

THE CLOUD FOR MEDIA:



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Enabled by



FOREWORD

The migration to cloud workflows within the M&E sector is advancing at pace. This includes the smallest post-production vendors, re-inventing themselves through necessity from the pandemic, right up to the largest content distributors, beginning to stream all their content from the cloud. As this Cloud for Media report highlights, the return on investment is justified by the time savings from increased performance and the ability to scale in more cost efficient ways.

A comprehensive security strategy underpins any successful cloud workflow. Without this you are taking unnecessary business risk and not taking full advantage of what the cloud offers.

At the DPP's September 2021 Media Supply Festival, Sky made an impressive live presentation about their new end to end cloud workflow which has been created in partnership with their third party SaaS application vendors. When asked what they saw as their biggest headache, Sky responded: "Security is the standout point. Don't come to us with a product that doesn't tick the basic security requirements. It could be the most amazing cloud native product, but if it doesn't have security, we simply can't use it."

While cloud providers do issue sound best practice guidance, implementing this isn't always straightforward, especially if you are doing it retrospectively. The number of vulnerabilities surfacing from an independent cloud security assessment, that a vendor was most likely previously unaware of, can be daunting. But there's a noticeable change in attitude and it's encouraging to see the supply chain embracing security which instils confidence for staff, partners and customers, ultimately making their businesses more successful.



Mathew Gilliat-Smith EVP, Convergent Risks

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THE CLOUD FOR MEDIA Post Production

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Introduction

In the DPP's 2020 report, *The Cloud for Media*, a picture emerged of the media industry on a rapid route towards the cloud. For many organisations, the most factory-like elements of the media supply chain, such as media processing and content distribution, were the first to make the leap. But a more mixed picture was seen throughout those areas in which creative craft is applied.

In early 2020, the world of post production seemed to be more conservative when it comes to the cloud

In general, the world of post production seemed to be a little more conservative when it comes to the cloud. Despite significant technology developments – from browser based editing to AI enabled automatic editing – the core of craft editing and finishing was more commonly performed on premise.

There were many understandable reasons for this:

- The need to deal with massive volumes of high resolution source media.
- Editors' requirements for specialist hardware interfaces, from jog wheel controllers to reference monitors.
- The need for purpose designed environments that provide ideal conditions for detailed colour and audio finishing work.
- Production clients' desire to work closely with post producers in a collaborative space.
- Requirements for consistent tools and interfaces, in order that staff especially freelancers can focus on creativity not technology.

However, that report was written in the early throes of the COVID-19 pandemic. Like so many of us, post houses and media companies had to find ways to work remotely during 2020. What many hoped might be short-term solutions ended up forming the backbone of their business for a year or more.



So after a year of remote operation, has the time now come for cloud based infrastructure and workflows to become truly mainstream in post production?

Has the time come for cloud to become truly mainstream in post production?

As people are allowed back to their workplaces, will post production houses continue to equip their server rooms with SANs and workstations? Or is cloud first post now the predominant model for our industry?

THE CLOUD FOR MEDIA SERIES

Post Production is one of four reports in the DPP's 2021 series, The Cloud for Media.

Each document in the series examines a different aspect of media in the cloud; the others focus on *Automating Media*, *Playout*, and *Streaming at Scale*.

These reports do not assume deep technical knowledge, but a high level understanding of key cloud technologies and terminology may be useful. We have therefore provided a brief accompanying guide, *Cloud Technology*.



Executive Summary

Post production is in flux

Post production has not yet moved fully to the cloud. Many companies have focussed on remote access to on premise hardware. But for those that are willing to make the jump, the cloud is ready to handle a wide range of post production workflows.

Connected hubs enable efficient ingest

Editing in the cloud relies on having media stored there already. To ensure that large volumes of media can be uploaded quickly, post production teams are creating ingest hubs at sites that have fast connectivity to the cloud.

Craft editing has gone to the cloud

Cloud based craft editing is now becoming widespread. This paves the way for the bulk of post production to take place in the cloud. It is generally achieved using cloud virtual machines running standard non-linear editing software.

Finishing remains largely on premise

High end content usually undergoes finishing processes such as grading and audio mixing. Currently, these processes are most often performed by downloading media to on premise facilities. More of these workflows will move to the cloud over time, though the cloud tools will still be operated from specialist environments.

Post production demands flexible spaces

Cloud edit suites can be operated from anywhere with sufficient connectivity, but creatives need appropriate physical spaces in which to work. Post production facilities of the future will have fewer server rooms and a more flexible mix of collaboration spaces, zero client editing stations, and specialist finishing suites.



Contributors

The content for this report has been gathered through workshops and interviews with subject matter experts from across the industry. Valuable input has been provided by our Expert Sponsors: Avid, Convergent Risks, and Object Matrix; and by our Contributing Sponsors: Base Media Cloud and LucidLink.

Although the content of this report has been informed by these discussions, it should not be assumed that every contributor shares all the views presented here.



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Understanding Cloud Post

KEY INSIGHTS

- Post production encompassess diverse processes, roles, tools, and companies. Some areas are more advanced on the journey to cloud than others.
- Visual Effects has been a leader, in part due to the immense computing power it requires, which the cloud is well suited to provide.
- There are multiple ways to move post production processes to the cloud – ranging from web based tools to virtual edit suites.
- In recent years, activity in cloud post production has shifted from proving technology to enabling creativity.

Post production is a highly diverse segment of the media industry. It incorporates boutique specialist facilities, in-house post operations at broadcasters, global service providers (often with specialisms such as localisation or QC), visual effects (VFX) companies, and more.

It can be difficult, therefore, to form a single view of the maturity of post production in the cloud. The most useful perspective is one which considers the different phases and functional elements of post production.



Post production is a highly diverse segment of the media industry, so it can be difficult to form a single view of cloud maturity

PHASES OF POST PRODUCTION

The following generalised phases are necessarily simplified. Not all of them will be used for every production, and each phase could in fact incorporate many different processes. But they nonetheless provide a useful framework for discussion.



In particular, rough cutting may be included, either as part of logging or as a first step in craft editing. Meanwhile, finishing could incorporate processes as diverse as online editing, colour grading, audio mixing, and more.

A note on terminology:

In TV production, the terms **offline edit** and **online edit** are commonly used, whether or not a proxy workflow is employed. Because online and offline can be confusing when talking about internet-connected workflows, this report primarily uses the terms **craft edit** and **finishing**.

POST PRODUCTION TODAY

In order to assess the maturity of the use of cloud across these phases of post production, the DPP gathered 20 experts from a range of different companies. Their insights, along with the real world experiences explored in case studies, form the basis of this report.

In general, our experts explained that some parts of the workflow – such as offline editing – are now relatively mature in the cloud. For others – such as finishing – effective cloud based workflows remain largely elusive.

Crucially, however, attitudes have definitely changed in the last two years. Where previously cloud post was characterised by technologists exploring the art of the possible, users are now looking to achieve their creative goals using cloud technologies.

Cloud post is no longer about technologists exploring the art of the possible. It's now about users achieving their creative goals

Although visual effects was not explored in great depth by our experts, it was noted that the VFX community is further ahead on the cloud journey than most. The huge computing capacity needed to render complex VFX shots leads naturally towards cloud render farms. And the need to access global talent means that remote collaboration has been widely used for some time.

WHAT DOES CLOUD MEAN FOR POST PRODUCTION?

The basics of cloud storage and computing are well understood by now. But as soon as we consider the complexities of a post production process, it becomes clear that moving it to the cloud is not a simple problem.

Moving the post production process to the cloud is not a simple problem

In a video editing session, for example, the editor is interacting with a complex software user interface (perhaps via dedicated hardware interfaces), and operating on a large volume of media. Is that media stored in the cloud and streamed in real-time to the editor, or is it cached on their computer? Does it need to be transcoded to enable this? Is the software itself running on the editor's computer, or in the cloud? If the latter, is it accessed through a web based interface or via remote desktop?

There are many possible solutions, each of which can be employed for different applications. Tim Burton summarised this well in our 2020 report *The Cloud for Media*.

66 There's three ways to solve the problem. There are editing tools that run inside a web browser. They've solved the problem by changing the tool. The next way is to bring the content to the person. So you put the edit system in a high power laptop and push the content or a proxy to them. The third way is to keep the compute and the content together in the cloud, and then use technology like PCoIP to stream an edit session over the internet.

TIM BURTON, 7FIVEFIVE

Browser based tools are now commonplace for certain use cases. One example is the fast turnaround world of sports, where production teams have been quick to adopt cloud based tools for quickly editing and publishing content.

Web based editing is commonplace for fast turnaround sports editing and publishing

These tools offer the ability to clip up key moments and publish them to social media, or edit them into longer form pieces with music and overlay graphics, for example.

Many also integrate machine learning systems for automated shot logging, which can be especially useful for high volumes of incoming content – such as college sports in the US. These capabilities are expected to have a growing impact on post production of all types, and are discussed further in another of the reports in this series, *Automating Media*.

However, browser based tools are used less in scripted production, especially at the high end. This may be partially due to the skills and habits of production teams, but it also relates to the technical limitations of web browsers.

These limitations can be overcome in time, however. The capabilities available today would have been unrecognisable to a user from ten years ago. Already, W3C, the leading standards organisation for the world wide web, has work underway to bring support for HDR video to the web.

In the medium term there will continue to be a mix of browser based tools, those running locally on the user's computer, and those running on machines in the cloud. But each will get more sophisticated, and that can only be good for post production as a whole.

The Importance of Ingest

KEY INSIGHTS

- Ingesting large volumes of media to the cloud can be slow. Many companies overcome this by creating physical ingest hubs with fast connectivity.
- For extremely large sets of content, such as existing libraries, it is even possible to send physical media to the cloud provider to be ingested.
- Real-time ingest of live content is challenging. But those challenges will be alleviated as live production itself moves to the cloud.
- Media Asset Management is more crucial than ever in the cloud. Not only does it enable users to find and interact with content, but it can help manage cloud costs.

In discussing the phases of post production in the cloud, our experts quickly identified that the first is one of the hardest.

Media must be uploaded to the cloud, and the files are often very large. Transferring content at home on domestic internet connections is likely to be very time consuming, slowing down the workflow. Home broadband is often asymmetric, which means it offers considerably slower speeds for upload (i.e. from the home to the internet – and hence the cloud) than for download.



A faster workflow can be achieved by uploading content from a location with high quality connectivity. In some cases, this will be a fast internet connection, while in others it will be a direct connection to the cloud provider's network.

Dedicated ingest locations can be created in production companies' offices, at post production houses, or even as dedicated facilities. Some companies mirror the workflow of a traditional on premise facility, by providing dedicated teams to ingest media from camera cards or drives, ensuring that it is managed and stored correctly.

Physical ingest hubs will be a critical part of future infrastructure

Many experts see physical ingest hubs as a critical part of any future cloud post production infrastructure.

BULK INGEST

For organisations with a significant back catalogue of media to ingest, major cloud providers offer a range of solutions. They can send empty hard drives to customers, who fill them with content and send them back. Or in the most extreme cases, they can drive a truck full of data storage media to a customer's premises, connect it to their local network, transfer the content, and drive it back to the cloud data centre.

> In extreme cases, cloud providers can send a truck full of hard drives to collect your media

This type of solution is only feasible for those with a huge volume of content and a need to ingest it quickly. In most cases, the more logical answer is to invest in high quality internet connectivity at ingest hubs, or direct connection into the selected cloud provider.

LIVE INGEST

Some organisations are less worried about ingesting old content than new. Major sporting tournaments, for example, can be creating tens or hundreds of simultaneous video feeds from an event. To get them all into the cloud in real time requires a huge amount of bandwidth from the venue.

A number of 'camera to cloud' technologies are available for this purpose. One option is to encode the live video feed from the camera, and deliver it into the cloud using protocols such as RIST, SRT, or Zixi.

Another is to save the video as files which can then be uploaded to the cloud. In this case, lower quality proxy files are often uploaded first, enabling the content to be viewed and edited as soon as possible. Larger full quality files are uploaded more slowly, or ingested later at an ingest hub.

Full quality real-time ingest of all camera feeds into the cloud is of course required when the live event itself is being produced there. As was discussed in *Live Remote Production*, this type of cloud live production is now possible, and although not yet ubiquitous it is becoming increasingly common.

Cloud live production unlocks the ability to instantly edit the content in the cloud

MANAGING INGESTED MEDIA

A final consideration highlighted by our participants was the need for excellent Media Asset Management (MAM).

The concepts of MAM, and variants such as Production Asset Management (PAM), are hardly new. There are many excellent asset management products on the market. But in production and post production, the maturity of their use has historically been varied.

In the cloud, MAM or PAM systems are essential for almost all organisations.

Media Asset Management is not a new concept, but the cloud makes it essential

Media in the cloud is usually housed in object storage, which cannot be easily browsed from users' computers, and which does not employ the traditional folder structures that are commonly used to organise media. MAM systems therefore provide critical playback, organisation, browse, and search capabilities for media libraries.

In addition, the different tiers of storage offered by the cloud providers make it important to actively manage where content is stored, in order to balance cost with performance. Doing so manually is prohibitive for large collections of content, whereas many MAM systems can automate this process.

And when media needs to be taken out of the cloud for local processing, partial restore (the ability to extract a segment of a media from a larger file) can ensure that only the required media is downloaded. Of course this saves time, but crucially it also saves on egress cost, keeping cloud bills down.

CASE STUDY



ACCESSING ATP'S ARCHIVE

Like many major sports governing bodies, the ATP Tour has its own content production and distribution arm, ATP Media. It is responsible for host broadcast production and content exploitation for men's professional tennis, covering 64 tournaments worldwide. As such, its library of content now spans over 30 years of tennis.

The ATP Media team needed to migrate their content from existing LTO tapes and disk based media, and looked for a managed service solution. As well as preserving the historic material, it was important to be able to combine it with current production media, and so a PAM feature set would be an important part of the offering.

They chose a private cloud solution from Object Matrix, which now incorporates 1Pb of replicated storage and the Vision PAM. The deployment also includes private fibre connectivity to ATP Media's premises, as well as on site at each event, allowing large volumes of content to be moved efficiently.

Even with fast connectivity in place, it was important to be able to retrieve the required content in the minimum time. ATP Media didn't want to have to download full match recordings just to extract a small clip, for example. As a result, partial restore capability was developed to allow editors to clip up content in the PAM and extract just the required media for download.



This flexible, globally accessible storage environment ensured that when the COVID-19 pandemic caused demand for remote access to explode, ATP Media was ready with a cloud solution that has continued to power its growing media creation ambitions.



Post Pandemic

KEY INSIGHTS

- During the pandemic, it was more common for post production to be performed using remote access to existing on premise facilities, rather than in the cloud.
- Such architectures, and hybrid variations, remain popular. They will continue to be useful for some time, alongside growing use of cloud post production.
- Whether the edit is running on premise or in the cloud, remote access enables new efficiencies, such as using teams around the globe to enable 24h production.

In 2020, the COVID-19 pandemic caused millions to shift to home working overnight. For many parts of the media industry, this drove a huge acceleration in the move to the cloud. But in post production, a different picture emerged.

> For much of the industry, the pandemic accelerated the move to the cloud. But in post production, a different picture emerged

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Some major broadcasters and service providers had already migrated supply chains to the cloud, and so they could edit content there too. And some organisations who'd already plotted a course for the cloud did indeed increase their velocity.

But for many more, the chosen solution was different: enable remote access to the existing on premise equipment. With capex investment in storage, workstations, and software licenses, it would have been wasteful to spin up new infrastructure in the cloud. And with large amounts of media on that storage, moving it to the cloud would have been time consuming and unnecessary.

18 months later, views on the future are mixed. One broadcaster told us that they were "very much able to serve our current needs with remote access into our office", while another contributor explained that, "it's where we find ourselves now, but it's only a stepping stone".

For some, hybrid solutions are seen as the best compromise. Technology solutions are now beginning to blur the lines between local and cloud storage, whether through syncing or streaming data. Some post production facilities see an opportunity to expand rather than reduce their physical infrastructure, creating their own small and specialised cloud offerings.

> Use of public cloud for post production will continue to grow, but remote access to on premise facilities is also here to stay

There is no doubt that more and more post production capability will migrate to public cloud infrastructure as time goes on. But remote access to on premise facilities is also here to stay, for the time being.

CASE STUDY

ENABLING HOME EDITING

The pandemic caused significant disruption to many companies, and VICE Media was no exception. Across 30 offices, staff had to begin working from home almost overnight. Initially, editors and producers were sent home with portable hard drives full of content, but that was not a sustainable solution.

Staff from 30 offices had to start working from home overnight. Many took hard drives full of content with them

In some teams, there were existing repositories of storage, but these were spread across cloud and on premise infrastructure in different locations. So the VICE team set out to find a solution that would enable editors to access the content they needed from home, as seamlessly as possible.

With a need to move quickly to ensure business continuity, a 30 day proof of concept was set up with LucidLink, employing their 'cloud NAS' technology that enables content to be stored in the cloud and dynamically streamed and cached to local devices.

BECOMING INDISPENSABLE

Confidence following the proof of concept was so high that all of VICE News production was moved across to the system. Although the initial use case was to enable editors working from home, the same system is now also often used by editors within VICE offices to access their content.

By moving content into the cloud, VICE has also enabled workflow enhancements that improve productivity. Editors around the world can now work on the same media, or even the same story or programme, employing a 'follow the sun' model. When an editor in the UK finishes for the day, for example, someone in South America could continue work on the same project. Cloud storage and remote editing has enabled VICE to increase efficiency by using a 'follow the sun' editing process

As noted in *The Importance of Ingest*, one of the major challenges is often getting content into the cloud in the first place. As some users are now allowed back into offices, VICE has taken advantage of the ability to use their premises as ingest hubs.

Staff make use of the fast connectivity at the company's physical locations to ingest content into the cloud, from where editors can access the elements they need. This hybrid approach offers flexibility to business users.

UNIFIED MEDIA ACCESS

As a company, VICE's global growth was rapid and organic. Its need for increasingly global workflows has led to a requirement for a centralised asset management platform.

The initial intention is to use a single asset management overlay to connect to many of the existing storage locations – both cloud and on premise – rather than centralising all media in one place.



An Iconik MAM system is being deployed, connected to the LucidLink solution. The archive will be moved to AWS Glacier, and other storage may be centralised later. But universal access, rather than centralisation, is the main goal.

CLOUD EDITING

The new systems have been highly effective in enabling editors to work from their own computers at home. And existing on premise edit infrastructure will continue to be used for the foreseeable future. But there is also an intention to use cloud hosted edit machines for additional flexibility.



Another proof of concept is now underway, with the BeBop cloud editing platform. There continue to be some challenges, especially with users' ability to connect their own peripherals such as control surfaces, which is not always seamless. But overall, results are good, with editors finding the systems performant and responsive.

The workflow change is significant though, requiring users to be trained on processes such as ingesting and managing media through the MAM, rather than plugging drives of media directly into edit machines. This is especially difficult when working with a flexible staff that includes many freelancers.

Finishing can still require an on premise step, as we explore further in **Online Stays Offline**. For VICE, the workflow involves conforming to the high resolution media, which can then be delivered to an on premise finishing suite, or accessed directly via LucidLink.

DEMOCRATISING TECHNOLOGY

The availability of editing in the cloud means that use of cloud resources sits in the hands of a broad range of users. This requires a change of mindset, and VICE has found that it is important to educate people on the cost implications of their workflows. Use of cloud resources comes with a need to educate users on the cost implications of their workflows

It can be tempting for users to see cloud storage as unlimited, for example, but it comes with a cost. Ensuring that the right media is retained on the appropriate tier of storage is crucial to managing costs. Similarly, users have to be taught that egress costs mean downloading all their content is not free.



The shift to an operational model means that we have to train people, who may not have a technical or financial mindset, that if they do things a particular way, it costs more.

DEE WASSELL



Head in the Clouds

KEY INSIGHTS

- Improvements in the performance of key enabling technologies have made cloud hosted edit workstations a reality.
- Post production houses are increasingly deploying zero clients, which provide cost effective and secure access to cloud workstations.
- Security in the cloud can match or better that achieved on premise, provided best practices are followed. These include access management, VPN connections, and monitoring.
- Cloud and on premise edit stations are not mutually exclusive; if planned accordingly, the two can be complementary.

The most common architecture for cloud post production today might be considered as an 'edit workstation in the cloud'. A cloud hosted virtual machine running non-linear editing software is accessed via a remote desktop connection.

Even a few years ago, such solutions were seen as unviable by many. But a number of key technical enablers have made it possible for cloud based virtual edit machines to become commonplace.

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Edit workstations in the cloud have rapidly gone from being seen as unviable to being commonplace

INCREASED PERFORMANCE

The first is the virtual machines themselves. Where earlier public cloud deployments typically relied on general purpose computing via CPUs, it is now possible to configure machines with graphics processing units (GPUs). The ability to use GPU acceleration for video decoding, encoding, compositing, and rendering, improves performance and enables much more advanced workflows.

Secondly, there have been advancements in the use of cloud storage for video editing work. Cloud providers have begun offering services including shared block storage and premium tiers of object storage. And software vendors such as Avid and LucidLink have built software layers that optimise the use of cloud storage for video work and collaboration.

Finally, the wide availability of high performance remote desktop tools has been transformative. Early protocols for remote desktop access were comparatively inefficient, essentially transmitting a full image of the screen many times per second. This required very large bandwidth, and/or caused quality and responsiveness to drop when bandwidth was constrained.

Wide availability of high performance remote desktop tools has been transformative

Modern protocols use multiple techniques to lower bandwidth requirements while maintaining quality. These include transmitting data only about the areas of the screen that have changed, using variable refresh rates, and other types of image compression. They also generally use UDP for data transmission, which is a network protocol with lower data overhead than the more common TCP. In many cases, the remote desktop session is accessed via an application on the user's own computer. However, it's also becoming increasingly common to deploy specialist hardware devices called zero clients. These are low cost hardware devices whose sole purpose is to connect to remote computers (such as those in the cloud), and to a local keyboard, mouse, and monitor(s).

CASE STUDY



THE ALL-CLOUD POST HOUSE

Green Rock began life as a boutique post production house in London. Increasingly, it works as much with brands as with TV producers, though recent credits include series for ITV and Netflix. So it was no small decision to take the business completely virtual.

The journey started in 2017 as a project to provide a central portal for content management, review, and approval. But as remote working became more normal, and with a desire to pioneer a more sustainable approach to post production, more and more of the business was virtualised. In 2021, the final step was taken, as Green Rock's six physical edit suites in Soho were closed for good.

What started as a central portal for content management grew into a complete virtual post production facility

BUILDING A VIRTUAL SOLUTION

Such a transformation doesn't happen overnight. The company has been working on its Virtual Creative Solutions product for a number of years.

Green Rock worked with cloud solutions provider BASE on the implementation of the platform. The foundation of the workflow is Adobe Creative Cloud, using BeBop Technology running on AWS. The virtual edit suites are integrated with the Iconik MAM running on Google Cloud Platform, with archive storage in IBM Cloud. The systems are made available to creative users through a branded portal, with Okta single sign on including two factor authentication. Additional elements of the toolset include DaVinci Resolve for grading, and BeBop Rev for both asynchronous and over the shoulder review.



EDITING EXPERIENCE

By offering an integrated solution, Green Rock aims to replicate the service level of a traditional post house, without the physical premises. The company offers traditional services such as managed ingest and content preparation, although customers can ingest directly if required via browser upload or hot folder synchronisation.

Editors generally find that around 20Mbps internet connectivity or above is sufficient to achieve a good remote editing experience. In recent years, it's become common for domestic broadband to offer speeds well in excess of this, making the solution accessible to many who work at home. A 20Mbps connection is enough to achieve a good remote editing experience, bringing it within reach of most domestic broadband connections

As with any network application, latency can be a limiting factor for long distance connections. Instances can be deployed in local cloud regions to overcome this, for example if for an upcoming project in India. However, Green Rock's clients have also reported working successfully across the Atlantic, with editors in the USA working on projects that were deployed in European cloud regions.

In most cases, full resolution media is used for editing. However, the cloud storage cost can be significant if the volume of media is large, so it is common for longer edit projects to use proxy media.

Following a conform, finishing can take place. This is the more challenging part of the process to complete in the cloud, and it is the most common point at which media may be downloaded for local work (as discussed in **Online Stays Offline**). However, this is generally only needed for higher end long form content, and a growing number of Green Rock's projects are able to be completed entirely in the cloud.

REALISING EFFICIENCY

Operating edit workstations in the cloud can be very cost effective, due to the economies of scale created when using shared infrastructure. However, it requires an understanding of cloud pricing, and a discipline around systems administration and management.

Running cloud edit machines 24 hours a day when they're actively being used for 8–10 hours is hugely wasteful, and that will be represented on the cloud bill. So it becomes necessary to actively manage the machines.

Similarly, content can be left to accrue on expensive high performance storage. Unlike on premise, the storage won't run out, but the bill will keep getting higher. So content must actively be managed onto appropriate storage tiers.

SECURITY BY DESIGN

The days when media companies dismissed the cloud as inherently insecure have been left behind. But it is also well understood that good security design and practices are needed in order to ensure that content is protected.

> The days when media companies dismissed the cloud as inherently insecure have been left behind

The level of security required in post production facilities has historically varied depending on the type of content being worked on, and this is no different in the cloud. However, the same basic principles apply to all organisations. It is important that thought is given to the requirements early on, so that systems can be designed with appropriate access controls, safeguards, and audit processes.

For those that have worked with on premise tools for many years, administration of cloud infrastructure and software could be daunting at first. But our expert contributors explained that there are inherent advantages to understanding and following cloud architecture best practices.

One of the most important is the use of identity and access management tools, which are offered by all major cloud platforms. They can be used to granularly control access to functionality, systems, and media, while providing a simple single sign-on experience for users.

Proper use of monitoring and logging can ensure that system administrators are given a complete view of activity, while real-time alerting ensures that any breaches or suspicious activity are responded to quickly.

Networks in the cloud, just as on premise, require careful configuration and management. For remote access, almost all of our experts reported using Virtual Private Networks (VPNs).

For cloud software companies, service providers, and media companies building their own cloud systems, it is recommended to consider the appropriate testing and assessment of security implementation. In some cases, such as when working with movie material for major studios, specific industry assessments may be mandated. In other cases, such as for major providers of Software as a Service (SaaS), clients expect particular certification. But even when such formal approval is not required, it is often highly advantageous to undertake third party reviews and tests.

CASE STUDY



EFFECTING CLOUD TRANSITION

Although it is small, Swedish visual effects company SWISS has worked on adverts for some of the world's most recognisable brands. Up until a year ago, the company's technology base was very much on premise. Even its website was served from an on premise server.

Before the pandemic, everything was hosted on premise, right down to the server for the company website

But in the middle of a pandemic, working from anywhere became essential. Remote desktop connections to on premise infrastructure using VNC were the starting point, before later moving to HP's remote workstation technology, Z-Central. But over time, a more ambitious plan led to the cloud.

Web servers and databases were moved to the cloud relatively easily, and media storage is partially hosted in Google Cloud. Alongside infrastructure moves, however, there has been a major shift towards the use of SaaS products for key business processes. This includes ftrack's Studio and Review products, which offer project management and media review, respectively.

The project management tool manages assignment of artists and coordinates their assets, tasks, and projects. Once a shot has been worked on, it can be rendered out of the creative tool (SWISS use animation and compositing tools including Maya, Houdini, Redshift, and Nuke) and sent for review. ftrack Review allows internal users to provide feedback and comments, as well as external client review.

SECURE WORKFLOWS

Security is important to all content companies. It is well known, for example, that those working on content for movie studios will be subject to particularly stringent security controls. But even in advertising, there can be a great deal of sensitivity around content security. A car brand wouldn't want their new model revealed ahead of its launch, for example.



Security has therefore been a key component of SWISS' move to remote working. They couldn't simply allow users to take home workstations full of high resolution content, so remote desktop was seen as more secure. Simple but important steps are being taken, such as enabling two factor authentication to access remote desktop connections.

The move to zero clients enables this to be taken one step further, meaning that users can only access the remote desktop, with no local computing on the device, and downloads to local USB-attached hard drives disabled.

Security is enhanced through the use of remote workstations accessed via zero clients, and access controlled online review tools

Authenticated online content review is another significant step, replacing a previously workflow that involved sending proxy media via file transfer solutions.

But ultimately, SWISS is a creative organisation, not a technology company. They rely on their vendors to follow best practices, so they look for assurances from their providers.

66 It's very important to us that vendors have appropriate security certifications.

ANDREAS WEIDMAN, SWISS

Vendors in turn often turn to specialists for advice, and to perform those certifications.

66 Part of our robust security measures at ftrack involves collaborating with third-party security experts like Convergent Risks, who conduct cybersecurity audits that outline any potential threats for us to resolve in the ftrack platform. Such specialist expertise plays a beneficial role in our security efforts as we build a solution that meets and exceeds the industry's expectations.

MAGNUS EKLÖV, FTRACK

NEW TECHNOLOGY, NEW SPACE

In the first quarter of 2022, SWISS will move to a new office, and the space has been designed with the assumption of a reduced on premise technology estate. The new space will have finishing suites with space for clients, though this will be separated from the main space used by the VFX artists, where zero clients will be deployed. Greater use of cloud technology will reduce the requirement for local render farms, while giving the company room to grow.

MIXED ECONOMY

Cloud and on premise edit machines are not mutually exclusive, of course. It is possible to have a mixed estate of on premise and cloud based edit systems.

For one global media organisation, it was necessary to employ different solutions to users in different regions. Those in northern and western Europe are able to connect via VPN to their cloud region in London with latency of around 10ms, which is usable for remote editing. But those in the United Arab Emirates suffered latencies closer to 150ms, making remote desktop experiences highly problematic. Although it would be possible to deploy editing in multiple cloud regions, the volumes and workflows involved mean that the simpler solution was to synchronise files to local storage for the UAE editors. When mixing cloud and on premise editing, the complexity comes from ensuring the right content is in the right place when it's needed

The complexity lies in ensuring that the right content is available in the right places at the right time. It is possible to proactively move and synchronise content either manually or using automation systems. And specialist storage management platforms are also available, to enable users to access cloud hosted content seamlessly.

CASE STUDY



EXPANDING IN THE CLOUD

A+E Networks has two main facilities in the USA: one in New York, and the other in Stamford, Connecticut. The latter is the main broadcast centre, where post production largely involves reversioning and QC of long form content, while the former houses the creative units which generate short form derivatives including promotions.

In 2019, it was common to be shuttling a large amount of content back and forth between the sites using file transfer technologies. A+E needed a more centralised solution to break down the walls between the two teams, and the cloud was the logical solution.

A+E needed to break down the walls between teams in different offices. The cloud was the solution Then when the pandemic sent staff home to work remotely, the need became even more acute. Staff initially worked from portable hard drives they'd taken home, and A+E Networks' existing cloud systems – a supply chain automation platform and a video sharing system – were hastily reused for hosting post production content. But those systems weren't designed for post production workflows, and capacity quickly ran out.

The strategy team started to look for new options, and rapidly alighted on LucidLink. Connected to A+E's own AWS S3 storage, the system allows editors on premise and in the cloud (using both Avid and Adobe editing software) to access the same media.

Because the storage is accessible as a filesystem on the workstation, it also allows existing hardware systems such as transcoders to access the same content, allowing for seamless workflows across the cloud and local infrastructure.



UNSCRIPTED, UNPLANNED

Only shortly prior to the emergence of COVID-19, A+E Networks had created two internal production labels in New York for unscripted content, Category 6 Media and Six West Media.

Production changed during the pandemic, but it didn't stop. More content was shot on phones, or recorded using video conferencing tools, or repurposed from the archive. But production output, and therefore post production workloads, continued to grow. So the shift to home working called for a new remote editing solution to be deployed quickly.

After some time using HP's RGS solution to access on premise workstations, they needed to scale up, and looked to the cloud. They adopted Avid Edit On Demand (EOD), and had such success with editing in the cloud that the platform was used for almost all of the unscripted productions' edit workload by summer 2021. Peak usage so far has been over 80 edit systems concurrently in EOD.

Cloud editing was so successful that there's now more workstations in the cloud than on premise

The on premise infrastructure is now being almost entirely used for promo creation and short form, while the cloud estate now houses around 1.5x the number of workstations as exist on premise, dedicated to long form production.

For the creative and technical operations teams, the cloud has enabled them to scale in a way that would not have been possible on premise.



Cloud editing has allowed us to probably quadruple our capacity for edit support

ED RUSSO, A+E NETWORKS

Really the only challenge that the team has encountered has been the time required to provision new cloud edit machines, which they hope will come down over time.

OUT OF THE CLOUD

These long form programmes are still brought back on premise for promo creation, however. In some cases, file transfer tools are used to move programmes back and forth, but most commonly LucidLink is used to enable media to be accessed by workstations both in the cloud and on site.

Finishing, meanwhile, is currently performed through an external service provider. This means that a traditional conform process is used to consolidate high resolution media and deliver to the external partner. A finishing suite is being built at A+E's site, though this will operate as an on premise system, using much the same conform and download process.

MEDIA MANAGEMENT

In addition to the main craft edit platform, another cloud editing tool was expanded and embraced during the pandemic.

Blackbird is now used for logging content, for online review, and also as a simple way to enable staff to access A+E's library of finished content. Thirty five thousand hours of library material has been indexed in Blackbird, from where users can now search and browse that content, view it, clip it, and download it.

Users can now access 35,000 hours of library content via cloud tools

This has been used not just by production and post production teams, but more recently also by legal and licensing teams to review content for international distribution.

Indexing such large volumes of content has caused some challenges in storage management. A+E Networks needs to manage the between storage tiers in order to optimise costs, but this isn't yet an automated process integrated into Blackbird. That means manually triggering a restore from AWS Glacier to S3 when high resolution access is required. What's still missing today is an overarching MAM. Blackbird provides simple access to the library of finished programme material, but it isn't a fully featured MAM, and it isn't configured to index A+E's separate libraries of masters and working content.

CONNECTED WORKFLOWS

For production teams, the workflow possibilities are now hugely more flexible than they were when using old on premise systems.

A typical producer's workflow, for example, might work something like this:

- 1 Browse Blackbird to find a piece of content
- 2 Generate a small reference file (in the AAF format) which incorporates a link to that content
- 3 Use the reference file to connect the media into their editing project, whether in the cloud or on their own computer

In this workflow, only these very small reference files need to be moved between systems. Because each system has access to the same content via LucidLink, the same media is available to them all directly.

ITERATIVE APPROACH

In totality, there is a complex web of tools in use across A+E's post production operations. This is largely a result of the iterative nature of the organisation's approach to technology development.

This isn't without pain points. In some cases there is doubling up of technologies or workflows, while in other cases – such as MAM – there are gaps in the toolset. But the payoff is that they have been able to respond fast, adjust the approach as business needs change, and deliver business benefits more quickly overall.

An iterative approach has enabled A+E to respond fast to changing business needs

Online Stays Offline

KEY INSIGHTS

- Not all content requires a separate finishing stage. But when it is required, it is most commonly still performed on premise.
- Higher bandwidth, combined with high quality colour accurate video outputs from the cloud, will enable more cloud finishing in the coming years.
- Wherever the computing and storage, specialist physical environments for accurate colour and audio work will always be required.

One phase of the post production workflow is still almost universally performed on premise: finishing.

Certain types of content can be completed entirely in the craft edit, and may not need a separate finishing phase at all. But for those that require processes such as colour correction and complex audio mixing, the need to work on full quality content with precision makes cloud workflows challenging.

For grading, the main issue is the need for colour accurate video outputs, usually delivered into reference monitors. Generally, remote desktop solutions do not provide high enough fidelity, while the commonly used IP video outputs are compressed, and may not be guaranteed to be colour accurate.

As one contributor put it, "when I'm thinking about online editing in the cloud, my concern is whether I can trust what I'm seeing and hearing."

dpp



With finishing in the cloud, my concern is whether I can trust what I'm seeing and hearing

For audio mixing, similar fidelity concerns apply. But it is also when editing audio that the increased latency of remote operation is most likely to be problematic.

For both video and audio, the physical environment is critical too. The use of dedicated hardware interfaces is more prevalent in finishing workflows, while specialist rooms are precisely lit, neutrally painted, and carefully sound treated.

In short, finishing workflows are difficult to perform from home. As a result, a significant majority of our contributors still prefer to keep finishing on premise.

WORKFLOW BREAK POINT

Although it is generally recommended to avoid moving workflows in and out of the cloud (to avoid the cost and time associated with moving content), there is a useful workflow break between craft editing and finishing.

In a traditional offline/online edit workflow, the two stages are interrupted by a conform process. The offline editor's timeline is recreated using the online (high resolution) media. But because the main editorial timing decisions have already been made (i.e. the locations of the cuts), the full source media is not required; only the segments that are used in the timeline.

The workflow break between craft editing and finishing enables media movement to be minimised

In a workflow with a cloud craft edit, the same technique can be applied. Only the required segments of media need to be downloaded or transferred for local manipulation on premise.

CASE STUDY

CRAFTING IN THE CLOUD

When Imagica Entertainment Media Services, Inc. (Imagica EMS) took on editing a major new movie in the midst of the COVID-19 pandemic, they knew they couldn't have multiple people sitting together for extended periods in a windowless edit suite.

Instead, they used a cloud solution based on Avid EOD to bring together a team virtually. The edit assistant ingested and prepared content from the ingest hub at the Imagica EMS premises, and the craft edit was performed entirely in the cloud. A staff editor worked in an Imagica EMS edit suite, while an additional freelance editor worked remotely from home.

The experience is based on a standard Media Composer interface, running on a GPU enabled virtual machine. Avid EOD manages the deployment, including running its NEXIS file system on top of Azure Blob storage to provide high performance collaborative editing, and enabling remote access via Teradici PCoIP.

For the editor on site, the experience was almost unchanged from using a local edit workstation. The content and processing were in the cloud, but the environment and interface were unchanged. The remote editor enjoyed the flexibility of working from home, and had access to the same media and software tools as their colleague at Imagica EMS's premises.



A remote editor at home had access to the same media and software as their colleague who was simultaneously working in an on premise edit suite

ON SITE FINISHING

Once the craft edit was completed in the cloud, the finishing was performed on premise. The edit sequence was relinked to high resolution media on site at Imagica EMS, where a comparatively traditional finishing process was completed.

As has been described elsewhere in this report, the need for mastering quality monitors, high quality audio environments, and physical control surfaces drove this choice. The end result is that the conform and finishing process worked very much like it would have done previously, without any significant extra complexity introduced by the cloud editing phase.

OPERATIONAL CONSIDERATIONS

The Imagica EMS team has used online review and approval tools extensively, but this was the first time using a cloud edit environment. So it would be expected that there were new complexities to consider.

Some administration considerations had to be thought through, such as the right amount of storage to allocate in EOD without over-provisioning. And additional tools were needed to enable communication between the editors, which was achieved simply using Zoom.

EOD can also route the editor's main video output to a Zoom virtual webcam or an IP feed (such as NDI or SRT) for over the shoulder viewing.

Crucially, the software was familiar to the editors, so no specific training was required. Some staff were initially nervous about using the cloud, and it took joint efforts from champions at Imagica EMS and Avid to overcome this.

But the experience was good, and Imagica EMS aims to position itself to be a leader in adoption of cloud technologies in the Japanese market.

REMOTE POSSIBILITIES

None of this is to say that finishing in the cloud is impossible.

One of our experts pointed out that colour correction is often performed shot-by-shot, by focusing on a representative still frame in each shot. This means that uncompressed frames could be loaded and worked on, before the processing is applied to the video. This avoids the need for the data rate of full uncompressed video playback.

When looking for colour accurate outputs, many have turned to the latest iPad Pro devices, which offer specifications coming close to a reference video monitor. They may not be sufficient for work on the highest value content, but our experts acknowledged that for many projects such devices represent a good – and comparatively affordable – option.

As protocols, bandwidth, and monitors improve, more and more finishing will undoubtedly be possible remotely, and from the cloud.

CLOUD CONNECTED FINISHING SUITES

The need for specialist environments for finishing high end content will not go away. But it is conceivable to build traditional-looking finishing suites with local monitors and control surfaces, but with the computing and storage in the cloud.

> It is conceivable to build full finishing suites with the computing and storage in the cloud

This requires a large amount of bandwidth, low latency, and colour-accurate video outputs from the cloud computing instances. Given the availability of direct fibre connectivity into cloud providers' networks, it is a realistic possibility. However, it is not one that is widely deployed today.

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Creative Collaboration

KEY INSIGHTS

- Collaborative working is critical to many of the creative processes that make up post production. A mix of virtual and in-person experiences will be required.
- Online review and approval is commonplace, proving highly convenient for many teams. It is a strong use case for cloud technology.
- Recent developments in 'over the shoulder' viewing solutions enable more immediate collaboration between editors and producers.
- There will be demand for flexible post production environments, for both individual working and team collaboration. These environments will offer specialist physical spaces and fast connections to cloud infrastructure.

Post production is often a highly collaborative process. At various stages, different members of the production team will review, feed back on, and approve the content.

Editors frequently work closely with producers sitting next to them in the edit suite. And in-person viewings allow groups to review the content in high quality, and collaboratively make suggestions and provide feedback.



Collaboration is seen as a hurdle to remote working by some in the post production community

As a result, remote working has been a challenge for some in post production. In some situations, nothing will beat the chance to view and work on content together, in person. But there are technical solutions which can be highly effective for most use cases.

They broadly fall into two categories: asynchronous review and approval, and 'over the shoulder' experiences.

REVIEW AND APPROVE

One of the earliest use case of online and cloud based tools in post production was for review and approval.

Whether a rough cut, fine cut, or finished programme, a video is made available via an online viewing portal. Common features allow reviewers to provide timecode-synced comments, mark up areas of the picture, and provide approval. Depending on security requirements, users may or may not be allowed to download a proxy (or full resolution copy) for offline review.

Such solutions are often integrated with MAM systems or editing platforms, and are available for audio and image content in addition to video. While there are on premise hosted options available, the need to offer viewing from any location means that cloud-hosted, internet-accessible systems are very common.

Indeed, they provide a first step into the cloud for many post production users.

Review and approval acts as a first step into the cloud for many post production users

CASE STUDY

FINISH

EVOLVING INTO THE CLOUD

Since its inception a decade ago, The Finish Line has been a distributed post production facility. But throughout that time, its use of technology and the cloud has evolved continually. In 2013, it moved from LTO tape to AWS Glacier for its archive. This ended up being the first of many steps into the cloud.

Moving the archive to cloud storage turned out to be the first of many steps into the cloud

More recently, that archive has been moved to Object Matrix MatrixStoreCloud, in order to take advantage of integrated functionality such as client viewing portals.

For craft editing, LucidLink is used to enable editors to work from their own machines while accessing cloud storage and sharing projects.





The company also maintains and operates its own servers, allowing projects with high security requirements to be remotely edited via Amulet Hotkey. This is often completed using zero clients which are sent to editor's homes.

Finishing takes place on local machines at over twenty different sites, with encrypted data replication between sites using Resilio Connect. LucidLink is also implemented during the delivery stage, to enable changes to be made to full resolution remote files, and delivery to automated QC tools.

CLOUD CHALLENGES

For many years, The Finish Line found that the biggest impediment to cloud based craft editing was licensing restrictions on running software in virtualised environments. Some post production work was moved to different tools to get around these restrictions, but this can be difficult due to the strong preferences and deep experience of editors and creatives.

As support for cloud based deployment becomes more widely available, more and more of The Finish Line's work is likely to be performed in the cloud. But the team continues to call for greater flexibility in software licensing.

REMOTE REVIEW

Cloud tools are used for review and approval, including various options for realtime 'over the shoulder' review, including Setstream.io. But The Finish Line team are particular advocates for asynchronous review tools, including Moxion, which they use for accurate reviews during finishing and for sign off of final deliverables.

The most significant challenge they have found with off-site review is ensuring that reviewers get a colour accurate view, especially for HDR content. To solve this, they mostly use iPads with HDR displays, which are easier to manage and calibrate than televisions, and cheaper than reference displays.

OVER THE SHOULDER

As remote working has increased, so has the importance of 'over the shoulder' workflows. These allow a remote collaborator, such as a producer, to virtually look over the shoulder of the editor, by watching their screen. There are multiple options for achieving this.

As remote working has increased, so has the importance of over the shoulder collaboration

Screen sharing enables the remote collaborator to see the editor's screen, generally including their editing software. This is achieved using standard tools such as video conferencing (Zoom, Microsoft Teams, Google Meet, Cisco Webex, etc all include screen sharing functionality) or dedicated screen viewing tools. Video conferencing systems are often chosen because they also provide audio or video communication between the users, to enable their conversation.

The second option is to take a video output from the edit system, showing the playback rather than the user interface. This is what would traditionally be displayed on a monitor within an edit suite, but instead is encoded as an IP video stream (using NDI, SRT, or another protocol) and made available to other users. In this scenario, a separate mechanism is generally required for communication between participants, but where bandwidth allows, it usually offers a higher quality video output.

A hybrid between these two options involves taking a video feed output from the editing system, and inserting it into a video conferencing system not as a screen share but a video source (sometimes called a virtual webcam). But whatever the technical method, over the shoulder solutions are now crucial to many cloud post production workflows.

BACK IN THE ROOM

Cloud post production will increasingly enable distributed working and global collaboration. But while users value the possibility for flexible working, many teams will still see benefit in meeting in person.

And even as it becomes more realistic to perform finishing using cloud computing, the hardware and physical environment requirements of these tasks mean that dedicated spaces will still be required.

So just as many businesses are emerging from the pandemic to redesign their workplaces to be more flexible, the same need is felt in post.

A number of our expert contributors called for post production specific flexible spaces. Or "WeWork for post", as some of them put it.

There is a need for flexible working spaces designed for post production

These spaces will be designed with the physical and connectivity requirements of post production in mind. But they will most likely be equipped with zero clients, enabling users from any production team to connect to their own cloud hosted edit machines.

When one considers that such spaces might also offer services and support to clients alongside the technology, perhaps this model isn't so different to a post house today.

But moving much of the infrastructure to the cloud could enable more facilities in more locations, connecting to the same cloud services. That in turn would deliver greater convenience and flexibility to more users.



Long Road to the Cloud

We began by considering the multi-faceted world of post production, and how difficult it is to make generalisations about the sector as a whole. So perhaps it is no surprise to discover that it currently exists in a state of flux.

Some post production workflows are being completed entirely in the cloud. Some remain entirely on premise, even if accessed remotely. And a great many use some hybrid of the two.

Indeed, we expect the predominant model for the next few years to be a hybrid. The industry is poised for a shift towards cloud as the default for craft editing of all but the most high end content. But many finishing workflows will remain on premise, for now at least.

The industry is poised for a shift towards cloud as the default for craft editing

It is clear that specialist physical spaces will always be required for high end post and finishing. But we expect that, over time, those spaces will become interfaces into remote cloud infrastructure, just as zero clients serve craft editors today.

The reasoning is broadly the same as for all moves to the cloud: access to the latest technology without being bound to capex cycles, the ability to associate operational expenditure to revenue, and the opportunity to focus on differentiated business value rather than commodity technology provision.

As one contributor explained with a smile, "my dream is to take all of our servers and sell them on eBay!"

The time may not yet have come for post production to exist entirely in the cloud. But there is no doubt that the cloud will be a crucial building block in the flexible post production workflows of the future.



The Cloud for Media series was researched and authored by Rowan de Pomerai.

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About the DPP

The DPP is the media industry's business network. It is a not-for-profit company with an international membership that spans the whole media supply chain, covering global technology companies, production companies, digital agencies, suppliers, service providers, post production facilities, online platforms, broadcasters, distributors and not-for-profit organisations. The DPP harnesses the collective intelligence of its membership to generate insight, enable change and create market opportunities. For more information, or to enquire about membership visit

thedpp.com

About Convergent Risks

Convergent is the leading provider of risk assessment and compliance services for the media & entertainment sector, providing assurance to vendors and content owners that systems and applications in cloud and hybrid workflows and are correctly configured and operating securely. Our experienced team of security assessors operate globally from our international offices serving EMEA, Asia Pacific and the Americas.

Convergent specialises in providing cloud and application security assessments for creative services vendors and SaaS application providers in the media and entertainment supply chain, using recognised industry best practices and standards. Our security assessment control framework has been shared with content owners and the trade bodies. It incorporates Azure, AWS and Google cloud best practices; CSA CCM; and OWASP based threat assessment web app & infrastructure penetration testing.

Other services include TPN and MPA site assessments; pre-assessment and remediation consultancy; Sanctum Hub management portal; SOC2/ISO/NIST readiness; privacy compliance; and policy development.

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