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Intelligent Broadband Networks

Global Internet Phenomena Report

Fall 2011

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Executive Summary

This report, the tenth in an ongoing series of comprehensive traffic analysis studies first issued in 2002, identifies and confirms a number of trends that will significantly shape the Internet landscape and impact all its stakeholders. The Global Internet Phenomena Report: Fall 2011 is based on September 2011 Internet traffic statistics voluntarily submitted by a representative cross-section of Sandvine's customer base. These customers include communications service providers in more than 85 countries, who collectively serve hundreds of millions of end subscribers.

This edition of the study includes detailed analysis of a number of regions and access technologies:

- North America, Fixed Access
- North America, Mobile Access
- Asia-Pacific, Fixed Access
- Asia-Pacific, Mobile Access
- Emerging Markets (Eastern Europe, Brazil and Africa), Fixed Access

Each of the regions listed above has a separate Spotlight document that offers greater detail and additional metrics. This global report outlines the major findings of these focused spotlights.

Top trends noted and discussed in detail within this global report include: increased Netflix and over-the-top services adoption, the market penetration of revenue-replacement applications, the overall increase in mobile marketplaces, and the impact of Internet-ready consumer electronics devices.

Within North American fixed networks, Real-Time Entertainment applications are the primary drivers of network capacity requirements, accounting for 60% of peak downstream traffic, up from 50% in 2010. Furthermore, subscriber usage is becoming increasingly concentrated in a smaller band of the evening, driving up network costs despite relatively constant per-subscriber monthly data consumption.

If this levelling-off of monthly consumption continues, then network operators might be on the cusp of a dramatic shift in how networks are engineered. In a world in which per-subscriber usage is relatively flat from month-to-month, investing to deliver increasing bandwidth no longer makes sense; rather, networks might soon be engineered to deliver a constant quality of experience. To do so effectively, communications service providers will need to look beyond bytes and into metrics that matter, like video quality of experience.

Rate-adaptive video represents the majority of video bandwidth, with Netflix alone representing 32.7% of peak downstream traffic - a relative increase of more than 10% since spring. This fact is of particular importance to network operators, since it means that most video traffic adapts to network congestion by shifting to lower bitrates and quality, which impacts the subscriber quality of experience. From a network engineering perspective, it means that when capacity is increased, adaptive video simply upshifts to a higher fidelity and fills the new capacity.

We have also entered a post-PC era, in which the majority of Real-Time Entertainment traffic on North America's fixed access networks is destined for devices other than a laptop or desktop computer. Game consoles, set-top boxes, smart TVs, tablets, and mobile devices being used within the home combine to receive 55% of all Real-Time Entertainment traffic.

Did You Know?

The four largest Internet services on North America's fixed access networks, by daily downstream volume, are:

1. Netflix – 27.6%
2. HTTP – 17.8%
3. YouTube – 10.0%
4. BitTorrent – 9.0%

Further Reading

For more information about how subscribers in the U.S. are consuming Real-Time Entertainment applicatoins, including a focus on Netflix and YouTube, check out the infographic **"Beyond Bytes"**, available on www.sandvine.com

The fact that more video traffic is going to game consoles than PCs should be a wake-up call that counting bytes is no longer sufficient for network planning, as consumer electronics can drive rapid adoption of new services, in some cases literally overnight (consider the upcoming U.S. Thanksgiving holiday shopping season).

Of course, Real-Time Entertainment's emergence is not exclusive to fixed access networks. Within the mobile networks surveyed, Real-Time Entertainment is the largest component of traffic over-all, and in Asia-Pacific it is even the largest on the upstream, thanks to peercasting applications like PPStream. With smartphone shipments finally surpassing those of feature phones[1], the future of mobile networks will be media-rich.

Suggestion Box

We welcome your suggestions for future Global Internet Phenomena Reports and Spotlights – if you have an idea, please feel free to share it with us!

Not all traffic on mobile networks is video, of course; for instance, Mobile Marketplace traffic accounts for 9.4% of peak downstream usage in Asia-Pacific and 5.8% in North America, led in both cases by iTunes and the Android Market. Additionally, applications like Skype and WhatsApp Messenger, that replace the traditional revenue sources of voice and texting, are being installed by growing numbers of subscribers.

For mobile operators, the subscriber shift to over-the-top messenger services is threatening the stability of the service provider business model. This adoption means that the average revenue per delivered byte is dropping, as SMS bytes, estimated to be generally $30,000/GB, are being replaced by over-the-top bytes that deliver a revenue on the order of $10/GB. Subscribers who see this transition as simple market economics at work aren't aware that the high-margin operations of a service provider typically offset the low- and negative-margin operations. When a major revenue segment disappears, but network operations costs remain constant, prices for all services rise, impacting all subscribers. There are already real-life examples of this trend at work.[2]

The pages that follow offer greater insight into the ever-changing Internet landscape, and the challenges and opportunities facing communications service providers.

1.Meeker, Mary. "Internet Trends 2011 — Kleiner Perkins Caufield Byers." Relationship Capital - Internet Trends 2011. KPCB - Kleiner Perkins Caufield Byers, 18 Oct. 2011. Web. <http://www.kpcb.com/internettrends2011>.
2.Poulus, Tim. "Blok Lays on the Warning at KPN." Telecompaper. Telecompaper, 21 Apr. 2011. Web. <http://www.telecompaper.com/commentary/blok-lays-on-the-warning-at-kpn>.

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North America: Fixed Access Networks

Examination of Internet traffic on North America's fixed access networks, and comparison to previous studies, leads to the identification of a number of broad trends and conclusions.

First, the network's peak time has condensed to become more concentrated and pronounced. While aggregate network traffic was within 5% of its peak value for a duration of 2.5 hours just six months ago, September 2011 saw a peak duration of only 2 hours. At the same time, per-subscriber usage remained generally flat overall (mean monthly usage dropped to 22.7 GB from 23.0 GB six months ago) and declined on the lower end (median monthly usage dropped to 5.8 GB from 7.0 GB), suggesting that subscribers are concentrating the same amount of activity within an increasingly narrow slice of time.

Did You Know?

The heaviest 1% of upstream users account for almost 43% of total upstream usage, a slight increase over their consumption in Fall 2010, while the top 1% of downstream users account for 'only' 15.2% of consumption, a slight decrease from a year ago. For comparison, the lightest 60% of subscribers account for only 10% of total traffic.

This shift in behaviour is a worrying trend for providers, who must engineer their networks for peak bandwidth. If we assume that a subscriber's perception of value is directly tied to his or her monthly usage, then this trend means that it now costs more for service providers to deliver a constant value to the end consumer, and the network itself is increasingly inefficient.

In a perfectly efficient network, the daily usage 'curve' would actually be a flat line. In reality, all the whitespace in Figure 1 corresponds to inefficiency – time during which there is available, but unused, capacity. To increase network efficiencies and decrease network capacity costs, many service providers are looking for ways to incent subscribers to move usage "off peak". However, the percentage of traffic for which subscribers are willing to shift their usage is shrinking. Consider that you are not likely to plan your day around shifting your online video and social networking habits, but you probably wouldn't mind setting your weekly online back-up to run at 3am.

Monthly usage quotas have only a limited impact, if any at all, on peak network demand; however, quotas that differentiate between peak and off-peak might have a larger impact. If users had 200 GB per month to use at peak, but unlimited usage at other times, then they would be more inclined to change their behaviors. As an added benefit, the user would perceive a higher value of service (again, if 'value' is directly associated with data consumption) due to increased overall usage, without the network operator incurring additional cost to deliver the off-peak bytes. Higher subscriber value and flat operator costs? Sounds like a classic win-win.

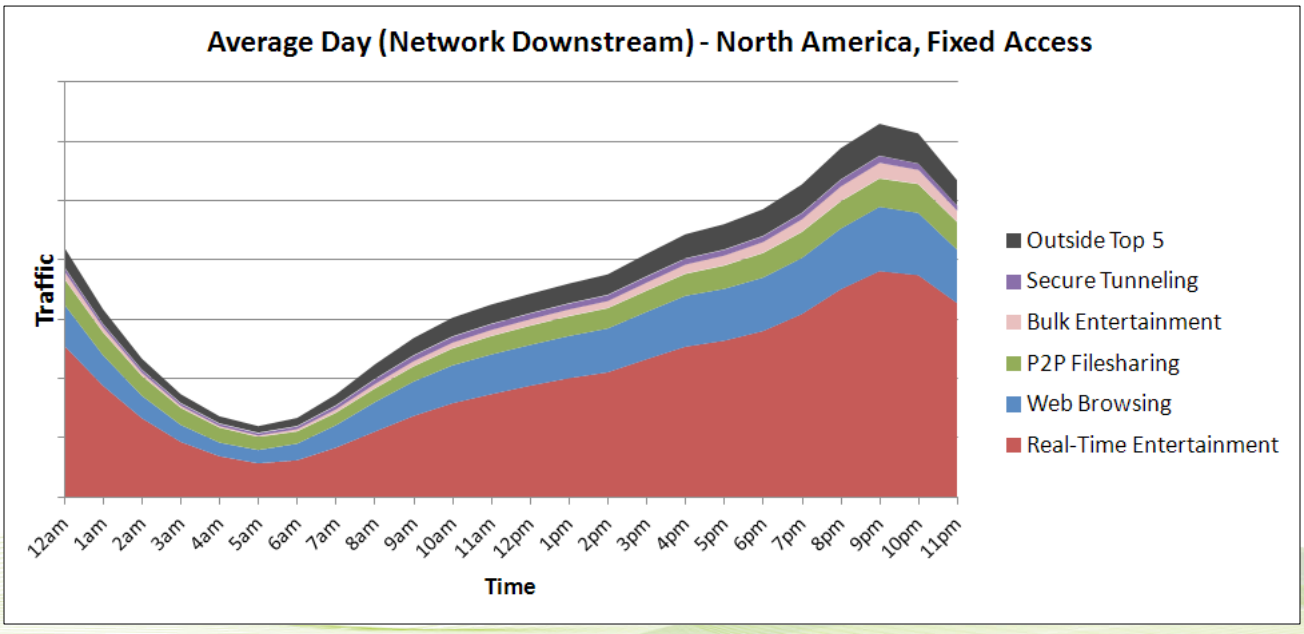


Figure 1 - Average Day (Network Downstream) - North America, Fixed Access

This report also sees the continued rise of Real-Time Entertainment traffic as the dominant component of North America's fixed access network traffic. During the evening's peak period, these "on-demand" applications account for 60% of downstream traffic, and 53.5% of aggregate utilized bandwidth.

Social Networking is always of interest to readers, but its 2.1% contribution to peak period traffic was only good enough for seventh spot overall (although it was fifth in the upstream). Note once again, though, that we are speaking in terms of relative share of total Internet traffic; we are not suggesting that absolute levels of Social Networking have declined.

Further Reading

For more information about broadband trends in North America, download Sandvine's ***Global Internet Phenomena Spotlight: North America, Fixed Access, Fall 2011*** from www.sandvine.com

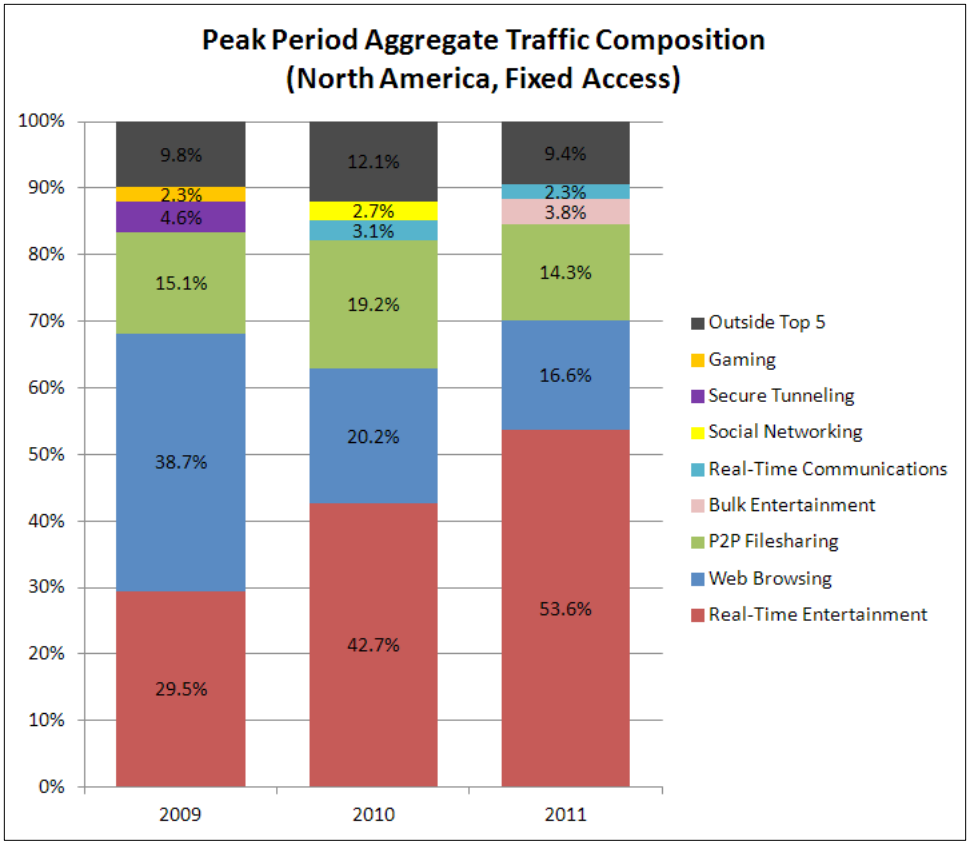


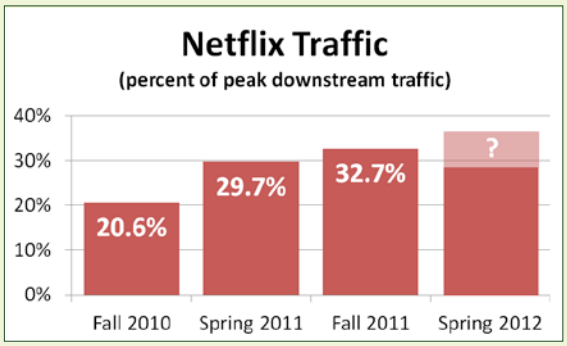
Figure 2 - Peak Period Aggregate Traffic Composition - North America, Fixed Access

Have we seen "Peak Netflix"?

This past July, Netflix announced changes to their pricing and package structure[1]. This announcement caused a subscriber backlash, with many users threatening to cancel their service.[2] FierceCable recently summarized the company's woes, complete with a timeline, in an article entitled, "Netflix's fall from grace: can it recover?"[3]

September is the month of reckoning for Netflix, as it is the month in which many subscribers will actually evaluate their account status and decide whether or not to make good on their threats.

This leads to the interesting question, have we seen "peak Netflix"? In other words, has Netflix traffic reached a maximum as a share of total Internet traffic in the United States? With so many Netflix-capable devices[4], the addressable market for the service is already enormous and will only increase, so it's hard to envision a scenario in which absolute levels of Netflix will decline. However, Netflix is facing increased local competition, and as a result new services might grow at a faster rate.



Globally, Netflix will grow – the service is available in almost 50 countries and the company is aggressively pursuing licensing deals with locally-focused content – but in the United States specifically, we might have seen the peak.

1. Stelter, Brian, and Sam Grobart. "Netflix Raises Price of DVD and Online Movies Package by 60%." The New York Times. 12 July 2011. Web. <www.nytimes.com/2011/07/13/technology/netflix-raises-price-of-dvd-and-online-movies-package.html>.
2. There are actually far too many articles on this to cite any particular one, but the estimates range from 10% will cancel to up to 41%
3. Bookman, Samantha. "Netflix's Fall from Grace: Can It Recover?" FierceCable. FierceCable, 14 Oct. 2011. Web. <http://www.fiercecable.com/special-reports/netflixs-fall-grace-can-it-recover>.
4. Shopping for something new? You can find lists of Netflix-ready devices here (www.netflix.com/NetflixReadyDevices) and here (http://en.wikipedia.org/wiki/List_of_Netflix_Instant_Watch_Devices)

Multiple Screens drive Multiple Streams

Subscribers are watching Real-Time Entertainment on an increasing number of screens. In many households you could very easily find a laptop or desktop computer, a smartphone, a tablet, and a TV with direct (smart TVs) or indirect (via a game console or set-top) Internet connectivity.

When subscribers watching online video are free to choose between screens, they generally choose to watch content on the largest screen available to them. A TV offers a better viewing experience than a computer, a tablet is preferred over a smartphone, and a smartphone is superior to nothing at all.

Screen size also has direct correlation to data usage. For example, when watching a video on a 60-inch HD capable plasma screen, most subscribers will opt for the highest video fidelity available. In that same scenario, higher-quality audio might also be provided to the home theatre system.

With so many screens available in a household it is also easy to imagine a situation where multiple streams occur simultaneously, like one individual watching a high definition Netflix movie on the primary television while another is flipping through YouTube clips on a tablet. Many services encourage this behaviour: for instance, Netflix, which offers some of the highest quality streams available, allows two concurrent streams. Netflix have also openly discussed the idea of a family plan which would allow multiple streams of multiple programs simultaneously.[1]

This increasing number of concurrent streams has the potential to severely disrupt network capacity planning models and service plan design and price. With Real-Time Entertainment usage focused during an ever-shrinking peak period, network planning that fails to account for simultaneous streaming will manifest as a poor video quality of experience visible to every subscriber in the home.

1.Roettgers, Janko. "Next Up for Netflix: Family Plans." Gigacom. Gigacom, 18 Apr. 2011. Web. <http://gigaom.com/video/netflix-multiple-streams-family-plans/>.

Netflix continues to be the most powerful driver of evening traffic, and for that matter, of daily traffic overall. Despite some negative subscriber reaction to price hikes, Netflix has continued to increase its presence by adding 1 million U.S. subscribers since the Spring 2011 report, and by many measures Netflix rules North America's fixed access networks. Consider these facts:

- Netflix accounts for 32.7% of peak period downstream traffic, almost double that of the next-largest source (HTTP is second with 17.5%)
- Netflix accounts for 29.0% of peak period aggregate traffic (HTTP is second with 16.6%)
- Netflix accounts for 23.3% of daily aggregate traffic (BitTorrent is second with 16.5%)

Perhaps the only measure by which Netflix does not come out on top is when examining the upstream, in which BitTorrent maintains its leading spot by virtue of generating 47.6% of all upstream bytes. However, even on the upstream, Netflix ranks third by contributing 7.7%, making the service particularly vulnerable to ACK starvation[3].

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	47.55%	Netflix	32.69%	Netflix	29.03%
2	HTTP	11.45%	HTTP	17.48%	HTTP	16.59%
3	Netflix	7.69%	YouTube	11.32%	BitTorrent	13.47%
4	Skype	4.27%	BitTorrent	7.62%	YouTube	9.90%
5	SSL	3.57%	Flash Video	3.41%	Flash Video	3.04%
6	Facebook	2.19%	RTMP	3.12%	RTMP	2.81%
7	PPStream	1.73%	iTunes	3.05%	iTunes	2.69%
8	YouTube	1.64%	Facebook	1.78%	SSL	1.96%
9	Xbox Live	1.31%	MPEG	1.72%	Facebook	1.84%
10	Teredo	1.25%	SSL	1.69%	MPEG	1.49%
	Top 10	**82.63%**	**Top 10**	**83.88%**	**Top 10**	**82.83%**

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

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

A final observation - one that might well shock many readers - is on what devices all that Real-Time Entertainment traffic is being viewed. By volume, 55% of Real-Time Entertainment traffic is destined for the television (either directly to a smart TV or via an intermediary like a game console or set-top device), a mobile device or tablet. The remaining 45% is being delivered to desktop and laptop computers; even then, some will be forwarded to a television.

Did You Know?

More Real-Time Entertainment bytes (55%) are destined for game consoles, smart TVs, handhelds and mobile devices than to desktop and laptop computers (45%). Consequently, many content producers, equipment vendors and communications service providers have adapted a "three screen" strategy to deliver content to TVs, computers and mobile devices.

Game consoles are powering this phenomenon, through manufacturers partnering with content producers. For instance, in October, 2011, Microsoft announced a massive expansion in the list of content providers that will be available on the Xbox 360, including such heavyweights as Bravo, Comcast, HBO, BBC, Telefonica, Rogers on Demand and Televisa.[4] Since Microsoft gains revenue from Xbox Live subscriptions, this impressive video line-up serves as a powerful differentiator against the other console manufacturers.

3. For more information about ACK starvation, see the feature "Starved for ACKs"
4. "Xbox 360 Teams Up With Entertainment Leaders to Transform TV." Microsoft News Center. Microsoft, 5 Oct. 2011. Web. <http://www.microsoft.com/presspass/press/2011/oct11/10-05XBTVPR.mspx>.

Starved for ACKs

More and more Internet service subscription packages are becoming exceptionally imbalanced between the downstream and upstream. For instance, consider a plan that offers 20 Mbps down and 0.5 Mbps up. Plans like this one simply reflect the reality that most users make extensive use of downloading, while uploading relatively little. In general, Internet traffic is following this trend[1], driven largely by online video.

However, subscribers to these types of plans often notice that they can't achieve full download speeds, and are curious of why this is the case. The cause is often a network condition called ACK starvation.

A full technical explanation of the concept is beyond the scope of this report and requires a fairly detailed understanding of TCP. However, in simple terms[2], if upstream is so heavily utilized that ACKs fail to reach the sender, then TCP responds by backing off its sending rate, which to the subscriber means reduced downstream speeds and will ultimately manifest as a downgrade in video quality.

Recall from Table 1 that Netflix is responsible for 7.7% of peak period upstream bandwidth on North America's fixed access networks. Netflix transmits little (or no) data on the upstream, so this 7.7% is purely in the form of TCP ACKs. If these ACKs are unable to quickly return to the originating server, then the TCP streams carrying the subscriber's video will slow down. In turn, this will manifest to the subscriber as a downgrade in their quality of experience.

The problem is exacerbated on mobile access networks, where upstream capacity is an especially scarce shared resource. This limitation means that one person's downstream experience can be severely impacted by something as simple as another user on the same sector being deep in a building and suffering from poor connectivity.

In practice, one method to prevent ACK starvation is to use a product like Sandvine's Fairshare Traffic Management to enforce network policy control on upstream traffic, ensuring that the ACKs for specific applications and impacted subscribers receive priority.

1. Flip through our Global Internet Phenomena Reports and look for "downstream-to-upstream ratio" numbers, and you'll see that this trend is well underway
2. For a less simple, but still understandable, explanation, visit: http://www.bsdtips.org/index.php/Vnetlab_ack_starvation

North America: Mobile Access Networks

Mobile network traffic in North America differs considerably from fixed access traffic, although there are some similarities in subscriber behavior.

The mobile networks we examined include a mix of devices, including a large number of feature phones (consider that of the world's 5.6 billion mobile phone subscribers, only 835 million have smartphones[5]).

Like the fixed access network, peak mobile network demand is concentrated in a two-hour band, between 7pm to 9pm. The three largest categories account for more than three quarters of aggregate traffic. Real-Time Entertainment generates 30.8% of peak demand (of which YouTube contributes the bulk, at 18.2%), continuing a growing trend, while Web Browsing is the second largest category, making up 27.3% of peak period traffic. Social Networking, at 20.0%, takes the third spot, driven primarily by Facebook, which alone accounts for more than 19% of aggregate traffic.

Did You Know?

Real-Time Entertainment represents 30.8% of peak traffic demand, while Social Networking accounts for 20%. Real-Time Communications applications, many of which compete with service provider revenue sources, account for 6.7% of peak upstream traffic.

The fourth- and fifth-largest categories are also of particular interest, as they might come as a surprise to many readers. In fourth place, Software Updates make up 5.8% of peak bandwidth demand on North America's mobile networks, while fifth place is occupied by Mobile Marketplaces with 4.7%. Note that in the latter case, the category focuses only on the actual acquisition of content from these marketplaces (applications, content files), rather than the traffic that the apps drive once they have been installed. Therefore, it can be reasonably concluded that 10.5% of peak network utilization is attributable to simply acquiring and updating applications.

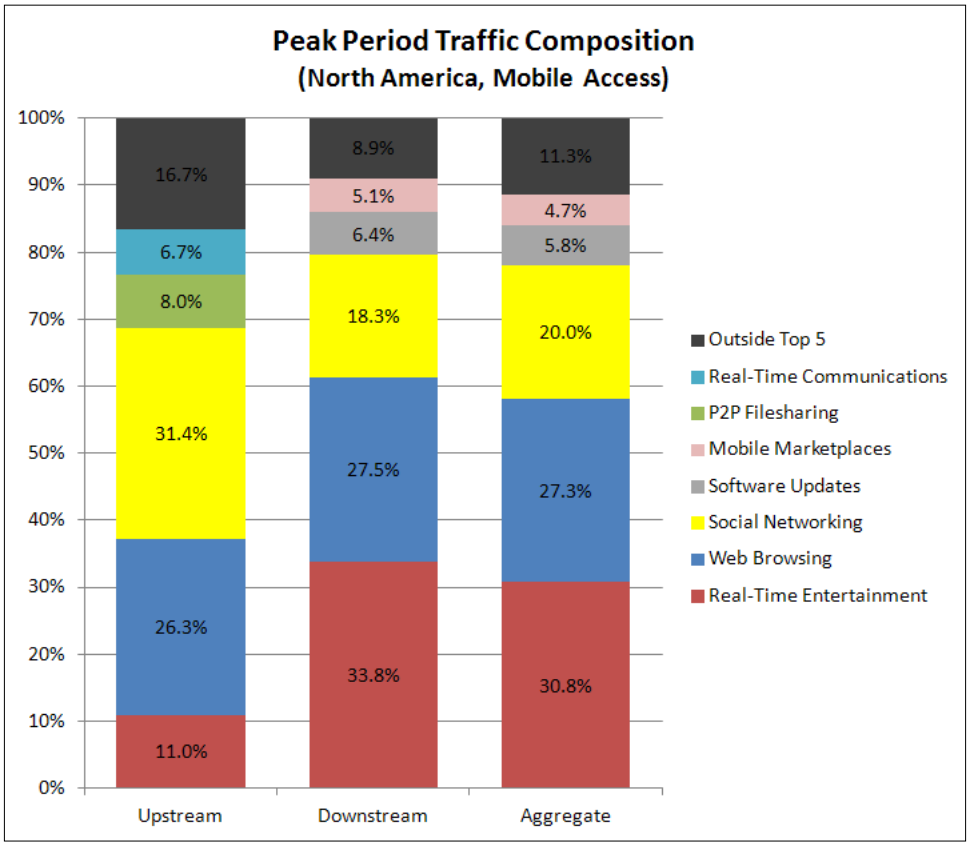

Figure 3- Peak Period Traffic Composition (North America, Mobile Access)

Subscriber usage shows a very wide variation, ranging from median monthly consumption of 3.1 MB (due to the remaining large population of feature phones) to a mean monthly consumption of 347 MB (which also includes feature phones, but is primarily driven by smartphones).

Did You Know?

Mobile Marketplaces and Software Updates combine to account for 10.5% of peak period aggregate traffic

By the Numbers

3.1 MB - median monthly aggregate usage

346.9 MB - mean monthly aggregate usage

109.15 - monthly aggregate mean-to-median ratio

Further Reading

For more information about broadband trends in North America, download Sandvine's ***Global Internet Phenomena Spotlight: North America, Mobile Access, Fall 2011*** from www.sandvine.com

5. Meeker, Mary. "Internet Trends 2011 — Kleiner Perkins Caufield Byers." Relationship Capital - Internet Trends 2011. KPCB - Kleiner Perkins Caufield Byers, 18 Oct. 2011. Web. <http://www.kpcb.com/internettrends2011>.

To clarify how a network can have such a disparate median and mean, look at Figure 4, which shows the usage distribution on one such network, where the median aggregate monthly consumption is 3.4 MB and the mean is 371 MB.

The blue area shows the percentage of subscribers with monthly usage that falls into a particular range of bytes. Unlike most histograms, the actual size of the byte ranges on this graph increases logarithmically, so pay close attention to the x-axis labels.

The red area shows the cumulative usage on the network. This network clearly has two subscriber clusters that reflect a heterogeneous device make-up: the left hump consists of subscribers with feature phones, while the right hump consists of smartphones and laptops. A network carrying smartphones, exclusively, would have a subscriber usage distribution essentially equal to the right hump. Also, notice also that the overall network usage is almost entirely due to the top 25% of subscribers.

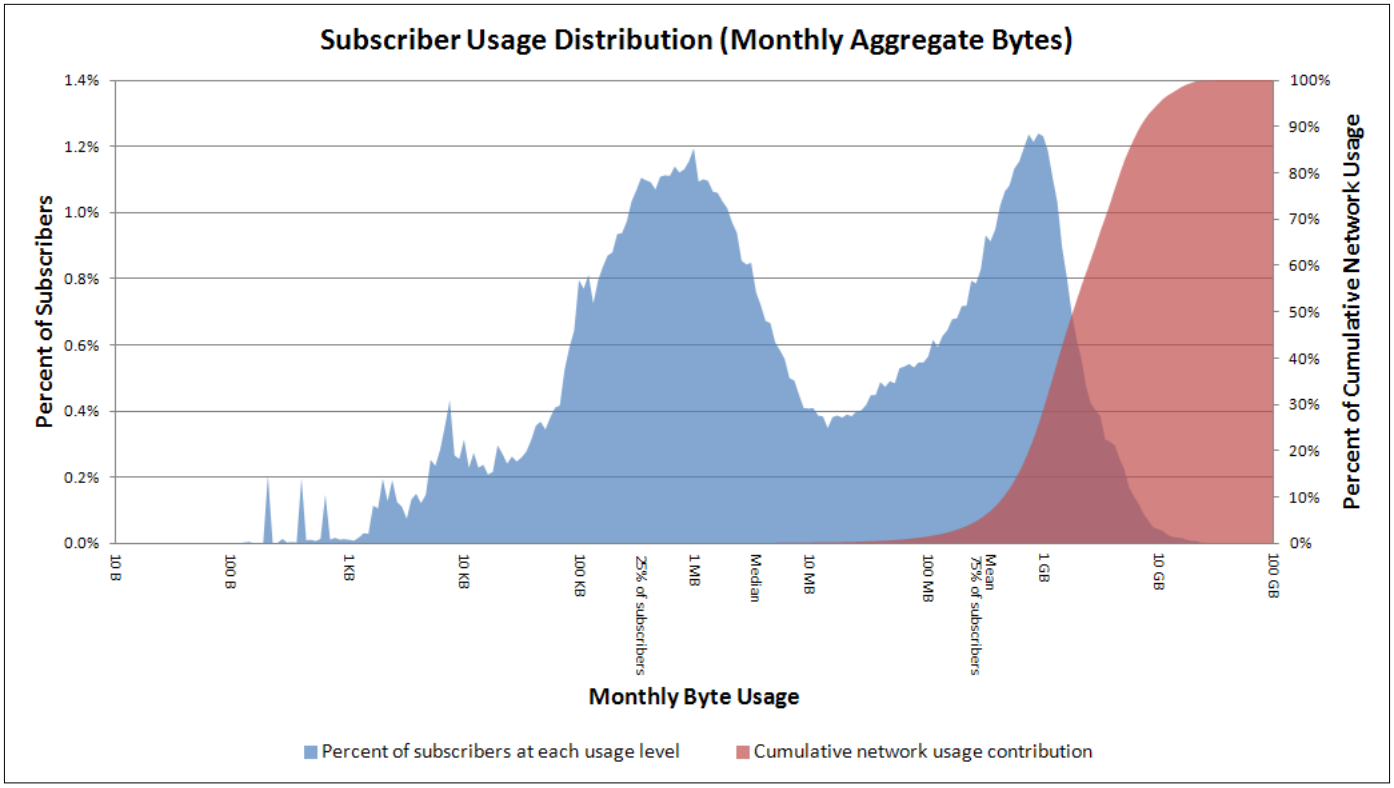

Figure 4 - Subscriber Usage Distribution (Monthly Aggregate Bytes) - Example North American Mobile Access Network

Not surprisingly, the overall distribution of consumption on North America's mobile access networks shows significant disparity: the heaviest 1% of upstream and downstream users account for 26.8% and 21.3% of upstream and downstream bytes, respectively. At the opposite end of the spectrum, which includes the large population of feature phones, the network's lightest 80% of users account for only 10% of total traffic.

Facebook accounts for more than 30% of upstream traffic on North America's mobile networks, typically through frequent photo uploads. HTTP, largely associated with mobile apps, accounts for 26.2% of traffic, and SSL (used for secure applications like online banking) makes up slightly more than 6%. YouTube generates 6%, followed by BitTorrent, with 3.83%. Oovoo and Skype, both of which offer voice and video call functionality, appear seventh and eighth on the list, respectively, marking the first time that we have seen Oovoo traffic exceed that of Skype. Note that this doesn't necessarily mean that Oovoo enjoys more users or is responsible for more minutes than Skype; Oovoo is less efficient on the network, so it will use more bandwidth for the same number of minutes.[6]

Did You Know?

Facebook accounts for almost 20% of peak period traffic (including almost 31% of upstream) on North America's mobile access networks. YouTube is close behind, making up 18.2%.

6. The efficiency is partly related to codec (Oovoo uses On2/VP8 and H.264 while Skype uses SiLK) and also because Skype performs adaptive rate adjustment

On the downstream, HTTP is the leader, although YouTube and Facebook both make impressive showings. Together, these three applications account for more than 65% of peak downstream demands.

When considering traffic in aggregate, HTTP (27.3%), Facebook (19.3%) and YouTube (18.2%) make up the bulk of traffic. YouTube's significance shouldn't come as a surprise; in September, Google announced that mobile devices are responsible for 10% of all YouTube downloads.[7] On a related note, Facebook attributes 33% of its byte volume to mobile devices, and Pandora (which doesn't appear in Table 2, but is the 12th-largest downstream source, responsible for 1.32% of bytes) attributes 60% of traffic to mobile devices.

The Windows Update traffic is the result of dongle-equipped laptops, which often power the P2P Filesharing applications that also appear on the lists of top applications.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	Facebook	30.85%	HTTP	27.46%	HTTP	27.31%
2	HTTP	26.24%	YouTube	19.99%	Facebook	19.29%
3	SSL	6.05%	Facebook	17.62%	YouTube	18.23%
4	YouTube	6.01%	Windows Update	5.17%	Windows Update	4.70%
5	BitTorrent	3.83%	Android Market	4.09%	Android Market	3.75%
6	Ares	3.45%	Flash Video	2.96%	Flash Video	2.66%
7	Oovoo	2.57%	SSL	1.97%	SSL	2.48%
8	Skype	1.81%	RTSP	1.89%	RTSP	1.67%
9	Gmail	1.49%	Shockwave Flash	1.75%	Shockwave Flash	1.63%
10	Windows Update	1.48%	MPEG	1.67%	MPEG	1.53%
	Top 10	**83.77%**	**Top 10**	**84.57%**	**Top 10**	**83.26%**

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

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Table 2 - Top Peak Period Applications by Bytes - North America, Mobile Access

Mobile Marketplaces - One-Stop Shopping on your Smartphone

Almost every smartphone or tablet sold now includes a built-in department store. These mobile marketplaces offer access to wide selection of movies, music, books, and apps at the touch of a button.

Worldwide, Sandvine has observed that Google's Marketplace and Apple's iTunes are consistently among the top traffic generators on mobile and fixedaccess networks. In Asia-Pacific, Mobile Marketplaces account for 8.2% of peak mobile network demand, while in North America the figure is 4.7%.

The fact that mobile marketplaces appear on fixed networks may be surprising to some, but many mobile operating systems force larger downloads to take place on WiFi networks to help preserve battery life and avoid bill shock for the user.

Much like Real-Time Entertainment adoption, we expect the traffic share of these Mobile Marketplaces to grow rapidly in the years to come. As mobile devices get more powerful, they are able display higher resolution video and more advanced games, which results in larger file downloads from the marketplace. As storage space also increases, users will be able to download even more content and consume that content wherever life takes them.

7. Ankney, Jason. "Google: Mobile Devices Generate 10% of All YouTube Downloads." FierceMobileContent. FierceMobileContent, 21 Sept. 2011. Web. <http://www.fiercemobilecontent.com/story/google-mobile-devices-generate-10-all-youtube-video-downloads/2011-09-21>.

Cloudy with a Chance of Bill-Shock

"The truth is in the Cloud."

Those were the words used by Steve Jobs to describe why cloud services are the future when he introduced Apple's iCloud back-up service in June of this year.[1] The idea that all of your devices will sync through the cloud isn't a new one, but it is closer to becoming a reality for mainstream subscribers, as more and more devices include such features by default. Before this transition takes place, both subscribers and network operators need to consider how these cloud services could impact peak and monthly usage.

In recent years Google, Microsoft, Apple, and Amazon have all made significant investments in their operating systems and cloud services so that computers and mobile devices will seamlessly and silently upload your most important files to one master location. These services mean subscribers will no longer have to directly connect devices to move a great photo from a smartphone to a home computer. Instead, as soon as a photo is taken it will be uploaded immediately to the cloud so that it can be viewed anywhere, on any device.

While physically syncing has always been a hassle, it has not placed additional strain on the network and has not contributed towards a subscriber's monthly usage; however, the cloud changes things.

Now, instead of consuming no bandwidth when syncing 100 MB of photos back to a computer, cloud syncing will now use 100 MB of data when uploading data and then and additional 100 MB when downloading to each device connected to the cloud. While most services offer the option to sync only when on WiFi networks (coffee shops, living rooms, etc), these cloud services could still result in significant additional bandwidth costs and potential bill shock for consumers. For subscribers who perform complete system back-up, the shock could be even greater.

Perhaps the near future will see operators zero-rating synchronization and back-up traffic, provided such actions meet requisite criteria. For instance, a premium mobile plan or a mobile plan with a two-year contract might include synchronization traffic at no additional charge, and fixed access services might zero-rate full system back-up if it is performed during off-peak periods.

1. WWDC 2011 Keynote. Perf. Steve Jobs. Apple. Apple, June 2011. Web. <http://www.apple.com/apple-events/wwdc-2011/>.

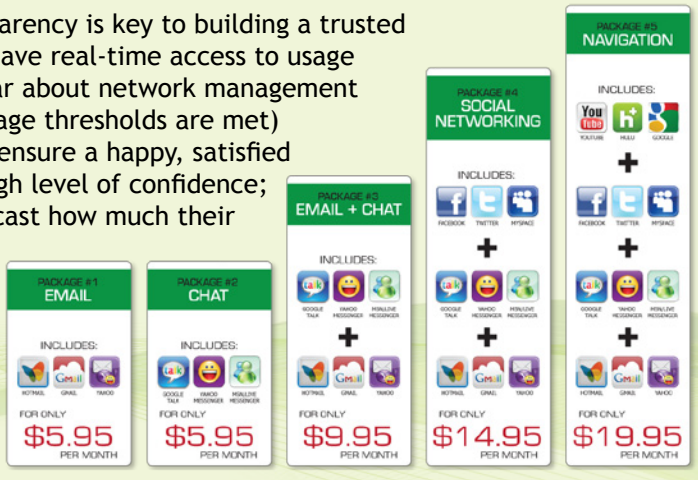
Best Practices for Transitioning to Usage-Based Billing

To ensure operational sustainability, it is imperative that average subscriber usage is aligned with the average cost to deliver that usage. To achieve this necessary alignment, many communications service providers are migrating away from unlimited data plans by launching packages that cater to distinct user behaviors.

As more providers gain experience rolling out these services, several best practices have emerged. Following these guidelines will help make this natural evolution a smooth one – both for network operators and for subscribers.

- **Lower-priced tiers for light users** – everyone agrees that subscribers who use more should pay accordingly, but it is hard to defend usage-based billing if nobody ends up paying less
- **Plan variety** – not everyone uses the Internet in the same way, so offering diversified plans empowers consumers to select a plan that is most appropriate
- **Transparency** – no one likes nasty surprises, so transparency is key to building a trusted relationship; transparency means subscribers should have real-time access to usage information, and it also means operators must be clear about network management policies (such as those that might be applied when usage thresholds are met)
- **Price Certainty** – consumer confidence is required to ensure a happy, satisfied subscriber base, and price certainty inspires a very high level of confidence; operators should provide customers the tools to forecast how much their Internet service will cost and offer an absolute maximum price to avoid bill shock

Sandvine's Usage Management product gives communications service providers the tools they need to launch new services while delivering on all four best practices, resulting in higher customer loyalty.



Asia-Pacific: Fixed Access Networks

Asia-Pacific has consistently been among the top consumers of bandwidth when compared to regions around the globe. As a region that is known to have higher connection speeds than most, and with communications service providers offering plans that often have no associated data cap, subscribers in the region have usage habits that make them among the most unique in the world.

Averaged over 24 hours, Real-Time Entertainment is the dominant downstream application category, accounting for 43.6% of downstream bytes. When combined with Web Browsing, these two categories represent 70.5% of all downstream traffic in Asia-Pacific.

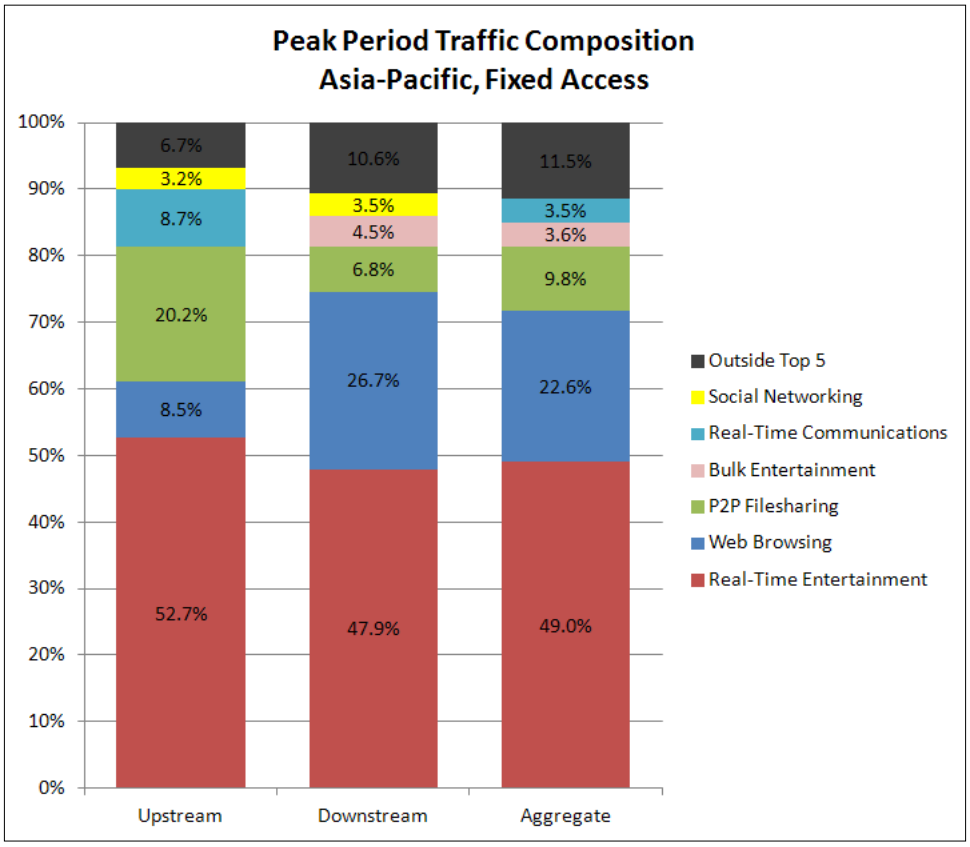


Figure 5 - Peak Period Traffic Composition - Asia-Pacific, Fixed Access

On the upstream, Asia-pacific is unique in being one of the only regions where on fixed access networks P2P Filesharing is not the top category. Instead, Real-Time Entertainment is the top category on the upstream, with the bulk of this traffic being attributed to the popularity of peercasting video applications. The most popular of these applications, PPStream, accounts for an incredible 34.77% of total upstream traffic during peak hours.

Did you know?

46.4% of daily upstream traffic is Real-Time Entertainment, the bulk of which is from popular peercasting applications. Asia-Pacific is the only region in which Real-Time Entertainment makes up a higher percentage of upstream traffic than it does downstream traffic.

By the Numbers

17.7 GB - median monthly aggregate usage

30.8 GB - mean monthly aggregate usage

1.74 - monthly aggregate mean-to-median ratio

Further Reading

For more information about broadband trends in Asia-Pacific, download Sandvine's ***Global Internet Phenomena Spotlight: Asia-Pacific, Fixed Access, Fall 2011*** from www.sandvine.com

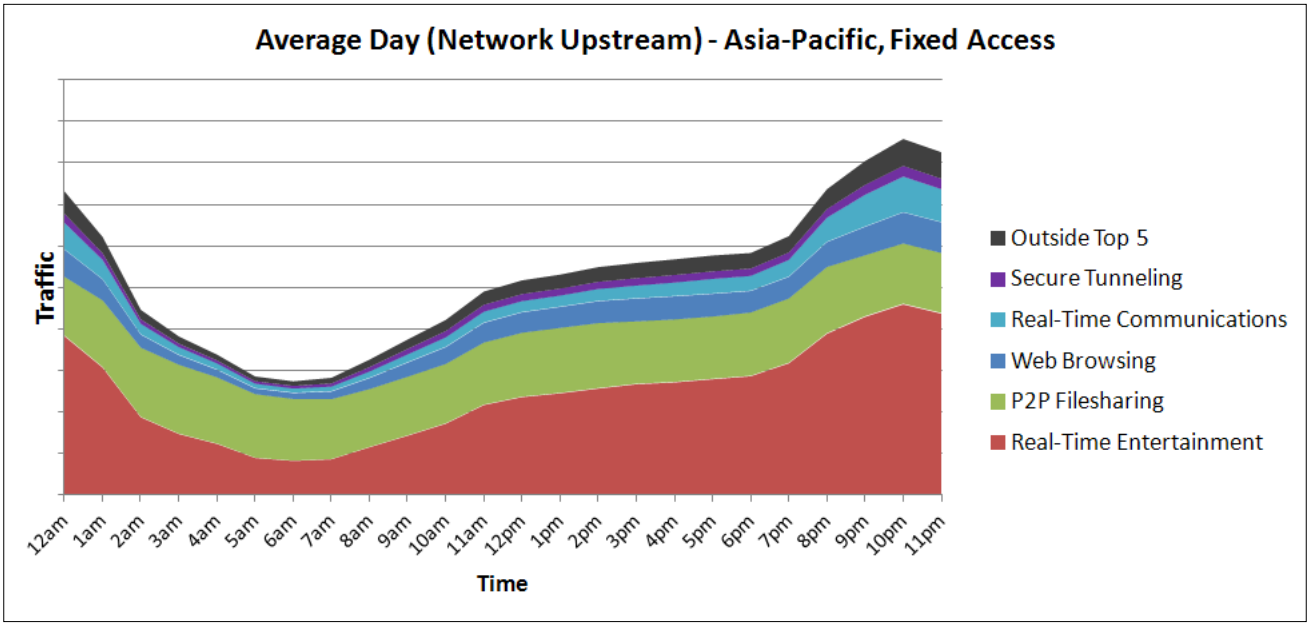


Figure 6 - Average Day (Network Upstream) - Asia-Pacific, Fixed Access

Median monthly usage is 17.7 GB, which is the largest we have ever observed, with consumption distributed fairly uniformly throughout the month. Collectively, the top 1% of heaviest upstream users account for 14.1% of total upstream usage and 9.6% of downstream usage. By comparison, the lightest 40% of subscribers overall only account for 10% of traffic.

Wagging Video's Long Tail

How many online video sites can you name? Take a minute to think about it.

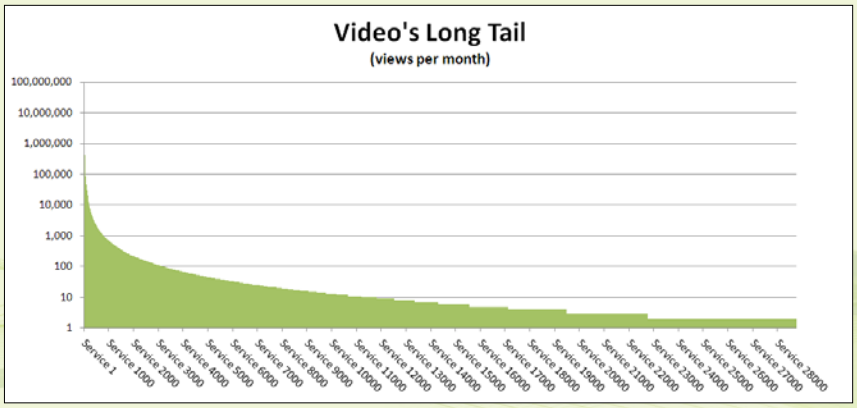
How many did you think of? Everyone can think of 5, many could name 10, a few could name 20…but even that is just scratching the surface. Over one month, on a Tier-1 U.S. network, we measured more than 42,000 unique websites that served at least one streaming video. The figure below shows the distribution of the 28,000 sites that delivered more than one video.

Online video services exhibit what is known as a long-tail distribution – while the sites at the top get the most attention, the list of sites outside the Top 20 actually account for a significant portion of Internet traffic, and this reality has implications for service providers who wish to optimize video delivery for quality and efficiency purposes.

In reality, what matters more is the distribution of distinct videos, rather than the service actually providing the content, but the same distribution applies. A caching approach works well for viral content, but does not solve the issues arising from the long tail, where videos will be cache-misses. In mobile networks, the challenges are exacerbated by the relatively low number of subscribers per sector and the relatively high degree of movement between sectors.

Unlike popular viral content, optimization for the long tail must be performed in real-time, through a method like transcoding. Such real-time approaches are also the only viable option for live content streaming, like those provided by many professional sports leagues.

Of course, without a detailed understanding of the video distribution on their networks, communications service providers are unable to assess the potential of each approach.



Asia-Pacific: Mobile Access Networks

Given what was observed on Asia-Pacific's fixed access networks, it should come as no surprise that the region's subscribers are also voracious consumers of mobile data.

Averaged over 24 hours, Real-Time Entertainment is the dominant category on both the upstream and the downstream, accounting 41.4% of aggregate traffic during the peak period. What is unique to the Asia-Pacific region is that Real-Time Entertainment is the top upstream category during the peak-period, accounting for 39.2%. For comparison, on North America's mobile networks, Social Networking is the top category, with 31.4% of peak upstream traffic. The primary drivers behind the popularity of Real-Time Entertainment in Asia-Pacific are the use of the popular peercasting application PPStream, and the prevalance of devices with high-quality displays.

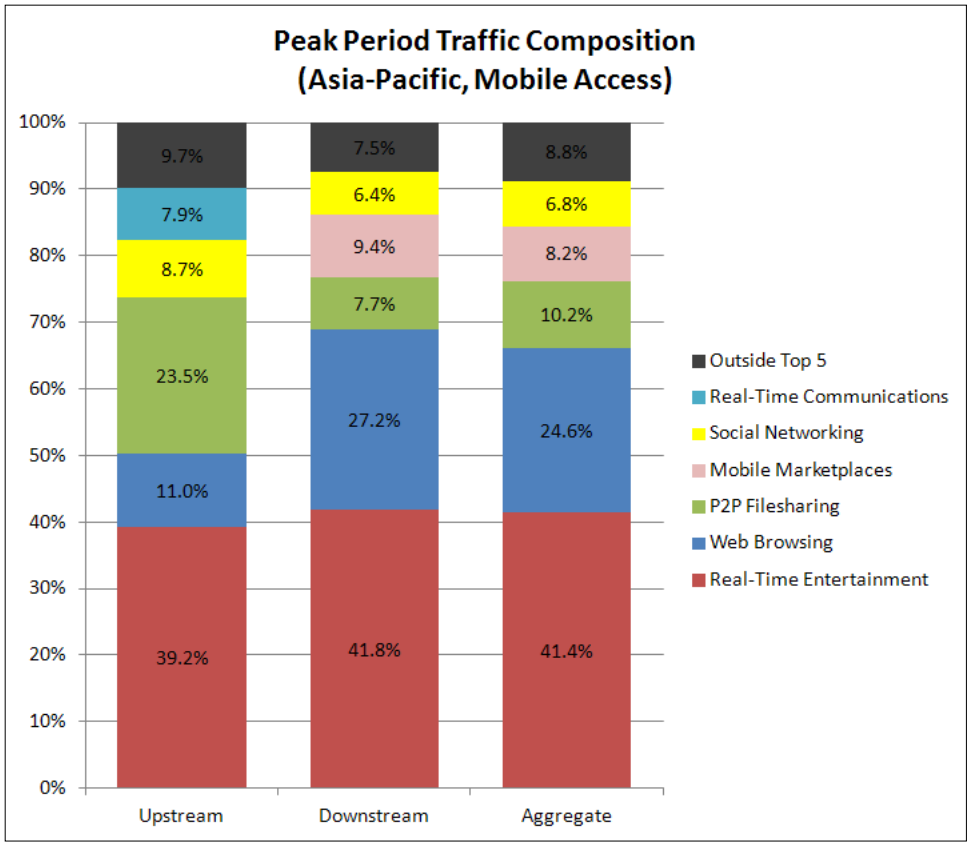


Figure 7 - Peak Period Traffic Composition - Asia-Pacific, Mobile Access

Did You Know?

Real-Time Communications applications, many of which compete with service provider revenue sources, account for 7.9% of peak upstream traffic.

By the Numbers

172.8 MB - median monthly aggregate usage

1.3 GB - mean monthly aggregate usage

7.91 - monthly aggregate mean-to-median ratio

Further Reading

For more information about broadband trends in Asia-Pacific, download Sandvine's ***Global Internet Phenomena Spotlight: Asia-Pacific, Mobile Access, Fall 2011*** from www.sandvine.com

Real-Time Communications is also a very popular category, consistent with observations in North America, with both Skype and WhatsApp among the top applications by volume. WhatsApp, a cross-platform instant messaging application which uses data instead of text messages, accounts for 2% of upstream bytes during peak hours and is used by 6% to 8% of subscribers in any given 15-minute period during peak. Additionally, Skype accounts for 3.19% of total upstream traffic during peak hours. Since both Skype and WhatsApp compete directly with traditional network operator revenue sources like SMS and voice, communications service providers should take note of these developments.

Mobile Marketplace traffic accounts for 8.2% of peak mobile traffic, and by Spring 2012 the category could surpass the volume of P2P Filesharing as smartphone and tablet ownership rates grow. The category primarily consists of the two most popular marketplaces: Google's Android Marketplace and Apple's iTunes, which make movies, music, books and apps available over the air.

Monthly consumption shows great disparity when compared to North American mobile networks (where relatively fewer subscribers use smartphones). In Asia-Pacific the median and mean monthly data usage is 172.8 MB and 1.3 GB, respectively, versus 3.1 MB and 346.9 MB in North America. Collectively, the top 1% of heaviest upstream users account for 66.6% of total upstream traffic, and the top 1% on the downstream account for 33.2% of downstream bytes. For comparison, the lightest 80% of subscribers overall only account for 10% of traffic.

What's Up with WhatsApp?

Why operators are feeling the pinch of revenue-replacement apps.

Talk to almost any BlackBerry user and there is a good chance they will rave to you about how much they love BlackBerry Messenger (BBM). BBM is a proprietary messaging service available only to BlackBerry users that allows them to easily send messages to each other. For those who have never used the service, it likely sounds a lot like text messaging, but there is one key difference. Rather than being billed per message, as done with SMS or MMS messages, all BBM messages are sent over the network as data, costing the subscriber no additional fees as long as they subscribe to a data plan.

For years BBM has been the killer app for BlackBerry, and users of other smartphone platforms have been left in the cold waiting for a similar service on their devices. Those non-BBM users are beginning to get their wish, because lately we have seen an explosion in popularity of cross-platform mobile messaging apps.

While subscribers love these apps, network operators do not. Apps that enable instant messaging and voice communication via data plans compete directly with the SMS and voice services upon which operators depend for a substantial portion of revenue.

In fact, for mobile operators, the subscriber shift to over-the-top messenger services is threatening the stability of the service provider business model. This adoption means that the average revenue per delivered byte is dropping, as SMS bytes, estimated to be generally $30,000/GB, are being replaced by over-the-top bytes that deliver a revenue on the order of $10/GB. Subscribers who regard this transition as simple market economics at work aren't aware that the high-margin operations of a service provider typically offset the low- and negative-margin operations. When a major revenue segment disappears, but network operations costs remain constant, prices for all services rise, impacting all subscribers.

The impact is already being felt by some carriers. Earlier this year, KPN issued a profit warning in which they directly cited revenue-replacement apps Ping and WhatsApp[1] as causes for a 10% decrease in text messaging revenue.[2] In response to the revenue decrease, KPN has revisited its data packages in order to better align usage and cost. KPN isn't alone – on Asia-Pacific's mobile networks, we observed that 1 in 12 mobile subscribers used WhatsApp in any given 15-minute segment during the evening.

Other operators are feeling the pinch of Skype, Oovoo and Viber, three popular cross-platform voice services, while LiveProfil, Kik and even Facebook are now offering dedicated messaging apps that can be installed on almost any smartphone and can send text, photo, sound, and video messages instantly using a data plan.

To combat this lost revenue, operators will need to explore new ways to package services. BBM's popularity in many countries is due in part to mobile operators offering data plans that zero-rate many popular social networking services, including BBM. These plans make instant messaging services available to users at a low, fixed price and allow mobile providers to gain additional revenue from customers who might not otherwise purchase a data plan at all. By offering similar data plans that include this new breed of messaging services, operators may be able to maintain a sustainable business in a manner that embraces subscriber preferences.

1. WhatsApp Messenger is a popular proprietary, cross-platform smartphone application
2. Poulus, Tim. "Blok Lays on the Warning at KPN." Telecompaper. 21 Apr. 2011. Web. <http://www.telecompaper.com/commentary/blok-lays-on-the-warning-at-kpn>.

Emerging Markets (Eastern Europe, Brazil, and Africa)

In this spotlight, we examine three emerging markets, drawing comparisons between each and to what we know of other regions. By "emerging", we mean that the markets are in a growth stage, expanding coverage and adding subscribers, as opposed to a "mature" market in which broadband growth is roughly inline with population growth rates.

The three regions examined in this spotlight are:

- Eastern Europe
- Brazil
- Africa

Further Reading

For more information about broadband trends in emerging markets, download Sandvine's ***Global Internet Phenomena Spotlight: Emerging Markets, Fixed Access, Fall 2011*** from www.sandvine.com

In mature fixed access broadband markets, some reasonably consistent observations emerge. First, we observe high median (5 GB and over) and mean (20 GB and over) monthly usage, usually the result of faster access speeds. Secondly, Real-Time Entertainment is typically the largest downstream category, and routinely accounts for more than 40% of downstream traffic. Third, this large amount of Real-Time Entertainment is usually associated with a decrease in the amount of P2P Filesharing traffic, which typically represents about 10% of downstream traffic in a mature market.

By contrast, emerging broadband markets can be thought of as moving along three stages that correspond to what a subscribers "gets" from the Internet:

1. Nothing – a market that does not yet have broadband
2. Needs – a market that is rolling out broadband, but in which coverage and speeds are both limited, so subscribers limit their usage to needs (characterized by high levels of Web Browsing and Real-Time Communications)
3. Wants – a market in which speeds and coverage have expanded, so subscribers are free to use connections for desirable, but non-essential, uses, like Real-Time Entertainment and Social Networking

By these heuristics, is it possible to assess at what stage of market development each of the three regions examined in this spotlight find themselves?

Let's start by comparing monthly aggregate data consumption.

	Monthly Aggregate Data Consumption	
Region	Median	Mean
Eastern Europe	227.3 MB	1.0 GB
Brazil	6.3 GB	14.8 GB
Africa	2.4 GB	6.8 GB

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

Table 3 - Median and Mean Monthly Consumption

By this measure, Brazil is most consistent with the low-growth broadband markets, while Eastern Europe's usage is much lower, with Africa falling somewhere in-between.

Moving our attention to the composition of downstream traffic, we find that in each of the three regions, there are three categories which make up the bulk of downstream traffic; Table 4 shows the percentage of peak period traffic attributable to each of these three categories.

	Region		
Category	Eastern Europe	Brazil	Africa
Real-Time Entertainment	26.9%	41.3%	23.2%
Web Browsing	47.4%	24.2%	32.3%
P2P Filesharing	12.8%	12.0%	19.3%

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

Table 4 - Peak Period Downstream Traffic Composition (Top 3 Categories)

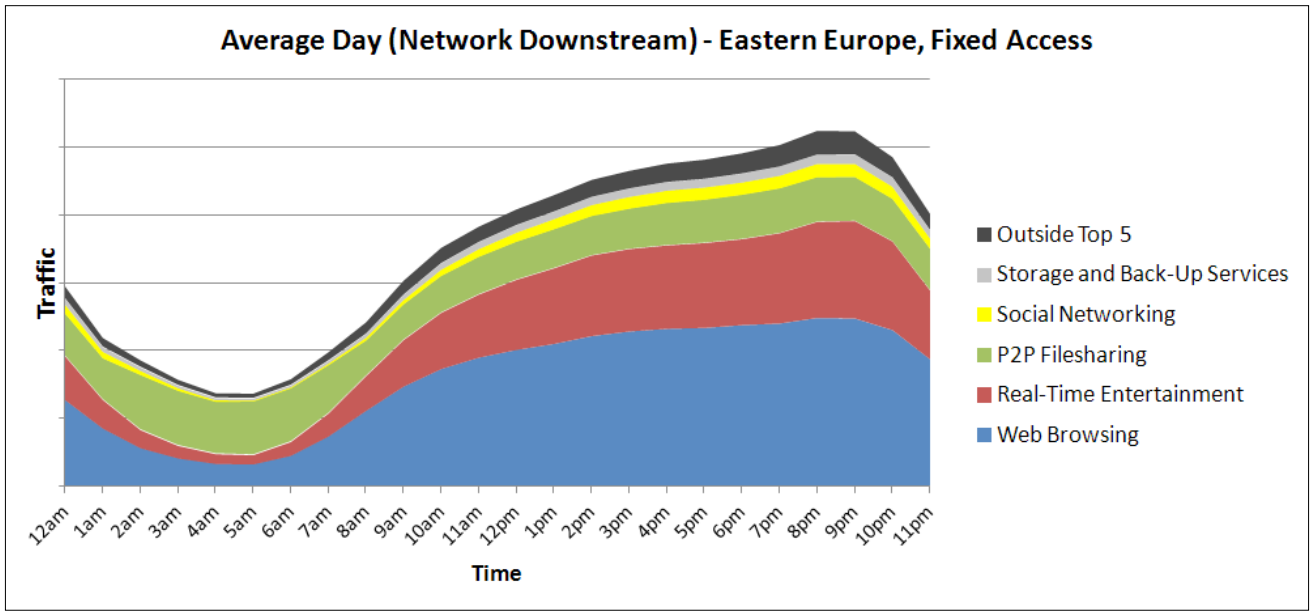


Figure 8 - Average Day (Network Downstream) - Eastern Europe, Fixed Access

Table 4 suggests that Brazil is most similar to mature broadband markets, while Eastern Europe is fairly advanced in its adoption of Real-Time Entertainment. Africa is still in a phase in which P2P Filesharing accounts for a large portion of traffic.

Shifting focus to the upstream (Table 5), the most interesting category is Real-Time Communications, as it is generally a higher percentage of peak upstream traffic in early-stage broadband markets. By this metric, Africa is at the earliest stage of growth, while Eastern Europe is further ahead, and Brazil further still.

	Region		
Category	Eastern Europe	Brazil	Africa
Real-Time Entertainment	10.9%	15.9%	6.4%
Web Browsing	23.6%	12.7%	11.6%
P2P Filesharing	43.6%	48.8%	44.3%
Real-Time Communications	10.9%	6.6%	23.2%

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

Table 5 - Peak Period Upstream Traffic Composition (Top 3 Categories)

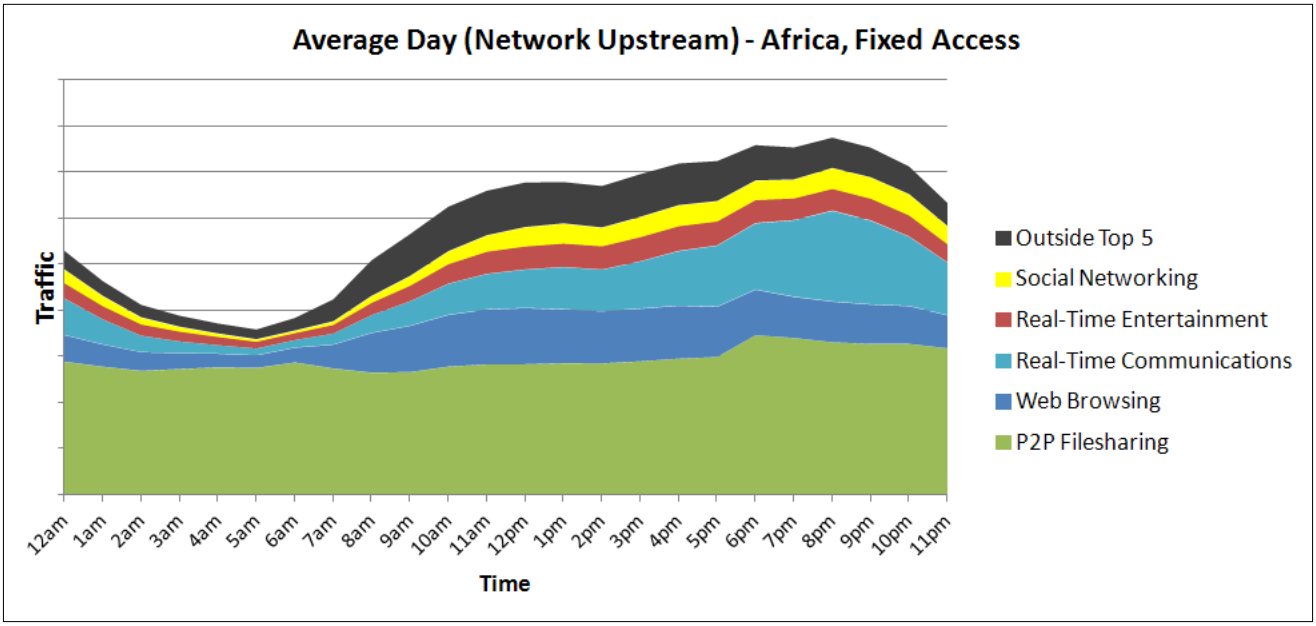


Figure 9 - Average Day (Network Upstream) - Africa, Fixed Access

On a per-application and per-protocol basis, each region showed local influence.

In Eastern Europe, regional influence is apparent in the presence of Vkontakte and Zshare, which generally don't appear in the top 10 lists elsewhere (except from time to time on mobile networks). Notably, Vkontakte traffic exceeds that of Facebook, and Zshare exceeds that of the more (globally) familiar storage sites.

In Brazil, we see local influence in the popularity of Orkut. Orkut is a social networking site that is known to be particularly popular in Brazil. Similar to the case of Vkontakte above, Orkut usage in Brazil exceeds that of Facebook.

In Africa, upstream capacity is consumed primarily by BitTorrent, which is the dominant P2P Filesharing network worldwide, but there is also an atypically large amount of eDonkey. However, it should be noted that eDonkey is known to be popular with French-speaking Internet users, and this spotlight included several networks from French-speaking African nations.

While Brazil seems to be the most advanced of the three regions in terms of traffic profiles, Africa and Eastern Europe both exhibit signs of maturation. Ultimately, comparison is just an academic exercise – in all three cases the broadband future is very bright, and the traffic profiles and usage characteristics seen today very much represent the "before" in a future "before and after" comparison.

	Eastern Europe		Brazil		Africa	
Rank	Application	Share	Application	Share	Application	Share
1	HTTP	43.84%	YouTube	24.80%	HTTP	28.94%
2	BitTorrent	17.02%	HTTP	22.53%	BitTorrent	20.81%
3	Google Video	6.40%	BitTorrent	11.65%	Skype	7.17%
4	Flash Video	5.41%	MegaUpload	9.45%	Flash Video	5.26%
5	RTMP	4.26%	Flash Video	4.00%	YouTube	4.96%
6	Skype	3.17%	Ares	3.87%	Facebook	4.42%
7	YouTube	3.08%	Orkut	2.65%	MegaUpload	3.11%
8	Vkontakte	2.56%	RTMP	2.49%	Megavideo	2.33%
9	PPLive	2.46%	Facebook	2.00%	iTunes	2.16%
10	Teredo	1.55%	Megavideo	1.97%	RTMP	1.83%
	Top 10	**89.76%**	**Top 10**	**85.40%**	**Top 10**	**81.00%**

SOURCE: SANDVINE NETWORK DEMOGRAPHICS

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Table 6 - Top Peak Period Applications by Aggregate Bytes - Emerging Markets, Fixed Access

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.

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 the 30 days, 7 days, and 1 day preceding the time of data collection.

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 endeavoured 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: Fall 2011*.

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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