ScreenPlays Executive Advisory

Video Streaming

The Game Changer for Bandwidth Management

How Technological and Market Forces Are Combining to Outmode Traditional Approaches

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The Emergence of Broadband TV

Nothing yet seen in bandwidth consumption compares to the traffic tsunami that's about to hit broadband service providers now that major TV networks and their over-the-top counterparts have settled on real-time streaming as the way to deliver long-form video to connected devices.

With the shift to streaming, multiscreen distribution has quickly become central to the business strategies of virtually every entity engaged in providing video programming to consumers. As a result, what was already a rapidly escalating volume of video streams entering access networks from OTT players like Netflix and Hulu is destined to quickly reach levels that will require operators to rethink their approach to adding network capacity. This unprecedented growth presents a strategic problem to the network operator – how to continue to add network capacity to meet demand without resorting to a massive spend on infrastructure.

One vivid illustration of the scale of what's in store can be found in NBC Sport's decision to stream over 1,000 live broadcast sporting events, including NFL football, racing's Triple Crown, NHL hockey, PGA Golf and much else, to users everywhere starting in the summer of 2013. NBC, like other pay TV suppliers, will adhere to subscriber authentication requirements in the case of events that are offered over cable channels but will make events delivered over the NBC broadcast network available universally.

The NBC Sports move, announced in April 2013, was the first live TV streaming plan for recurring programs to be officially acknowledged by a major over-the-air broadcast network, although a month earlier the New York Times had reported ABC is developing a mobile app that will make much of its live programming available to the smartphones and tablets of authenticated pay TV subscribers. But on the cable network side the move to live streaming, following the pioneering lead of HBO Go, has been underway for some time as a direct-to-subscriber complement to the aggregated TV Everywhere lineups offered by the major pay TV providers. ESPN has been especially aggressive on this front.

Adding to the competitive push to online streaming of high-profile programming are the big investments of OTT suppliers in original programming. Inspired by the success of the Netflix series "House of Cards," Hulu,

This unprecedented growth presents a strategic problem to the network operator – how to continue to add network capacity to meet demand without resorting to a massive spend on infrastructure.

Amazon, Microsoft, AOL, Yahoo! and a host of other entities have committed to unprecedented volumes of ad-supported original programming. In fact, the scale has reached the point where, for the first time, these players in late April staged the Digital Content NewFronts, their equivalent to the TV industry's "up-fronts," as a way to promote forthcoming series to Madison Avenue.

All of this comes on top of the well-established market for stored TV programs and movies that has been the early driver behind the rapid

escalation in video streaming traffic. As a case in point, Netflix, the leader in this space, saw the volume of content streams to its subscriber base nearly double from a monthly rate of 192 million in mid-2011 to 368 million in mid-2012, according to the Nielsen Co.

In terms of sheer volume, as reported by Sandvine in its 2013 traffic report, Netflix is by far the largest traffic generator in North America. Its video streams account for 32.25 percent of all downstream peak-period consumer traffic on fixed-access networks, far outstripping YouTube, the second largest traffic generator, which accounts for 17.11 percent of that traffic. Sandvine says Netflix now drives one-third of network operators' capacity infrastructure costs.

Significantly, traditional pay TV providers like Comcast with its Streampix service and Verizon in its deal with Redbox are leveraging the same types of delayed-window content availabilities for OTT delivery that Netflix, Amazon, CinemaNow, Hulu, Vudu and many other entities are offering through various on-demand subscription, pay-per-view and ad-supported models. DISH Network, through its Blockbuster brand, is in this game, as is DirecTV with its Everywhere service.

Along with the emergence of video streaming as the technological cornerstone, the primary forces behind this quantum shift to what can arguably be called broadband TV include:

- Mass market consumption of TV programming, movies and other long-form video entertainment on connected devices of every description,
- The rapid increase in fixed and wireless broadband access speeds, and
- A universally shared perception on the part of TV networks and other content suppliers that this change in consumer behavior opens new revenue opportunities that transcend the norms of previous OTT business models.

The Impact of Adaptive Bitrate Streaming

The role of streaming as the linchpin to these new strategies rests on the rapid maturation of what is known as adaptive bitrate (ABR) technology, which was first introduced by Move Networks in 2008. ABR represents a major advance over the Flash and other streaming modes that were widely used with short-form videos and has largely supplanted the progressive download mode that dominated long-form video distribution.

Whereas progressive download is simply a mechanism for transferring an archived video file to a computer in a way that lets the video play out as the download is underway, ABR is the Internet equivalent of a narrowcast cable TV channel, although, unlike narrowcasting in cable, it delivers live as well as on-demand content on a dedicated per-user basis. In the time since it came into wide use, most notably with the Netflix shift to online subscription service in 2010, ABR and the HTTP (Hypertext Transport Protocol) content delivery network (CDN) architecture on which it is based have matured to where broadcasters can rely on ABR as a viable mode for distributing the highest value content in 1080p HD with dynamic placement of interstitial advertising targeted to each user.

The bandwidth implications of making prime time TV available via individual streams to each user are stunning in comparison to the efficiencies of shared channel access traditionally associated with live TV programming. For streams targeting big-screen TV sets at 1080p resolution the per-session data rates typically run at 5 megabits-per-second or above.

The 2012 Olympics Experience

The breakthrough to live streaming for broadcasters came in the summer of 2012 when NBC, the BBC and other major broadcasters began streaming some 3,000 Summer Olympics events live to every class of connected device worldwide. Nothing approaching this scale of live streaming had ever occurred before.

According to figures compiled by NBC Sports and other entities tracking U.S. viewing, the network's online coverage broke multiple online streaming records, starting with the fact that 159 million video streams consuming 20.4 million hours of total viewing time. Live events accounted for 64.4 million of those streams and 13.6 million viewing hours.

First and foremost, the technical achievement underlying the success of ABR is that it continuously adjusts the bitrate to support uninterrupted viewing at the most optimal screen resolutions that can be achieved within available bandwidth constraints over the course of a viewing session. Equally important to the business opportunities, ABR, as an IP-based technology, facilitates the interactive functionalities and data-gathering capabilities that are vital to advanced advertising and other revenue models.

Moreover, ABR enables the use of a hierarchical distribution infrastructure that employs distributed storage mechanisms (caching) supplied by providers of caching and CDN technology and services. Caching provides a means to minimize bandwidth consumption over network links upstream of the caching points while making it easier for content suppliers to meet quality of experience expectations commensurate with their business goals. For broadband service providers, the scalability of caching technology as a traffic control mechanism that can be positioned at deeper points in the distribution chain affords them a cost-effective way to prevent video streaming from overwhelming their networks.

By making the case on an unprecedented scale that ABR was ready for prime time TV the 2012 Olympics experience transformed the strategic outlook for the Internet as a conduit for TV-caliber entertainment. The maturation of ABR as a technology that allows content suppliers to achieve performance capabilities on par with traditional modes of TV distribution represents a force for disruption in the television business that's at least comparable to what occurred with earlier technology-driven transitions when TV went from analog broadcast to analog cable and then to digital broadcast, satellite and cable and eventually to digital HD.

Key Advances in ABR

One of the factors contributing to the rapid rise of ABR as the dominant mode of online video distribution has been the ability of the vendor community to address key issues that at one time threatened to slow market adoption. These fast-moving advances can be hard to follow, leaving less-than-attentive observers vulnerable to reliance on outmoded assumptions.

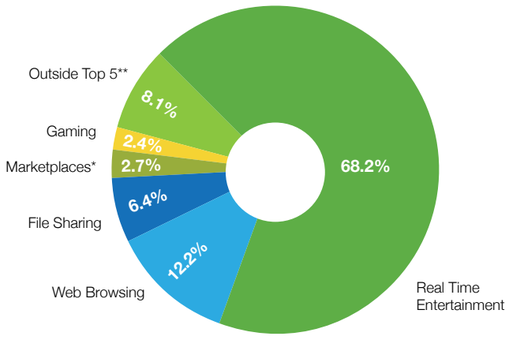
ABR employs a "pull" mode in distribution technology that is altogether different from the "push" mode of traditional digital TV. Every few seconds an ABR-enabled device, by referencing the bitrate options or "adaptation sets" listed for a given piece of content in a manifest file sent from an HTTP server, asks the server to send a segment or fragment, also called a chunk, of streamed content at the most optimum bitrate, depending on how much bandwidth is available at that moment in time and how much processing power the device has available for decoding the bit streams.

While each chunk is delivered, the device monitors the bandwidth and CPU usage conditions, referencing the variant playlist file in the file manifest of the ABR system so that the next chunk properly conforms to conditions. All the profiles for each device are synchronized or aligned with each other in the content provider's transcoder so that the appropriate file for each chunk is transmitted in seamless sequence with no skips or frame misalignments.

Starting in 2010 and extending through much of 2012 the Internet video world was in a state of disarray over competing ABR formats and the codecs they use. While each of the major ABR approaches, including Microsoft's Smooth Streaming, Adobe's HTTP Dynamic Streaming (HDS) and Apple's HTTP Live Streaming (HLS), provided compelling means by which distributors could leverage the installed base of HTTP servers to support uninterrupted delivery of content across the Internet, the incompatibilities among these three protocols fragmented the market. They all use the MPEG-4 H.264 video codec along with MPEG Advanced Audio Coding (AAC), but each uses a different approach to constructing fragments, timing their sequence and communicating manifest files to clients.

There are also incompatibilities that had to be addressed with respect to content protection. The Smooth Streaming client software is designed primarily to work in conjunction with the proprietary PlayReady DRM system. Adobe has its own DRM format, Flash Access. The HLS client has a more open format that fully defines the encryption approach using a set of AES-128 16 bytes keys, but leaves unspecified the management of the delivery of these keys. This means that each media asset prepared by

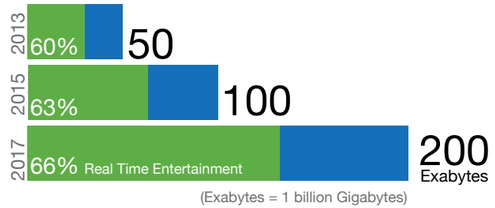
North America Peak Period Fixed Access Downstream Traffic Consumption



*Sites where subscribers can purchase and download media & applications,
**All sites other than top 5
Source: Sandvine Global Internet Phenomena Report 2013

Figure 1a

Projections U.S. Fixed Access Traffic & % Entertainment Video

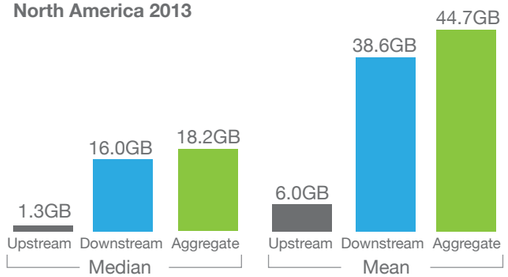


(Exabytes = 1 billion Gigabytes)

Source: Sandvine Global Internet Phenomena Report 2013

Figure 1b

Fixed Access Monthly User Consumption North America 2013



Source: Sandvine Global Internet Phenomena Report 2013

Figure 2

a transcoder must be formatted and encrypted for the type of device on the receiving end, and the key server must deliver keys matched to the DRM system that works with that device.

While the incompatibilities persist and efforts to overcome them through the standards initiative known as MPEG DASH (Dynamic Adaptive Streaming over HTTP) have made limited headway, the real force behind minimizing the problem has come through a combination of factors, including technology innovation, the growing dominance of two of the three major ABR modes, Smooth and HDS, and the faltering of Google's efforts to unseat ABR with an alternative streaming mode known as WebM.

Since 2011, when all these formats were aggressively positioning themselves in the nascent long-form streaming market, the success of the iPad and Microsoft's Xbox Live initiative have pushed HLS and Smooth to the forefront, sidelining HDS as a contender in the early multiscreen premium-service arena. While WebM made some inroads, especially in short-form video distribution and niche long-form markets, the format hasn't taken hold in mainstream high-value video content market, as evidenced by the fact that the latest versions of the Google Android OS are configured to use the HLS mode of AR.

Equally important, ongoing development efforts by suppliers of transcoding, DRM, CDN and other distribution technologies have greatly minimized the inconvenience of these incompatibilities. As a result, issues viewed as real barriers to progress as recently as the first half of 2012 are now of far less concern to OTT video distributors.

Further easing the technical hurdles is the fact that turnkey cloud-based solutions like Microsoft's Azure Media Services, Accedo and iStreamPlanet have exploited the improved technology platforms to create cost-effective ways to utilize ABR at global scales. NBC Sports, for example, has relieved itself of the technical hassles by employing Azure to take care of everything, including management of dynamic advertising and CDN distribution as well as the core transcoding and content processing.

Trends in Video Streaming and Consumer Usage

Along one trajectory there's the surging rate of long-form video consumption on a rapidly expanding population of devices, including tablets, smartphones and smart TVs, that weren't even on the radar screen when TV networks and motion picture studios began making content available on the Internet a few years back. Several research reports provide perspective on access speeds, usage patterns and what can be expected in the years to come.

The Video Impact on Internet Traffic Patterns

Fixed Access

One perspective comes from monitoring of Internet traffic patterns across fixed and mobile access networks, as reflected in Figures 1-4. In the case of Sandvine (Figure 1), the firm's most recent traffic statistics offer a snapshot of current usage patterns drawn from monitoring devices operating on networks worldwide, with extrapolations here focusing on usage in North America. Sandvine's statistics apply to consumer usage only and so provide a very specific view of the role of entertainment video in the traffic flow.

Sandvine's projections equate to 4X growth in annual fixed access traffic from 2013 to 2017. Remarkably, with the share of traffic represented by entertainment video increasing over that period, the projected volume of entertainment traffic comes to 2.6X the total traffic that was projected for all types of usage in 2013.

Global Consumer Internet Video 2011-2016

	2011	2012	2013	2014	2015	2016	CAGR
Fixed	10.2	16.4	20.0	24.0	31.7	40.5	32%
Mobile	0.2	0.5	0.9	1.7	3.0	4.7	90%
Total	10.4	16.9	20.9	25.7	34.7	45.2	
By Category							
Short form	1.2	1.7	2.3	3.0	4.0	5.3	34%
Long form	6.4	9.9	10.9	12.4	14.5	17.3	22%
Internet video to TV	0.9	1.7	2.3	3.1	4.3	5.5	45%
Live Internet TV	1.0	1.6	1.9	2.4	2.9	3.6	29%
Other	0.7	1.5	2.8	4.9	3.6	11.0	90%
North America Internet Video							
All Categories	3.3	5.4	5.7	6.2	7.0	8.1	20%

Source: Cisco Visual Networking Index, 2012

Figure 3

Category definitions:

Short form: User-generated video and other video clips generally less than 7 minutes in length

Video calling: Video messages/calling delivered on fixed Internet initiated by smartphones, non-smartphones, and tablets

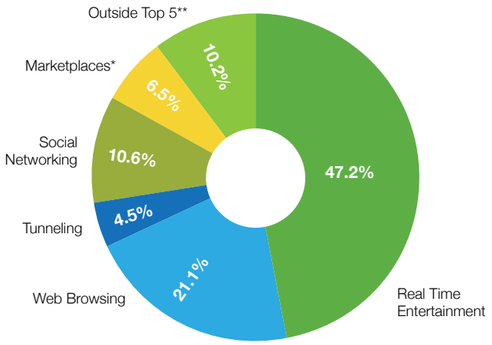
Long form: Video content generally greater than 7 minutes in length

Internet video to TV: Video delivered through the Internet to a TV screen, by way of an Internet-enabled set-top box (for example, Roku) or equivalent device (for example, Microsoft Xbox 360), Internet-enabled TV, or PC-to-TV connection

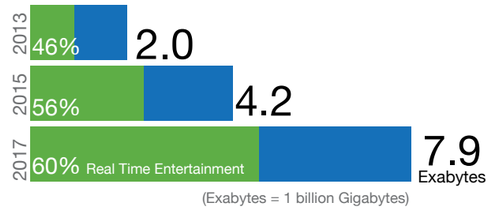
Live Internet TV: Peer-to-peer TV (excluding P2P video downloads) and live television streaming over the Internet

Other: Internet PVR; Ambient video (cams), and mobile video

North America Peak Period
Mobile Access Downstream Traffic



Projections U.S. Mobile Access Traffic
& % Entertainment Video



* Sites where subscribers can purchase and download media & applications,
** All sites other than top 5
Projections U.S. Mobile Access Traffic & % Entertainment Video

Source: Sandvine Global Internet Phenomena Report 2013

Figure 4

The Sandvine report also provides an interesting glimpse into individual usage rates on fixed access lines in North America and the U.S. (Figure 2) Service providers can expect those rates to climb commensurately with the projected traffic rates in Figure 1, less the amount of traffic attributable to new subscribers. This suggests the monthly downstream mean fixed usage rate in the U.S. could reach 150 GB per user or more by 2017, which today is a usage rate reached by less than ten percent of all subscribers, according to figures compiled by Sandvine in its 2012 report.

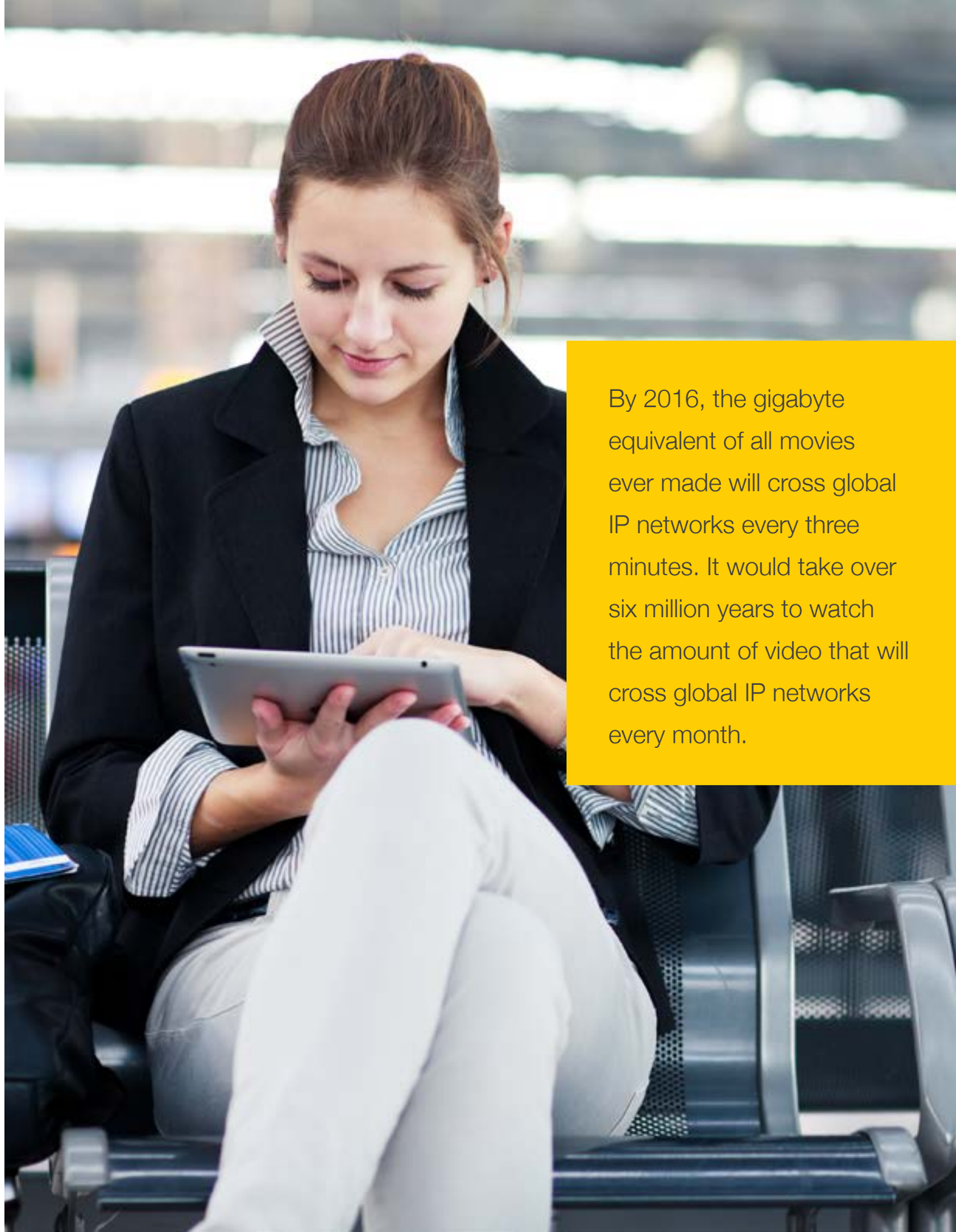
Serving to buttress the outlook offered by Sandvine is another perspective on traffic patterns provided by Cisco Systems through its Visual Networking Index series. Cisco's metrics and extensive projections for global and regional usage, which track both consumer and business consumption, are based on its own routing compilations along with research from other entities (Figure 3).

Cisco cites some dramatic comparisons to highlight the coming impact of video on Internet traffic, noting, for example that, by 2016, the gigabyte equivalent of all movies ever made will cross global IP networks every three minutes. It would take over six million years to watch the amount of video that will cross global IP networks every month, Cisco says.

Video, not counting peer-to-peer file sharing, will account for 55% of all consumer Internet traffic by 2016. Counting p2p the ratio will be 86%, the company says. A trend line of special interest to pay TV service providers is the one pointing to consumption of Internet video on TV sets, which by 2016 is projected to increase six fold from 2011, which is when such viewing took off with a doubling of traffic volume over the previous year.

Mobile Access

While cable providers have largely moved away from the mobile business, the amount of video traffic anticipated for mobile networks is of



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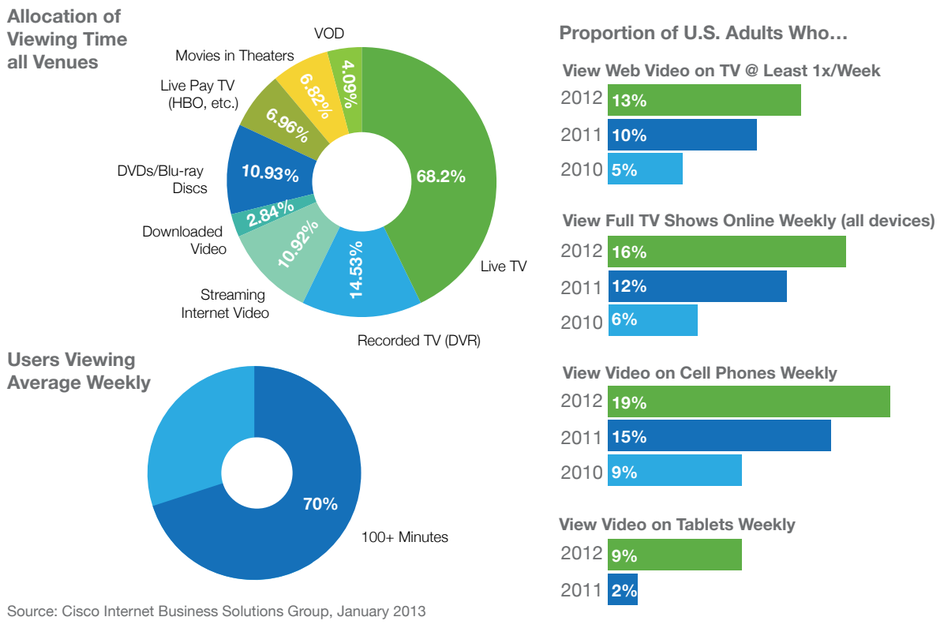
great concern, given that users on dual-mode mobile devices within reach of a broadband Wi-Fi connection typically are switched over to the Wi-Fi. This already has implications for in-home video consumption on mobile devices and will be of greater concern traffic-wise as operators continue to build out their outside Wi-Fi networks. Figure 4 summarizes Sandvine's findings on the mobile side.

As seen in Figure 3, Cisco, too, points to the surge in mobile data traffic as a portion of overall Internet traffic growth in the years ahead. In a report focusing strictly on mobile traffic released in February 2013, Cisco predicts mobile data traffic volume will increase 13 fold from 2012 to 2017 with the video share of that traffic rising from 50% in 2012 to 66% in 2017. Of the 11.2 exabytes per month crossing the mobile network by 2017, 7.4 exabytes will be due to video, the report says.

The report also analyzes the impact video viewing on mobile devices is likely to have on Wi-Fi access usage resulting from automatic cutover from mobile to Wi-Fi when dual-mode devices are in reach of Wi-Fi connections. The report says its offload volume projections are determined by smartphone penetration, dual-mode share of handsets, percentage of home-based mobile Internet use and percentage of dual-mode smartphone owners with Wi-Fi fixed Internet access at home. While the percentage of tablets with cellular connectivity is on the rise, the offload figures don't include tablets at this early stage of evolution in that device category.

Trends in Broadband Access Speeds

The good news for broadband service providers, especially on the cable side, is they've been able to keep pace with bandwidth demand by funding capacity expansion at relatively low costs. The bad news is consumer and content supplier awareness that more bandwidth is available contributes to the rising tide of video streams coming over the networks.



Source: Cisco Internet Business Solutions Group, January 2013

Figure 5

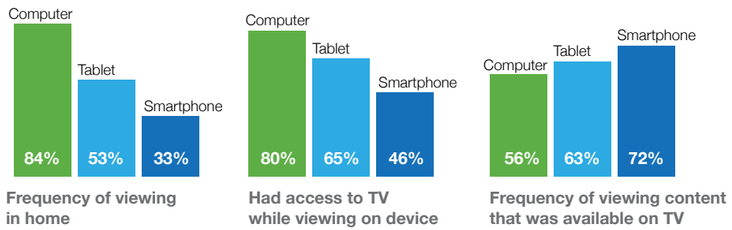
According the latest State of the Internet report issued by CDN provider Akamai, the average downstream connection speed, which is a measure of how fast data is flowing to each user during each online session, rose globally by 25 percent over the most recent 12-month period of measurement, going from 2.3 mbps in Q4 2011 to 2.9 mbps in Q4 2012. In the U.S. the average connection speed rose 28 percent over that period, going from 5.8 mbps to 7.4 mbps.

In terms of broadband subscription rates, which is to say, the rate advertised with a broadband subscription, the average subscribed speed in the U.S. is now 15.6 mbps, representing an average annualized speed increase of about 20 percent, according to the FCC's 2013 Measuring Broadband America—February Report. But even as the access rates go up, the impact of peak usage on those rates is increasing, the report notes.

For example, whereas results reported in July 2012 showed that peak-period session speeds decreased from 24-hour average speeds by 3.9 percent on cable broadband networks, the February 2013 report found the peak-period rate drop had risen to 4.2 percent. The same phenomenon was revealed with fiber-to-the-home networks, where the peak drop off went from 0.9 percent to 2.4 percent, and DSL, where the drop off went from 3.5 percent to 4.0 percent.

Congestion issues aside, existing subscribed data rates on fixed and mobile networks are more than adequate to the needs of video streaming. The FCC said its February 2013 test results *"suggest that video streaming will work across all technologies tested, though the quality of the video that can be streamed will depend upon the speed tier."* This means, for example, that standard definition TV resolution can be supported at speeds ranging from 1 to 2 mbps, depending on streaming modes and other factors, and that full 1080p HD can be streamed at 5 mbps, the report says.

Connected Device Usage in U.S. Broadband Households



Source: CTAM May/June 2012 Pulse Research conducted by Chadwick Martin Bailey

Figure 6

Given the much smaller screens in play with mobile access, current data rates are sufficient to video streaming requirements on those devices, where, according to Cisco's 2013 mobile VNI report, the current global average access rate is 526 kbps across all generations of mobile network platforms now in operation and is projected to climb to 3.9 mbps by 2017. Smartphone access, operating over 3G and 4G mobile networks, is already at 2 mbps and is expected to hit 6.5 mbps by 2017, Cisco says.

But as access rates encourage greater use of video streaming, the strains on local backbone transport capacity mount. Unlike access routes where operators can allocate more of available spectrum to broadband at relatively low infrastructure costs, the need to add backbone capacity incurs high incremental costs insofar as operators typically don't provision more than they need at any given time.

Consumer Usage Patterns

With video now easily accessed on multiple types of devices, it's no surprise that consumer usage patterns are responding accordingly. Research results shown in Figure 5 provide a variety of insights into online video usage in the U.S.

The smartphone, tablet and PC offer viewers a personalized experience that doesn't rely on reaching a consensus on what to watch with other family members.

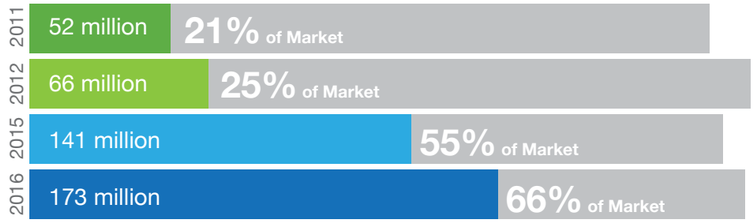
For example, the findings reported by Cisco Systems' Internet Business Solutions Group in early 2013 show that when percentages of viewing time allocated to streamed and downloaded Internet video are combined, the total, 13.7%, exceeds average time spent viewing video delivered through several traditional outlets, including DVD/Blu-ray, premium TV networks, movie theaters and VOD. And it's fast approaching the percentage, 14.53%, allocated to viewing home recorded video.

A particularly interesting aspect to consumers' use of connected devices for video entertainment is how frequently they use these devices as the preferred access option even when the pay TV-connected TV set is close at hand, and even when what they're watching on the connected devices is offered over a pay TV channel they subscribe to. The numbers reflecting this trend from a recent study commissioned by the Cable and Telecommunications Association for Marketing (Figure 6) no doubt have a lot to do with the preferences of younger viewers in the household, but they also attest to the fact that the smartphone, tablet and PC offer viewers a personalized experience that doesn't rely on reaching a consensus on what to watch with other family members.

It's important to note that a new phase in online video consumption has set in with the emergence of the smart TV and a variety of retail devices designed to deliver online video to legacy TV sets. Figure 7 provides recent findings from various researchers tracking how the connectivity of the TV is impacting viewing trends.

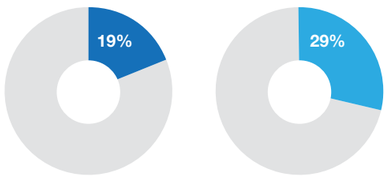
The smart TV represents a new force for disruption that pushes OTT video consumption into the pay TV stronghold. So far, amid surging smart TV sales worldwide penetration in the U.S. market has lagged other countries,

The Impact of Connected TVs
Global Smart TV Penetration & Projections

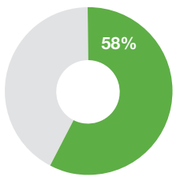


Source: IHS Screen Digest, February 2013

Percentage of HDTV Sets Connected to the Internet

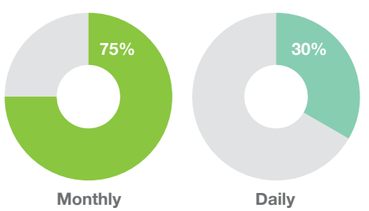


Percentage who Regularly View OTT Video

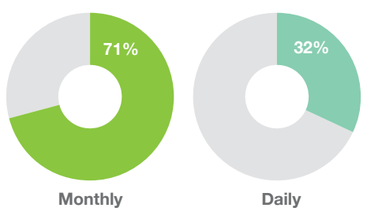


Source: The NPD Group DisplaySearch, 2013, and Connected Intelligence, Applications & Convergence, 2012

Percent of U.S. Smart TV Owners Who Watch…
Online Movies



Online TV Shows



Source: Parks Associates, 2012

Figure 7

Trends in Online Video Ad Spending
Category Comparisons in Digital Advertising

	2010	2011	2012	2013	2014	2015	2016
							($ billion)
Total Digital Ad Spending	$26.29	$31.99	$37.31	$42.50	$47.77	$51.95	$55.25
Y-to-Y Growth Rate		21.7%	16.6%	13.9%	12.4%	8.7%	6.4%
Display Ad Spending	$9.91	$12.33	$14.80	$17.67	$20.69	$23.13	$25.21
Display as % of Total	37.7%	38.5%	40.2%	41.6%	43.3%	44.5%	45.6%
Y-to-Y Growth Rate		24.4%	20.0%	19.4%	17.1%	11.8%	2.5%
Video Ad Spending	$1.42	$2.00	$2.93	$4.14	$5.75	$6.99	$8.00
Video as % of Total	5.4%	6.3%	7.9%	9.7%	12.0%	13.4%	14.5%
Y-to-Y Growth Rate		40.8%	46.5%	41.3%	23.7%	11.7%	8.2%

Source: eMarketer, September 2012

In-Stream Video Ad Placements

	Q4 2011	Q1 2012	Q2 2012	Q3 2012	Q4 2012
Short-Form (<5 min.)					
Digital Ads per Video	0.54	0.53	0.56	0.52	0.66
Completion Rate	54%	64%	69%	67%	68%
Mid-Form (5-20 min.)					
Digital Ads per Video	1.22	.20	1.32	1.41	1.27
Completion Rate	68%	76%	80%	79%	81%
Long-Form (>20 min.)					
Digital Ads per Video	6.92	6.29	7.96	6.94	9.41
Completion Rate	88%	85%	1%	93%	93%

Source: FreeWheel, Video Monetization Report, February 2013

Figure 8

including, most notably, China, where penetration is now 41 percent versus about 19 percent in the U.S., according to the latest findings from NPD Group's DisplaySearch unit. But given the use of devices like IP set-tops and game consoles that connect traditional TVs to the Internet, U.S. consumers' consumption of Internet content on their TVs is actually much greater than smart TV penetration numbers would imply, as reflected in the NPD numbers in Figure 7.

In any event, the smart TV penetration rate is bound to increase. Another researcher, eMarketer, projects smart TV penetration in the U.S. will rise from 15.2 million households at yearend 2012 to 40.2 million in 2016. Critically, as the sales volumes increase, the capabilities of the models being shipped are expanding as well, creating a new foundation for advanced applications with broad implications for advertising and the broadband TV experience.

It's All about the Money

ABR and the new connected device ecosystem are establishing a foundation across all viewing locations not only for a new type of consumer entertainment experience but for a new approach to advertising as well. Already this has made online video advertising the fastest growing category in Internet advertising with a year-to-year growth rate exceeding 40 percent since 2010 (see Figure 8).

Of course, at this point online video advertising, registering close to $3 billion in 2012, according to the estimates of eMarketer, pales next to the $70 billion spent on TV advertising. And while the rate is projected to continue outpacing other Internet segments with the annual total closing in on $8 billion in 2016, the question for content suppliers is whether their commitment to a much more ambitious pursuit of ad dollars with their expanded video streaming strategies can drive the revenues to much greater heights in the years ahead.

Certainly the results with advertising in long-form video so far, as reflected in the FreeWheel metrics in Figure 8, bode well for the prospects. Already, FreeWheel reports, the in-stream video ad count is topping nine per long-form video with a completion rate on viewing of full ads hitting 93 percent as of Q4 2012.

Programmers' expectations gained new credibility with a report entitled "2013 Online Advertising Performance Outlook" produced in spring 2013 by Vizu, a Nielsen company, in collaboration with the CMO Council. Ad agencies responding to Vizu's survey reported they expect to increase spending on online video by a whopping 73 percent in 2013.

The biggest factor behind agencies' and programmers' more aggressive push into online exposure for their ads and content is the fast-growing audience of consumers who can best be reached on connected devices. But much of the excitement around the ad revenue potential for streamed video also rests on the potential for higher revenues from targeted advertising.

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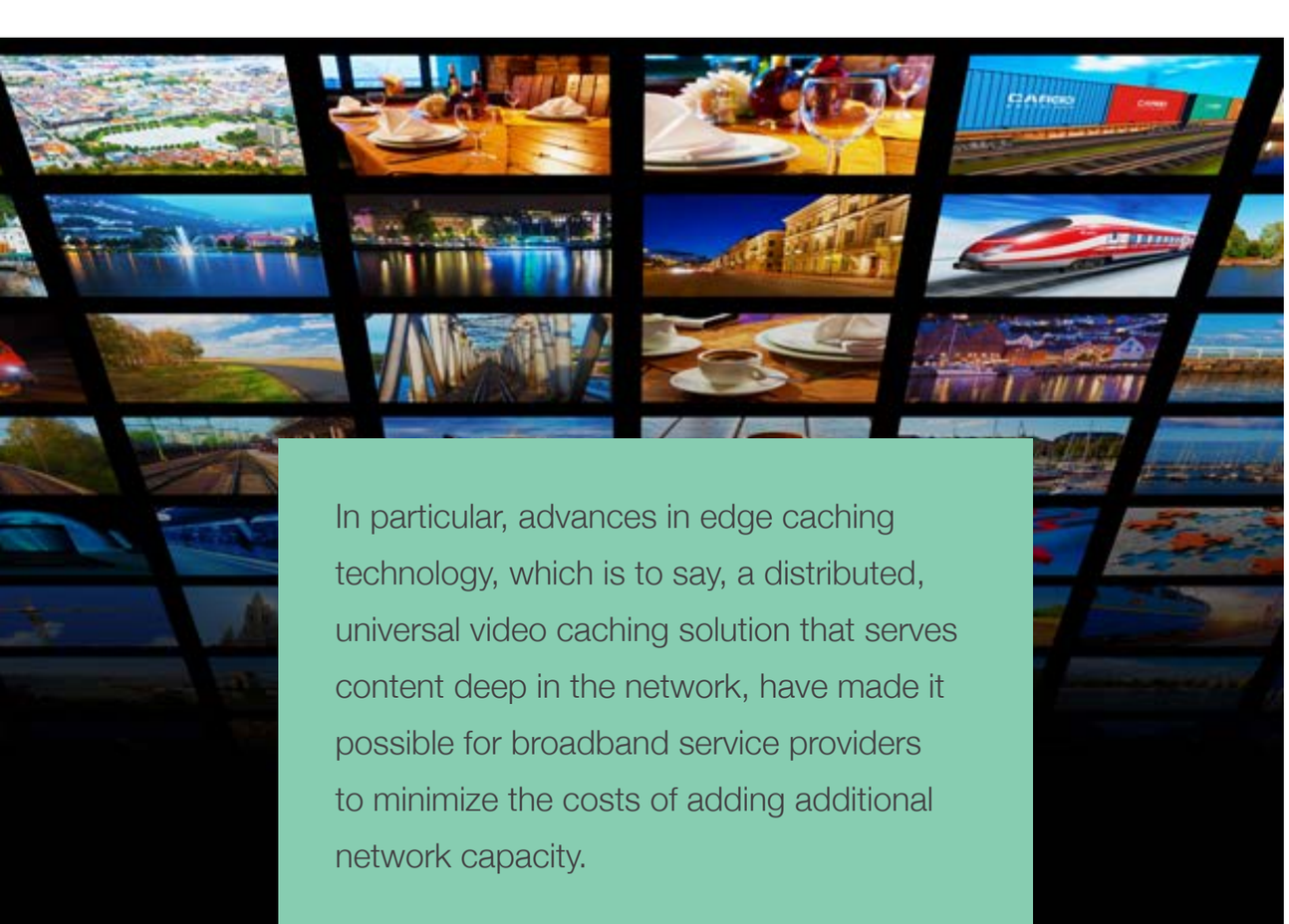
By virtue of the communication flow between servers and devices that's intrinsic to the ABR fragmentation and manifest process, it's possible to precisely time dynamic ad insertions with the flow of spot avails on a per-session basis. Moreover, the streaming platform can be used to feed the information it is collecting about the device and user into a third-party ad network, enabling personalized delivery of ads with each session and collection of viewing metrics as the ads run.

Such capabilities are coming into play thanks to efforts by ad and streaming system suppliers to create an interoperable ecosystem for advanced advertising tied to ABR. As a result, prospects are good that targeting viewers with ads matched to their demographic and geographic profiles as well as the context of what they're viewing will result in higher CPMs for ad views than programmers get for traditional spot ads on broadcast TV.

Players in this market readily admit that there is no common “currency” for setting such CPM rates such as has developed around Nielsen ratings in traditional TV advertising. But advertising agencies, Nielsen, programmers and service providers are making rapid progress in that direction, as evidenced by Nielsen’s May 2013 launch of a pilot program with NBC, Fox, ABC, Discovery and other programmers to test a new tool for measuring online viewing of TV shows.

Meanwhile, content companies are reporting good responses to proposed ad strategies tied to online streaming of high-value programming. For example, Hulu, jointly owned by Comcast, Disney and News Corp., after registering a 60 percent jump to $420 million in revenues in 2011 logged an even bigger spike at 65 percent in 2012 with a reported $695 million in advertising and subscription sales. With more spending than ever going to original programming, including four new shows launching in the second half of 2013, Hulu clearly expects this trend to continue.

As another example, NBC Sports spent much of the year prior to announcing its live streaming plans determining whether advertisers would be willing to pay higher CPMs for the targeted spot inventory it intends to make available. The entire inventory for all 1,000 plus events slated for the year following summer 2013 launch was sold out as of spring 2013, reports Rick Cordella, senior vice president and general manager for digital media at NBC Sports and Olympics.



In particular, advances in edge caching technology, which is to say, a distributed, universal video caching solution that serves content deep in the network, have made it possible for broadband service providers to minimize the costs of adding additional network capacity.

Leveraging a Bandwidth Friendly Architecture

What all this means for broadband service providers in terms of the potential impact on bandwidth usage is in many respects up to them. As things now stand, the immense surge in unicast streams of long-form video looms as a daunting challenge to anyone who hopes to cope with the rising tide solely through massive spending on brute force capacity expansion.

Compounding the problem, wide-scale use of dynamic advertising will trigger still another flood of video content across operators’ networks as each user session triggers a call for multiple ads to be streamed independently from ad servers wherever they may be for placement on client devices. Notwithstanding all the potential ad dollars and other revenues flowing to the OTT content providers, the prospects for recovering the costs of accommodating all this traffic are uncertain at best.

Fortunately, the fact that CDN caching architecture is intrinsic to the ABR streaming infrastructure provides a means of achieving higher bandwidth efficiency that could significantly reduce operators’ capital spending costs as the video traffic intensifies. To realize such benefits operators would need to add a new more localized and operator-owned caching tier to the CDN caching hierarchy as a way to reduce traffic volume between their interfaces with the core Internet transit and peering facilities and their hubs, mobile gateways and other local distribution points.

The primary role of caching technology is two-fold: to position Internet content closer to end users thereby speeding its delivery to requesting clients and to minimize traffic congestion on core networks. CDN providers position caching servers by the tens of thousands at regional hubs across the globe to facilitate temporary storage of content so that once a request has been received by the originating website from a client in a given region subsequent requests for that content from that region can be directed to the regional cache.

CDNs use a variety of algorithmically orchestrated policies to determine when and for how long content is cached at any given location. For whatever duration a particular content element is cached all requests from users served by that caching location will be directed to that cache, thereby avoiding the need to retransmit the content from the point of origin.

Caching has had a major impact on the ability of the core Internet backbone to survive the traffic pressures arising from escalating volumes of video transmissions from websites. When broadcasters decided to stream all of the 2012 Olympics events live to users around the world, many experts warned the traffic loads might be too much for the core network to bear. But, by virtue of measures taken by broadcasters like NBC to maximize use of caching technology, there were no disruptions reported from the record-setting streaming traffic even at peak usage periods.

With the costs of adding a gigabit of operator backhaul capacity now reaching $50,000 or more, caching solutions offer a much more cost-effective approach to managing traffic, especially if they’re applied in ways that maximize efficient use of operator network resources. In particular, advances in edge caching technology, which is to say, a distributed, universal video caching solution that serves content deep in the network, have made it possible for broadband service providers to minimize the costs of adding additional network capacity.

There's great serendipity in the fact that the very technology that is unleashing an unprecedented expansion in traffic flow over broadband distribution networks also provides a means to cost-effectively control the impact of that traffic.

With such capabilities operators can set policies respecting targeted traffic to great degrees of granularity, leaving other traffic untouched while ensuring real-time user experiences are preserved across all types of traffic. For example, caching resources can be engaged to focus strictly on the traffic of greatest concern, such as long-form video, where the goal is to identify and capture content responsible for a large share of bandwidth consumption on the operator's transport network. Similarly, as dynamic advertising comes into play, the caches can also be focused to cache ads for ongoing placement across multiple streams as user requests come in, thereby avoiding repeated transmissions of those ads from their points of origin.

Conclusion

There's great serendipity in the fact that the very technology that is unleashing an unprecedented expansion in traffic flow over broadband distribution networks also provides a means to cost-effectively control the impact of that traffic. For broadband service providers the challenge is to create a new strategic plan for their networks so that they don't find themselves forced to continue using traditional and costly network capacity investment models in response to growth in OTT video.

Engineering practices that have been used to project future capacity needs based on monitoring past trends in traffic flows and usage patterns must be supplemented by a clear-eyed understanding of how market and technology developments are likely to impact those historical trend lines. The scale of activity on the part of major TV networks and the powerhouses of Internet video together with the mass consumer market shift to long-form video consumption on connected devices leaves no doubt that broadband TV will be a catalyst for strategic change when it comes to how operators go about managing traffic on their networks.

If the online coverage of the 2012 Olympics established the viability of ABR streaming as a new mass distribution medium, it also proved the power of caching technology as the key to controlling its otherwise disruptive force. As network service providers find ways to adapt their business models to accommodate the shift to broadband TV, their ability to put caching technology to use in their networks could go a long way toward strengthening ROI on those new business models.