



White Paper

Making the Business Case for Cloud DVR

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Introduction

Less than two decades after TiVo and Replay introduced the first digital video recorders (DVRs) at the 1999 Consumer Electronics Show (CES) in Las Vegas, the technology behind the popular device is now in the process of being utterly transformed. Several carriers and cable operators in Europe, North America, Asia, South America and elsewhere around the world are now introducing cloud-based DVR service to their video customers. Also known as network DVRs, cloud DVRs take the complex digital recording and trick-play functionality out of the digital TV set-top boxes (STBs) in the customer's home and place them in the data center, or cloud, instead.

As a result, video service providers can potentially deliver the benefits of DVR service to their entire video customer base, not just those subscribers who happen to have the properly equipped STBs. Providers can also offer more, value-added DVR services, much higher storage capacity for recorded programs, the ability to record multiple programs simultaneously, and greater service reliability and availability, among other things. In addition, subscribers can gain easier access to multiscreen video capabilities, enabling them to take their favorite recordings with them on various video devices wherever they go.

Thus, the numerous customer benefits of cloud DVR service are clear. What hasn't been as clear so far, however, are the powerful benefits that cloud DVRs offer to pay-TV providers, even though those benefits are just as numerous. Service providers can leverage the cloud to cut STB costs, store recorded programs more efficiently, upsell advanced services to video subscribers and reduce costly truck rolls to customers' homes. Providers can also take advantage of the cloud to boost customer satisfaction, slash churn rates, provide better visibility, increase control over video consumption and generate fresh revenue streams.

This white paper looks at the chief financial benefits that service providers can gain from launching cloud DVR service. It examines the business case for offering the service, despite such major challenges as securing content rights from video programmers, storing large numbers of individual copies of shows (at least in the U.S.), transcoding so many different programs at once, dealing with heavy concurrent use by customers, and scaling the technology to millions of homes. It also offers some practical steps to providers for rolling out cloud DVR service effectively and efficiently. And it presents a case study of a hugely successful deployment of the service by a leading carrier, Telefónica, in Spain.

The Shift to On-Demand Viewing

Over the past few decades, consumers in many Western nations have quietly made a historic change in their basic TV viewing patterns. Thanks first to the introduction of the VCR in the 1970s, and then even more to the introduction of the DVR at the turn of the century, TV viewers have gradually shifted from always watching linear channels at scheduled times to enjoying their favorite programs any time they want. This trend has been particularly evident in the U.S., U.K. and some other parts of Western Europe, where as much as 50 percent of TV viewing now takes place on an on-demand basis, according to the latest data from Parks Associates.

Two companies, TiVo and Replay, invigorated the on-demand viewing movement when they debuted new products at CES 1999 in Las Vegas. These two disruptive tech startups introduced the first DVR models to the world then, exciting TV viewers with their advanced trick-play functionality, while scaring programmers and advertisers worried about losing eyeballs for their shows and commercials. While Replay didn't last very long, it and TiVo made a lasting impact on both the consumer electronics industry and the pay-TV landscape, as viewers quickly embraced the idea of recording their favorite shows much more easily and simply than they could with their VCRs.

In fact, the DVR proved to be such a popular invention that satellite TV, cable and other pay-TV providers soon began incorporating their functionality into their digital STBs. Before the end of 2001, for instance, DirecTV, BSkyB and other satellite TV operators had already started working with TiVo and other hardware makers to offer DVR service to their premium subscribers. So now consumers could get both their regular pay-TV service and new DVR service in one integrated digital STB, rather than need two separate boxes attached to their TVs.

With viewer demand for on-demand viewing clearly growing, DVRs quickly started evolving into more sophisticated, complicated devices. The first dual-tuner DVRs hit the market about a dozen years ago, enabling consumers to record more than one program at the same time, or record one show while simultaneously watching another. This development was followed a couple of years later by the introduction of multi-room, or whole-home, DVR service, which allowed viewers to record and watch shows on every TV in their home.

Cloud DVR service represents another major step in the DVR's evolution. Under this concept, the critical engine driving the trick-play functionality of the DVR is moved out of the individual STBs themselves and into the service provider's network or data center. Once service providers began delivering whole-home DVR service, it was almost inevitable that they would seek to streamline the process and trim their capital and operating costs by shifting the DVR functions into a virtual environment.

The roots of cloud DVR technology go back further than is commonly believed. In fall 2001, ThirdSpace, an early interactive TV joint venture between Alcatel and Oracle, actually staged the first live demonstration of cloud DVR technology at the IBC show in Amsterdam. Known as "Re-Cast" and designed to work with existing IPTV STBs, the network-centric DVR service boasted the capability to capture the entire output from all broadcast channels for at least the last 48 hours. Programs could be viewed immediately or stored in a "personal video locker" within the network for later viewing.

However, it would take some time for this breakthrough technology to become commercially viable for a variety of reasons, including the lack of a solid business model and the lack of content rights. In particular, it took a while in the U.S., where digital recording technology, like cassette recording technology before it, became tied up in nasty, prolonged legal disputes over copyright issues.

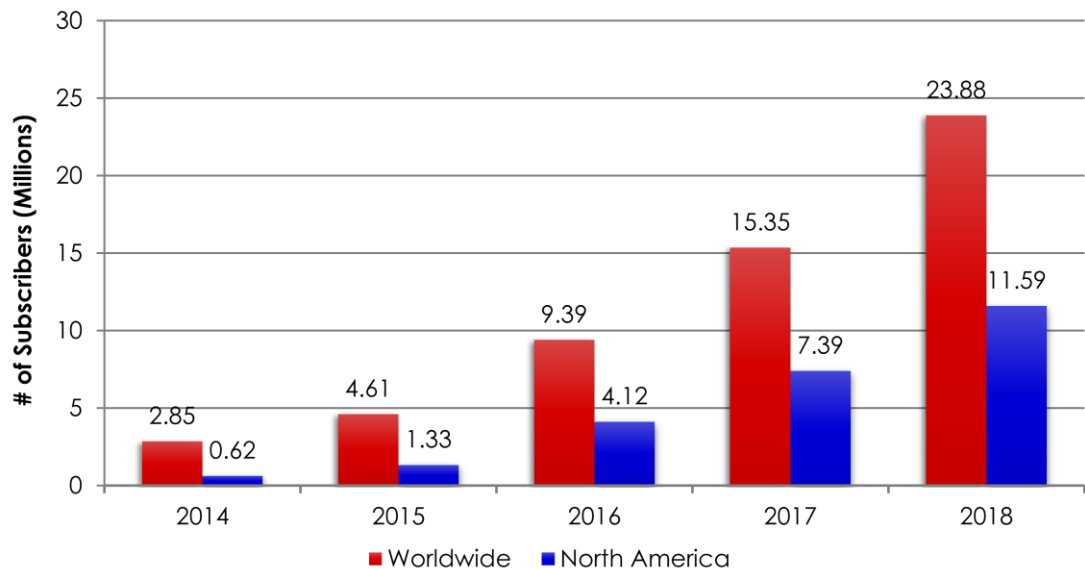
Indeed, even though Time Warner Cable successfully introduced two partial cloud DVR implementations, known as "Start Over" and "Look Back," in 2005 and 2006, it wasn't until the U.S. Supreme Court handed down its historic ruling in favor of network DVRs in June 2009, upholding a lower federal court decision, that the legal issue was finally settled. As a result, it would take close to a decade after the first live cloud DVR demo for the technology to actually be deployed by service providers.

Thanks to the favorable court rulings, Cablevision Systems finally became the first U.S. pay-TV provider to launch a full-scale cloud DVR service in 2011, when it started rolling out the service in the New York City metro area early that year. Comcast, the largest MSO in the U.S., then followed suit about two years later, introducing its cloud DVR service in Boston in spring 2013 and subsequently extending it to other markets. Other U.S. cable operators and IPTV providers have also pursued cloud DVR offerings since the courts decided the Cablevision case.

In contrast, telco IPTV providers have mainly led the way in Europe. Working with Alcatel-Lucent, for instance, Arcor, a unit of Vodafone, rolled out network DVR service in Germany in 2007. Similarly, Swisscom began deploying cloud DVR service in Switzerland in 2012, once again in conjunction with Alcatel-Lucent. Pay-TV and online video providers started offering network DVRs in other parts of Europe as well, including Vcast in Italy and TVkaista in Finland, although with mixed results because of channel restrictions in nations such as Germany.

With the spread of the cloud DVR phenomenon, time-shifted viewing will undoubtedly reach new heights as the service catches on in new regions, more content owners and pay-TV providers reach agreements on content rights, and DVR services expand beyond today's Catchup TV and live/pause/rewind options. The big question is just how high time-shifted viewing will soar. But the era of linear TV dominance is clearly drawing to an end.

Figure 1: Global Forecast of Cloud DVR Subscribers (2014-2018)



Source: Parks Associates

Chief Benefits of Cloud DVR for Service Providers

As alluded to earlier, the cloud DVR potentially offers numerous benefits to both pay-TV providers and their video subscribers. This section will focus on the main benefits for service providers, showing why it makes financial sense for them to invest in next-generation network DVR technology.

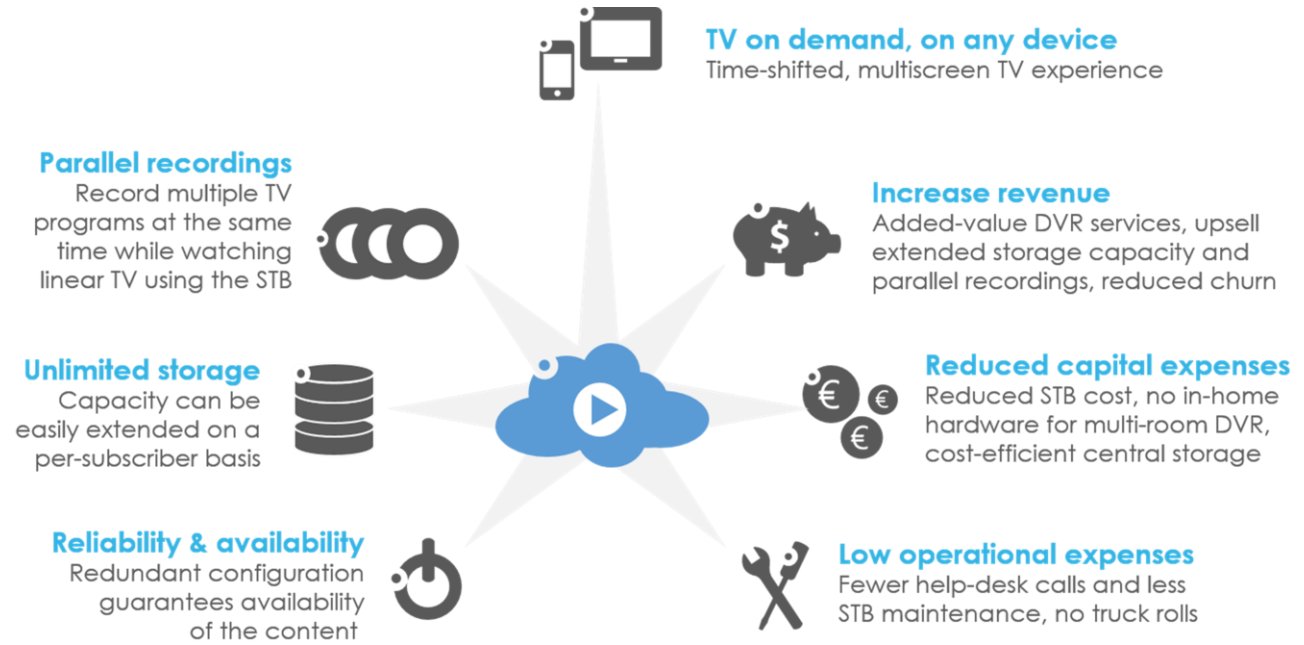
One chief benefit of cloud DVR technology for service providers is that it enables them to slash their STB costs dramatically. By moving the critical trick-play functionality from its digital STBs and gateways to the network or its data centers, providers can leverage either the existing digital STBs in the home or deploy even cheaper, dumber boxes. Either way, they can cut their capital expenses on equipment by spending much less on customer STBs.

Besides cutting their capital costs, service providers can markedly trim their operational expenses by deploying network DVR technology. For one thing, providers can reduce their expensive truck rolls to subscriber homes because cloud DVR service can run on existing, less complicated digital STBs. Few, if any, new boxes need to be installed to make the service work.

For another, cloud DVR technology enables service providers to store recorded programs far more efficiently, especially outside the U.S. (where copyright rules still mandate that each subscriber's individual recordings be stored separately). Instead of needing to store many multiple copies of programs so that each can be delivered to a particular home or subscriber, providers can now store just one or a few copies in a central location or the network edge, making it easier and quicker to deliver the desired show when a customer requests it. Unused storage is also shared (people only use a small portion of the storage capacity). More efficient storage also leads to lower operating expenses.

Finally, service providers can take advantage of cloud DVR technology to exert greater control over subscriber usage of the digital recording functions and features. This greater control also leads to greater operational efficiencies, enabling providers to trim operating costs even further.

Figure 2: Cloud DVR Value Proposition



Source: Alcatel-Lucent

Global Cloud DVR Deployments

Although it took some time for cloud DVR technology to become commercially viable, it has begun to spread its wings as the technology has matured, business models have emerged, and content rights issues have started getting settled. On both sides of the Atlantic, cable operators, satellite TV providers and telcos have now started deploying network DVR service in one or more of their main regions.

Figure 3: Cloud DVR-Related Deployments

MEDIA COMPANY	MARKET	DEPLOYMENT DETAILS
Hrvatski Telekom	Largest telco in Croatia	Cloud Video IPTV pilot
Disney	ABC Television Stations Group	Branding and content playout in cloud
Tata Communications	Leading telco in India, media service provider	Cloud-based video transcoding and delivery
Comcast	Largest U.S. media and cable provider	X1 cloud DVR, 3M+ subscribers served
Cablevision	Top tier U.S. cable provider	Cloud DVR with 1M subscribers (34% penetration); DAI on cloud DVR streams @ 4x CPM
Rogers	Leading Canadian media and cable provider	Slated to deploy cloud DVR in 2015
Kabel Deutschland	Largest German cable provider	Plans to launch integrated cloud video delivery network by 2016/17
NET	Largest cable provider in Latin America	Cloud DVR deployments across Brazil
Telefónica	Largest telco in Spain	Cloud DVR deployments across Spain

Source: Alcatel-Lucent, Imagine Communications, Heavy Reading research

Two of the five biggest U.S. cable operators – Comcast and Cablevision Systems – now offer network DVR service to many, if not all, of their digital video subscribers. Cablevision, the first of the two MSOs out of the gate, has rolled out the service throughout its sprawling New York City metro area franchise, which is its only one.

Comcast, which introduced the service about two years later, has now rolled out cloud DVR to its Northeast, Midwest and Western regions. Plans call for it to complete its rollout throughout the U.S. by the end of 2015.

As mentioned earlier, though, North America has probably been the most problematic region, due largely to the unique copyright restrictions of U.S. law. Specifically, as the federal courts have ruled, service providers must set aside a separate, private copy of each recorded program for each subscriber requesting it. So the "shared copies" storage efficiencies that network DVR technology offers can be far more difficult to achieve in the U.S., as providers must spend much more to store all the individual copies.

Seeking to ease this dilemma greatly for U.S. pay TV providers, Alcatel-Lucent has introduced a new "virtual private copy architecture" that combines economical tiered storage with enhanced intelligence in its Velocix content delivery network

(CDN). Every time a user moves to record a show, the Alcatel-Lucent scheduler logs the request and initiates the private recording. All the recordings are stored in low-cost archives, because they don't require fast and frequent access. The CDN then distributes these unique recordings in a way so that they can be cached, reducing latency and cutting storage costs by up to 75 percent, according to the vendor.

Below the U.S.-Mexico border, South America's largest cable operator, Net Brasil, has started embracing the network DVR concept. So far, Net Brasil has conducted lab tests of the technology in preparation for a possible commercial rollout. Elsewhere in Latin America, Columbus Communications (now part of Cable & Wireless Communications) began deploying a cloud DVR service in the Caribbean region in early 2013.

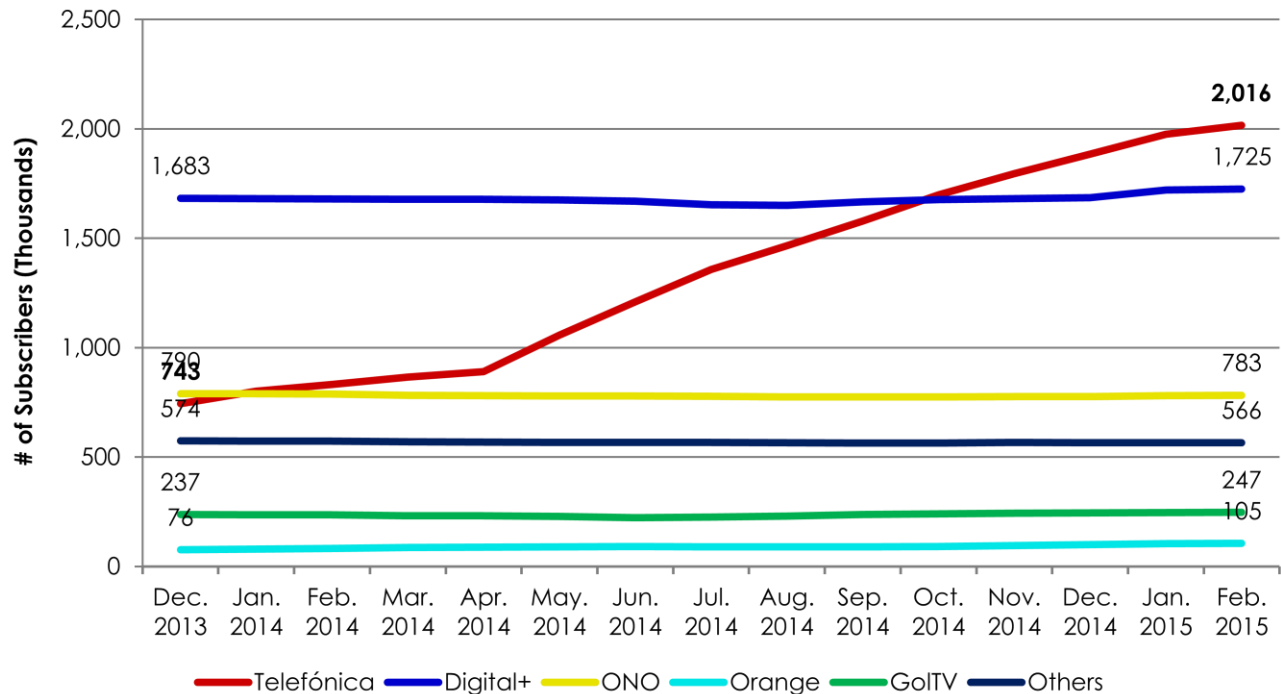
On the other side of the Atlantic, leading cable operators and telco IPTV providers such as Kabel Deutschland, Swisscom, Belgacom and Telefónica have all launched network DVR service, or have at least started preparing for it in their respective sections of Western Europe. Likewise, in Asia, pay-TV providers in such regions as Hong Kong and Singapore have begun offering network DVR service as well.

The next section will focus on one of the most prominent rollouts, namely Telefónica's deployment of cloud DVR service in Spain.

The Telefónica Case Study

Telefónica's initial deployment of cloud DVR service in Spain represents a prime example of how the next-generation video technology can pay off for service providers. Introduced in December 2013 as a key part of the provider's new and improved Movistar TV package, the service has proved to be immensely popular throughout the country, attracting many new customers in the first 12 months of operation. Thanks in large part to its inclusion in the Movistar TV bundle, Telefónica has more than doubled its number of Movistar TV subscribers, from 740,000 to more than 2 million, vaulting it into the leadership role in the Spanish pay-TV market.

Figure 4: Spanish Pay TV Market Evolution



Source: Telefónica

Roberto Porras, brand manager of Movistar TV for Telefónica, explains that the provider launched the new Movistar TV service with the customer proposition that it was "TV as you have never seen it" ("la televisión como nunca la habías visto," in Spanish). Among other things, the new Movistar TV offering features premium content, such as Moto GP, Soccer and Series programming, as well as a set of new ways for tapping into this content, such as cloud DVR and multiscreen video.

"Cloud DVR has been one of the building blocks of our market proposition and certainly our most successful services on IPTV so far," Porras says. "It's one of the most used features by our customers."

Telefónica, which is the first pay-TV provider in Spain to take this route, offers two tiers of cloud DVR service in its various Movistar TV content bundles. The basic video package features 50 hours of storage for recorded programs for €65 a month (along

with such other communication services as fixed and mobile broadband). The more advanced content package features 350 hours of storage for all service bundles above €73 a month, which also include the other communications services. Although there's virtually no technological limit to the amount of programming that can be stored in the network, the provider's commercial policy sets the limit at 350 hours.

Telefónica has not yet disclosed how many Movistar TV customers take the basic cloud DVR package and how many are using the more advanced option. But both packages have clearly proven to be very popular with Spanish TV viewers, driving both the frequency of usage and the average amount of usage by subscribers.

Consider the growing frequency of usage first. In February 2015, after the first 13 months of operation, Telefónica reported that the number of cloud DVR users had quintupled just since October 2014, just four months earlier. Plus, an overwhelming 80 percent of cloud DVR users said in February that they "very often" tap into the service. "It's a big jump," Porrás says. "We couldn't have imagined in June of last year this incredible increase of usage in a few months' time."

Then there's the growing amount of usage by subscribers. In February 2015, the latest month for which figures are available, Telefónica reported that its cloud DVR customers had increased their hours of usage by 19 percent since October 2014. "It's [usage is] increasing every month," Porrás says. "We are increasing the number of users and the intensity of usage is higher."

Porrás cites several key reasons why the Movistar cloud DVR service has succeeded so far. First, he says, the service has paid dividends because of its "accessibility." As mentioned earlier, the provider does not need to install new STBs in customers' homes for them to tap into the service. So interested subscribers can immediately use the service on their existing STBs. "We can reach all of the existing CPE for customers," Porrás says. "We don't need to put advanced set-top boxes in homes."

Second, he says, the network DVR service has scored for Telefónica because of its great flexibility. By relying on the cloud, the IPTV provider can craft and revise its video subscription packages for customers without needing to replace any in-home equipment. As a result, it can add new features and make other service changes quicker, easier and cheaper than before. "It's 100 percent flexible," Porrás says. "It's only a service configuration. There's no physical device dependent on storage capacity."

Another key success driver for the cloud DVR has been the new user interface for Movistar TV. Among other things, the new and improved interface fosters greater subscriber usability and feature discovery, Porrás says.

Last but not least, the cloud DVR implementation has helped Telefónica cut costs on both the capital and operating sides of the ledger. While the provider does not reveal how much money it has saved with its cloud DVR service, the savings are clearly substantial. "It's much more efficient in the network," Porrás says.

Seeking to build customer loyalty by positioning Movistar TV as "a premium service" that delivers "a premium experience," Telefónica executives are not looking for ways to monetize their cloud DVR product any further. Right now, Porrás says, company officials are content to package network DVR service with their other IPTV and broadband offerings, not break it out and charge extra for it.

"This is a basic service that supports our customer promise," Porrás explains. "For this reason, we want to open it to all our product options and make it accessible for all

our customers. As a result, we are not considering options to monetize this feature on top of the normal monthly fee for the service right now."

In fact, Telefónica officials are so pleased with the service that they have already moved to introduce a new, more advanced service, called Cloud Catchup, in April 2015. This new premium service automatically records all programming on all channels over the last seven days. So, customers can now catch up with any shows they might have missed over the previous week.

To be sure, Telefónica still faces plenty of competitive challenges from other major players in the Spanish pay-TV market, which has seen a lot of consolidation over the past year. Since the middle of 2014, the big European carrier Vodafone has plunged into the Spanish market by buying ONO, the nation's largest cable provider. At the same time, the French wireless carrier Orange TV has entered the market by acquiring JazzTel, one of the nation's biggest broadband providers.

Further, more competition will come in October 2015 when Netflix brings its popular online subscription video service to Spain as part of its ambitious global expansion push. So Telefónica will have its hands full.

But Porras believes that Telefónica, which has also bulked up by buying the Spanish Canal+ pay-TV service, is well prepared for these challenges, especially with the re-launch of Movistar TV. As of February 2015, Movistar TV is easily the top pay-TV service in Spain, with a growing lead over Digital+, ONO and its other market rivals.

A Practical Guide to Launching Cloud DVR

By just about any measure, launching a cloud DVR service is a transformational step for service providers. Unlike linear or broadcast TV, which is a multicast service because it's delivered to many viewers at the same time, time-shifted TV is a unicast service because it's delivered to one subscriber, or even one video device, at a time. Thus, time-shifted services place an increasingly heavier traffic burden on the video delivery network as the number of subscribers grows.

What this means is that service providers should think long and hard about upgrading their network architecture before deciding whether to deploy cloud DVR service. This section will spell out some key recommended steps that providers can take when considering a rollout of network-based time-shifted services, based on Alcatel-Lucent's experience with a large number of customer rollouts, with more than 50 petabytes of storage capacity deployed so far.

First and foremost, providers should assess the situation and model their proposed cloud DVR solution so that they can understand the impact that the cloud DVR service will have on their networks. This process entails identifying the types of services to be offered, whether personal recording, catchup TV or restart TV. It also includes weighing a whole range of other factors, including:

- The number of subscribers to be served
- The level of concurrency (how many viewers can access the service at the same time)
- The time to ramp up to maximum throughput
- Video startup time
- The number of TV channels involved
- The number of video assets, e.g., TV shows, movies, personal recordings, etc.
- The size of those video assets
- The duration of those assets
- The streaming protocols supported, including constant bitrate and adaptive bitrate
- The service profiles for the adaptive bitrate protocols, ranging from several hundred kbit/s to several Mbit/s

Second, service providers should examine how they can meet the significant storage capacity challenge of cloud DVR service. With hundreds of channels, thousands of programs, and hundreds of thousands or millions of pay-TV subscribers involved, the volume of storage required can be tremendous. So providers with large customer bases will likely need to interconnect multiple storage nodes within a 10 GigE LAN topology to accommodate all of the recorded programming involved.

Faced with this kind of storage demand, providers should consider the following set of factors when looking at how to scale their data centers and networks:

- Quantity and locations for expected cloud DVR points of presence
- Interconnection requirements between cloud DVR nodes
- Disaster recovery requirements

Software-defined networking (SDN) could play a critical role here. Indeed, service providers are already starting to use SDN technology to automate connectivity within virtualized data centers and establish connections between new cloud DVR nodes.

Once they have decided how to build their cloud DVR architecture, the next step for service providers is to figure out how to feed the time-shifted unicast video streams into their networks through some kind of edge router. While the types of edge routers traditionally used by cable operators and IPTV providers may differ, what both kinds of edge routers have in common is that they were developed to support highly oversubscribed, best-effort Internet connectivity, not high-quality video service. As a result, they are now becoming bottlenecks for delivering the rapidly growing number of unicast video sessions.

To cope with this increasing shift to unicast delivery, providers must upgrade or replace their edge routers, whether they be video routers or cable modem termination systems (CMTSs) deployed by cable operators, or broadband network gateways (BNGs) or broadband remote access servers (B-RAS) deployed by IPTV providers. In addition, providers must look at distributing these routers further in their networks to help carry the heavier traffic load.

What's more, pay-TV providers should consider ways to boost the quality of the unicast video streams delivered over their networks. Instead of viewing OTT video service and TV Everywhere service to connected devices as second-class offerings deserving just best-effort treatment, providers should apply the same quality-of-service (QoS) standards that they apply to the signals they deliver to STBs in the home. That means prioritizing the unicast traffic.

Further, pay-TV providers should explore their ways to scale their networks to greater heights. More specifically, they should look at how to use CDNs to cache the most popular programming at the edge of the backbone. This caching approach can greatly reduce the bandwidth load on the backbone network, protect the origin server from high peak requests and slash both the cost of the origin server and the required investment in legacy infrastructure.

A recent Bell Labs study has found that distributing the caches even further into the metro network can reduce the total traffic by as much as 41 percent. To optimize their traffic, what pay-TV operators must figure out is how many caches they need, where the caches should be located and how far into the network they should be distributed. Operators should weigh prospective bandwidth savings against the extra cost of the caches. Alternatively, the resulting QoS improvements could justify the investment.

Finally, pay-TV providers should examine their options for boost throughput per user in the access network. For example, cable operators can choose from the following three options:

- Upgrading their HFC networks by extending the frequency range with the new DOCSIS 3.1 broadband standard
- Reducing the split ratio of their HFC segment by installing a micro-CMTS deep into the network and cutting the number of homes per segment
- Deploying a passive optical fiber-to-the-home (FTTH) network as a future-proof solution

These steps will go a long way toward preparing for the cloud-based, time-shifted world of the future.

Conclusion

Despite some unexpected twists and turns in the road along the way, the cloud DVR is now here to stay. Thanks to the development and deployment of more advanced video technologies, IPTV providers, cable operators and other pay-TV providers can now upgrade their networks to offer improved recording, storage and delivery of TV programs and movies to their video subscribers.

As this paper shows, there are many good business reasons for providers to adopt the cloud DVR model. With this network-centric approach, providers can slash their STB and other equipment costs, reduce their operating expenses, store recorded programs more efficiently and effectively, and gain more control over subscriber usage. Just as importantly, service providers can increase recurring revenues, boost customer satisfaction and loyalty, and cut customer churn rates.

Like any transformation program, though, launching a cloud-based DVR service requires a lot of planning and forethought. Providers will need a deep understanding of the entire video service delivery chain, as well as vast expertise in IP, backbone, metro and access networks. It's not an effort for the unprepared or faint of heart.

Fortunately, there are some critical steps that pay-TV operators can take to embrace the network DVR concept. As the paper spells out, these steps include assessing the situation, meeting the capacity challenge, prioritizing unicast traffic and scaling the backbone, metro and access networks.

The key is to get started right away. As the Telefónica case study indicates, providers that enter the market early can seize the advantage over their pay-TV rivals and sign up droves of subscribers quickly. Those that hesitate will likely not be so lucky. So don't get stuck with your head in the cloud.