Cloud DVR

Key Considerations

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Cloud-based digital video recording (CDVR) technology enables consumers to record and playback live video programming using servers and storage resources hosted in the network by a service provider. Unlike traditional DVR set-top boxes, no disk storage or specialized consumer premises equipment is required to enable the service. In this paper, we will explore the key considerations for video service operators interested in launching a CDVR solution.

The History of Time Shifted TV

Consumers have been recording and watching video content on a time-shifted basis since the invention of the VCR in the late 1970's. However, it wasn't until the first DVR set-top boxes were launched in the early part of this century that consumers really began to record TV content with regularity. Disk drive based DVRs made video recording easy, which led to steady year-over-year increases in the number of hours consumers spent watching time-shifted video programs. By 2008 Nielsen found usage high enough to add time-shifted viewing to its live TV audience measurement data, reporting that 11% of viewers aged 18-49 in DVR homes were watching recorded content during primetime hours. Today, about half of all pay TV households in the US and Western Europe own a DVR, and according to the Consumer Technology Association more than 55% of millennial TV viewers report that they prefer to watch time-shifted content versus live TV. In fact, for many consumers, time-shifted viewing has become central to how they watch TV programming and the idea of not being able to pause or rewind live shows seems intolerable.

Unfortunately, while DVR boxes revolutionized video recording, there were some serious challenges with them. First, DVR set-top boxes needed to be deployed by the millions to get into consumer's homes. This meant building low cost set-top boxes that included spinning disk drives to record content. In order to keep set-top box prices as low as possible, manufacturers had to use relatively inexpensive disk drive technology to support recording functions. These low-cost disk drives were prone to failure due to age, frequent usage, and heat. When disk drives failed, consumers permanently lost all of their DVR recordings, which made for some very unhappy customers. It also prompted the operator to initiate expensive truck rolls to replace or repair boxes in the field.

Beyond reliability, set-top box DVRs lacked several features that were of interest to emergent multi-screen video consumers. Set-Top DVRs were designed to connect to TV sets, but millions of people were spending more and more time watching video using other devices. Consumers wanted to watch content on any device, at home and on the go. Unfortunately, content recorded on traditional DVRs could not readily be accessed or viewed on other devices. Consumers were also growing frustrated with the fixed amount of storage capacity provided by set-top DVRs. Once a consumer's recordings would fill up the available storage space, they were blocked from storing any more content. Consumers were left with no option but to delete valued content in order to make space for new recordings. Fortunately for consumers, Cloud DVR technology was introduced to address these shortcomings and provide support for the next stage of time-shifted viewing requirements.

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Cloud DVR

Cloud DVR moves video recording and playback out of the home and into the network, replacing set-top box DVRs with specialized servers and storage solutions that are hosted by service providers at their own facilities. Consumer directed video recordings are orchestrated by software that controls how content is ingested and stored in the network, helping to maintain compliance with the operators negotiated rights and applicable regulations.

From a consumer perspective, cloud DVR is distinguished from traditional DVR services by the following features:

Traditional DVR	vs.	Cloud DVR
TV Viewing Only Content recorded on the DVR is only accessible on the locally connected television sets.	▶	**Multi-Screen Viewing** Content recorded in the cloud can be viewed on TVs, PCs, tablets, phones, and other connected devices.
Fixed Recording Capacity Storage and simultaneous recording capacities are constrained by the set-top box hardware capabilities.	▶	**Scalable Recording Capacity** Operators can control and adjust content storage and simultaneous recordings capacities for each user.
Content is Tied to the Set-Top Box Content is stored on a single set-top box disk, so it can be lost due to a hardware failure or box upgrade.	▶	**Content is in the Cloud** Content resides in cloud storage that is resilient to hardware failures and accessible to new devices.

Cloud DVR also offers an abundance of benefits to operators, that range from cost savings and operational benefits to the introduction of new revenue opportunities. Operator benefits include:

Reduced Set-Top Costs Operators can deploy less expensive disk-free set-top boxes in the field by relocating DVR to the cloud.	**New Revenue Opportunities** Expanded storage and recording capacity can be sold to generate a new source of monthly revenue.	**Lower Maintenance Costs** Removing failure-prone disk drives from the home reduces the number of expensive truck rolls.
Improved Efficiency Hardware and environmental costs can be reduced by distributing load across shared Cloud DVR resources.	**Extended Service Reach** More consumers can be served by supporting a broad range connected consumer electronics devices.	**Reduced Churn** Better service reliability and a larger captive archive of personal content yields higher customer loyalty.

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Modeling Cost Benefits

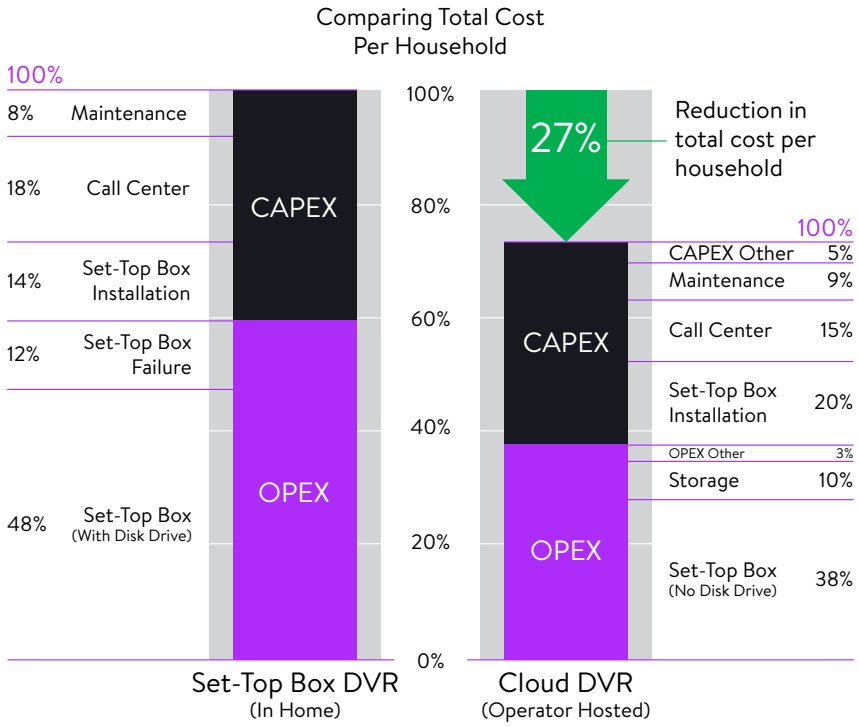
Comparing costs between traditional DVR services and Cloud DVR makes it clear why operators are quickly migrating toward network based recording services. Velocix modeling suggests operators can reduce costs by at least 27% over a period of 5 years.

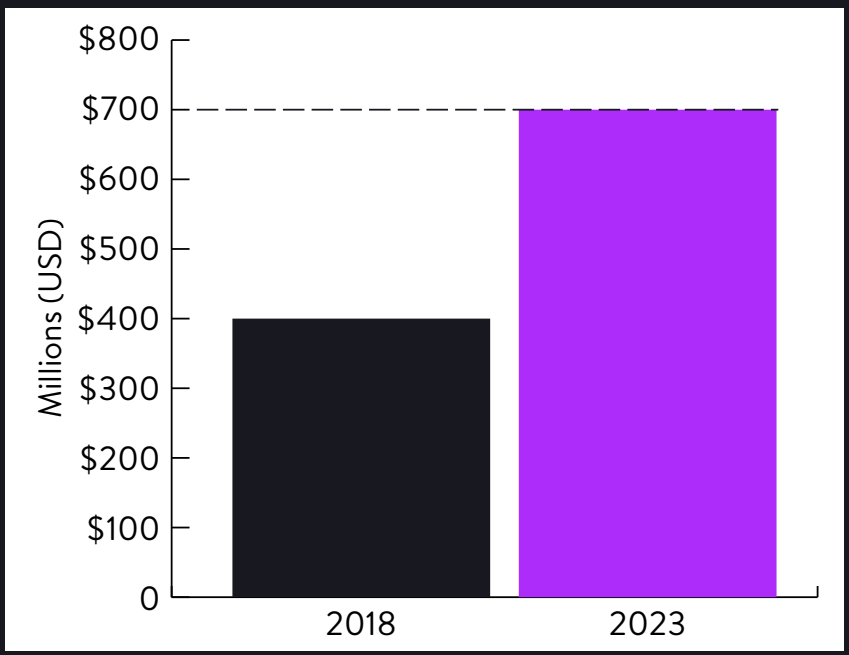
The Cost Benefits of Cloud DVR

27% Cost reduction over 5 years

Less Costly to Deploy and Maintain

- Better Reliability
- Less Call Center Traffic
- Higher Customer Satisfaction





The Cloud DVR Market Opportunity

$700M

The time is right for operators to modernize aging set-top box based DVR platforms. According to ABI Research, annual consumer spending on Cloud DVR is expected reach nearly $700 million by 2023. The number of Cloud DVR users worldwide is expected to surpass 64 million by 2023.

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Key Considerations for Operators

There are many factors that service providers need to keep in mind as they consider Cloud DVR.

- **Content Rights Compliance**

  In most countries there are laws that dictate how and under what circumstances copyrighted TV content can be recorded and stored. Generally, consumers have been allowed to record copyrighted broadcast TV content for private use inside the home under "private copy exception" rules. However, services like Cloud DVR have presented a challenge to these laws because while content is being recorded for private use, it is being stored outside of the home by a service provider that reaps a commercial benefit from running the service. In an effort to protect their copyright, content owners have pushed, with mixed success, for new legislation that places restrictions on cloud-based video recording. In Europe, for example, the European Court of Justice ruled in late 2017 that the implementation of cloud DVR services requires a well-defined agreement between operators and content owners. In the United States, the U.S. Second Circuit Court of Appeals ruled that operators are allowed to record copyrighted content on behalf of consumers as long as a private recording is made for each consumer and that copy is never shared or replicated. In other countries, regulations are looser, allowing content to be recorded once and shared with many different viewers. Of course, operators may also opt to obtain a license from content owners that provides them with specific recording rights, however this carries cost and may not be warranted for all channels. Given the regulatory complexity associated with cloud based recording, operators should make sure their Cloud DVR architecture can support both private copy and shared copy recording. Solutions should also include a strong recording management platform that can orchestrate recordings and make sure legal compliance is maintained. Lastly, the recording and storage methods employed by Cloud DVR solution provider should be well studied to make sure the implementation doesn't run afoul of copyright laws.

- **Private vs. Shared-Copy**

  Private and shared-copy recording methodologies impose very different scaling requirements on Cloud DVR platforms. While the economics of Cloud DVR are better than set-top DVR under both recording models, operators can benefit from understanding the differences between recording approaches. Private-copy implementations are less efficient than shared-copy due to the way content is recorded and stored. With private-copy, individual recording instances must be made in parallel for each consumer and stored independently. Content may not be replicated at any point in the capture, storage, or delivery process under private-copy guidelines, so servers and storage must be provisioned to support simultaneous recording at scale. In shared copy, recording and storage demands are more modest given concurrent recording requests for the same TV show can be fulfilled by making one common recording that can be viewed by many subscribers. The chart below shows the delta between the recording and storage demands for each model under the same circumstances.

Private-Copy Recording

- A distinct recording is made for each user
- Content files are managed independently
- Content cannot be copied or cached

Example

Requests to Record the Same TV Show	10,000
Simultaneous CDVR Recordings Made	10,000
CDVR Files Stored	10,000

Shared-Copy Recording

- A common recording is made for all users
- Content files are collectively managed
- Content can be copied and cached

Example

Requests to Record the Same TV Show	10,000
Simultaneous CDVR Recordings Made	1
CDVR Files Stored	1

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Shared copy methodology is clearly more economical, making it an ideal choice for operators. Unfortunately, for many shared copy is not an option unless recording rights can be obtained. Obtaining these rights requires negotiation with content owners to determine how the commercial proceeds from the Cloud DVR service will be shared. While the cost to obtain recording licenses may be significant, licensing fees can sometime be offset by the savings operators realize from the reduced hardware, software, and labor requirements associated with shared copy recording. A key objective for operators should be to use shared-copy recording whenever it is economically plausible and legal.

Another consideration related to private-copy implementations is whether technology like data de-duplication may be employed to reduce storage demands. Under some circumstances, it is allowable for content to be optimized in storage using de-duplication techniques. Typically, this is only done after the TV audience measurement period has lapsed, for example after the Nielsen C3 (3-day) or C7 (7-day) viewing windows in the U.S. After this period, content archives can be scanned for duplicate recordings and replicated data discarded in favor of a common source asset, which can be used to reconstitute the original recording when playback is requested. Several major operators have deployed Cloud DVR solutions with de-duplication and have experienced dramatic reductions in the amount of storage required to support long tail recording archives.

In summary, operators have several options when it comes to recording methodologies and understanding each alternative can help to determine the best approach.

- **Storage and Recording Quotas**

  Unlike set-top DVRs, Cloud DVR enables storage and simultaneous recording capacity to be configured separately for each user. There are no limits to how much capacity can be configured, as there are no physical constraints to content with, as there were in the case of set-top boxes. Operators therefore have more flexibility on how much capacity they would like to natively provision for each subscriber. In some instances, operators prefer to provision less capacity at the start, taking advantage of the scaling capabilities of the Cloud DVR platform to sell incremental capacity to consumers and drive higher subscription fees over time. In other cases, operators tie DVR capacity to customer tier, giving premium customers more capacity than those at the basic tier. In the end, it is up to the operator to decide how they can benefit most from the scalable storage and recording quotas enabled by Cloud DVR architectures.

- **Advertising**

  One of the features people like most about DVRs is the ability to skip advertisements. However, advertisements are important to content owners and are an important part of how video is monetized.

  With Cloud DVR, operators have the ability to control whether consumers can skip ads at a very granular level. Fast forward and rewind can be disabled entirely or just at specific points. Controls can apply to specific subscriber tiers or only certain programs. This capability can be beneficial when negotiating recording rights, as content owners are keen to have ads remain intact. Operators must balance the interests of the consumer with their own business needs in determining what level of controls to apply.

  Another consideration related to advertising is ad replacement. With time shifted content, advertisements may become stale after a certain period of time. These ads may be candidates for replacement with more relevant ads. Operators should consider what level of ad replacement they can do and how this might improve the overall business case for Cloud DVR.

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Why Velocix for Cloud DVR?

The Velocix Cloud DVR platform consists of several products that work together to form a complete solution.

- **Velocix Recording Manager (VRM)**

  VRM orchestrates the recording and management of live video content using a combination of operator-defined business rules and user-directed recording requests. Rules can be set to define the attributes of the consumer facing Cloud DVR service, as well as the recording methodology used to capture individual channels or programs. Advanced functions are also included such as sliding windows

- **Velocix Origin**

  The Velocix origin is a scalable recording engine and multi-screen distribution server for Cloud DVR content. The origin receives instructions from VRM on what programs to capture and how to record them. Video is typically recorded in a common source format to save on storage space. Once content is recorded, the origin fields consumer requests to playback recorded content. Source content is adapted on output using built-in just-in-time processing capabilities to apply the right content format and digital rights management to suit the consumers viewing device.

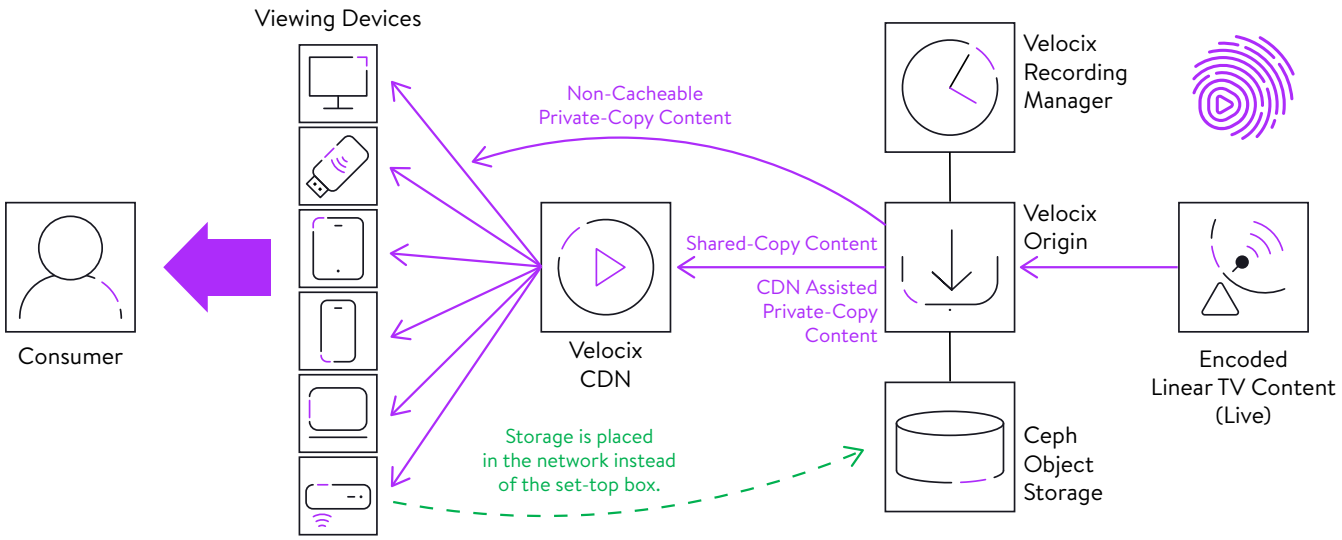
- **Ceph Storage**

  Cloud DVR content is recorded to modular, independently scalable, software-defined object storage based on open-source Ceph. Storage software has been specially tuned by Velocix to support the unique performance requirements associated with Cloud DVR.

- **Velocix CDN**

  The Velocix CDN is a scalable content delivery network solution that supports time shifted video applications like Cloud DVR. The Velocix CDN can be used to deliver Cloud DVR content recorded using both shared and private-copy methodologies. Shared-copy content can be cached by the CDN to improve stream scaling. Private-copy content is not cached in order to comply with the applicable regulations.

Velocix Cloud DVR Solution



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Features and advantages of the Velocix Cloud DVR solution include:

True Multi-Screen

Multi-screen playback features allow Cloud DVR content to be watched on TVs, PCs, tablets, smartphones and other connected devices, at home or on the go.

Private and Shared-Copy Recording

Support for private-copy, shared-copy, or hybrid recording ensures full compliance with content copyright regulations and negotiated rights agreements.

Cost Efficient Scaling

High density recording servers and independently scalable, software-defined object storage reduce the amount of hardware required to launch Cloud DVR.

Resilient Operation

Baked-in resiliency features make sure that programs are successfully recorded and stored by detecting and routing around failure conditions.

Low Lag

Quick start features enable live content to be watched as it is being recorded, with less delay relative to the original live source.

EPG Adjustments

Sliding windows allow program guide corrections to be applied after a show has been recorded to account for changes in the start and end times for live events.

Store Once, Stream to Any Device

JIT packaging and DRM protection lowers storage costs by enabling content to be recorded in a single format and then adapted on playout to suit the viewing device.

Trick Mode Disablement

Controls enable fast forward and rewind functionality to be enabled or disabled for specific content or segments of content, for example during advertisements.

Private-Copy De-duplication

Storage software identifies duplicate private-copy recordings and applies optimization techniques to deliver a more efficient storage model.

Visual Trick Modes

Trick mode and scrubber features provide smooth, image-rich fast-forward and rewind controls that mimic the experience of DVD and Blu-ray players

CDN Assisted Private-Copy

Innovative system architectures enable private copy content to be cached inside the CDN, improving the efficiency of the end-to-end solution.

Open and Integrated

Open, published APIs and pre-certified interfaces with industry leading ecosystem partners make it easy to integrate the Velocix Cloud DVR solution quickly.

Flexible Consumer Quotas

Adjustable storage and simultaneous recording quotas provide a way for operators to generate additional revenue by selling incremental Cloud DVR capacity

Advertising

Open, published APIs and pre-certified integrations with industry leading ecosystem partners make it easy to integrate the Velocix Cloud DVR solution into a multi-vendor best-of-breed video network.

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Emmy Award Winning Technology

Only Velocix has the Emmy Award winning technology required to support the most advanced Cloud DVR requirements. With more than 80 petabytes of Cloud DVR capacity deployed at top-tier service providers around the globe, Velocix has the real-world experience necessary to execute a stress-free launch of Cloud DVR services.

In Summary

Deploying Cloud DVR can increase service provider revenues, decrease operational costs, and improve customer satisfaction. Selecting the right partner to work with is critical to understanding the various design considerations, navigating potential pitfalls and avoiding unnecessary costs. Velocix offers a comprehensive suite of products designed to make Cloud DVR more scalable, flexible, and easy to deploy. With years of practical experience and a community of satisfied customers, Velocix is well positioned to help operators define their Cloud DVR strategies and launch solutions that meet the specific needs of their business.

Contact a Velocix salesperson to learn more.

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