



Delivering a High Quality Cable IPTV Service

Solution Brief

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INTRODUCTION

The market landscape and competitive environment of cable operators (MSO) is undergoing a fundamental restructuring phase. In addition to increased competition from traditional rivals such as the satellite and telco providers, new players mainly focused on content delivery over the Internet are introducing new concepts that may change this market forever. The Internet is becoming a more widely accepted infrastructure to deliver broadcast and narrowcast content. Broadcasters and Internet TV players alike are aiming to break the traditional habits of content consumption and the existing value chain, and rely on a younger generation with different content viewing patterns. Over-the-Top (OTT) video is increasing exponentially as the medium propels new advertising concepts.

Faced with this reality, the traditional players are realigning their approaches to better cope with the expected churn. Satellite providers are using their technological advantage to deliver more High Definition (HD) content and compensate for their unidirectional technology by teaming up with telcos and other ISP players for on-demand delivery. The telcos, on the other hand, hope to leverage interactive applications to differentiate their IPTV offerings. Such interactivity is in essence built on the core competence of managed IP networks. Additional bandwidth is offered to the subscriber, but always along with new and interactive applications.

For cable operators, simply providing triple-play services is no longer enough. Cable subscribers are looking forward to improved quality of experience. It is becoming clear that merely offering high-speed data is insufficient. For the potential customer, bandwidth muscle is valuable only when it is coupled with enabled interactive applications. Hence, to justify higher revenue per user, the provider must deliver new services in addition to high-speed data service.

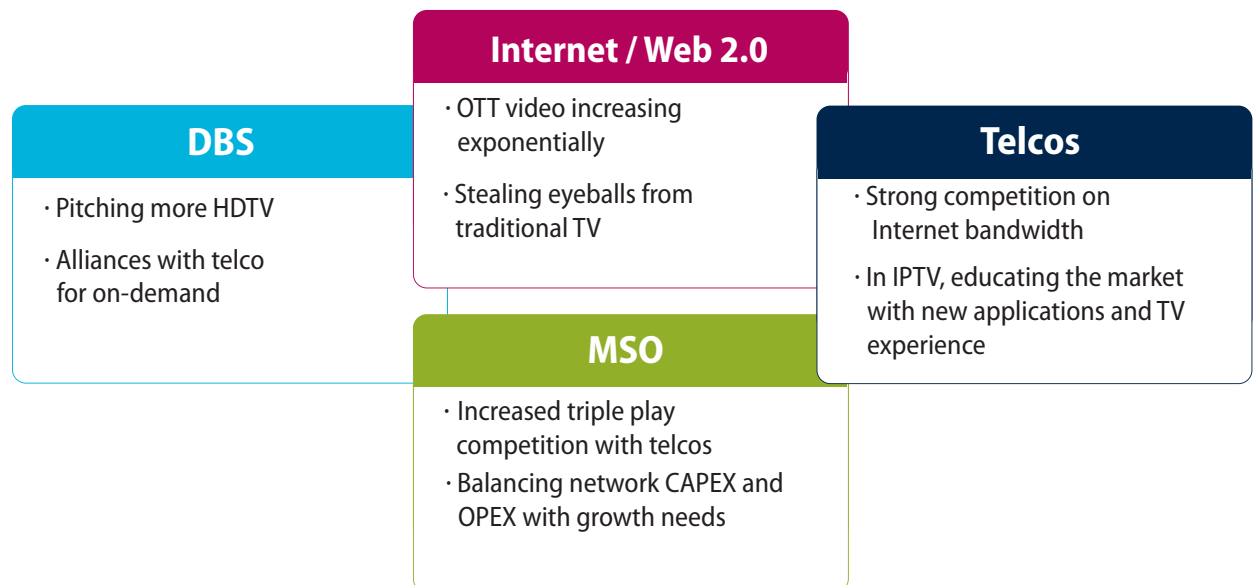


Figure 1: Competitive Forces

Looking at the competitive landscape, Cable IPTV is an obvious path to providing new and exciting services on top of the current cable infrastructure. For this paper, Cable IPTV is defined as video content delivered over traditional HFC to IP devices at the home. This means that Cable IPTV replaces the traditional cable set-top box (STB) as the end device and instead makes use of an IP STB, PC or any other IP device. The range of applications supported can be similar to what is currently provided by the MSO (i.e. Linear Broadcast, On-Demand and high definition) as well as new services such as user-generated content. Cable IPTV is delivered over a managed network with Quality of Service (QoS) control and an IP-oriented interactive application environment.

Cable IPTV may present some challenges, but it carries a unique message of opportunity. MSOs' most valuable infrastructure assets are their HFC networks. By harnessing this resource to deliver IPTV, MSOs can successfully defend and grow market share. In fact, MSOs have already footed the bill for a significant portion of the infrastructure that brings IPTV into the home. Over the past several years the cable industry has invested millions of dollars to ensure reliability, quality, and the ability to expand both in capacity and function. New standards are emerging to meet the increased needs, and cable operators are looking to get maximum return out of their investments while fending off competitive pressure.

Direct-to-Edge™ (D2E) is Harmonic's solution for Cable IPTV. It is based on separating out video content flow from the existing CMTS platform, and channeling it directly to the Edge devices via HFC network to the DOCSIS 3.0 CM.

WHY CABLE IPTV?

In order to face competition from telcos, satellite providers and now also OTT video services providers, MSOs need to deliver an innovative and compelling TV experience. Although the old saying in the industry that "content is king" is true, as competition gets fierce, packaging of the content and the overall viewer experience will become as important. Furthermore, as personalization becomes more and more affordable—and is advocated by OTT service providers with the right platform to support it—the user experience must be customized as well as compelling.

In the past few years, initiatives such as MHP and OCAP have attempted to standardize cable STB middleware, striving to provide a platform on which application developers can deliver a modern and compelling user experience. On the other side, IPTV deployments in the telco space have typically used different combinations of standard technologies, mostly based on HTTP browsers, to deliver IPTV to a myriad of IP set tops, PCs and other video-capable devices.

Today, the cost of an STB is mostly dictated by the volume of units ordered, and thus it is no surprise that low-end cable set tops are far cheaper than some IP set tops. Given the ubiquity of Ethernet technologies, and higher volumes expected when IP STBs are rolled out in numbers, it is fair to assume that the cost of IP STBs will either be on par with or lower than cable STBs. As far as capabilities are concerned, it can be argued that any application running on a modern IP STB can be run with equal results on a cable STB. Most modern cable STBs can launch a browser with an HTTP request/response-model guide, rather than the traditional carousel. The fact is, however, that most cable STBs address the mass market of incumbent MSOs, and thus need to support MPEG-2 backward compatibility even when running in H.264. In reality, most are used with carousel-based applications rather than browser-based EPGs. The most likely outcome of this combination of market forces and product design is that IP set tops will be deployed alongside a compelling and application-rich guide.

Another advantage of video over IP delivery is the ability to target multiple devices in the home. Large players in the telco IPTV domain have been advertising the "Connected Home" vision for some time now. This vision may come at a slower or faster pace, depending on geography, market forces and consumer habits, but it is hard to argue with the trend and direction. Merely the advent of new CE categories such as DMA (Digital Media Adapters), DVD and Internet-enabled gaming consoles, and bare-bones PCs running "media center" software should point out that the future is going in the direction of low-cost IP connectivity and multiple video devices in the home. Given the previous observation, it is clear why MSOs should be looking into the next video and service delivery technologies.

Pending the current state of a given MSO deployment, different roadmaps may apply for the introduction of such technology. For example, an MSO with several millions of deployed MPEG-2 cable STBs would probably consider different rollout schedules for Cable IPTV services, accounting for CPE cost models and simulcast considerations. A greenfield operator, looking to roll out a new VOD service in the next year, may have a different set of considerations, and may adopt the Cable IPTV rather than implementing legacy VOD.

With the use of different target devices comes the flexibility of implementing new and innovative applications. A trivial example may be the use of a PC platform for implementing new advertising models. It is a known fact that the TV industry has very strict and defined rules for advertising, including a long value chain of players, restricting regulations, etc. On the other hand, Internet advertising is led by giants such as Google, but also pioneered by many smaller companies. This alternative marketplace to traditional advertising can offer new possibilities for MSOs. A linear TV portal may include non-video advertising models common to the Internet such as in-page advertising and flash intros, probably with less restrictive regulation. Such a portal may be used for the MSO promotional escapades, or maybe even implementing a “free-content-for-consuming-ads” model. Clearly the marketing department of any service provider can take this much further, but the point of the technology and platform enabling new services should be clear.

Establishing an alternative, cost-effective IP pipe to the home may also be used to improve the quality of data services and lower costs. A typical CMTS platform is robust but expensive as it is built to cope with the most generic type of data flow, such as supporting multiple routing protocols, BPI encryption and a large number of concurrent, low bit-rate flows. Using an alternative method to bypass the CMTS, utilizing a small number of flows that contribute to a relatively high portion of the bandwidth, can help utilize the CMTS platform in a more efficient way. One application is to separate OTT traffic such as YouTube streams, and pass the streaming video directly to the edgeQAM with pre-assigned bandwidth reservation per stream. The result can be a smoother experience for PC Internet streaming, combined with more moderate over-subscription of the regular CMTS or M-CMTS QAMs. As opposed to the previous examples, this application is less geared towards increasing revenue and providing new services, but rather is intended to lower costs and improve the efficiency and resulting user experience of existing data applications.

CABLE IPTV – THE BUSINESS CASE

The business case for Cable IPTV may vary considerably for different operators. However, two types of MSOs will probably find the Cable IPTV offering most compelling. The first type consists of hybrid MSOs, or MSOs which own multiple video-capable distribution networks such as telecom networks (xDSL, FTTX etc.) as well as HFC networks.

A typical On-Demand service requires the following components:

- **Video Delivery.** This includes video servers, offline encoders, encryptors, etc.
- **Service Delivery.** This includes session managers, application portals (guides), CAS, etc.
- **Network.** A bi-directional network with enough bandwidth for delivering the required video concurrency rate to subscribers.
- **CPE.** Customer Premise Equipment to decode, decrypt and display the video content.

A hybrid MSO contemplating a video-on-demand service can gain substantial savings by reusing as much infrastructure as possible for delivering video services to both its telecom-connected subscribers and HFC subscribers.

The following table summarizes the typical systems used in cable VOD and telco IPTV VOD for each component, as well as the expected systems to be used in Cable IPTV.

	Cable VOD	Telco IPTV	Cable IPTV
Video Delivery			
Codecs	Typically MPEG-2	MPEG-4 (H.264)	MPEG-4 (H.264)
Video servers	Video pumps & SRM & Backoffice as a package	Lower cost per stream video pumps	Lower cost per stream video pumps
Encryptor	Edge encryption (EQAM)	DRM pre-encryption	DRM pre-encryption
Service Delivery			
CAS	DVB CAS, or Moto/SA Proprietary CAS	DRM, smartcard-less	DRM, smartcard-less
SRM	Legacy SRM Bundled with the video pump or in newer architectures: ERM & VOD SM	#NA (for Telco IPTV)	Cable IP SRM & ERM
Portal/Guide	Integrated with specific cable STBs	HTML & browser based, portable to other platforms	HTML & browser based, portable to other platforms
Network	HFC	FTTx / xDSL	HFC
CPE	Cable STBs	IP STBs	IP STBs

An IPTV platform is likely to reuse most of the components of a regular IPTV platform, with the exception of the network itself, of course, and an additional component that “bridges” between the shared nature of an HFC network and the point-to-point connectivity required for an IP-based delivery network. That component is the Cable IP session resource manager (SRM) and edge resource manager (ERM), or in Harmonic’s terminology, the D2E Manager.

The second type of MSO which is more likely consider Cable IPTV is a greenfield operator planning a rollout of VOD services. Typically, such an operator has a given installed base of analog STBs, so new STBs will need to be sourced. The choice between cable STB or IP STB will be based on performance. As the two STBs are expected to have similar costs with volume purchase, flexibility for future applications will be a major decision factor.

In order to assess the alternative costs of deploying a legacy VOD system versus a Cable IPTV VOD system, the following model is used. System components for legacy VOD and Cable IPTV are compared for costs.

System Function	Comments
Backoffice	
IPTV MW / VOD Guide	In both legacy VOD and Cable IPTV VOD, cost per subscriber is about \$15-\$25 yearly depending on volumes
Session management	The session management function is required in both cases - either by legacy SRM/ERM, or by D2E ERM & Application Manager ,and is assumed to have a similar price benchmark
Network	
Narrowcast capable network	Proper segmentation and return path is required both for Legacy VOD and Cable IPTV
Narrowcast QAM	Price depends on number of QAMs per port (lower QAM counts per port cost more) and volumes. Also, licensing costs for D2E encapsulation may add an average 25% to the cost of QAMs (being DOCSIS QAMs, and supporting encapsulation)
CPE	
DOCSIS 3.0 Cable Modem	Assumed to exist both in legacy VOD with triple play, and in Cable IPTV
Set-Top-Box	Price of Cable STB and IP STB depends on volume but is expected to even out over time

As demonstrated, no major CAPEX difference stands out between the options above. However, other qualitative arguments can support choosing an IPTV system over a legacy VOD system. Faster navigation based on HTTP request/response, rather than cached and non-cached carousel-based guides may encourage subscribers to order more VOD. Delivery to home PCs means more digital video platforms in the home, which may translate to additional recurring revenue coming from higher tiers of subscription. Home PCs may also be harnessed as a platform for targeted ads, which obviously translates to different financial calculations.

THE DIRECT-2-EDGE PROPOSAL

Direct-to-Edge (D2E) is Harmonic’s solution for Cable IPTV. It is based on separating the video content flow from the existing CMTS platform and channeling it directly to the Edge devices via HFC network to the DOCSIS 3.0 CM. The following sections present the steps from existing services to a full-fledged Cable IPTV implementation.

PRESENT SITUATION (DATA / I-CMTS)

DOCSIS has brought cable operators to the present state, in which they can deliver triple play services to a broad subscriber base. It seems logical that DOCSIS would carry the industry into the future. The following diagram depicts a typical I-CMTS system delivering data to cable modems, in parallel to a VOD system delivering on-demand video to cable STBs.

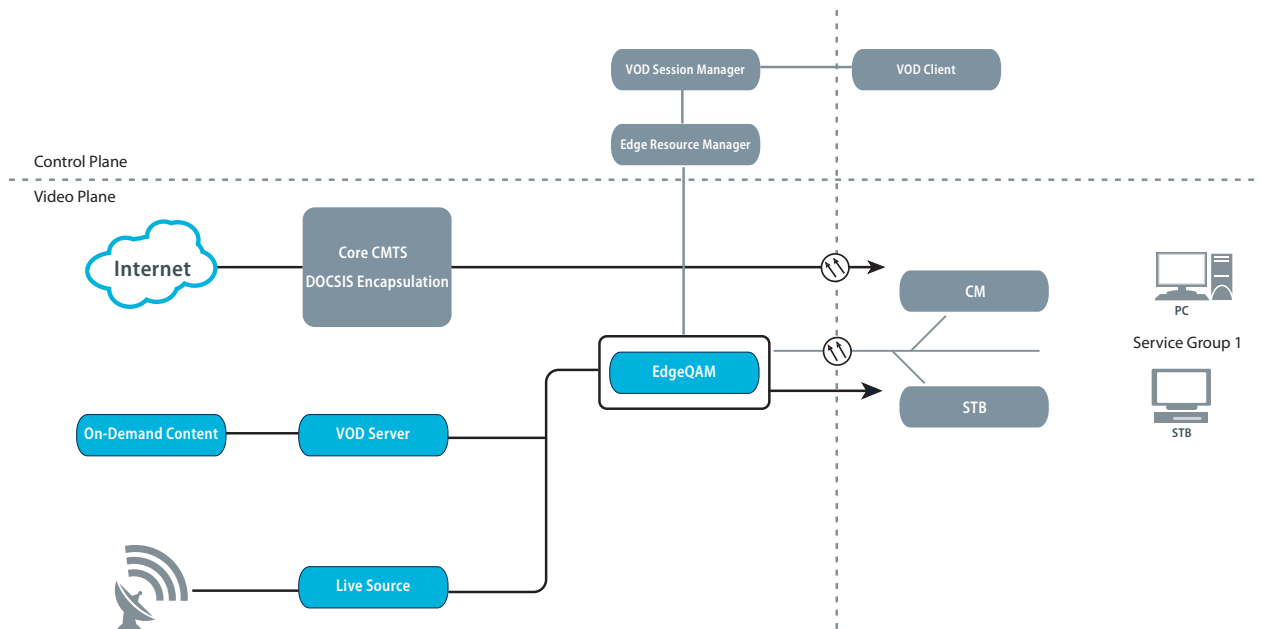


Figure 2: Data with I-CMTS & Video by EQAM

This architecture of different silos providing data and video services is very common to cable operators, allowing delivery of triple play services, but at a high cost per data downstream QAM.

DATA & M-CMTS

DOCSIS 3.0 and M-CMTS address this cost issue. The defined and deployed M-CMTS initiative from CableLabs helped to drive down the cost of a DOCSIS downstream QAM by about half, using the cost-effective RF scaling of today's universal EdgeQAM devices and leaving the IP processing, MAC layer and upstream RF in the CMTS. The next diagram shows the routing of data flows tunneled over L2TPv3 towards an EQAM device for QAM modulation and upconversion.

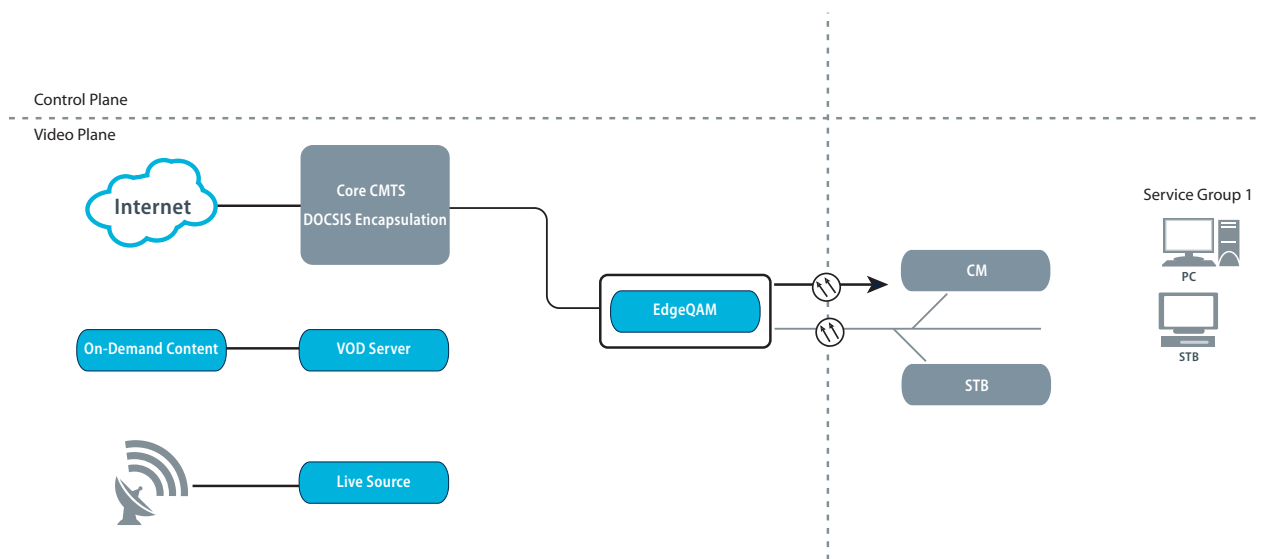


Figure 3: Data with M-CMTS

VIDEO & M-CMTS

Attempting to use the M-CMTS architecture for delivering video over DOCSIS QAMs hits the next constraint of the CMTS, which is the IP processing and MAC layer. One feature of this solution is that all the data is funneled through the CMTS, irrespective of its source. This means that Internet data and video data all pass through the same pipe on the way to the HFC network. In principle this seems attractive, but passing sustained video bit-rate instead of bursty data flows through a CMTS is again not scalable enough in terms of cost.

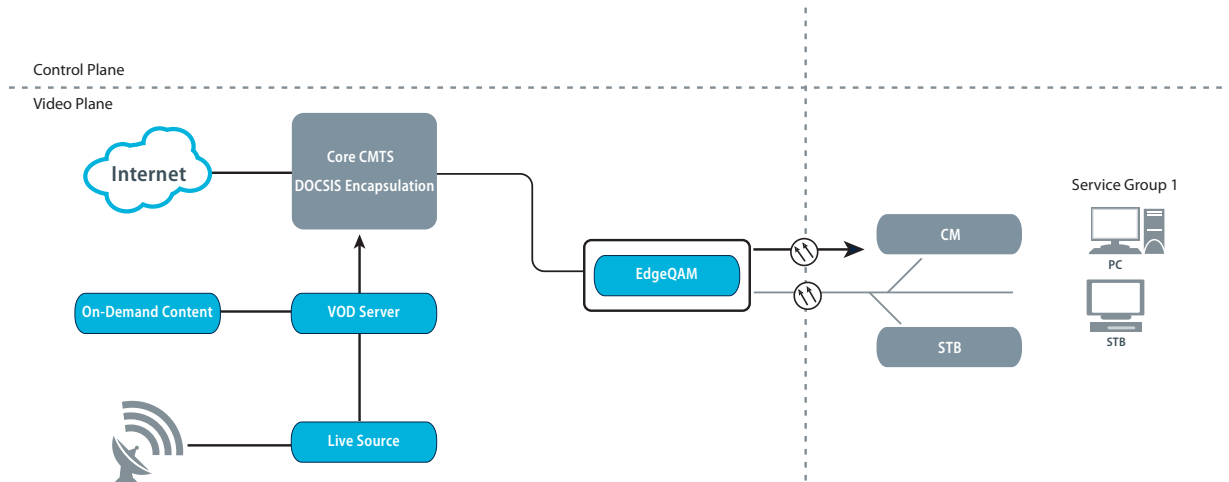


Figure 4: Video with M-CMTS

CMTS devices are designed to support multiple routing protocols and a high number of data flows. This is important for Internet-based UDP and TCP traffic. However, video flows usually exhibit a low count of sessions per given bit-rate. The amount of processing such as queuing and QoS is also far more basic for UDP flows than for TCP. This allows a great cost reduction given that these video streams are passed to a lower cost, lower scale platform that is only used to process these kind of streams.

HARMONIC D2E VIDEO

Harmonic's Direct-2-Edge (D2E) solution addresses these issues, and provides significant advantages when serving the different types of video. Stated most simply, D2E is used to offload the CMTS even further than M-CMTS, adding certain MAC functions such as the DOCSIS MAC encapsulation, and selected DOCSIS management functions to the EQAM device. This allows walled garden video streams to be sent directly to the edge, rather than relying on the CMTS for replacing the L2 from Ethernet to DOCSIS. D2E works alongside the CMTS, leaving the CMTS free to process Internet data such as VOIP, HTTP, and email.

While cost is the main challenge in video over DOCSIS, it is not the only one. Theoretically, a DOCSIS IP pipe allows point-to-point connectivity over a shared HFC media, and this is indeed true when deploying one, two or several QAMs. The challenge comes when the complete video/DOCSIS offering exceeds the number of QAMs a given cable modem can tune to in a given time.

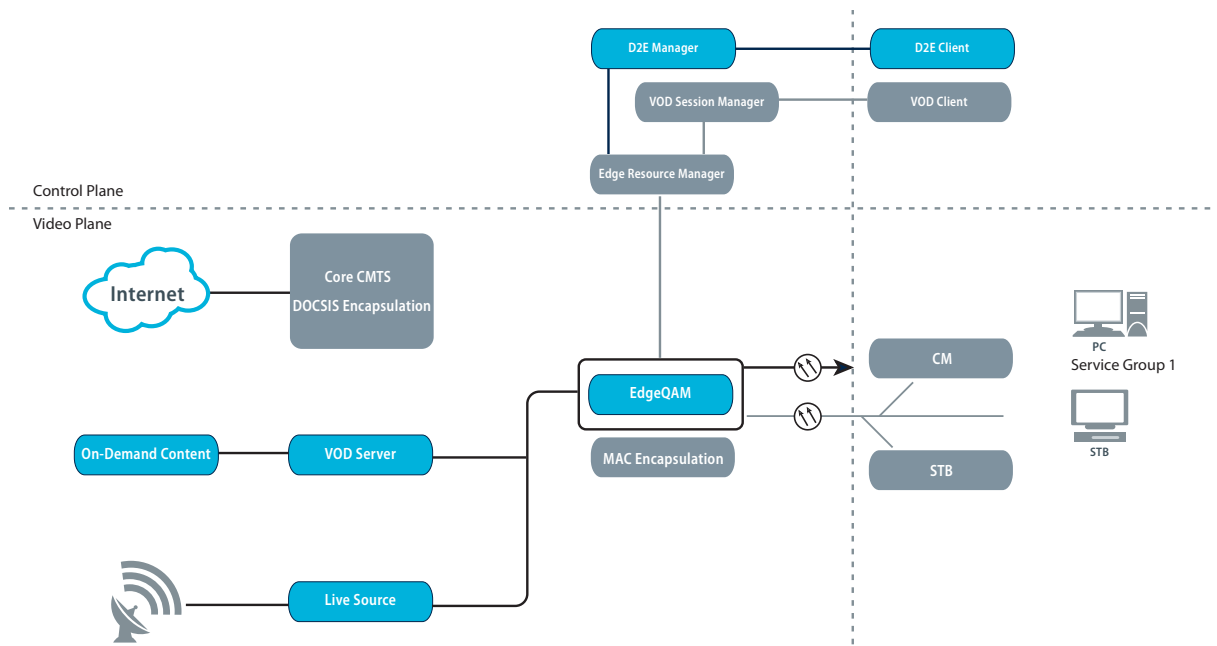


Figure 5: D2E Video

For example, new DOCSIS 3.0 cable modems can tune to eight QAMs, bonded or not bonded, but an IPTV linear broadcast offering may feature 200 H.264 channels that occupy as many as 12 QAMs. In that case, how can the system correlate a service request (e.g. IGMP Join) from an IP client behind a cable modem with which QAM frequency the CM should tune to in order to service that channel?

The Harmonic D2E solution addresses this challenge with a server-based control plane implementation, which sends commands to the CMs to change QAM frequencies according to service requests or any other logic. This is a necessary component for any IPTV system, regardless of whether the MAC encapsulation is done at the edge or at the CMTS. The D2E architecture section below describes the control plane and message flow.

SUMMARY

Harmonic's D2E solution can be used to cost-effectively deploy IPTV over the cable HFC infrastructure. The advantages of IPTV video delivery include great flexibility in the choice of target devices and a highly customized and personalized user experience. Targeting IP set-top boxes and PCs helps in retaining subscriber base by preventing churn to over-the-top viewership. It may also introduce new sources of revenues such as affordable targeted advertising.

The benefits of direct-to-edge video delivery are multiplied for hybrid operators with HFC and FTTx or xDSL networks due to savings in the service delivery, video delivery platform and install based of STBs.

Harmonic's D2E technology is part of a much wider offering in the video delivery value chain. D2E complements Harmonic's digital headend solutions and on-demand video delivery solutions, providing a cost effective, video-enabled pipe over a DOCSIS cable network. D2E is a proven and deployed solution, tightly integrated with other Harmonic products such as the NSG™ 9000 universal edgeQAM and the StreamLiner® video server.

Operators considering the rollout of new digital services such as SD and HDTV broadcast and video on demand can use the D2E solution today for delivery of triple play services, including High Speed Data (HSD) and Voice over IP (VOIP). D2E technology is an enabling platform for future applications, reaching more devices in the connected home and geared towards the next decade of video services.

D2E incorporates a number of advantages to the MSO:

- Cost effectiveness. Delivering video directly to the edge reduces cost when compared to X-CMTS delivery, bringing the cost in line with that of classic MPEG-to-QAM delivery.
- End-to-end video delivery solution. The Harmonic D2E solution incorporates the full video delivery pipeline. Apart from the edgeQAMs acting as encapsulators and media converters and the D2E servers managing the control plane, Harmonic also provides VOD library servers, encoders, transcoders and a wide range of DTA equipment for a full end-to-end solution.
- Retention of physical investment. D2E uses the NSG 9000 edgeQAM for the RF output, with the DOCSIS MAC encapsulation added in. Existing NSG installations can be retrofitted with encapsulation as needed by simple firmware upgrades. In addition, as NSG is a universal edgeQAM it can be used in a system that shares M-CMTS QAMs with D2E QAMs. This presents a unique migration path from legacy narrowcast installations to IP over cable.



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