ADOPTION TRENDS OF OVER-THE-TOP VIDEO FROM A NETWORK PERSPECTIVE

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ABSTRACT

The video content delivery industry is in a state of flux due to the changing business models for delivering video to the consumer. The traditional business models used by the cable companies are being challenged by new models for delivering the content due to technology innovations in consumer devices that have been fueled by the wide-spread adoption of both wireline and wireless broadband services.

This paper looks at the effects of technological and market advances on subscriber usage behavior and network traffic.

INTRODUCTION

The adoption of broadband service with DOCSIS over the past ten years ignited a market for the delivery of video content using these same broadband networks. The wide spread adoption of broadband service, the ever increasing speeds of service, and the growing ubiquity of Wi-Fi enabled devices capable of receiving and playing video, has created a tidal wave of demand for content from subscribers.

For this paper, a study was performed to look at trends in over-the-top video and its impacts on North American wire-line broadband networks. The study included an examination of the trends in broadband connectivity speeds in North America, and of data collected over the last four years by Sandvine as part of its Global Internet Phenomena report in order to identify the effects of the changes in broadband connectivity speeds. Finally, the research also included a case study as an example of the type of on-line viewing events that have been enabled with the advances in technology.

In brief, the study showed

- Broadband speeds in North America continue to trend up
- The growth and adoption of over-the-top video correlates with the increases in the broadband connectivity speeds
- A growing trend towards alternate platforms for viewing video

This paper provides a detailed analysis and summary of the findings.

YEAR OVER YEAR TRENDS

Average Measured Connection

To understand what is enabling the growth of over-the-top video traffic, it is important to look at the average broadband connection speed. Akamai's *State of the Internet* which is published quarterly provides a snapshot of the measured average speed of Internet connections, by country on a global scale. As shown in Figure 1, the average connection speed in North America has been going up since 2008. The speed trend in North America roughly aligns with the wide spread offering of DOCSIS 3.0 by the North American cable operators.

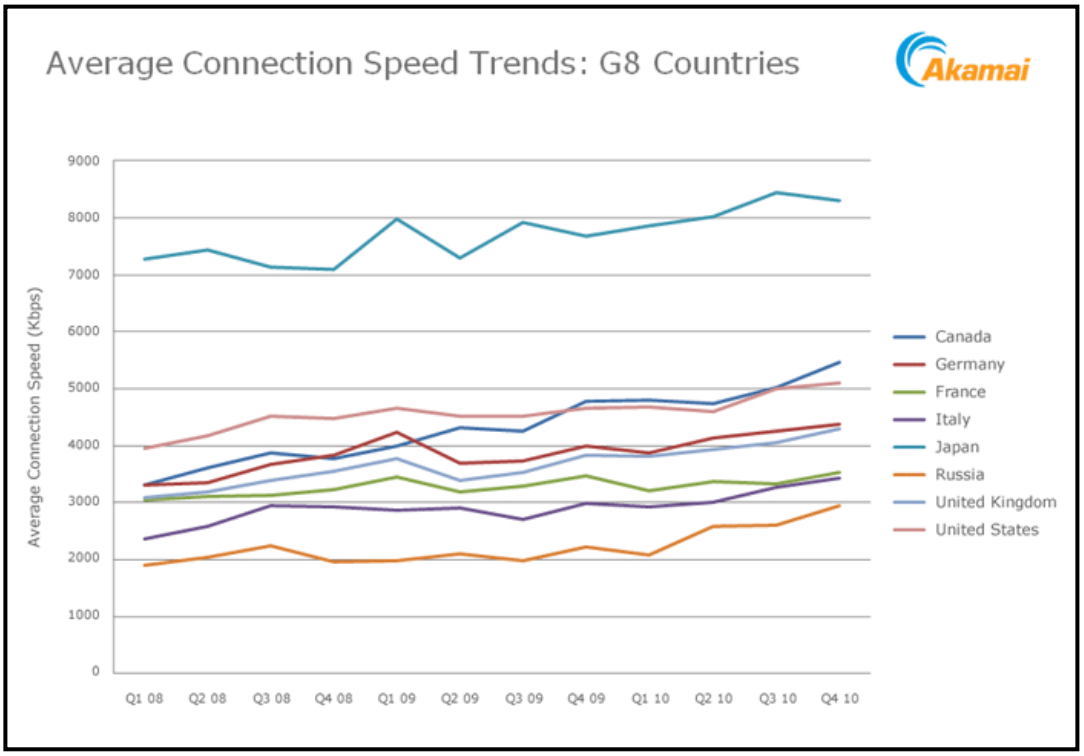

Figure 1: Average Connection Speed Trends: G8 Countries

Period	United States - Average Measured Speed
Q4 – 2008	3.9 Mbps
Q4 – 2009	3.8 Mbps
Q4 – 2010	5.1 Mbps

Table 1: Average Measured Connection Speed for Select Quarters[1]

Adoption of New Computing Devices

Over this same period, subscribers began adopting additional computing devices to access content using their broadband connection. The Apple iPhone was released June 29, 2007[2] followed by the release of the 3G version a year later in June 2008. Around the same time other manufacturers released similar smartphones. The wide spread adoption of smartphones led manufacturers to release tablet computers with a look and feel similar to smartphones. Apple released the first generation iPad in June 2010[3] which was quickly followed by similar releases from other manufacturers.

Subscriber Usage Behavior

What is the effect of the increases in broadband connectivity speeds and device choices? The key change is a shift in subscriber usage behavior. Sandvine conducts and publishes annually its *Global Internet Phenomena report*[4][5][6], wherein it looks at trends in subscriber usage behavior with respect to applications. The report is global in scope, and breaking down trends and usage by subscribers on a regional level. For this paper, data was gathered from the 2008-2011 studies with a focus on North American subscribers and content being delivered to the subscriber (which is commonly referred to as in the downstream direction). The report summarizes and categorizes the

applications. The data for this study was grouped by application genres to illustrate the subscriber usage trends as it relates to over the top video. The content category definitions are as described in Table 2.

Content Category	Definition
Web	Web browsing protocols and specific websites such as HTTP
P2P	File-sharing applications and protocols that rely on peer-to-peer network models for content distribution such as BitTorrent, Gnutella, and eDonkey
Real-time Entertainment	Application and protocols that allow "on-demand" entertainment that is consumed as it arrives such as Flash video, Slingbox, PPStream.
Other	All other protocols

Table 2: Content Categories and Definitions

Table 3 and Table 4 show the aggregate traffic composition for each year, for the top four categories. The data show constant a year-over-year decline in web traffic, and a trending decline in P2P traffic. The declines in the web traffic and P2P traffic are matched by similar increases in real-time traffic. These downward trends in web and P2P traffic and the corresponding increase in real-time traffic illustrates the continued shift from a reliance on "download now, use later" content acquisition to a on-demand mentality where bytes are consumed as they arrive.

	2008	2009	2010	2011
Web	57%	39%	20%	19%
P2P	19%	16%	19%	13%
Real-time Entertainment	10%	29%	43%	53%
Other	14%	17%	18%	14%

Table 3: Aggregate Traffic Composition by Category

	2008	2009	2010	2011
Web		-19%	-19%	-1%
P2P		-3%	4%	-6%
Real-time Entertainment		18%	14%	11%
Other		3%	1%	-4%

Table 4: Year-Over-Year Relative Change

The overall usage is interesting in itself, but what is important to the network engineers is the distribution of the usage during the peak hour. The figures below show the downstream traffic profiles for 2009-2011. Examination of the traffic profiles again shows the shift to real-time entertainment, in particular during the "peak hours". There has been continued expansion of the window of peak hours as well as "how" subscribers use the network during peak hours. In 2009, the majority of the traffic during the peak hours was from web traffic and the second largest category of traffic was real-time entertainment. 2010 shows both a dramatic increase in the overall percentage of traffic that is categorized as real-time entertainment as well as the expansion of the peak hours.

This trend continues into 2011, with real-time entertainment continuing its expansion both in time and usage. The other trend that can be observed in the data is the change in the ratio of the

peak-to-trough. From 2009 to 2011 we see the peak-to-trough increase; further evidence of a shift from "download now, use later" to on-demand. When P2P traffic was dominant, the peak-to-trough ratio was less due to the around-the-clock nature of P2P downloads. The shift to an on-demand mentality is causing the peak-hours to get busier and the off-hours to be less busy.

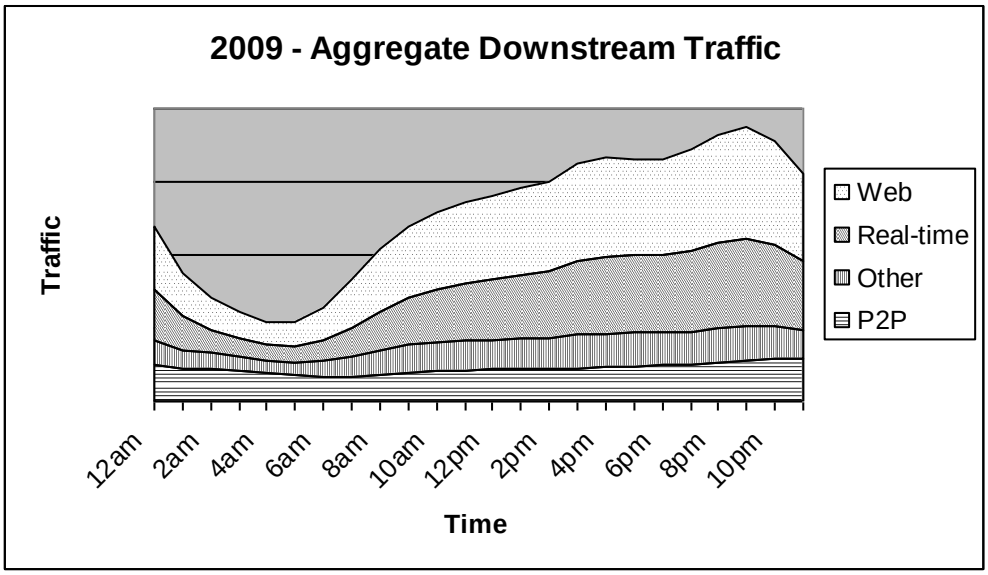

Figure 2: 2009 - Downstream Aggregate Daily Traffic

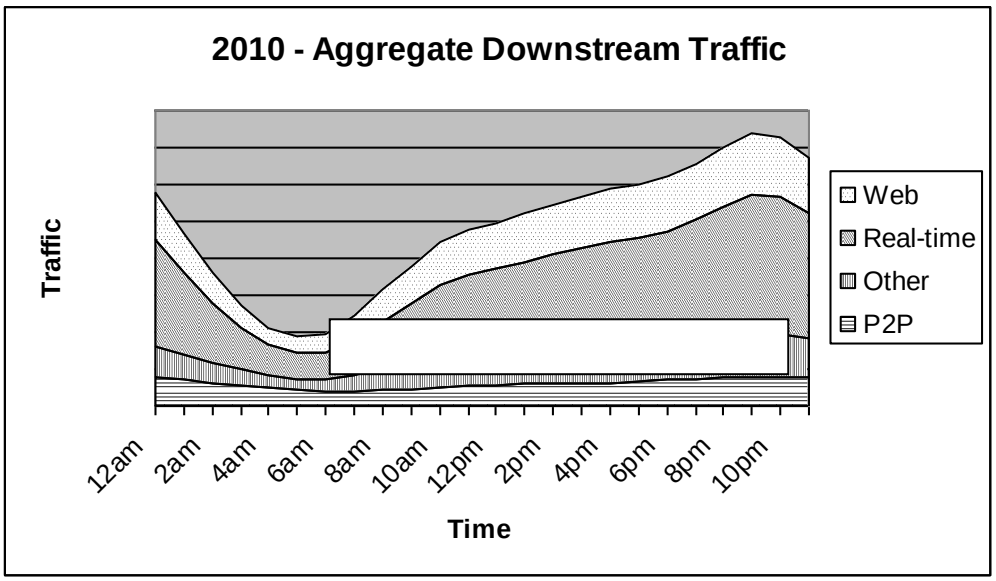

Figure 3: 2010 - Downstream Aggregate Daily Traffic

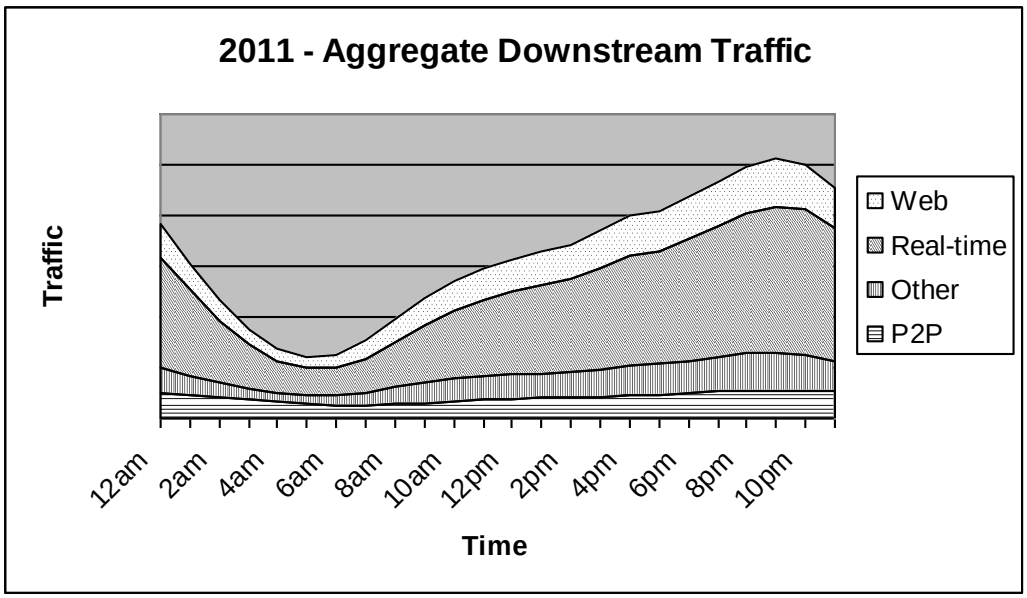

Figure 4: 2011 - Downstream Aggregate Daily Traffic

These drivers of "peak hour" are illustrated in Table 5. Downstream traffic during the peak period over the last three years is comprised increasingly of real-time entertainment.

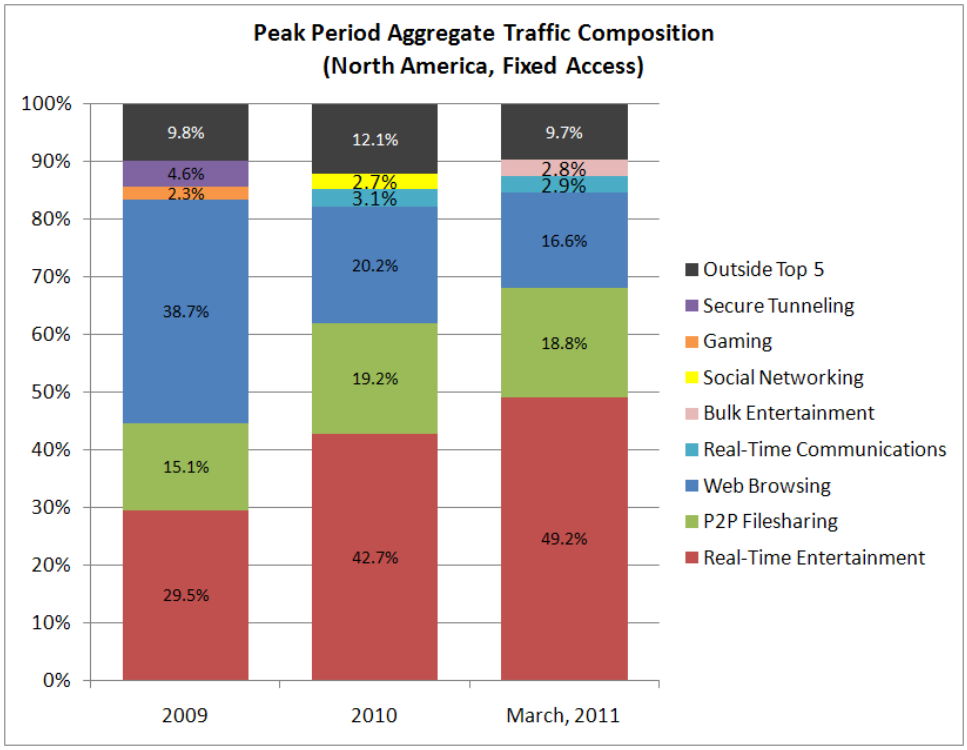

Table 5: Peak Period Aggregate Traffic Composition - North America, Fixed Access

CASE STUDY

Increases in broadband connectivity speed and the introduction of multiple platforms for receiving and viewing broadband content has fueled over-the-top video events, whether as on-demand content such as movies or live appointment content such as sporting events. For this paper, the 2011 NCAA Men's Basketball tournament served as a case study in order to explore possible implications of these technological and market changes for network traffic management.

Media coverage of the basketball tournament, as in year's past, included a live video stream, referred to as NCAA® March Madness® on Demand (MMOD) carried on the Internet by Turner Sports, CBS Sports and the NCAA. MMOD delivered a 63% increase in total visits compared to 2010 as well as 13.7 million total hours of streaming video consumed through iPad and iPhone applications, representing a 17% increase over 2010[7].

Simulcasting on the Internet and broadcast television provided a unique opportunity to measure subscriber preferences. For this study, the network probe was programmed to measure and record the number of concurrent video streams, total usage per subscriber, and the type of device the used to access the data. The data was collected from March 25-28 during the early rounds from a set of sites at residential, broadband wire-line with a sample size of 450,000 subscribers. The data collected provides a snapshot of how residential broadband subscribers used their service within their homes during a live media event also available via legacy television systems (CATV, broadcast, satellite).

Figure 5 graphs the aggregate number of minutes of streamed video during each 30 minute sample periods over the course of the case study. The peaks in the minutes watched closely align with when the games were being streamed live by the MMOD service. Interestingly enough, the number of minutes did not go to zero between games. One possible explanation for this is that viewers were utilizing this time to view the available video highlights and the option to rewatch the games.

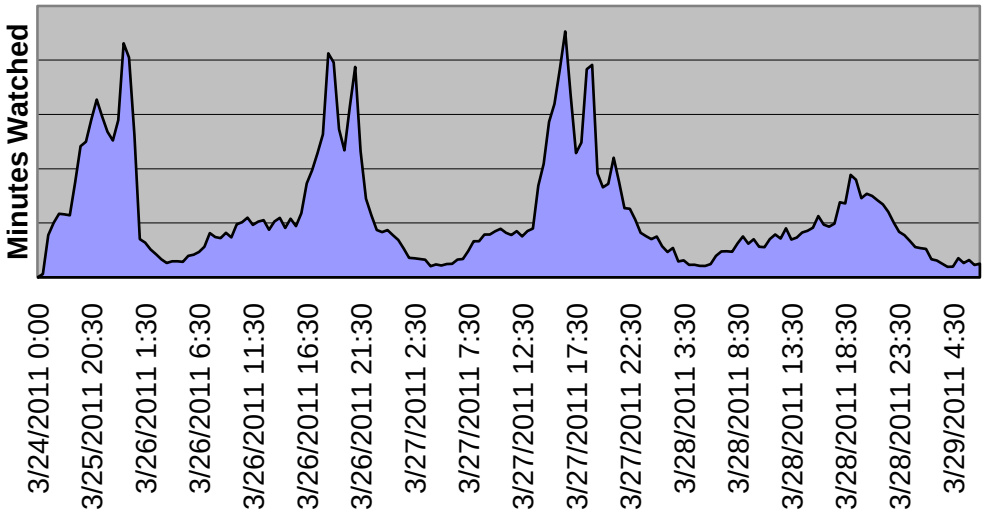

Figure 5: Minutes Watched

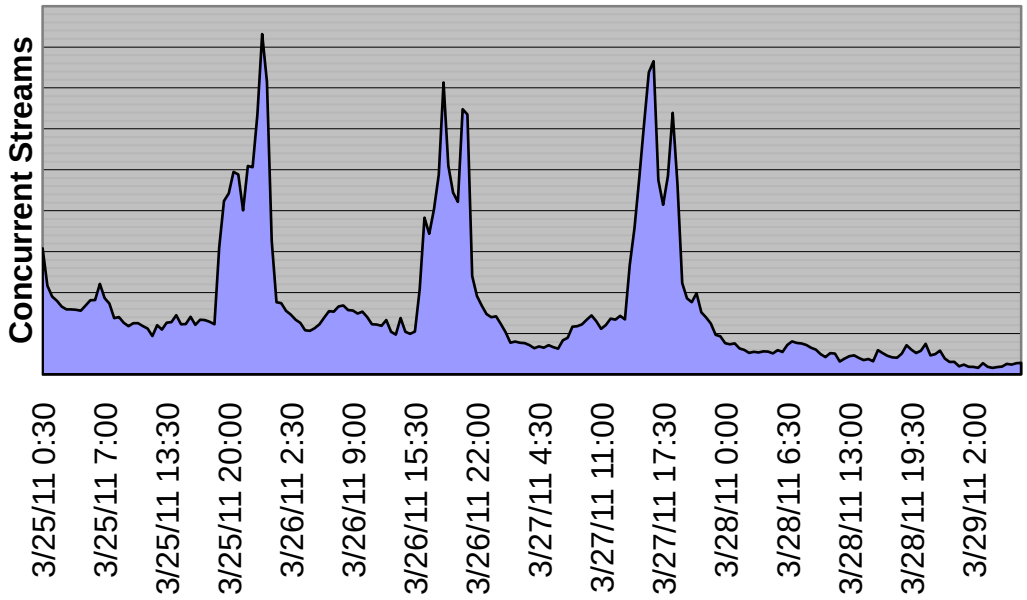

Figure 6: Concurrent Video Streams

Figure 6 shows the number of concurrent streams for the same period of time. Again the peaks align with the simulcast of the live games. Assuming one video stream per subscriber, this then shows that during the peaks 3-4% of the subscribers were accessing the MMOD service with their residential fixed broadband service.

As part of the study, the device type used to access the MMOD service were recorded and categorized as follows:

Figure 7 shows the number of views grouped by device category. For the residential subscriber, the device of choice when the games were being played was the desktop machine. As shown in Figure 8, between games there is increased usage of alternate devices such as the iOS and Android powered devices such as smartphones and tablets that have Wi-Fi capabilities.

Category	Devices
Desktop	Window PCs, Apple Macintosh, and Linux
iPhone/iPad	All iOS devices – iPhone, iPad, iTouch, iPod
Blackberry	All devices running a Blackberry OS based browser
Android	All devices running any version of the Android OS
Playstation	All Playstation devices

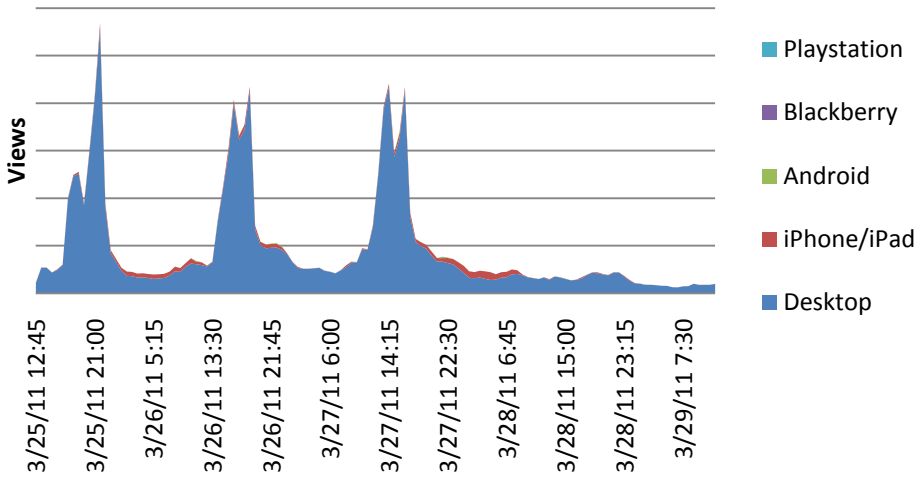

Figure 7: Views by Device Category

Of interest in the graphs is increased usage of devices other than the desktop computer in valleys in Figure 7. Figure 9 and Figure 10 show in greater detail the first valley from 1:00 AM on March 26th until about 2:00 PM on the March 26th. A closer examination of these valleys shows that during the periods when the games were not being transmitted live that there is an increase in the usage of the non-desktop device for accessing the MMOD content. During the period between games, subscribers opted to substitute the use of device with a smaller, lower resolution screen such as a Smartphone (iPhone) or Tablet (iPad). One possible explanation for the increase usage of iPhone/iPad between games could be that the subscribers were watching highlights from the earlier games or "snacking" on video chunks on the smaller screens.

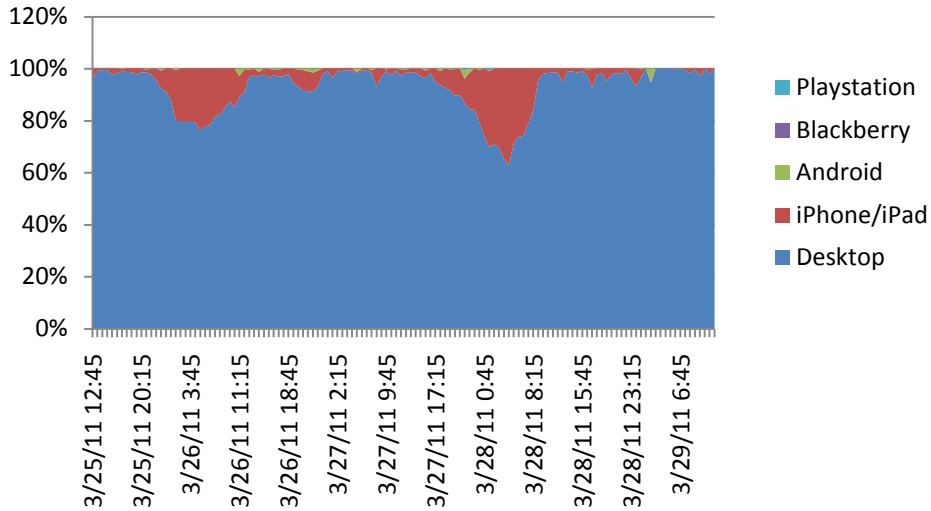

Figure 8: Relative Views by Device Category

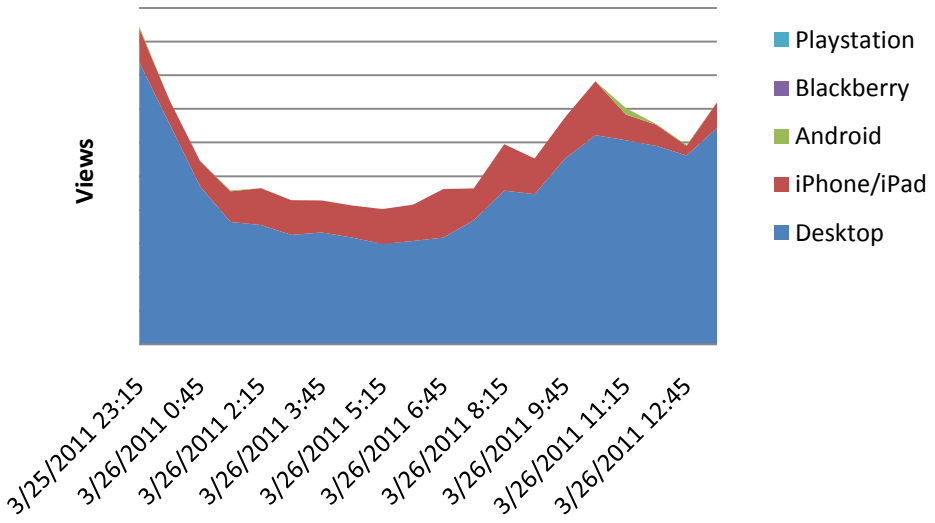

Figure 9: Views by Device Type March 25-26th

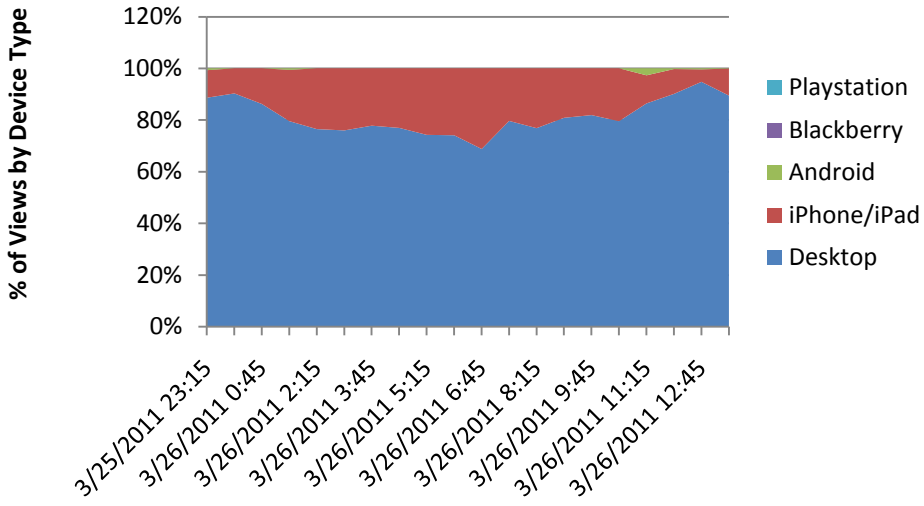

Figure 10: Relative Views by Device Type March 25-26th

The case study discussed here illustrates the effects of the adoption of smartphones and tablets on subscriber behavior and network traffic. Peak network traffic is still aligning with the live event, and during the periods between events, subscribers are filling this time with the use of a smartphone or tablet to watch on-demand content. The net effect of this is both an increase in the peak traffic as well as the overall expansion of peak traffic period due to traffic from the smartphones and tablets.

CONCLUSION

Although not exhaustive, this paper provides some interesting insights into trends with regards to subscribers and their online video viewing behavior. One possible conclusion from this study is, as broadband connectivity speeds continue to increase, this will continue to amplify the shift of traffic to peak periods as well as the expansion of the peak periods. The peak-to-trough ratio should continue to grow unless subscribers are incented to shift their behavior.

In summary:

- Broadband speeds continue to rise;
- Enabling a shift from "download now, use later" to on-demand for content;
- Peak-to-trough ratio for traffic is growing;
- And peak periods are expanding as subscribers use Wi-Fi enabled devices to access content on the shoulders of the peak hours.

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[1] "The State of the Internet"; Akamai; Q4 2008, Q4 2009, Q4 2010; http://www.akamai.com/stateoftheinternet/

[2] "History of the iPhone", Wikipedia, http://en.wikipedia.org/wiki/History_of_the_iPhone

[3] "iPad", Wikipedia, http://en.wikipedia.org/wiki/IPad

[4] "2010 Global Internet Phenomena Report", Sandvine, http://www.sandvine.com/news/global_broadband_trends.asp

[5] "2009 Global Broadband Phenomena Report", Sandvine, http://www.sandvine.com/downloads/documents/2009%20Global%20Broadband%20Phenomena%20-%20Full%20Report.pdf

[6] "2008 Global Broadband Phenomena Report", Sandvine, http://www.sandvine.com/downloads/documents/2008%20Global%20Broadband%20Phenomena%20-%20Full%20Report.pdf

[7] "2011 NCAA March Madness on Demand Sees 63% Increase in Total Visits and 17% Increase in Video Consumption across Multiple Platform for the NCAA Division I Men's Basketball Championship"; Turner Sports, CBS Sports, and NCAA press release April 5, 2011 on Turner Sports web site, http://news.turner.com/article_display.cfm?article_id=5636