THE COMPLEX TRANSITION TOWARDS CLOUD CPE

Challenges and Key Decisions for TV Service Providers

accenture

CPE moves to the cloud

TV service providers are at an inflection point. Cord-cutting continues to chip away at their subscriber base, and OTT providers are moving in to capture this lost revenue. To remain competitive against OTT market power[1], service providers need to embrace new customer-centric, agile operating models that use CPE to transform the customer relationship. Moving CPE functionality to the cloud allows it to be deployed instantly to all users thus enable a highly agile operating model.

Customer Premise Equipment[2] (CPE) has long been a part of TV service providers' operations. Now, service providers need to look beyond CPE as solely a vehicle for video delivery and use it as their launchpad to the future. Cloud-based CPE gives service providers the opportunity to transform their core CPE model and innovate beyond their existing business areas by identifying new sources of value and delivering highly-personalized customer services.

Embrace new customer-centric, agile operating models that use CPE to transform the customer relationship

Cloud CPE is a new agile concept that delivers most of the functionality of a traditional CPE through a cloud-centric architecture. While each service provider will need to arrive at a Cloud CPE solution architecture that is unique to their existing network, investment capacity and targeted offering, the strategy and implementation roadmap is the same.

An added incentive, is that cloud native and test automation capabilities lower costs and increase development throughput. When combined with a data-driven operating model that continuously baselines deployment KPIs it will efficiently improve products and eliminate waste. Service providers can quickly discover the merits of new ideas, innovate confidently and accelerate investments.

Bringing together our innovation emphasis, strategy expertise, industry experience, and operations excellence, Accenture is uniquely positioned to support service providers on this transformation journey.

[1] Forbes: How OTT Will Innovate In 2018 (January 23, 2018)
[2] In this document, we refer to the Set-Top-Box, TV Box and similar as CPE – and exclude home gateways.

Critical aspects of a successful transition towards Cloud CPE

At the heart of every successful Cloud CPE transition, you will find the following:

Impressive Customer Experience

Service providers need to deliver on increased customer expectations, including state-of-the-art features like personalized recommendations based on viewing habits and an immersive, uninterrupted flexible and convenient TV experience. They also need to plan for intuitive control and user experience, which is becoming increasingly important to customers and can be a key differentiator[3]. Cloud CPE enables a unified, all-in-one User Interface (UI)— shaped by people-centric methodologies, e.g. Design Thinking, with rapid prototyping and strong feedback culture—to fulfill customers' desire for seamless, reliable and fast access to linear and non-linear content on any device. With the added advantage that it can be deployed to all users instantly, unlike traditional CPE platforms.

Agile Development and Operations (DevOps)

A cloud-centric operating model gives service provider's instant access to data on what and how customers are using the service and consuming content. Such a data-driven, precise, and real-time view of the user enables service providers to differentiate on two levels: Firstly, they can invest in content to create a proposition targeted to customers' preferences. Secondly, the customer experience for example specific UI elements, can be adapted and tailored to users' behaviors to increase customer satisfaction. Applying collaborative, state-of-the-art methods like DevOps allows product development and operations to pivot based on customer feedback and needs throughout the product design journey, while maintaining balance between business requirements and technical feasibility. Agile development methods, such as SAFe, set the necessary framework, allowing fast validation of product viability and adapting the product roadmap. This means the CPE product feature can evolve iteratively and in much shorter development lifecycles, preparing service providers to meet quickly-moving OTT competition and customer expectations.

(Cloud) Platform

Moving from proprietary stand-alone CPE towards a homogenized, abstracted CPE and app platform also releases value into the organization by driving down costs. This single platform can serve multiple ecosystems, providing the same back end for all frontends—from mobile device to OTT app to service provider's cloud

CPE. In addition, with fewer CPE-specific features, this thin client hardware is more commoditized and less expensive. Most critically to service providers, which need to rotate towards new business models to stay competitive with OTT players, this open software platform creates exciting opportunities to generate new revenue streams and create value through CPE apps, e.g. by evolving the CPE into a Home Hub for entertainment and home automation.

A physical CPE footprint in the home remains a strategic asset for service providers. As platform companies including Amazon and Google intensify their efforts around home devices, retaining a physical footprint gives service providers the potential to broaden the scope of their services into a Home 2.0 proposition. TV service providers typically have a Business-to-Consumer business model focusing on creating, acquiring, aggregating and distributing content to consumers. Cloud CPE makes it possible for them to pursue Business-to-Business opportunities. Functionality in the cloud can facilitate the repackaging of features (e.g. the HTML UI) for enterprise customers. Making it easier to white label their proposition for other service providers, or for new use cases in industries such as hospitality and healthcare, to create new revenue streams.

A New Operating Model Driven by Data

Cloud CPE operating models facilitate the collection of business aligned KPIs, which help drive efficiency of effort and resources to the right areas. When combined with a governance model based on data and measured outcomes, investment can be focused on higher value features, with wasteful practices being made transparent and easier to eliminate. With business priorities tied explicitly to technology investments, outcomes can be rapidly evaluated from the real-time data available from the cloud platform. KPIs can be used to drive every part of a new supercharged cloud based business cycle.

Market Factors Driving Cloud CPE

In the past, operators were locked into maintaining an expensive population of CPEs, which often included generations of products requiring support well beyond their expected useful lifetimes.

Gradually, there has been a transition from this traditional mode of operation for **four reasons:**

01 The evolution of broadband streaming, which has become a competitive delivery mechanism for most content

02 The widespread availability of open platforms (e.g. Android TV) that are being used by service providers to build their own thin client

03 The prevalence of app platforms (Apple TV, Amazon FireTV) that can be leveraged by a service provider's cloud CPE app

04 Competitive threats from Cloud-only operators that are unhindered by traditional broadcast operators' legacy equipment costs

To identify market dynamics around Cloud CPE, Accenture conducted research across worldwide markets[4], representing 36 of the largest service providers and encompassing
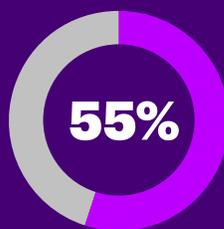
55% of TV-service providers plan to adopt Cloud CPE in the coming years
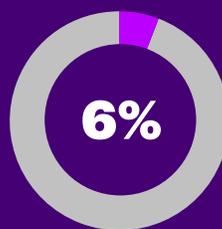
6% of subscribers in the analyzed markets are offering Cloud CPE today

$1.9B+ total investment potential in cloud CPE market

Charting the Cloud CPE Journey

## Why haven't more service providers moved to Cloud CPE? First, there are several challenges to overcome:

The complexity of a transition project towards a cloud CPE platform

Low market pressure, optimizing short term cashflow

Setup costs to provide digital content (content delivery platform, legal limitation for digital content distribution[5])

A successful Cloud CPE transformation requires that service providers address the underlying technical issues accompanying these challenges and upgrade their network accordingly. In addition, they need to define their individual commercial strategy and ambition and mitigate potential bottlenecks. One significant hurdle, for example, is renegotiating content rights to cover all new, online distribution channels. While there is no "one-size-fits-all" blueprint for making this transition, service providers need to manage these activities in an integrated way.

We recommend the following approach:
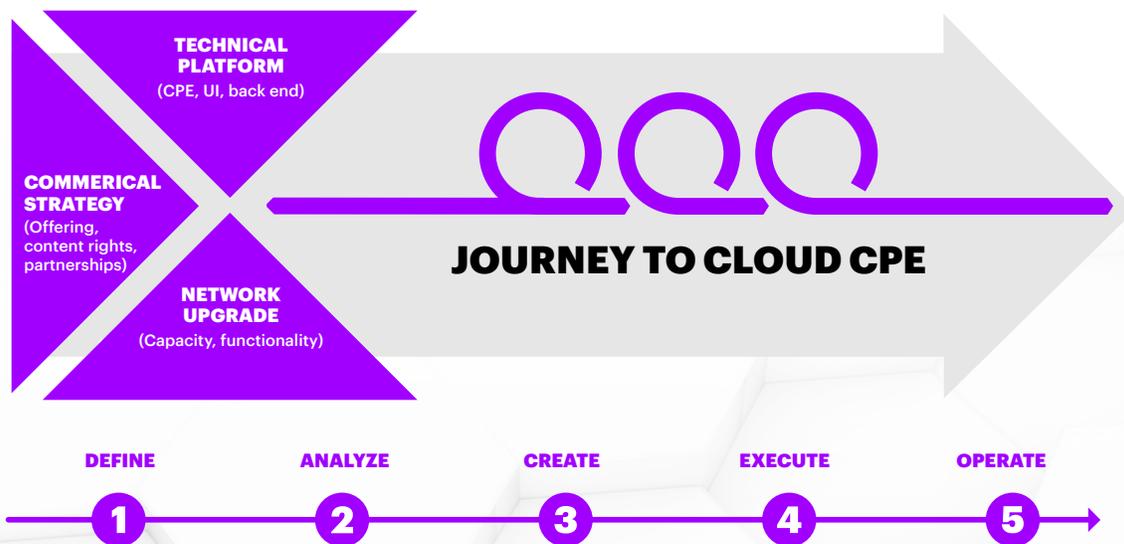
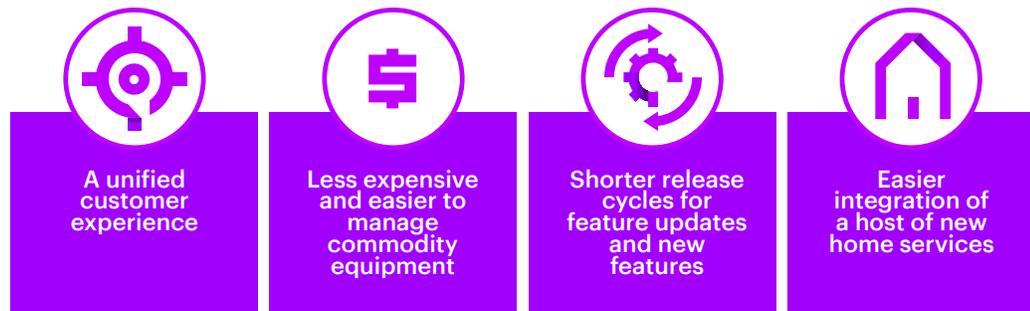| DEFINE	ANALYZE	CREATE	EXECUTE	OPERATE
1	2	3	4	5

1 Define TV offering and CPE strategy

Service providers must first define their ambition going forward. This includes identifying the extent to which they want to control a physical device within the consumer home. Strategic options are varied—from providing just an app on a third-party platform (e.g. Apple TV), to upgrading or replacing their own-branded Set-Top Box (STB) TV experience, to evolving the CPE into a Home Hub for entertainment and home automation.

For those operators whose strategy depends on control of a physical device footprint within the home to develop and deliver new services, Cloud CPE allows them to do so while reducing costs, increasing agility and improving customer experience.

The Potential of Cloud CPE

| A unified customer experience | Less expensive and easier to manage commodity equipment | Shorter release cycles for feature updates and new features | Easier integration of a host of new home services |

When moving to the Cloud, there are three main approaches an operator may take: **Hybrid, Thin Client, and Cloud Client CPE.**

Hybrid CPE

Some CPE functions are moved to Cloud, with others still embedded in CPE hardware

Typically used to enhance existing STB deployments

Useful for upgrading CPEs with limited capabilities. For example, adding Network PVR function to a STB Zapper CPE

Thin Client

Business logic across most functions moves to the Cloud and is accessible from CPE using a HTTP API

CPE handles input parsing, video streaming and rendering of UI

Commodity Hardware (HW) or User Device can be used

Cloud Client

Full business logic and CPE functionality is moved to Cloud

Client is just responsible for collecting and sending user input to the cloud

User Device only needs to be capable of video streaming

User Interface (UI) can be rendered in the cloud and overlaid on video

Commodity HW or User Device can be used

The right ecosystem is critical to the development of an effective platform for future product growth. This should encompass features and functionalities such as:

- **Personalized recommendations**

- **Advertising analytics**

- **Digital Rights Management (DRM)**

- **Personal Video Recorder (nPVR)**

- **Other third-party services**
  - Related content (e.g. actor biographies, short clips)
  - Other Video on Demand (VoD) services (e.g. Netflix)
  - Commercial services (e.g. Live Betting / Gambling)

2 Analyze network impacts and infrastructure requirements

Evolving to Cloud CPE will impose new requirements on the service delivery networks and infrastructure. These can be broken down into two areas:

Capacity requirements – Additional infrastructure and network capacity is needed to acquire, record, store and deliver the DVR/PVR service traffic, which was previously played out from the local STB Hard Disk Drive (HDD). This is also required to handle factors resulting from the altered solution architecture and network topology, such as increased computing power, database and storage capacity, purpose-built hardware appliances, network connectivity throughput and latency.

In order to evaluate the business decisions, capacity demand can be linked to meaningful business metrics, such as:

CATEGORY	BUSINESS METRICS
CORE SERVICES	Subscriber numbers and service mix (Live, PVR, Time Shifted TV, VoD)
CHANNELS	Number of live and DVR channels
TRANSCODING	Transcoded hours of content per month
CDN TRAFFIC	Number of GBs of traffic distributed to end consumers

Functional requirements – Cloud-based delivery models will need to be underpinned by new capabilities across the end-to-end solution ecosystem—from the back-office, through the infrastructure and network, to the CPEs.

3 Create the Platform Infrastructure

Developing a platform from the scratch can drain valuable capacity and resources. Employing available market solutions, where applicable, for a Cloud-first product management approach can reduce lead time and initial costs.

Consider the following principles:

01   Virtualizing the infrastructure

02   Leveraging off-the-shelf capabilities of public Cloud offerings

03   Migrating existing solution components and capabilities to the Cloud

The infrastructure analysis should also include "Private vs. Public Cloud" considerations, especially where service providers already have private Cloud capabilities or initiatives combined with large international operations.
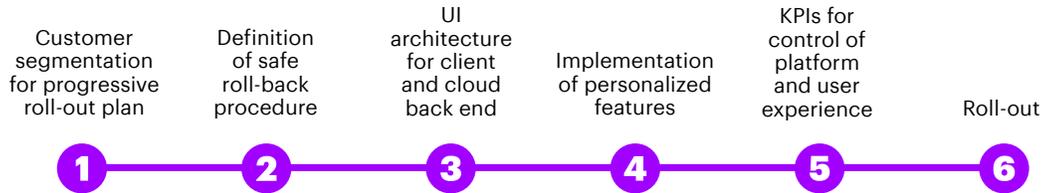
Of course, any TV service provider moving to a Cloud CPE model must have a valid business case. While this transition requires upfront investment in network infrastructure and data centers, there will be short-run savings—such as reduced cost for HDD in each CPE box. But, more importantly, migration to a modern cloud-native microservice based architecture will enable long-term success by unlocking innovation and teeing-up service providers to pivot to new revenue streams and opportunities. A Cloud-based solution opens important opportunities to further engrain the role of CPE—and service providers—in the home by improving customer experience and delivering new products. And, by enabling new kinds of subscriptions and upsell opportunities (e.g. bundling with Internet and/or mobile subscriptions), service providers can attract new customers and pursue new revenue streams.

That's not to say it will all be smooth sailing. As we touched on earlier, there can be bottlenecks and additional costs involved in renegotiating content delivery rights via this new ecosystem. Cable or satellite providers' rights typically include only TV delivery (channels and VOD) via cable or satellite systems. However, when calculating this equation, keep in mind that the cost of these digital rights or IP-delivered content will depend upon the chosen CPE operating model.

4   Execute the Roadmap

The roadmap blueprint for execution follows common implementation and migration steps.

For a both a Thin Client or a Cloud Client roll-out strategy, specifically, we have defined the following[5]:

Customer segmentation for progressive roll-out plan	Definition of safe roll-back procedure	UI architecture for client and cloud back end	Implementation of personalized features	KPIs for control of platform and user experience	Roll-out
1	**2**	**3**	**4**	**5**	**6**

The implementation of back end and client features can be detailed by strategy:

THIN CLIENT	CLOUD CLIENT
BACK END	**BACK END**
Move the business logic from Client to Server to secure full control from the back end Implement complex orchestration and data mashup, centralizing complex business logic, enhancing security and reducing impacts on client application and testing Provide advanced UI personalization tools for page composition, cluster management	Integrate a cloud UI back end and implement a JavaScript HTML application to be executed on Cloud UI Estimate peak concurrency model to define the dimensioning of Cloud UI platform Plan field trial to measure concurrency of a production user experience and refine the previous model
CLIENT	**CLIENT**
Identify a light- and high-performance HTML browser supported by low-end CPE but also providing support for high-end CPE scalable user experience (UX) Provide a pure JavaScript-optimized framework to offer a centralized common implementation supporting a high-performance HTML JavaScript application	Adapt Toolchain Integrate cloud UI Software Development Kit (SDK) on CPE and integrate with CPE Conditional Access System (CAS)/DRM

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[5] A hybrid CPE strategy can be introduced as part of regular CPE lifecycle management. No hard cut-over from the old architecture to the new stack this required and therefore this scenario is not described in detail.

Critical Success Factors

The new interface between CPE and Cloud back end is of critical importance. This needs to be newly defined, with implications carefully considered, such as the user or support model.

Iterative testing will be key to design validation. A potential approach can be to move from internal testing to crowd testing to a controlled launch before starting the actual user migration. This iterative method of testing of hypotheses—around factors such as internal processes, communication with users, marketing etc.— enables them to be refined before migrating to and rolling out Cloud CPE. Moving Cloud CPE to a full DevOps model (like those employed by Spotify, Netflix and Amazon) is ideal because it enables changes to be instantly deployed to any segment of the user population.

Testing in live mode (IT Test environment linked to Cloud back end and Network components) and regression testing on old back ends are highly recommended to ensure the IT landscape and new cloud back end are working from an end-to-end perspective.

"Batched" migration and roll-out through several phases will ease users' transition to the new solution. For example, users are first enticed through a pop-up notification to try the new service. Next, they are encouraged to migrate through more active communication. Finally, they are required to migrate to the new solution.

❝

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5 Operate with Agility

An agile, data-driven operating model where service providers use data to constantly advance the customer experience, apply learnings from multi-variate testing and adopt a "fail fast" approach, requires a nimbler approach to Operations.

Operations must itself become more data-driven if it's to improve KPIs such as Net Promoter Score and reduce customer service call volumes. Access to real-time data, augmented by Artificial Intelligence /Machine Learning, can greatly enhance
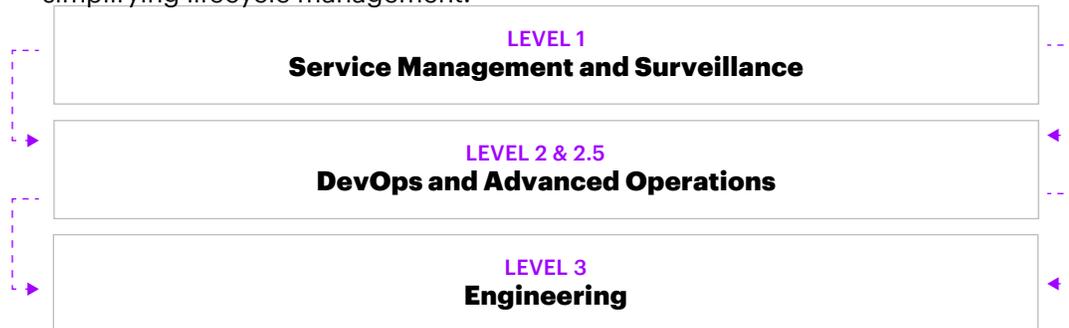
01 an organizations capability to collect and monitor:

02 Telemetry data from the device to detect problems earlier and take reactive or proactive measures.

User behavior data to detect patterns which indicate potential service issues, and proactively take remediation actions.

Shifting business logic from the device to the cloud also makes it easier to maintain and operate multiple platforms. This makes the client firmware more lightweight, opening the possibility for accelerated update cycles. And by moving

certain functions such as nPVR to the cloud, one can enable thinner, lower cost devices further simplifying lifecycle management.

LEVEL 1
Service Management and Surveillance

LEVEL 2 & 2.5
DevOps and Advanced Operations

LEVEL 3
Engineering

LEVEL 1 support provides 24x7 surveillance of the platform to proactively identify incidents and respond to automated alarms. In instances where automated remedial procedures are not available or effective, Level 1 can escalate to a first responder from the DevOps organization.

The DevOps organization is also essential to shift the balance of effort from operations to platform innovation. This can be done by tracking the effort spent on operational activities and looking for ways to reduce it, such as creating automated remedial procedures for issues that occur frequently, or enhancing the logic or machine learning algorithms used to spot anomalies in platform data and

behavior. In turn, these activities reduce effort required for pure operational activities and free up time to work on new features, tools, alerts, and so on. This behavior is at the core of the DevOps model.

Where incidents do occur, **LEVEL 2 (DevOps) AND 2.5 (Advanced Ops)** support resolve the incidents and related problems or identify appropriate workarounds.

If the incident is related to a software problem, Level 2 support engages the relevant area of **LEVEL 3** for problem resolution.

Cloud Architecture Example: Network based Personal Video Recorder

Cloud PVR (also: nPVR) is a key feature of Cloud CPE – independent of the specific strategy (Hybrid CPE, Thin Client, Cloud Client). However, implementing a Cloud PVR service isn't simply about moving recordings storage from the STB to the Cloud. All PVR features and business logic in the video platform back end must also be moved into the Cloud to benefit from this centralized architecture that enables optimization of recordings management.

The following picture shows the high-level concept of the nPVR service that is based on two key components: **the nPVR back end and the capture server.**
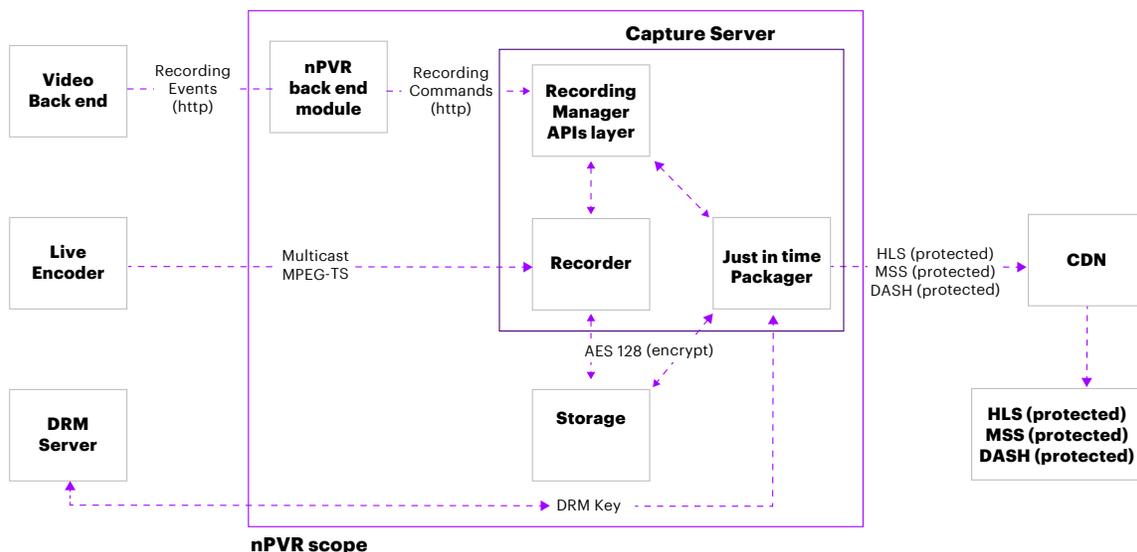
THE nPVR BACK END

The nPVR back end is in charge of the recordings management and has two tiers:

The business logic tier manages the following key features:

- Catch-up TV and start-over TV, also commonly called Operator nPVR features

- Scheduled recordings, instant recordings, series recordings, also commonly called End User nPVR features

- Updates of all recordings schedules according to new/changed programs included in the periodically published Electronic Program Guides (EPGs)

The adaptation tier manages, in an isolated, the integration of the proprietary interfaces exposed by the capture servers'. The lack of a standard set of APIs provided by the capture servers vendors is addressed by this decoupling tier, where a plugin specific for a vendor can be added in an isolated way from the core of the component and from other plug-ins.

THE CAPTURE SERVER

The capture server needs to provide these key features:

Just in time packaging (JITP) – This enables streaming of the recording play-out from a mezzanine format that is converted and protected on-the-fly in the target one supported by the requesting device (i.e. HLS, DASH, SmoothStreaming). This enables critical benefits:

- Reduces storage needs: For each recording, only the mezzanine format is stored in the disks. During the play-out, formats required from the plethora of devices/OS (e.g. Android smartphones and tablets, iOS iPhone and iPad, Windows PC, Mac OS, etc.) are generated on demand. This typically saves storage capacity by 60-70%.

- Avoids DRM lock-in: Since the content play-out protection is executed on-the-fly as well as the format conversion, the DRM technologies can be changed at any time without affecting existing recording.

Storage vendor independency – Storage is critical for nPVR service. Obviously, being free to choose from a set of certified/preferred storage vendors provided by the capture server vendor optimizes the storage solution cost. In fact, some capture server vendors have certified storage in the Cloud with the goal of reducing these costs and simplifying the management process. Others, instead, require specific or proprietary storage that de facto lead to a capture and storage vendor lock-in.

CDN integration – To reduce the workload of the JITP that generates the recording play-out, a CDN needs to be integrated in the streaming architecture. This enables delivery of play-out chunks and, hence, caching recording chunks that can be delivered for next requests of the same recording without hitting the JITP again.

Single copy – In some countries, e.g. USA, the law requires that recordings of the same program requested from different end-users be stored separately for each one. Because this can heavily affect storage needs and JITP workload, some vendors provide a solution to at least maximize the efficiency of the JITP and keep this cost low.

Conclusion

An effective Cloud CPE strategy positions service providers to hold their own against OTT companies that are continuing to move in on their customers and revenue. The TV experience will remain center stage for controlling the service provider's brand and protecting the core portfolio of associated video offerings. However, Cloud CPE creates a springboard for new products, services and revenue streams—creating the opportunity to capitalize on additional advanced entertainment services and strengthening service provider's role in consumers' lives and homes.

While the global pace of this digital rotation is asymmetrical, with some markets well along in this transition and others yet untapped, Accenture's analysis highlights the growing global demand and potential for Cloud CPE. The growing penetration of broadband access in rural areas and developing countries is anticipated to accelerate the IP-TV based approach, potentially boosting the Pay-TV market, while sophisticated Cloud CPE-enabled digital services bring more balance to the competition with OTT players.

Service providers are moving in this direction and have started to shift more CPE features to the cloud. Previous technical challenges have been addressed and remaining hurdles in place due to legal, content rights and licensing issues are anticipated to be resolved before long. This leaves the core hardware features that are pertinent to signal demodulation and coding on general purpose hardware.

Agility is king when moving to Cloud CPE. Shorter lifecycles and increased competition put pressure on service providers. However, a TV experience based on a scalable cloud infrastructure enables faster innovation at lower cost as well as faster and cheaper hardware refresh cycles. Multi-channel access will only be possible with an abstracted CPE. A big threat for traditional Pay-TV, OTT is positioned to capture most of the revenues generated in the market. To fight back, mitigate churn ("cord-cutters") and attract native OTT subscribers ("cord-nevers"), Pay-TV must provide an OTT-like video experience (anytime, anywhere) that accommodates customer habits.

Accenture is uniquely positioned to offer end-to-end transition services. We can support our clients in all aspects of this transition—from defining the right strategy, to analyzing the network impact, to actually delivering the new platform. Accenture brings together the experience, capabilities and platforms—such as our Accenture Video Solution—to help our clients complement their portfolio and offer a tailored solution.

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