

# CONNECTIVITY, THE CLOUD AND THE CREATIVE PROCESS

A NEW APPROACH TO NETWORKING  
FOR A CHANGING HOLLYWOOD



# CONNECTIVITY, THE CLOUD AND THE CREATIVE PROCESS

## CONTENTS

1	Introduction
9	Development
12	Pre-production
16	Production
20	Post-production
27	Distribution
32	Source Notes

# INTRODUCTION

Even as it disrupted lives and stalled production, the Covid-19 pandemic created an opportunity for cloud services, network services and software developers who work with the entertainment industry. As social distancing and the need for remote operations forced storytellers to try new tools and processes, a new window opened for technologists to show that their tools can become intuitive industry standards.

That means dialog between the two communities is more important than ever. The artists and businesspeople who make movies and TV shows are focused almost entirely on creating and telling their stories. The technology behind their tools is at best invisible; at worst, it gets in the way. Under pressure of budgets, time and creative stress, patience levels can shrivel to zero.

The aim of this paper is to bring creatives into the conversation about how their industry is being transformed by cloud technology. It looks at the production process from idea inception to distribution. What do creatives want and need when they connect remotely and access the cloud? What's technically possible?

The use of on-premise storage, compute, specialized hardware and delivery services for transferring files, and for cooling systems to process and store them, is becoming, if not a thing of the past, no longer a foregone conclusion. The move of our workflows into data centers off premises (ie "the cloud") is increasing, as are the Software as a Service (SaaS) developed for work in the cloud.

It follows that next up for adoption is change to the internet itself, or how we actually reach the cloud. This discussion is usually one for networking engineers and architects, not creatives. When Hollywood asks "Where is the internet headed?" the answer tends to go only as far as "5G is coming" and that fast wifi is important.

***This paper introduces a faster, more secure, more scalable way to connect: an on-demand internet fabric acting as a gateway to the cloud and to a private media and entertainment community.***

Network variables like bandwidth, latency and jitter affect the quality of work within SaaS workflows and the creative experience itself. Therefore, it has become important to include this piece in any discussion about migrating to cloud.

Traditional fiber carriers, like Comcast, Zayo, Crowncastle, GTT and Lumen, have successfully provided services to many of the studios, post and VFX houses in media and entertainment. ***Now, a private internet backbone has become more accessible, and the door is open for agnostic partnerships with those carriers, expanding reach and drastically lowering egress costs as the acceleration to the cloud continues.***

## The Cloud: A Closer Look

“The Cloud” is something of an oversimplification. There are several different types of cloud environment—public, private and edge based, hybrid, multi—all calling for a less clunky, more nimble way to connect.

### Public Cloud

Accessible internationally by consumers and enterprises. In the media and entertainment industry, the primary providers are Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure.

### Private Cloud

Smaller clouds that are not accessible by the average consumer or are run on premises by the end user. Microsoft and Amazon offer private clouds, but here we are talking about equipment owned by and dedicated to one company, and limited to whatever fits in its space. The physical footprint can be massive or as small as a minivan.

### Edge-Based Cloud

There are many examples of private clouds with data centers and services near the end user, “at the edge” of wide area networks. Some have been acquired by cloud service providers. Edge based clouds improve user experience and are instrumental for content delivery networks (CDNs) in their aggregation of data for region-specific streaming. As well as providing pathways to these nearby clouds, PacketFabric is moving into data centers at the edge and will soon be “renting out” its ports there to virtual computer users, a scalable service called Distributed Edge Compute.

### Hybrid Cloud

Defined by a company’s self-managed equipment which is housed and powered by a third party colocation data center, and connected to the company’s campus and often, the public cloud. A user example is Digital Domain, one of many M&E enterprises using hybrid clouds.

### Multi Cloud

Some companies use multiple cloud providers for different steps in their production pipeline. In addition, vendors working on specific aspects of a project may use still another CSP, requiring yet another connection.

Given the relatively recent change in both the landscape of network connectivity, and the emergence of varying cloud strategies, this paper looks to apply a creative perspective to the holistic definition of “working with the cloud,” especially the ways of getting there and back.

***Whatever the size and distance of the “cloud,” and however it’s defined, a private pathway as an alternative to the public internet, is key.***

## Connectivity Then, Now and Tomorrow

Here is a brief overview of the trends in connectivity as it relates to film and TV production:

### **The Public Internet**

This is the model that led to sneakernet for manual file transfer, in large part because the public internet is simply not secure and didn’t have the bandwidth to make large file movement fast enough. Everyone traverses it, with intentions ranging from noble to nasty. Its inherent insecurity led to the misconception that using the cloud itself was not a safe thing to do.

5G internet service, when and where it becomes available, will improve public connectivity. But even then, there are doubts that the public internet will be up to the task of securely moving petabytes of data for real-time VFX artistry, precision finishing, rendering and other jobs in a timely manner, wherein the goal is hours and not days or weeks.

The arrival of VPN tunnels and dedicated links has created a more personalized and private network, albeit still via the public internet.

### **Private Networks**

Traditional service providers, Comcast, Spectrum, AT&T and others, comprise media networks that run dedicated connections through data centers where equipment for those individual companies are housed. Since the network is beholden to that carrier or ISP (internet service provider) only, and is not agnostic or carrier neutral, connectivity is limited to where those PoPs (points of presence) exist.

Expanding those networks to new cloud locations and clients entails costly rebuilds which take time to spin up and troubleshoot. Once in place, changing nimbly between clouds and regions is still limited. Sohonet Media Network is currently the most popular, and the primary private network for media and entertainment.

### **Networks as a Service (NaaS)**

***The on-demand networking model of today is a private internet fabric that allows users to create their own virtual connections and cloud pathways within minutes as an alternative to, or with, any traditional service provider.***

With transfer capability ranging from one gigabyte per second to multiple hundreds, they are full connectivity systems, allowing agile movement via more PoPs than most, between clouds, data centers, and client locations. The network itself is private, secure and does not require additional VPN technologies, tunnels, overlays or links to manage.

The creative-friendly model is portal accessible and demystifies the traditionally outsourced, laborious process of working with telecom carriers, eliminating the problems of cost, time-to-provision, and bandwidth.

## NaaS Meets M&E

With all the phases of production, sub phases and workflows involved in the M&E pipeline, multiple cloud service providers (CSPs) are often enlisted for their varying specialties. Because they're competitors, however, they don't provide direct access to one another.

PacketFabric's NaaS offers a way to create and coordinate a multi-cloud production pipeline. Their proprietary cloud routers allow the public clouds to be stitched together and accessed at will, allowing easy transition between CSPs, useful for collaborators or vendors working in different cloud environments.

When a middle-mile service such as PacketFabric is paired with a network like Sohonet, the connections already in place gain expanded access to everywhere and every service.

Ultimately, cloud-based creative applications and complex workflows through all stages are an API or point-and-click away; to be accessed on-demand and billed only per project.

"Three things are really rapidly accelerating right now," said Dave Ward, CEO of PacketFabric. "One, use of the cloud; two, private network fabrics, but then three—distributing that cloud to the edge, bringing it nearer the user; and also having the capacity to move petabytes, full seasons of raw footage. It would be a mistake for the industry to think it has to wait for 5G. If they do, they may find it's a dream that doesn't come true."

## A Pre-Pandemic Trend

"Hollywood" is a fairly nebulous term, shorthand for show business as it relates to scripted TV and feature film production. Its artists and professionals, whether freelance or company-employed, work not only in Los Angeles' 90028 zip code, but all over the world.

Aside from the pandemic, which created an unprecedented need for remote and cloud based work, several non-Covid factors were already driving the trend of decentralization and remote work.

"Three things are really rapidly accelerating right now," said Dave Ward, CEO of PacketFabric. "One, use of the cloud; two, private network fabrics, but then three distributing that cloud to the edge, bringing it nearer the user; and also having the capacity to move petabytes, full seasons of raw footage. It would be a mistake for the industry to think it has to wait for 5G. If they do, they may find it's a dream that doesn't come true."

1. Tax incentives and lower labor costs attracted production to locations all over the map. FilmLA's list of the top 10 TV project locations in 2019 was more diverse than ever, with a growing number of shoots in New Mexico, Georgia, New York, the UK and Canada.<sup>1</sup> This created a global workforce that doesn't always speak the same language—and doubled down on the need for user-friendly, easy-to-learn tools.
2. Scaled cloud operations promised reduced capital expenditures on line items such as building leases and on-prem hardware, while allowing more operating budget room for data-intensive processes like VFX.
3. The growth of OTT streaming services added to the long list of studios already outsourcing productions. Technology decision makers vary for those independently run companies, but almost all are focused on a “story first” principle, and favor the practical and tested. At the first signs of workforces becoming more decentralized, it became clear new methods were needed.

Pre-Covid production in general was healthy; in the UK, film and high-end TV spending was on a record pace.<sup>2</sup> While the pandemic stifled live-action projects, animation went full speed ahead once artists began working remotely.

In its visionary 2019 paper *The Evolution of Media Creation*, MovieLabs, a joint venture of the major Hollywood studios, foresees a merging of the main production phases in a world where virtually all work is done in the cloud.<sup>3</sup> Research for this paper found that process to be clearly under way.

Movielabs' industry experts set out 10 principles for the future of media creation in 2030. The first principle: “All assets are created or ingested straight into the cloud and do not need to be moved”—everything from first script to raw footage, edits, visual effects and meta-data. Cameras, mikes, sensors and even script supervision systems will feed straight to the cloud, the study envisioned.

In February 2020, the Hollywood Professional Association (HPA) hosted production of a proof-of-concept short film showing how camera output could be streamed to the cloud. In it, a cloud-based integration of Colorfront and Frame.io was used to stream camera originals to the AWS cloud, allowing instant playback for dailies, editing and VFX.

In August, Universal announced that it was beginning the process of moving its on-premises film and TV production to Microsoft's Azure cloud platform. “Covid is certainly an accelerator,” Michael Wise, CTO of Universal Filmed Entertainment Group, told *Variety*. “But we knew this was the way we had to go long-term.”<sup>4</sup>

When Hanno Basse, former CTO at 20th Century Fox, became Microsoft Azure's CTO for media and entertainment in April 2020, he and his consultant team conducted dozens of interviews to see what creatives wanted from cloud technology. There were two main things:

“With Mike’s level of prep, actors and artists feel like part of a well oiled machine,” said Kate Siegel his wife, collaborator, and lead actress on *Midnight Mass*, one of the few TV shows heading into production as of early August 2020.

“No. 1 would be to really, truly enable global collaboration of people,” he said. “So if you need a rigger, you need a modeler, you need a sculptor, you need an animator, you can now hire them basically from across the globe, it doesn’t really matter where they sit. As long as they have access over the cloud to the content they need to work on, you’re good...”

“And the other thing is to have content available in one place and have it available very quickly, much quicker than it can be available today.”

## Hollywood Is Adapting to the New Reality (And It’s Time to Catch Up)

Years before the pandemic, some production jobs had already found a home in the cloud and moved in to stay. Some specialties have been harder to adapt, and some artists have been skeptical.

Over the past decade there has been an increasing demand for virtual workstations, as creative artists and executives take to remote work with over-the-shoulder and cloud-based tools. It’s no longer imperative for a director to be in the same room with an editor, a VFX artist to work next to a render farm or for network executives to appear for in-person pitches.

Also picking up are cloud instances at studios, post-production houses and visual effects companies. For example, producer/director Mike Flanagan (*Hush*, *The Haunting of Hill House*, *The Haunting of Bly Manor*) has been using cloud workflows and remote connectivity for several years, for everything from animated shot lists to editing to VFX. He has often supervised the editing of one project from the set of the next. As a result of being an early adopter, Flanagan’s most recent show was able to move forward at a time when few shows were.

“With Mike’s level of prep, actors and artists feel like part of a well oiled machine,” said Kate Siegel, his wife, collaborator, and lead actress on *Midnight Mass*, one of the few TV shows heading into production as of early August 2020.

“His tools and processes mean we can create freely within clear parameters, even before Covid, but especially now. They also gave Netflix the confidence that we could safely meet the moment.”

As creatives adopt workflows in the cloud, they need a new kind of network connectivity that supports their evolution; a turnkey private internet service that can also meet the moment.

## What Creatives Want

The trends show a need for more virtual workstations and virtual tools that are more learnable, accessible, scalable and easy to use. “We filled a need that no one foresaw,” said Roger Sherwood, Global Practice Manager for Media & Entertainment at AWS. “And there’s no going back from here.”

No matter where they worked in the production pipeline, artists interviewed for this paper cited four common needs when talking about their tools and workflows. They must:

### 1. Be user friendly

“When software or technology is too complicated to use the first time, it usually doesn’t get a second chance,” said Sandra Valde-Hansen, a cinematographer and senior lecturer at the American Film Institute Conservatory.

John Canning, Executive Producer of New Media & Entertainment at Digital Domain, said of those working in M&E, “It’s not that they’re Luddites, that they’re averse to new technology, It’s just such a gambling industry to begin with that they don’t like to gamble on things they can control. Like, ‘What’s a hit movie? I don’t know, can’t control that. But we sure as hell can control everything that goes into making that movie.”

### 2. Be fast and jitter free

Over the long term, remote connections must become jitter-free in order to work their way into the creative muscle memory, said Sohonet Chairman and CEO Chuck Parker. “The actual creative participation in a workflow where you need to be frame-accurate, color-accurate, with real fidelity—there are just some plumbing pieces that need to get fixed,” he said.

As a film producer who’s now a domain expert at GCP, Buzz Hays has seen that issue from two sides.

“I’m spoiled, I go to the office and I have negligible latency on anything I access because of our super fast network,” he said. “And then I get home and I’m dealing with the cable company and whatever their internet decides to do today. That’s the same problem most everyone working at home is experiencing.”

### 3. Have the capacity to scale and to transfer large files

The cloud’s storage and compute capacity are practically unlimited, and so is its elasticity, the ability to scale up or down to fit job and budget requirements. The same can’t be said for the public internet.

“In terms of enabling a broadly distributed remote workforce to access the desired media at a speed and latency that parallels what they would experience on-premises...the public transport infrastructure and service availability simply isn’t there, no matter what you’re willing to pay,” said Matt Lewis, president and CEO of Practical Magic (*Dunkirk VR*, *Grease AR*).

“In terms of enabling a broadly distributed remote workforce to access the desired media at a speed and latency that parallels what they would experience on-premises...the public transport infrastructure and service availability simply isn’t there, no matter what you’re willing to pay,” said Matt Lewis, president and CEO of Practical Magic (*Dunkirk VR*, *Grease AR*).

“Until 5G and technologies beyond are deployed in such a manner that we’re able to better use remote storage in ways we would use directly connected storage today, there’s almost no point in thinking too much about shooting masters directly to the cloud on today’s in-

infrastructure,” Lewis said.

“The infrastructure threshold we have to cross is where we make it irrelevant that the media isn’t on-site,” he said. “It could be in Seattle or it could be in the next room and you don’t know and don’t care. That has to be true.”

#### 4. Be secure

Working in the cloud “is the future, it makes us more flexible as a company and I think it would be useful for everyone,” said visual effects artist Julie Long of Framestore. “From my perspective, it would make things really efficient to utilize the cloud on all of our projects but we have to adhere to the security protocols of our clients and the use of cloud rendering is often prohibited due to client security concerns.”

Hacks and thefts are an obvious concern and should remain so no matter how data is moved, said Mike O’Gorman, CTO of cloud security at Cisco Systems. “What blew my mind when we talked to media companies is that some wouldn’t use the cloud to move files around. Instead they would put them on hard drives and give them to a motorbike courier to drive all over LA to get them to another building. Is that really secure?”

“Artists can spin wondrous tales in a vacuum, but with the right tools they can make them shine,” said Bruce Long, CEO of BeBop Technology, a cloud-based service specializing in post-production.

### The Pathway Forward

Visual storytelling is undergoing changes as drastic as the switch from silents to sound, black-and-white to color or analog to digital, and it’s all happening fast. ***Adoption, not only to the cloud, but the way we connect to it, is critical for artists and those who make their tools.***

Cloud providers have begun mapping out dozens of service offerings to help creatives all along the production pipeline, from development through distribution, move their work into the cloud. Yet when artists cited concerns, they sometimes blamed software or the cloud itself rather than their cloud pathway connections, often the real, unidentified problem.

***Not only must a network offer seamless connections between workstations, cities, countries and continents; it must also allow fast and secure data flow between separate clouds.***

“Artists can spin wondrous tales in a vacuum, but with the right tools they can make them shine,” said Bruce Long, CEO of BeBop Technology, a cloud-based service specializing in post-production.

The rest of this paper addresses the vital relationship of connectivity to those tools, and how it affects workflows throughout each phase of production, from Development through Distribution.

# DEVELOPMENT

Who's involved:

1. Producers
2. Writers
3. Showrunners (TV)
4. Investors
5. Agencies
6. Legal teams

What happens:

1. Stories developed and pitched
2. Rights and intellectual property licensed or acquired
3. Consumer market analyzed
4. Talent packaged

Through more than a century of film and video storytelling, one step has remained untouched by technology: somebody gets an idea. After that, there's a tool for practically every job in the story process, and cloud-based tools now play a role from the start.

Entertainment specific, over-the-shoulder collaboration tools are being used throughout all phases of production, beginning at the beginning. They enable remote and cloud-native workflows, connecting artists with tools for scripting, storyboarding, animating, editing, coloring, mixing, and finishing.

Directors and editors cited several of these services, including BeBop, EverCast, and So-honet's ClearView Flex, which created remote collaboration environments for most of the production phases through the last season of Westworld . BeBop's client base has grown exponentially since March; Evercast's Google Images integration allows for collaborative location scouting.

## Virtual Collaboration: a Culture Shift

Executives in the entertainment industry are considering what remote collaboration could look like in the longer term. There's been a shift in the creative workspace, but also in the way we interact overall. "Moving forward, we may have to invest in more production support to ensure the remote team," said Vicki Dobbs Beck, executive in charge at ILMxLAB, Lucasfilm's immersive entertainment studio.

Dobbs Beck also sees an opportunity for positive change. "In a future where we can be flexible with regard to requiring physical relocation to San Francisco, the cloud may unlock

the potential for a more diverse workforce,” she said. “In turn, that can enrich the breadth and depth of our creative content.”

For writing teams, whether they’re developing scripts from scratch or building on previous work, collaboration tools like Zoom or Microsoft Teams and online whiteboard services have become essential.

Writer/producer Samir Mehta (*Narcos*, *The Sinner*, *Fear the Walking Dead*) and others cited Miro as their online whiteboard tool of choice. Even though the service isn’t designed specifically for movie and TV writers, it’s widely used in the industry.

A lot of writing is done in isolation, but much of the teamwork in “breaking a story” — mapping out the blueprint of a season, a movie or an episode — is about conversation. So are conferences on casting, locations, budgets and a long list of other executive decisions. When people are pitching, writing or developing a project, tone and body language are important.

“It’s a performance, even for writers,” said Mehta. “Successfully pitching executives can come entirely down to the mood in the room. So if the chemistry is off, that’s it.”

Writers aren’t generally known for their acting skills, so pitching and selling an idea verbally has historically been challenging. It can be even more so in a remote world. Some writers are opting for pitch videos, produced versions of their pitch. These can vary in production value, but “they may well become their own business going forward,” Mehta said.

Writers, as well as artists in other production specialties, said remote collaboration narrows and sharpens attention on one hand, but on the other, it slows things. Annotating and post-it notes simply take longer. Then there’s sometimes that annoying screen freeze followed by the notice “Your internet connection is unstable.” Mehta cited a condition affecting occupations everywhere as the pandemic wore on: Zoom fatigue, especially after hours in a virtual writers’ room.

Executives on the receiving end of pitches know the feeling. “We’ve all accepted it and learned to adjust and pretend it’s normal, but we all also know that the quality of attention is simply not the same,” said Ray Ricord, SVP for development at Sony Pictures TV’s Gemstone Studios.

“In terms of pitching, this divided, virtual attention makes it clear that brevity is ever more the soul of wit,” he said. “And also that a visual deck is now critical to give the network something to rest their eyes on, some way to keep them looking up and following along.”

For these reasons, quality connections are particularly important to artists and executives in development.

“Moving forward, we may have to invest in more production support to ensure strong communication and provide the bandwidth to focus on the health and well-being of the remote team,” said Vicki Dobbs Beck, executive in charge at ILMxLAB, Lucasfilm’s immersive entertainment studio.

## **Rights, Avails and Market Analysis**

As an executive producer, Ricord doesn't directly handle rights and avails, the process that deals with contracts and determines which versions of projects will end up in which geographic location. However, he does work closely with the book scout and legal team which does.

Many companies have long used Rightsline to help with rights and avails, but cloud providers are also focused on the service, exploring how artificial intelligence and machine learning can streamline decisions for acquisition and distribution of assets. The two processes go hand in hand because distribution is usually considered before a project is funded, and will be explored in the Distribution section of this paper.

Big data has become a part of how executives package talent and do market research before committing to projects. Cinelytic's cloud-based platform uses artificial intelligence to help studios and independent production companies make calls on acquisitions, greenlighting, release dates, release locations and other decisions.

Given the rise of streaming, remote collaboration and, since Covid, the elusive nature of box office-related analytics, staying in sync and secure with this sensitive data has become more important for studios than ever.

# PRE-PRODUCTION

Who's involved:

1. Producers
2. Writers
3. Showrunners
4. Directors
5. Directors of photography/cinematographers
6. Casting directors
7. VFX artists
8. Visual “world building” teams including costume and production designers

What happens:

1. Pre-visualization (previz)
2. Storyboarding
3. Location scouting
4. Tech scouting
5. Casting

Before principal photography can begin, contributors line up shooting locations, actors, crew, and work out the overall look and feel of a project. In the last few years, the process has been transformed by emerging technology. ***As with other workflows, the key to adoption may be the way in which stakeholders connect, collaborate and make decisions.***

## Setting up the Shots: Exit Stick Figures

Pre-visualization has become breathtakingly elaborate, on screen and in its application throughout the production cycle. The virtual sets, animatics and other digital assets created with newer previz tools are being used for tech and location scouting and carried all the way through post-production, and even afterward. Visual effects artists, traditionally specialists in post-production, have become an important part of the process from beginning to end.

Previz teams must be quick and nimble, creating animatics and making iterations on the fly to fit script changes, often at the last minute. “The interesting thing about previz is the speed,” said John Canning, of Digital Domain.

“We have a separate pipeline for that team because of the speed at which they need to work, to iterate...The world of previz is getting more complex and rich, then you add a layer of collaboration on top of that, and it's important how you share.”

Companies such as Digital Domain, the Third Floor and others generate whole digital worlds in cloud-stored files. Because of the growing complexity, cloud-based dynamic asset

storage and meta-tagging have become important. They allow the content created in previz to be retrieved and used again, not only in the production itself, but in sequels, promotional pieces, VR experiences, games and elsewhere.

The ongoing archival of assets beginning at pre-production also helps downstream teams to access the embedded animation, effects, and corresponding workflow data they need.

Not so long ago, storyboard artists would use photos, artists' renderings or even rudimentary drawings to sketch out the "look" that directors were going for, to work out camera angles or plan the placement of actors in key scenes. Often as not, the sketches would end up in the trash bin even before the show wrapped.

"Animated shot lists are a way of bringing what once was just a drawing into the world-building process," Kate Siegel said from the set of *Midnight Mass*. "It starts the creative process earlier and ultimately helps Mike run a tighter ship."

"Animated shot lists are a way of bringing what once was just a drawing into the world-building process," Kate Siegel said from the set of *Midnight Mass*. "It starts the creative process earlier and ultimately helps Mike run a tighter ship."

For previz, Flanagan uses Pix, one of several companies that began in the early 2000s to offer a range of tech services, increasingly using the cloud to do so. Magnopus applies virtual and augmented reality to scouting and previz. Zoic Studios' Zeus previz process is widely used for TV series. The Third Floor also offers "Techviz," an analysis of specifications such as lens types, camera distances, size of a green-screen or the speed of a car being shot.

The pandemic accelerated a trend of VFX artists, traditionally post-production specialists, being called to help with planning by using previs or virtual production techniques, noted Julie Long (Syfy's *Happy*). When actors or standins can't be in the same room, for example, a VFX specialist may be asked to map out scenes.

As an independent cinematographer who can't always work with art departments or use elaborate previz services, Sandra Valde-Hansen (*The L Word*, *Now Apocalypse*) often has to keep it simple.

"Say I'm shooting a scene with two people at a table," she said. "If we have the ability to go into the space, I will use my DSLR (digital single-lens reflex) camera or one of those director viewfinder apps and take the still image, then I will do an overhead lighting diagram, very simple, with a bunch of just basic shapes.

"For that scene, I could probably put it together in ten minutes and show that to a director. If this can happen quickly and efficiently with some sort of digital file sharing, great. If it can't, it sort of all goes out the window."

A culture of speed and efficiency permeates the entertainment industry, from heads of studios and production companies to vendors and freelancers through each phase of produc-

tion. Everyone has an eye on budgets and schedules.

Larger studios and post houses rely on their own data centers for ease of access, speed and economy. “For companies like Digital Domain, we have a data center, we have legacy hardware, we’ve built up expertise over the years,” said John Canning. “We are not a greenfield opportunity. It’s still cheaper for us to do rendering on our farm on prem, but as we need to expand and add capacity and the option is between buying, renting or cloud solutions...the new breed of cloud solutions are starting to look attractive.”

A global visual effects company, Digital Domain is looking to the future but is mindful of cost. “The cloud seems inevitable, it is more an issue of how we get there both conceptually and physically,” Canning said.

A global visual effects company, Digital Domain is looking to the future but is mindful of cost. “The cloud seems inevitable, it is more an issue of how we get there both conceptually and physically,” Canning said.

As they do expand, the hybrid cloud environment that Digital Domain has created allows them to access their own data center, plus whichever public cloud matches the needs of the project, service and studio client. ***A scalable internet fabric suited to nimbly hop between data centers is perfectly suited to such rendering and transfer workflows.***

When it comes to deciding where and how to shoot a show, many producers, directors and directors of photography still rely on physical scouting and intuition as well as technology.

“We already do initial location scouting virtually, looking at and narrowing down the range of possibilities amongst producers, executives, and the creative team,” said Ray Ricord at Sony-Gemstone.

“That said, few or no directors will do a completely virtual tech scout. Directors and DPs generally need to really be in a space to make sure it works. However, there may end up being innovations that allow for yet more virtual scouting to be done with some confidence.”

## Headshots Go Paperless

The process of hiring actors for TV and film begins with the casting director. Although casting is notoriously analogue and paper-dependent, platforms such as Embershot and Synchronize now provide secure uploading of confidential “sides” or scenes of a script used for auditions. Castiko and other online services help casting directors find actors, schedule auditions, keep updated profiles and record audition videos.

Self-tapes, as opposed to in-person auditions, became more common during the shutdown, and most actors don’t mind, said Briana Frapart, head of casting at the new Venn TV network. They have more time to prepare rather than having to do “cold reads.”

Actor Samantha Sloan (*Scandal*, *Grey’s Anatomy*, *Midnight Mass*) would much rather audition in person. She suspects that the next-best solution could be access to a “popup,” where

actors who don't have personal resources could be properly lit and miked to work remotely with the casting director, in an experience "as close to personal as possible."

Cloud-based kiosks equipped for remote work are being considered for VFX artists and other specialists as well. "Cloud-based popups for visual effects are the future," said BeBop's Bruce Long.

If that's the case, the public internet would not be high-capacity, fast or secure enough. The popups would need to take advantage of a data center-connected private internet fabric. ***And soon, an edge-based network like SD-WAN (software-defined wide area network) attached to the private fabric, will be able to connect the artist directly to the multiple clouds.***

# PRODUCTION

## Who's Involved:

1. Executive producers
2. Directors
3. Directors of photography /cinematographers
4. Line producers and production coordinators
5. Actors and extras
6. Lighting and sound teams
7. Digital imaging technicians
8. Dozens of “below the line” professionals including script supervisors, makeup artists, set decorators and electricians

## What happens:

1. Principal photography
2. Playback and video village
3. Transcoding
4. Dailies/immediates

People were shooting movies and TV shows long before there was a cloud or an internet, and they still are. Of all the links in the production pipeline, set and location work, often in remote locations without any kind of internet access, may be thought of as the least dependent on connectivity. Like everything else in the industry, that's changing. Getting the captured content to off-set directors, producers and remote artists as fast as possible is now the name of the game.

## Galaxies Not Far Away

Advanced technologies like LED screens, holographic and volumetric capture and other means of virtual production require constant connectivity and large file sharing. A light-field camera can produce data output of up to 400 gigabytes per second. As filmmakers like Jon Favreau push the boundaries of their art, low latency, high capacity, private connections and accessible cloud storage have become essential.

*“The Mandalorian* was a game changer as far as our productions are concerned,” said Kate Siegel. Among other virtual production techniques, its previz and actual shooting took place against sets of LED walls, rendered in real time, changing to accommodate each scene's action. Rather than having to build multiple sets and travel to remote locations, Favreau's team was able to capture alien worlds in a studio.

Besides eliminating the costs of location travel, virtual studio production can benefit from proximity to data centers, and therefore private secure networks. In the summer of 2020, filmmakers found that they also make for safer shooting under pandemic protocols.

*The Ripple Effect*, a short film collaboration of USC's Entertainment Technology Center, major studios and VFX companies, was a virtual production project aimed at minimizing on-set crew, and it effectively showed how safe shooting could go on during the pandemic.

Game engines, or real-time engines, play a big role in virtual production. Both *Ripple Effect* and the larger budget *Mandalorian* used Unreal Engine, a tool for photorealistic rendering, dynamic effects, animation, data translation, and more. With live concerts in limbo, many LED walls that served as music backdrops are now used on sets.

Cinematographer Sandra Valde-Hansen was preparing to shoot a road movie when the Covid shutdown stopped the project. Rather than using the old-fashioned "poor man's" process trailer for car shots, producers had been considering the PRG OverDrive LED system. She looked forward to the project restarting, possibly with the new virtual tool.

"I have to see a silver lining in all of these things, and I hope people will see how this makes productions work better, more efficiently more collaboratively, and then they will either go with it or go with some hybrid of it," she said. "That people will use it more and that pricing will come down, I think that kind of goes hand in hand."

***NaaS models like PacketFabric charge monthly, and significantly reduce the cost of cloud connectivity.*** Their way of getting stages and studios to the cloud will inarguably turn that hope into a reality.

## The Call for Connection

Most cloud service providers offer their own on-ramp services. Azure's Express Route and AWS' Direct Connect for example, are made up of dozens of telecoms and private networks. PacketFabric is one such, often white labeled, carrier and cloud neutral network which provides a "middle mile" taking the user to a data center. With this service, a private, low cost, low latency, high capacity pathway would carry the footage directly from the set to the cloud, no matter which CSP the production company or studio is working with.

Decentralized, global productions have been stretching networks along with workflows. In September 2020, Weta Digital VFX house in New Zealand (*The Lord of the Rings*, *Avatar*) closed a deal with AWS for cloud support for its 100 proprietary effects tools and its new LED-stage virtual production service. <sup>5</sup>

Netflix estimated in 2018 that its post-production, which is outsourced to locations around the world, generated more than 1.6 exabytes of data a year. <sup>6</sup> It set up a special hub to help collaborators work with AWS.

In July, Australia announced a \$400 million incentive aimed at attracting new film and TV production, on top of the 30 percent tax break already on offer. It would bring in up to \$3 billion in spending, the government estimated. <sup>7</sup>

Around the same time, PacketFabric was taking calls from studios interested in its under-sea, high speed fiber connection to Sydney. A “neutral carrier,” the network can install PoPs down under and anywhere else a need exists, said CEO Dave Ward. ***“With a high speed, high capacity network that can be anywhere now and be at the edge tomorrow, ubiquity of on-demand networking is inevitable.”***

## A Global Village

“Covid is creating an opportunity for everybody in production to just think about how we can work differently,” said Framestore’s Julie Long. “I think for visual effects in particular there is a change in the tide right now that I think could actually make things better overall.”

An uptick in production after the initial Covid shutdown meant that more directors, crews and talent were adapting to the new ways of working. On Sept. 3, FilmLA said it had received 1,127 applications for 829 unique projects since it reopened on June 15 after closing in March.

Overall volume was still far below what the agency would normally see, but the July to August increase was 40 percent.<sup>8</sup> Animation projects were obviously well suited to the new world, as were reality shows that could shoot subjects in isolation.

But even traditional scripted projects were being planned and shot without people having to be in the same place. ClearView Flex, EverCast and other platforms allowed on-set video villages to operate remotely.

That’s significant for several reasons. In the pre-Covid world, video villages were the province of a handful of decision makers, usually the director, producers and DP. Now, VFX artists need playback access in order to inform the director what effects would be possible to change a scene or to give input on LED backdrops.

Remote monitoring helps with social distancing in front of the camera as well. A VFX artist with access can bring together actors standing six feet from each other, so that the director and others see a pre-Covid version.

A cloud-based alternative to directors’ traditional method of reviewing dailies is what Moxion calls “Immediates,” a platform in partnership with Sohonet’s ClearView Flex. It runs HDR playback with its metadata minutes after shooting, allowing editors, VFX artists, colorists and others to see the footing on iPads and laptops. They can begin work while shooting is still going on and make changes on the fly.

“Covid is creating an opportunity for everybody in production to just think about how we can work differently,” said Framestore’s Julie Long. “I think for visual effects in particular there is a change in the tide right now that I think could actually make things better overall.”

“I would recommend it for every show going forward,” said TV Producer Stephen Welke (*Code Black*, *Treadstone*, *Star Trek: Enterprise*, *Star Trek: Voyager*), “whether you’re an executive producer that can’t get out of the writers room, or like me...

“They were off shooting inserts and I couldn’t break free from editorial, so they were sending me the link saying, ‘We need you to check the framing, check these takes, we’re going to play it back through the video village. I could approve stuff without going out to set for one or two inserts—two hours to drive out to set, two hours to drive back when I’m in the middle of editing. It was great.’”

“It’s all about access, and the way the industry’s adapting to a whole new way of looking at dailies is another aspect of that. We’re going into the next wave of even more complex remote viewing and annotation and interaction,” said John Canning. “The pandemic has forced the hand of some things that were just ‘nice to have’ like the remote video village.”

Review by off-set stakeholders is now possible, and while artists said they generally appreciated the tech advances, some were uneasy about producers, investors or executives being able to see unfinished work. That’s one reason why password protection and team-specific channels have become important pieces of the newer tools.

***The most seamless way for these workflows to be executed is with an internet fabric that acts like a high speed, private highway, which multiple companies can access easily to immediately spin up connections as needed.***

# POST-PRODUCTION

## Who's Involved:

1. Producers
2. Editors
3. VFX artists
4. Colorists
5. Post-production supervisors
6. Voice actors
7. Compositors

## What happens:

1. Editing
2. VFX
3. Color grading
4. Rendering
5. Additional dialog replacement (ADR) and group ADR (looping)
6. Finishing

Even though changing workflows are taking much of the “post” out of post-production, the main aspects still converge where they always have — at the end of the process. Once footage is shot, the mass of resulting data must be manipulated and shared among creative teams. Artistic choices which earlier called for human interaction have now become digital.

During principal photography, a cinematographer is a director's key collaborator; producers and obviously actors play their roles on each side of the camera. Later on, editors, post-production supervisors and VFX artists continue to carry out their directors' vision. Before Covid they would often work side by side.

VFX artists, traditionally a major part of post-production, are joining in the process much earlier, tuning into virtual video villages for access to playback of what's been shot, and manipulating LED screens during shooting. They may jump in mid-production to supply a CG crowd, a real-life impossibility due to Covid.

***With downstream processes coming into play earlier in the production pipeline, the need for scalable connections, able to switch seamlessly between data centers and CSPs, is more evident than ever.***

## Long Distance Editing

Natasha Bedu (A&E's *Intervention*, HBO Max' *Equal* and currently *Breaking Bobby Bones* for Nat Geo) has been isolating with her family in Maine during the pandemic. Starting her latest job in September, she began remotely accessing an Avid system at FotoKem post house in Burbank.

"I am a little worried about internet connection," she said. "We had a snowstorm the first week I was working from home back in March and my internet went out for half a day. So that would be a lost work day."

Editing from a distance of 3,000 miles has gone generally well, she said. Since 80 percent of *Equal* had already been shot, the proxies were loaded onto hard drives and sent to her by mail. "Then when other footage came in after lockdown, we used WeTransfer," she said.

As with other workflows in post, large files need to be shared with ease and security. In the absence of a high capacity, private network, mailing hard drives or using couriers has often been more efficient than the public internet. "Mailing drives is still often the best way to go if we're talking about a ton of GB worth of stuff," Bedu said. "We would then use WeTransfer or even just email bins with new cuts, etc. since those are generally under half a GB."

Bedu's lack of access to a data center is not unique for artists and creative professionals in M&E. Much of the industry, even before the pandemic, relies on work done from home or on location from a distant set.

***PacketFabric is working with companies like Cisco on an SD-WAN for its network's placement at the edge. These services coupled with a cloud native SaaS for VFX artists or editors, could be game-changing for post-production and other workflows.*** The solution would bring the private network fabric closer to, if not inside, the home or office of the end user and eliminate the need for a "last mile" connection to a data center.

Mario Monello, M&E specialist at Amazon Web Services, is at the helm of a new program he established for creative end users, enabling multiple new virtual production workloads on AWS.

AWS is offering virtual workstations for use with Adobe Creative Cloud, with applications preloaded to support high-speed file transfers and stand-alone media players. Microsoft Azure has a similar alliance with Avid.

With several editors working in several places, things can get complicated. On his latest project, Stephen Welke needed to coordinate the work of four to five editors separated by the pandemic. "We had to think of a way to get it all to connect," he said. "This is what I did; how am I going to get it to everyone else's computer?"

"We tried a system called Resilio, and I've got to say it's been a godsend, it's just been bulletproof." Resilio, formerly BitTorrent Sync, was designed for all sorts of business uses from tracking cash flows to tracking traffic flows. It uses private cloud software and works at the edge to move and coordinate large files over the internet. Adapted to entertainment industry use, Welke found it could take the place of a studio-based nexus.

Pre pandemic, producers like Welke could be working from an office or studio lot. But often, even before Covid, they worked from home or set. In that situation, an edge-based solution like SD-WAN would enhance all of their connections, to the cloud or elsewhere.

## Matching Colors

Framestore's Julie Long often uses Aspera, an IBM web-based upload for cloud storage transfer, to deliver back files for color grading. Moxion, Frame.io, Streambox, Sohonet's ClearView Flex, X2X' Pix system and others also offer cloud-based file transfers that are HDR compatible. But while transmitting files via the cloud is possible, actual color grading there is another story. Along with post audio, color grading requires such precise accuracy that it's not yet being done in the cloud.

However, the HPA short film demo in February showed how raw masters could be linked to Nuke, Avid or Resolve in the cloud for editing and color correction, the first step in the color workflow. Artists were able to start work almost as soon as a take had been shot, resulting in ACES-compliant color and sound-synced files.

Remote review of color grading is another bit of tricky business. For one thing, the artist and reviewer, usually a post-production supervisor, cinematographer or director, need to be using compatible monitors at each end.

"We're an HDR show using Dolby Vision, and we don't actually know what the show looks like on a correct monitor," said Welke. "We can't set it up at home to play back a Dolby image correctly. It's too cost prohibitive for something that's just for the short term.

"We've got the newest and greatest iPads, and we watch SDR output through Streambox, and it's fairly representative. But we all know that the highlights and some of the other values aren't coming across," he said. "That's the biggest frustration for the DP and the visual effects supervisor and myself. We're all—not flying blind, because we have the iPads—we're just not exactly sure of things."

With Dolby Vision, an HDR version adopted by Hollywood studios and several streaming services, "You want to make sure that the display the approver is looking at is consistent with the mastering monitor that the colorist uses," said Ron Geller, VP-Worldwide Content Relations at Dolby. "During the pandemic it's been a big priority for us. We decided early on we wanted to be of assistance to the market instead of just sitting back and waiting until this darn thing is over.

"Our webinar in July presented possible solutions ranging from real-time review to the more common use case of encoding a file and delivering to the reviewer...Some partners are looking to leverage the high-end OLED TV's that some approvers own, while others are looking for portable solutions that support Dolby Vision like laptops, iPhones and iPad Pros."

Because it has over 170 points of presence internationally, and can spin up redundant circuits within minutes as opposed to weeks like traditional carriers, PacketFabric operates fluidly with a cloud computing model, allowing access to multiple “rented” computers in various or the same cloud environments at once.

Whether for Dolby’s coloring work, or Welke’s watch and review process, connections must be quickly accessible to whichever CSPs match the workflow, whenever and wherever is necessary.

## **Modern Farming**

Rendering, the time-consuming process of combining digital effects and images onto each frame of a show, traditionally takes up a lot of office space with rooms full of physical computers or “render farms.” Framestore will utilize cloud rendering on occasion, when it has a lot of projects running at the same time or when something urgent comes up. But it considers each use carefully.

“Obviously there’s overhead for the render boxes that we have already purchased,” Julie Long said. “But the cloud costs money too, so we always weigh what has to be rendered in the cloud...It’s a pretty thorough internal discussion.

“I think with the cloud and the new technology there’s a little bit of ‘That sounds cool, let’s all jump on that and get it started,’” she said. “But the understanding of how that works and the education that goes with it to make sure everybody’s on the same page and these workflows are established in a way that works for everybody—I don’t think that’s going to happen overnight.

“I would hope there are more security protocols that come into play,” to ease client concerns about working in the cloud, she said.

Some post jobs are just too big for internet connections to handle, said Philip Garcia, CEO of SkyTech Media Solutions. Garcia likes BeBop because it’s “super fast. But with finishing, a job might be 60TB or 40TB of data. To edit that with full res is a challenge over the public internet. With a private network, it’d be a different story.”

## **Home Studios and Other Sound Solutions**

Audio requires such precision that the major makers of digital audio workstations have been reluctant to sanction running their software in the cloud, and remote work has been a challenge for sound specialists.

For looping and ADR, up to 12 actors gather on a sound stage to replace original dialog where necessary, record vocals for crowd scenes and overdub extras, who are usually non-union actors and therefore may be seen but not heard. Shut out of sound stages because of the pandemic, voice actors began working at home, improvising connections to engineers, post supervisors and post production houses.

In late summer 2020, members of Holly Dorff's Virtual Looping Group had to become their own technicians. "Getting everybody hooked up is one thing, but on the studio side they want everyone to sound like we're all in one location, so there's got to be the same or comparable equipment in each voice actor's home," said group member Moosie Drier. "For sound capture compatibility, everyone needs to have their settings at 48 kHz, as one of many examples."

"For someone like me this is a huge amount of technology to be able to run and make sure everything is working," said Dorff. The group used Source-Connect, the standard ISDN replacement app, and Matthew Wood of Skywalker Sound (*Star Wars* sequels, *Mandalorian*) engineered the sessions, recording separate tracks for each actor from a home studio in the Bay Area.

When this paper was written, the group had completed one feature film virtually, Focus Films' *Half Brothers*.

Cloud native SaaS and CSPs are developing tools and services to meet the needs of audio artists. ***As sound stages such as Parabolic and Igloo gain access to data centers, Packet-Fabric will be poised to provide low latency, bounded jitter and redundant virtual connections which can allow for syncing audio with picture on-demand.***

## Cost and Complexity

As the Looping Group's experience shows, post professionals often have to be technically adept as well as creative. In some cases, they have parlayed their overlap of talents into working with cloud-native services and SaaS companies. Bruce Long was executive VP at Technicolor as well as a producer and executive producer in both TV and motion pictures before co-founding BeBop Technology, where he is CEO.

"Over the years speed and time to market became the priority, and quality was compromised," Monello said. 'People were given hybrid jobs like 'preditor' (producer/editor) to produce and finish the content so it could be distributed faster. With the cloud, multiple creatives can be reached more easily wherever they're located, and those combined jobs aren't always necessary.

Mario Monello worked in post-production during the early days of HBO before becoming an M&E specialist at AWS. He sees a side benefit of working in the cloud that's not normally mentioned. "Over the years speed and time to market became the priority, and quality was compromised," Monello said. 'People were given hybrid jobs like 'preditor' (producer/editor) to produce and finish the content so it could be distributed faster. With the cloud, multiple creatives can be reached more easily wherever they're located, and those combined jobs aren't always necessary.

“It also helps that enterprises don’t have to maintain so much hardware and infrastructure,” he said. “You only pay for what you use, this reduces a tremendous amount of overhead costs.”

That meets with agreement from Buzz Hays at Google, which offers its clients cloud computing, or the opportunity to “rent” cloud-based virtual hardware. “I’m constantly running into situations where people say, ‘If it costs me \$1,200 to run a virtual machine for a month, I can just buy a machine for that.’ Yes, but what about the underlying costs: staff, the building, the electricity, the fire suppression, the software support, the engineering? It’s important to get a realistic total cost of ownership to understand the value of working in the cloud. These things need to be a part of the conversation.”

## Internet, But Better

New partnerships are bringing the cloud closer to the industry. In 2019, GPU giant NVIDIA purchased Mellanox, now NVIDIA Networking, to stream IP-based content through the cloud via software defined infrastructure. It’s designed to speed up post-production work, content distribution and live broadcasting.

“Today you’re always limited by location, depending on the company. If you’re doing business outside major cities, finding others to work with isn’t always easy,” said Microsoft Azure’s Hanno Basse. “So the cloud makes that problem totally disappear.”

In New Zealand, Weta set up remote collaboration when the Covid shutdown began so it could keep working on *Avatar* sequels, CEO Prem Akkaraju said.<sup>9</sup> The deal with AWS will let it implement a proprietary cloud pipeline and take its production global.

“By leveraging AWS’s global network and backbone, production possibilities are limitless,” said Monello. “We enable producers, directors and content creators to share their vision and storytelling as if they were working in their own backyard.”

“Today you’re always limited by location, depending on the company. If you’re doing business outside major cities, finding others to work with isn’t always easy,” said Microsoft Azure’s Hanno Basse. “So the cloud makes that problem totally disappear.”

Cloud provider RStor is working on a “far edge” capability called Rwave, which will put the cloud even closer to production centers and make individual homes far more cloud-capable.

***In the not too distant future, private virtual networks will be able to expand out further towards individual creative professionals, regardless of access to a data center.*** Coupled with a private cloud at the edge, speed and transfer capacity will change dramatically.

Along with its ability to connect to Rstor, studios and their vendors, Sohonet is able to provide the industry with much-needed storage and transfer.

Partnered with PacketFabric, other networks could increase their PoPs, reduce customer costs, significantly reduce latency and expand the footprint needed to deliver a truly global service. Add an SD-WAN solution to the mix, and the above becomes possible regardless of artist location.

# DISTRIBUTION

Who's involved:

1. Producers
2. Sales agents
3. Studio executives
4. Distribution entities (often studios)
5. Content distribution networks (CDNs)
6. Marketing executives
7. Programmers

What happens:

1. Versioning
2. Creation of language, format and caption transcoding profiles
3. Creation, encryption and delivery of the digital cinema package (DCP)
4. Caching of files via CDN, out to regional data centers and homes
5. Marketing and promotion

Before a movie or TV show is distributed to audiences, it must be stored so that future related productions, episodes, sequels, and immersive and gaming tie-ins can make use of its assets. With workflow technology becoming more robust, and with digital artistry taking place as early as previz, storing and accessing those assets is happening throughout the production pipeline and becoming more streamlined.

Accordingly, the demand for archival software management platform partnerships between studios and cloud companies is on the rise. There is now a clear need for machine learning-assisted meta-tagging so that files can be connected with the people who created and worked on them.

“Right now, everybody saves everything because everyone’s afraid of being the one who threw away that one piece that’s not important now but might be sooner or later,” said Google’s Buzz Hays. “You just keep filling the wheelbarrow with stuff and at the end of the day you dump it into a pile and then try to sort it out, and that’s the problem...Some of the studios claim they have footprints as big as six to eight petabytes per movie, if you take everything that contributed to that movie. That’s a lot of stuff!

“The way I think of archiving is, it starts from the minute you start creating assets, so it actually starts in pre-production...tagging things as you go so at the end of the show you turn the lights off and everything is already properly tagged and ready for archiving.”

Innovative Dynamix has developed a cloud-native catalog platform called The Mix to sort and tag the data from Hays's metaphorical wheelbarrow. How does it work? "Take all your content and data and just dump it in the Mix," the company says. Ownzones is another tool offering AI integrated cloud-based options for downstream workflows related to versioning and archiving.

"As an industry, we're already looking at on-premise management platforms the same way we look at distribution via magnetic tape—a relic of the past," said Gabriel Grünbaum, CEO of Innovative Dynamix.

"As the accelerated migration to the cloud is under way in all other parts of the industry as well—from pre- to post-production, content transcoding, format conversion, consumer access and so on—having a cloud-native system will quickly move from being a good idea to a requirement."

## Coming Attractions

For movie theater distribution, "The cloud is a game changer," said Jason Brenek, CEO of MetaMedia. The former IMAX HOME president and senior Disney executive introduced his cloud-based distribution company in March 2020, just as the Covid lockdown was closing theaters all over the world. By September, the company had signed distribution deals with Cinemark, Cinépolis, Landmark Cinemas of Canada, Emagine and Independent Cinema Alliance.

"I think over 70 percent of U.S. theaters are open and over 90 percent of theaters around the world are open," he said in mid-September. "So we are increasingly optimistic that Covid is not going to end the theatrical business. It's not going to change 100 years of consumer behavior.

"The cloud opens up a world of programming and targeting capabilities that are certainly not there with satellite or hard drive distribution," Brenek said. Among other benefits, he cited versioning, that is adapting a movie to regional technical specifications, ratings guidelines and language.

"You could envision a studio delivering a movie, say Disney's *Mulan*, in English to all the theaters with an English-speaking demographic, and simultaneously in Chinese to targeted theaters," he said. "They're producing a lot of great content in Korea that could be aired in Korean-speaking neighborhoods here. With cloud technology those kinds of decisions can be made much more quickly.

"We like to talk about ourselves as the 'Apple TV of cinema,' but with cloud technology, there's no reason that any big screen out-of-home experience couldn't be programmed as flexibly and consistently and as locally as any television screen," Brenek said.

Before it's sent to broadcast companies, cable networks and streaming services, TV and OTT streaming content must be encoded to fit the requirements of those platforms. Movies need to be processed into digital cinema packages for distribution to theaters.

“Cloud-based encoding is becoming more common and more efficient,” said Dolby’s Ron Geller. The company’s Hybrik workflow system looks at all the virtual machines available in a user’s cloud account, breaks down a movie and allocates a piece to each machine so they can all work at the same time. Then the system recombines the pieces into a single file.

“You could use one computer on-premises for 12 hours, or you can have 100 machines in the cloud work together to do it in less than 10 minutes. This gives you more time for review and approval, and provides great flexibility and cost-effectiveness,” Geller said.

Companies such as Akamai, Wowza and Limelight maintain PoPs around the world, bringing content as close to viewers as possible to minimize latency and maximize delivery speeds. To handle its mass of streamed programming, Netflix developed its own CDN, called Open Connect.

In order to provide streaming services to each region, CDNs use a process called caching, which predicts programming for any given region and pre-populates the applicable content in the data center closest to the end user, outside the wide area network. PacketFabric is a pathway for many CDNs from the point of distribution to the data center, providing the highway on which the CDN transfers content to the edge. A solution like RStor’s can be used for storage, while programmable, open cache CDNs can be distributed into POPs as the edge-based cloud.

## **Legacy Systems and Security in a Risk-Averse Industry**

Cloud providers hope to put AI and machine learning to work not only on archiving and distributing content, but on the often cumbersome and time-consuming rights and avails process. Today’s legacy systems for doing those jobs are “manual, monolithic, expensive and difficult to scale,” said AWS’ Roger Sherwood.

“These shortcomings result in reduced visibility into owned content, poorly informed sales teams, and slow licensing deal processing,” not to mention unrealized revenues, he said. “‘What, where, when, and to whom should I license my content?’ That’s a question we want to help answer.”

However content is packaged, sold and delivered, “There’s a spectrum of security that has to be met from end to end,” said Brenek. “The broadcast center, the post house, the studio, through the cloud—all the way through the last mile and the last foot.

“What’s happening at the moment is that 75 percent of the world receives premier versions of films on hard drives delivered by third-party shipping companies that have no affiliation with the industry or studios,” he said. “For that high-water mark of secure delivery, the studios are comfortable with content sitting on someone’s DHL bicycle in the south of France being moved to the theater.”

In the absence of secure private networks, it’s easy to see why the industry relied so long on low-tech “sneakernet” hand delivery of data. “At least you can know who wore the sneakers,” John Canning quipped. “If Johnny is the only person who has the capability of moving bits

from point A to point B and suddenly those bits show up on the internet, then who's the first guy you're going to send the FBI to?"

Canning believes security concerns can sometimes get in the way. "This is an industry that wants to four-wall your production team and have all USB ports disabled on every computer because somebody with a USB stick can steal the next blockbuster film and you've lost all your revenue," he said. "So you have an industry that's so paranoid and locked down and concerned with security that it hampers getting business done."

In many ways, the Covid pandemic created a need. Stephen Welke said that in past years he had tried some remote and cloud-based services. "I found in general that they didn't work as well as they purport to work, so I was always kind of against using them. But since the pandemic forced my hand I've gotten into it. Everything I've learned about them, I've learned since the pandemic started."

The aim of the Network as a Service model is to provide companies with an automated alternative to "Johnny."

Most observers agree that the entertainment industry has been slow to adapt to emerging technology in general. As Canning said, "Adoption of these technologies is really based on either need or proven track record...It's either, 'I'm going to adopt it because everybody else is using it and I'm going to be behind if I don't,' or 'I have to adopt it because it solves a problem.'"

In many ways, the Covid pandemic created a need. Stephen Welke said that in past years he had tried some remote and cloud-based services. "I found in general that they didn't work as well as they purport to work, so I was always kind of against using them. But since the pandemic forced my hand I've gotten into it. Everything I've learned about them, I've learned since the pandemic started."

"If you ask me why people aren't using these technologies? It's only because of the organization's culture," said Sumit Grover, Business Head of Cable, M&E at the Tech Consulting & Systems Integration company, Tech Mahindra. "The shift in business models and the cultural shift that's happening right now, it's a blessing in disguise because of Covid." He added, "I see a huge, huge value with telco infrastructure, especially around the edge."

The 2019 MovieLabs paper was a call to action for the industry to cooperate in dealing with the seismic technological changes in the decade ahead. Many of those approached for this paper saw it as a major change in the studios' outlook. Its objective: "to empower storytellers to tell more amazing stories while delivering at a speed and efficiency not possible today."

It may already be happening. “Artists have two choices. We can be intimidated by the technology, or embrace it,” said the Virtual Looping Group’s Moosie Drier. “We are choosing the latter.”

## But How Do I Get There?

As those we interviewed fundamentally recalibrate their tool sets and habits, the cloud is positioned to provide symbiotic environments along the pipeline, providing less expensive and more functional workflows and a more effectively distributed workforce for tomorrow’s media and entertainment landscape.

So what’s the missing piece?

It’s often assumed that when it comes to M&E, security is the most relevant offering in a network. A private fabric allows security to be relied on as a given, allowing the NaaS to focus on the other requirements cited by creatives: speed, capacity and ease.

“Artists have two choices. We can be intimidated by the technology, or embrace it,” said the Virtual Looping Group’s Moosie Drier. “We are choosing the latter.”

These qualities and PacketFabric’s data center neutrality, which effectively allows it to seamlessly facilitate work in a multi-cloud environment, poises it to meet the multidirectional, holistic approach towards which content production in the cloud is headed.

## The Bottom Line

In the wake of Hollywood adopting a new reality, the Network as a Service model is an alternative to the public internet and to traditional private networks. However its ability to expand the reach of those private networks is what makes PacketFabric not only a disruptor, but also inevitable.

# SOURCE NOTES

1. *2019 Television Report*, [https://www.filmla.com/wp-content/uploads/2019/10/2019\\_TV\\_Report\\_WEB.pdf](https://www.filmla.com/wp-content/uploads/2019/10/2019_TV_Report_WEB.pdf), FilmLA, accessed August 19, 2020,
2. Michael Rosser, *UK domestic film production falls 72% in Q1 pre-shutdown as inward investment booms*, Screen Daily, May 7, 2020.
3. *The Evolution of Media Creation, A 10-Year Vision for the Future of Media Production, Post and Creative Technologies*, MovieLabs, accessed August 2, 2020.
4. Todd Spangler, *Universal Shifting to Microsoft's Azure Cloud Platform for Live-Action, Animation Production*, Variety, August 21, 2020.
5. Dade Hayes, *Weta Digital Pacts With Amazon Web Services For Cloud-Based Visual Effects And Animation*, <https://deadline.com/2020/09/weta-digital-pacts-with-amazon-web-services-for-cloud-based-visual-effects-and-animation-1234568247>, Deadline, September 2, 2020.
6. *Netflix—post-production Media Delivery at Scale with AWS*, <https://aws.amazon.com/snowball/?whats-new-cards.sort-by=item.additionalFields.postDateTime&whats-new-cards.sort-order=desc>, AWS video, accessed September 7, 2020.
7. Jack Derwin, *Australia is making a big, \$400 million play for more international film and TV production to come down under*, <https://www.businessinsider.com.au/location-incentive-australian-film-tv-production-2020-7>, Business Insider Australia, July 17, 2020.
8. Third Update on Production Restart Progress, <https://www.filmla.com/filmla-issues-third-update-on-production-restart-progress>, FilmLA, September 3, 2020.
9. Deadline, *Weta Digital Pacts With Amazon Web Services For Cloud-Based Visual Effects And Animation*

This paper was published by PacketFabric's M&E vertical for information purposes only. It is not intended as an endorsement or criticism of any other companies or products, and any omissions are unintentional. Unless stated otherwise, those who contributed did not do so as an endorsement of PacketFabric or of any other company other than their own.

