

HYBRID SOLUTIONS FOR CLOUD DVR: MEETING THE NEEDS OF CONVERGING LEGACY AND OTT PLATFORMS

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***Abstract:** A change in Cloud DVR (Digital Video Recorder) deployment strategies has been driven by a few factors including regional copyright laws and specific legal restrictions in North America and consolidation between cable and telecom players, especially in Europe. With M&A and increased competition between traditional pay-TV and newer Over-The-Top (OTT) operators, many service providers are streamlining technologies and adopting broader TV strategies to deliver content access features increasingly demanded by subscribers while driving further cost efficiencies.*

In this paper, Ericsson will discuss how this may impact technology decisions surrounding time-shifted video solutions and drive adoption of innovative hybrid approaches to Cloud DVR and VOD.

To ensure that these new businesses are able to cater to consumer demands for time-shifted viewing, operators need to seek out flexible and scalable infrastructures and rethink their approach. Ericsson will provide an overview of the challenges that cable businesses face and the types of hybrid approaches that are emerging in Europe and further afield.

CLOUD DVR

Cloud DVR deployment strategies are shifting. This is being driven by several factors, both technical and geographical in nature. An ongoing trend of mergers and acquisitions within US cable companies and European Telcos, as well as mounting frustration with varied and sometimes very stringent copyright laws, has led to more creative thinking when implementing a Cloud DVR solution.

MAJOR CONSOLIDATION

In recent years there has been growing consolidation of Telcos in Europe and Cable operators in the US. Not only are they hoping to expand their subscriber footprint but also aiming to establish a greater reach into their subscribers' daily lives.

Europe is a highly fragmented telecom markets with the majority of nations supporting at least 4 large competitors

and many smaller challengers. However, consolidation is greatly reducing this number. By leveraging their existing broadcast services, many more multi-play service options are possible, including a quadruple play of Internet, TV, land line, and mobile phone services. This is a clear advantage over OTT providers, who are quickly becoming a major threat to operators everywhere.

While there have been many such mergers, several notable examples stand out. Hong Kong's Hutchison Whampoa purchased Telefonica's O2 division in 2015, reducing the number of UK mobile providers to three. The UK's BT Group expanded its offerings to include mobile with the purchase of the Deutsche Telekom and Orange wireless carrier EE. Also in early 2015, TeliaSonara purchased Tele2 in Norway and Tele Columbus bought rival PrimaCom creating the third largest cable operator in Germany. Entering into the US market, Altice purchased Suddenlink and then Cablevision this year.

The impact of these consolidations and others can complicate the implementation of Cloud DVR. Often in the interest of efficiency, an operator's overall integration strategy requires consolidation of disparate TV platforms into one unified solution. This may challenge the ability to reuse existing infrastructure or migrate content. The goal of achieving a unified solution will generate significant impact on compute, storage and throughput. As operators aim to offer an equality of service and often under a single brand, the unified platform must scale to the combined size and processing needs, and be flexible enough to work with different and unique copyright laws in order to provide the upgraded services. Consolidation also brings with it potential regulatory and compliance issues.

NORTH AMERICA REGULATORY PRESSURE

In 1984, the 'Betamax case' ruling allowed for recording individual copies of complete television shows for purposes of time shifting, defining it as fair use. This paved the way for set-top DVRs and the 2008 Cablevision decision. The U.S. Court of Appeals for the Second Circuit held that Cablevision's Remote-Storage Digital Video Recorder ("RS-DVR") does not infringe copyright owners' public performance rights. The RS-DVR allows subscribers to record television programs for later viewing, just like a VCR or set-top DVR, but it stores the recordings remotely at Cablevision's head end. This was deemed a private viewing,

as the only person who can play back a recording is the one person who made it.

Storing a unique copy of the video file for every user can be an overwhelming storage and ingest challenge when supporting private copy cloud DVR services. With private copy, when users choose to record a program, service providers need to maintain a dedicated copy of that file for that user. For example, if 5,000 customers put a sporting event on their DVR, the operator needs to store 5,000 copies of that video. This presents major challenges, as capacity requirements are significant and also difficult to predict. Payout is erratic, and storage volume constantly changes. Ingest is of paramount concern. Simultaneously recording thousands of recordings is quite difficult. Consistent and high throughput read and write is critical.

This “private copy” model has set the precedent in the US and American companies are struggling to find a solution to handle the scale and performance requirements of such a service.

SHARED COPY

The legal climate in Europe gives telecoms and cable service providers a unique opportunity to offer Cloud DVR services based on shared copy models. Laws in Europe do not clearly mandate private copy, thereby making shared copy models an option.

A shared copy model for Cloud DVR means that only one copy of a program is recorded and all playouts will be from the same physical recorded copy. All the subscribers that requested to record the program are assigned with a ‘reference’ and share the same physical recorded asset. The main advantage of this model is high capacity efficiency due to a significantly lower footprint on storage capacity than in the “private-copy” model.

As a single copy exists per program (for all subscribers who requested to record the program), the storage capacity is not affected by the number of subscribers. However, the streaming throughput capacity requirements increase in accordance with the growth in number of subscribers.

The cacheable nature of the “shared-copy” content allows this type of deployment to seamlessly operate in a distributed architecture which caches the most popular content in the access network and streams it from the proximity, which results in lower latency and reduced network resources consumption.

However, there are still challenges. Reliability issues can have an adverse impact on Cloud DVR models based on shared copy, but the methodology offers considerable potential. When handled well, shared copy licensing models

enable service providers in Europe to implement Cloud DVR solutions while maximizing revenue potential.

TIME SHIFTING IS THE NEW DEFAULT

Time-shifted content is now a core subscriber requirement from pausing and restarting live TV to VOD. These options all involve a careful examination of regional copyright laws and effort to stay in compliance.

- **Catch-up TV:** This allows subscribers to replay a show broadcast in the past. It also provides an alternative to on-demand movies and to monetize content through targeted advertising. It can be complex to implement, especially matching VOD content to the Electronic Program Guide (EPG). Storage must be expansive and elastic and there must be superior performance to convert on the fly.
- **Start-over TV:** This feature allows a subscriber to replay a live broadcast already underway and to switch back to a real-time broadcast feed. Advertising is not always an option as there is usually a need to comply with live agreements.
- **Pause Live TV:** This allows the subscriber to pause while live and return to the show later. Very often there are particular legal considerations for how long you can pause.

Each of these features requires flexible yet scalable storage with highly concurrent streaming rates while adhering to security requirements enforced by the service offering.

NEW HYBRIDS ENTERING THE PICTURE

In order to work around the ongoing challenges of enormous storage required with private copy, tricky copyright laws for time shifted services, and the changing legal climate that may allow for shared copy in some instances, creative solutions are beginning to surface.

Hybrid copy= Per channel/ program

In this hybrid solution, the Cloud DVR records some of the content in private copy and some of the content in shared copy. This is decided by the specific rights of the content owner. Different broadcasters may dictate that different rules and restrictions are applied on a channel or even program level.

In this option, the recording type is dictated by the recording initiator – Back-Office/Scheduler application, and determined by using the HomeID attribute in the recording request API. If the Home ID is associated with a specific user provisioned on the system, the recording created will be a unique copy for that specific user. If the Home ID in the request is a 'dummy' ID that is used for shared model, then a shared copy will be created. This shared/master copy will be

deleted after all subscribers that requested to record the program have requested to delete it.

Private copy combined with time-shift buffer

In the private copy model, time-shift services such as Start-Over, Record in the Past, and Pause Live TV (PTLV) are typically cost prohibitive due to the extreme storage requirements. For example, recording the previous two hours per each channel for each subscriber in order to enable Start-Over or creating a separate copy for each subscriber that paused a live program would run into Petabytes of storage for just a few hundred thousand active subscribers on a typical service.

An alternative is a flexible hybrid configuration that combines a pure private copy model for scheduled recordings with a small shared buffer system that can offer the mentioned Time-Shift services with additional enhancements. This has no impact on storage capacity and costs.

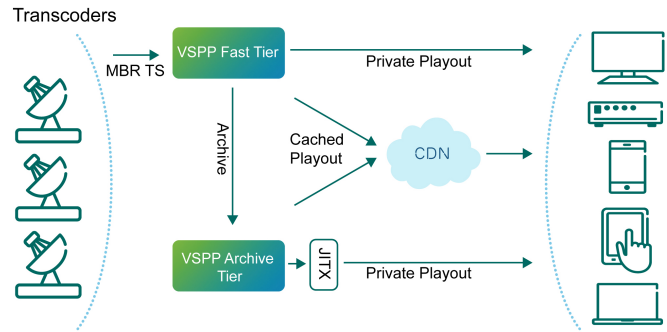
A shared time-shift buffer of several hours (~1-3) will record all the channels using a small system resulting in minimal storage and throughput requirements. Using the shared buffer significantly enhances the user experience and offers the following services also for the private copy deployments:

- **Record Now** - allows impulse recording of a program which has already started. This solution can initiate a private recording on impulse for the subscriber and privatize the missing part from the shared Time-Shift buffer
- **Record in the Past** – same as above, but for the program that was already broadcasted.
- **Pause Live TV** – serve PLTV resume requests from the shared buffer. On save request, this hybrid option can privatize it as a unique subscriber recording.

Record private – play cached

This type of hybrid Cloud DVR model may be applied to comply with the legal requirements to record and present a unique private copy of each subscriber’s recordings stored and managed by the Cloud DVR platform during the entire recordings’ lifecycles. However, it doesn’t have the restrictions on the playout aspect and allows serving content out using the cached model.

This type of solution presents significant cost saving for the Cloud DVR platform’s streaming throughput requirements, since the selected single copy recording can be cached and fanned-out by the CDN caching tier.



For even better utilization of the provisioned Cloud DVR resources to enable further cost efficiency, at some point in time - dictated by content age/total storage capacity constraint - recordings can be optionally uploaded to a public cloud or to another cheaper storage tier in order to free up space and reduce overall cost. This model is based on field data that suggests that after 2 weeks the majority of recordings will not be viewed and can be considered long tail content.

Private copy de-duplication

As a concept, de-duplication as a method of “single instance storage” is technically the shared copy Cloud DVR model with an ultimate storage saving factor defined as 1:N (where N is number of subscribers recording requests for the same content). However, this model can be adapted and offers private copy de-duplication as another approach that drastically reduces the required storage capacity for the private copy deployments.

This model is quite beneficial in situations where legal requirements dictate that each subscriber plays out a request from his or her unique 'virtual box'. This option allows some flexibility on the storage side. At a pre-defined time after the recordings are complete, most of the recordings produced for the same content are deleted, leaving a configurable number of master copies only.

From the flow perspective, the recording is done in the typical private copy model of saving a unique copy per subscriber. However, once that content has aged a set amount of time, the number of recorded copies of each asset is reduced to X master copies and the rest of the physical copies are removed. The de-duplicated form may also differ, based on the legal obligations and required rules.

The de-duplication implementation deletes all the physical assets leaving only DB representation of each unique recording. This is the most optimized approach in terms of storage.

On the playout request for the recording that was de-duplicated, a reclamation process is triggered by the control plane. The master copy is duplicated into the subscriber’s

virtual box in real-time and played out. From the logical point of view, this approach may also be considered a "Record Shared – Play Private" hybrid model.

FLEXIBLE SOLUTIONS REQUIRED

As this space becomes increasingly multifaceted, operators will need a different mixture of technologies and services that can deliver a vast array of time and place shifted programs to their subscribers on demand. The advantages of cloud-based implementations are now coming to the foreground, offering the agility necessary to enable operators to push the boundaries of broadcasting.

Advantages and challenges of shared copy Cloud DVR models

Establishing a hybrid option involving shared copy cloud DVR offers service providers a unique opportunity to monetize their DVR solutions, but doing so depends heavily on understanding the nuances of managing such a configuration and working to optimize the technology. With that in mind, it is vital that organizations consider the key benefits that come with shared copy models alongside the service model's challenges.

Storage demands are not as significant as in private copy. Storing a copy of the video file for every user can be an overwhelming storage challenge. Shared copy eliminates these challenges. With shared copy, service providers only need to maintain a single source file of video that users record. The potential storage savings are staggering. That said, customers will often demand a variety of features and a wide range of content, so the amount of video being stored can still end up being huge. In particular, the need to reliably provide content can lead to unexpected storage challenges. This issue is emphasized in the way that shared copy makes each individual file more important.

Every file copy is critical

The problem with a shared copy model is that service providers can't afford to have anything go wrong. If a technical error leads to a show not being recorded, then you are suddenly facing a situation in which thousands of users could be let down and become dissatisfied with the service. In many cases, service providers will choose to record every show, leading to a continually rising storage demand.

As if this scalability issue was not enough of a challenge, operators must also keep the source copy in place as long as any user has the recording saved in their DVR, forcing operators to retain large amounts of information that grows in line with subscriber numbers.

While this scalability challenge is significant, it is often less of a problem than it is for a private copy system, though the

actual amount of storage space required will vary based on user subscriptions and similar issues. The big advantage for shared copy is that the amount of storage needed is incredibly predictable. In a private copy setting, operators are at the whim of what video files users record and how they adjust their subscriptions at any time. Shared copy lets operators precisely anticipate how much space will be needed.

Revenue potential is optimized

Cloud DVR revenues are often dictated by the difference between money spent on storage and content delivery relative to the number of users subscribing to the service. When each user gets a private copy, the amount of profit generated per file is minimal. It adds up to be significant revenue, but the fiscal potential escalates considerably when you only have to save one source file for each video.

USING TECHNOLOGY TO SUPPORT HYBRID MODELS

The technological framework needed to support hybrid Cloud DVR models can be complex, but there are three key issues that service providers should keep in mind:

Integrating storage and processing

Segregating storage and processing means that adding storage capacity makes corresponding processing upgrades necessary. A system that integrates the two functions into a centralized computing model makes it easier to scale storage without adversely impacting processing functionality. The result is a much less complex technology environment in which management overhead is limited because the actual IT configuration is easier to deal with even as storage demands rise.

Getting the network in shape

Content delivery network systems and internal connectivity capabilities must also be optimized within the Cloud DVR system. Failing to address the network alongside compute and storage can lead to major problems for end users. As such, shared copy strategies depend heavily on effective network systems as part of the data center setup.

Optimize data management

On one hand, shared copy makes reliability incredibly important as the loss of any file can lead to many users being unable to access that content any longer. At the same time, having multiple copies of a file becomes incredibly problematic because it can quickly clog the storage system with unnecessary data. The result is a need for advanced data protection and de-duplication tools that ensure operators only have the files on hand they need, but also keep those files safe through highly available infrastructure.

REGIONAL CONSIDERATIONS

Across Europe and most of Asia and Africa, operators are generally freer to adopt any of these Cloud DVR models. However, in North America, where the ground rules and guidelines are evolving at pace, it will prove more complex. It will be up to the most innovative operators to identify a unique approach that will enable them to compete in the future. As consolidation continues, these often incongruent infrastructures will need a flexible platform to allow for the implementation of strategic Cloud DVR solutions.