at the 'cool' end of the hardware spectrum, beautifully engineered and fascinating to watch in action they remain the coolest kit at the show (for geeks like me perhaps!) but now many of the manufacturers are shaken up by the massive change as post-production machines fall into disuse due to the complete shift from film based capture to file based capture in the majority of TV and film productions, it seems that now all of the future business for these companies will be in the archive sector. This will cause a shakeout in the scanner business, some companies will move away from this product area others will be acquired and some will inevitably disappear as the overall demand for this type of capital equipment decreases.

This shakeout and restructuring is well underway and evident at NAB with two major scanner manufacturers being acquired by other companies in the last year. DFT were acquired by Prasad Group and Cintel by BlackMagic design with two very different outcomes.

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Prasad were a major customer of DFT for many years, their acquisition of DFT (and Precision Mechatronics the engineering and manufacturing company who build their scanners) has been sympathetic to the company's structure and branding with many of the leading faces behind DFT remaining to provide continuity to its customers. DFT recognise that the market is changing towards meeting the needs of archives and position their scanners at the high end in terms of both price and quality with key features such as their capstan drive lending themselves to ingest of delicate archival film.

The acquisition of Cintel by Blackmagic is a very different affair, Cintel were liquidated in early 2012 and the assets of the company were bought by Blackmagic Design. Blackmagic Design are a leading hardware manufacturer in the video editing space best known for the DeckLink video capture cards. In recent years they have acquired a number of companies and have taken an aggressive strategy launching disruptive products providing high-end features at low prices, this trend kicked off with their introduction of the Blackmagic Cinema Camera in 2012 and looks to continue with the introduction of a HD Film scanner in 2014. However there does seem to be a pattern in terms of getting their products to market as was evident with both the Camera and Scanner where Blackmagic launched a prototype or concept product at NAB to see how the market engages before they lock down the product spec and begin to manufacture. The presentation of a sprocket driven 'Ultra HD' film scanner at NAB raised much interest, primarily due to the price tag of $30,000 which, if compared to the price of Cintels previous products sets it well below any of the companies legacy peers and well below most other manufacturers in the market. Pricing a scanner at this level sets it in a different category for support and maintenance contracts, the price to buy this scanner is less than the support contract on many top end scanners, however this of course does not consider the quality or features of the product. The striking marketing literature for the scanner is very 'design led' presenting a consumer 'lifestyle' technology product, in contrast to the more formal and spec driven marketing literature usually seen at the tech shows. There are some 'gotchas' as far as we could see that would need to be considered before investing in this product, although the scanner has audio inputs provided in the front panel the representative at NAB could not provide any recommendation for an audio track reader and stated that one is not currently provided by Blackmagic. The fact that the scanner uses a sprocket drive means that it will be unsuitable for any archive film that suffers from shrinkage, the representative at NAB told us that the tolerance level for shrinkage is around the 2% level, after that the product may have problems with film transport. The scanner will operate at real-time (up to 30fps) at what Blackmagic describe as 'Ultra HD' but it is not clear at this point whether this refers to the UHD standard of 3840 × 2160 or the 4K Native 4096 × 2160 in terms of pixel dimensions.

However the biggest gotcha was when the scanner will actually begin shipping, the system we saw at NAB was a prototype and Blackmagic were unable to give a firm date for

Exhibit 1: The Cintel Scanner from Blackmagic Design.

when the scanner would be available but did suggest that it will start shipping in the Autumn of 2014. Perhaps by then they will have figured out how to support audio, we will check in with them at IBC.

When it becomes available Cintel scanner will ship with a copy of the DaVinci Resolve colour correction software and easily hooks up straight to a Mac via a thunderbolt connection, overall a fantastic looking concept at a very competitive price and we look forward to seeing how it develops.

Another interesting new addition to the low cost end of film scanning is a Dutch company called FilmFabriek, the team from the Netherlands were at NAB demonstrating their

modular Muller HD film scanning system. Modular is the best way we can think of to describe their approach which is to leave the choice of components such as the camera and lens to their customers, they offer a 1CCD 1K and 3CCD 1k or 2K options. The scanner is hand assembled in Holland and comes with a Wetgate as standard and plates for 8mm and 16mm including both S formats, 9.5mm and Pathe film gauges (with an option for 17.5mm), there is no audio playback capability. A software program called Streampix is provided for file creation and image restoration tasks such as de-noising, stabilisation, sharpening, de-graining and auto colour correction, the system can create 8, 10 or 12bit uncompressed AVI or other formats such as DPX.
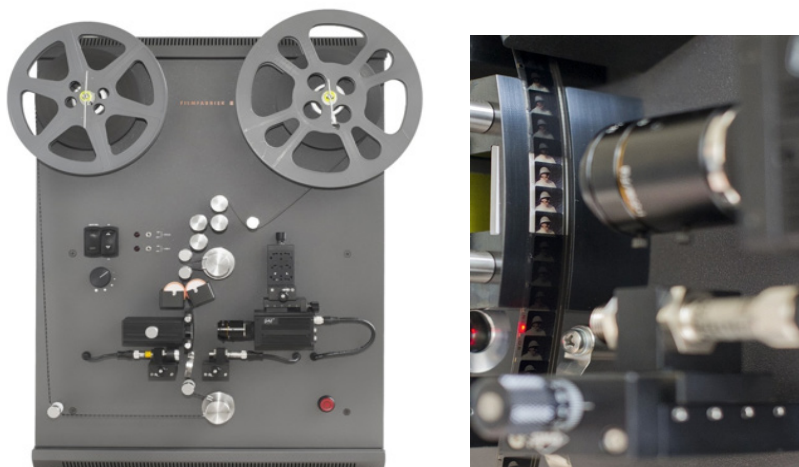

Exhibit 2: The Muller HD film Scanner from FilmFabriek – uses a roller drive with laser to align camera.

The scanner can handle negatives and colour reversal film and runs at between 10 and 18 fps depending on the target resolution and uses a sprocketless drive system which includes four cleaning rollers and a wetgate as standard. Given its wide feature set and simple operation this would make an interesting choice for access applications where a wide range of older or damaged film materials (shrinkage or damaged sprocket holes) are to be made available on a constrained budget.

Prices for the Muller HD film scanner start at around €15,000 without the camera which can cost between €3000 and €7000 additional depending on the spec, a generic high performance PC workstation to house the capture card and run the software is also required. FilmFabriek build the system to order and install with training on site.

In addition to their high-end Director scanner, Laser Graphics were showing a very interesting scanner for high-speed ingest called the ScanStation. This scanner is designed for use by non-technical operators and will scan at speeds of up to 60fps and includes soundtrack readers and direct synchronised output of audio and image elements straight to ProRes files with no need for any third party tools or encoders, this is a great approach for archive access projects where high volume throughput is required.

The ScanStation has a sprocketless drive and will auto adjust for film shrinkage handling 8mm and 16mm (including S formats) with a 35mm upgrade option (9.5, 17.5 and 28mm options are also available). The price of this scanner is US $90,000 for the 8/16mm version or $170,000 for 35mm. Another novel feature of the ScanStation is a built-in splicing table and a system feature that automatically finds the last frame and remains synchronised after a repair is made.

Other scanner manufactures at NAB showing new additions to their line-up for 2014 included MWA who have now improved their Vario and Choice scanner models to offer Native 4K 4096 x 3072 sensors. MWA have also improved the transport system on their continuous motion capstan drive Vario 16/35 model to achieve realtime 4K scanning.

Exhibit 3: Scanstation from Lasergraphics - designed with high speed / high volume access projects in mind

3. File based Video QC

Another area we focussed on for this year's NAB was file based QC tools, as we move from physical to file based media we must ensure that our digital assets are free from artefacts or errors introduced by encoders or the failure of playback equipment. In recent years a number of companies have emerged in this space such as Tektronix with their Cerify product and Interra who market Baton, more recently some new additions have arrived so we took the opportunity to look at some of the newer kids on the block.

Vidcheck are based in Bristol and were set up in 2009 as a relatively new company, however the people behind the company have been involved in the video quality space for many years and were actually behind one of the first products in the market: VQual which was acquired by Tektronix.

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Vidcheck have a highly integrated strategy in terms of how they see their products being used in the future, they tend to 'plugin' to other systems such as AmberFin, NOA, Digital Rap-

ids and Root6. This integrated approach has been supported by the development of the system behind a straight forward API that allows for easy integration with other systems such as encoders, MAM's or video editors. They feel that their stand-alone product will eventually disappear as their technology becomes part of the fabric of other systems requiring Video QC.

One feature that marks Vidchecker apart from other systems on the market is their automated repair features. The VidFixer component of their system allows for real-time repair of Luma, Chroma, Gamma and audio loudness issues that may be present in files. This is a great feature given that many of the traditional products on the market will detect problems but will not automatically repair them, so this development by Vidchecker is a very valuable improvement to the QC tool landscape.

One problem that some users and suppliers have in this space is the complexity of setting up a Video QC system, in many systems the operator is required to manually enter a very large set of parameter thresholds for a particular checking routine. Vidcheck recognised this can be a major barrier to progress (particularly where less technically trained operators are using the system), in an effort to overcome this time consuming task they have developed their system to automatically extract key parameters from a good piece of sample media provided by a user, this allows for a general set of quality thresholds to be automatically configured based on the attributes of the 'golden' sample file provided.

Exhibit 4:
Vidchecker file based QC tools.

The Vidchecker software is priced on a per channel software license starting at around $7000 for 4 x concurrent streams (as with all QC systems the throughput is dependent on the depth of analysis and the performance of the system running the software application). The Vidfixer component is an additional upgrade with pricing starting at around $10,000. Vidcheck are working on a pay as you go cloud based VideoQC service currently with a number of clients, however this seems to be at an early stage and no pricing information is currently available.

Another interesting new Video QC tool being demonstrated at the 2014 NAB show was the VidiCert Video QC software from Austrian company Joanneum Research. JRS will be familiar to many PrestoCentre friends and archives as they are a partner in the Presto4U project and have been at the centre of the Presto series of projects over the past decade as well as other well-known collaborative research and standards projects such as FIMS and MPEG.

VidiCert has been developed by JRS with the needs of archives and archive digitisation projects in mind, the system was launched in 2013 and is based on research undertaken in the European FP7 projects DAVID and PRESTO and as well as national level research projects in Austria such as VDQA.

Vidicert is a purely software based video QC system which runs on generic hardware, however as JRS is a CUDA research centre certain components of the system have been developed to run on GPU's delivering optimised performance for computationally intensive image processing tasks.
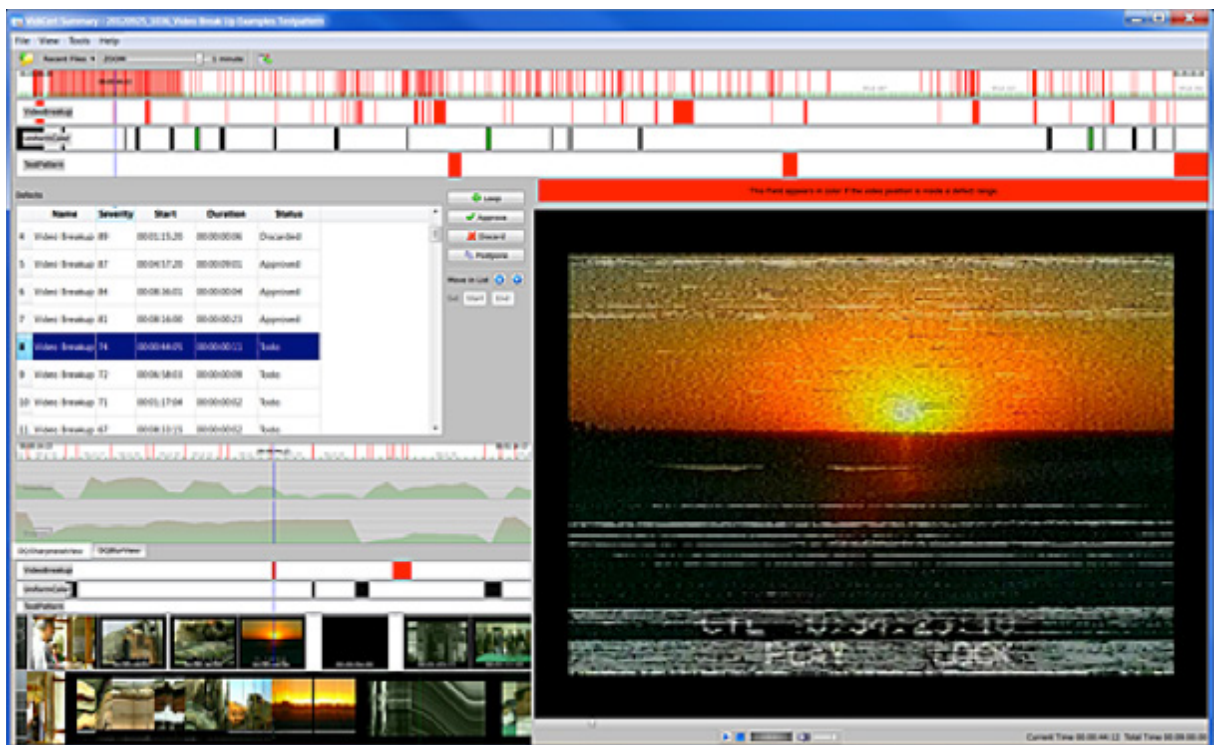

Exhibit 5: Currently Vidicert is offered by JRS as a standalone system and as a plug-in to CubeTecs video digitisation systems with other integrations planned in the near future.

4. Storage and Metadata Solutions at NAB 2014

In the storage and metadata area, the two most important themes observed at NAB 2014 were efficient and long-term handling of Big Data and personal archive solutions. With regards to this, new updates on LTO (Linear Tape-Open) Ultrium format were observed. LTO storage products offer ultra-high capacity reliable storage options. The combinatorial advantage of linear multi-channel, bi-directional formats and dual partitioning enables Linear Tape File System (LTFS), WORM (Write-Once, Read-Many), encryption, servo technology, data compression, track layout and error correction features.

LTO 6 drives offer 256 bit encryption and are up to 43% faster than LTO 5 tapes. Their storage capacity is up to 6.25 TB per cartridge. This is a huge leap forward in storage capacity (LTO 6 cartridges can hold more than triple the amount of data than that on a LTO 4 cartridge). This makes significant reduction in storage costs (1.3 cent per GB). The advancement in technology of LTO 6 ties in with the most prevalent trend in video storage and delivery as observed at NAB – 4K (see workflow section). LTO Ultrium-6 technology has up to 400 MB/s data transfer rates to improve efficiency which is over 1.4TB per hour of backup performance per drive. Both LTO 5 and 6 allow data access through two media partitions. With LTFS, one partition holds the content and the other holds the content's index. This can be beneficial in archive management as the archive is self-describing. This makes migration between file to tape easier and faster than before.[1]

According to a study done by University of California, Santa Cruz, more than 90% of disk stored data was never accessed again and another 6.5 was only accessed once. LTO 6 offers a cost effective storage and archival tape alternative to disk. LTO-6 users can simply drag and drop files as they would to a hard drive using LTFS software. Apart from broadcast, other areas where LTO-6 based archives would benefit include geospatial imaging, media and entertainment and personal collections. Further, many archive insurance companies are making it a legal obligation to enforce the use of LTO and LTFS.

With this ease of use, there is another emerging trend which is personal archives. The Archiware P5 Platform[2] offered an easy to manage solution for long-term archives along with the ability to annotate the collection with extendable metadata fields for effective search and retrieval at a later stage. The focus here was to make the process of archiving collections so easy that people with personal collections as well as large organisations could make use of it at the same time. More and more software based archive solutions are providing platform and hardware independent solutions and have an access layer (semantic search) to retrieve any segment of the archive in real-time. Desktop archival solutions are being seen as the future trend as more and more people are looking at the preservation of their personal collection and as the budget cuts in large organisations means that it is becoming increasingly difficult to make the case for a large scale archives with significant investment.

There was an on-going interest (after IBC 2013 in technology development for archival and preservation in cloud based architectures. Crawford Media's Archive3 package is an example of this. The argument here is that setting up a stable, secure and backed up environment for huge volumes of data is very risky and costs more than one would expect (with or without tape). They offer enterprise-class private data centres around the world for media archival purposes. Also on offer is a web based front end 'ENGAGE' which allows users to search, managet and retrieve any segment of the archive based on metadata, keywords, sound etc.

In terms of pure hardware solutions, LTO based archive systems ranging from 60TB to 1.18 PB (Petabytes) were the major players. For example the SXL-500 system from XenData[4] offers LTO scalable video storage from 200TB to 1.18PB. It is a NAS based architecture and comes built-in with an archive server with 6 to 2TB of RAID cache for archival and restoration. This eliminates any lag faced due to LTO storage. Another notable vendor in this space was Strongbox.[5] They focus on long time storage (20 years) with the ability to access data at any time and with a very low cost. Their main focus was on providing a NAS based storage solution much cheaper than competitors in the market. Again, LTO/LTFS was the chosen option here. StrongBoxT30 provides support for up to 1.6 billion files and with 21TB disk cache. It has support for both LTO 5 and LTO 6 as did most of the hardware solution providers.

1. http://www.trustlto.com/index.html
2. http://www.archiware.com/
3. http://www.crawford.com/?page_id=12799
4. http://www.xendata.com/products09/products.html
5. http://www.crossroads.com/data-archive-products/strongbox

As far as standards and metadata go, JPEG2000[6] and its relevant J2K[7] decoders were most prominent during the event. JPEG2000 supersedes JPEG standard and offer superior compression performance, multiple resolution representation, and progressive transmission by pixel and resolution accuracy and offers a choice of lossy or lossless compression. J2K-Codec is a JPEG2000 decoder which is easy to integrate and use. It is much faster than other competitors in this area (e.g. JasPer, OpenJPEG etc.) and offers support for Multi-core CPUs, video hardware and a simple yet power API with a C++ wrapper. All the archive storage vendors interviewed during NAB 2014 mentioned that they enable J2K support in their tools.

6. http://www.jpeg.org/jpeg2000/
7. http://j2k-codec.com/