



Technical Paper

Putting the Best of the Web into the Guide

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Abstract

Today, Internet-sourced content comes in a variety of encoded formats and does not use common, structured metadata by which to identify the content reliably and consistently. In order to bring Internet content into the controlled, structured world of digital cable, an intermediary process is required to locate online content, maintain links to the content, transcode the various video formats into a common format and quality, generate metadata descriptions for the content, and link the content to the structured data-set used by the User Interface (UI) to access content delivered across Multi System Operator (MSO) networks.

This intermediary process is operationally intensive and is generally proprietary and replicated independently based on each platform's requirements and policies. A better approach is to use a cloud-based IP aggregation service to manage the operations. This approach supports the growing demand for aggregating online content with premium broadcast content, such that each operator can benefit from accessing content processed for others and the operational costs are shared amongst many.

A further overhead is the need to negotiate carriage rights for online content, which is a necessary exercise for traditional premium content channels, but becomes operationally cost prohibitive for the vast amount of online content available beyond popular, premium content. Therefore, a cloud-based IP aggregation service that can provide automated and simplified carriage license agreements for operators makes the acquisition of online content for inclusion in their content offering simple.

By using a cloud-based aggregation service, the operations and management overhead of providing online content alongside 'traditional' content is minimized and leads to a consistent, high-quality viewer experience. The operator can adopt this approach in phases, using it to provide a limited choice of popular online content as part of their content offering, delivered over DOCSIS to the Set-Top Box (STB) and aggregated by the guide. The MSO can then gradually increase the online content choices by taking advantage of the automated licensing capabilities of the cloud-based service. In the future, all cable content could potentially be

distributed and aggregated in this manner, particularly as MSOs move to all-IP delivery to the home. Furthermore, by aggregating online content in the cloud, contextual links can be made to premium content, such that viewers can be offered online content that is supplemental to the main stream content they are watching in a convenient, meaningful way, avoiding the viewer having to scroll through long lists of online content choices. Some examples include: online news clips linked to mainstream news programs, interviews with the actors in a movie and travel programs related to the location in a program, etc.

This paper will discuss how cloud-based aggregation services have the potential to revolutionize content delivery, in that the operator is no longer required to be the transit center for content. It will describe how MSOs can start including Internet-sourced content today, with their current linear and Video on Demand (VOD) offerings via the set-top box in an automated, controlled manner, with minimum impact on operations, while providing a viewer experience that enriches their broadcast and VOD offerings.

Comparison of Web and TV

The primary differentiators between delivering video content via the web compared to delivering content over a cable video platform are the network on which it is being delivered, the device on which the video is being received and the presentation of the video library that the viewer uses to discover and select their viewing choices.

Network

Web-based video is delivered over an unmanaged network, which means the bandwidth available between the content delivery network and the receiving client can vary over time, based on the amount of traffic on the shared network. As a consequence, internet video delivery mechanisms have evolved to optimize the Quality of Service (QoS) depending on the bandwidth available at any given time. For example, Adaptive Bit Rate (ABR) encoding technology delivers multiple video streams concurrently, each at a different bit rate and video quality, and the receiving device switches to the highest bit rate stream automatically to optimize the experience, depending on the delivery bandwidth available at that time. Cable television video is delivered over a managed Quadrature Amplitude Modulation (QAM) network, which means an allocated amount of bandwidth is pre-assigned for the content, whether it is a linear, broadcast channel, a switched digital video channel or VOD. Consequently, cable television guarantees a certain QoS for all content delivered.

Receiving Device

Devices used to receive video content from the web are typically open devices, owned and under the control of the viewer. Therefore the viewer can be prompted to download new software and is not limited by the type and frequency of downloads, which are run in the device's memory. Therefore, web-delivered video can use a variety of encoding technologies, which can be downloaded to the device when needed. Cable television however, utilizes STBs for receiving video, which have limited processing and memory (to minimize costs) and perform all video decoding within the STB chipset hardware. For this reason, cable STBs only support MPEG-2 and, in more recent years, MPEG-4 encoded video content

Content Library Presentation

The video library is typically presented on internet devices using Hypertext Markup Language (HTML), dynamically delivered to the device and capable of being updated at any time. The metadata used to identify and describe the video content is generally under the control of each specific service and, as such, does not require any standardization between services. The metadata includes a Universal Resource Locator (URL) that points to the location of the video content so that, upon selection, the internet device can be directed to the source to start receiving the streamed video content. Cable television utilizes a guide application that is resident and runs on each STB. The guide application expects guide data in a structured format that can be displayed in the guide application (typically Rovi, Tribune Media Services or DVB, depending on the supplier of the guide application). Although the guide application can be updated, this is done rarely (no more than once every one to two years) due to the integration and testing required of the guide across a large number of STB models. Therefore, the guide data delivered to STBs is of a highly structured format that rarely changes over time.

Quality of Service

One further difference between video delivered via the web and via a cable television service is the perceived quality and resilience of the service to the viewer. On occasion, a viewer choosing to view video over the web, will encounter issues, such as broken links, meaning the video source cannot be found, poor video quality and long periods of frozen video due to limited bandwidth. These situations are almost expected and tolerated by the viewer. However, when viewing content via the cable television service, interruptions to viewing are rarely tolerated and as such, it is important that when aggregating web-based video content into the cable television experience that the content be adapted, through some intermediary process, to the same standards and quality limits defined by cable television.

The following chart highlights the differences between web-based and cable-based video delivery:

	<u>Web Content Delivery</u>	<u>Cable Video Delivery</u>
Network	Delivers video over an unmanaged network, optimizing QoS depending on the bandwidth available.	Delivers video over a managed QAM network guaranteeing QoS for all content delivered.
Devices	Uses open devices, owned and under the control of the viewer requiring the viewer to download players or codec software before viewing can occur.	Utilizes STBs for receiving video, performing video decoding in the STB chipset. Supports MPEG-2 and MPEG-4 encoded video content.
Presentation	Uses HTML delivered to the device, which is capable of being updated at any time. The metadata used to identify and describe the video content does not require any standardization between services.	Utilizes a guide application that is resident and runs on each STB. Guide application is updated no more than once every one to two years due to the integration and testing required.
Quality of Service	Viewer can encounter broken links, poor video quality and long periods of frozen video due to limited bandwidth.	Interruptions to viewing are rarely tolerated. Internet or web content should be adapted to the same standards and quality.

Figure 1: Comparison of Web and Cable TV Video Delivery

Intermediary Process

There are many steps involved in the intermediary process of acquiring content from the internet and making it available on a cable TV service. These steps break down into two disciplines; the business processes of content acquisition, which are related to acquiring the rights to the content, and the provisioning processes, which are related to how the physical content is accessed and brought into the cable plant to be accessed by the cable subscribers.

Business Processes

Much of the intermediary business processes are related to searching and filtering the vast array of content available on the web to find subject matter that is of a high enough quality that can supplement the cable TV viewing and be of interest to viewers. It is essential that a trusted set of internet-based locations be identified from which video content can be consistently acquired, that are of a consistently high quality and include valid metadata to describe the content. The cable operator must negotiate with the various content sources in the market place to identify and agree carriage rights in order to ingest the content for inclusion in their cable TV service.



Figure 2: Operationally Intensive Intermediary Process for Sourcing Internet or Web Content

Provisioning Processes

As a consequence of the differences in pace and frequency of technological advances between the internet and digital cable, as described in the previous section, an intermediary process is essential to convert internet sourced content into a format that is compatible with a cable television service and viewable on a digital cable STB. Due to the dynamic nature of the intermediary process and the high level of processing required, it is more practical and economical to host the equipment for performing this provisioning phase in a headend, rather than within the cable STB receiving the service.

The intermediary process is responsible for:

- Maintaining links to the video content via methods such as URLs and RSS feeds, including maintaining links when they are updated or relocated by the content providers.
- Re-encoding the content from a variety of possible encoding formats into constant bit rate MPEG2 and/or MPEG4 format that can be decoded by the STB either in real-time, when the content is being viewed, or in advance as part of a caching process (generally for more popular content).
- Packaging and distributing the content to the appropriate video access network for the cable system [VOD, Switched Digital Video (SDV) linear channels, DOCSIS/IP, for example] and ensuring they are correctly referenced within the video plant.
- Collating metadata descriptions by which the content can be identified. This may involve scraping the metadata from numerous trusted internet sites and auto-checking the validity of the metadata to the content source (title, description, cast and crew, genre,

production year, etc.).

- Generating guide data for the cable television service so that the content can be made available within the guide and also determining how the content is to be delivered to the STB when viewed.

Pros and Cons to Operator Managed Processing Versus Cloud Based

The intermediary processes required to ingest content into a cable operator's service can be performed by the operator and, as such, instills complete control to the operator over the service. This does ensure optimum production of both video and metadata assets to ensure that they match the formats required of the cable operator's plant. However, as described previously, the intermediary process is operationally intensive and, as it is replicated by every cable platform wishing to provide supplemental online content in their service offering, results in operators each performing the same intermediary processes, often on the same content.

By collaborating and utilizing a common, cloud-based IP aggregation service to manage the operations, cable operators can share and therefore maximize resources. A cloud-based IP aggregation service supports the growing demand for aggregating online niche and specialist content with each operator's premium content, such that an operator can benefit from accessing content processed for other platforms and the operational costs are shared amongst many.

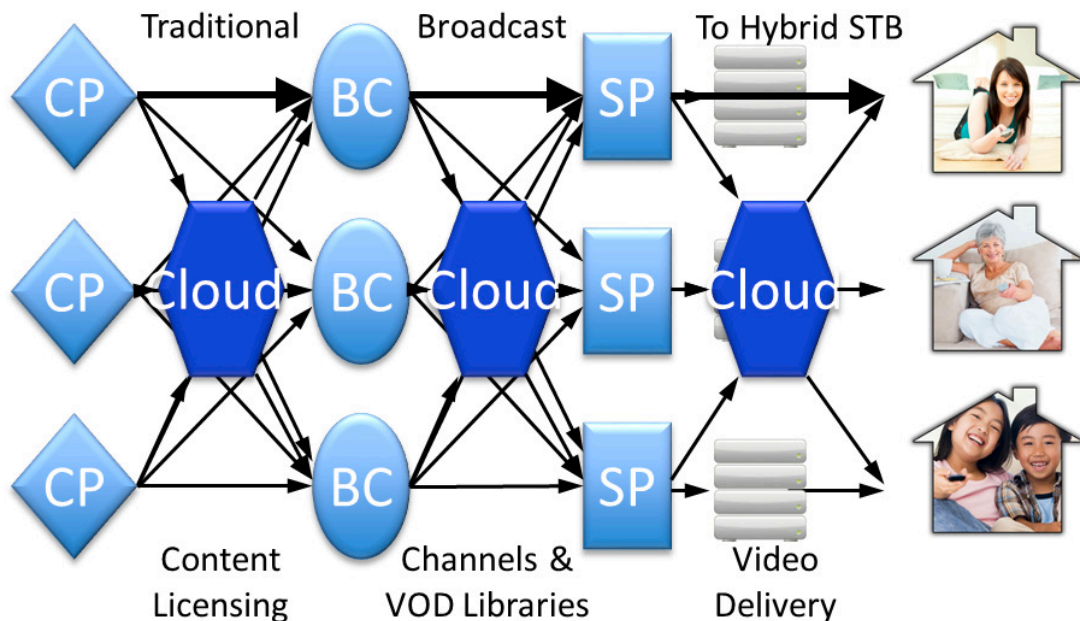


Figure 3: Operational Simplification Offered by Cloud-Based IP Aggregation Approach

Business Considerations - Carriage Agreements

As new media platforms continue to be introduced, content owners retrofit new distribution windows into their traditional distribution lifecycles with varying definitions, durations and media types. These new windows, coupled with the multitudes of service providers in the IP content space, have resulted in an incredibly complex distribution marketplace. For operators, deciding to broaden channel offerings to a spectrum of thousands of channels requires a shift in the traditional content acquisition process and highlights the need for simplified content discovery and negotiation of carriage agreements, including the need to standardize rights definitions.

In order to provide a broad range of channels, operators first need tools to discover the content that will connect with its audience. The importance of robust metadata and recommendation engines to bridge this gap is increasingly important in a thousands-of-channels environment. The core requirement to enable high volumes of content transactions requires standardizing carriage agreement terms and revenue participation to each of the stakeholders in the specialty content distribution ecosystem. In the online distribution world, equitable participation has largely meant advertising revenue share agreements which could become a leading TV carriage business model for specialty content. This standardization requirement solves a key need for small content providers who have limited distribution paths to monetize their content. Standardization also removes the overhead burden required to negotiate carriage rights for online content (distribution costs that traditional premium content channels can afford) but becomes operationally cost prohibitive for the vast amount of specialty content available beyond popular, premium content. Most often, specialty High Definition (HD) content is directly distributed to a small base of consumers via websites or podcasts rather than being integrated into a television experience and reaching a larger audience through many different service providers. Finding the appropriate mix between standardization and flexibility is an important process, accommodating the intricacies of multi-channel deals, large VOD libraries and restrictions based on available music licenses, and not assuming a 'one size fits all' negotiation template. A cloud-based, IP aggregation service that can provide automated content discovery and recommendation, plus standardized carriage license agreements for operators makes the acquisition of online content for inclusion in their content offering simple.

Operations Considerations

By using a cloud-based aggregation service, the operations and management overhead of providing online content alongside 'traditional' content is minimized and leads to a consistent, high-quality viewer experience. The operator can adopt this approach in phases, using it to provide a limited choice of popular online content as part of their content offering, either distribute to VOD or SDV systems for traditional delivery to the STB, or delivered over IP to DOCSIS enabled STBs and aggregated with traditional content by the guide. The MSO can then gradually increase the online content choices by taking advantage of the automated licensing capabilities of the cloud-based service and ABR delivery to consumer devices. In the future, all

cable content could potentially be distributed and aggregated in this manner, particularly as MSOs move to all-IP delivery to the home. IP delivery removes many traditional broadcasting cost barriers that have restricted a broad base of channels in the past. However, operators still require content that will attract an audience, increase Average Revenue Per User (ARPU) and reduce churn. By aggregating online content in the cloud, contextual links can be made to premium content, such that viewers can be offered online content that is supplemental to the main stream content they are watching in a convenient, relevant way, avoiding the viewer having to scroll through long lists of online content choices. Some examples include: online news clips linked to mainstream news programs, interviews with the actors in a movie, travel programs related to the location in a program, etc.

Some of the essential operational requirements from intermediary platforms to ensure high quality consumer experiences yet minimize operational costs for operators will begin with the need for robust metadata following one of the leading industry standards today (such as CableLabs® ADI 1.1). Robust metadata will ensure discovery of content during the business-to-business and business-to-consumer sales cycle and will enable relevant linking of content. Recommendations, particularly social recommendations of content, will become a consumer's primary discovery tool and should be seamlessly integrated into the user interface.

As content is ingested, intermediary platforms will be required to ensure a high quality video experience, normalizing video feeds, automatically running quality control processes, rejecting content that does not meet a provider's minimum delivery requirements and transcoding video files for the respective viewing devices. Video files can be aggregated into channels with programmable channel branding and advertising rules that will transform simple playlists into the quality television channel experience consumers expect.

As content is broadcast out to consumers, intermediaries will be required to provide the advanced analytics, content vetting, Digital Rights Management (DRM) and payment support required by operators. Advanced analytics will enable the performance tracking of channel libraries and tools to optimize line ups, recommended additions, etc. Vetting and rating services will enable operators to get high level feedback from consumers and quickly be able to customize the content offered to individual viewers. Finally, payment services will streamline payments for companies within a platform – enabling payments of advertising revenue share, channel license agreements or any other payment structures automatically. Payment processes can also extend so operators can offer consumers individual or multiple channel purchases integrated into their bill or separately invoiced to a consumer's credit card.

Finally, intermediaries will need to continually evolve their APIs and device roadmap to support an ever expanding supply of connected devices connected to an operator's IP control plane, receiving content over IP, in parallel to the legacy broadcast network.

Individual operators will be challenged to meet all of these requirements whereas an intermediary platform that is neutral and transparent to end users can play an important role

in quickly evolving the distribution of a large number of IP channels to consumers via their existing service providers.

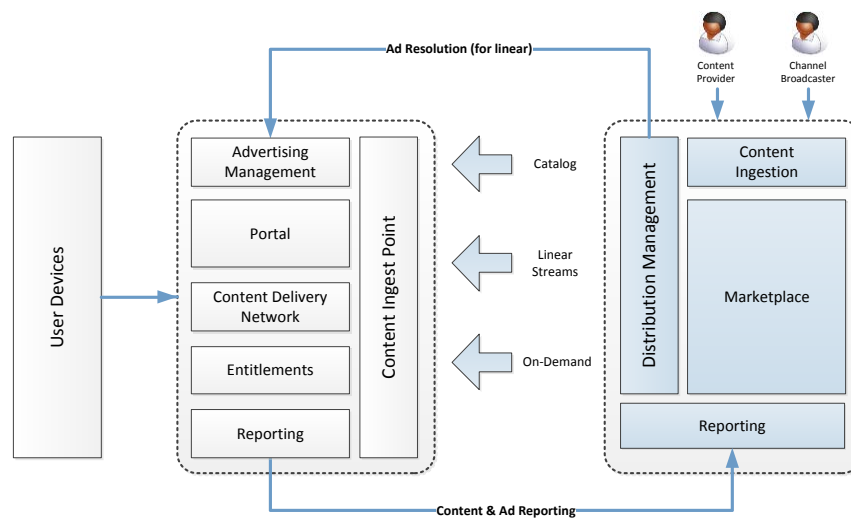


Figure 4: Network Architecture: Cloud-Based IP Aggregation Service for Internet-Sourced Content

End Viewer Experience

Cable operators have a number of options for how they incorporate online content into their cable TV service, which depend on the viewing devices they wish to support; typically STBs, DOCSIS STBs and IP devices. In order to maximize viewer reach, such that the content is available to all viewers, internet-sourced content can be distributed to their VOD servers and incorporated within the operator's on demand service. This enables an operator to provide a menu of web content to their viewers, which can be browsed and searched.

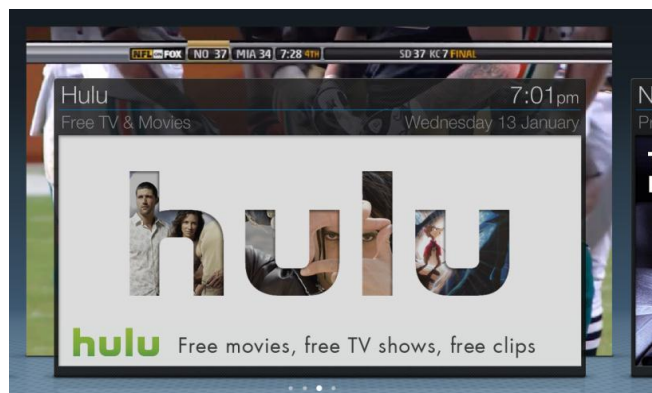


Figure 5: Web Content Accessible Through VOD Menus

Similarly, online linear content and playlists generated by the intermediary process can be distributed to SDV servers, such that they are given channel numbers and included within the

traditional channel listings in the guide. In this case it is unlikely that the operator will have a future list of programming events for the channel, so the listing is restricted to the title of the channel and a description of the genre of content it provides.



Figure 6: Web Channels Accessible Through the Guide

When using traditional delivery mechanisms to the STB, as with the previous examples of VOD and SDV, the viewer is required to seek out the content using the onscreen menu or guide, which reduces the opportunity for viewers to become aware of the content. However, hybrid STBs that include a DOCSIS modem (e.g. tru2way STBs) can utilize a centralized program guide database in the headend, through which guide data for online content can be linked, searched and promoted with metadata for premium content, with access from the STB over the DOCSIS path, such that links to online content can be provided contextually, in real time, to supplement the viewing and browsing experience.

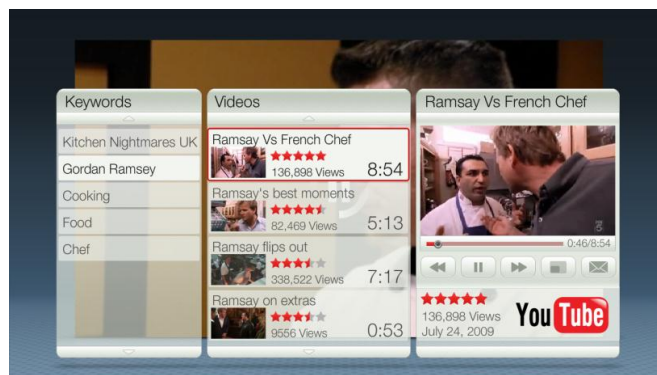


Figure 7: Using Program Guide Keywords to Find Related Online Content



Figure 8: Using Channel Descriptions to Find Related Online Content

In this way, viewers can be made aware of supplemental or niche content related to what they are watching or looking up in the guide. So, in addition to using online content to increase the viewing choices for their subscribers, cable operators can also provide contextual linkage points from traditional content to online content to give viewers the opportunity to drill down further and replicate the web experience in a controlled TV viewing environment.

Conclusion

Cloud-based aggregation services can enable cable operators to start including Internet-sourced content today, using existing linear and VOD offerings via the set-top box. This approach offers an automated, controlled manner, with minimum impact on operations that also provides a viewer experience that enriches an operator's broadcast and VOD offerings. By using a cloud-based aggregation service, the operations and management overhead of providing online content alongside 'traditional' content is minimized and leads to a consistent, high-quality viewer experience. Operators can implement a cloud-based approach in phases, using it to provide a limited choice of popular online content as part of today's content offerings and then gradually increasing the online content choices by taking advantage of the automated licensing capabilities of the cloud-based service and ABR delivery to consumer devices. Looking ahead, this approach could enable operators to distribute and aggregate all cable content in this manner, especially as MSOs transition to all-IP delivery to the home.