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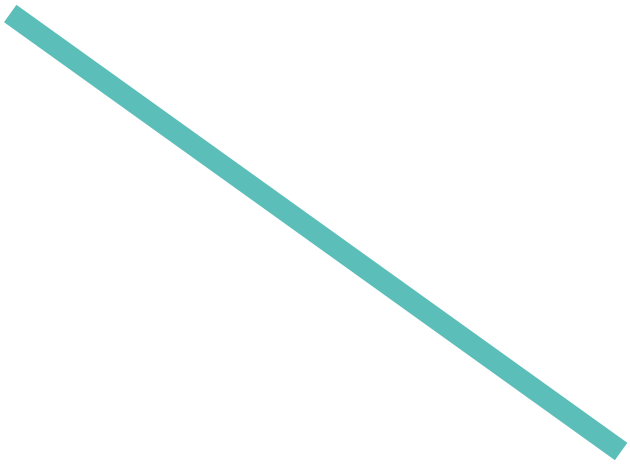
Connecting IT to Broadcast

Cloud Microservice Workflow Design



Essential Guide

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ESSENTIAL GUIDES

Introduction

By Tony Orme, Editor at The Broadcast Bridge

The power and flexibility of cloud computing is being felt by broadcasters throughout the world. Scaling delivers incredible resource and the levels of resilience available from international public cloud vendors is truly eye watering. It's difficult to see how any broadcaster would run out of computing power or storage, even with 4K and 8K infrastructures.

Cloud computing wasn't built specifically for broadcasters, but to provide more generic business workflow solutions for industry in general. Manufacturing, publishing, medical, finance and retail, but to name just a few, are industries that have all benefited from the development and continued investment in cloud infrastructure.

That said, all these industry sectors do have much in common with broadcasting. They all have peaks and troughs in their delivery cycles, and they all find it difficult, if not impossible to predict future trends with absolute certainty. In recent years cloud computing speeds have reached a point where they can now be used in real-time television thus enabling us to ride on the crest of innovation that many other industries have been enjoying for years.

Although broadcasters have built flexibility into their infrastructures by using central routing matrices, tie-lines and patch cords, the limiting factor has always been our reliance on the specialist SDI and AES distribution systems - synchronous transport stream methods that have served the broadcast industry well for decades. Unfortunately, they are static and difficult to scale.

Transitioning to IP has helped many broadcasters transcend the limitations of SDI and AES to provide asynchronous and scalable networks. Furthermore, adopting IP facilitates connectivity to computers through the ethernet port which in turn removes the broadcaster's reliance on custom interfaces. This has inadvertently provided a gateway to cloud computing.

Treating the public cloud as a gigantic compute and storage resource only scrapes the surface of its capabilities. The real power becomes apparent when we consider the scalability of the cloud and its ability to dynamically respond to the peak needs of the business.

There are few industries in the world that can boast constant demand for their products and services with little variation, and broadcasting is no different. Most, if not all broadcast infrastructures have been designed to meet peak demand. Often, expensive resource sits around doing nothing as the natural cycles of broadcasting means the equipment is not used every minute of every day.

Being able to add and remove computer resource "on demand" delivers new opportunities for broadcasters. And the key to making the most effective use of the cloud is to build systems, from the ground up that exploits this scalability. It might sound counter-intuitive to a seasoned broadcast engineer who's cut their teeth on thirty years of hardware, that we can simply delete resource and stop paying for it when we no longer need it, but this is exactly what we do with cloud computing.

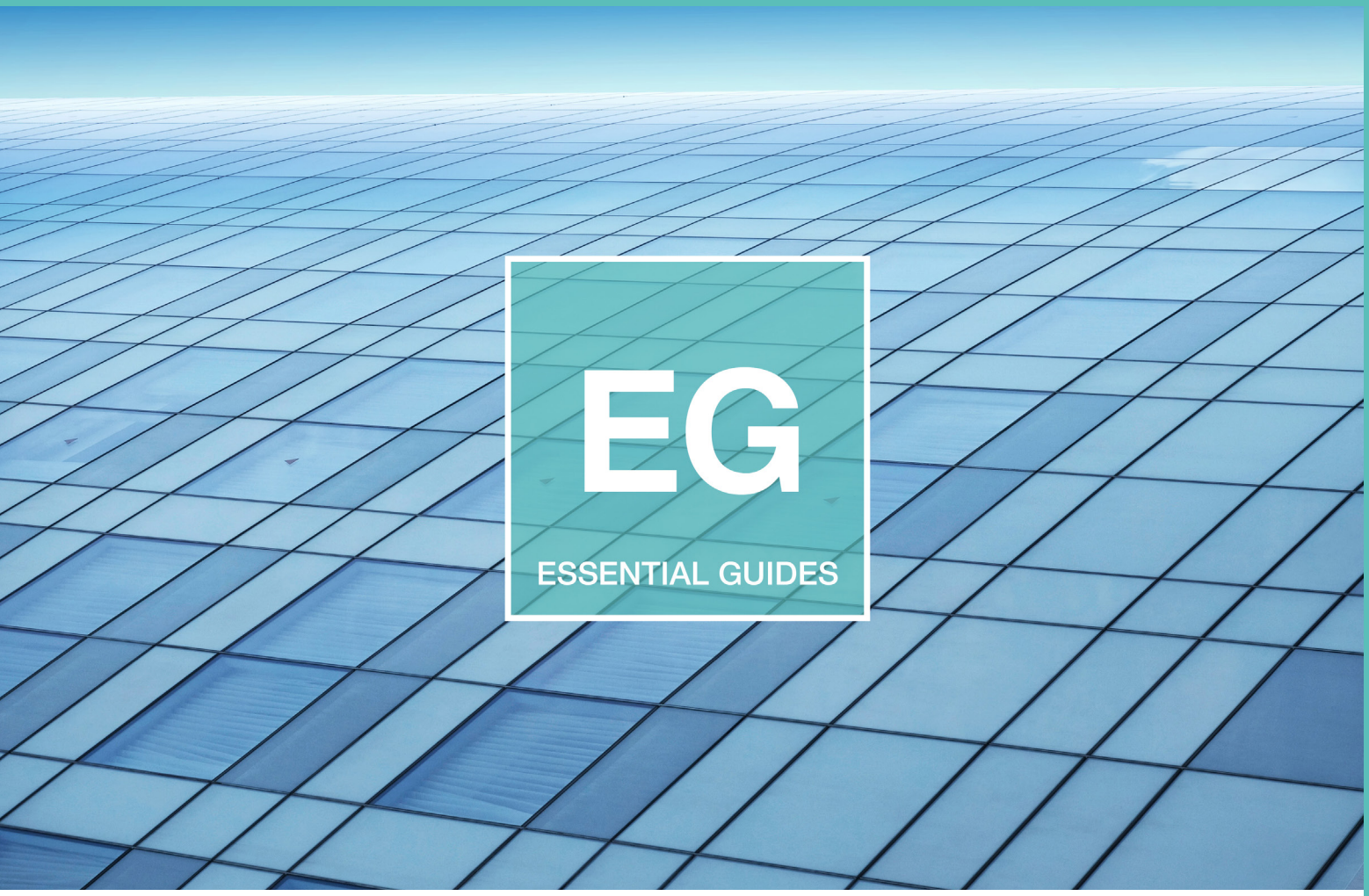
Tony Orme.

Broadcasters often transcode media assets, but not all the time, they may only do this during the week for eight hours each day. Using the traditional hardware solutions meant expensive resource spent most of its time doing nothing. With cloud computing, we can spin up new services as required. It might be that during an eight hour shift the operator needs four transcoders instead of one. They can simply spin up three additional services and quadruple their efficiency.

Cloud computing is the next major development for broadcasters. Combined with dynamic workflows and cloud microservices, efficiencies are set to skyrocket and broadcasters will be able to design on a "needs basis" as opposed to peak demand. A welcome result for any CFO and any engineer looking to design for the future.

Tony Orme
Editor, The Broadcast Bridge

Cloud Microservice Workflow Design



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To truly deliver the efficiencies and reliability COTS infrastructures and cloud deployments promise to offer, we must adopt entirely new design philosophies that cut to the very core of our understanding of how broadcast infrastructures operate.

Simply provisioning software versions of the components that make up broadcast workflows doesn't even get close to leveraging the power of cloud systems.

Their dynamic ability is much more than just pay-as-you-go computing. If correctly embraced, the philosophy of scalability soon demonstrates how cloud systems are about much more than just saving money.

Few broadcast infrastructures use all their resources 24/7. Even in these days of highly efficient automation, expensive hardware can sit around for hours or even days without being used. Most workflows need human intervention at some point and are constrained by the availability of operators and engineers. Production requirements often exhibit usage patterns based on peak demands, limiting the efficiency of workflow components.

Hardware Inefficiencies

On-prem datacenters go some way to alleviate these challenges. Historically, broadcasters have had to procure specialist hardware that could only be used for one specific purpose. For example, a standards converter would only ever deliver this one task. It's possible that some sub-functionality of the product could be used, such as its color corrector in the preamp. Still, these were often use-cases that were at the periphery of the operation and added little to the monetary efficiency of the standards converter. COTS servers allowed multiple software applications to be run on them, thus making better use of the capital resource.

One of the challenges broadcasters have faced since the delivery of the first television studios is that they must provision for peak demand. The high bandwidth nature of video distribution and processing has left little scope for making more efficient use of on-prem datacenters. The same challenges apply leading to server, storage and network resources all being designed for the worst-case-scenario, or peak demand.

It is possible to spin up and spin down virtual machines within your own on-prem datacenter. However, design engineers must still provision for peak demand to make sure there is enough hardware resource available. With the speed at which requirements change and scale, this can be a daunting task, especially if the old-school static methodologies are applied.

Responding To Peak Demand

In this context, the case for cloud computing is compelling. Broadcasters do not need to be concerned with peak demand as there is always more resource in the cloud. One of the challenges broadcasters do face is understanding when to provision just enough cloud resources and where to scale. By the very nature of the transient demands modern broadcasting places on resource, getting this demarcation right is not as easy as it may first appear.

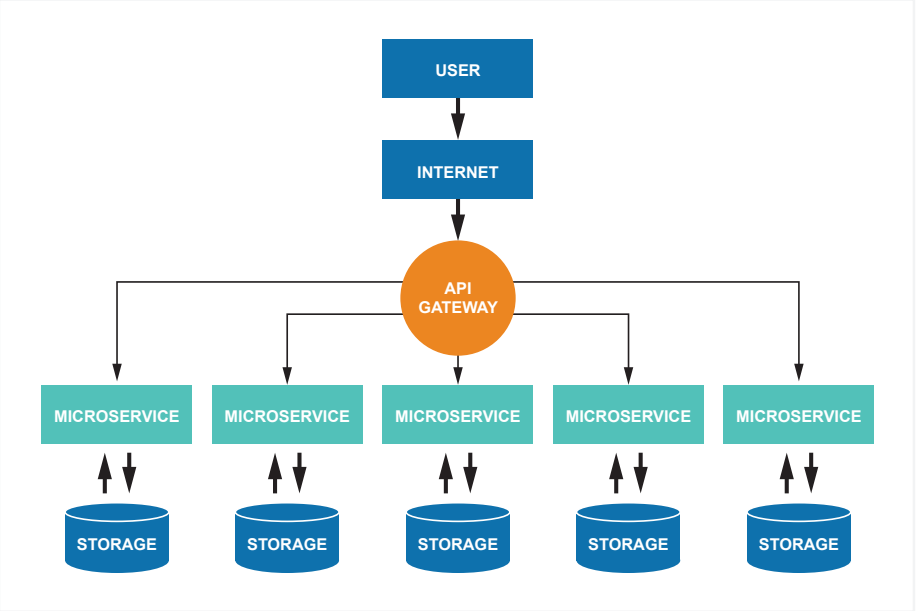


Fig 1 – Microservice functionality is abstracted away from the user through the API gateway. This greatly reduces the complexity of the broadcaster's workflow design as they only see a REST API gateway. Furthermore, the broadcaster can allow microservice vendors granular access to parts of their storage, enabling efficient cloud-based media asset processing.

Agile development methodologies embrace change. Modification isn't just an add-on, it's at the very core of their design principles and made all the more powerful by cloud computing. Agile developers are adept at working on remote systems that change by the minute. Scaling systems up and down is key to how they operate, and this is a design principle that broadcasters can greatly benefit from.

This further leads to provisioning microservices in media supply chains. Traditional software relied on large monolithic designs that had to be recompiled in its entirety every time a new feature was added, or a bug fix deployed. For small-scale software this was relatively easy to work with, but as software became more complex, the ability to maintain it became an increasingly difficult challenge.

Software Optimization

Microservices solve two fundamental challenges: they deliver highly maintainable software and facilitate fast deployment streamlined to the hardware they operate on. Although the Von Neuman x86 architecture is ubiquitous in every datacenter throughout the world, it has more variants than we care to think of.

This leads to the potential for suboptimal software as any fine-tuning for a particular vendor's hardware will unlikely be able to be replicated on another vendor's hardware.

Operating in the cloud helps resolve this. The microservices vendor not only fine-tunes the software for the platforms they support, but they are able to test the code in a well-defined system that can be reliably replicated. This leads to highly efficient reliable systems.

The systems developers are writing code on are exactly the same cloud infrastructures as those used by the broadcasters when employing the media processing facilities. The broadcaster will select their preferred cloud vendor and from there select the microservice they want to use. Code maintenance is further streamlined as broadcasters do not need to update software themselves as this is automatically provided by the vendor when they update the microservice. Testing and QA (Quality Assurance) is applied by the vendor and quite often the broadcaster may not even be aware a new software version has been deployed.

Although virtualization can meet the demands of dynamic systems, they are relatively slow and resource thirsty when compared to microservices. The key to understanding the efficiency gains is to recognize the locality of the operating system. Multiple microservices have their own container to hold the application specific libraries and software but reside within the same operating system kernel thus making creation and deletion much quicker. Unlike a virtualized machine, the host server doesn't have to create multiple instances that are resource intensive. Instead, each microservice is a relatively small, compartmentalized container of code and libraries that can be quickly designed, tested, QA'ed and enabled for operation.

Dealing With Peak Load

Advanced monitoring is installed by the microservice vendor that anticipates server load and can schedule new jobs or spin up additional servers as required, often before they're needed. This all happens in the background, so the user does not need to be concerned with load balancing and server utilization. They only need to access the microservice through an API.

Interaction with microservices uses REST (Representational State Transfer) for control and monitoring microservices. REST is a software architecture that uses HTTP for transferring data over the internet and four methods provide the basic primitives to send and request data from the microservice servers. As the internet relies on the client-server model, and the server facilitates the microservice, the client computer must initiate any data transfer from the microservice.

REST methodologies often rely on stateless interactions, that is, the microservice has no persistence of data outside of the function it is being used to execute. For example, when a microservice has completed a transcoding job, no data will be retained, leaving it free to move on to service another client with complete anonymity. This leads to very high levels of security as only small sections of the media file are read into memory at a time so the whole asset is never available to the cloud vendor's hardware, or the microservice provider's software.

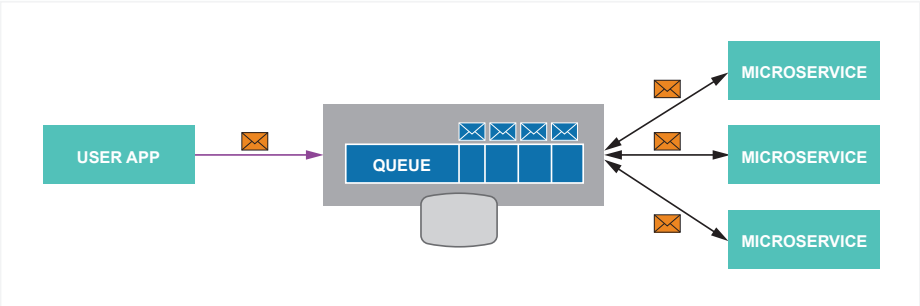


Fig 2 – Microservices often use a queueing method to determine how many processing jobs have been requested by the broadcaster's applications, when the queue reaches a threshold, more microservices are created to dynamically respond the increase in workload. All this happens automatically under the control of the microservice providers monitoring software without any intervention from the broadcaster.

RESTful Integration

The API interface embraces the REST methodologies and is a standard operational interface for Agile developers working with internet server-client technologies. This makes integration into workflows straightforward as the interfaces are well-defined and predictable. Broadcasters do not need to be concerned with how a microservice provides a service, such as color correction or aspect ratio conversion, only that the service is available as a callable software function that is able to facilitate the technical requirement.

Transferring media files from on-prem to the public cloud is incredibly inefficient and potentially very costly. To alleviate this, broadcasters are storing more of their media in the cloud for convenience and reliability and keeping the processing in the cloud leads to greater efficiencies. Most public cloud providers supply ultra-high-speed links between their datacenter regions to facilitate high-speed low-latency data transfer, these are many orders of magnitude higher than what is available for transfer to the cloud from the broadcaster's premises.

This leads to the concept of bring-your-own-storage. Cloud vendors often provide high levels of access security for data assets with granular access control. For example, using the AWS IAM (Identity and Access Management) system for S3 storage, broadcasters can manage who has access to specific media sources, where and when. For microservices this is a major benefit as IAM creates highly secure keys under the broadcaster's control that have a user defined lifetime.

These keys are used by IAM to access the media asset with read-write-delete control further allowing the broadcaster to fine tune access, they may only grant read access to a transcoding microservice for the duration of the job. As the microservice only loads segments of the media asset file into its own memory and not the media file in its entirety, security is maintained stopping the media asset from falling into the wrong hands.

Storage Deployment

Providing "access on your terms" not only provisions high levels of security to keep valuable media assets secure, but also maintains high levels of efficiency by keeping the storage in close proximity to the processing microservices.

The concept of keeping media assets in the cloud and providing secure granular access to third-party vendors allows for the concept of "bring your own storage". Broadcasters will have their own media asset management system that may well be a complex hybrid on-prem and cloud solution. As microservices can be easily created in cloud-regions around the world, the microservice function can be moved to the locality of the storage housing the media asset, thus greatly improving efficiency, and keeping costs optimized. This is an automated service provided by the microservice vendor and not something the broadcaster will see or be involved with.

Software development cycles are much faster than the equivalent hardware solutions and this helps facilitate the provision of cutting-edge technology. As cloud infrastructure processing and distribution speeds now exceed the requirements of broadcast television, software-only services are the natural progression.

Embracing Innovation

A great deal of research is being conducted in image processing that has a direct impact on broadcast television. The level of technology available in terms of processing algorithms is improving with incredible pace. Vendors are taking advantage of this innovation and providing microservices for solutions at the bleeding edge of color science, image compression and format conversion.

As media asset files are processed on computer servers and distributed in IP, the services provided are no longer constrained by the limitations of SDI or AES. Video can easily be distributed and processed using 16bit data samples so that even higher quality thresholds can be achieved. Broadcasters benefit greatly from this as much of the color science used in the medical and display industries use 16bit data samples. Noise is reduced, color rendition is improved, and clarity is greatly enhanced.

Advances are not just limited to video but also embrace audio including loudness normalization and sound processing. High precision audio processing with greater bit depth and sample rates is also possible leading to greater sound clarity and depth.

Efficient Microservice Workflows

Research in video and image and audio processing is far from standing still, especially when we look at what is occurring in other industries. Having a microservice based approach to providing processing takes the responsibility away from the broadcaster leaving them to concentrate on optimizing their own workflows.

Every broadcast facility is unique. Due to the localization and community requirements workflows vary enormously, leading many broadcasters to build their own development teams to design workflow solutions that optimize their operations and maintain an immersive environment for their community of viewers.

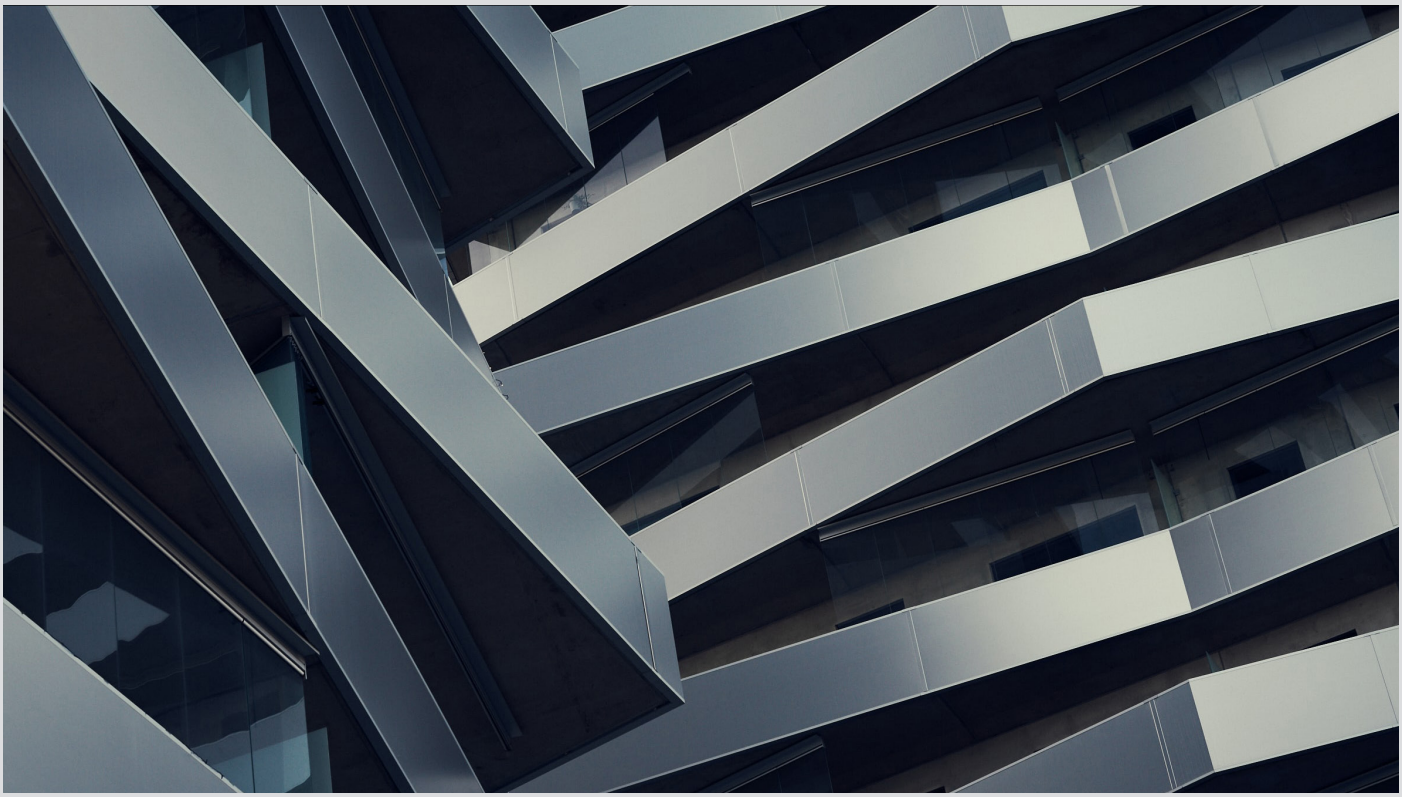
The move to cloud computing with its associated microservices improves security, quality of the video and audio, and program delivery. Combined with “bring your own storage”, optimized APIs and an incredible number of processing solutions, custom workflow design has never been easier for broadcasters.

The Sponsors Perspective

Broadcast Transformation In The Cloud

By Reuben Cohn, Cloud Transcoding Product Manager at Telestream.

We live in fascinating times: increasingly, we live in the era of cloud-based broadcast operations.



Growth in cloud computing has been a central trend over the last decade, with the market experiencing triple-digit annual growth as recently as 2015. According to Deloitte research, growth among the largest hyperscale public cloud providers had declined to “only” 31% annually by the end of 2019, and this rate had been projected to (slowly) decline further in 2020 and 2021 as the industry matures, growth in cloud continued to outpace that in many other sectors.

Like every industry, the media & entertainment (M&E) industry has been thrown a curveball with COVID-19, and a recent report from PwC and Microsoft highlights how they’re accelerating their cloud investments and moving away from legacy production systems.

As recently reported in TechRepublic, production delays and the under-delivery of episodic content could result in over $3.5 billion in lost ad revenue for broadcasters, according to the report, “The show goes on in the cloud.”

Although M&E businesses have been resistant to embrace emerging technologies in the past, they’re now focused on digitally transforming themselves. The pandemic “is changing underlying model assumptions and proving the value of cloud and putting more revenue in the pockets of media companies that weren’t quick to embrace cloud as they have,” said CJ Bangah, a principal at PwC US.

Intelligent cloud transformation will enable innovation and efficiency, according to Mark Borao, a partner at PwC. For example, some studios went straight to streaming while a film festival stood up its event in the cloud. Other production companies and commercial advertising agencies leveraged cloud technologies to keep their employees safe and productive, the report said.

Deloitte calls cloud “fourth generation broadcast infrastructure,” following the first three generations starting with analog – then digital – then data center. And now, cloud.

Several factors are fuelling the transition to cloud-based broadcast operations and make it highly relevant to today’s business landscape.

Cloud Infrastructure Adoption – Across the M&E industry, there is a mindset change underway from owning and managing a private datacenter to adoption of cloud infrastructure for storage and management of media content.

SaaS Availability - As cloud adoption becomes more ubiquitous there is a need to have cloud native software services available to execute media workflows. Bringing the Telestream Media Framework to the cloud allows for continuity for our customers workflows by using an underlying technology they can trust.

Elastic and Scalable - The Telestream Cloud portfolio can meet the expectations of rapidly changing business requests by expanding and contracting based on need at the time of execution. There is no need to overbuild or put off workflows to a later date, we can provide the service now and scale it up or down on demand.

Remote Availability - As the decentralization of workers accelerates, cloud SaaS products allow remote workforces to more easily collaborate and not rely on hardware and locally installed software.

Media Company Personnel Skills - there has been a change in who manages the operations of the media companies. More and more, there is core competency in software development and Telestream’s Transform service, as an API-first software product allows those groups to be flexible in their deployment of their workflows.

M&E Cloud Pioneers Reap Rich Dividends

One of Europe’s largest commercial television networks and a global production and distribution business is pioneering the cloud-based broadcast operations. For several reasons, the broadcaster decided to move a significant amount of its content preparation operations into the Cloud. The project sees it migrating many of its current on-premise media processing operations into the Cloud.

Commencing pre-pandemic, the broadcaster started bringing in-house a range of content processing operations that had previously been provided by a third-party service. At very short notice, it was unable to use the supplier, and with only a few weeks’ notice, it had to design and build a new solution for the preparation of content.

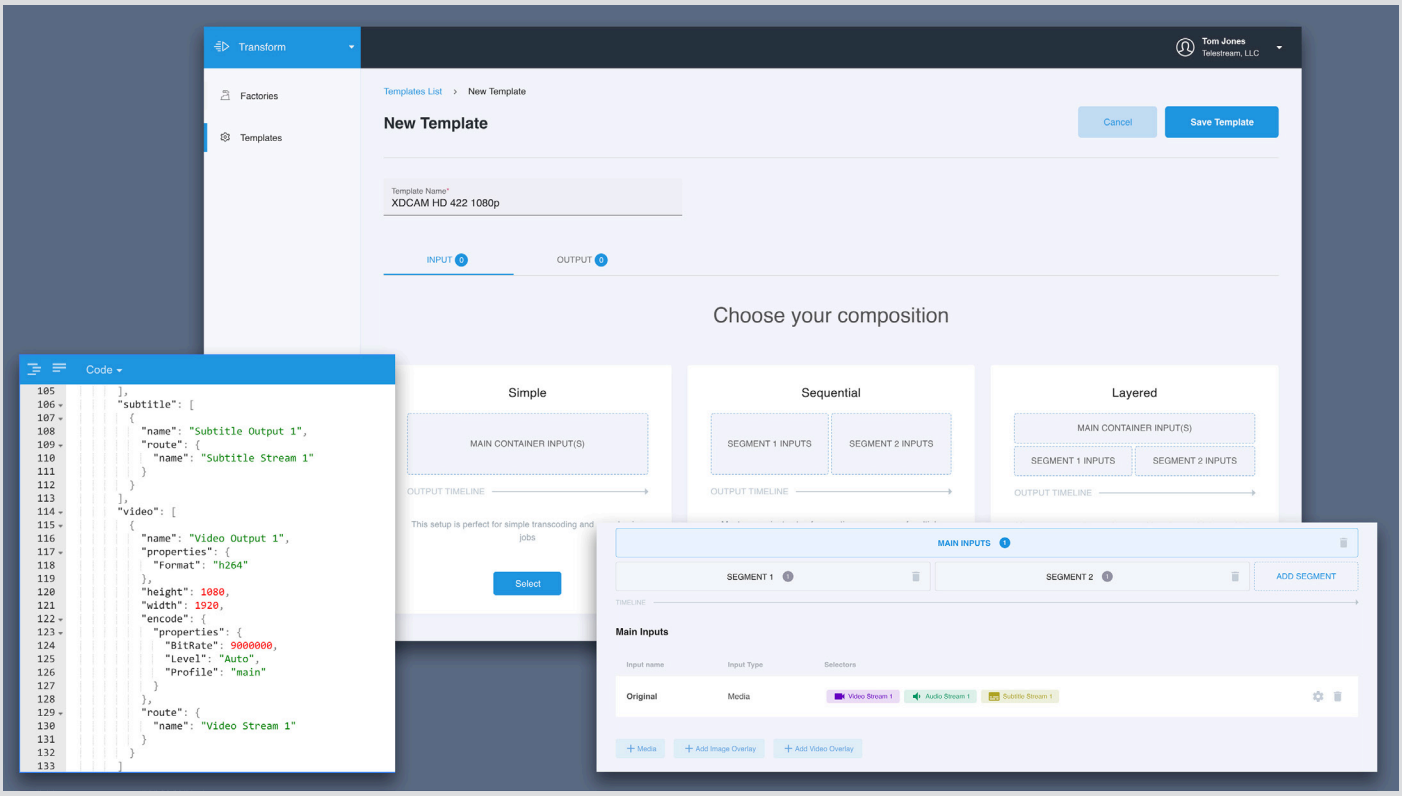
The broadcaster’s creative team was expanded to accommodate any craft edits, while the team was faced with the need to rapidly scale up content encoding and packaging workloads. Cloud-based services were the only practical solution, and after evaluation of several alternatives, it selected the Telestream Cloud solution and worked with Telestream’s team to onboard a cloud-based workflow for their own content.

“We only had sight of the workflows required from the client side, so we had limited knowledge of what we could build,” explained the broadcaster’s Content Processing Team Lead. “Very quickly, we had to get up to speed, since we needed to minimize business disruption and we must not have screens turning black.

“Already, we were well embedded with Telestream using its on-premise solutions,” he explains. “So, it was a natural progression to investigate what Telestream Cloud services offered us.”

With Telestream’s help, the broadcaster created a POC (Proof of Concept) system, which replicated its existing Vantage workflows on Telestream Cloud and proved highly successful. Phase 1 was fully operational within six weeks, allowing the broadcaster to process 50 percent of its normal throughput.

“Within 12 weeks, we were exceeding our previous content preparation capabilities. It was a roller coaster ride with us learning on our feet,” he explained. “We went from POC to full production in one of the quickest turnarounds that I have ever experienced.



Cloud Transform user interface (courtesy Telestream).

"A lot of this was thanks to the Telestream team and their ability to visualize what we wanted to do. Now, we are in Phase 3 of re-factoring the Vantage workflows, streamlining them and making them productionized. It's going really well."

The Need To Empower Broadcaster's Internal Development Teams

While the European broadcaster project is a source of great pride within Telestream, there is a need to reduce the emphasis on Telestream's support team. Instead, we need to enable and empower our customers' internal development teams so that they can perform these tasks themselves. This is Telestream Cloud Transform's 'raison d'étre'.

Transform is highly scalable (to hundreds or potentially thousands of simultaneous sessions). Also, it is highly secure, with encrypted communications and API-key access. With Telestream Cloud, you bring-your-own-storage: we never store your sensitive media. And Telestream Cloud Transform is cloud agnostic: it runs in whichever provider/region stores your media, avoiding any egress charges.

In developing Transform, Telestream is targeting numerous organizations - both traditional ones such as broadcasters and post-houses, as well as relative newcomers such as social media platforms and app developers. Telestream Cloud Transform is mainly targeted for developers and development teams within media companies as well as other possible opportunities referenced above.

Traditional broadcasters and others in the media and entertainment industry are looking towards an architecture that shifts some or all of their existing workflows into the cloud to take advantage of the massive scalability and cost-effective SaaS solutions to be found there. As these large enterprises want to scale up or shift load into the cloud, in addition to flexibility and security they need a foundation of technology they can trust to meet their demanding and detailed specifications.

As others outside of the traditional media space go in search of tools to integrate into their platforms and the backend of apps for processing media, they also desire highly scalable SaaS solutions to accommodate a wide variety of transcoding scenarios. The need for modern architecture and API-driven products is critical to teams mainly consisting of developers. As with the first group, a trustworthy foundation of technology to ensure that specs can be met and that beautiful pictures are created for consumers is a must.

Transform is an API-first service, aimed at developers who may not be media processing experts. It leverages flexible JSON-driven compositions to achieve desired outcomes; and is scriptable both in terms of API and Composition creation/ manipulation. This new service employs a SaaS deployment model and has the Telestream Media Framework under the hood.

What Is The Telestream Media Framework?

For decades, Telestream has been developing the workflow and transcoding technologies used by media and entertainment companies worldwide. The Telestream Media Framework is what sits behind our Vantage Media Processing Platform, Vantage Cloud Port and now, the Telestream Cloud Transform service. This is the proprietary software that's been developed by Telestream over the past two decades and powers some of the most important media workflows in the world. All of the trust that our customers have in our on-prem products is available in Telestream Cloud by taking advantage of the Telestream Media Framework.

Why Introduce Another Transcoding Service?

Telestream Cloud Transform is different from other systems in three ways. Firstly, at many different organizations, development teams are now building transcoding and media processing workflows, and Transform has been created for them. The components of the Telestream Media Framework can now be in the hands of software developers at media companies, so they can create their own compositions for manipulating media.

Many organizations know that they should be working with cloud-based workflows but they are not sure how to do this. At Telestream, we have taken the media expertise we honed over the past two decades and put it into our cloud products. This means our large media customers and now some non-traditional, but video heavy enterprise customers can have access to the Vantage heritage in a cloud-native package.

Telestream is one of a small group of companies that is cloud agnostic. Our customers can choose to use any cloud partner they prefer, and we are able to meet them there. Some of the other transcoding services in the market lock customers into their cloud infrastructure and do not offer a choice.

So, what can customers do now they could not do before? Transform is a cloud service that allows developers to work on their applications, and not spend years learning the intricacies of the countless video formats in use worldwide. Through its API, development teams can write JSON compositions to manipulate media without ever worrying about what's under the hood. This means that they design the processing workflow that works for their organization and Transform manipulates media and puts the assets where the organization needs them. Other technology solutions are not able to provide the breadth of transcoding and media processing capability that's available in Transform with the Telestream Media Framework.

We're in a world where video has become as ubiquitous as the written word and providing the computational hooks to put those pixels to work - that's what Telestream Cloud Transform does. And it does this across virtually every codec or format, whether you're focussed on consumer – or professional - acquisition formats like XAVC or MXF, editing formats like DNxHD or ProRes, or distribution formats like h264 or h265.

The Transform API is straightforward – it starts jobs, stops jobs, and requests status. Developers are familiar with how to talk to the Telestream Cloud Transform API. The composition language is the "special sauce." That's where the instructions are given to manipulate the media.

A Template pre-processor fills in the gaps that may exist between what is being requested in the original composition with the details the Telestream Media Framework needs. For example, a request may be made by the incoming composition to extract and process two audio channels, and the pre-processor will find the channels, determine which decompressor is needed, etc. It does this by looking at the composition and what the Telestream Media Framework needs, inspecting the incoming media, and then it fills in the gaps.

As we reported at the start of this article, PwC's Mark Borao believes that intelligent cloud transformation will enable innovation and efficiency. At Telestream, we wholeheartedly agree with this sentiment. Back in 2015, we made our first major cloud investment when we acquired PandaStream and ever since we have invested major resources in developing solutions and systems that will help organizations of different size and scale to harness the power of the cloud in broadcast operations.

By a country mile, Transform is the most significant cloud-based transcoding and media processing technology introduction to come from Telestream so far. We look forward with great anticipation to see how the market will respond to it. For more information, go to https://www.telestream.net/telestream-cloud/transform.htm.

Reuben Cohn, Cloud Transcoding Product Manager at Telestream.

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