

# WHAT TECHNOLOGY WILL WIN IN THE BATTLE TO DELIVER BROADBAND VIDEO TO CUSTOMER DEVICES?

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*allowing operators to potentially leverage the best aspects of all technologies.*

## *Abstract*

*Today, with consumers increasing their consumption of broadband video and with cable operators and programmers continuing their entry into the online video space, the need to understand content delivery options is paramount. Cable operators already have the network capacity for delivering the content. The question is one of where to store the content and stream it from. The first issue is whether to build an infrastructure using generic web streaming and download servers, or to build a content delivery network (CDN) to handle the job. Cable programmers often have relationships with commercial CDNs but they may not be efficiently leveraging their internal digital storage and streaming servers.*

*Peer-to-peer (P2P) also presents another option. Cable operators can build their own application that leverages P2P protocols. P2P eliminates the cost of storage and Gigabit Ethernet ports required when building a CDN by pushing that cost to the individual users (the service provider is essentially co-opting their users' PCs for the storage and streaming). But, this method incurs additional costs for more upstream bandwidth, and potentially dealing with network congestion. Plus, what's the incentive for users to "donate" a portion of their bandwidth and computing and storage resources on their PC? Hybrid models also exist,*

*A media management and publishing system can give the cable operator or programmer more control over their delivery options. Traffic can be dynamically directed to files on different CDNs without consumers experiencing any quality impacts. Policies may be applied to media to automate the management and storage of old or unpopular media files. As decisions to switch to a new content delivery option arise, a media management solution can ensure the transition is easy for production staff and seamless for viewers.*

*This paper will look at the impacts on the network for both downloading content and streaming content, as well as using CDN technology versus P2P technology to actually deliver the content (whether it's being streamed "live," or downloaded for future viewing). Media management systems may be applied to provide additional control over delivery policies. Virtualization of content, storage, and applications can also be leveraged by cable operators and programmers for delivery of content and even web-based applications in the future.*

## INTRODUCTION

More and more, consumers are looking to the Internet to get their content. And while user-generated / contributed

content sites like YouTube.com continue to dominate the online video market, the Internet is rapidly becoming a viable

means to distribute premium studio content as well.

<b>Top U.S. Online Video Properties by Videos Viewed Jan. 2008<sup>i</sup></b>		
<b>Total U.S. – Home/Work/University Locations</b>		
<b>Property</b>	<b>Videos (000)</b>	<b>Share (%) of Videos</b>
<i>Total Internet</i>	<i>9,814,010</i>	<i>100.0%</i>
Google Sites	3,363,335	34.3%
Fox Interactive Media	584,132	6.0%
Yahoo! Sites	315,001	3.2%
Microsoft Sites	199,288	2.0%
Viacom Digital	197,737	2.0%
AOL LLC	118,033	1.2%
Disney Online	95,041	1.0%
Time Warner - Excl. AOL	85,467	0.9%
ESPN	81,402	0.8%
ABC.COM	49,017	0.5%

Figure 1: Top U.S. Online Video Properties by Videos Viewed Jan. 2008

<b>Top U.S. Online Video Properties by Unique Viewers Jan 2008<sup>ii</sup></b>		
<b>Total U.S. – Home/Work/University Locations</b>		
<b>Property</b>	<b>Unique Viewers (000)</b>	<b>Average Minutes per Viewer</b>
<i>Total Internet</i>	<i>139,521</i>	<i>206.3</i>
Google Sites	80,056	109.9
Fox Interactive Media	53,913	11.7
Yahoo! Sites	36,362	18.0
AOL LLC	21,859	7.4
Viacom Digital	21,690	33.0
Microsoft Sites	20,842	30.0
Time Warner - Excl. AOL	13,914	18.2
Disney Online	13,005	8.9
ESPN	8,798	15.9
Apple Inc.	8,743	21.2

Figure 2: Top U.S. Online Video Properties by Unique Viewers Jan. 2008

Major studios and content owners are looking to the web as a new outlet and method to monetize their content. With more consumers turning to the Internet as a source for video, the increasing load will force both the content owners and

service providers to examine new technologies to handle the distribution effectively while maintaining a high quality and reliable consumer experience.

Today, “Internet Video” is largely a computer-only phenomenon. But we are rapidly approaching a time when consumers will have a choice on how they will receive their “television and movie” content, from whom, and on what device. Digital Media Adapters (DMAs) and Digital Media Servers (DMSs) are available from major consumer electronics vendors today, with new models that drive consumer trends being announced every month. When consumers have a choice of getting premium content through their cable operators, as well as a variety of traditional and online competitors, the providers with the most accommodating overall solution will come out on top. Given their incumbent position with both television and broadband Internet service, cable operators are in a prime position to be that provider.

### CONSUMER NEEDS

Hundreds of television channels, thousands of websites, millions of videos, all a few clicks away. This is an era where there are very few barriers to making content available to consumers, leading to an unprecedented amount of entertainment options from a rapidly growing number of sources. This has great promise, because of the high likelihood that something very tailored to every consumer’s taste is available out there somewhere.

This simple consumer proposition places a heavy burden on content providers. It requires a balance between

providing a breadth of content choices and enabling easy discovery of that content by the consumer. Breadth is increasingly measured in the hundreds of thousands or even millions of titles. Discovery of those titles has to be intuitive and fast. And the personal connection between a person and “their shows” requires that the service is always available.

At the same time, the growing popularity of digital video recorders (DVRs) and portable media players (such as the iPod) is causing consumers to demand a much more personalized and portable video experience. They want to view content highly relevant to them, on their terms. They want it on whatever device they happen to be using at that particular moment, and they want the content to be available all the time.

### Engagement

According to a 2007 viewer study, nearly 60 percent of adult consumers surveyed stated that they watch online video<sup>iii</sup>. More businesses are recognizing that broadband video can help them target audiences, generate real revenues, and gain creative control of the user experience. Broadband video supports brands in a way that breathes vitality into and can extend the life of a media or service provider business. It adds flavor, perspective, and additional information to existing pages, increasing audience engagement. Figure 1 shows audience engagement for a top destination site on the web.

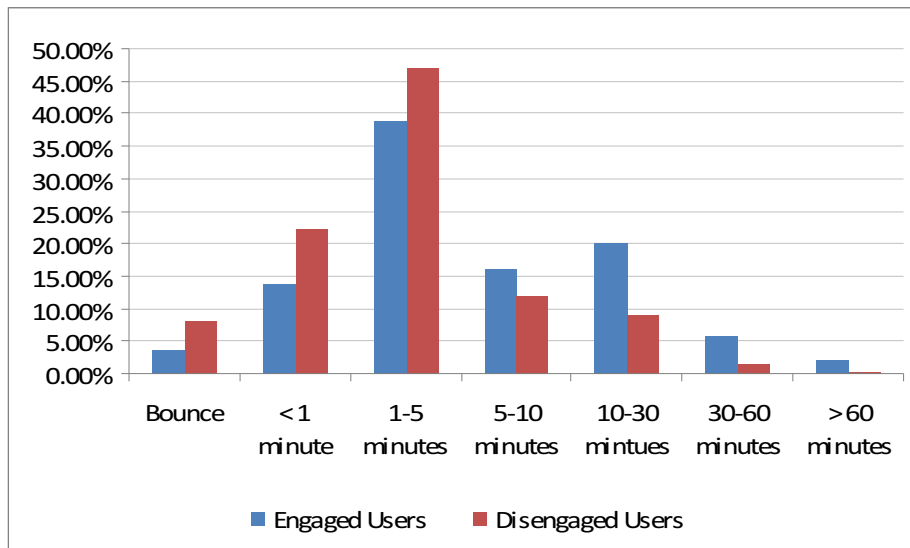


Figure 3: Sample Engagement Data for an Online Video Site

### Relevancy

Programming has a valuable place in the entertainment universe. On TV, a network orders its shows to naturally lead the viewer from one to the next. This provides convenience and a sense of flow that can make the experience more enjoyable with less work. The challenge in front of us is how to apply the notion of programming to a much broader set of content while presenting a very personalized and relevant experience. Clearly, the traditional model of people making editorial decisions that result in a broadcast schedule begins to break down as the model moves increasingly towards a 1:1 engagement with consumers and includes a much larger body of content. Technology will have to play a bigger part in determining what is presented to a consumer if the promise of personalized programming is to be realized. The payoff for figuring this out is a better consumer experience, driven by the presentation of more relevant content.

Layering better-informed programming with technology designed to improve and measure the effectiveness of the content guide, the results are very smart, proactive recommendations that give consumers what they want - the convenience of low-touch programming with the benefit of highly personalized, relevant entertainment. This approach allows everyone to win--consumers get a better experience and content owners increase viewership, and ultimately, service providers can improve the experience and value of their service. But the consumer experience doesn't stop with content sourced from the network. Increasingly, consumers are contributing content as well. It might be highly personalized content meant for family and friends such as video from a family event, or it could be quickly captured video destined for a larger audience. Consumers want the user-generated content experience to be seamlessly integrated with the television and movie programming experience. This

increasingly complex mash-up of personal content, friend and family content, professional programming from multiple content owners, and new independent content optimized for web distribution places even more demands on the cable operators and content owners looking to distribute content.

### CONTENT OWNER NEEDS

At the same time that consumer requirements are increasing, content owners are asking for more. Media companies have an unprecedented ability to reach their audience through multiple outlets. This includes cable, Video on Demand, Digital Video Recording, DVD, the Internet, and mobile devices. Aggregators that have the ability to distribute content across platforms while maintaining a consistent, high quality experience will have an advantage.

### Branding and Cross-Platform Promotion

In a world that isn't necessarily anchored by a channel on the TV, providing branding opportunities around the content becomes critical. Associating the show with the provider allows content owners to leverage their brand investments and connection to an audience. As soon as a content owner feels comfortable with their brand attribution in one medium, cross-platform promotion becomes a requirement. Leading a consumer from promotional clips on their mobile phone to the full show on the web or a video on demand (VOD) system and finally to a linear channel to find other, similar shows will become the norm.

Content owners' final requirement is to decrease their distribution costs.

When each incremental audience member costs the content provider more, aggregators that can reduce this expense become very attractive partners.

### Distribution Costs

Service and content providers concerned over costs of distribution have recourse to new management capabilities that can significantly lower the expense of doing business with content delivery network (CDN) suppliers.

Traditionally content providers have relied on one or even two CDN suppliers under multi-year contracts, which limits their ability to take advantage of recent changes in the CDN market. But, with over a dozen global CDN suppliers now vying for business in the U.S. alone, there's no longer any reason for content providers to tolerate onerous contractual terms with built-in cost escalators and other unnecessary cost burdens.

Fortunately, the costs of implementing dynamic control over CDN services are miniscule compared to the potential savings. By turning to highly automated operations support tools and services, content distributors of all types and sizes can achieve cost breaks across the CDN domain, avoiding over-priced services and remaining flexible enough to take advantage of advances in CDN technology wherever they occur.

### Unnecessary Cost Drivers

CDN providers typically set terms that require customers to pay minimum monthly fees for storage and distribution, covering all traffic volume up to a certain limit. After exceeding that limit, the charges are then based on incremental storage and distribution

volume, which can add up quickly. There are ways to shift that traffic to cheaper distribution channels, and there are typically no contractual barriers to doing so. What can be termed “success-based” cost escalators also come into play with delivery of advertising with content over CDNs. As users access more ad content in the service stream, content providers have to pay more to CDNs, sometimes upwards of \$7 per thousand views, which translates to a large share of the \$14-\$25<sup>iv</sup> cost per thousand (CPM) rate content suppliers typically charge advertisers. Some media companies are reducing CDN costs by leveraging management tools that dynamically execute their CDN requirements across multiple providers. This is often done by coordinating use of CDN options with in-house storage capabilities.

### Cost-Cutting Strategies

There are many ways media management infrastructure can be used to help bring down CDN costs. Some approaches coordinate external CDN resources with sizeable in-house infrastructures. Other approaches rely more heavily on external support. In all cases, the content provider must be in a position to manage CDN fulfillment in a streamlined, dashboard-based environment with mechanisms in place to seamlessly switch content flows from one CDN to another.

Companies utilizing their own digital media storage systems need to actively manage files by pulling them from the CDN when those files are not in use. This is especially relevant for those companies that have large content

libraries or already have invested in storage devices.

Some firms may also want to direct consumer video requests in non-peak hours to in-house distribution servers, only using CDNs for peak traffic. Policies that govern how traffic is allocated between internal resources and outside CDNs can be very simple, for example setting a weighted control on the flow of user requests for content where 60 percent may be directed to the internal servers and 40 percent to CDNs. In some cases, the content provider might build a system to monitor flows and manage traffic so that, if traffic hits a certain threshold, it is switched over to outside CDNs.

Achieving such capabilities requires highly sophisticated management software and infrastructure controls capable of switching traffic across multiple CDNs without disruptions to end users. Whether or not a company has internal storage and delivery resources, it will want to use CDN switching resources to direct traffic to multiple CDNs to ensure contractual caps are never surpassed.

This allows content providers to avoid paying inflated rates for files already duplicated and stored in the network that are on the downside of their usage curves. By moving such files out of the high-cost CDN storage environment, the content provider pays storage rates that square with current usage trends.

The need to ensure that quality parameters on each content stream meet end user requirements also has an impact on the CDN selection process. As

content providers enable flows that support full screen viewing, the file storage and distribution volumes escalate. The content provider must be responsive to situations where high bandwidth requests are pushing traffic volume over a particular CDN cap faster than expected.

Along with sophisticated operations functionalities, successful management of CDN services requires a savvy approach to contracting services. While long-term contracts might appear to offer aggressive rates, CDN providers know that by locking customers in they will make out very well as traffic and storage demand exceeds caps. Even if a content provider has recourse to capabilities discussed above that can use multi-CDN access to avoid over-cap costs, it's prudent to use those management capabilities to facilitate working in an environment where one-year contracts are available.

Short-term contracts will allow a broadband video business to capitalize on lower bandwidth costs and the latest delivery technologies. In fact, broadband video providers with low volumes can gain leverage in their negotiations by looking at very short-term contracts of just a few months duration. The company can then bargain for reduced fees in exchange for agreeing to a longer-term contract.

The key for content providers is to configure their systems to optimize traffic distribution, taking into account such factors as the extent to which in-house resources can be leveraged and how the provider can work within existing CDN contract terms to improve efficiency.

Implementing architecture that supports ever-changing dynamics of the business, including expansions of fields covered by the system, extensions of metadata categories and application rules, types of security to be applied to various content categories and ongoing variations in end user pricing and access rules is also a critical component.

### Selecting Content Libraries

In addition to making premium content available online, television networks and cable programmers have mined their stockpiles of content, knowing that supporting video and audio clips make newer offerings more interesting to their audience. Very often businesses have a lot of content in their archives that could pull in a very large online viewership, either by itself, or when used as supporting material for related content.

There are several major content sources from which companies can harvest media that paves the way for broadband video business success. The best way to maximize content is to get it into a digital library and add value with commerce and advertising solutions that use IP based-communication and web-based presentation.

### Multiple Outlets/Distribution

As big television networks and broadcasters move their content online, one big challenge that presents itself is that unless you have incredible brand awareness, exclusively focusing on building your own destination site is only one small part of building a successful online strategy.

Going halfway is not a winning proposition. Content providers have to commit to getting the content to all of the online destinations (i.e. syndication) that make sense: that's distribution. It will entail headaches. It will involve dealing with multiple video formats, different policies, and different advertising models. To get content out there and to monetize it is a lot of work.

This strategy involves thinking approaching online video holistically. ABC, CBS, NBC, Fox have all built their own Websites to host their television content, but they've also invested in distribution.

Previously, broadcasters have seen the Internet as supplemental to the TV business; it's something they've used as a promotional tool. Online, broadcasters can go out and find an audience rather than rely on an audience to find them. Beyond promotional deals, it's that long tail that allows broadcasters to connect with an audience.

Here's an example: If a consumer watches *Heroes* for the first time on TV and really wants to catch up on what she missed, she can go online and watch back episodes. In essence that library of long-tail content becomes a destination. This is a nice driver for the market: Broadcasters can find out where there is demand and do some real-time determinations of what kind of content is popular.

Broadcasters, cable channels and operators need to create a destination to catch all of these viewers. But they also have to be willing to follow the consumer. If a consumer can't get what

they want through one outlet, then they will go elsewhere because it doesn't end with having just one destination to catch these kinds of viewers. Brands have to reach different kinds of people across the Internet, with different preferences on where they want to go to get their content and how they want to consume it.

If a media company cuts the right distribution deals, its shows can land in the places where consumers are landing natively. They can reach customers in a way that's not quite the same as in the operator environment where walled gardens are the norm. This, in fact, flies in the face of a walled garden.

As more network TV content moves online, there will be increased pressure to open up the walled garden a little bit and allow content to flow to more than one place. Ultimately, that helps create the seamless experience the consumer is after.

Success will mean interoperability across platforms and distribution of content far and wide. Standards are now emerging that will ease interpretability between different platforms and enable seamless and even greater multi-platform delivery of content.

#### CONTENT DELIVERY METHODS

There are two primary methods for getting content to consumers: the consumer downloads the content for either immediate or later viewing, or streams it for viewing "live". Streaming is generally defined as content being delivered to the subscriber "just in time" for viewing, typically without the ability

for the user to “record” or keep a copy of the content. Downloading is generally defined as transferring the content to the subscriber’s device and then viewed locally. However, the boundaries between these two methods are blurring as new technologies come on to the market. Protocols typically used for downloading can be used to simulate a streaming experience, and vice versa.

### Streaming

Today’s protocols for streaming video depend on a fairly reliable transport network. The video is sent at a constant rate, and any variance in delay (jitter) in the stream is compensated for by buffering at the client. This results in delayed startup of streams while buffering, as well as delays when switching from one stream to another (which requires buffering of the new stream).

Streaming via traditional IP streaming protocols presents a problem for video delivery across the “generic” uncontrolled bandwidth of the Internet, as it is subject to congestion and choke points across the network. The solution for this is to stream the video from a source as close to the subscriber as possible. By eliminating as many potential points of congestion from the network as possible the video can often be streamed at a higher rate with better quality for the subscriber. A second improvement for delivering video via streaming protocols is to apply Quality of Service (QoS) to the stream, giving the video packets higher priority in the event of network congestion. However, this is typically only viable on a single, controlled network, not across the

Internet in general. In fact, this is typically the way that cable operators transport both broadcast and on demand video across their regional networks.

Streaming protocols typically limit the bandwidth to the actual stream rate. On one hand, this can prevent the client from taking advantage of “pre-buffering” the video when extra bandwidth is available. For example, by enabling fast start capabilities native to some streaming protocols. On the other hand, streaming protocols are very efficient in that they only send packets if the client is viewing them. For example, if a user starts watching a 10-minute video but decides to stop one minute in, only the first minute of the video is transferred.

### Downloading

Downloading content gives the user more control over when and where they want to view the video, as once it’s downloaded to the client device, no network connectivity is needed to view the video. This allows for a very high quality video experience regardless of available network bandwidth or connectivity, assuming the subscriber has downloaded the video in advance. Digital Rights Management (DRM) can be used to limit transfer of the content, the number of times the content can be viewed, the viewing window, etc. Downloading video via broadband is most often done using the HTTP protocol, but can be done via proprietary protocols with dedicated clients as well. Dedicated video clients also provide more capabilities for the subscriber by managing where videos are stored on the device, preventing screen captures of the content, providing a common navigation

engine, or allowing users to set up subscriptions to download multiple videos.

Progressive download is the ability to start viewing a downloaded video as soon as there is enough video “in the buffer” to continually play the asset given the transfer speeds that are seen during the initial buffering. Progressively downloaded content allows the subscriber to start viewing the video as soon as possible while simultaneously saving the video for later viewing. Within the progressive download model, downloading can simulate a streaming experience, but using downloading protocols instead of streaming protocols.

Whole asset downloads, and proprietary methods of downloading small “chunks” of the video are common methods utilized today. These methods provide the benefit of using download-type protocol architectures while utilizing burst transfers of the video at faster than stream rate for quicker delivery. Some methods also provide the efficiency of streaming protocols by only transferring just the video that is being watched in addition to a small buffer.

### Peer to Peer (P2P)

P2P protocols can be used to enable download type services or streaming type services. Where both traditional downloading and streaming protocols work get their content in a fairly linear fashion (start at the beginning, keep going until the end) from a single source, P2P clients can get content simultaneously from a large number of sources, and do so in a non-linear

fashion (getting the last part of the file first for example). However, while P2P clients can source the data from multiple locations, it still must all traverse the same broadband access link. Thus, P2P will have the same broadband download bandwidth issues as traditional streaming and downloading protocols will. P2P protocols have routing metrics to determine the nearest, highest bandwidth, most reliable sources to source content from, increasing the subscriber’s utilization of the access network. However, because there are not commonly accepted standards for P2P networking protocols, they are not integrated into popular browsers, and typically require custom clients.

P2P protocols have a great advantage for content owners in that they don’t require any streaming or downloading infrastructure. Content owners need only to seed the content once into the P2P network. As more clients download that content from the initial peers, they in turn make that content available to other peers. Thus, the content owner’s individual subscribers are using their own storage, streaming resources (their PC) and broadband network connection bandwidth to distribute the content for them, all at no cost to the content owner. Since P2P protocols work best when there are a large number of peers in the network with the content a client is asking to download, it tends to work best for the most popular content, as that is likely to reside on the greatest number of peers.

P2P clients have downsides as well. For long tail or niche content, the number of peers with the content might be very low, resulting in slow download performance and a poor experience for

the recipient. Since most P2P networks rely on individual users who may or may not be online at any given time, niche content may not even be available to requestors who wish to view it. Most P2P networks are also not managed by any central source or entity, and thus may end up being less reliable overall as they rely on the individual users to each do their part.

P2P relies on individual users to source the content over their asymmetric broadband connections. While download speeds can be very fast, the upload bandwidth is typically a much lower speed, and more subject to congestion. A P2P user can easily consume a large percentage of both the upstream and downstream available bandwidth of a given network segment, depending on the popularity of content they host, and the volume of content they seek to obtain. The effects of popular P2P applications that are used to distribute copyrighted content is the best example recognized by operators today.

The use of P2P protocols isn't limited just to clients trying to use the Internet to distribute content. Service providers could leverage P2P for distribution of content within their network, as well as potentially leveraging P2P protocols to "peer" with other service providers for content, in a similar way as they peer for Internet packet transport today. Instead of publishing their content to 3<sup>rd</sup> party CDN providers (described in the next section), or to client-based P2P networks, content owners could publish their content to a select number of service providers they peer with at a content level, who would in turn distribute that content as needed either to other service providers for delivery to

their customers, or direct to consumers who are using service providers that don't have content peering relationships.

### Content Delivery Networks

To help scale the delivery of content across the Internet, CDN providers have built infrastructures that help virtualize that content across the network. Conceptually, CDNs work by ingesting the content from a source (such as a content owner's website) into a network of intelligent caches distributed throughout the network. As subscribers request to view content, a copy of that content is stored in a cache closest to that subscriber. When the second subscriber requests to view that same piece of content, the request is redirected to the local cache, with no need to go back to the original source. As local caches "fill up" with content requested from subscribers, the least popular content is purged to make room for more popular content. CDN caches can be placed in a tiered hierarchy, allowing for content population to match the interests of its local subscribers. This demand-based method keeps the most popular content closest to the users requesting it, resulting in the best performance for those subscribers. Niche content, however, is always available from the source. CDN caches simultaneously serve the content to the requestor while the content is populating the CDN cache's local storage repository.

But as described in the previous section, the more popular the content is, the more it is downloaded and the more the content owner is charged for distribution. This is in stark contrast to P2P, which performs best (and least

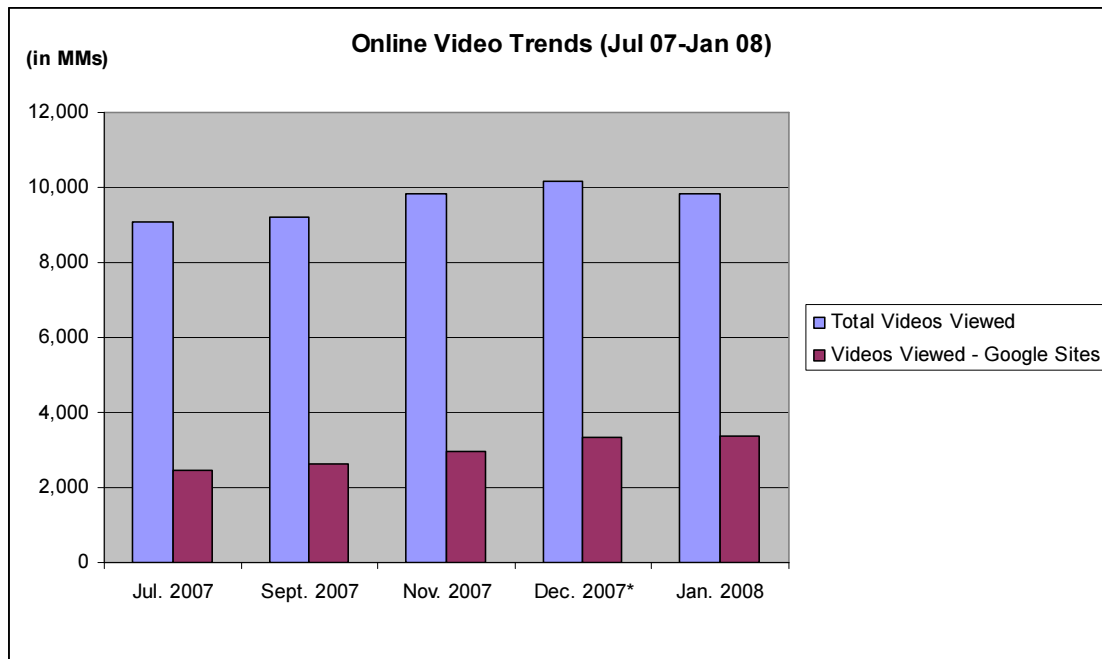
expensively) for the most popular content. However, also in contrast to P2P, CDNs are managed networks and can provide service level guarantees to content owners, and deliver all content regardless of how popular it is, from within the operator's own network. The most popular content is more widely distributed throughout the network, and thus typically resides close to the subscriber, minimizing the number of "hops" or links through the network the content must traverse to reach the subscriber. The closer to the subscriber, the better - proximity minimizes the potential for congestion and enhances the overall customer experience.

#### Hybrid Delivery Options

Some companies are starting to look at hybrid P2P and CDN delivery options. A client would first look to see if the content is available from peers, and if not, start sourcing that content from a CDN provider. Thus, the most popular and expensive content traditionally provided by a CDN would be delivered via the "free" P2P network instead.

#### Role of the Cable Operator in Online Video

Today, when it comes to content destined for the television, the cable operator acts as the primary, and often only, aggregator and distributor of content from multiple content owners to the operator's subscribers. Consumers navigate linear broadcast content via a program guide, with a menu-based navigation portal for accessing popular movies, TV shows, and niche content on demand. But when it comes to broadband video, many cable operators don't have a presence at all. Today's business models are still developing around what and how consumers will pay for online video. But as the comScore numbers in figure 1 show, consumers aren't waiting for their cable company to figure out. Cable operators have the opportunity to play the same aggregation and distribution role for online content as they do for traditional television content, and in some cases, controlled delivery of the content may almost pay for itself.



\*Single heaviest month for online video consumption since comScore initiated its tracking service

Figure 4: Online Video Trending July 2007-Jan 2008

### Impact of Over the Top Video Delivery on Cable Operators

Subscribers watching online video “over the top (OTT),” or using the cable operators bandwidth for video not distributed by the cable operator, is effecting the operator both technically and financially. The most obvious is the substantial traffic growth Cable operators are already transporting all of the online video that their subscribers are watching – they’re just not getting any revenue from it aside from the revenue they are receiving for providing broadband Internet connectivity. For popular content, the cable operator is probably transporting the same exact content countless times across their backbones. In addition to the hit that cable operator backbones are taking from a bandwidth perspective,

operators are also facing a service substitution challenge. This is happening today in the voice market with OTT providers such as Vonage and Skype. Once premium video is available online, and viewable on the television set via retail DMAs, subscribers can also start shifting their content spend from the cable operator to other providers. A subscriber shift is starting to happen today through such devices and services as Apple TV and iTunes, Vudu, and Microsoft Xbox LIVE Marketplace. And as services continue to shift, so too will the advertising revenue associated with those services.

### Cable Operators as Online Content Distribution Partners

By becoming an active participant in the distribution of online video, cable operators can accomplish multiple goals

while providing more advantages to both the content owner and consumer at lower cost than traditional CDN providers. Cable operators already own their regional network and broadband infrastructure, and have fundamentally lower cost structures for building a CDN than providers which need to lease those facilities. In addition, this infrastructure is already being used for the transport of other services that are largely funding its build-out; such as traditional cable TV, voice services, business services, and even OTT online video itself.

By leveraging CDN technology within an existing infrastructure, cable operators can cache popular content at the edge and eliminate duplication of bandwidth across the network to help alleviate some of the costs already incurred. Because the operator controls the infrastructure, cable operators can also leverage QoS capabilities to prioritize video traffic in the event of network congestion, providing a better experience for consumers. With fewer potential congestion points and the ability to prioritize video streams, cable operators can deliver higher quality, higher bit-rate video to the consumer, further enhancing the experience vs. OTT delivery, which contributes to continued subscriber loyalty and brand awareness.

#### Cross-Platform Service Capability

Beyond the advantages of more efficient delivery of content, cable operators can add significant value in the services they can bundle together and offer consumers. As cable networks transition to all-digital with set top boxes, digital video recorders have become commonplace in nearly every

cable household. A common platform establishes a foundation for cable operators to provide the same content to multiple screens for the consumer. By partnering with the content owners, cable operators can provide customers who are subscribers to premium tiers access to that same content online. Consumers could access that content through a portal that both maintains branding for the content owner and gives the consumer a single destination for all things video-related.

As cable operators begin to deliver content across platforms with a single infrastructure, they can also start working with advertisers on cross-platform advertising capabilities. Advertising campaigns can span from television content to long-form online advertising. Targeted banner and bumper ads can accompany online video, and different ads can be shown each time the consumer watches the content. By integrating online video with communication services such as email and VoIP, cable operators can enhance the video experience by becoming involved in the subscriber's social experience.

#### Capitalizing on the Online Portal

Opportunities for additional advertising or click-through revenue rise once mainstream, premium content is presented along with niche, long tail content and user-generated content. The goal for cable operators is to become both the distribution network and the jump off point for all things video and content related. By integrating all of a consumer's content needs, across multiple content owners, premium and free content, and personal content the

cable operator can become the primary video experience provider for their consumers. Beyond a single portal for video content, the cable operator has the opportunity to integrate management of all video, content, and communication services for the subscriber into a single experience, allowing the subscriber to access any service regardless of the device they're using.

### NEED FOR MEDIA MANAGEMENT AND PUBLISHING

Once a cable operator/content provider has their distribution strategy worked out, the next step is figuring out the media management. Everyone in the value chain benefits from a system that can provide the control and automation necessary as content is provided across platforms. Figure 5 provides an overall sense of the data flow involved in publishing online video.

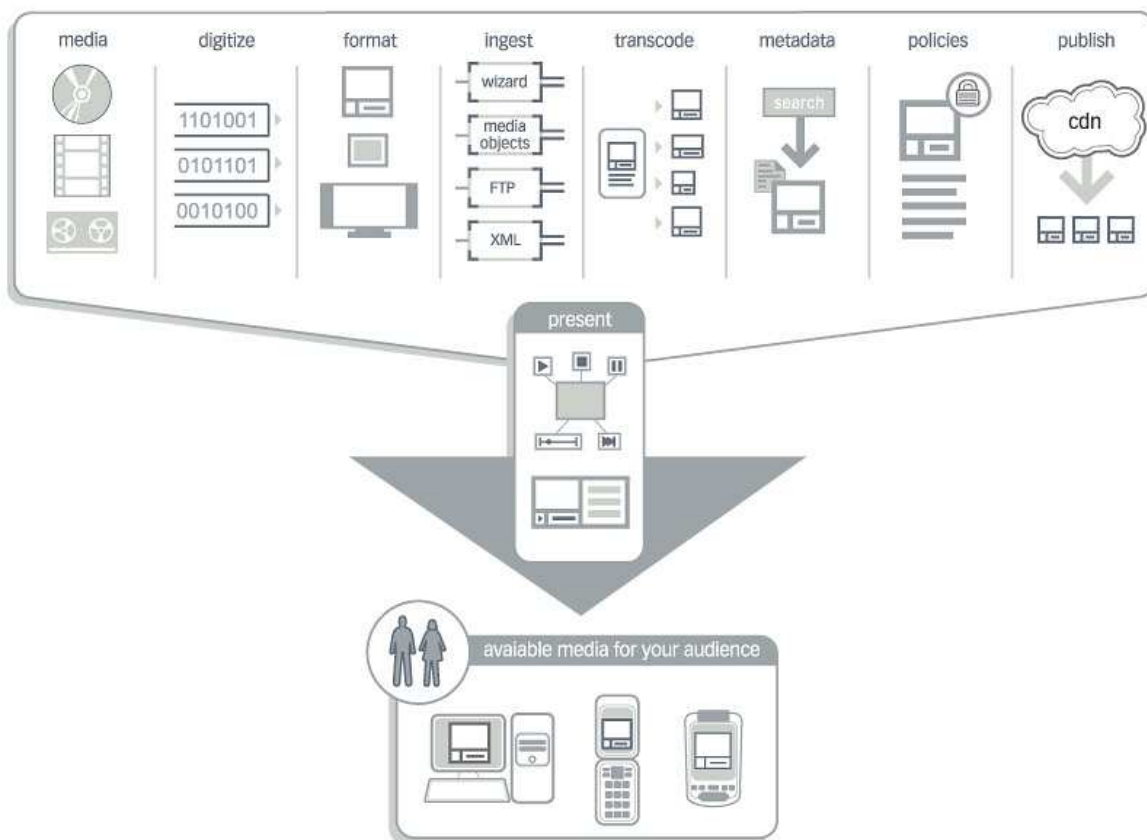


Figure 5: Online Video Workflow

#### Applying Business Policies/Control

Control leads to the application of business policies for each piece of

content. A media management system must be able to reflect the carriage deal including geographic restrictions, air dates, end-user restrictions, digital rights

management, pricing models and advertising policies. These set parameters that control when content is available, who can access it, when it expires, and what delivery methods are allowed. As these policies are applied to a video, they must be enforced in every medium including VOD, the web and mobile.

Common types of broadband video controls include:

- **Content restrictions.** Scope content usage to reflect business requirements. Examples include restricting media so it can be accessed only on certain dates or in certain geographies.
- **End-user restrictions.** Control user access via an integration with existing “single sign-on” authentication application. These controls enable the system to perform all the response tasks (prompting the user for ID and password if necessary), and either generating a license directly, or using a management system to pass the license information and grant access.
- **Pricing policies.** Help monetize video content by supporting pricing schemes such as free trial periods, pay-per-view, and pay-per-download.
- **Advertising policies.** Ensure a tight integration with advertising campaign management systems to target and track ads.

### Automation

The only solution to complex content distribution strategies is automation. A media management system should gracefully meet various metadata schema and video format requirements. The heavy-lifting tasks of transcoding, file transfers and encryption are best accomplished programmatically, eliminating the need for personnel to manually start each chore.

### Dynamic Entitlement

The final mission of a media management system is to enable the monetization of content. Entitlements should be dynamic, allowing operators to combine consumer segments with pricing models and content restrictions. Advertising needs to merge the emotional connection of the television with the targeting of the web. An open approach to trying new advertising campaign management systems and relentless testing will result in consumers receiving more relevant ads that are actually appreciated for their educational value.

### Choosing a Content Delivery Network

If content owners have a large library of video they may choose to select a CDN to host their files once they are published. The selection process isn't one that can be addressed briefly. There are a lot of factors to consider in determining the best value: quality of service, the number of sites the content is uploaded to, and what reports and alerts are offered.

Applying policies that govern how traffic is allocated between internal resources and outside CDNs, or directing

traffic to multiple CDNs to ensure that contractual caps are never surpassed are a couple ways to reduce CDN costs. Another approach is to move older files out of high-cost CDN storage to an in-house storage as the audience moves on to newer content.

### Determining Formats

The next step after content ingest is formatting content. The formats needed depend on where the media is being sent, as different media have disparate technical requirements. This often means creating more compressed versions of a video for viewing within a browser or for faster download for viewers without broadband connections. Some examples

include media companies that want viewers to be able to watch video as it downloads or content providers who wish to support both Windows and Mac players.

In addition to selecting the appropriate formats for a content or service provider's own site(s), there are also additional formats required for syndicating media. For example, when syndicating to a mobile carrier, files must be provided in formats that work on their devices. Considerations in selecting format can be impacted by the target audience, the video/audio quality required, file security and the content being posted to live or on-demand media.

Format	Description	Compatible platforms
3GPP, 3G2	Specifications for creating, delivering, and playing back media over high-speed broadband mobile networks to multimedia-enabled cell phones. Intended for mobile, but playable on desk/laptops.	<ul style="list-style-type: none"> <li>• Mac</li> <li>• Windows</li> <li>• mobile</li> </ul>
Flash Video (.flv)	Flash video is compact and supports both progressive and streaming downloads.	<ul style="list-style-type: none"> <li>• Mac</li> <li>• Windows</li> <li>• mobile</li> </ul>
MPEG-4	Used for streaming media video on the web, CDs, and broadcast television.	<ul style="list-style-type: none"> <li>• Mac</li> <li>• Windows</li> <li>• mobile</li> </ul>
Windows Media Video (.wmv)	Used for several proprietary codecs developed by Microsoft.	<ul style="list-style-type: none"> <li>• Non-Windows computers require that an extra (free) component be installed. Some newer-format Windows Media video cannot play on non-Windows computers.</li> <li>• Supports mobile, depending on the codec used.</li> </ul>

Figure 6: Common Broadband Video Formats

Most videos files have at least two types of file formats, the container and the codec. The video file container holds data like audio and video, which have been compressed using codecs. Codecs compress files so they take up less

storage space on a computer and can more quickly be transmitted across the Internet. Figure 6 lists some common container formats for broadband video. Note that there may be exceptions—some formats will play on certain

platforms only if a special plug-in is installed, or some videos will play on a device only if the correct codecs are in the container file.

### SUMMARY

More, more, more: More content choices, more devices to view that content on, and more ways to find the content. Consumers only have so much time during the day to view video content, and want that time to be spent viewing relevant content, not figuring out what to watch, where to find it, and how to get it on the device they want. Content owners want more ways to monetize their content. They want to sell it direct to the consumer when they can, but also leverage the most popular distribution outlets to make sure their content is easily accessible to consumers.

This means streaming the content live to consumers, allowing them to download it for either immediate or later viewing, and giving them the flexibility to move that content around and share the experience with friends and family. Cable operators are one of the primary distribution outlets for television content today, but certainly not the only one. The same television show is available initially via broadcast, and then online via the programmer's website, online through retailers such as iTunes and Amazon.com, on demand through cable operator's VoD platform, and ultimately on DVD and syndication as well.

The Internet gives both content owners and consumers more avenues for receiving and viewing that content. Cable operators have the opportunity to continue to play their current TV

distribution role for online video as well. Multiple partnership and engagement models exist, ranging from acting as a wholesale CDN provider up to and including being the aggregated retail storefront for content. And by integrating the online video experience with the current bundle of digital video, voice, and broadband data cable operators can further enhance their value proposition for consumers.

But managing all of this content from so many different sources to so many different destinations requires a sophisticated system for media management to help automate and scale the process. Additionally, it provides mechanism for extending content and the consumer experience to broadband with the flexibility to assign specific policies and business rules applicable to operators and programmers, and most importantly, accomplishes this without relinquishing control over specific media objects. As the market continues to evolve and grow, the management of online media will continue to grow in complexity with sheer volume and types of content available. As new formats emerge and the delivery mechanism, type of content and business rules change, media management systems need to serve as an extension of the programmer/operator product teams and dependably deliver video that meets the expectations of viewers accustomed to high quality video over the TV.

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