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OTT has come down from the clouds.

It's ready for prime time, within an overall video delivery **strategy**.

Time to extend IPTV's reach

Time to open a new world of opportunities

Executive summary and paper contents

Key Takeaways on Delivering video Over The Top

Underlying technologies to cost-effectively deliver video content over the Internet have matured enough for carrier grade deployments.

Competitive pressure and customer expectations have take away time to learn as you go.

The large one-stop-shop suppliers don't yet have a reliable end-to-end solution and it's a jungle out there.

So how can you choose the right way forward?

This White Paper discusses the principle technical, business and user experience issues that are still unresolved for many service providers.

After clarifying what OTT is all about, we argue that new open standards like MPEG-DASH and pre-integrated building blocks are now enabling operators to deploy OTT services based on best-of-breed components within a short time-to-market.

Structure of this White Paper

The introduction ponders if all the fuss about OTT is justified. It describes what the White Paper is about and why you must read it: rate-adapt or die now that competition is just a click away on the TV too.

We then cover the most salient points of how OTT is delivered with a special note on the importance of MPEG-DASH.

The CDN (Content Delivery Network) section focuses on the burning build or lease question.

The challenges of delivering a good user experience in an OTT environment are covered next, followed by the new user interface opportunities that come with OTT technology. Flexible rights management is key for OTT success, and that is described before discussing some of the business opportunities OTT is opening up.

The White Paper finally makes the case for a pre-integrated solution and closes with a look into the near mid-term future where we believe the OIPF has a role to play.

The annexe contains references for further reading, a glossary of terms, and some contact details to get more information from the author, Broadpeak, Harmonic Inc, or Viaccess-Orca.

Introduction

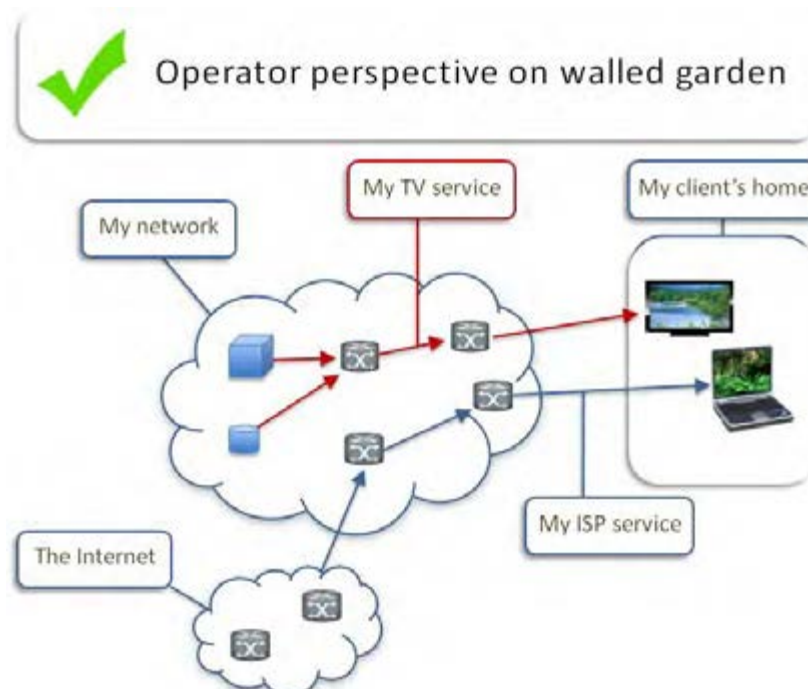
What this White Paper is about

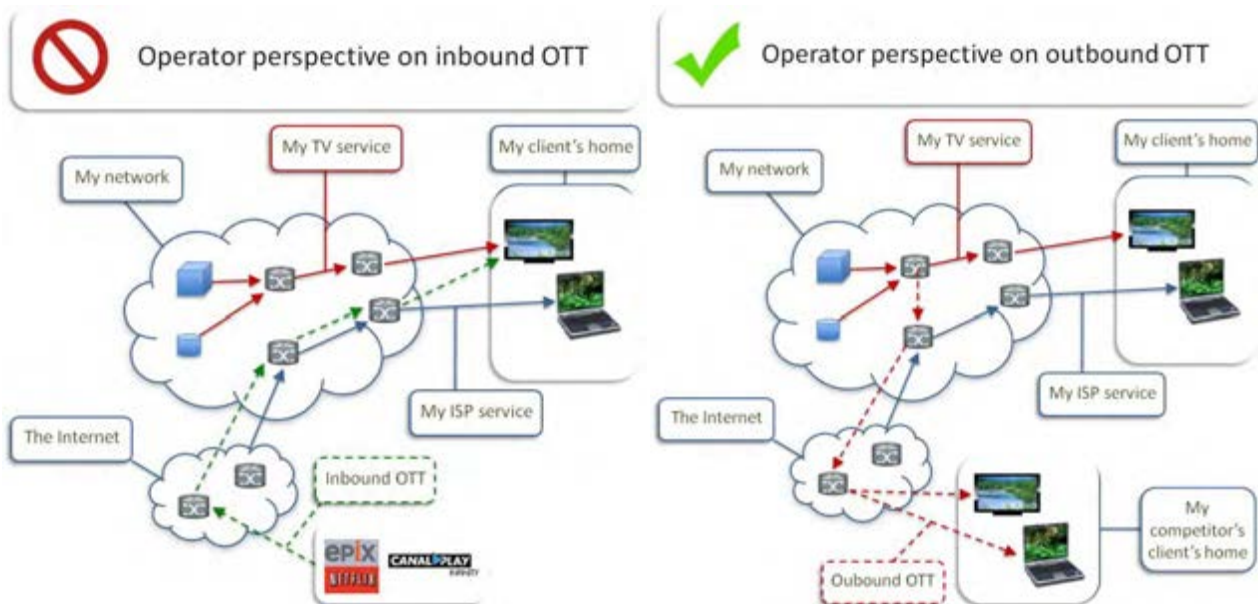
This paper is about the challenges and rewards of adding Over-The-Top (OTT) TV to an existing TV service in the context of converging User eXperience (UX). We focus on the real world, looking at what people are actually doing. This is not yet another catalogue of the equipment and platforms out there in the world of OTT. We will look at one pre-integrated solution that is starting to deliver on the promise of OTT. Our story is structured around the quotes of a few people actually doing it today.

UX is a broad concept capturing the whole of the user's journey from initial acquisition, through calls to customer service, and churn. It is a superset of Quality of Experience (QoE), typically restricted to the quality of one aspect of a service, such as the visual impairments of the video stream.

UX has already started to slowly converge across different operator networks (IPTV, Cable, Satellite), and at the same time expanded to embrace multiple device types. As other technology issues with OTT are resolved, including streaming and content security, the main stumbling blocks remain the UX and the business models – or lack thereof.

A graphical definition of the two sides of the OTT sword for IP operators





Why you need to read this White Paper: rate-adapt or die

After at least two decades of skirmishing, OTT could represent a final reckoning between the worlds of broadcasting and telecommunications as convergence becomes inevitable. The two camps may still emerge as allies or cutthroat competitors, but whatever happens both are rushing headlong into OTT. The race to make the full range of digital content available on all fixed and mobile connected devices is on. Technologies under the OTT banner such as adaptive streaming achieve this most effectively within the constraints of bandwidth, latency, and display capability.

OTT is becoming essential, but it is not a one size fits all technology. Different flavours and categories are emerging to suit a wide range of deployment requirements. OTT will be like a cookbook with different recipes to suit varying tastes or requirements, but each of which conforms to common standards of preparation and delivery.

OTT is not all of a sudden going to be capable of delivering reliable HD quality to all devices over any network, so compromises will have to be made, with broadcasters and operators alike having to decide what the priorities are. For broadcast applications such as live events, low latency may be the most critical aspect, while for a mobile TV service, footprint extension may be more important. There will be many situations where the operator must move to Adaptive Bit Rate (ABR) technology or become obsolete with solutions too slow to adapt to demand.

Why this White Paper is different: customer managed relations, not CRM

It has taken the corporate world decades to get to the level of finesse over Customer Relation Management (CRM) currently in place in business-to-consumer enterprises including Telcos and TV operators. These companies feel they own the relationship and have learnt to profit from it accordingly. But this is changing as the consumer takes back much of the ownership of that relationship. During the Internet bubble customer-facing enterprises were made brutally aware that competition was just a mouse-click away.

The same phenomenon is now reaching the Pay TV landscape as the “walled gardens” are transformed into operators’ extended gardens, with an inner wall, and outer public areas that have varying degrees of access and ownership. In some regions including much of Europe, premium live sports are one of the remaining bastions that the big incumbent TV players are still keeping beyond the reach of newcomers, but that may not be the case for much longer as first generation OTT players start eating away at the rights.

The US may be showing the way forward since most premium sport events, such as the National Football League (NFL) and National Hockey League (NHL), can be accessed with an OTT package on almost any device. This is why Pay TV operators like DirecTV and Verizon also offer these sports on all screens today, to keep their subscribers happy, while increasing ARPU and (hopefully) decreasing churn.

But this isn’t about securing the big screen with the best content while delivering OTT content for other screens. Pay TV operators will use OTT to make premium content available everywhere. Even if most consumers will still prefer to watch it in their living room on the big screen, there will be many occasions when a major live event takes place while they are away from the home, and the ability to view the content OTT on a PC, tablet, or even smart phone will be important to pay TV success.

For the consumer, such OTT access to premium content will also be an important aspect of empowerment. This has security consequences for the operator and affects their relationship with customers. In just a few years, CRM departments and the IT systems they use must be changed into CMR, or Customer Managed Relations, as the consumer is empowered. Operators and their CRM partners face the challenge of striking a new balance between the user’s freedom and the content owner’s need for reassurance.

All stakeholders are becoming cruelly aware that competition is now just a click away even on the TV.

In this White Paper we stick our necks out and highlight the phenomena we think are important. We take sides on the key technology issues, for example explaining why MPEG-DASH isn't just one of several streaming options for delivering OTT content, but a breakthrough enabler that is changing the rules of the game.

We also stress both the difficulties and the growing potential of OTT for monetization. Until recently operators considered OTT to be of secondary importance, fit mainly to combat churn, and be seen to be keeping up with competitors. Operators must have the right unified platform with components that work together seamlessly to monetize the new OTT opportunities. Such a platform must interoperate with all the main devices and rights management systems out there. We make the case for the pre-integrated approach as being the one that brings the right technologies while guaranteeing that they will work together with the minimum of effort, and with a short deployment time. This approach will provide operators with the best future proof guarantee, and enable them to maintain best-in-class components throughout their ecosystem as it evolves into a Unified Service Delivery Platform or USDP.

Is all this fuss on OTT Delivery a little OTT?

The term OTT, until a few years ago, simply meant extravagant or excessive. The buzz about OTT video delivery is not in that sense OTT and you're doing the right thing reading this White Paper this far! But could OTT just be this year's fad?

OTT holds incredible promise for new business models. The seemingly unstoppable rise of Netflix, despite its recent pricing blunders, is causing concern for many throughout the content industry. Of course the perceived risk of Netflix eating your lunch is just the other side of the opportunity coin. So whether you're a broadcaster, a content operator, or a network operator, OTT delivery is an urgent topic to tackle.

Disruptive OTT business models that we see in embryonic form in the Netflix phenomenon could surprise us all by still taking decades to really prosper. Indeed we've all witnessed dozens of OTT failures over the last few years and the diagnosis is always the same: the business model often just doesn't fly – who remembers Joost for example? Many current deployments by TV operators are still defensive, churn reducing rather than revenue driving. Closed broadcast and walled garden managed networks could still be delivering the bulk of premium TV content many years from now...

But rest assured, even under this lacklustre scenario, the OTT investments of 2012 will be recouped. This is because OTT is also about reaching multiple devices seamlessly, which users/subscribers are rapidly growing to expect as the norm. Through Adaptive Bit Rate streaming, OTT technology is also the best way to get as much capacity as possible out of the existing network bandwidth, which is going to be in short supply, at least over the next five years or so.

Equally it is worth emphasising that OTT is not simply IPTV mark 2, but much more important than that. IPTV emerged for Telcos to get into the TV business using as much of their existing infrastructures as possible for access, DSL first, now increasingly Fibre. While OTT is also great for Telcos, it is essential for all operators to reach multiple screens and in some cases extend footprint, however business models evolve.

As FTTH gradually removes the last-mile problems associated with the copper legacy, the home network is emerging as a new frontier. Distributing video content around the home has been a nightmare for operators and subscribers alike. The ABR streaming at the heart of OTT delivery was invented in response to varying Internet conditions, but it's also well suited for coping with varying in-house networks where interoperability, automatic device discovery, and secure content delivery, will eventually be provided within a framework such as DLNA.

Finally it is also worth considering that in many parts of the world, IPTV services have not been possible so far because the infrastructure is not good enough, a point well illustrated by Laurent Chivallier, Director Group Digital LIFE – Business Development NextGen TV/OTT Video Emerging Markets at Singapore Telecommunications Limited (SingTel), the Singaporean Telco and one of the world's heavyweight mobile operators with a total of 445 million customers. He told me "unlike in developed markets, infrastructure is rarely adapted for IPTV in emerging countries. In a country like the Philippines, probably less than 12% of the 20 million households could be reached with a high quality IPTV solution. So we really need to use a combination of hybrid and mobile OTT approaches alongside IPTV to reach enough potential subscribers."

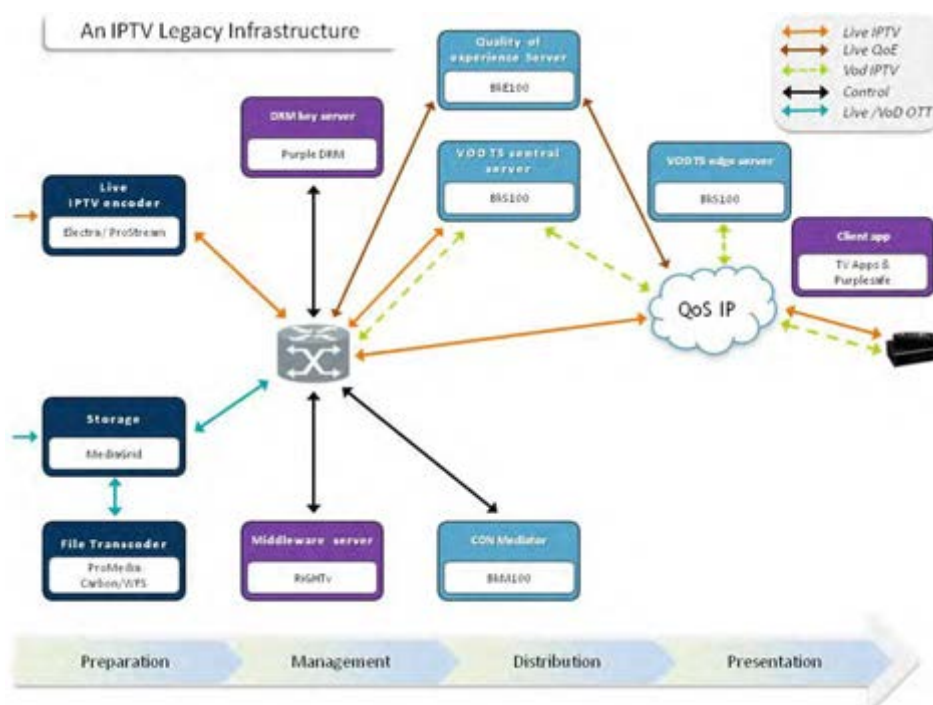
How OTT delivery works

OTT video delivery is simpler to understand from a business perspective than from a technology one. To deliver video streams, a service operator must go through some kind of network. From a business perspective OTT means that the operator need not be concerned with the cost of building and maintaining that network, which can be the open Internet. But there is a potential cost to offering the best possible UX, since two key technical building blocks are required for OTT delivery. One is the CDN, discussed later in this section. The other is Adaptive Bit Rate (ABR) streaming. ABR streaming is the OTT mechanism for delivering video consumer devices over non-dedicated networks like the Internet.

It ensures that the show will go on so long as minimal resources are available, and at the same time delivers video at the maximum quality possible at a given time. IPTV by contrast has the benefit of a dedicated network infrastructure with controlled end-to-end bandwidth, even though it still uses IP. Adaptive bit rate streaming is discussed in detail in several excellent White Papers including those mentioned in the references at the end of this document.

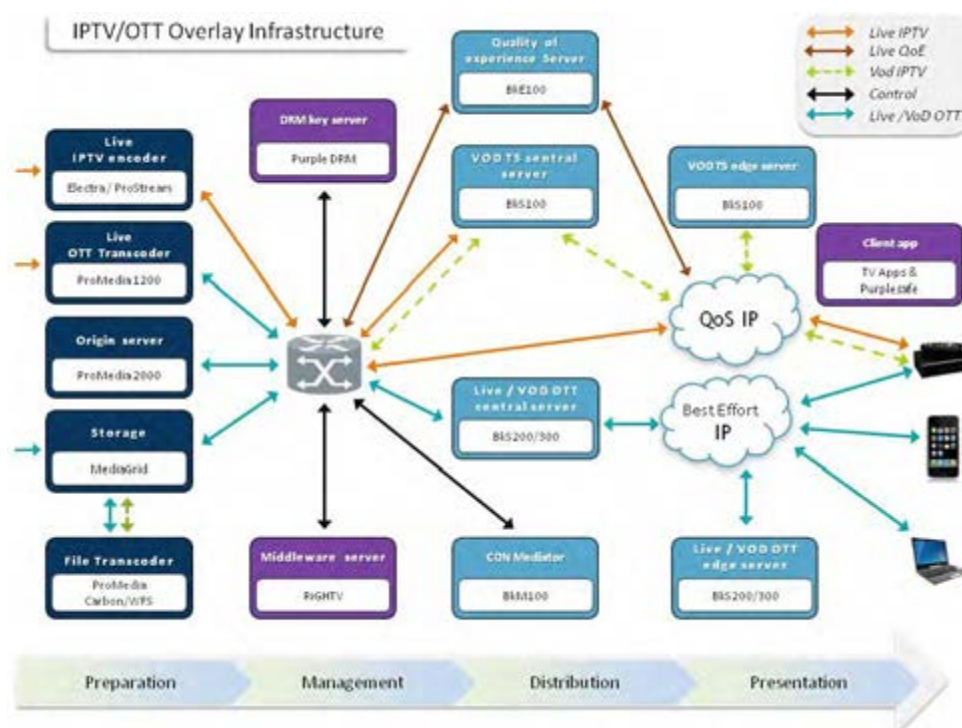
Legacy IPTV architecture

“Legacy IPTV” was an oxymoron up to two years ago. But to better understand the transition to OTT video delivery architectures, let’s start with a plain vanilla IPTV setup

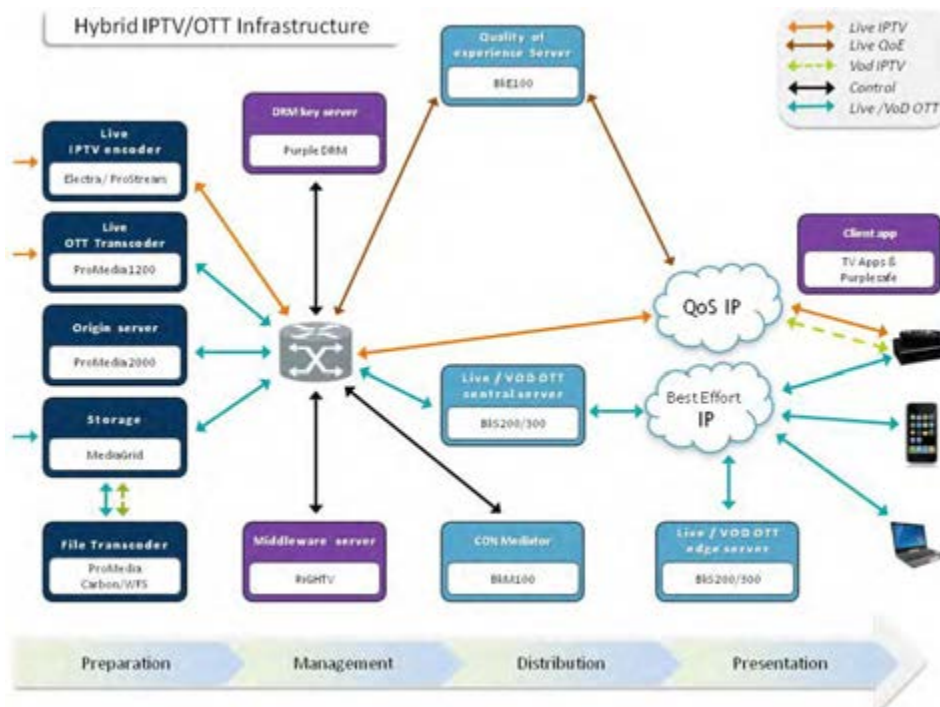


Overlaying OTT delivery on top of IPTV

OTT is being deployed into managed networks. The diagram below illustrates this with the pre-integrated components discussed throughout this paper.



But many operators are using the opportunity of OTT deployment to optimize the use of their IPTV infrastructure. One idea is to use only best of both worlds. IPTV is then dedicated to mainstream live TV while OTT infrastructure is dedicated to on-demand content and less popular live channels. Multicast is only used by IPTV and IPTV only uses multicast. The same becomes true of unicast and OTT. The IPTV infrastructure in the diagram below includes a Broadpeak Quality of Experience Server to enable Fast Channel Change (FCC) and RTP Retry mechanisms to ensure happy live PTV customers.



The importance of MPEG-DASH

In standardising the format, MPEG-DASH is doing for streaming what Ultraviolet is for download. MPEG-DASH has gone one stage further by being totally DRM agnostic, whereas Ultraviolet listed five alternative DRM's (Adobe Flash Access, CMLA-OMA V2, The Marlin DRM Open Standard, Microsoft PlayReady, and Widevine,). Contrary to other similar groups, the MPEG-DASH group doesn't take sides on DRM. This is important because the major industry players have so far backed different DRMs.

Microsoft and Adobe are supporting DASH, while Google has not made any formal announcements yet, although it has announced that the Chrome browser will support it in HTML5 and its content security company Widevine will support CENC, the Common ENcryption standard used by MPEG-DASH.

The major threat to harmony is, as so often, Apple. If Apple doggedly sticks with its HLS, then at least we'll only have 2 formats that are quite similar anyway. The main difference is that Apple uses a proprietary format in the manifest files, whereas MPEG-DASH is based on XML. A key problem of HLS is that it is restricted to one DRM and so is not likely to gain wider adoption in the OTT world beyond Apple iOS – admittedly a large camp.

We see several key benefits in using MPEG-DASH. The following table summarises the main differences between the various ABR solutions:

Table 1 Key differences between the main ABR technologies

| Feature | Apple | Microsoft | Adobe | MPEG-DASH |
|---------------------------------------|--|--------------------------------|------------------------------|--|
| Adaptive streaming technology | HLS | Smooth Streaming | HDS | MPEG-DASH |
| Codec used | H.264 | H.264/VC-1 | H.264, VP6 | H.264/AVC or other MPEG codec family (SVC, MVC, HEVC) |
| Open standard | No | No | No | Yes |
| Adopted by industry consortium | No | No | No | HbbTV, YouView published DASH based standards, 3GPP, DECE and DLNA work on a DASH based standard |
| Subtitle support | Partial | Yes | Partial | Yes |
| Multiple audio support | V4 only * | Yes | No | Yes |
| Interop testing | No | No | No | Yes |
| Trick mode support | Partial | Yes | Partial | Yes |
| CDN friendly | Requires chunk carriage optimization | Requires specific IIS-7 server | Requires specific FMS server | Yes |
| Device support | IOS, Mac, Xbox, PlayStation, STB, TV, Android. | PC, Xbox, STB, TV | PC, TV | Limited in 2012. TV, Tablet, phone in 2013. |
| Device adoption | High | Medium | Low | Netflix** |
| Common encryption (Multi DRM support) | No | No | No | Yes |

| | | | | |
|-----------|---------|---------|---------|----------------|
| Licensing | Unknown | Unknown | Unknown | ISO policy *** |
|-----------|---------|---------|---------|----------------|

(*) only works on iOS 5.1, other versions require separate stream with single audio

(**) Pre-DASH On demand Profile (ISOBMFF)

(***) Discussions going on for a royally free DASH

CDN: to build or lease

Content Delivery Networks or CDNs are a key component for OTT video delivery. The CDN business is a natural fit for existing network operators, and embracing the CDN world wholeheartedly will enable them to stay higher up in the content value chain than merely being providers of dumb pipes.

The question though that all operators are asking is whether to build or lease.

In this context to **build** actually means to acquire the delivery servers and the management system from a technology provider, and to deploy these in the operator's own network. To **lease** a CDN means having a global CDN provider add its equipment into the operator's network with some form of rental agreement.

The lease option may look attractive for the following reasons:

- the CDN infrastructure already exists and deployment is therefore much faster,
- the simplicity of just adding a few servers into the operator's network and linking them to an existing global infrastructure,
- the benefit from all the features that have already been deployed,
- the benefit from a larger footprint than on the operator's own network.

There are however some drawbacks:

- losing control of infrastructure, for example with the lack of control of streaming formats available for the ingest procedure,
- waiting for new technologies to be adopted because of the larger number of servers to be updated,
- lacking in control of the footprint outside the operator's own network where SLAs can be harder to enforce and some promises may not be kept,
- leveraging existing IPTV infrastructure that might already be deployed will not be efficient,
- pricing will not be flexible as it can be hard for an operator to maintain competitive edge with a compulsory mark-up on leased servers,

- maintaining a win-win relationship will be challenging when the operator can become its provider's competitor, without being able to offer better prices.
- Beyond these limitations, a generic solution will not take into account an operator's specific requirements, such as the:
 - management of rights that imply that some content is only delivered to some regions,
 - scheduling of replacement content for live programs: content is often associated with distribution rights for a given territory only. Replacement content must be shown when an end-user located in a restricted region accesses live content,
 - types of quotas that are available: quotas can be based on the instantaneous availability of bandwidth, on the number of simultaneous sessions, or on the volume of data that travels in the network per month.

In conclusion, we believe that the CDN **lease** can be a way of testing the market, or a solution for very small operators, but only a CDN **build** will provide a sustainable solution for most operators to remain attractive to content providers.

Paul Berriman, CTO of the Hong Kong incumbent PCCW points out one key reason why CDNs are so important: "The core network can't currently support millions of unicast streams in SD let alone HD. By the time it might be able to, in a few years, users will be expecting HD if it isn't some form of 4K or ultra-HD format by then".

Key challenges in converging IPTV & OTT delivery

OTT may seem poised to take over the video delivery world by storm, but existing IPTV infrastructure will remain for at least the following four reasons:

- Operators doggedly keep their infrastructure until investments have been recouped. In the special case where VDSL is deployed in the access network, the uptake of ABR for live TV will also be slowed. Indeed whereas in dense ADSL networks the DSLAM is a good place for a cache that may serve up to 10 000 subscribers, cabinets in VDSL networks are less accessible and often serve too few homes to justify a cache.
- Operators for which live TV is still central, that have an existing multicast enabled network, will be hard pressed to justify the cost of deploying a CDN capable of scaling with live TV.
- IPTV is still the best way to guarantee service availability and content security over IP, which explains for example why more and more of the growing tide of catch-up TV services are delivered in France through operator controlled networks – over 50% in 2011, from less than 25% a year before.
- Operators can add on multiscreen to an existing IPTV rollout without needing to revamp the whole infrastructure.
- Operators can extend their footprint with OTT technology that is better at handling variable network conditions, without needing to embrace the OTT business model.

The points above are restricted to comparing OTT delivery with IPTV. But if we extend the comparison to other broadcast technologies the case gets stronger. As often with network options, it is not an either-or question, but one of complementarity. How best can an operator get OTT delivery to complement its existing infrastructure, be it broadcast or IPTV based?

For IPTV players and broadcasters alike, the most powerful argument in favour of OTT delivery is the incredible reach it can offer. The economics of homes passed vs. service uptake are blown away. Fixed network operators will often look for an early service uptake of at least 10% to justify an FTTH rollout.

In studying a recent business case for an OTT offering targeted at the global Indian diaspora of 40M people I realized that if 50k subs was the break-even, an uptake of 0.125% is all that is required to justify the launch!

The TV User eXperience (UX) remains central

We mustn't get carried away with the financial side, however appealing. Watching TV is something people do for pleasure and it must be both fun and easy or it just won't happen.

The lean-forward TV experience with companion screens and social media is becoming part of the TV experience. The jury is still out on whether generation Y will still be tweeting and surfing while watching TV after having put child number three to bed, in another 5 to 10 years. But in any case, for the rest of us, the lean-back or couch potato model must still be supported.

The new kid on the block that is making the news in Europe, and soon in the US, is Zeebox, co-founded by OTT visionary Anthony Rose who previously designed the biggest OTT success story so far: BBC's iPlayer. His new venture delivers a pure second-screen experience. The app running on iOS, Android or even Windows devices extends the viewing experience by re-creating a virtual community around live TV. According to Rose, the App does a zillion things, but we focused on two: it helps you find what to watch by seeing what your friends are watching, and once you are watching something, it extends that experience by letting you interact with others about the content. Rose confesses, "In this sense Zeebox is using OTT delivery to breath new life into linear TV".

Similarly in the US, satellite operator DirecTV is delivering companion screen integration through a partnership with Miso, a social TV start up backed by Google. Miso has developed an app for the iPhone that encourages sharing viewing experiences with friends by identifying automatically what you are watching. Miso has deployments with other operators including AT&T.

Through such second screen capabilities that enhance the UX, pay TV operators are already squaring up to the emerging threat posed by Apple and Google, which over the next decade aim to squeeze value from networks. Telcos may be able to counter and retain network value by building media awareness into their infrastructures that delivers HD video with lower latency and fewer dropped packets, improving quality overall. At the same time the end devices will play bigger roles in managing the quality of experience. This will need the support of the network for optimal performance. We argue then that Google and Apple will not be able to remove the value of the network entirely, even if they can squeeze some of their direct competitors such as Blackberry out of the picture. Amongst other issues, Blackberry has fallen behind on video. It will in any case be sometime before Apple and Google emerge with affordable services that really do deliver on the UX.

There is an opportunity for existing operators to score heavily in OTT by delivering a consistent and intuitive UX across many devices over the next year or two. Some operators are already working towards this by developing downloadable apps that can set up their UX on the desired target devices, one example being the French mobile phone and Internet services provider Bouygues Telecom. Their VP for content and services Frank Abihssira told me "If Apple's rumoured 46 inch TV comes in 2012 or 2013, that will only concern a minority of households that can afford Apple's world, while Google isn't really ready yet on the TV yet. So a gap will remain in the market for operators like us to deliver a coherent and consistent UX. It is not a question of whether a Bouygues App will arrive on connected TV's, it's just a question of when."

Abihssira also made the point that such an App would by default be available on devices even across competitors' networks. This highlights the changing competitive framework of OTT, where Telcos will be competing for customers across each other's networks, and at the same time promoting their own infrastructures as the best for delivering high quality content to third parties.

It is still unclear how power will be redistributed in the dawning OTT era and there is still all to play for. Great opportunities exist for operators to build on their existing customer relationships through a consistent UX extending to multiple devices.

Where OTT delivery makes UX better (& lowers the price)

Delivering video streams OTT has a major impact on how quality is managed and on how interactive video based services are deployed.

The WebTV UX challenge of short channel-change time, or simply short start-up, can be met very well with OTT delivery. Indeed the inherently multi-bit rate nature of ABR means that devices can request a new channel at a low bandwidth first, then move up to the optimal stream before the user has noticed. A trained eye will actually detect a grainy slightly jerkier image for the first second or so only, but this will be tolerated even if it is noticed, and is greatly preferable to channel change delay.

In some US cable operator VoD deployment the same content on a legacy STB can deliver a poor UX, while on an iPad, the operator's App enables a whole new user experience using exactly the same content. There are even US MSOs that are looking at keeping video delivery over QAM while using IP technology for the UI.

Another US based example of enhanced UX through OTT is the Roku box. If a subscriber wants a bigger VOD catalogue, the \$60 device gives access to a broad range of OTT services. In the same vein, a basic Netflix package costs \$8 a month, as opposed to \$5 a title for many Cable VoD assets. Although the content type and window is complementary and most of the time mutually exclusive, it is not difficult to predict on budget driven criteria, that OTT content with all-you-can-watch packages a la Netflix will gain ground.

Apart from cost, OTT also promises to improve the user's experience simply by providing access to a wider range of content. Beyond making premium content available wherever the user wants to watch it, this means making it easier for consumers to find niche material that can only be cost-effectively delivered through OTT mechanisms. Delivering the famous "long tail" of content from within mainstream TV packages means you will soon be able find and watch that rare video that only you and a dozen other people on the planet are interested in, directly on your living room TV.

So will Pay TV operators be willing to deliver a Netflix type of service on their own STB, or will users still be going through other CE devices such as game consoles, Blu-ray players, and connected TVs, connecting consumers more directly with content providers?

Comcast, the world's largest pay TV operator, is answering this by delivering some of its VoD content to game consoles, purely to compete with Netflix. Other MSOs will follow suit and extend their OTT offerings to compete with pure play OTT operators. Recent moves by the major content producers and rights holders themselves illustrate the urgency of moving forward on this. A good example of this threat to the status quo of pay TV is *Epix*, a joint venture between three Hollywood studios, Viacom through its subsidiary Paramount Pictures, Metro-Goldwyn-Mayer, and Lionsgate. *Epix* delivers its VoD titles to Samsung connected TVs, iOS and Android devices and via the Roku box at the same time as to the MSOs has access to the same content. This is probably a sign of things to come and illustrates further why pay TV operators need to be preparing now.

Back in Europe, Canal+ is promoting OTT SVoD to its Pay TV subscribers as well as non subscribers. This illustrates how the French operator has moved beyond using VoD and OTT just as an upsell tool to get subscribers to the "real pay TV product", but now sees OTT as a central part of its future.

Where OTT delivery is still challenging for the UX

A UX challenge that still remains for the ABR video delivery underlying OTT is the delay in transmission of high quality real-time video. The impact here is mainly for live sports. Hearing the neighbours shout “goal” up to half a minute before the OTT subscriber sees the goal is clearly an issue. OTT delays may only be a bit longer than with IPTV, in turn a bit longer than for cable, in turn longer than with satellite (often because the content goes by satellite anyway), in turn longer than for terrestrial transmission. So in the worst-case scenario, if the neighbour is watching via terrestrial, those short increments can add up to an unacceptable delay in multiple tens of seconds.

If part of the network path used is totally uncontrolled (i.e. the open Internet without any SLAs) then we are back to the Internet's “best effort” model where it is impossible to guarantee service continuity. It is unclear how users will react to such limitations in case of severe outages. The rise of IP telephony a decade ago, when it was even more unreliable than it is today, proves that sometimes users will accept lower quality of service if the context and pricing are right. People in developed markets, on the move, will be happy to watch say Olympic events on tablets, laptops or smartphones with slightly poorer or more intermittent quality, and yet at home in front of a 52” TV, for mainstream content, quality will have to be pristine. We see customers accepting degradation in quality if the content is unique, such as special interest content (ethnic, special sports) or from YouTube. I was recently stuck in an airport lounge in Riyadh during a Champions League semi final. I was so happy to find that my Canal+ subscription worked there that I really didn't mind the odd freeze for a second or two. But in the foreseeable future, the day England play France in a major tournament final, I'll just make sure I'm somewhere with Pay TV.

Without quality assurance, OTT could end up increasing rather than reducing churn. I asked Stuart Newton, General Manager at Ineoquest EMEA, a vendor in Quality monitoring and management, how he saw his operator clients handling the UX challenge with OTT. He told me about video quality issues and program availability metrics on a channel-by-channel basis that have been understood and implemented for a while in IPTV. “For over two years we've been focused on bringing that kind of functionality to OTT delivery. Providers' operations technicians often do not yet fully understand how the new adaptive bit rate streaming video works. This creates a challenge to operationalize the end-to-end Quality Assurance monitoring and analytics for OTT delivery. As an example, we've been working in environments where 6 bit rate files per channel have to be delivered in 5 different formats (HLS, Smooth, HDS, etc.), producing 30 variations per channel. In such a deployment, with a 150-channel line-up up to 4500

variants have to be monitored. This is further compounded by thousands of different devices joining those variants.”

Stuart went on to say, “OTT is very different from linear IPTV where providers have a managed network and can more easily perform root cause analysis. This is exponentially more difficult to do in an OTT environment where after encoding in the head-end, the origin servers and cache architecture varies from vendor to vendor. As a result, a pre-tested, pre-integrated solution clearly makes sense, but when the architecture is open, we can still integrate easily to provide deep analysis of the video deployment.” This also highlights how one single file format like MPEG-DASH will ease the monitoring issue.

Another monitoring vendor Agama Technologies told us that some operators were already making a mistake assuming that adaptive streaming would solve their quality assurance issues just by being able to alter the bit rate up and down. It was assumed that adaptive streaming would always deliver at the highest quality the network was capable of all the time, using TCP’s built-in error correction and packet retransmission to overcome transient problems. “But retransmission won’t help if packets arrive too late or the underlying content contains errors,” noted Johan Görsjö, Director of Product Management at Agama Technologies. “Adaptive bitrate streaming certainly helps to make a service more robust, but service disruptions, such as jittery playback or inconsistent video and audio quality, can easily occur and, if left unchecked, will lead to dissatisfied customers.”

So for the best possible UX operators must strive to deliver the best possible QoE. This in turn requires monitoring to be integrated into the ecosystem, from encoding through CDN to security playback, and there will be some land grabbing occurring as the different stake holders play this out. As in any gold rush spade-sellers will always win.

Personalization, recommendation, social TV and OTT delivery

OTT delivery is going to be the main way to set up new content delivery for 2012 and probably beyond.

At any point in time existing TV UIs were designed over two years ago. In 2012 that means they were conceived before social media was recognized as a ubiquitous phenomenon. Today subscribers expect more than the integration of social media, but a whole personalized experience, and a content navigation and recommendation platform must be part of a competitive solution.

Integrating these leading edge aspects into an OTT delivered solution is easier because OTT delivery is based on proven web technologies that support personalized services. Content recommendation providers have already exploited these technologies. Viaccess-Orca's COMPASS content discovery solution is an example that delivers a high level of personalization, combining knowledge of the user with non personal information including the type of content, and other factors such as location.

Content discovery represents a key monetization opportunity for OTT by exploiting one-to-one relationships with customers, and harnessing the full power of content search combined with the ability for users to set preferences and manage their personal profile. Content discovery is also a good differentiator of individual services and platforms within the OTT arena. A range of algorithms can enable users to search and explore effectively within the great ocean of content accessible via OTT services. No single algorithm satisfies all content discovery requirements. A blend of techniques must enable service providers to maximise revenue generation by trying out different targeting strategies, and finding out which works best in each case, rather than taking a one size fits all approach as has tended to be done for linear TV. Social network interaction comes in here, enabling service providers in effect to recruit their customers as marketing agents, promoting their content by recommending it to friends. Social networks can be integrated into the content discovery process, providing another medium for users to find what they want to watch, and one that can be harnessed by the operator. This is also an ideal way to extend the engagement of subscribers with their operator.

OTT also helps enable personalization, bringing revenue possibilities both through content recommendation and targeted advertising. Personalization enables users to be differentiated within a household, so that each one can be addressed individually. That way each person in any household can be recommended content of interest to them. The same content recommendation principles can be applied to targeted advertising, which will be a growing source of revenue from OTT services. As operators become familiar with their content discovery engine, they will be well placed to start applying the same tools for targeted advertising, perhaps in collaboration with broadcasters. There will be great scope for revenue sharing models, and integrating with external ad serving platforms.

Even though OTT platforms enable personalization there is still a usability challenge from the operator's point of view to offer a seamless personalized UX across devices.

Challenges and UX impact of doing things at the network's edge

Edge processing is different from edge delivery. The impact on UX is different yet significant in both cases. Assuming the CDN challenge is met properly, popular content makes its way only once to the edge and is then served to many devices, mimicking a “network broadcast” or multicast behaviour.

Edge delivery solutions, like those provided by Broadpeak for example, enable the most popular content to be closest to the end-users. This way live content can be fetched faster with minimal delays that the user will not notice.

Edge processing on the other hand introduces a perceived delay to the end user. It involves delivering a common high bitrate or Mezzanine format to all edge processing points, then encapsulating and encrypting the content at the network edge. It can be difficult to deploy, as it requires content to travel un-encrypted in the network, which will make most content owners balk. But we maintain that this effort is required because edge processing will be the most efficient way of delivering large amounts of content to many devices. “Delivering the right content in the right format at the right time is strategic for operators. Edge caching and processing represent a clear way forward,” said SingTel’s Chivallier. Again DASH makes the situation simpler as all content can be encrypted just once at the source, minimising processing overhead.

This leads on to another point, relevant in particular for global and long distance distribution of content, which is that a local operator closer to the subscribers will often be better placed to provide a high quality of service. This argument has been made forcibly by a number of providers of IPTV and more recently OTT services around the world, such as Hong Kong based operator PCCW. “As an example of how local operators can do a better job, local cloud storage that we provide in Hong Kong has 40 to 50 times faster download speeds than a global Dropbox, due to the Cloud Storage platform being directly connected to the PCCW internet core and customers, not somewhere out there on the public Internet” said PCCW’s CTO Paul Berriman. “The same goes for OTT content going through local operator.” In other words OTT will continue to require local distribution and edge processing in the long term, with core network capacity unlikely to increase faster than the traffic levels it has to support.

In the case of IPTV, after up to 10 years of service provision, operators have become quite adept at optimising VOD content propagation according to its popularity. The most popular content is cached further down the network so that it has a shorter journey to make to the many users that want to view it at different times. This shortens the final unicast path, trading bandwidth for storage cost, while reducing latency.

For OTT, the approach to edge processing is similar in principle, usually based on caching techniques like those developed for enterprise data, where information is moved up and down storage hierarchies according to how often it is being accessed. This approach can deliver a high level of response, but may be less efficient, as some low popularity content will be cached as well, requiring large storage capacity at the edge.

Operators that do not have a CDN can be tempted by rate-shaping techniques that lower bandwidth requirements for content delivery, but with a potentially negative impact on UX (see reference at end of document). Serving content from the edge can guarantee a better UX while reducing the impact on the operator's bandwidth, which removes the need to use traffic shaping.

The rights management challenge

A full OTT or "TV Everywhere" service will need to support many different connected and mobile devices, with live and on-demand video running side by side over both managed and unmanaged networks. This poses a number of challenges for content protection and authentication, especially for Pay TV operators used to having full control over their infrastructure and CPE (Consumer Premises Equipment). To introduce a "TV Everywhere" service, operators face the challenge of maintaining the security of retail CE devices secure for premium content. This has always been a challenge in Pay TV distribution, but is greatly amplified as the variety of target devices increases. Pay TV operators will need to deploy robust content protection and ensure that this solution will remain secure

over time, in order to fulfil their contractual obligations to content owners. This means that the Pay TV operators will need to monitor piracy activity and manage security upgrades.

In some cases a complete TV Everywhere service will need to support multiple CA (Conditional Access)/DRM standards as well as multiple devices. This is because not all devices that an OTT service needs to reach will always be running the same CA/DRM. For instance, the operator may need to support Microsoft PlayReady for PCs and tablets OTT, and a CA/DRM from a specific vendor for STBs in its managed network.

Under this scenario, Microsoft would be in charge of security for the PC, and a vendor such as Viaccess-Orca would be in charge of the client technology that it would provide (a DRM client based on PlayReady for tablets and smartphones, and a DRM client based on Viaccess-Orca's own technology for STBs). At present the service provider would have to cope with such multiple DRM configurations,

as well as the complex license provision with the multiple CA/DRM keys for the user's various devices. The new pre-integrated approach being promoted by Harmonic, Broadpeak and Viaccess-Orca can relieve operators of these complexities.

At the same time the industry is moving towards a set of common OTT standards for streaming, encryption and file structure that will help support different DRMs in future. The objective is to enable operators to encode and encrypt content just once for distribution and playback across all the target devices they may want reach in a complete TV Everywhere deployment.

This convergence around common standards is being driven by two parallel and complementary standards movements, MPEG with DASH, which is described above, and the Digital Entertainment Content Ecosystem (DECE), with its UltraViolet download to own/rent platform. Both DASH and UltraViolet have adopted the Common File Format (CFF) and Common Encryption (CENC)) for transmission of video, laying the ground for convergence towards a unified online video framework.

This separates encryption from the DRM, which is an essential step for large scale OTT, enabling a service provider to address a multi-DRM constellation of devices from a single head end, encrypting just once. It recognizes the fact that, while there is broad agreement now that CENC provides sufficient protection for video content, there will be different DRMs to suit varying device platforms and service requirements. It means that specific DRMs can be deployed on particular devices to satisfy the requirements of content owners.

The idea is equivalent to what the DVB achieved with Simulcrypt, in agreeing a common encryption system but then allowing individual DRMs or Conditional Access (CA) systems freedom to decide how to distribute the keys. UV and MPEG-DASH have taken a similar approach in separating the DRM from the encryption. This makes sense given that encryption is used to generate keys for transmission of encrypted control words that in turn scramble the content, and these keys can then be distributed and managed in different ways to suit varying service requirements.

The Common Encryption Scheme (CENC) specifies standard encryption and key mapping methods that can be exploited by many key management systems so that a given file can be decrypted using different DRMs. The scheme operates by defining the common format for the encryption-related metadata necessary to decrypt the protected streams, but crucially leaves the details of rights mappings, key acquisition and storage, and rules over DRM compliance, to the individual DRM system, or to the system supporting the encryption scheme.

The head-end challenge

For many deployments, scalability can still be challenging, especially if many different encoding profiles are required. The sheer volume of video chunks to be sent to the network requires state-of-the-art storage management. Integrating the head-end architecture with the CDN is critical to managing this scalability issue. A pre-integrated solution is particularly critical for short time-to-market here.

But even for a smaller standalone OTT deployment, flexibility is required in the encoding solution. Harmonic Inc. powers the encoding of the pre-integrated solution discussed in this paper. The ProMedia head-end software suite addresses this flexibility issue head-on with *ProMedia Live & Package* for live TV, and *ProMedia Carbon & WFS* for VoD.

For hybrid IPTV/OTT deployments, scalability and cost are also challenging, and the ProStream 1000 ACE hardware based architecture is designed to meet this challenge for Live Multicast and ABR encoding.

Another issue a multiscreen Head End must resolve is the seamless integration of encoding and Origin server, together with storage. Here the ProMedia Origin server is a multi-protocol scalable solution. When coupled to the Intelligent NAS Mediagrid storage, the two systems enable the support of millions of chunks for the storage. Integrating this with a Content Management System (CMS) enables VoD as well as other de-linearized services (catch-up, start-over, nPVR ...). In our case, Viaccess-Orca's RiGHTv Middleware is pre integrated.

Carrier grade redundancy is as important for OTT as it is for IPTV for any operator wanting to provide high quality service competing with broadcast.

Opportunities with OTT delivery

Paul Berriman, CTO of PCCW in Hong Kong stresses that monetization is both “the key challenge and the biggest potential reward for operators to reach with OTT. Technology like virtualizing the STB into devices is now clearly a Capex and Opex reward, where STB management used to be a challenge”.

He went on to say that “OTT clearly represents a huge opportunity for local players like PCCW. We can add a lot of value as a subscriber accesses content by packaging, promoting, profiling on devices, location, demographics, usage etc. as well as providing a single subscription.”

We've seen that OTT has moved beyond the me-too services some TV operators initially threw up to reduce churn. But that early motivation still stands and OTT video delivery does still reduce churn by extending the service reach through different networks onto multiple devices.

So we see that for a number of operators, there is still a defensive element to their OTT strategy. This used to be the case at Canal+ for example, but now OTT is also being pitched as an entry-level service for people not yet willing to go to the full satellite offering. Canal+ is then able to upsell the full package to some of these OTT customers. OTT is again a two-edged sword, defending against churn and acting as a carrot to entice new customers.

Telecom Italia illustrated another aspect of this double-edge with its Cubovision OTT offering, used to complement the core IPTV product. After explaining how they extend footprint to homes with as little as 1,5 MBPS connections, including beyond their own network, Telecom Italia recently said of its OTT product: “Cubovision suite is available beyond IPTV traditional boundaries granting HD quality to the majority of customers”.

Some IP network operators in very large sparsely populated territories see OTT video delivery as a way to leapfrog over IPTV. This is what Telstra has done reaching a third of a million homes in less than two years, without the huge cost of upgrading its network to support multicast.

The advantage of pre-integration, bringing rights management together with streaming and a great UX, is time-to-market, which can be paramount where first time mover can give a decisive advantage.

Opportunities for revenue sharing exist between different combinations of broadcaster, content owner and operator, and will open up new kinds of opportunities we can't yet see.

Thanks to plummeting CDN costs it is already cheaper in 2012 to unicast live TV via OTT than over satellite for smaller deployments of up to one million subscribers. We anticipate that within few years, at current HDTV bandwidths, it will also be cheaper for the largest deployments with tens of millions of subs to go OTT. Of course this doesn't address the quality issues discussed above.

Criteria for defining OTT delivery strategy & ecosystem

Custom build, best of breed or single-vendor? → pre-integrated!

As with build or lease, this dilemma is constantly present for major operators deploying video delivery infrastructure. In the case of OTT delivery, the underlying technology, the business models, and the user experience are all still changing so fast that only a best of breed approach can keep operators at the forefront.

But the best of breed approach has a major downside in integration.

A pre-integrated solution offers the best of all three worlds, with minimal deployment risk, and the ability easily to swap out any single component were it no longer to be in the best-of-breed category. The great benefit of this is that OTT will come in many shapes and sizes, depending on factors such as the scale of the service, its geographical reach, and profile of the operator. OTT is a very different proposition for a satellite operator such as Sky, a Telco like Deutsche Telekom, a major public service broadcaster such as the BBC, and a dedicated online service provider like Netflix. There will be many shades in between, and we see OTT being like a cookbook, presenting many different recipes, each one of which can be assembled to order by our pre-integrated approach.

It is also important to realize that standardization efforts are making it easier to ensure that although this cookbook contains many different recipes, they can all be produced using the same set of tools and building blocks. We have described how key standards such as MPEG-DASH and Ultraviolet are converging and pulling common components such as CENC and CFF together. The Digital Living Network Alliance (DLNA) is also playing a key role in uniting underlying standards within a common framework for device and service interoperability within the home.

The following tables sums up the pros and cons of different approaches.

| | Custom Build | Single Vendor | Best of breed | Pre-Integrated |
|---------------------------------|--------------|---------------|---------------|----------------|
| Tailored to operator needs | ✓ | | ✓ | ✓ |
| Fast time to market | | ✓ | | ✓ |
| Future proof | | | ✓ | ✓ |
| Ability to swap out a component | | | | ✓ |
| Standards compliant | | | ✓ | ✓ |
| Low integration risk | ✓ | ✓ | | ✓ |
| Scalability | | | ✓ | ✓ |

The Open IPTV Forum (OIPF), has emerged as a kind of overarching arbiter of OTT standards. The OIPF is now working towards the ambitious but attainable goal of facilitating interoperability, not just between devices and components of a single OTT service, but between multiple services. This is being achieved within the OIPF's Open Internet Profile, according to Nilo Mitra, OIPF President. "This provides support for streamed and downloaded Video on Demand using HTTP as a delivery mechanism, as well as mechanisms for interactivity with the content".

The core part of this specification is the OIPF's Declarative Application Environment (DAE), which is a browser for TVs with support for various presentation mechanisms including HTML4, HTML5, SVG, and CE-HTML. Its key components are objects written in the JavaScript language that enable manipulation of media for both on demand applications and live streaming. They also facilitate interactions with local and remote storage, while providing control over the adaptive streaming process as required for delivery of OTT content over the Internet.

The fundamental point from the interoperability perspective is that the OIPF specifications make all interfaces between the service provider and the consuming device transparent. "Thus, if a service provider and a connected TV were to implement a portal based on the OIPF's DAE browser specifications, content protection based on its choice of a content protection solution, which is Marlin, and the specified media formats for content, these should interoperate out-of-the box," said Mitra. "Indeed, the OIPF has interoperability events where connected TVs and STBs from member companies are tested against portals and media streams provided by its service provider members."

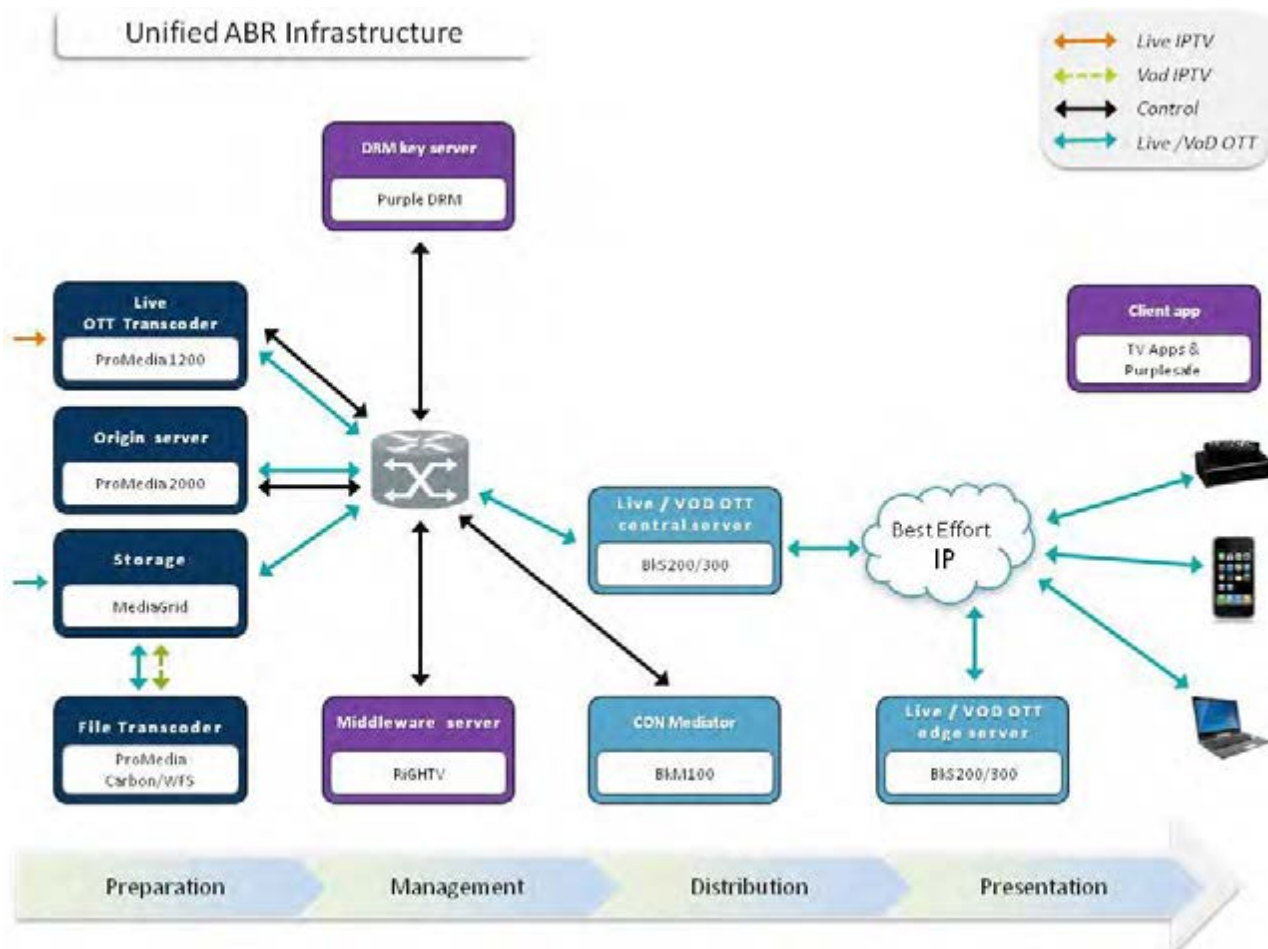
Yet interoperability will not remove the logistical and support complexities of OTT services, which is a major reason we believe so strongly in our pre-integrated approach. Irrespective of progress on standardization, OTT is going to present great operational and support challenges on a much bigger scale than either cable TV or IPTV, where the operator's remit generally ends with a set top box or gateway that they own and can access remotely for troubleshooting, and if necessary swap out. Now OTT introduces a grey area consisting of devices that the user has introduced and may well be the cause of a service problem through no fault of the operator, and yet which the consumer expects to be able to resolve over the phone or online, and perhaps if necessary through an engineer's visit. This point was made by Bouygues Telecom's Abihssira, noting "the challenge of OSS/BSS is tougher than many OTT hopefuls realize." Abihssira highlighted the issues faced by Sony with its Play Station 3 Live service 2011 on this front, where rival Microsoft with Xbox was able to gain ground because of superior support. The challenge is simple to state, as Abihssira pointed out. "Who do I call when it's broken?"

This led Abihssira to argue that OSS/BSS gives operators an opportunity to differentiate their service. We agree with that, but with the important caveat that delivering on OSS and BSS will be much easier if operators adopt the right OTT platform. A pre-integrated approach is well placed to match the OSS/BSS requirements of most deployments.

Above all pre-integration takes most of the risk and pain out of OTT deployment, while giving the operator or broadcaster the benefit of best of breed technology in the key sectors including content discovery, streaming, and security, as well as OSS/BSS. This is of course assuming the right choice of pre-integration provider is made. Just as with any other major deployment decision it is important that the operator chooses a set of partners with strong credentials forged in the pre-OTT era of broadcast and video infrastructure. The pre-integration group should be able to demonstrate leadership in each of the respective fields, that the components really do fit together, and that the combined platform has the

flexibility and scalability to match all Unified Service Delivery Platform requirements now and going forward.

A pre-integrated approach like that of Viaccess-Orca, Broadpeak and Harmonic meets these requirements, and one more important one: being future proof. This is ensured by each vendor's commitment to interoperability, thus insuring that best-in-class components can always be chosen and swapped in or out. All vendors here share a common vision of how OTT will evolve around the unifying platform of MPEG-DASH, bringing together the key underlying technologies for OTT of streaming, with processing distributed with agility from core to edge, content security, and presentation.



Looking forward...

In the User eXperience debate, broadcasters still have the upper hand for service availability and reach when it comes to HD video. The jury is still out as to how far users will accept potentially lower quality in exchange for lower prices. The future will probably provide a mixed answer but one clear set of winners will be the quality monitoring vendors that will integrate into the whole ecosystem.

Broadcasters are already investing more in OTT VoD than classical VoD, as we saw with several examples like Canal+. This trend is bound to grow as in the end it enables VoD to be offered from many more sources. But for broadband operators as well it also enables walled garden VoD to any connected devices. OTT technology, namely ABR, leverages available resources to deliver superior video quality, including over home networks. So once OTT is prevalent, we believe its long-term convergence with IPTV is inevitable. Only a single delivery architecture can truly unify network encoding, security, delivery, and most importantly the user's experience.

But as we saw previously, this will take time: it will be difficult to make the business case and recoup recent investments, in particular in VDSL deployments.

OIPF is currently in the best position to organise and standardise this solution. The technology has been around for a few years already but we need components such as DASH or DLNA to keep costs low enough for new business models to enable this future.

Annexes

Some references

| | Reference | URL |
|---|--|---|
| 1 | White paper on ABR, authored by Benjamin Schwarz | http://goo.gl/DZH6Q |
| 2 | Short Harmonic Article on MPEG-DASH | http://goo.gl/HwEi1 |
| 3 | OIPF White Paper on connecting TV to the future | http://goo.gl/QOQaa |
| 4 | Blog on the death of IPTV | http://goo.gl/P67ZQ |
| 5 | LinkedIn comment thread on the above blog | http://goo.gl/KgiPq |
| 6 | ISP traffic shaping | http://goo.gl/UdIPf |
| 7 | Viaccess-Orca White Paper on OTT | http://goo.gl/sT6tn |
| 8 | Viaccess-Orca's 3 multi-screen maxims | http://goo.gl/AVSAF |
| 9 | Viaccess-Orca blog: TV in the cloud – is there really a doubt? | http://goo.gl/U5cNA |

Glossary of acronyms

| | |
|-------|---|
| ABR | Adaptive Bite Rate (Streaming) |
| CA | Conditional Access |
| CAS | CA System |
| CDN | Content Delivery Network |
| CENC | Common Encryption |
| CFF | Common File Format |
| CMS | Content Management System |
| DECE | Digital entertainment Common Ecosystem |
| DLNA | Digital Living Network Alliance |
| DRM | Digital Rights Management |
| EPG | Electronic Program Guide |
| FCC | Fast Channel Change |
| FTTH | Fibre To The Home |
| HbbTV | Hybrid Broadband Broadcast TV |
| HD | High Definition (Video) |
| HLS | HTTP Live Streaming (Apple format) |
| HTML | Hypertext Mark-up Language (initially used to write Web pages in) |
| HTTP | Hypertext Transport Protocol (used to transport HTML) |

| | |
|-----------|--|
| IPTV | Internet Protocol based TeleVision |
| KPI | Key performance indicator |
| KQI | Key quality indicator |
| MPEG | Moving Picture Experts Group |
| MPEG-DASH | MPEG – Dynamic Adaptive Streaming over HTTP |
| MOCA | Multimedia Over Coax |
| MSO | Multiple System Operators (US Cable operators) |
| OIPF | Open IPTV Forum |
| OTT | Over The Top |
| SD | Standard Definition (video) |
| SDP | Service Delivery Platform |
| SLA | Service level agreement |
| SvoD | Subscription based VoD |
| TDM | Time division multiplexing |
| TvoD | Transaction based VoD |
| UI | User Interface |
| USDP | Unified Service Delivery Platform |
| VoD | Video On Demand |

For more information

For information on the pre-integrated solution mentioned in this White Paper please contact:

| | | |
|---------------------|--|--|
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