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Intelligent Broadband Networks

Global Internet Phenomena Report

1H 2012

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Executive Summary

The Global Internet Phenomena Report: 1H 2012 shines a light on fixed and mobile data networks around the world, identifying facts, fads, and the future trends that will shape the Internet's future. Within this report, we present a mix of high-level observations, regional-focused analysis, deep-dives into specific subjects, and educational tidbits. Communications service providers (CSPs) in particular are in the position to act on this information, but we believe that the findings will be of interest to a wide range of readers.

At the highest level, we observed that Real-Time Entertainment (comprised mostly of streaming video and audio) is the largest traffic category on every network we examined. Furthermore, with the sole exception of North America's fixed access networks (where Netflix is dominant), YouTube is the largest single source of Real-Time Entertainment traffic. With appeal that crosses regions, access technologies and devices, **YouTube has emerged to account for more Internet traffic than any other service**.

We also observed that rich communication services like WhatsApp, that replace traditional source of operator revenue, continue to enjoy widespread adoption – we counted an average of 7.6 million WhatsApp messages per day on a mobile operator with 1 million subscribers.

North America's mobile networks have the highest proportion of Real-Time Entertainment traffic – **in fact, the majority of mobile data in North America is streaming audio and video**. YouTube leads the way, accounting for 23.4% of daily traffic, but **Pandora Radio has emerged to make up 6.4%**. Based on our past observations, we predict that Real-Time Entertainment traffic will exceed 60% of mobile data in the United States by late 2014.

Netflix is supported on a range of mobile devices, and we are starting to see Netflix become more prominent on mobile networks. In North America, **Netflix now represents 2.1% of mobile data**, good enough to make it the 8th largest source of traffic. In the report, we explore Netflix's international expansion, and discuss some of the challenges facing the service at it seeks to become a global presence.

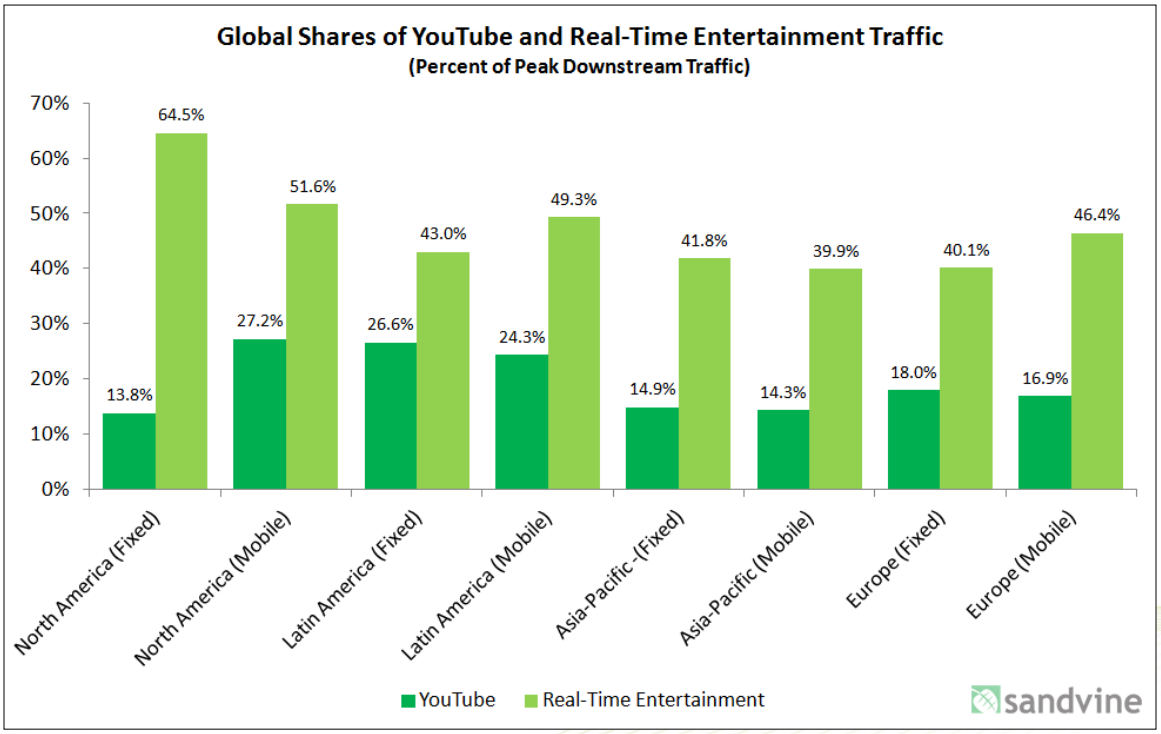


Figure 1 - Global Shares of YouTube and Real-Time Entertainment Traffic

Mobile device usage isn't limited to mobile access networks, and "home roaming" (the use of mobile devices on the home wifi network) comprises a growing portion of fixed access traffic. For instance, **we observed that 9% of North America's fixed access traffic is driven by mobile devices**, primarily due to high levels of Netflix and YouTube use.

Home roaming, which leads to more devices concurrently using the network, is one reason why **median monthly usage in North America jumped 47% year-over-year** and mean monthly usage grew by 40% in the same period. Of course, growing subscriber appetites are a global phenomenon – in Asia-Pacific, mean usage increased by 11% in six months. The report includes analysis of fixed access networks in four regions, so readers will be able to see how traffic is evolving around the globe.

Sometimes, documents like this one take for granted that readers will share common perspectives, linguistic definitions, and levels of technical understanding, but experience suggests that this assumption is erroneous. To help address this situation, our "Networks 101" featurettes seek to objectively educate, so that you:

- Know what terms like "peak period" and "prime time" define
- Understand what network congestion is, and how it can be fairly managed
- Learn why display quality and transport quality are both necessary components of a meaningful video quality of experience (QoE) score
- Find out why measuring quality via packet drops belongs in the 1980's

In a similar vein, the report includes focused featurettes that examine a particular emerging trend or observation. Interspersed among regional summaries, readers will find sections that:

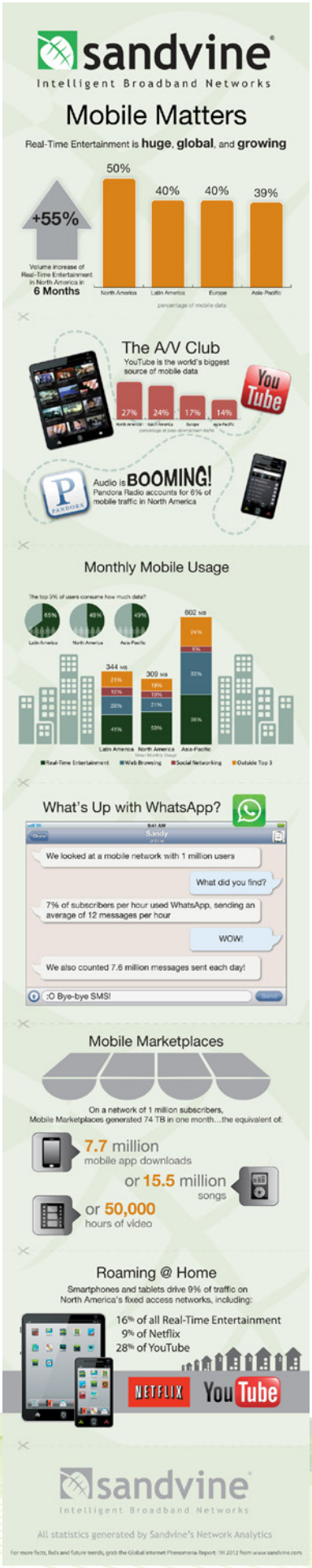
- Examine the fallout of the MegaUpload shutdown
- Set the stage for World IPv6 Launch
- Diagnose Netflix's international growing pains
- Take an early look at the click-to-cloud trend
- Begin to quantify the home roaming phenomenon
- Ask, "what's up with WhatsApp?"
- Investigate the concept of carrier-branded content delivery networks (CDNs)

This Global Internet Phenomena Report includes summaries of findings from seven regional spotlights, all of which are available on www.sandvine.com:

- *North America, Fixed Access*
- *North America, Mobile Access*
- *Latin America, Fixed Access*
- *Latin America, Mobile Access*
- *Europe, Fixed Access*
- *Asia-Pacific, Fixed Access*
- *Asia-Pacific, Mobile Access*

Further Reading

For more information about mobile facts, fads and future trends, be sure to check out our Mobile Matters infographic, available on www.sandvine.com



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YouTube? More like EverybodyTube.

When analyzing data for this report, one common thread emerged on every network, no matter the region or access technology: Real-Time Entertainment traffic, comprised of streaming video and audio, is truly a global Internet phenomenon. Within that category, another observation was common on all but one of the networks we examined: with the exception of North America's fixed access networks, where Netflix is the largest application, YouTube reigns as the global leader in Real-Time Entertainment traffic.

Not only is YouTube already big, but it is still growing rapidly. Over the past three years in North America, YouTube has grown modestly from 9.9% to 12.2% of peak downstream traffic on fixed access networks, but has exploded on mobile networks from 12.3% to 27.2% in the same period.

In the Fall 2011 Global Internet Phenomena Report, the average duration of a YouTube video was about three minutes, and since then the figure has risen by 15 seconds[1]. This length makes YouTube particularly well-suited to mobile device viewing, either while on the mobile network or while roaming at home.

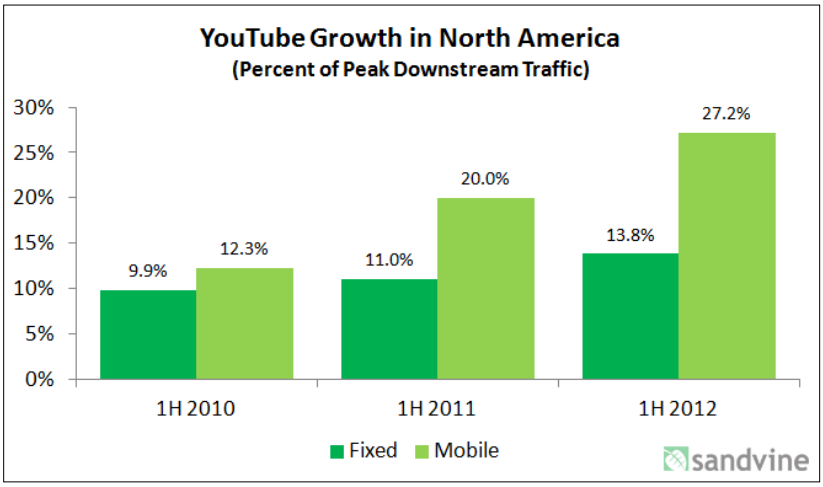

Figure 2 - YouTube Growth in North America

While YouTube built its tremendous success and popularity primarily on short-length videos, the service is making a strong push into longer form content that has the potential to earn it an even bigger piece of the traffic pie[2].

YouTube's push into longer duration content comes largely through the YouTube Live[3] initiative, which aims to add live streaming to complement a vast library of on-demand videos. Over the past twelve months, a number of major world events, from the Royal Wedding[4], the U.S. State of the Union Address, to music festivals like Coachella, have been streamed live, for free, on YouTube. These singular events join ongoing activities like the Indian Premier League cricket matches that already have a strong following. This growing availability of live content is fundamentally shifting how the typical subscriber may be using the service, and how many subscribers use the Internet. There is little doubt that we will see the average duration of YouTube videos gradually rise in the coming months and years, to the point where a significant amount of traffic is long duration live content streamed at a high display quality.

"The combination of increasing device capabilities, high-resolution content, and longer video duration (largely due to live content) means that YouTube's growth will continue for the foreseeable future."

The combination of increasing device capabilities, high-resolution content, and longer video duration (largely due to live content) means that YouTube's growth will continue for the foreseeable future. Operators in all regions offering any combination of access technologies should carefully watch this trend, as it will be hugely influential on network requirements, subscriber demands, and subscriber quality of experience.

1. This statistic is from North America's fixed access networks, but serves to illustrate the relatively short duration of most popular YouTube videos
2. Lest you point out that you wouldn't want to watch a low resolution video for a long time, take a moment to review YouTube's display quality capabilities - you might be surprised http://en.wikipedia.org/wiki/YouTube#Quality_and_codecs
3. http://www.youtube.com/live
4. http://www.betterbroadbandblog.com/2011/05/global-internet-phenomena-spotlight-the-royal-wedding/

Networks 101: Peaks, Primes, and Percentages

Two important exercises for network operators are capacity planning and understanding subscriber behavioral trends.

Capacity planning revolves around peak demand – networks are engineered to accommodate the largest subscriber demand at any instant – so network operators carefully monitor network characteristics relating to this concept:

- What is the peak value? How is it changing over time and by location?
- How many subscribers are active at peak? What applications are driving peak?
- What is the bandwidth per subscriber at peak? What is the quality of experience?

Understanding subscriber behavioral trends is a bit more nuanced, and involves answering a range of questions:

- Which applications are becoming more popular? Less popular?
- How much data do subscribers use? How does this vary throughout the subscriber population?
- How many days per month are subscribers active? For how long per day?
- Which devices are subscribers using? Which new devices are emerging?

The insights gained help CSPs design service plans that cater to the changing needs of their subscriber base, with astute providers reaping the business rewards of subscriber loyalty and gaining a marketplace advantage. To assist with these planning activities, CSPs rely on specific terminology to describe the behavior of measured value – the exact terms used vary from operator to operator, but generally capture the same concepts. In this report, we use this terminology:

- **Peak Value (or just Peak)**: the highest instantaneous value observed
- **Peak Time**: the time at which Peak Value is observed
- **Peak Hour**: the sixty minute period, containing Peak Value, during which the highest average value is observed
- **Peak Period**: the entire period during which the observed value is higher than a specified percentage (frequently the 95th percentile) of the Peak Value
- **Prime Time**: defined by a start time and end time, this period is typically used when examining network usage characteristics for subscriber behavioral trending, rather than capacity planning

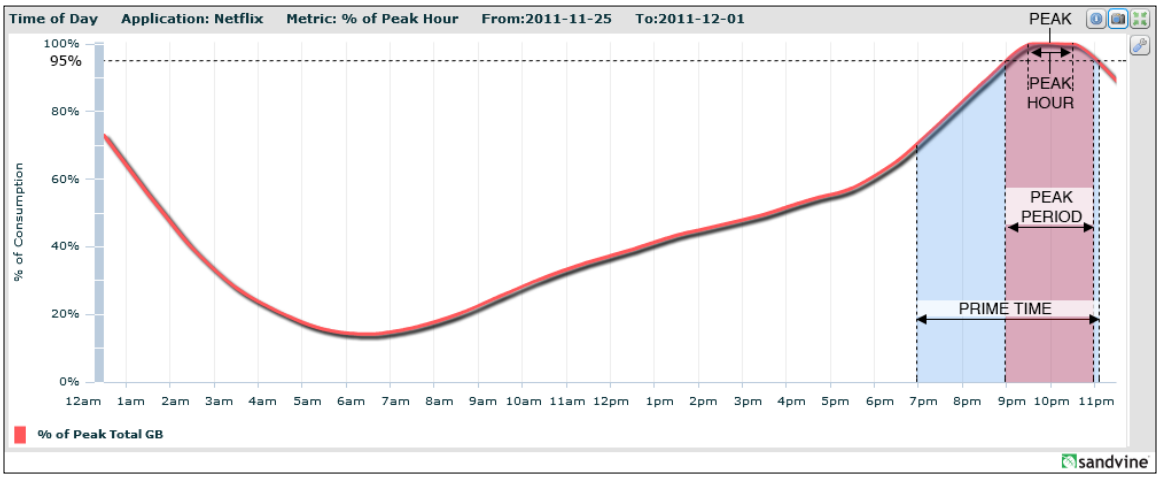

Figure 3 - Illustration of Peak Hour, Peak Period and Prime Time

It is worth noting, for simplicity, that the peak is assumed to be uniform over the network; however, in reality this assumption is far from the truth. Different locations peak very differently from each other, which is why it's necessary to use dynamic, real-time location-aware traffic management (the art of maximizing user experience for a given capacity) to mitigate network congestion. Note also that traffic management is fundamentally different from usage management (the art of optimizing revenue for a given capacity), which can only indirectly impact peak demand by providing subscribers with financial incentives to alter behavior[5].

5. Donnelly, Tom. "Sandvine's Better Broadband Blog : "Savvy Differentiation from TekSavvy: Variable Charging and Unlimited Off-Peak Usage"" Better Broadband Blog. Sandvine, 6 Jan. 2012. Web. <http://www.betterbroadbandblog.com/2012/01/savvy-differentiation-from-teksavvy-variable-charging-and-unlimited-off-peak-usage/>.

North America – Mobile Access – Summary

Mobile traffic in North America has reached a tipping point and is now experiencing explosive growth, driven largely by increased smartphone penetration and the influence of device capabilities on subscriber usage.[6]

From the time of our last report, in October 2011, to this one, monthly median usage has increased more than eight-fold from 3.1 MB to 25.5 MB, while monthly mean usage has declined slightly from 346.9 MB to 312.8 MB.

This dramatic increase in median is caused by the increased number of smartphones on the network, which was likely accelerated in part to the holiday shopping seasons. These users would typically be newer smartphone owners who are still learning how to utilize their powerful devices, placing their usage above the 50th percentile (which is influenced by the large number of people still using feature phones), but below the power-users who are making the most of their smartphones' capabilities.

"With more smartphones in use, in just six months we have seen Real-Time Entertainment jump from 30.8% of peak traffic to now account for the majority of mobile network traffic at 50.2%."

With more smartphones in use, in just six months we have seen Real-Time Entertainment jump from 30.8% of peak traffic (upstream and downstream combined) to now account for the majority of mobile network traffic at 50.2%. YouTube accounts for more than half, and represents 27.2% of peak downstream traffic, but Real-Time Entertainment's growth isn't limited to only video. Streaming audio, in particular driven by the popularity of Pandora Radio, has seen significant growth in just the past six months. Pandora Radio is the fifth largest downstream application and accounts for 5.4% of peak traffic, and streaming through services including Spotify and Rdio, and specialized apps like TuneIn Radio is also on the rise.

While Facebook is still among the top three applications on the mobile network, the service and the Social Networking category as a whole have seen their traffic share almost cut in half. This drop is not due to declining usage, as Social Networking applications are typically among the most popular applications on every smartphone platform; rather, Social Network traffic is simply being outpaced by Real-Time Entertainment. Video and audio traffic consume so much more data than a simple status update on Facebook, that Real-Time Entertainment's rapid growth has simply dwarfed that of other categories. Until a time comes where we start sharing videos extensively via Facebook and other social media platforms, Social Networking will continue to shrink in relative share.

"While Facebook is still among the top three applications on the mobile network, the service and the Social Networking category as a whole have seen their traffic share almost cut in half."

North America Mobile

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	HTTP	20.52%	YouTube	27.17%	YouTube	24.99%
2	Facebook	20.46%	HTTP	19.90%	HTTP	19.97%
3	SSL	10.66%	Facebook	8.67%	Facebook	10.02%
4	YouTube	8.06%	MPEG Streaming	7.18%	MPEG Streaming	6.58%
5	Skype	2.32%	Pandora Radio	5.40%	SSL	5.49%
6	Google Talk	2.07%	SSL	4.83%	Pandora Radio	5.00%
7	Pandora Radio	1.90%	Google Market	3.51%	Google Market	3.23%
8	MPEG Streaming	1.89%	Netflix	2.24%	Netflix	2.06%
9	Gmail	1.38%	Flash Video	1.74%	Flash Video	1.58%
10	BitTorrent	1.32%	Windows Update	1.68%	Windows Update	1.54%
	Top 10	**70.58%**	**Top 10**	**82.32%**	**Top 10**	**80.46%**

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

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Table 1 - Top Peak Period Applications by Bytes (North America, Mobile Access)

6. Smartphones are now owned by 50% of mobile subscribers in the United States: http://blog.nielsen.com/nielsenwire/online_mobile/smartphones-account-for-half-of-all-mobile-phones-dominate-new-phone-purchases-in-the-us

Linking Insight with Action: Business Intelligence and Network Policy Control

Insight and action are inextricably linked: insight leads to action (when you learn something, you take action), and action leads to insight (when you take action, you learn something).

Communications service providers, regardless of access technologies and local market dynamics, are challenged by rapidly-changing subscriber behavior and the influence of new consumer devices. Increasingly, operators are implementing solutions to gain insight into their networks, as a means to combat rampant uncertainty and to lessen risk. These business intelligence solutions help operators measure the present, understand the past, and predict the future.

"Business intelligence solutions help operators measure the present, understand the past, and predict the future. Based on the insight gained, they take action."

Based on the insight gained, communication service providers take action: they design new service plans based on shifts in subscriber demand, they make capital investments to expand network capacity and coverage, and they identify areas where they can save on operational costs. Frequently, the action to be taken requires management policies to be implemented on the network's data and control planes, and for these activities operators call upon network policy control solutions.

Network Policy Control is a network and service management technique to identify converging network conditions, evaluate business rules in real-time, and enforce policy actions locally and remotely. In concert, these three activities enable valuable service creation, traffic optimization and operations management solutions for communications service providers while preserving and even enhancing subscriber quality of experience.

The Global Internet Phenomena Report provides high-level insight to operators worldwide – it is our sincere hope that the information and findings herein will be incorporated into the strategic planning process, helping operators to prepare for tomorrow and act today.

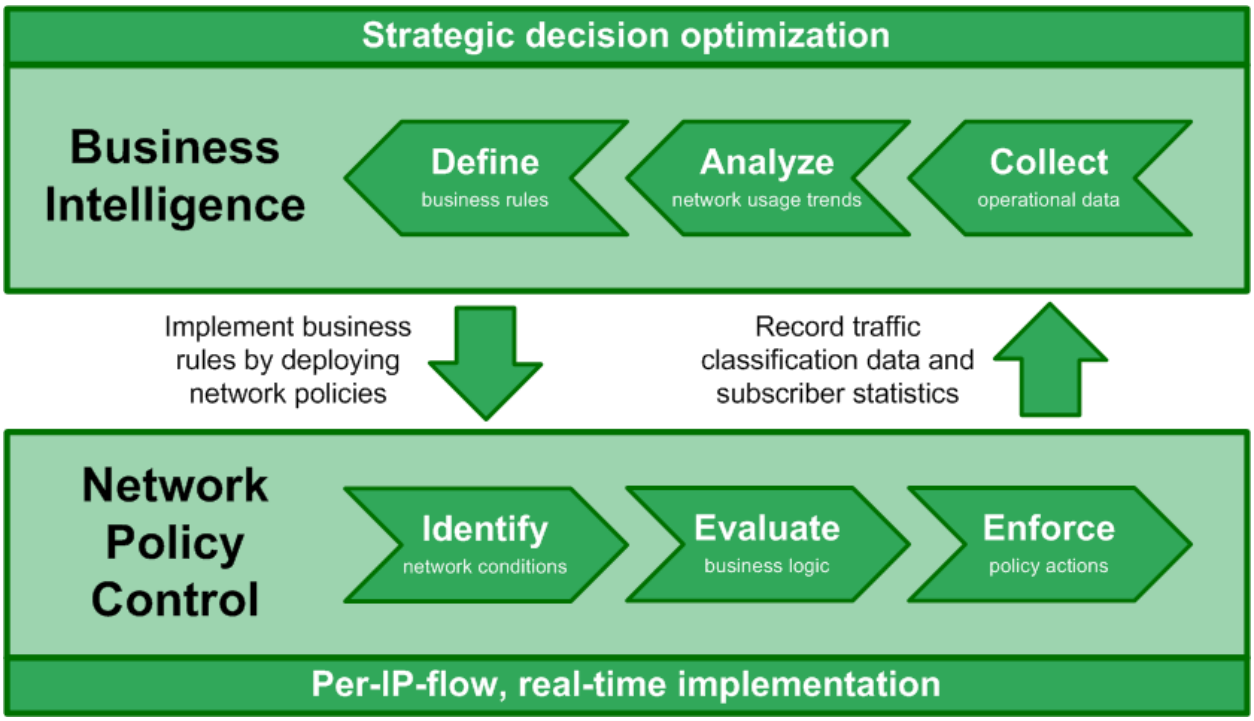

Figure 4 - The Relationship between Business Intelligence and Network Policy Control

The Future Ain't What it Used to Be: Mobile Video Races Ahead of Projections

"It's tough to make predictions, especially about the future." This statement was true when first uttered by Yogi Berra, and it still remains true today.

Projecting the composition and amount of Internet traffic is a complicated affair that's impacted by shifting subscriber preferences, the introduction of revolutionary devices, new applications and services, ever-increasing access speeds and diversification or specialization of users (machine-to-machine and telematics, for instance). Here at Sandvine, we go where the data takes us, favoring detailed analysis over wild guesses – in short, our futurist team does its best.

Last fall, we projected that Real-Time Entertainment would account for 38.4% of mobile network traffic in the United States by the end of 2012, a significant increase over the 30.8% we observed in September 2011. This projection was carefully crafted from the bottom-up, based on detailed analysis of measured traffic profiles, observed traffic trends, device usage characteristics and device market share.

"Real-Time Entertainment will cross the 60% threshold in late 2014 or early 2015, and will plateau around 70%."

As you can see by the chart below, the 38.4% projection missed the mark…badly. Between September 2011 and March 2012, Real-Time Entertainment came to account for more than 50% of mobile traffic in the United States. Can it continue to outpace all other application types well into the future? Probably. Per-minute of use, video accounts for far more traffic than anything else, with the possible exceptions of P2P and large file downloads (two use-cases that are very rare on mobile networks). Audio streaming, which also belongs to the Real-Time Entertainment category, is a widespread mobile use-case that consumes a significant amount of traffic (Pandora alone is 5% of downstream mobile traffic). Based on our latest observations, Real-Time Entertainment will cross the 60% threshold in late 2014 or early 2015, and will plateau around 70%.

Nevertheless, with all the factors that go into shaping tomorrow, only one thing's for certain, "The future ain't what it used to be."

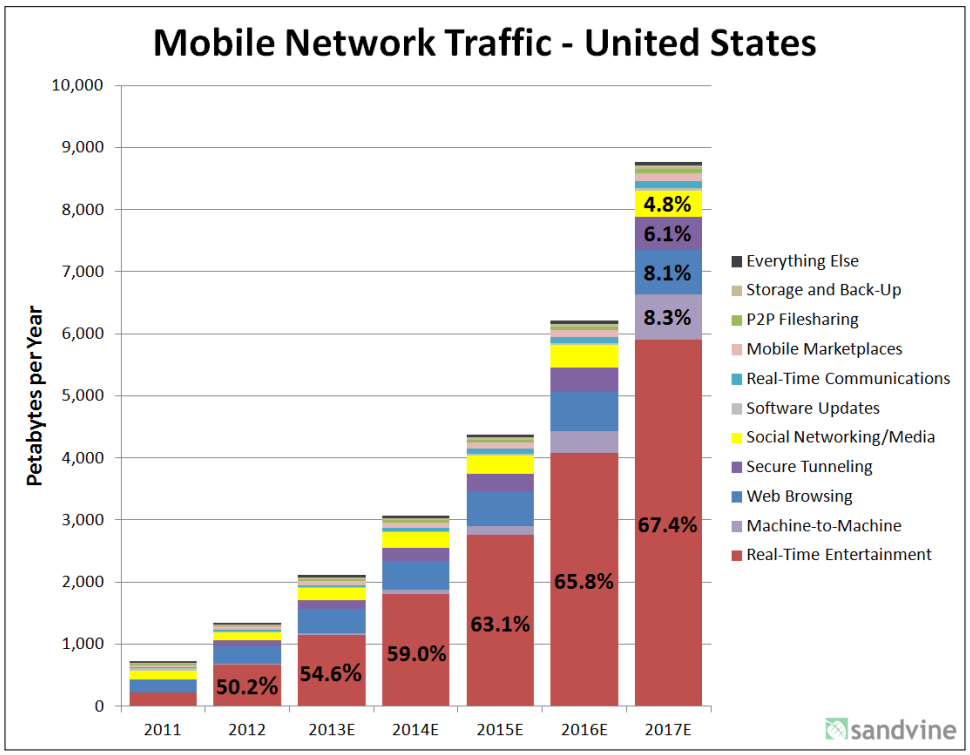

Figure 5 - Projection of Mobile Access Traffic in North America

Roaming at Home

In our Fall 2011 Global Internet Phenomena report, we revealed that the majority of Real-Time Entertainment traffic on fixed access networks in North America was destined for devices other than PCs[7].

Much of that traffic was driven by subscribers using their game consoles, set-top devices or Smart TVs to watch Netflix, but what about subscribers who are using smartphones or tablets on home wireless networks?

Did You Know?

Mobile devices roaming at home now account for 9% monthly data on North America's fixed access networks

In our Spring 2011 Global Internet Phenomena Report, we predicted that as smartphone ownership rates continue to rise, mobile devices would begin to consume a greater amount of traffic on fixed access networks. We dubbed this behavior "home roaming", since the devices were essentially no longer using the mobile network for data, and were instead 'roaming' on a local wifi connection.

Sandvine's device-aware traffic classification technology lets communications service providers monitor this trend on their own networks, and these operators are reporting that our predictions are accurate. For instance, mobile devices roaming at home now account for 9% monthly data on North America's fixed access networks, driven mostly by being responsible for 15.6% of Real-Time Entertainment. Looking even deeper, mobile devices account for a whopping 27.8% of all YouTube traffic, an incredible number when considering that over a 24-hour period, YouTube is the second largest application on the network.

7. You can find this information on our "Beyond Bytes" infographic at http://www.sandvine.com/general/infographic_10-2011.asp

From Click to Cloud

The best camera is the one you have with you…and it's using your bandwidth. In recent years, smartphone cameras have drastically improved in resolution capabilities and overall quality to the point where many people have stopped carrying smaller point and shoot cameras. An entire generation's lives will largely be captured by smartphones[8].

As a result, smartphone users often have hundreds of photos on one device – a single point of failure for irreplaceable memories. Of course, everyone knows that regular back-ups are a prudent habit, but few people actually engage in such activities. What is the casual user to do?

"Mobile shutterbugs with a 5 Megapixel camera on their phones could be sending 1.5 MB to the cloud with each picture they take. With smartphone adoption rates climbing and the quality of integrated cameras also steadily improving, mobile networks must bear a significant increase in upstream data usage."

Enter the cloud. Many smartphone manufactures and device developers have begun to integrate cloud backup directly into their camera and photo library applications. Now, when you take a picture on an Android smartphone your photos can automatically be uploaded to your Google account, or a third-party storage solution like Dropbox. With Google's default settings allowing these photos to be uploaded directly over the mobile network (using Google+), mobile shutterbugs with a 5 megapixel camera on their phones could be sending 1.5 MB to the cloud with each picture they take. Services like Instagram make click-to-cloud a snap, while adding a layer of style. How important is this space? Important enough that Facebook recently purchased Instagram for a cool $1 billion[9], suggesting that the social network giant has some big plans on the mobile side.

Google introduced the instant photo upload feature on Android phones in June 2011, and since then we've observed a steady rise in upstream SSL traffic on mobile networks carrying Android devices. In North America, between September 2011 and March 2012, SSL rose from 6.1% of peak upstream traffic to 10.7%, at least partially (and perhaps largely) due to encrypted click-to-cloud applications. As further evidence of the impact of mobile photography, Photobucket (which is a partner of Twitter) accounts for almost 1% of upstream mobile traffic in North America.

With smartphone adoption rates climbing and the quality of integrated cameras also steadily improving, mobile networks must bear a significant increase in upstream data usage.

For subscribers, this increased upstream bandwidth is a double-edged sword. The peace of mind that comes with having their treasured photos backed up in the cloud is a valuable feature (at least, in retrospect, it will be when the phone goes swimming), but those backups open the door for an unpleasant bill-shock when returning from a snap-happy vacation.

8. To their dismay, many will find out that much of the Internet is public and permanent
9. Price, Emily. "Why Instagram Was Worth $1 Billion to Facebook." Mashable - Social Media. Mashable, 12 Apr. 2012. Web. <http://mashable.com/2012/04/12/instagram-worth-1-billion/>.

Latin America – Mobile Access - Summary

Latin America is largely a fixed-replacement market, so the region's mobile networks offer a mix of personal handsets and mobile aircards, both of which frequently serve as a household's primary means of Internet connectivity. This device mix generates traffic profiles that combine elements of both fixed and mobile usage, and applications and traffic categories that are typically popular on both mobile devices and PCs are usually the most significant.

Did you Know?

As smartphones increasingly deliver a "good enough" Internet experience, Latin America's traffic profiles are less influenced by aircard-enabled laptops. For example, Ares traffic fell from 15.5% of aggregate peak traffic a year ago to only 4.8% today.

In Latin America, like most regions, Real-Time Entertainment is the largest driver of traffic, accounting for 45.9% of peak downstream traffic. YouTube is the largest source of that traffic, representing 24.3%, but the amount of Flash Video is also notable. On mobile networks where smartphones are the main data drivers, Flash Video usage is typically very low because only a few smartphones currently support Flash playback; however, in Latin America, because of the large number of aircards connected to laptops, Flash Video is the fourth largest component of traffic, accounting for 5.8% of peak downstream bytes – significantly higher than the 2.6% we observed in North America.

Latin America's mobile operators are among the global leaders in offering prepaid data to subscribers. These prepaid packages make smartphone ownership affordable, and increased device capabilities have led many subscribers to choose a "good enough" smartphone connection over selecting an aircard. Evidence of aircards' decreasing influence is seen in the declining share of P2P Filesharing. Ares, in particular, suffered a major drop, from 15.5% of aggregate peak traffic a year ago down to only 4.8% in this study.

Because of this changing device landscape, consumption in Latin America has experienced significant shifts over the past year. Monthly median usage increased from 58.1 MB to 67.5 MB at the same time as monthly mean usage dropped from 893.7 MB to 344.1 MB.

Latin America Mobile

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	Facebook	21.12%	YouTube	24.30%	HTTP	22.57%
2	HTTP	19.84%	HTTP	23.57%	YouTube	21.71%
3	YouTube	14.67%	Facebook	15.18%	Facebook	16.78%
4	Ares	8.27%	Flash Video	5.75%	Flash Video	4.87%
5	Skype	4.36%	Ares	3.57%	Ares	4.83%
6	BitTorrent	3.80%	Windows Update	3.08%	Windows Update	2.79%
7	SSL	2.97%	SSL	2.62%	Skype	2.77%
8	Flash Video	2.48%	Skype	2.19%	SSL	2.72%
9	Windows Update	1.98%	MPEG Streaming	1.94%	BitTorrent	2.26%
10	STUN	1.48%	BitTorrent	1.70%	MPEG Streaming	1.61%
	Top 10	**80.97%**	**Top 10**	**83.91%**	**Top 10**	**82.91%**

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

sandvine

Table 2 - Top Peak Period Applications by Bytes (Latin America, Mobile Access)

Sponsorships – not just for celebrities!

What if there was a way for subscribers to get free access to the mobile apps they want, while operators still get paid for the bandwidth? This isn't a hypothetical scenario from the land of make-believe, it's part of a valid model that is already emerging thanks to sponsored connectivity.

In the current pay-it-yourself model, for a subscriber to use mobile data on their smartphone or tablet, he or she must pay the carrier directly either before use (prepaid) or after (postpaid). With sponsored connectivity, instead of the subscriber paying for the data associated with a certain application, website, or device, a third-party does so. In this sponsored model, such data usage does not count against existing usage-based billing quotas, so subscribers with a subscription plan get free usage, and subscribers who lack even a basic subscription can gain completely free access if they purchase a sponsored device.

Sponsored data apps have the potential to create a win-win-win scenario for subscribers, operators, and content providers alike:

- subscribers benefit from free data access
- mobile operators still get paid for the bandwidth they deliver
- the sponsor (app or device developer) gets increased traffic, impressions, and users

"From the network operator's perspective, sponsored connectivity requires a traffic classification and charging system that can cope with the myriad of services using the network."

Who stands to gain from sponsoring such connectivity? E-commerce sites like Amazon are obvious candidates. In fact, this is precisely the model that Amazon is using for their e-readers. The subscriber buys an e-reader and Amazon pays for mobile coverage based on the assumption that content sales through the device will more than cover the sponsorship cost. General Motors' OnStar[10] capability is another example, although you aren't (yet) buying apps through your car's dashboard[11]. Lest you think the idea of a connected car is far-fetched, Fierce Wireless recently posted an article that said, "The connection fee could be included in the price of the car…In many respects, the old Kindle model is applicable, where the consumer never knowingly paid for the cellular connection, even though they used it."[12]

Of course, sponsorships aren't limited to companies selling hardware. Retailers have much to gain if subscribers can browse their websites free of data charges.

Nor is the use case limited to traditional retailers – game developers can sponsor the data for game connectivity in order to improve adoption rates and increase the revenue they make off both advertising and in-game purchases. This model is especially attractive for freemium[13] games like Temple Run[14].

In the near future, at least, sponsored connectivity is not going to replace the traditional model in which a subscriber pays the network operator directly, but it is definitely a growing trend that already has some major players onboard[15].

From the network operator's perspective, sponsored connectivity requires a traffic classification and charging system that can cope with the myriad of services using the network. Even in simple implementations, the device and service combinations alone could overwhelm systems designed for a simpler environment, so network providers must plan ahead and ask their vendors some tough questions.

10. You can learn about OnStar at http://www.onstar.com/web/portal/landing
11. Could Angry Birds be a soothing treatment for road rage?
12. Hold, Eddie. "Hold: Auto Makers Still Test Driving Broadband Connections in Cars." FierceWireless. 20 Apr. 2012. Web. <http://www.fiercewireless.com/story/hold-auto-makers-still-test-driving-broadband-connections-cars/2012-04-20>.
13. http://en.wikipedia.org/wiki/Freemium
14. http://en.wikipedia.org/wiki/Temple_Run
15. Learn about 0.Facebook.com at http://www.facebook.com/blog/blog.php?post=391295167130

Asia-Pacific – Mobile Access – Summary

Networks in Asia-Pacific have traditionally shown the highest consumption numbers, and 1H 2012 is no exception. Monthly median consumption in the region is 140.4 MB, while mean consumption is 601.9 MB - numbers driven higher than other regions primarily due to a higher rate of smartphone ownership among subscribers.

In Asia-Pacific, Real-Time Communications applications are widely used, and we find both Skype and WhatsApp among the top applications. While Skype is no stranger to our Top 10 lists, WhatsApp's presence is notable. WhatsApp is a cross-platform instant messaging application that has been identified by operators as a major threat to SMS revenue, and on the networks we examined in Asia-Pacific it accounts for 2.0% of upstream traffic in peak period, a very high number for an application that doesn't provide voice streaming.

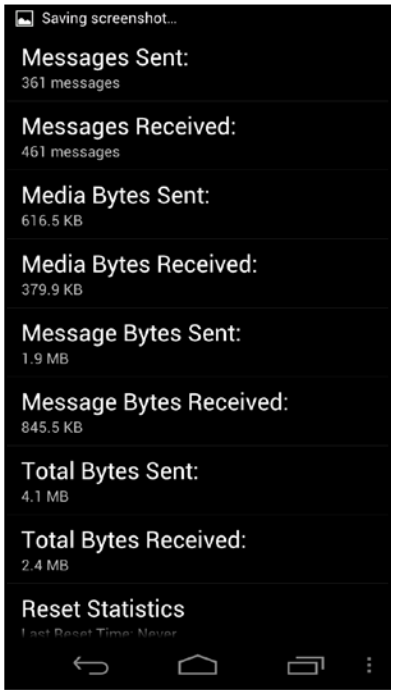

Figure 6 - Anecdotal WhatsApp individual usage

How is such high WhatsApp traffic explained? In this case, there are three causes:

- Market penetration: communications applications benefit from tipping points – once your friends are using the app, you use it too – and WhatsApp, like Skype, has emerged as the standard cross-platform communications tool on many networks (on the Asia-Pacific networks we studied, WhatsApp is used by 7-8% of active subscribers in any one hour period)
- Attachments: when we look deeply at WhatsApp traffic, we find that a significant portion (usually from one-third to one-half) of the bytes actually belong to media attachments
- Other: on Android and Blackberry devices, bytes are consumed in the background – over time, and depending upon individual usage, these can represent a surprisingly large portion of total WhatsApp usage

Mobile Marketplaces continue to be very popular in the region, with the category accounting for 7.5% of downstream traffic during peak hour. The bulk of this traffic is from Apple's iTunes store (5.2%) and Google's Play16 store (2.3%), with marketplaces from other vendors accounting for only a marginal amount of traffic.

YouTube is the largest Real-Time Entertainment application, accounting for almost 13% of aggregate peak traffic, with PPStream not far behind at 9.50% (easily higher than in any other region).

Asia-Pacific Mobile

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	HTTP	15.53%	HTTP	32.85%	HTTP	30.68%
2	PPStream	11.62%	YouTube	14.27%	YouTube	12.83%
3	BitTorrent	9.31%	PPStream	9.19%	PPStream	9.50%
4	Facebook	8.21%	iTunes	5.17%	Facebook	4.98%
5	SSL	5.74%	Facebook	4.52%	iTunes	4.74%
6	Thunder	3.72%	MPEG Streaming	3.81%	MPEG Streaming	3.38%
7	Funshion	3.46%	BitTorrent	2.41%	BitTorrent	3.27%
8	YouTube	2.76%	HTTP Live	2.39%	HTTP Live	2.58%
9	Skype	2.13%	Google Play	2.29%	SSL	2.14%
10	WhatsApp	1.99%	SSL	2.13%	Google Play	2.06%
	Top 10	**57.59%**	**Top 10**	**72.22%**	**Top 10**	**69.38%**

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

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Table 3 - Top Peak Period Applications by Bytes (Asia-Pacific, Mobile Access)

16. Google Play is a rebranding of Android Marketplace

Rich Communication Services and Revenue Replacement

In our last report, we noted the growing popularity of data messaging apps on mobile networks[17], and six months later we are observing continued growth. In Asia-Pacific specifically, we observed that during peak period, between 7% of all mobile subscribers were using the messaging application WhatsApp, a smartphone app that allows subscribers to use their data plan to send text and picture messages without having to pay any SMS or MMS fees.

BlackBerry users have long praised BlackBerry Messenger (BBM) for its ability to send messages using a data plan to other BlackBerry users, but in recent years as the smartphone marketplace has become more fragmented, messaging apps that allow cross-platform messaging have enjoyed rising popularity. Hookt, Kik, and Skype are just a few of the apps available that offer such functionality, but WhatsApp's popularity is undeniable – the service is now reporting that their users are sending over 1 billion messages each day.[18]

"On one network with approximately 1 million subscribers, we observed that when subscribers are actively using WhatsApp they are sending on average 12 messages per person each hour. For an average day, we measured over 7.6 million messages sent."

On one network with approximately 1 million subscribers, we observed that when subscribers are actively using WhatsApp they are sending on average 12 messages per person each hour. For an average day, we measured over 7.6 million messages sent. The daily distribution of these messages is shown in Figure 7.

While it's clear that subscribers love these apps, network operators are less enthusiastic, because such applications compete directly with the SMS and voice services upon which operators depend for a substantial portion of revenue. The Dutch operator KPN brought attention to the impact of these revenue replacement apps when the mobile operator issued a profit warning in which they directly cited revenue-replacement apps BBM and WhatsApp as causes for a 10% decrease in text messaging revenue.[19]

SMS revenue isn't threatened only by cross-platform services (Apple's iMessage application bypasses SMS for Apple-to-Apple communication) and voice revenue isn't immune from erosion (Skype enjoys massive global popularity).

To combat the lost revenue from these messaging apps, operators must explore innovate ways to package their services. Savvy operators have recognized that subscribers value these applications, and are betting that embracing the application is a positive strategy[20]. One option is to include this new breed of messaging services in low cost app bundles, while another is to offer a bolt-on to an existing SMS messaging. Regardless of the precise plans created, CSPs must ensure they have the traffic classification capabilities to accurately measure the amount of messaging traffic flowing through their networks.

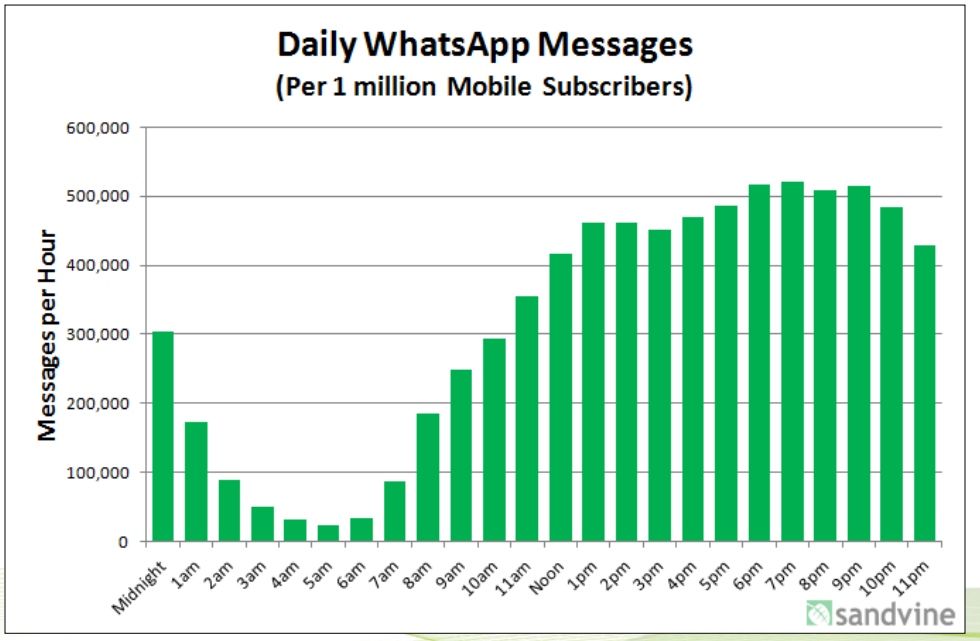

Figure 7 - WhatsApp messages sent in an average day on an example mobile network

17. See the section, "What's Up with WhatsApp" on page 17 of the Global Internet Phenomena Report: Fall 2011
18. "WhatsApp." One Billion Messages. WhatsApp, 31 Oct. 2011. Web. <http://blog.whatsapp.com/index.php/2011/10/one-billion-messages/>.
19. You can learn more about the situation at http://blogs.wsj.com/source/2011/04/21/kpn-outsmarted-by-smartphones/
20. Here is one such example from Movistar Colombia: http://www.movistar.co/Personas/Internet_Movil/WhatsApp/

Networks 101: A Case of Congestion

Mainstream news articles[21], industry publications[22], academic research[23], online encyclopedias[24], service plan fine-print[25] and even Global Internet Phenomena Reports all talk about network congestion as if everyone has an equivalent definition and understanding of the concept, but is this a reasonable assumption?

In Sandvine's filings to regulatory bodies like the FCC and CRTC, we define congestion as, "the situation in which an increase in data transmissions results in a proportionally smaller or even a reduction in throughput" – the more you try to send, the less you succeed in sending. Conversely, a non-congested network is one in which the latency (end-to-end delay) is relatively constant, and has little packet loss.

Congestion occurs at all aggregation links in a network, in some ways, congestion is like a weighted Whac-A-Mole[26] game – while most incidents of congestion occur during peak period, and some locations might have more incidents than others, it can still occur unpredictably at any time, on any link.

Not surprisingly, the most effective and most fair way to manage congestion is to implement corrective policies that are localized at the time and site of congestion itself. In fact, this precision approach is what the FCC defines as "narrowly tailored"[27]. Referring to Figure 8, if congestion occurs at A* and only affects households 1-5, then the congestion management solution should apply at A*, and should not have any impact on households 6-15.

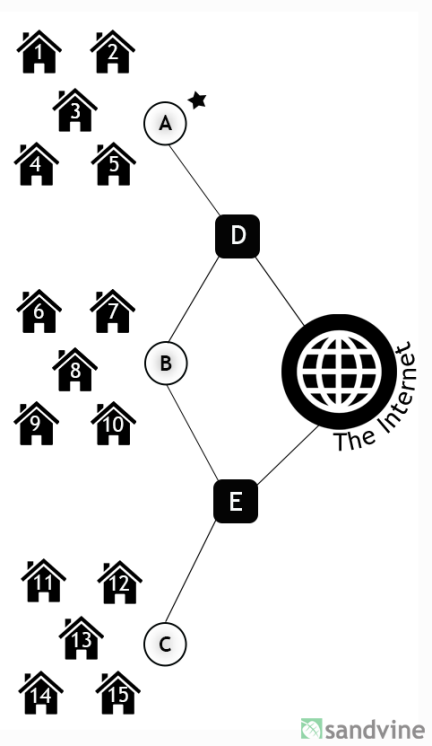

Figure 8 - Simplified network hierarchy

Sandvine manages link congestion by examining, identifying, and prioritizing time-sensitive applications (gaming, voice-over-IP, video and audio streaming) over time-insensitive applications (web browsing, e-mails, P2P) or, alternatively, prioritizing the traffic of users who are not contributing to congestion over those who are contributing the most.

Importantly, Sandvine's congestion management solutions are applied only when and where congestion exists, as close to the affected subscribers as possible. This focus on maintaining the subscriber quality of experience[28] is a major differentiator, because competitive offerings only manage aggregate traffic patterns. For subscribers, this means that the Sandvine approach only affects subscribers who are already being impacted by congestion, while the competitive approach impacts everyone.

Congestion does happen, and will continue to happen, regardless of capacity expansion and advances in technology (for instance, LTE networks will exhibit congestion). The Internet has been specifically and intentionally designed to be oversubscribed, so that there is access for all. The economic models that allow affordable access and upon which network design and capacity decisions are based, do not allow for enough network capacity to overcome all congestion at all times, so management solutions are required. When evaluating congestion management solutions, communication service providers should carefully consider how precisely these competing methods address congestion.

"While most incidents of congestion occur during peak period, and some locations might have more incidents than others, it can still occur unpredictably at any time, on any link. The most effective and most fair way to manage congestion is to implement corrective policies that are localized at the time and site of congestion itself."

"Congestion does happen, and will continue to happen, regardless of capacity expansion and advances in technology (for instance, LTE networks will exhibit congestion). When evaluating congestion management solutions, CSPs should carefully consider how precisely these competing methods address congestion."

21. http://tech.fortune.cnn.com/2012/01/06/dont-blame-the-iphone-4s-if-your-network-is-congested/
22. http://www.heavyreading.com/4glte/details.asp?sku_id=2673&skuitem_itemid=1315
23. http://www-inst.eecs.berkeley.edu/~ee290t/sp02/Network_Congestion.ppt
24. http://en.wikipedia.org/wiki/Network_congestion
25. http://support.verizonwireless.com/information/data_disclosure.html
26. http://en.wikipedia.org/wiki/Whac-A-Mole
27. Genachowski, Julius. "The Third Way: A Narrowly Tailored Broadband Framework." Broadband.gov. Broadband.gov, 6 May 2010. Web. <http://www.broadband.gov/the-third-way-narrowly-tailored-broadband-framework-chairman-julius-genachowski.html>.
28. We have a real-world case study, "Improving Quality by Managing Congestion" at www.sandvine.com

A New Paradigm in Provisioning

Many operators provision their network, and thus prioritize capital investments, based on either peak period traffic volume or a measure of the per-subscriber bandwidth at peak (or peak hour, or peak period). Increasingly, though, service providers are exploring alternatives.

At the 2012 CableLabs[29] Winter Conference, a number of operators asked us about metrics that could be used instead of basic bandwidth thresholds to optimize where and when capital investments should be made[30]. Two metrics that suit this objective are round-trip time (a measure of network latency) and video quality of experience. By examining these metrics instead of, or in conjunction with, bandwidth utilization, operators can focus investments in areas of the network where quality is beginning to suffer – in essence, they'll be growing the network where growth is most needed to protect and improve the subscriber experience.

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Sandvine's Network Analytics[31] allows for just this type of analysis, and optimizing capacity planning is one use case thoroughly covered by our Traffic Management Dashboard. By using the dashboard's Resource Utilization Histogram and detailed Resource Trend projections, customers are able to determine which cable modem termination system (CMTS) resources are characterized by the longest access round-trip time (aRTT).

While the individual aRTT measurements offer per-device precision, for this use case it is sufficient to aggregate them by CMTS slot and port, giving operators network-wide granular visibility into resource performance and allowing the engineering teams to precisely identify resources that are delivering a poor quality of experience. By joining the aRTT histogram data with reports counting the number of active subscribers per resource, prioritizing investments based on where they will have the largest positive impact for the largest number of subscribers is a straightforward exercise.

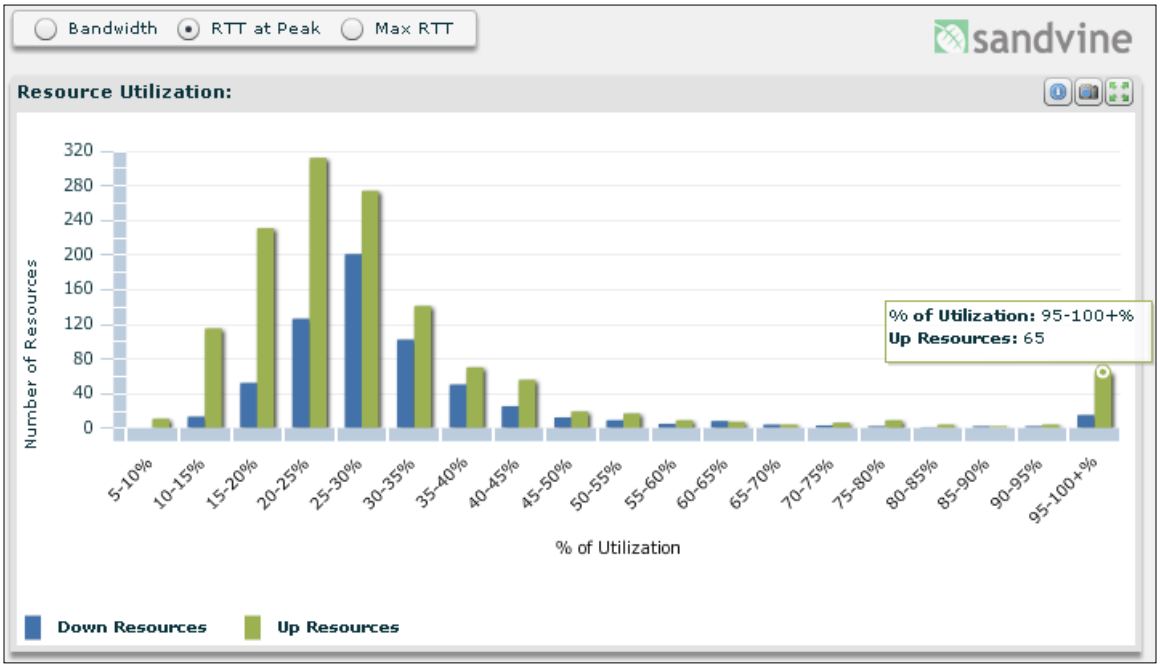

Figure 9 - Resource Utilization widget from the Network Analytics Traffic Management Dashboard

29. To learn more about the great work done by CableLabs, visit http://www.cablelabs.com/
30. Bowman, Don. "From the Conference Floor: CableLabs Winter Conference." Better Broadband Blog. Sandvine, 13 Mar. 2012. Web. <http://www.betterbroadbandblog.com/2012/03/from-the-conference-floor-cablelabs-winter-conference/>.
31. Interested readers can find out more product information at http://www.sandvine.com/products/network_analytics.asp

North America – Fixed Access – Summary

When compared to the same time period in 2011, North American fixed access networks have seen a significant year-over-year traffic increase: median monthly usage increased by 47% (to 10.3 GB from 7.0 GB) and mean monthly usage increased by 40% (to 32.1 GB from 23.0 GB).

Real-Time Entertainment is gaining a 4-5% share of total traffic every six months, and now accounts for 58.0% of peak aggregate traffic, up from 53.6% in the September 2011, and from 49.2% a year ago.

The leading application on the network continues to be Netflix, which in the past six months slightly increased its share of peak hour downstream from 32.7% to 32.9%. It should be noted that this small amount of share growth should not be interpreted to mean that Netflix's volume is flat. When taking into account increased network traffic, Netflix's total volume has grown by approximately 30% in the past six months.

Did you Know?

15.6% of all Real-Time Entertainment, by volume, is watched on smartphones or tablets using home WiFi

27.8% of all YouTube traffic is consumed on a smartphone or tablet

While Netflix' share remained more or less constant, YouTube grew from 11.3% to 13.8% of peak aggregate traffic. Hulu also experienced significant gains with its share doubling from 0.8% to 1.6% in the past six months, compared to 1.1% a year ago. Hulu's fluctuations are likely driven largely by the availability or lack thereof of new, compelling television content. Recall that the Fall 2011 report relied on data collected in September, before the new U.S. television season has begun.

Year-over-year, BitTorrent's share declined sharply from 17.2% of peak aggregate traffic to 11.3%. It also experienced a drop in overall ranking, falling from being the second largest application on the network, to being the fourth, with YouTube and HTTP web browsing leapfrogging the popular P2P protocol.

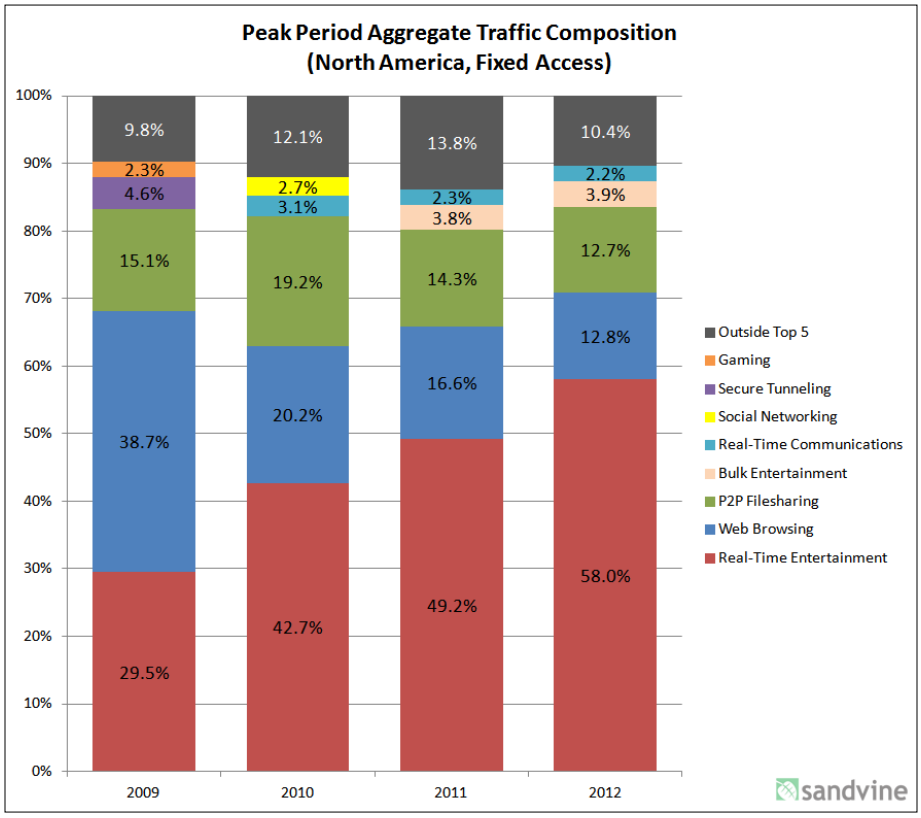

Figure 10 - Peak Period Aggregate Traffic Composition - North America, Fixed Access

Back to the Future – Projecting Fixed Network Traffic in the United States

In the United States, the number of people online via fixed access is growing roughly in lock-step with the rate of population growth, so overall traffic growth is driven mostly by increases in individual consumption (which also owes at least some of its growth to individual subscribers having multiple devices), rather than simply having more people online.

Looking forward, Real-Time Entertainment applications will represent the majority of Internet traffic for the foreseeable future, thanks to several interrelated factors:

- Connected Devices: 38% of households now have a TV connected to the Internet[32] (via a gaming console, set-top box, other computing device, or direct network connection), and the percentage of HD TVs continues to rise. Additionally, mobile device roaming at home will play a large role in driving video consumption. Many of these devices feature high resolution displays, and their portability lends itself to convenience – a force that can't be underestimated.
- High Fidelity: The fidelity of streamed media continues to climb, keeping pace with device capabilities, so even if the total minutes viewed remained constant (which it won't), the byte consumption will increase dramatically.
- Connection Speeds: The rollout of DOCSIS 3.0 and Fiber gives households the last-mile capacity to enjoy the potential of HD streaming applications. Throughout history, when capacity is increased, consumption rises with it.
- Concurrent Streams: With more connected devices and higher connection speeds, the number of households engaged in multiple concurrent streams will increase. The mean number of TVs per household in the United States is 3, with a mean of 1.3 HD sets[33] – even if these figures don't rise, in combination with the penetration of HD-capable tablets and phones, these multiple screens will drive multiple streams.

We also anticipate that P2P Filesharing will very slowly shrink as a percentage of overall traffic (but will not go away), while Storage and Back-Up services will see dramatic growth as transparent automated back-ups become commonplace.

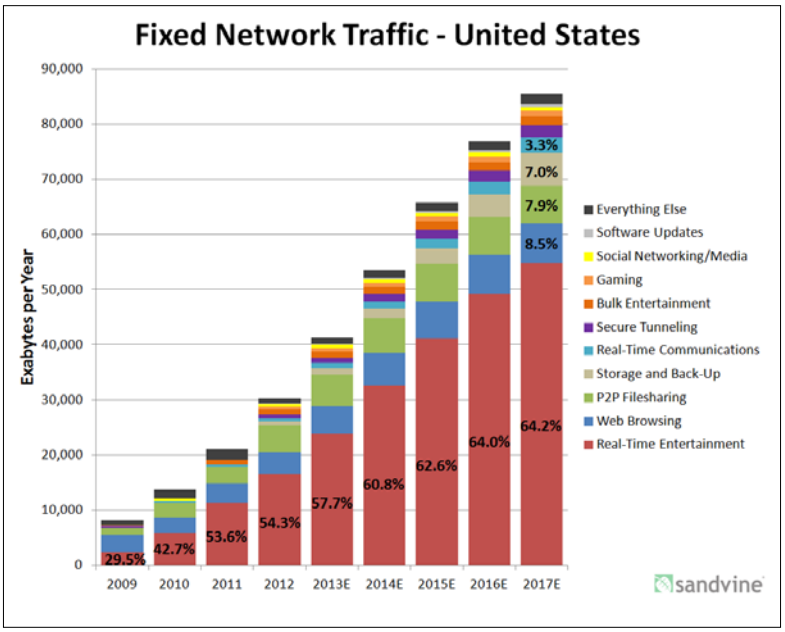

Figure 11 - Projection of Fixed Access Traffic in North America

32. Leichtman Research Group, Inc. "Smart TV Sets - Today's Shimmer?" Research Notes. Leichtman Research Group, Inc., Apr. 2012. Web. <http://www.leichtmanresearch.com/research/notes04_2012.pdf>.
33. Leichtman Research Group, Inc. "Smart TV Sets - Today's Shimmer?" Research Notes. Leichtman Research Group, Inc., Apr. 2012. Web. <http://www.leichtmanresearch.com/research/notes04_2012.pdf>.

Growing Pains for Netflix

In North America, Netflix is far and away the largest single source of traffic on fixed access networks. Counting all traffic (upstream and downstream), and measuring over 24 hours, Netflix represents 24.4% of total volume, well ahead of BitTorrent, at 14.2%. On the downstream, Netflix accounts for 32.9% of peak hour traffic, up only slightly from 32.7% in September 2011. From the network operator's perspective, Netflix drives one-third of capacity infrastructure costs.

Since achieving success in the United States and after making a positive debut in Canada[34], Netflix aggressively expanded into Latin America in September 2011 and the United Kingdom in January 2012. Investors, Internet junkies, and service providers alike are wondering how successful these launches have been, and they aren't alone – at Sandvine, we have extensive coverage in Latin America and the U.K., and have been eager to share what we've observed.

Did You Know?

On the Canadian networks we examined, Netflix accounted for between 6% and 10% of peak hour downstream bandwidth – but bear in mind that Canadian viewers get a lower default display quality than their counterparts to the south

So how is Netflix faring outside of North America? The reception in Latin America has been lukewarm, at least when measured in terms of bandwidth usage. Netflix accounts for just 0.75% of downstream traffic on fixed access networks, and only 0.73% on mobile networks. To put things into context, however, these usage levels still make Netflix the 13th-largest source of peak hour traffic on both fixed and mobile access networks.

In the U.S., Netflix enjoyed a combination of high network quality, large disposable income coupled with credit card usage, widespread Netflix-capable device penetration, and a relative lack of competition. In Latin America, the environment could scarcely be more different.

"Since few Latin American subscribers have access to the high speeds, consistent quality and large usage allowances available on cable or DSL connections, Netflix faces an uphill battle for the time being."

In North America, most subscribers have a fixed connection that serves as their primary means of Internet access, largely relying on mobile networks as a convenient secondary connection. In Latin America, many countries have limited deployment of fixed access networks, so subscribers often rely on mobile connections as the primary Internet access (this is termed a Fixed-Replacement market). Since few subscribers have access to the high speeds, consistent quality and large usage allowances available on cable or DSL connections, Netflix faces an uphill battle for the time being. Additionally, credit cards have much lower penetration rates in Latin America, so Netflix' challenges extend into payment logistics.

Subscribers may also be hesitant to adopt the service because of a perceived lack of compelling content. Movie and television studios often require their programming to be licensed separately in each country or region. While Netflix has a large catalogue in the United States, customers in Canada and Latin America were offered a much smaller library, often lacking marquee titles. Regional content is especially important in Latin America, because while Netflix is working hard to provide subtitles for the majority of their content, if video isn't offered in a region's native language (Spanish and Portuguese, primarily, in Latin America) then it can create a huge barrier for entry for new subscribers.

However, Latin America offers a tantalizing growth opportunity, with many potential customers, and arriving early will let Netflix quickly learn from mistakes and tweak their service offerings before the early majority are ready to adopt.

Shifting attention to the United Kingdom, we find a market that's similar in network capabilities to North America, but that features more competitors than Netflix faced initially in the United States. Amazon's LoveFilm[35] service has a long head-start on Netflix, and Sky's SkyGo[36] offering has more local brand equity, while BBC's iPlayer[37] is the dominant long-content streaming service (accounting for 6.4% of peak period downstream traffic). Nevertheless, in the two months since launch, Netflix has risen to account for 2% of prime time downstream traffic, which is no small feat.

"Latin America offers a tantalizing growth opportunity, with many potential customers, and arriving early will let Netflix quickly learn from mistakes and tweak their service offerings before the early majority are ready to adopt."

34. Sandvine. "Sandvine Global Internet Phenomena Spotlight - Netflix Rising." Sandvine. Sandvine. Web. <http://www.sandvine.com/general/document.download.asp?docID=20>.
35. http://www.lovefilm.com/
36. http://go.sky.com/vod/page/default/home.do
37. http://www.bbc.co.uk/iplayer/radio

When Netflix first launched "Watch Instantly" in the United States in 2008, they were one of the first companies to offer a high quality, long content viewing experience. Their brand recognition and embedded device capabilities gave them an enormous head start on subsequent services and helped established the leadership position they still hold today. In the meantime, and perhaps in response to Netflix' domestic success, similar services popped up around the world. These incumbents, which include NetMovies[38] in Brazil, the U.K. services already mentioned, and the international SundayTV[39] service from Telefonica, are enjoying a welcome reception not unlike the one Netflix received when it launched, and they are in no less a hurry to relinquish their early market-leading positions.

So will Netflix be a success outside North America? It is still too early to tell, and the world is a very different place than the U.S. was back in 2008, but Netflix' CEO is on record as saying the company would like to be in "all the markets where people have broadband and like TV" [40], so it's likely that we'll look back on this period as just the beginning.

Have we seen "Peak Netflix"? Part II.

In the previous Global Internet Phenomena Report, we asked, "has Netflix traffic reached a maximum as a share of total Internet traffic in the United States?"[41] Figure 12 shows that Netflix grown slightly as a share of peak downstream traffic, from 32.7% to 32.9%, and Netflix continues to be the largest driver peak downstream traffic in the U.S. However, the explosive growth seems to be over, and we expect the 2H 2012 report to show a slight decline in peak share, down to 32.5%.

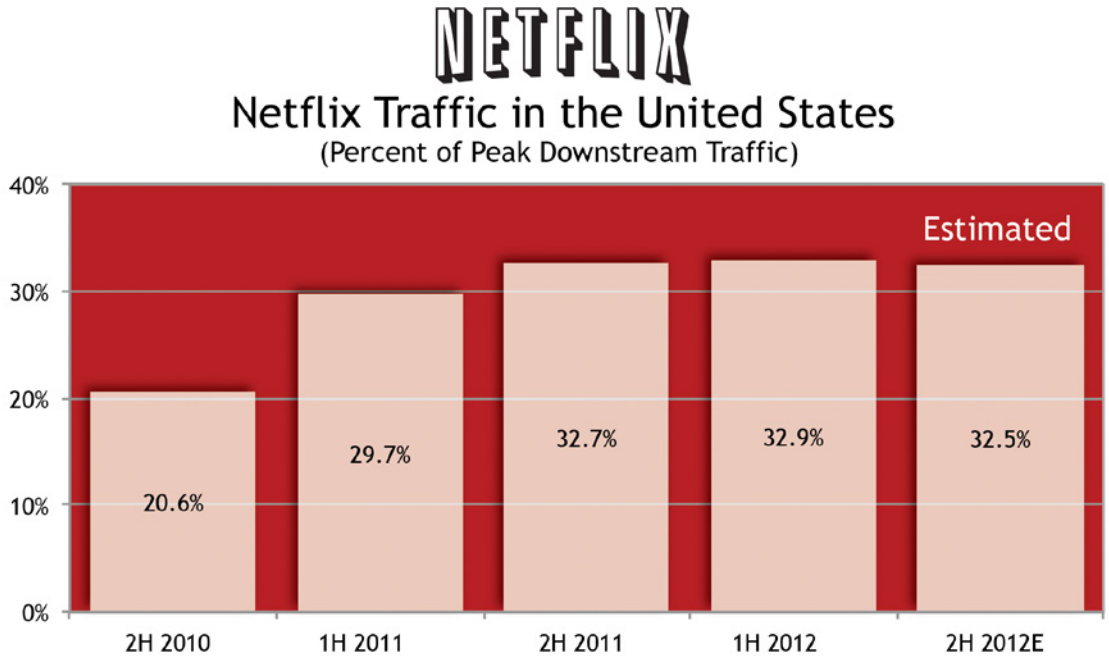

Figure 12 - Netflix Traffic on Fixed Access Networks in the United States

Going forward, Netflix faces increased competition from the likes of YouTube (the second-largest source of peak downstream traffic, at 13.8%), Hulu, HBO Go, Amazon Prime, and traditional TV networks streaming their content to game consoles and other devices. Furthermore, the company faces business challenges from increased content licensing costs, which have the potential to impact the content catalogue. However, all of these services face a tremendous uphill battle to knock Netflix off its perch, and many will have to overcome the same licensing issues as Netflix, so don't expect Netflix to fall from the top spot anytime soon. Those companies that already own vast content libraries and can control or influence licensing discussions will play a particularly interesting role in the developing market of content streamers.

38. http://www.netmovies.com.br/
39. http://www.reuters.com/article/2012/03/17/us-telefonica-terra-streaming-idUSBRE82G00020120317
40. Vlessing, Etan. "What Netflix CEO Hopes U.S Won't Notice." The Hollywood Reproter. The Hollywood Reporter, 23 Sept. 2010. Web. <http://www.hollywoodreporter.com/ news/whatnetflix-ceo-hopes-us-28218>.
41. We asked this question on page 7 of the Global Internet Phenomena Report: Fall 2011

Latin America – Fixed Access – Summary

Being a fixed-replacement market, one would expect Latin America's fixed access networks to exhibit traffic profiles that are broadly similar to the region's mobile networks, and that is in fact the case.

Real-Time Entertainment traffic, led by YouTube, is the primary driver of traffic and accounts for 43.0% of peak period usage. While Netflix is available to subscribers in the region, the service is struggling to find a foothold accounting for only 0.8% of downstream traffic, well behind YouTube's leading 29.6%.

Unsurprisingly, P2P Filesharing is higher on Latin America's fixed networks than on the region's mobile networks, with BitTorrent overtaking Ares to take the title as the top P2P network.

Driven by high levels of Real-Time Entertainment and P2P Filesharing traffic, median monthly aggregate consumption in Latin America is 3.1 GB, while mean is 6.2 GB. These numbers are significantly below fixed network consumption numbers seen in other regions, but that can be attributed in part to generally lower connection speeds and the limited availability of over-the-top (OTT) video services that typically drive significant usage in other regions.

Latin America Fixed

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	18.29%	YouTube	29.63%	YouTube	26.61%
2	YouTube	15.06%	HTTP	21.80%	HTTP	19.98%
3	HTTP	13.03%	BitTorrent	6.87%	BitTorrent	9.24%
4	Skype	8.59%	Facebook	6.74%	Facebook	6.97%
5	Facebook	7.83%	Flash Video	6.50%	Flash Video	5.83%
6	Ares	7.03%	Skype	2.71%	Skype	3.93%
7	Flash Video	3.25%	MPEG Streaming	2.31%	Ares	2.77%
8	SSL	2.05%	Windows Update	2.10%	MPEG Streaming	2.04%
9	STUN	1.71%	Ares	1.66%	Windows Update	1.85%
10	Teredo	1.10%	iTunes	1.65%	SSL	1.45%
	Top 10	77.94%	Top 10	81.97%	Top 10	80.67%

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

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Table 4 - Top Peak Period Applications by Bytes (Latin America, Fixed Access)

Networks 101: The Two Vectors of Video Quality

When you're watching a video online, what's most important to you: that it gives you the highest possible display resolution, or that it plays smoothly without interruption? No doubt, you'd prefer if you could get both, but the real world is full of concessions.

Whether you know it or not, in answering the question above you made a trade-off between two factors:

- **Display Quality**: how good the picture looks
- **Transport Quality**: how often the picture stalls and rebuffers

Why is it important to be aware of this distinction? Not all Internet video behaves in the same manner. Progressive[42] video takes the user's request for a particular level of quality and starts downloading the file. In a progressive download, the video usually does not start playing until the buffer has grown large enough to ensure stall-free playback. Adaptive[43] video takes a different approach, achieving transport quality at the expense of the display quality (to the viewer, this manifests as down-shifts and up-shifts in display quality).

There are also models in which "chunks" of video (several minutes of content) are independently fetched. Many video providers rely on multiple CDNs. For subscribers, this means that when you're watching a movie, it is fetched in sequential chunks that arrive through different network paths and CDNS. Of course, there's no guarantee that the quality will be consistent – this is why you might have two minutes of lower-definition content interspersed throughout your high-definition movie. Our own observations show significant variation in video QoE between different CDNs.

The network is only responsible for transport quality, but true subscriber video QoE is a function of both transport quality and display quality. For operators, there are two important take-aways:

1. When calculating video quality of experience, you must apply different algorithms to different types of video (incorporate stalls in progressive streaming, and downshifts/upshifts in adaptive streaming)
2. Your video QoE metric must consider display quality - if the traffic classification technology you've employed does not differentiate between levels of display quality, then neither does your video QoE

If a technology can't identify the display characteristics, then it can't recognize when these characteristics change, and as a consequence it can't truly measure quality. This deficiency can cause major problems for operators who don't understand it. For instance, a high QoE that fails to account for display quality might cause an operator to conclude that the subscriber experience is terrific, masking a reality in which the majority of subscribers have been (to their dismay) downshifted to lower display qualities that are merely being transported better.

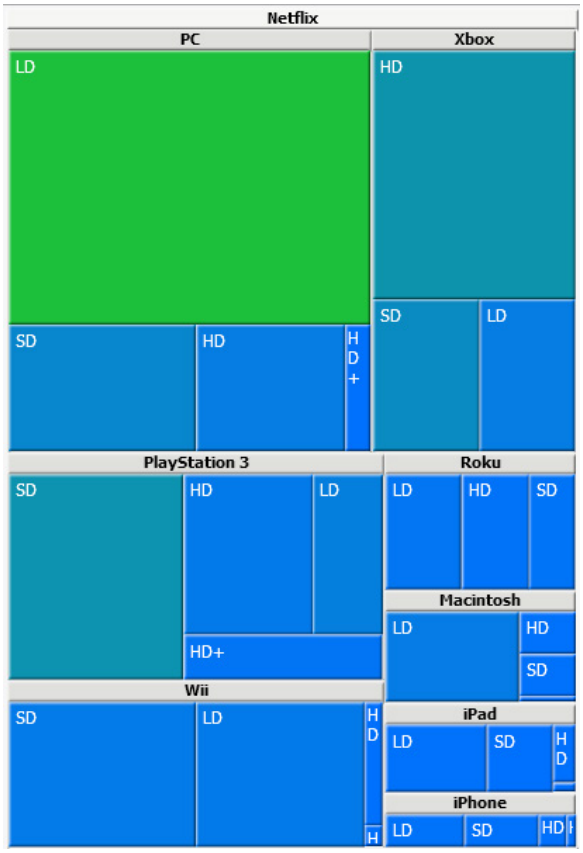

Figure 13 - Dynamic Analysis Heatmap, from the Network Analytics Real-Time Entertainment Dashboard, showing Netflix display resolution per device

42. http://en.wikipedia.org/wiki/Progressive_download
43. http://en.wikipedia.org/wiki/Adaptive_bitrate_streaming

Internet users value consistency, so a variation in display quality (Figure 14) can be more damaging to a network's reputation than consistently poor overall quality.

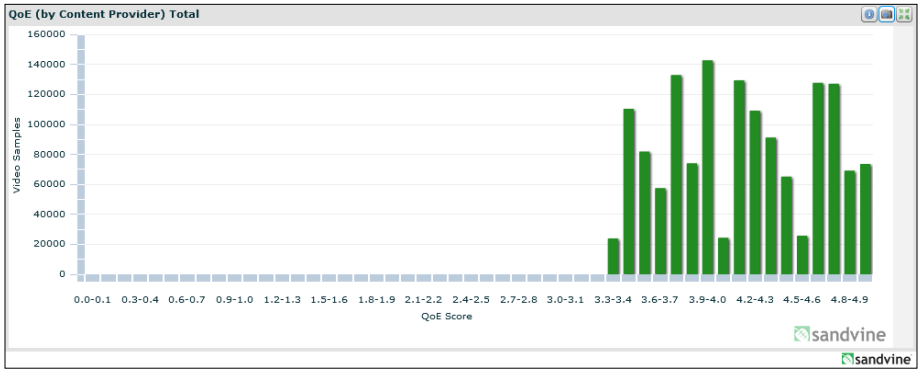

Figure 14 - Video QoE Histogram, from the Network Analytics Real-Time Entertainment Dashboard, showing the distribution of video quality

In practice, video QoE varies between video services, CDNs, network location, device, and time of day (Figure 15), so granular information is required in order to diagnose the cause of a habitually low QoE score. Notice that, in the figure below, Video QoE declines in the evening when the network is carrying the most streaming media traffic.

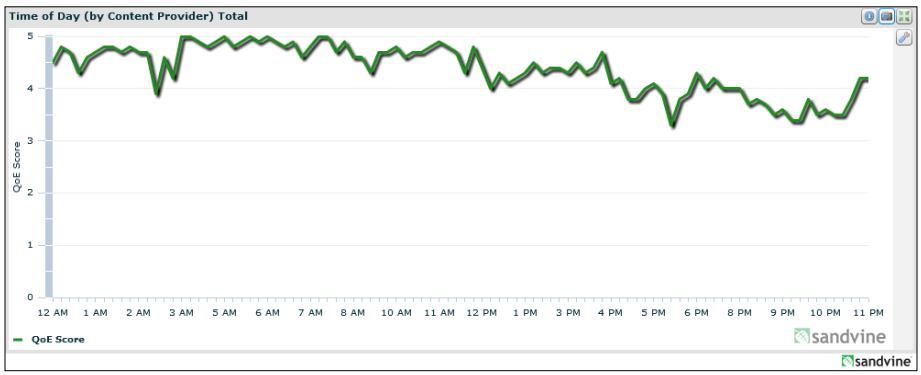

Figure 15 - Time of Day graph, from the Network Analytics Real-Time Entertainmetn Dashboard, showing how Video QoE varies by time

Big Hair, Neon Colors, and Measuring Quality by Packet Drops

TCP is a fine protocol that has been with us for many years. In its earliest incarnation, it just went as fast as it could, all the time, and if packets got dropped they were retransmitted.

In the mid 1980s, the Internet began to collapse under the load of congestion. Like in any good story, a hero emerged: enter Van Jacobson[44]. Mr. Jacobson invented a method by which TCP will, on packet drop, slow down so it stops dropping. Now, when your 1 Mbps home connection tries to pull content from a server capable of 1 Gbps, you don't experience 99.9% packet drops.

Nevertheless, even people in the industry continue to believe that when demand exceeds capacity, the entire difference is simply dropped, but this is not the case. In fact, TCP rarely drops any packets, and the drops that do occur are not correlated at all to the bandwidth.[45]

Still, there are those who promote "TCP Packet Loss" (typically presented as a percentage of dropped packets) as the ultimate measure of network quality. Such a claim is either deliberately misleading or the result of genuine ignorance. Regardless of the actual cause, like neon colors and big hair, it belongs in the 80s.

44. Get to know Mr. Jacobson at http://en.wikipedia.org/wiki/Van_Jacobson
45. http://en.wikipedia.org/wiki/TCP_congestion_avoidance_algorithm

Europe – Fixed Access – Summary

Europe presents a mix of mature and emerging markets and cultural and linguistic diversity that combine to create very localized traffic profiles. Consequently, aggregated "top application" lists are insightful when showing the popularity of broadly popular applications, but do not capture the precise make-up of any particular country.

For example, in the United Kingdom, BBC's iPlayer video application accounts for 5.6% of downstream traffic, but due to geographical restrictions that limit its access it appears only as number ten among Europe's top applications in total bytes. Of course, if you're in a country where iPlayer is unavailable, then even seeing it at number 10 doesn't make sense.

"Generally, Europe's networks have a consistent set of dominant applications and services that account for 80-85% of traffic, and then a set of very local websites and applications that make up the remainder."

Generally, Europe's networks have a consistent set of dominant applications and services that account for 80-85% of traffic, and then a set of very local websites and applications that make up the remainder.

Levels of P2P Filesharing and Web Browsing traffic have changed dramatically since 2009, with no consistent trend appearing. We see higher levels of P2P Filesharing than in many other regions, at least partially due to geographical licensing challenges that restrict the availability of legitimate Real-Time Entertainment services. Both BitTorrent and eDonkey are among the top five applications during peak, accounting for a combined 29.7% of traffic during the peak period.

Europe Fixed

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	31.69%	HTTP	19.46%	BitTorrent	20.32%
2	eDonkey	18.23%	YouTube	18.00%	HTTP	17.70%
3	HTTP	11.29%	BitTorrent	17.20%	YouTube	15.25%
4	YouTube	5.24%	eDonkey	6.96%	eDonkey	9.39%
5	Skype	2.48%	Flash Video	5.62%	Flash Video	4.70%
6	SSL	2.47%	RTMP	2.80%	RTMP	2.47%
7	Teredo	2.31%	Facebook	2.54%	Facebook	2.43%
8	Facebook	2.02%	MPEG Streaming	1.98%	SSL	1.74%
9	Flash Video	1.34%	iTunes	1.68%	MPEG Streaming	1.66%
10	BBC iPlayer	1.27%	SSL	1.54%	iTunes	1.53%
	Top 10	**78.34%**	**Top 10**	**77.78%**	**Top 10**	**77.19%**

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

sandvine

Table 5 - Top Peak Period Applications by Bytes (Europe, Fixed Access)

Filling the Megaupload Void

In January of this year, Megaupload, one of the Internet's most popular Storage and Back-Up Services, was shut down by the U.S. Justice Department for allegedly violating various copyright laws.

The shutdown impacted global network traffic almost immediately, as Megaupload accounted for a significant portion of global Internet traffic.[46] The closure of Megaupload also prompted some competing services to cease operating, out of fear that they could face a similar fate.[47] In two blog posts covering the shutdown's fallout, we promised to continue to monitor the situation and provide an update in a future report, and now we're making good on that promise.

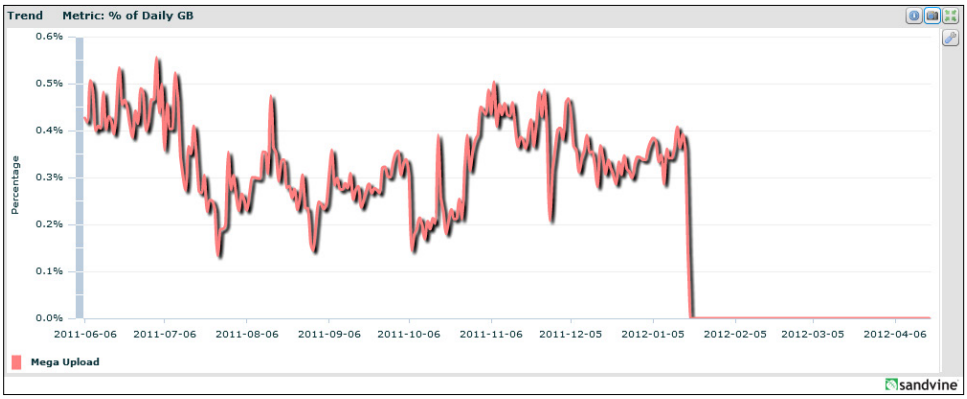

Figure 16 - Network Analytics graph showing MegaUpload's sudden exit

Megaupload's popularity with subscribers proved that there is demand for cyberlocker type storage services, but in the three months following the shutdown, no other service has risen to become a clear replacement.

Looking at North American fixed access networks, in September of 2011 Megaupload was the 14th largest source of downstream traffic, accounting for almost 1% of traffic. As of March 2012 however, no single Storage and Back-Up Service grew to be a comparably large source of traffic, despite the fact that many popular competitors like Rapidshare, zShare, and 4shared are still operating.

So why has no new clear leader emerged? There are probably several reasons. First, the whole cyberlocker landscape has been thrown into turmoil[48], with many services introducing major changes to their terms of usage and stringently policing content, which has driven away users looking to illegally share material. Additionally, a service that is in a state of flux will find it difficult to keep casual users.

"With major players Google, Apple, and Microsoft entering the space, casual users who find comfort in familiar brands are simply waiting until these services are available."

Second, the "once bitten, twice shy" maxim applies – huge numbers of subscribers and small businesses using Megaupload for completely legitimate reasons[49] have lost (or, at least, been unable to access) their data[50]. Such users, and anyone who has followed the situation closely, will no doubt think twice before trusting their content to another service that might also be accused of hosting illegal content.

Third, subscribers have likely found new ways to view the content they want – consider that Real-Time Entertainment services have grown from 60.0% to 64.7% of downstream traffic in the past 6 months alone. With services such as Netflix, Hulu, Amazon, and HBO GO, not to mention traditional video-on-demand services, subscribers have many more options (and much more content) available than even a year ago.

Finally, and perhaps most importantly, with major players Google, Apple, and Microsoft entering the space, casual users who find comfort in familiar brands are simply waiting until these services are available.

46. Tooley, Matt. "Megaupload Gets Shut Down." Better Broadband Blog. Sandvine, 20 Jan. 2012. Web. <http://www.betterbroadbandblog.com/2012/01/megaupload-gets-shut-down/>.
47. Bowman, Don. "Megaupload's Mega-Fallout." Better Broadband Blog. Sandvine, 24 Jan. 2012. Web. <http://www.betterbroadbandblog.com/2012/01/megauploads-mega-fallout/>.
48. Ernesto. "MPAA Targets Fileserve, MediaFire, Wupload, Putlocker and Depositfiles." TorrentFreak. 31 Mar. 2012. Web. <http://torrentfreak.com/mpaa-targets-fileserve-mediafire-wupload-putlocker-and-depositfiles-120331/>.
49. Electronic Frontier Foundation. "Brief of Interested Party Kyle Goodwin." Electronic Frontier Foundation. 30 Mar. 2012. Web. <https://www.eff.org/document/brief-interested-party-kyle-goodwin>.
50. Geuss, Megan. "Megaupload User Asks for His Perfectly Legal Videos Back." Ars Technica. 31 Mar. 2012. Web. <http://arstechnica.com/tech-policy/news/2012/03/megaupload-user-asks-for-his-perfectly-legal-videos-back.ars>.

Riddle of the Links: What has two sides and three winners?

CSPs are increasingly exploring the concept of ARFU (average revenue from users - revenue based on subscriber activities, but does not come directly from subscribers), with two-sided business models frequently being cited as a potential source. Content delivery networks (CDNs) are being seriously investigated by many operators, as one such possibility, and many operators are already building expertise in this area by launching their own CDNs to deliver their own content (e.g. tablet multi-screen applications).

A CDN is a system of computers that stores copies of popular Internet content and bypasses transit links by inserting this content into the service provider's network closer to the subscriber. Prominent examples of companies in the CDN business include Akamai, Limelight Networks and Google – the latter becoming so big that it became its own CDN (it was cheaper for Google to become a CDN than to buy space from other CDNs – no doubt, Google also enjoys access to usage metrics that would otherwise not be available). Content providers like Netflix use CDNs because it allows their content to be simultaneously hosted in multiple locations across the globe. This distributed hosting gives subscribers quicker access to the files they want, and allows content providers to avoid having to deal with the hassle of hosting multiple copies of the content themselves. They can focus on developing content, and pay someone else to handle the distribution.

"Because the provider owns and operates both the entire access network and the CDN itself, they can place the content closer to the subscriber than any competing third-party could achieve. What is the advantage gained by the content provider and the subscriber from such placement? A higher quality of experience."

By owning and operating a CDN that delivers something that can't easily be matched by a 'traditional' CDN, a CSP can establish a business partnership directly with content providers who are willing to pay for that something. All that's missing is the something.

CDNs typically charge based on either data volume per month or 95th percent of peak rate, and per server (rack unit) capacity, so, beyond competing on price, what other benefits could a CSP-operated CDN provide? The most obvious advantage a CSP can offer is the placement of the CDN in the network. Because the provider owns and operates both the entire access network and the CDN itself, they can place the content closer to the subscriber than any competing third-party could achieve. What is the advantage gained by the content provider and the subscriber from such placement? A higher quality of experience – and the something has been found.

Does quality really vary that much between CDNs? The evidence favors this conclusion. Consider Figure 17, which shows the Video QoE between the four largest CDNs on a large operator's network. Measuring video quality of experience is an art in and of itself, requiring us to measure both the transmission quality (e.g. TCP stalls) and the selected codec fidelity (e.g. the target bitrate and resolution). The delivered quality ranges from about 2.5/5 to around 4/5, and this is what we see everywhere we look. While the actual ordering of each CDN provider varies, there is almost always a significant variation in the quality each delivers on any particular network, and CSPs are betting that content owners are willing to pay for a consistently positive subscriber experience. Is this a safe bet? It would seem so - Amazon has gone on the record as saying that[51] each 100ms of latency costs them 1% in sales.

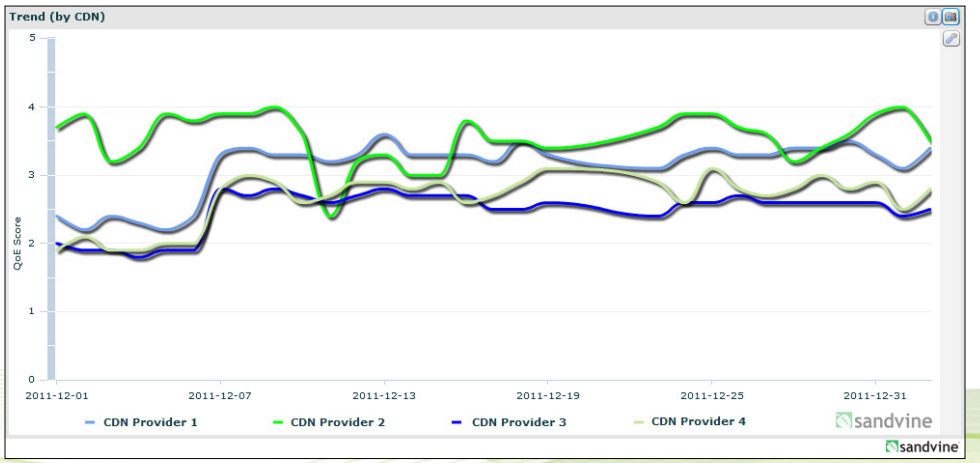

Figure 17 - Network Analytics graph showing variation in CDN video QoE

51. Liddle, Jim. "Amazon Found Every 100ms of Latency Cost Them 1% in Sales." The GigaSpaces. 27 Aug. 2008. Web. <http://blog.gigaspaces.com/2008/08/27/amazon-found-every-100ms-of-latency-cost-them-1-in-sales/>.

Due to the CDN being in closer to the access edge, subscribers benefit from lower latency (round-trip time) and improved QoE, particularly for sensitive applications like streaming video and audio. This differentiator is particularly important as real-time entertainment continues to grow as the dominant traffic category, and subscribers, many of whom have paid to subscribe to a particular video service, demand a high-quality streaming experience.

Content providers win by having their brand associated with the best possible subscriber experience.

"By owning and operating a CDN that delivers a demonstrably better quality of experience, as measured by accepted metrics like round-trip time (RTT) and video QoE, CSPs could muscle into the CDN market and even charge a premium over the traditional vendors."

By owning and operating a CDN that delivers a demonstrably better quality of experience, as measured by accepted metrics like round-trip time (RTT) and video QoE, CSPs could muscle into the CDN market and even charge a premium over the traditional vendors.

Provided that the content owners agree that higher quality is a desired characteristic, the result is a win-win-win situation for subscribers, content owners, and CSPs alike.

However, CSPs also stand to gain in another way – by hosting the content, they can directly monitor how it is accessed. Provided their traffic classification technology yields insight into device characteristics and can subscriber usage (including measurements that go far beyond simple byte counts), CSPs can develop and sell aggregate, anonymous usage data, as all CDNs do already today.

If these two ready-made sources of recurring revenue, combined with a higher subscriber quality of experience, weren't tantalizing enough reasons to investigate a self-CDN, there's a third benefit for CSPs: with the transition towards usage-based billing (UBB), there is also the potential for content providers and CSPs to form strategic partnerships. In one such arrangement, the content from a strategic partner could be zero-rated (that is, it would not count against a monthly quota). In this example, the CSP could charge the content provider a premium over traditional CDNs, since the CSP can ensure both superior QoE and also additional views (and additional advertising revenue for the content provider), because subscribers know that content will not count against their monthly usage cap. "CDN Neutrality" would imply that the operator CDN would also offer to host any third-party content for which there is no similar partnership arrangement on a non-discriminatory basis.

"With so many benefits from a single investment, it's no small wonder that service provider CDNs are a hot topic right now. Nevertheless, before a CSP can begin to implement any CDN strategy, it is essential to have a detailed understanding of the network environment, including the performance of existing CDNs."

With so many benefits from a single investment, it's no small wonder that service provider CDNs are a hot topic right now. Nevertheless, before a CSP can begin to implement any CDN strategy, it is essential to have a detailed understanding of the network environment, including the performance of existing CDNs. Traffic classification and measurement tools that produce valuable performance metrics, like RTT and video QoE, and network analytics tools to provide business intelligence, are prudent parts of any strategy. These tools lessen risk and increase confidence by providing the insight to shape the business case and the objective metrics that let the CSP approach the content providers from an informed position.

CSPs have a unique opportunity to develop a two-sided business model that offers compelling competitive advantages to content producers and additional revenue to the CSP, while delivering a better quality of experience to subscribers.

Flipping the Switch on IPv6: "World IPv6 Launch"

Under the headline, "This time it is for real", on or before June 6th, 2012, major network operators, home equipment manufacturers, and websites and services around the world will permanently enable IPv6[52].

World IPv6 Launch is a follow-on to World IPv6 Day[53], which brought together Internet stakeholders from around the world to identify, address, and learn from potential stumbling blocks as the Internet transitions from IPv4 to IPv6.

Not everyone is waiting for June 6th: Akamai, the world's largest content delivery network (CDN), will offer IPv6 services to its entire customer base in April[54], helping these enterprises and web properties serve content to subscribers who have IPv6-only web addresses. Later in the year, U.S. government agencies face a self-imposed September 30th deadline to support IPv6.

For network operators, the transition to IPv6 is not without risks. Over the years, many networks have implemented 'tricks' to optimize IPv4 routing. For instance, the origin of DNS requests and geo-IP techniques ensure that your content is fetched from the lowest-cost source, typically from a very local CDN, or via peering links rather than the more expensive transit links. These same mechanisms will work differently (or not at all) when IPv6 is initially rolled out, and massive swings in routing could prove very costly for network operators. Huge changes in traffic routing also have the potential to severely hamper redundancy models – routes with plenty of excess capacity in IPv4 might suddenly see that buffer consumed, literally overnight.

For operators, one key to a smooth, successful transition to IPv6 is to ensure appropriate visibility into traffic characteristics and routing.

To help service providers investigate the ongoing adoption of IPv6 and transitional technologies on their networks, Sandvine introduced the IPv6 Transition Dashboard. This dashboard, the latest free addition to the Network Analytics dashboard line-up, gives network operators exclusive insight into the applications and devices driving their IPv6 growth. No doubt, our customers will gain some interesting and valuable insights when we reach World IPv6 Launch.

We participated in IPv6 Day, and even released a special Global Internet Phenomena Spotlight[55] containing our observations, and we'll definitely be keeping an eye on World IPv6 Launch and its impact.

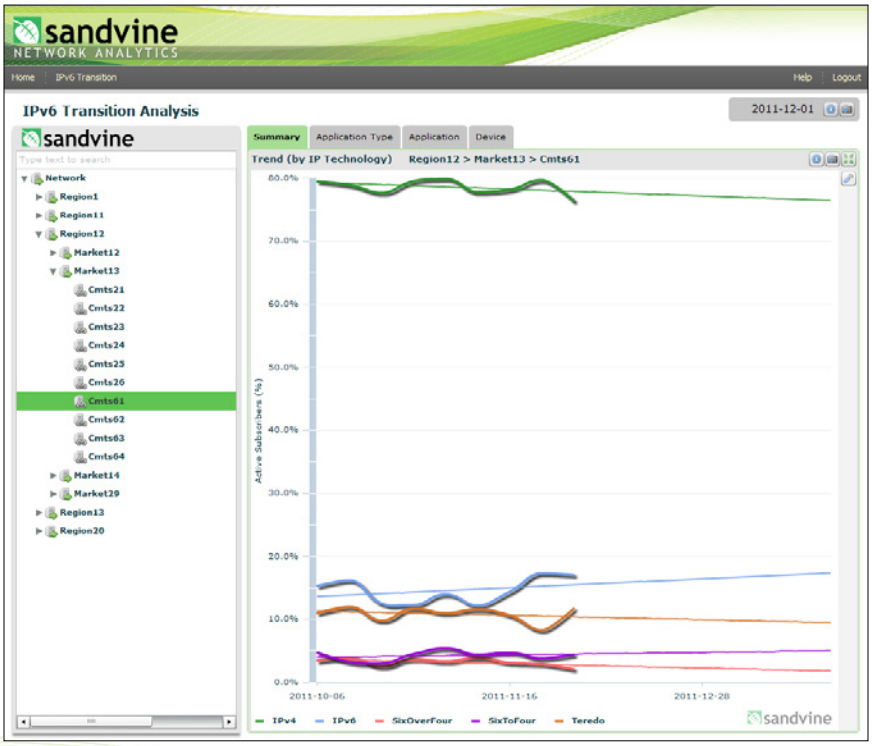

Figure 18 - Screenshot of the Network Analytics IPv6 Transition Dashboard

52. Join the fun at http://www.worldipv6launch.org/
53. Bowman, Don. "World IPv6 Day – Sandvine Policy Traffic Switch Records a Smooth Test Flight." Better Broadband Blog. Sandvine, 9 June 2011. Web. <http://www.betterbroadbandblog.com/2011/06/world-ipv6-day-%e2%80%93-sandvine-policy-traffic-switch-records-a-smooth-test-flight/>.
54. Marsan, Carolyn Duffy. "Big News for IPv6: Akamai to Launch Service in April." Network World. 26 Mar. 2012. Web. <http://www.networkworld.com/news/2012/032612-akamai-ipv6-257634.html>.
55. http://www.betterbroadbandblog.com/2011/06/global-internet-phenomena-spotlight-world-ipv6-day/

Asia-Pacific – Fixed Access – Summary

Subscribers in Asia-Pacific have a reputation for being on the bleeding edge of technology trends, and for this study, Asia-Pacific has both the highest monthly median usage (13.5 GB) and mean usage (34.2 GB) among all of the regions we examined.

This high consumption is driven by the use of Real-Time Entertainment, which accounts for 48.6% of total downstream traffic. As observed almost everywhere, YouTube is the most popular Real-Time Entertainment application, but a unique characteristic of the Asia-Pacific region is the popularity of peercasting applications. In particular, PPStream (which allows users to stream live video) is the fourth-largest application on the network, accounting for 6.4% of total traffic at peak, and the second-largest on the upstream accounting for 8.6%.

P2P Filesharing, and in particular BitTorrent, still makes up a large percentage of traffic in Asia-Pacific. In fact, BitTorrent accounts for more peak hour traffic (27.3%) than anything else, while Thunder (another P2P client) accounts for 4.6%.

Asia-Pacific Fixed

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	43.89%	YouTube	21.63%	BitTorrent	27.19%
2	PPStream	8.63%	BitTorrent	18.07%	YouTube	14.94%
3	Thunder	8.15%	HTTP	14.60%	HTTP	10.44%
4	QVoD	5.02%	PPStream	5.13%	PPStream	6.36%
5	HTTP	2.82%	Flash Video	4.97%	Thunder	4.62%
6	YouTube	2.66%	iTunes	2.74%	Flash Video	3.36%
7	Skype	1.96%	Thunder	2.69%	QVoD	3.44%
8	Teredo	1.90%	Facebook	2.64%	Facebook	2.08%
9	Funshion	1.25%	QVoD	2.58%	iTunes	1.86%
10	SSL	1.16%	MPEG Streaming	2.39%	MPEG Streaming	1.61%
	Top 10	77.44%	Top 10	77.04%	Top 10	75.08%

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

sandvine

Table 6 - Top Peak Period Applications by Bytes (Asia-Pacific, Fixed Access)

Peering in on Peercasting

P2P Filesharing used to be the largest source of traffic on the Internet, but thanks to the explosive growth of Real-Time Entertainment that is no longer the case. Over the past few Global Internet Phenomena Reports, it we have tracked the continued growth of a type of application known as peercasting[56].

Traditionally, when watching live video from a service such as MLB.TV[57] or YouTube Live, the stream is unicasted, with each subscriber connecting directly to a server providing the content. Once each frame of video is viewed, it is briefly cached, but then eventually deleted automatically after a certain length of time.

"While peercasting is unlikely to replace traditional live streaming methods anytime soon, the model has proven its viability."

In the peercasting model, peers throughout the network help to serve content as they simultaneously consume it, in a similar fashion to Bittorrent. The difference is that peercasting is used to view live video content, whereas BitTorrent is mostly used to download content now that is consumed later.

In order to view a video through peercasting, users must connect to a tracking server to locate peers who are serving the desired content. Once connected to those peers, the live stream begins; but instead of the computer automatically deleting the video frames once viewed, the peercasting application uploads those frames of video to another user looking to stream that same content.

While peercasting reduces demand on a single server, because of its distributed model it is not without its limitations. If a stream lacks participants, the user may be subjected to frequent buffer stalls while waiting to receive the next frames of data. Also, because peercasting relies on someone else having viewed it first, streams can often be several minutes behind the live event. For sports fans, this can be problematic, although most diehards would rather endure a jittery almost-live feed than no feed at all.

The most popular of these peercasting apps is PPStream. Initially only popular with Chinese language populations, PPStream gained mainstream popularity. In the Fall 2011 report, we showed that PPStream was the 7th largest source of upstream traffic on North America's fixed access networks, and in this study it has risen to 6th, accounting for 2% of volume. On the downstream, PPStream is dwarfed by traditional unicast services.

Still, though, PPStream enjoys its highest popularity in Asia-Pacific, where support for several local languages and a reputation for local content contribute to its widespread success. On Asia-Pacific's fixed access networks, PPStream is the second largest Real-Time Entertainment application, trailing only YouTube, and accounts for 10% of upstream traffic and 4.84% of downstream traffic during peak period.

While peercasting is unlikely to replace traditional live streaming methods anytime soon, the model has proven its viability, and websites like CNN now choose to use this method (through services like Octoshape) for broadcasting some of their breaking news events. Peercasting is a great option for services that are prone to large spikes in usage, but lack the justification for building out permanent streaming capacity. Mainstream adoption is causing network operators to keep a close eye on peercasting's growth, as these CSPs seek to ensure their subscribers receive a high quality of experience, regardless of the behind-the-scenes mechanisms.

"Mainstream adoption is causing network operators to keep a close eye on peercasting's growth, as these CSPs seek to ensure their subscribers receive a high quality of experience, regardless of the behind-the-scenes mechanisms."

56. http://en.wikipedia.org/wiki/Peercasting
57. Go Blue Jays, this is the year!

Study Details

Sandvine's Global Internet Phenomena Reports examine a representative cross-section of the world's leading fixed and mobile communications service providers and are made possible by the voluntary participation of our customers. Collectively, Sandvine's customers provide Internet and data service to hundreds of millions of subscribers worldwide.

In the Global Internet Phenomena Report: 1H 2012, we examined four regions:

- North America
- Latin America
- Asia-Pacific
- Europe

The data gathered for these reports is completely subscriber-anonymous. No information regarding specific content or personally-identifiable information (including, but not limited to, IP or MAC addresses and subscriber IDs) was collected during this study.

This study reflects the traffic profiles of real service providers, including the impact of any network management (for instance, congestion management and traffic optimization) policies that may be in place.

The data collected includes the bandwidth per second per protocol and the number of active hosts per protocol on the network at each hour. Data also includes the total transmitted (upstream) and received (downstream) bytes, from the subscriber's perspective, attributable to each subscriber for a period of 30 days.

The datasets were used to create a 24-hour profile of each network, normalized by the number of active subscribers at each hour in the day. These profiles were then aggregated hierarchically for each region with weightings based on subscriber counts and access technology market share.

The transmitted and received bytes per subscriber data sets were used to create ordinal rankings of all subscribers on a network based on a combination of data direction (upstream, downstream, aggregate) and data period (day, week, month), for a total of nine ranked lists ordered by total byte usage. These lists enabled consumption analysis based on percentile ranking and cast light on the widely varying data needs of individual subscribers.

In parts of the report we reference industry publications, analyst studies, media articles and other sources. As such, we are indebted to the collective work and wisdom of a large number of individuals and organizations and have endeavored to correctly cite all sources and to identify the original creator of referenced material.

Explanation of Categories

The table below describes each of the categories used in the *Global Internet Phenomena Report: 1H 2012*.

Category	Description	Example Applications and Protocols
Anonymity	Protocols that mask or obfuscate application or individual identity	Tor (The Onion Router)
Bulk Entertainment	Entertainment that is acquired in bulk then consumed sometime after arrival	Movie download services
Bulk Transfers	Large data transfers using the File Transfer Protocol or its derivatives	FTP (File Transfer Protocol)
E-mail	Service-provider and webmail e-mail services	SMTP, POP3, webmail (Hotmail, Gmail, etc), BlackBerry encrypted e-mail
Encapsulation Tunnelling	Tunnels used for wrapping traffic	L2TP, GRE, Teredo, 6 to 4
Gaming	Console and PC gaming, console download traffic, game updates	Nintendo Wii, Xbox Live, Playstation 2, Playstation 3, PC games (for example, World of Warcraft)
Mobile Marketplaces	Marketplaces where mobile subscribers can purchase and download media including applications, music, movies, and books	Google Android Marketplace, Apple iTunes
Network Administration	Protocols and services used to administer the network	DNS, ICMP, NTP, SNMP
News Groups	Network news services (where “news” means “data” – it doesn’t have to be actual news	NNTP, encrypted NNTP (over SSL)
P2P Filesharing	File-sharing applications that use a peer-to-peer distribution model	BitTorrent, eDonkey, Gnutella, Ares, Winny, Share, Foxy, Pando
Real-Time Communications	Applications and protocols that allow interactive chat, voice, and video communications	Skype, MSN Messenger, ICQ, SIP, MGCP, IRC, Oovoo, Jabber, Gadu-Gadu, MGCP, Facetime, WhatsApp Messenger
Real-Time Entertainment	Applications and protocols that allow “on-demand” entertainment that is consumed (viewed or heard) as it arrives	Streamed or buffered audio (Pandora, Rdio) and video (RTSP, RTP, RTMP, Flash, MPEG), peercasting (PPStream, Octoshape), placeshifting (Slingbox), specific streaming sites and services (Netflix, NCAA, Hulu, YouTube, Google Video, Spotify, BBC iPlayer)
Remote Connectivity	Protocols and services that allow remote access to network resources	Remote Desktop, VNC, PC Anywhere
Secure Tunnelling	Encrypted tunnels typically used for Virtual Private Networks and secure web transactions	SSL, SSH
Social Networking	Websites and services focused on enabling interaction (chat, communication) and information sharing (photos, status, etc) between users	Facebook, MySpace, Twitter, Habbo, Bebo, Orkut, Vkontakte
Software Updates	Application updates for software, firmware, and operating systems	Windows Update, anti-virus updates
Storage and Back-Up Services	Services that provide file-hosting, network back-up, and one-click downloads	PDBox, Netfolder, Rapidshare, MegaUpload, Mozy, zShare, Carbonite, Dropbox
Web Browsing	Web protocols and specific websites	HTTP, WAP browsing

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