Cloud for Media Processing

Technical Brief

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1 Rethinking infrastructure and operations

Operators are transforming their infrastructure and operations to become more responsive to rapidly changing business requirements. This is being done by removing boundaries between engineering and operations to facilitate the agile development and deployment of new and improved products and services.

In most organizations, this begins with standardizing data center infrastructure management and operational processes across the organization to reduce overall expenses. This implies the abstraction and rationalization of computing, networking and storage resources from both management and cost points of view. This is followed by the data center offering these resources to the rest of the organization, including to media and content operators.

The rationalization of data center resources enables operators to:

- Maximize re-use of existing infrastructure, generally made of both servers and appliances
- Adopt new operational models such as “DevOps”, where development and operation teams share a common goal.
- Buy additional resources either located On-premises or Off-Premises using models such as Infrastructure-as-a-Service, Platform-as-a-Service and Software-as-a-Service.

2 Is the cloud model possible for video?

2.1 Video is not any type of data

Given its specific nature, video raises challenges for cloud deployment:

- Video consumes a lot of processing, bandwidth and storage space. In a way it can be extremely demanding with its uptake of resources especially if the workflows have not been optimized
- Live video should not suffer service interruption. While a few minutes of downtime in a VOD service might be acceptable, having a live program interruption for more than a few seconds will have a negative impact on the audience.
- Video has intrinsic value and has to be protected from theft
- Video workflows are becoming increasingly complex

2.2 Cloud benefits

When looking at all these constraints, there were some initial degrees of skepticisms regarding the suitability of cloud architecture for video.
Nonetheless, there are clear upsides to moving to a cloud architecture:

- Cloud architectures are built to scale with processing, storage and network demands
- There is a healthy ecosystem of tools and technologies available to deploy, scale and operate efficiently with much less time and resource efforts compared to dedicated hardware platforms
- The investment in the infrastructure is protected and optimized: thanks to software and virtualization, multiple applications can coexist on the same server infrastructure, as opposed to deployed dedicated silo for each application

The “holy grail” of video cloud development is to gain all the benefits of the cloud in terms of cost and operation optimization without sacrificing any of the core specificities and quality standards inherent to video services.

3 What does “Cloud” mean?

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

3.1 Main benefits

The essential benefits of cloud computing are: pooling of computing resources, ubiquitous network access from a variety of platforms, rapid elasticity to scale with demand, on-demand provisioning of computing capabilities, and last but not least, optimal resource monitoring and measurement capabilities. These cloud metrics are set according to service requirements.

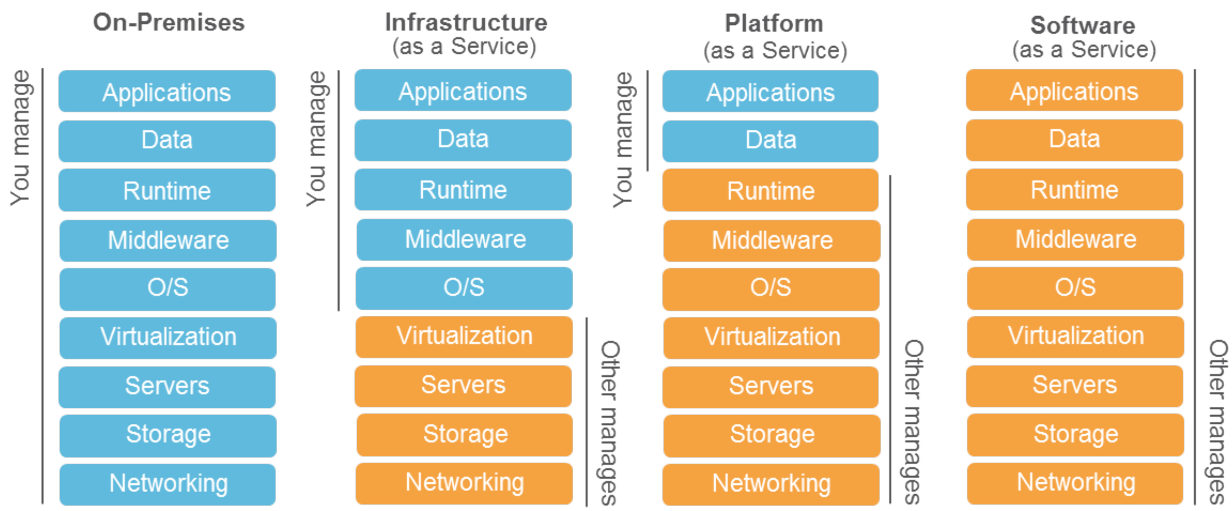
3.2 Service models

There are three common service models for cloud computing:

- **Software as a Service (SaaS)** gives the cutomer ubiquitous access to the provider applications running on a cloud infrastructure.
- **Platform as a Service (PaaS)** gives the customer the capability to create and deploy onto the cloud infrastructure applications using programming languages, libraries, services, and tools supported by the provider.

› **Infrastructure as a Service (IaaS)** gives the customer the freedom to deploy and run arbitrary software and operating systems. The customer does not manage or control the underlying cloud infrastructure but has a limited amount of control over some elements (operating systems, storage allocations, deployed applications, host firewalls).

These cloud service models are deployed and enforced at the public, private and hybrid level.



3.3 Deployment models

3.3.1 Private cloud

The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple customers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

3.3.2 Public cloud

The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic institution, government organization, or some combination of them. It exists on the premises of the cloud provider.

3.3.3 Hybrid cloud

The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

4 DevOps

High quality and high reliability are standard expectations for business applications. Error messages, such as site not responding, application not loading or other failure attempts to run rich media content puts reputation, trust and satisfaction at risk. DevOps is a way to overcome these down times and deliver timely progressive design improvements through the collaboration and integration of the various key roles of the developer, QA engineer and IT administration. Fast changing market demands require fast development to deployment cycles as well as approaches to monitor and diagnose new product or service releases – which is exactly what DevOps is addressing.

The traditional video industry has been disrupted by the emergence of new players coming from the Internet. These players usually have an organization leveraging the agile methodology and DevOps approach to launch and adapt new products quickly.

5 Cloud & Video processing

A cloud approach can apply to numerous related video services. For example, Content Management, Digital Right Management, Subscriber Management, Middleware back-end, and Ad Decision servers, etc. are moving towards Software-as-a-Service models and are increasingly being handled from public clouds.

Cloud for video requires an understanding of video workflows. We often come across the following types of services:

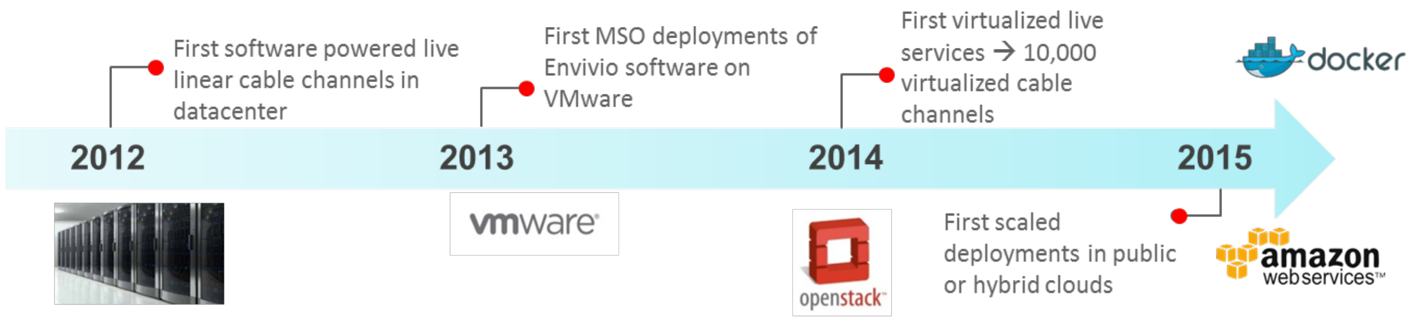
- 24/7 live broadcast service: distribution of linear channels from a video headend
- Live events: specific distribution set up for a limited period of time (e.g. sports game retransmission, concerts, live coverage)
- File transcoding: encoding for Video on Demand

The potential benefits of a cloud approach vary according to each type:

	24/7 live broadcast	Live events	File encoding
Characteristics	› Permanent resources › Guaranteed performances › High availability › High quality	› Temporary resources › Guaranteed performances › High availability › High quality	› Temporary resources › Variable processing load › High variety of workflows
Cloud benefits › **Infra cost reduction**	› Very limited	› Medium › Infra can be repurposed for other applications once events are done	› High › Load balancing between various workload › Switch between different applications
Cloud benefits › **Operations**	› Software roll-out, management and upgrade › Deployment automation	› Software roll-out, management and upgrade › Workflow instantiation and automation	› Software roll-out, management and upgrade › Workflow instantiation and automation
Cloud benefits › **Reliability**	› Requires additional management for better uptime	› Redundancy Management	› Redundancy Management

6 Ericsson Approach

6.1 Heritage

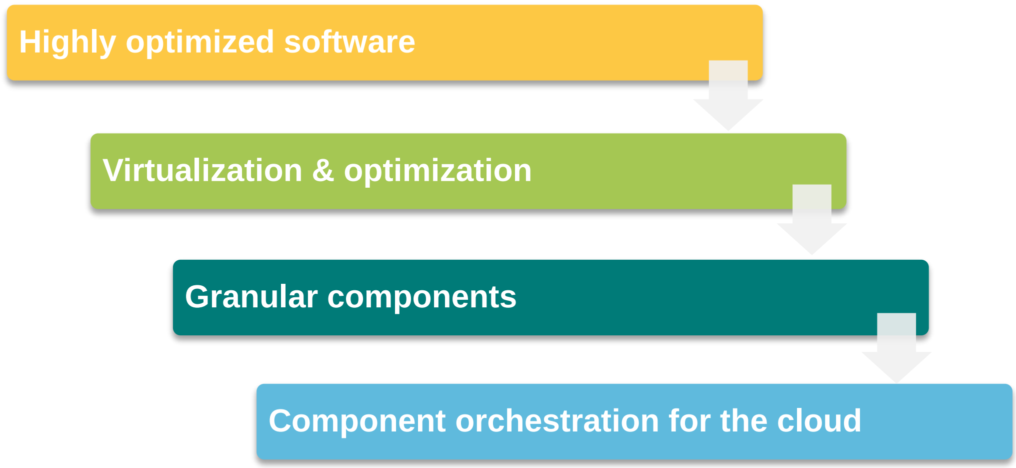


Envivio has pioneered the deployment of 24/7 live services in both private and public infrastructures.
In 2012, Envivio deploys software-based only video head-ends for two large US operators: Verizon and Time Warner Cable.
In 2013, Comcast deploys Envivio Muse transcoder in its datacenter using VMWare.
In 2014, Envivio deploys more than 10,000 live channels in a virtual environment and demonstrates how OpenStack and Amazon Web Services can be leveraged for launching live events applications.
In 2015, the industry is widely embracing the cloud approach, and Envivio continues to expand tools and technology to support the cloud, notably with the implementation of containers and Dockers
With the acquisition of Envivio, Ericsson is building a suite of “engineered for the cloud” technologies providing organizations with the components to build superior video products and services with faster, cheaper, and more reliable than ever before results

7 Necessary steps for migrating to the cloud

Until recently, deploying video solutions meant for most operators sourcing dedicated hardware appliances based on specialized ASICs. Today, the resource allocation game has changed thanks to the engineering of highly mature software-based video codecs and efficient multi-core CPUs. These developments along with constant updates to innovative services are necessitating the need for service evolutions, which are best implemented by the deployment of software over standard servers.

But adopting software is not enough: transitioning to cloud architecture requires additional transformations and optimizations to unlock additional operational benefits. The following section discusses the necessary steps towards transition.



7.1 Software

Ericsson is a pioneer in delivering pure software based solutions that meet broadcast requirements. Deploying highly optimized software without compromising video quality or reliability is the first key step toward a video cloud migration. Running pure software is the only way to guarantee a good level of abstraction from the underlying infrastructure and leverage all the tools, technologies and ecosystems developed around the cloud.

7.2 Virtualization

The second step is Virtualization, building reproducible runtime environment templates and efficiently leveraging the underlying infrastructure. Network and CPU optimization, as well as building optimal images with small footprints are key to keeping high performances and reliability on the overall system.

Standard virtualization approaches are primarily based on virtual machines. Although well spread and mature, this technology has some caveats: each virtual machine requires a lot of memory and storage space and consumes additional CPU cycles to run its OS. Transferring and loading virtual images can take more time than what is usually acceptable for video workflows.

An interesting approach is based on Operating-system-level virtualization where the kernel of an operating system allows for multiple isolated user space instances. Such instances, often called containers, behave like standalone virtualized applications. This technology has existed for a long time in various forms, but more recently, Docker, a container management technology for Linux has gathered massive attention. Like the “traditional” virtual images, containers can also help partition resources on the host platform but they have a significant advantage over virtual images: they share the same operating system, they are a lot more lightweight, and overall they consume fewer resources. They can therefore be deployed and launched more quickly – making them a suitable technology for video workflows management.

7.3 Modularity

The architecture of the “software products” has to be reexamined in order to leverage all the benefits of a Cloud and DevOps approach. This implies that:

- The software product can be controlled by rich APIs, so that an upper management system can control each instance and launch them dynamically
- The software product can be broken down into smaller components that can be modified and upgraded separately

The DevOps approach promotes regular and frequent updates to a system in operation. A monolithic product with a lot of external dependencies is highly incompatible with this philosophy. This is why products now have to be designed as a consistent set of “micro-services”, each serving a specific purpose with its own way to scale.

7.4 Service Management

Careful consideration and selection of cloud service management options can help improve the quality of experience and reduce costs. For example, an application management layer can automate the system configuration, allocate resources, and control the lifecycle of each software component. These monitoring and control services will help ensure proper uptime and guarantee the distribution of video services across the different infrastructures.

8 Ericsson MediaFirst Video Processing

Ericsson Mediafirst Video Processing relies on software components and therefore allows great compatibility with private and public clouds. In order to help operators build their own video cloud, with MediaFirst Video Processing, Ericsson provides:

- Highly optimized video processing software with configurations for virtualization (VMware, Docker) or bare bone installation on Linux (RedHat and CentOS)
- Product scripts for the most popular deployment tools (such as Puppet)
- A suite of components for configuring and managing applications in the Cloud
- Professional services for expertise, migration, and deployment

While the type of infrastructure and related management systems are chosen by the operator, Ericsson provides all the elements to deploy the video application layer and its management.

9 Architecture overview

The most straightforward fashion to build video services in a datacenter consists in deploying video processing software on top of an operator system installed on servers. The servers are administered by the server management tools, the OS is deployed and upgraded with a remote deployment administration system, and the video processing software is managed from a central interface and/or a Network Management System.

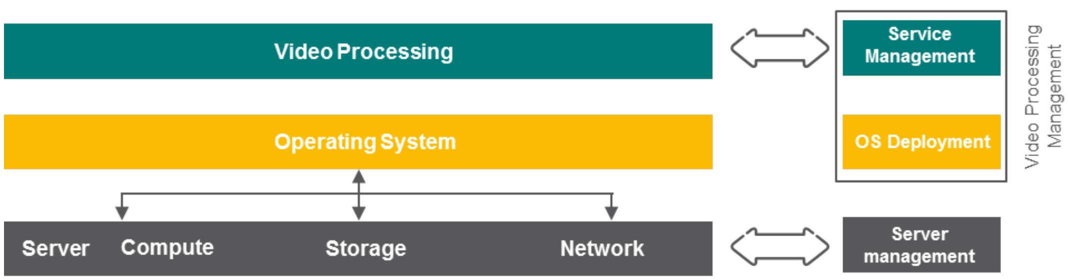


Figure 1: Software deployment on bare metal servers

In a cloud approach, the compute, storage and network resources may all or in part become virtual: CPU virtualization, software-defined storage and network function virtualization (NFV) are providing the required abstraction between the operating system and the underlying datacenter infrastructure.

The operator system can itself host multiple containers, each including a video processing application. This additional layer of containers is optional, but facilitates the application lifecycle management.

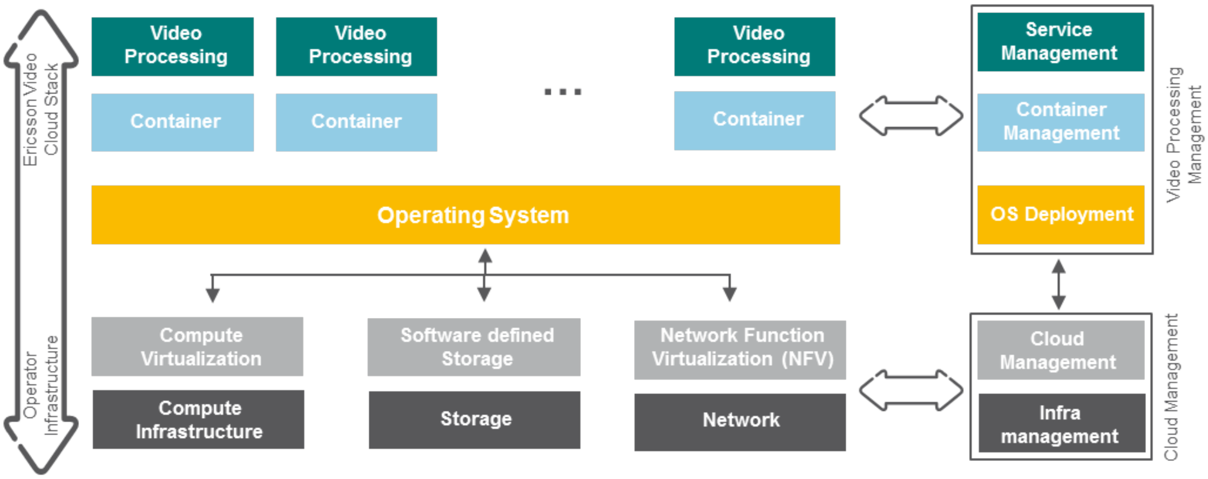


Figure 2: Cloud architecture

10 Deployment and trial examples

10.1 Technology selection

Today, there are various technologies and options available to build and manage cloud services, each with varying levels of maturity. Ericsson has deployment experience in the following areas:

- Infrastructure management: *VMWare* suite of products is still the industry reference today for private clouds, but recently a lot of operators have expressed interest in *OpenStack*. With these virtualization management systems, virtual instances are managed against user quotas and hardware resources. *OpenStack* goes beyond compute virtualization as it also offers an interface for software-defined storage and network.
- Operating systems: there are numerous projects and distributions for “lean Linux operating systems” that makes them more suitable for virtualization and containers. A small size OS offers better manageability, faster deployments, more granular updates and lower image storage costs.
- Virtualization / Containers: VMWare VSphere ESXi, KVM, Xen are few examples of commonly used virtualization technologies. In 2014, Docker a containerization technology garnered a lot of interest as a lightweight alternative for virtualization – even though the management tools might not be as mature yet.

Along with these core components, there are numerous tools to script the deployments, and a wave of new initiatives have emerged to better package and manage virtual instances and containers: OpenStack, but also Kubernetes (open sourced by Google) and Mesos (Apache foundation) to name a few. These initiatives are fairly recent, but given the velocity of their releases, they are rapidly gaining momentum and maturity and there is no doubt that they will play a major role in hybrid cloud deployments.

10.2 24/7 Live broadcast

Ericsson has now one of the largest deployments of virtualized live channels for a Tier 1 cable operator. Faced with a massive number of channels to deploy and configure, VMWare was used to facilitate the roll-out. Envivio's Muse transcoder and the VMWare ESXi settings were specifically tuned to achieve performances close to bare metal servers, and Envivio Guru was deployed to manage the various services and ensure high availability. Envivio's Muse and Guru products are now part of Ericsson MediaFirst Video Processing.
More recently, Envivio's trials with Docker on bare metal or embedded in virtual images have shown very good returns in operations, notably for configuration and upgrade management with minimal downtime.

10.3 Live events

Introduced at the National Association of Broadcast (NAB) in 2014, Envivio demonstrated the first implementation of live event transcoding inside OpenStack.

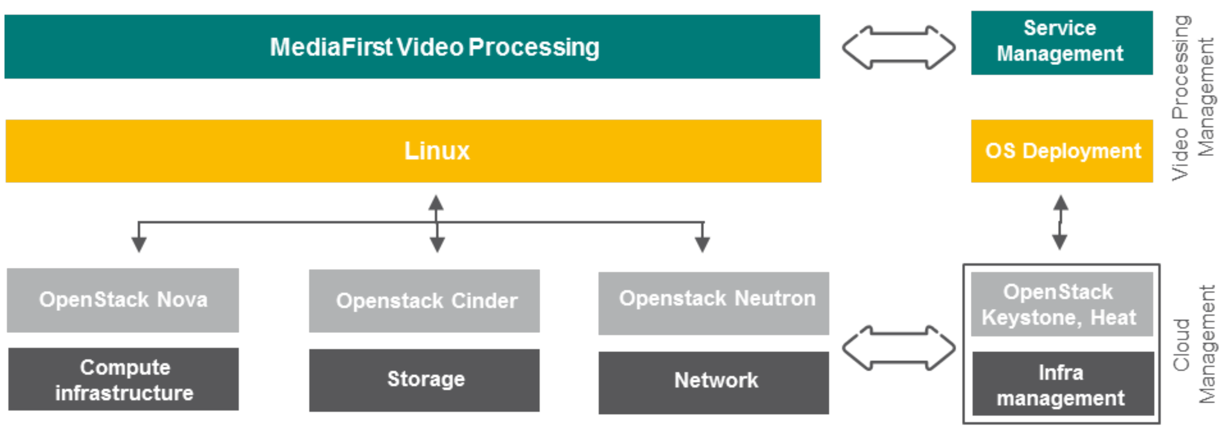


Figure 3 Live events: cloud architecture leveraging OpenStack and Ericsson MediaFirst Video Processing

This technology was chosen because of its ability to manage resource allocations globally or per user and respond in real time to the needs of the live event application. Computation resources are allocated for transcoding tasks during a defined period of time and in turn the underlying infrastructure can be optimized for various jobs.

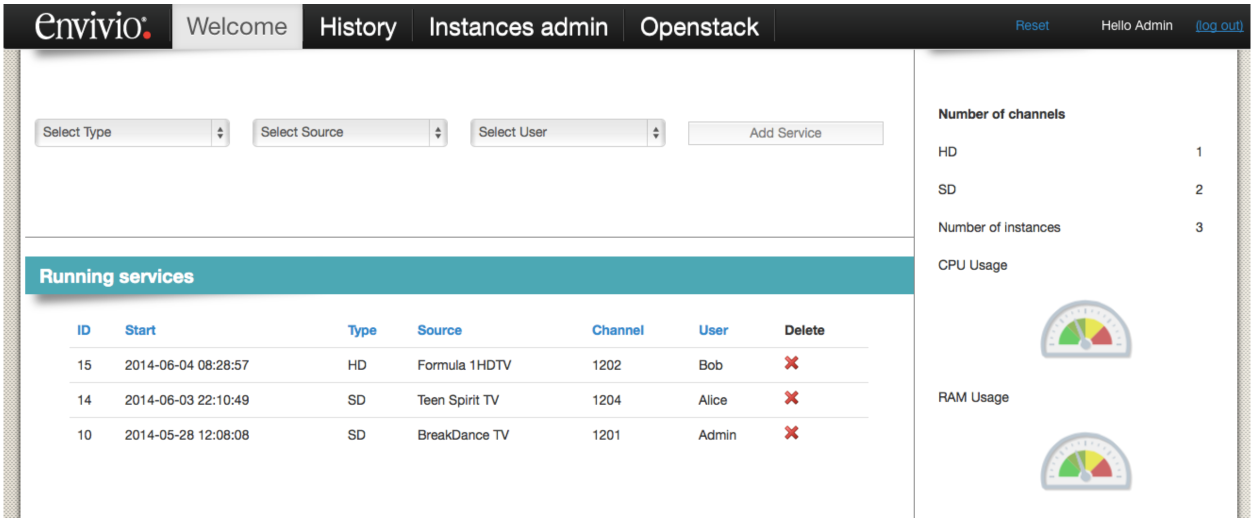


Figure 4: Control interface built on top of OpenStack and Envivio Muse Live for live events

11 VOD transcoding

In partnership with a major European Telco operator, Envivio deployed its VOD encoding workflow on a private cloud, using VMWare. In this case, the operator had many different workflows working on dedicated servers with sub-optimal usage. Virtualization allowed the operator to consolidate the processing consumption and balance the load onto fewer servers.

12 Benefits

Ericsson's video cloud stack approach brings several key benefits:

› **More choice for deployment**: with a solution based on software and the decoupling between application and infrastructure, video services can easily be deployed on any type of cloud: private, public, or hybrid.

› **Efficiency**: through deep optimization, Ericsson components minimize the processing footprint required and reduce the amount of infrastructure investments.

› **Evolution**: flexible modular architecture allows components to be incrementally scaled or upgraded. With a continuous stream of small changes instead of long and massive upgrades with non-regression testing, operations can adapt faster to market demands.

› **Reliability**: Ericsson incorporates additional redundancy automation to improve the system uptime. Quality and uptime remain the paramount metrics of video operations as they have notable direct link to customer satisfaction.

› **Automation**: The deployment can be entirely scripted. This greatly facilitates the move to DevOps approach and system maintenance through regular essential updates.

- **Open:** Ericsson's cloud approach relies on the best breed of cloud management technologies and interoperates with other building blocks. Operators are not locked into a specific and proprietary approach, but can select among technologies to meet specific needs or requirements.
- **Expertise:** Ericsson was the first to deploy pure software video workflows in a virtualized environment with different types of technologies. There's a lot of complexity involved in these project rollouts, and through the years Ericsson has developed advanced experience and expertise on how to achieve better performance with different technology capabilities. Ericsson aims to deliver and share this know-how.

13 Changes ahead

Operators and content distributors now have multiple ways of deploying media processing solutions from Appliances to Software-as-a-Service, as well as multiple ways of hosting from on-premises to off-premises and hybrid. This allows differentiation from the competition, by shortening product launch cycles and by enabling operators to respond quickly to market changes.

To achieve this, numerous structural changes have to be applied in the organization:

- Break the organizational walls between Engineering and Operations and create a collaborative environment with common goals. This is in essence the philosophy of the DevOps model: developers, testers and operators are sharing the same environment to roll-out applications more often without any interruptions in services.
- Leverage the processing, storage and network resources that are immediately available in private or public clouds.
- Leverage the tools for the cloud: there is a healthy ecosystem of deployment tools to script and monitor complete roll-outs, roll-backs or update services.
- Think application and services: use the best breed components and assemble them to innovate, differentiate and create unique services.

For nearly 25 years, Ericsson has pioneered the world's most advanced video compression technology and solutions, enabling industry transformations from analogue to digital, to HD, to multiscreen and soon, new formats such as HDR and 4K UHD.
With the acquisition of Envivio, Ericsson becomes the leader in software for video processing and service convergence thanks to more than a decade of expertise in media compression, software architecture and optimization for multi-core CPUs.
Cloud for video processing is the next big evolution.
With its expertise and experience forged with large private and public cloud deployments, Ericsson is the ideal partner to help perform this transition.

14 References

Apache Mesos : http://mesos.apache.org/

Docker : http://www.docker.com/
Ericsson MediaFirst Video Processing:
http://www.ericsson.com/ourportfolio/products/mediafirst-video-processing?nav=productcategory007
Google Kubernetes : http://kubernetes.io/
KVM : http://www.linux-kvm.org/page/Main_Page
Linux Containers : http://linuxcontainers.org/
Marathon: https://mesosphere.github.io/marathon/
NIST definition of Cloud Computing : http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf
OpenStack: http://www.openstack.org/
VMware VCloud : http://www.vmware.com/products/vcloud-suite/
Xen : http://www.xenproject.org/