Leveraging the Cloud for File-based Workflows

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Benefits of Cloud

- **Cap-ex to Op-ex**
  - Moves infrastructure off the balance sheet
- **Pay As You Go/Utility Cost Model**
  - Variable cost vs. fixed.
- **No Need to Build Out for Peak Demand**
- **Reclaim Space**
- **Management Efficiency**
- **Reduced Technology Refresh Risks**
- **Creates Central Repository of Data and Applications**
  Regional, National or Global

![Traditional Data Center](chart)
IT Cloud vs. Media Cloud

- Allows for “Digital Transformation as a Service”
- Three key benefits
  - Economics
  - Accessibility
  - Scalability
- Content Storage + Digital Asset Management (DAM)
- Must be “media aware”
- Object oriented
  - Multi-layered Essence Files
  - Metadata
- Collaboration
- Integrates with the Facility
  - Broadcast Ops
  - Post
- Uses APIs or ESB approach
Basic Media Cloud

Prod Unit 1 (Post Prod)

Prod Unit 2 (Research)

Broadcast Unit 1 (Broadcast Ops)

Broadcast Unit 2 (News Ops)
Public vs Private Cloud

- **Public**
  - Cost Efficiencies
  - Shared Resources
  - Utility Model

- **Private**
  - Studios/Large Media and Entertainment Organizations
  - Intracompany billing model
  - MPLS (Multi-protocol Label Switching) via Private Internet Protocol
    - Central-casting

- **Hybrid**
  - Private to Public
  - Facility to Public
Hybrid Clouds

Enterprise Data Center

Private Cloud

Dedicated Cloud

Colo, MSP & Cloud Services

Multi-tenant Cloud

“Utility” Cloud Services
Security

- VPN/V-LAN connectivity
- Encryption
  - Data level
  - Drive level
  - Network level
- Cloud Isolation Technology
  - Control of Cloud applications from Client site
- Digital Rights Management as an Application
Cloud Isolation Technology

The diagram shows a customer data center/private cloud connected to two cloud environments through virtualized storage and encrypted tunnels. Each cloud environment includes a CloudSwitch Instance (CSI) and an application (App 2 and App 3 in Cloud 1, App 2 and App 5 in Cloud 2). The diagram also highlights the virtualized storage and virtual management/controls within the data center.
Cloud-based Media Workflow

- **Digital Content Storage**
  - With Archive/Content Storage Management
- **Digital Asset Management application layer**
- **Other integrated workflow applications**
  - Transcoding
  - Editing
  - Digital Rights Management
  - Multi-Platform Distribution
Content Storage Network in the Cloud

- HSM (hierarchical storage management) System
  - Business rules to enable content migration from various levels of storage

- Initially Targeted to Secondary, Tertiary and Disaster Recovery (DR) Tiers

- Media Files -- in a wide array of formats -- must always be available, accessible and usable.
  - Requires an **intelligent middleware management layer** -- i.e. Content Storage Management (CSM) system formerly referred to as Archive Management.

- Two Alternative Integration Methods:
  - Pre-existing API integration directly into the post production, DAM, and broadcast operations environments
  - Future - **Enterprise Service Bus (ESB) Web Service**. An ESB would also act as a middleware layer facilitating the loosely coupled integration of Cloud workflow services

- May Run on One or Many Distributed Servers
  - Advanced features include replication, distributed transcoding, asset management, partial file restore and content distribution
Object Store Concept

• Key to Media and Entertainment asset storage and preservation is an “Object Store”

• An Object Store encapsulates all related files (essence, metadata, ancillary files) into a single package maintaining critical asset relationships

• Content Storage Management (CSM) solutions are Object Stores by definition -- HSM systems are NOT

• This concept becomes even more important when we extend the CSM functionality into the cloud and asset transport
CSM as an Object Store

Content Storage Management (CSM) Solution

- Archive
- Cloud
- Disk and Flash

File Collection
Metadata
Source Information
Archive eXchange Format

- Archive eXchange Formant (AXF) is a SMPTE 31FS initiative that will standardize the way media objects (and any other file collections) are transported, stored, and preserved.

- AXF is like an advanced ZIP code that encapsulates any number of files, metadata, and a ubiquitous file system.

- AXF packages can exist on block-based storage as well as any file or operating system on any media type—now and into the future.

- AXF is an IT-centric technology which brings the same level of universal transport and interoperability to storage as MXF has for media.

- For more information please visit OpenAXF.org.
Archive eXchange Format

Asset Components
- Structured
- Unstructured
- Proprietary
- Open

Preservation Elements
- Access Control
- Provenance
- Fixity
- Context
- Reference

File System

Universal Storage Agnostic File System

AXF Object

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Content Storage as a Service
DAM as a Cloud Service

• Three key benefits:
  - Cost efficiencies
  - Reduces complexity
  - Collaboration

  • Federated DAM can allow retention of legacy systems. Examples include:
    - News archive applications for station groups
    - Shared digital library for production group
Transcoding as a Service

• Use throughout the workflow chain
  – Post-Production, Broadcast Ops, Digital Libraries, Digital Distribution
• Can be integrated into CSM or stand-alone systems
• Like DAM, clients have preferences
• Use processing horsepower of the cloud to alleviate demand pressures in infrastructure
Editing as a Service

• Distributed ingest, search, retrieve, edit and archive for news
  - Avid’s Interplay Sphere News application
  - Expands the newsroom
• Backpack reporter
  - Wireless-powered cameras for field journalists
• Content staging in the Cloud (pre-edit)
• Edit at the laptop; conform in the Cloud
  - Work with proxies and metadata; essence in the Cloud
Challenges

- **Security**
  - Network
  - Content
  - Control/Access

- **Bandwidth**
  - Film
  - High end post-production
  - Accelerators
    - Signiant, Aspara, Brevity
  - Data tape

- **Latency**
Digital Distribution

- **Becoming “Content Centric”**
  - Getting control of assets
  - Lower OPEX Cost
    - Reduce content “re-work” through improved asset control
  - Swifter Monetization
  - Shared Infrastructure
    - End to End: Production to Distribution
- **No single source today**
  - Some assembly required

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**Client Back Office Systems**

**Content Management (Rules Engine)**

- Content Assembly
- Transcoding
- Security (DRM, Watermark)
- Packaging & Publish
- Common Storage

**Multiplatform OTT, TVE**

**Production & Post**

**Broadcast Affiliates**

**Syndication**

**CDN**
A Look Ahead – A Media Cloud Conceptual Workflow

Acquisition

4G LTE

Post Production / Edit

Legacy DAM

Content Staging

Digital Dailies

Post Production Workflow

Editing/Conforming → Transcode → DRM → QC → Final

Archived Manager

Push to / retrieve from Archive

SAN

Broadcast Operations

Assets to Video Servers; Metadata to Automation

TV Broadcast Operations

Multi-platform Distribution & Publishing

Client Multi-platform CMS Systems

4G LTE

Data Tape Archiving

4G

Ingest

Meta Tag

Transcode

Encrypt

Monetize

Publish

Distribution CMS

CDN

Content Monetization & Distribution

Front Porch Digital
In Summation - Cloud Allows for “Digital Transformation as a Service”

- Leverage cloud services across the supply chain
  - From post to multi-platform distribution
  - Integrated applications
  - Public/Private or Hybrid environments
  - Simple to complex workflow assembly
  - Support for rules based processing
    - Automating workflow processes
- Can be set up as a client specific instance
  - IaaS provider (e.g. Verizon’s Terremark)
  - Managed service provider
- Resources assigned on “as required basis”
  - Pay for what you need – only when needed
- Clear CAPEX Savings – (CAPEX to OPEX trade-off)
- Security
Leveraging the Cloud for File-based Workflows

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The Media Cloud

The information technology (IT) industry has, for several years, embraced the cloud as a viable means of transforming the technical infrastructures of its businesses. One of the key advantages has been the ability for cloud computing customers to migrate from a capital expense (cap-ex) funding model for IT infrastructure to a model where IT becomes an operating expense (op-ex), helping to improve their financials and mitigate risk. Moving to the cloud has allowed the Chief Information Officer's organization to operate on a “pay as you go” basis, rather than necessitating the design and build of costly infrastructure to meet peak demand. Enterprises can conduct business more effectively by getting what they need, when they need it, where they need it. Along with that benefit has come the ability to more adequately manage staffing, reduce the need for periodic technology refreshes and free up valuable real estate within their facility.

The Media and Entertainment (M&E) industry, however, has been slow to adopt cloud services. We believe this is at least in part due to the fact that M&E operations typically fall outside the domain of IT, an area which has much more exposure and experience with the many benefits offered by the cloud. In addition, there are concerns within the M&E industry around content security, the cost of bandwidth and storage to migrate and archive high resolution video content, as well as the need for bulletproof and frame-accurate reliability. Finally, there is recognition that media files must be managed differently than standard IT files. File sizes are considerably larger and involve not only media “essence” files but numerous associated files including the rich metadata that converts content into assets. With both storage and bandwidth costs dropping, however, and with new entrants like Amazon offering commoditized pricing on its EC2 computational and S3 storage platforms, the cloud appears poised for wider adoption by media and entertainment organizations. The power of the cloud for M&E organizations lies in three key areas – economics, accessibility and scalability. While we could devote an entire white paper to exploring the economic benefits, suffice to say that the shift to an op-ex model puts more financial control of cost (and lower risk) in the hands of the Operations and Engineering management. Rather than filling equipment rooms with racks of servers and spinning disks, and devoting valuable floor space to robotic storage devices, this capital investment is replaced with a variable cost model in which the media enterprise can simply pay a monthly fee based on its utilization of services. In so doing, a large organization can then charge back those fees to the individual broadcast or production business units. This also provides media companies the ability to easily share assets and applications across the enterprise and around the globe through ubiquitous web interfaces with high reliability and scalability on demand. Finally it allows smaller media organizations (or smaller broadcast or production units of larger media organizations) to take advantage of workflow functionality such as Digital Asset Management.
(DAM) which may have been too costly to implement from a cap-ex perspective, thus expanding the availability and affordability of these services.

Security and Public vs Private Cloud Models

Notwithstanding the economic and collaborative benefits, some media and entertainment organizations may be philosophically averse to allowing their prized assets outside the facility, even with advances in physical and cybersecurity systems. In those instances a private cloud offers an alternative approach. A private cloud can be designed and implemented within a media and entertainment organization (or hosted externally) and linked through private networks, allowing that organization to reap the benefits without assets leaving their facilities and without the need to share infrastructure. Communications companies like Verizon offer MPLS (Multi-protocol Label Switching) networks that use the power of Internet protocol (IP) to provide shared high bandwidth connectivity to all participating parts of the enterprise through which assets and metadata can be securely shared. Centralized storage, archiving and asset management services, for example, then can be accessed by individual business units and charged back by the CIO organization. In both public and private cloud models, services are typically made available through a Web Services portal or adept application programming interfaces (API) allowing simple integration with business systems, workflow, billing and monitoring tools. In instances where additional computing power might be required, the option exists to extend the internal cloud by linking to an external (i.e. public) cloud for additional horsepower during peak demand in what is known as a “Hybrid Cloud” model.

Other “hybrid” models can be created which bridge the customer facility with the cloud, extending both security and control into the cloud. Technologies like Verizon Terremark’s CloudSwitch use “cloud isolation” to allow applications to run securely in the public cloud while maintaining tight controls at the customer location, creating a single unified environment. (Figure 2).

Private, high bandwidth MPLS-based clouds could be an ideal option for a central-casting model for station groups, using IP to migrate shared video (i.e. syndicated content or interstitial spots) from the central “hub” to the station spokes as well as the return of IP based broadcast program streams to the hub for monitoring purposes. In addition, file-based content could be archived at the hub (for news, for example) and made available to local stations to searched and pulled on demand -- reducing production and distribution costs as well as the duplication of labor across the enterprise.

Private clouds may be suitable for a large studio, but many companies may find more economic benefits with a public cloud. Even when a public Cloud is adopted, technologies exist today to extend the security measures that currently “protect the perimeter” of a facility or datacenter into the cloud itself. For example, some enterprise cloud services, such as those provided by Verizon Terremark offer secure
virtual private network (VPN) access to the cloud and a V-LAN between the cloud and each connected facility. This acts as a virtual tunnel protecting content from the outside world. In addition, content may be encrypted at a variety of levels (at the file, network path and/or at the storage level) that renders the file unusable without a privately held “key” to decrypt the content. Such security measures have helped many IT organizations become more comfortable with cloud adoption.

Figure 2

Cloud Based Media Workflow

Cloud services fall into two key segments – Infrastructure as a Service (IaaS), representing the use of storage, servers, etc. and SaaS (Software as a Service) representing the use of cloud-based applications. The Media Cloud combines both elements – the ability to provision servers and storage on demand as well as the ability to access cloud-based service offerings such as digital asset management with a storage platform that is “media-aware.”

We see the Media Cloud containing three potential tiers of services:

1) Digital Content Storage and Archive/Content Storage Management
2) Digital Asset Management application layer
3) Other integrated workflow applications (transcoding, editing, digital rights management (DRM), distribution)

Digital archive and asset management are the two key cornerstones in the evolving area of cloud-based media services, which may exist as a la carte web services or as part of a more integrated composite workflow suite.

Digital Content Storage and Archiving

The Content Storage Network

Offering digital content storage “as a service” first entails creating a multi-tiered storage network and hierarchal storage management (HSM) system capable of applying business rules to enable content migration from various levels of storage (higher performing disk, for example, to less timely and less costly robotic data tape libraries). Since media organizations may be averse to providing their primary content to the cloud (due to security and bandwidth concerns), they may be more likely to opt to place secondary and tertiary versions of their content into the cloud or use the cloud as backup for disaster recovery. These cloud infrastructures targeted at the media and entertainment industry typically leverage
A majority of storages in media applications are typically heterogeneous — a complex collection of media and ancillary files that must be maintained carefully in order to reconstruct, access, or reuse these assets. This concept is typically referred to as an “object store” and is the fundamental basis of advanced CSM solutions. Rather than just maintaining a simple collection of unrelated files, paths, and folders as in the case of a simple file system, HSM system, or other technology such as Linear Tape File System (LTFS), CSM solutions treat related media assets as a single unified object. The complexity surrounding the storage, recall, replication, distribution, repurposing, and
transformation of these complex media objects is handled by the CSM system. For example, DPX assets can be comprised of hundreds of thousands of frame based image files and important metadata files that describe their relationships. If these relationships or metadata files are misplaced or a series of frames lost, the entire asset can be rendered useless. The object-store characteristics of CSM solutions allow the transparent handling of complex media assets and moves are underway in industry standards bodies to extend this model to the physical storage devices themselves.

The Archive eXchange Format (AXF)

To put a physical context to this object store concept, important standards work is underway within the Society of Motion Picture and Television Engineers (SMPTE) Archive eXchange Format (AXF) group. AXF takes the concept of the object store to a physical level by offering a fully self-describing, self-contained encapsulation format for complex file collections. AXF offers a standardized way of storing files or file collections of any type and size, along with their associated metadata collections, on any type of storage technology or device (including flash media, spinning disk, data tape, cloud) while remaining fully independent of the host operating or file system.

At the most basic level, you can think of AXF as a universal container that encapsulates any number of related files (of any type and size) into a fully self-describing and protected object package. It supports the inclusion of any amount of open or vendor-specific, structured, or unstructured metadata encapsulated as part of the object itself, strengthening its self-descriptive nature. AXF also extends its self-descriptive nature to the storage media that contain AXF objects, allowing easy access using any AXF-aware system, and providing long-term accessibility and protection regardless of whether the original system is available or not.

AXF offers significant benefit in the area of Cloud-based storage and distribution of media assets as it provides a universal, protected and authenticated container for complex collections as a single data package that can be easily transported, stored, restored and distributed. Also, AXF is universal in its design and need not apply to media assets alone. AXF can offer these same benefits to all aspects of file-based asset transport, storage and preservation with very little overhead.
Digital Asset Management (DAM)

The third “layer” of the Media Cloud becomes the digital asset management system. DAM allows archives to be catalogued with rich metadata, protected with rights management, searched, previewed, retrieved and repurposed. While early DAM systems tried to market themselves as stand-alone point solutions, today, many DAM solutions are fully integrated with core post production and broadcast operations workflows.

There are three key benefits to moving DAM into the cloud. The first is economic. DAM systems can be pricey, particularly when combined with archive solutions. A cloud-based model allows the application to be priced on a per user basis or some other variable cost model, allowing the fixed costs to be spread across many users and/or customers. This opens up the market for DAM solution providers to smaller, midsized media companies as well as other industry segments such as the corporate enterprise.

The second is complexity. DAM systems have traditionally taken a large amount of technical and operational knowhow and experience to implement, often taking many years to address all of the needs of the enterprise. By leveraging cloud-based DAM, these technical complexities are borne by the service provider and often require little in-house knowledge or expertise to implement and maintain.

The final benefit is collaboration. It is not an uncommon occurrence to see media organizations – large broadcast networks or production companies that have very sophisticated, yet siloed operations -- lacking the ability to readily share digital assets and/or metadata from one unit to another.

A cloud-hosted DAM environment could allow disparate parts of a media organization to contribute metadata and proxies to a centralized DAM system, thus allowing their sister divisions to leverage these rich archives. Using a federated approach, it is possible for each production or broadcast unit to retain their legacy systems, while using standard XML formats for metadata contribution, and standardized proxy formats for preview.

An example would be a station group of 40 or 50 stations each of which has various legacy asset management tools for their news archives which have worked fine, and the head of operations sees no compelling need to force 30 of them to change to a standard system. Another might be a group of television production units within the same production company that would like to make their footage available to the other units, without having to standardize on one user interface.

A key element of today’s DAM solution providers is the ability to integrate directly into broadcast and production workflows as well as CSM-based archives as part of an advanced Media Cloud services model.

Transcoding

As a compute intensive operation, transcoding is well adapted to the cloud space – both public and private. There are a number of cloud based services available today which can support transcoding operations – either stand alone or as part of an overall set of workflow components. As part of a broader workflow, transcoding platforms may be integrated with workflow and rules based engines allowing automatic creation of differing content formats based on specific production workgroup and/or distribution...
needs (increasing operational efficiency and collaboration while reducing CAPEX expenditures on systems and tools to deal with multiple formats within multiple departments).

Cloud-based transcoding leverages storage and computational capacity on an as-needed basis. Therefore, transcoding capacity can elastically adapt to fluctuating demands and easily handle unexpected spikes when required, thus eliminating the need to build infrastructure to always meet those worst case scenarios.

As with locally managed transcoding platforms, workflows can be established to address relatively complex assembly requirements such as Edit Decision List (EDL) based conformation, logo insertion, ad inventory marking/black insertion, closed captioning as well as subtitle handling.

Depending on a media organization’s needs, cloud transcoding can be leveraged to address applications from production to broadcast to multi-platform digital distribution.

**Editing**

We are already starting to see integrated cloud workflows – such as Avid’s Interplay Sphere. Avid’s taken its integrated Interplay solution into the cloud allowing users to ingest, search, retrieve, edit and archive assets on a distributed basis. It is primarily targeted as a news-oriented solution, extending functionality beyond the newsroom, with a primary benefit being speed to air.

One can imagine however, taking this approach a step further and allowing a newsroom to move its integrated editing, archiving, and asset management functions into the cloud where the only assets on-site are laptops (or commodity PCs), proxies and metadata. This effectively frees the newsroom of its physical boundaries and becomes a virtual news environment. The same could be said for the production of reality shows and other content whose bandwidth requirements are not overbearing. The cloud can then provide the “horsepower” to conform EDLs generated in post-production to create a new video composition, from which a newly rendered composite proxy can be provided back to the editor for review. The newly edited essence file can remain in the cloud until it might be needed for re-edit, archive or distribution.

The cloud could also potentially be used as a “staging” area for large quantities of video for review, collaboration, editing or processing. “Digital Dailies” is one application for review and approval providing easy global access for studio execs. A-Frame is a start-up company providing cloud-based ingest services, enabling footage to be first staged in an external hosted environment where individual segments can then be selected for editing. This enables the producer or editor to screen the footage before actually ingesting it into the editing systems. There are also a host of “backpack reporter” solutions being offered by companies such as Comrex and LiveU, which provide 4G LTE enabled devices that attach to cameras and empowers the cameras to shoot in the field and transmit footage back wirelessly to a cloud for immediate review, editing and distribution.

The explosion in news and reality television production has also led to a corresponding explosion in the quantity of video being shot. All that video (including the unused ISO feeds and B-roll) may have value and could also benefit from cloud-based archiving for future re-editing and re-purposing.

Finally with the advances in GPU (graphics processing unit) technology, the cloud is an ideal solution for a cloud-based editing platform harnessing the cloud for compute-intensive conforming and rendering.
Current Challenges

Of course, file sizes could pose an issue with respect to ingest, as could latency. In high end television and film production using uncompressed or losslessly compressed files, it may not be practical to be sending files back and forth between the cloud and various locations today.

File-acceleration solutions such as Signiant, Aspera, and newcomer Brevity can easily be adapted to the cloud and currently offer cloud-based deployments. While Signiant and Aspera offer uncompressed acceleration techniques, Brevity has come to market with a combined transcoding and “visually lossless” file-transport solution which claims up to 30X acceleration. (The solution is currently being trialed by some major media companies). Signiant also provides useful cloud-based workflow orchestration tool allowing various workflow functions to be virtually connected.

Iron Mountain has addressed the high end uncompressed file size issue by offering a simple solution – an extension of their physical archive business but shuttling Linear Tape Open (LTO) tapes to and from studios and ingesting them into their digital version of their physical archive system. They are then made searchable and available on demand (either in lower res format or in the original format via a return LTO tape shipment back to the studio). A similar service is offered by Front Porch through their cloud-based Lynx platform.

Latency is also a challenge with respect to editing, where time is money and there are in many instances very tight time windows with which to distribute the final cut. In these instances it may not be as pragmatic to host the application in the cloud, but simply the hi-res essence files. The editors can work from edit decision lists (EDLs) and proxies to then conform back in the cloud where they can also initiate a transcode for distribution. Next generation clouds are currently in design to dramatically reduce latency issues.

Digital Content Rights Management

As stated previously, there are a number of tools that can be applied to enhance security in the cloud – from transport and storage encryption to full distribution level Digital Rights Management (DRM). Each of these should be adapted to the specific workflow environment. As an example, transport and storage encryption may not be quite as secure as full DRM level encryption. However, transport and storage encryption are commonly applied in the content production process in that they have a minimal workflow disruption impact when compared to a fully applied DRM encryption (which is typically applied at point of content distribution). Case in point, full DRM encryption commonly requires decryption keys or a so called “master key” to manipulate the content (whether it is conformation, transcoding, Quality Control (QC)) - complicating and potentially delaying the production workflow process. It is common in the industry to couple transport and storage security techniques with prudent authentication and even physical security to achieve an acceptable level of security without notable workflow impacts.

An additional level of security may be obtained by applying forensic level technologies such as watermarking and fingerprinting. These technologies may not stop content piracy or theft but they will allow for identification of where a security breach may be occurring.

If requirements include the distribution of content “out of house” to affiliates, consumers and others, an authenticated DRM key level encryption should be considered. There are a number of solutions available (including consumer distribution Google Widevine, Adobe Pass, Motorola SecureMedia, etc.) to meet your needs. There are a number of considerations when selecting a DRM format which are outside the scope of this paper (transcoding technology integration, distribution format, key management, and
consumer player support) – but the application of DRM in the media and entertainment space is very mature and a number of providers can assist in its implementation.

**Digital Distribution**

Depending on a media organization’s supply chain model, digital distribution can mean a number of things – interdepartmental distribution, contribution, affiliate distribution, even consumer level distribution. That said, as producers become more “content centric” they are looking for more effective ways to address the end to end production and supply chain – in many cases all the way to the consumer.

It comes as no surprise that this is not a trivial matter. Many content owners now need to publish to multiple platforms – requiring multiple workflows and formats, from traditional television to mobile and PC based environments addressed by Over the Top or TV Everywhere distribution models.

In effect, this really means being able to swiftly and effectively manage and monetize produced content. Considering this, an effective cloud model might not only support internal production but also, as an example, “publish” content intended for Over the Top or TV Everywhere multiplatform distribution directly from the central media archive – in an automated fashion.

Creating an integrated environment where media production, archive and content distribution services co-exist are available today but typically requires integration between service platform providers. There are a number of service providers with extensive tool sets and service-based API integration capabilities (allowing for integration between cloud services as well as with existing client systems). In brief, a cloud-based service provider’s workflow and content management systems should allow for automated publishing destined for multiplatform distribution. This may be accomplished by integrating with a client’s back office business systems to “push publish” content based on contractual or schedule based requirements. In addition, this will also require effective integration between the cloud-based archive platform, content publishing, and content distribution network vendors. Most recently there have emerged a few vendors with the broad solutions and resources necessary to provide the full end to end solution – such as Verizon’s Digital Media Services -- but successful end-to-end implementation is highly dependent on specific needs and environment.

The payoff from this level of integration is clear – resulting in lower operational costs by minimizing level of effort and work duplication (through asset control and automated scalability). Couple this with greater revenue through swift and adaptive content monetization and you have a compelling model indeed.

**Workflow in the Cloud – The Future**

One can imagine that any media workflow function that can be performed at a facility could eventually be migrated to the cloud at some point in time. Many of these services are available or are being planned today – including archiving, DAM, transcoding, editing, QC, DRM, Digital Distribution and Disaster Recovery (DR). If we peer into our crystal balls, we can envision an environment where we can select the workflow elements we would like to retain on-premise, and those which we would like to select as a service from various cloud environments, allowing us to orchestrate seamless workflows based on ever changing requirements. This can be architected using a Service Oriented Architecture (SOA) approach such as that being developed by the Advanced Media Workflow Association (AMWA). In their Framework for Interoperable Media (FIMS) model, an enterprise service bus allows data to be moved between services via abstracted workflow and infrastructure service adapters -- typically utilizing REST (representational state transfer)-based web services -- to provide interoperability between disparate
systems. This in effect becomes a new standardized middleware layer or “glue” between applications and between the application and the content.

In an integrated cloud workflow suite, the media asset, once migrated to the cloud, might never need to leave until they are ready for distribution. Once content is acquired and ingested, essence files might be retained within the cloud archive, with editors working with proxies and metadata, and simply sending EDL’s to be matched to the media files in the cloud. Those files can then be confirmed, archived, transcoded, meta-tagged and distributed to any number of internal or external destination points, for both linear and non-linear distribution across multiple media platforms.

Figure 4

We’ve seen that the cloud can provide a number of potential benefits to media and entertainment organizations, facilitating cost savings, collaboration, workflow optimization and scalability. These benefits can be achieved through a public multi-tenant approach, a private cloud approach or a hybrid model, offering the media and entertainment company maximum flexibility while still providing a secure environment in which media assets are protected. With decreasing bandwidth costs, increasing security protections, and with more solution providers ready to migrate their media solutions to the cloud, we predict significant Cloud adoption by both chief information officer and chief technology officer departments within media and entertainment organizations in the years ahead. With the widely held belief that media content will fuel the growth in cloud computing services, which Forrester forecasts the global market for cloud computing will grow from $40.7 billion in 2011 to more than $241 billion in 2020, I guess it’s time for all of us to get our heads in the cloud.

1 Forrester Research, Inc: “Sizing The Cloud” April 2011, Stefan Ried, Ph.D. and Holger Kisker, Ph.D.