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Intelligent Broadband Networks

Fall 2010 Global Internet Phenomena Report

This report, the eighth in an ongoing series of comprehensive traffic analysis studies, is the first report in which we compare and contrast both fixed and mobile networks, reflecting the belief that, to most subscribers, "the Internet is the Internet".

The major findings reveal subtle yet significant differences between how subscribers in different regions and accessing the Internet via different technologies use their broadband connectivity. The study also identified shifts in behavior over time that highlight the transient nature of the connected world.

Sandvine's Fall 2010 Internet Phenomena study examines a representative cross-section of the world's leading fixed and mobile data providers and is 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.

Enabling rapid service creation for the world's largest fixed and mobile operators through standards-based network policy control, Sandvine is focused on protecting and improving the quality of experience on the Internet. Our award-winning network equipment and solutions help cable, DSL, FTTx, fixed wireless and mobile operators better serve the subscribers and understand network trends; offer new services; mitigate malicious traffic; manage network congestion; and deliver QoS-prioritized multimedia services.

Executive Summary

Same Destination, Different Routes: Converged Subscriber Expectations Highlight Demand For Converged Network Reality

In our 2010 Mobile Internet Phenomena Report we remarked that, "To subscribers, the Internet is the Internet, whether it's accessed through a wire or over wireless spectrum. Much like how many subscribers don't differentiate between cable and DSL, history suggests that subscribers will view wireless technologies as one – perhaps even more so given that there isn't a piece of wire coming out of the wall to aid in the differentiation."

The Fall 2010 Global Internet Phenomena Report, the eighth since 2002 in an ongoing series of comprehensive traffic analysis studies, takes this statement a step further. This is the first report in which we compare and contrast both fixed and mobile networks, reflecting the belief that subscribers increasingly make little distinction between the two, at least not in terms of how they choose to use the connection.

Our major findings reveal subtle, yet significant differences between how subscribers in different regions access the Internet via different technologies and how they use their broadband connectivity. The study also identified shifts in behavior over time that highlight the transient nature of the connected world.

International findings include:

- Social networking services like Facebook, continue to be a significant and growing proportion of mobile Internet traffic; in eight months the percentage of mobile traffic in Latin America attributable to social networking almost doubled, and in North America it increased by 33%

- There is wide variation between the average amount of time per month for which Internet connections are active; for instance, in North America fixed connections are active for about 3 hours per day, whereas in Asia-Pacific fixed connections are active for 5.5 hours per day

- Median fixed access data consumption ranged from 4 gigabytes per month in North America to almost 12 gigabytes in Asia Pacific

- Real-time entertainment (streamed or buffered real time audio and video) is unquestionably the dominant driver of data consumption on fixed and mobile networks worldwide, and is still growing substantially; up to 43% of total Internet traffic is real-time entertainment, up significantly from past studies

- Within the Real-Time Entertainment category, streaming applications that rely on peer-to-peer architectures (sometimes called "peercasting"; prominent examples include PPStream and PPLive) have achieved worldwide market penetration

- Networks around the world vary in levels of congestion: networks in North America are most able to deliver increased subscriber traffic during the evening's peak hours, while networks in Latin America show the most congestion

We also examined regions individually and compared these observations to past reports.

Within North America, we observed that Real-Time Entertainment is the largest contributor to data consumption on both fixed (43% of peak period traffic) and mobile access (41%) networks. Within that category, Netflix is a major source of content, representing more than 20% of downstream traffic during peak hours on fixed access networks, and is heaviest from 8pm to 10pm. Finally, fixed access networks in North America deliver the highest prime time ratio (1.42) of any network examined in this report, indicating that subscribers are able to increase their usage during the evening without being constrained by the network.

Real-Time Entertainment has grown to be the dominant application category in Asia-Pacific, particularly during the evening hours, and exerts significant influence on the upstream due to the success of the peercasting applications, PPStream and PPLive. Nevertheless, P2P Filesharing remains a major component of traffic and exhibits remarkably consistent upstream levels throughout the day – over a 24 hour period, P2P Filesharing traffic accounts for 37% of all bytes carried. Within this category, BitTorrent is the dominant application, representing almost 38% of upstream bytes during peak period and nearly 17% of downstream bytes.

In Latin America, networks are experiencing significant congestion during periods of peak usage: fixed access networks have a prime time ratio of 0.97 while mobile access networks are even lower, at 0.89, indicating that individual subscribers are receiving a smaller slice of bandwidth when the network is busiest. Latin America remains a very healthy market for P2P Filesharing (37% of peak period traffic on fixed access networks), but Real-Time Entertainment is emerging as the dominant source of content (27% of peak period traffic on fixed networks and 35% on mobile networks), showing a shift in subscriber behavior towards favouring on-demand applications.

In Europe, Web Browsing accounts for more byte usage than any other category at almost 45% of aggregate bytes during the peak evening hours. Meanwhile, BitTorrent is the dominant P2P Filesharing protocol (indeed, this is the case everywhere except Latin America, where Ares reigns), representing almost 30% of upstream peak period traffic and slightly more than 8% of downstream peak period traffic. Finally, zSHARE has displaced MegaUpload and Rapidshare as the favored Storage and Back-Up Service in Europe and now accounts for 3% of downstream traffic during the peak period, showing that dominance on the Internet can be fleeting.

The data examined in the remainder of this report merely scratches the surface of what is possible. Service providers with traffic identification and network business intelligence solutions in place can explore their network usage in remarkable detail – enabling managed accounting based on data – and can maximize profitability, while at the same time maximizing subscriber experience.

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Introduction

In our 2010 Mobile Internet Phenomena Report[1] we remarked that, "To subscribers, the Internet is the Internet, whether it's accessed through a wire or over wireless spectrum. Much like how many subscribers don't differentiate between cable and DSL, history suggests that subscribers will view wireless technologies as one – perhaps even more so given that there isn't a piece of wire coming out of the wall to aid in the differentiation."

The Fall 2010 Internet Phenomena Report takes this statement a step further; this is the first Phenomena report in which we will compare and contrast both fixed and mobile networks, reflecting the belief that subscribers increasingly make little distinction between the two, at least not in terms of how they choose to use the connection. In other words, "The Internet is The Internet".

As mobile options are aggressively rolled out (the Global mobile Suppliers Association estimates that 132 operators are investing in LTE in 56 countries[2]), many subscribers around the world are finding themselves in one of two groups:

1. Those who have an existing fixed Internet connection must decide whether it is worth purchasing a mobile connection; those who elect to purchase a mobile connection must then choose whether the mobile connection will replace the fixed connection, or will augment it

2. Those who do not have an existing Internet connection must decide whether it is worth purchasing one; those who elect to purchase a connection must choose between a fixed connection or a mobile connection, or both

Network operators with large fixed access market shares are hoping that subscribers choose to carry two connections (as we have largely seen in the United States) rather than electing to replace the fixed connection with a mobile connection. Operators who are deploying mobile coverage in regions previously not served by fixed access networks stand to gain no matter what.

It's certainly not all rosy for mobile providers, however: a number of publications have reported that mobile data traffic has exceeded mobile voice traffic[3], and there are countless stories highlighting the "revenue gap" whereby data growth is vastly outpacing revenue. The need to remain connected while on the go is driving many subscribers to sign up for data plans, but it takes billions in investments to build the networks necessary to deliver that data with reasonable quality. Revenue forecasts point to significant challenges ahead for many network providers.

> **Terminology: Replacement Market and Augmentation Market**
>
> A **replacement market** is a region in which a mobile Internet connection renders a fixed access Internet connection unnecessary. In some cases, a mobile connection might outright replace an existing fixed connection. Alternatively, in regions where fixed access has not reached high levels of penetration, the mobile connection might be the first Internet connection for a subscriber who will never have a fixed connection
>
> Whereas, an **augmentation market** is a region in which a subscriber typically has both a mobile and a fixed Internet connection.

Meanwhile, many fixed network operators are seeing revenues eroded by over-the-top services that are replacing traditional pay services. Subscribers are turning to Skype in massive numbers, and are progressively less reliant on subscription-based telephony, whether IP-based or circuit-switched. There are also a plethora of content sources threatening the video-on-demand services offered by many network operators.

In response, network operators are investing heavily in technologies that let them better understand their subscribers and rapidly launch services that appeal to an increasingly discerning subscriber base looking for packages that match widely varying lifestyles and usage requirements.

In general, subscribers are aware that usage caps don't impact the vast majority of network users. Many "average" subscribers have decided that they don't want to subsidize the heavy network users, but are still reluctant to embrace metered billing. For their part, network operators are investigating technologies that solve issues like localized network congestion without unfairly impacting subscribers.

Furthermore, providers around the world are realizing that managing usage and managing congestion are two very different things: while congestion management aims to address network congestion in the fairest ways possible, usage management aims to help network operators to deploy rich service packages that meet subscriber needs without

1. Interested readers can download the full report from: http://www.sandvine.com/news/global_broadband_trends.asp
2. Rasmussen, Paul. "Operators Respond to Demand by Hitting the LTE Gas Pedal - FierceWireless:Europe." Wireless Industry, Wireless Technology, Wireless Companies - FierceWireless. 27 Aug. 2010. Web. <http://www.fiercewireless.com/europe/story/operators-respond-demand-hitting-lte-gas-pedal/2010-08-27>.
3. For one such report that cites an Ericsson study, see: http://www.convergedigest.com/Bandwidth/newnetworksarticle.asp?ID=31173

compromising business sustainability (for more about Usage Management, see "Spotlight On: Usage Management"). Some subscribers like prepaid plans, others like postpaid. Some subscribers are accepting of so-called "soft bytecaps", whereby once a cap is reached the network speed is limited during heavy periods; whereas others prefer "top-up" options available at an extra cost. Some subscribers use the Internet on a daily basis, others don't[1].

Spotlight On: Usage Management

As simple Internet connectivity is commoditized and price pressures drive average revenue per user (ARPU) down, capital infrastructure costs remain a constant. Meanwhile, subscribers demand personalized plans that reflect their network usage and ensure superior access to the applications they value most. Service creation solutions enable the delivery of tiered and subscriber-initiated services to accelerate and simplify entry into service differentiation.

The image to the right shows a Network Analytics screen that provides statistics on different service packages, providing information that can help to tune existing packages or introduce new ones.

Statistics – Domestic 10G

Key Metrics		% Change From LM
Total Subscribers	10,349 ↑	13.6%
Median MB	1,038.37 ↑	23.9%
Total GB	4,023.44 ↑	20.7%
Median Overages (MB)	920.35 ↓	-7.3%
% Subscribers Over Quota	2.1% ↓	-7.1%
% Subscribers Topped Up	1.1% ↑	10.2%
% Zero Rated Bytes	0.2% ↑	23.6%

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With subscribers only relatively recently experiencing the true potential of mobile connectivity through powerful devices and fast networks, it remains to be seen exactly how fixed access and mobile access will settle into a steady state – only a handful of markets worldwide are mature enough for to enter this state in the near future. In rapidly expanding markets such as China, India, and Latin America, the near-term priorities for network operators are rolling out service and signing up new subscribers.

If history has taught us anything about the Internet, it's that there is only one constant: change. The remainder of this report analyzes network data and creates portraits of fixed and mobile access networks worldwide.

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1.   For instance, see "3 Introduces £2 per day 500MB mobile broadband": http://www.techwatch.co.uk/2010/10/05/3-introduces-2-per-day-500mb-mobile-broadband/

Analysis of Regional Network Traffic Profiles

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- Networks around the world vary in levels of congestion: networks in North America are most able to deliver increased subscriber traffic during the evening's peak hours, while networks in Latin America show the most congestion

The sections that follow explore separate geographic regions and present findings and observations identified in each

Spotlight On: Network Analytics

Sandvine's Network Analytics gets the data out of the network and brings it to the boardroom. Network Analytics is a sophisticated analysis tool that empowers confident business decisions through network-wide visibility[1].

Unlike data gleaned from billing and operations systems alone, Network Analytics provides real network statistics with application-level, subscriber-aware intelligence; this powerful combination bridges the gap between critical operations' systems enabling insightful analysis and measurable business impact.
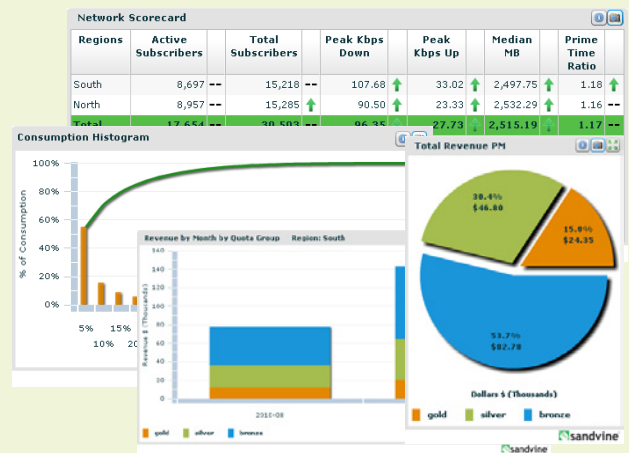
1. To see a video of Network Analytics in action, visit: http://www.sandvine.com/products/network_analytics.asp

North America

Network operators in North America are always making headlines: from Verizon and Google issuing a joint proposal to present a vision of an 'open Internet'[1], to AT&T announcing a shift towards consumption-based billing for mobile broadband[2], to Sprint's Virgin Mobile announcing that they will roll out unlimited mobile broadband prepaid packages[3]; North American operators have not been shy about making their thoughts and intentions clear.

Which billing and network management approaches attain market supremacy remains to be seen, but what is becoming clear is how subscribers make use of their network connections. The challenge for service providers is creating sustainable business models that ensure fairness in terms of billing and management, while appropriately aligning with subscriber expectations.

Of all the regions included in this report, North America provided the richest data, making a large amount of analysis possible on both fixed and mobile access networks. This analysis leads to the following conclusions:

- Real-Time Entertainment is the largest contributor to data consumption on both fixed (42.7% of peak period traffic) and mobile access (41.3 percent) networks

- Within the Real-Time Entertainment category, Netflix is a major source of content, representing more than 20% of downstream traffic during peak hours on fixed access networks, and is heaviest from 8pm to 10pm

- Fixed access networks in North America deliver the highest prime time ratio (1.42) of any network examined in this report, indicating that subscribers are able to increase their usage during the evening without being constrained by the network

- There is wide variation between the average amount of time per month for which fixed and mobile Internet connections are active; fixed connections are active for about 3 hours per day, while mobile connections are only active for about 45 minutes per day

Average Day

In 2009, we observed that North America fixed networks exhibited the smallest variation between the high and low subscriber levels during the course of a day. This characteristic has only grown in the past year. Indeed, the low subscriber point in 2010 represents about 75% of the peak, showing that North American subscribers tend to leave devices turned on when connected to fixed networks (in fact, the subscriber count is within 5% of peak for an astonishing 12 hours every day). Those devices aren't particularly active, as evidenced by the traffic curve which has essentially remained unchanged from 2009 to 2010.
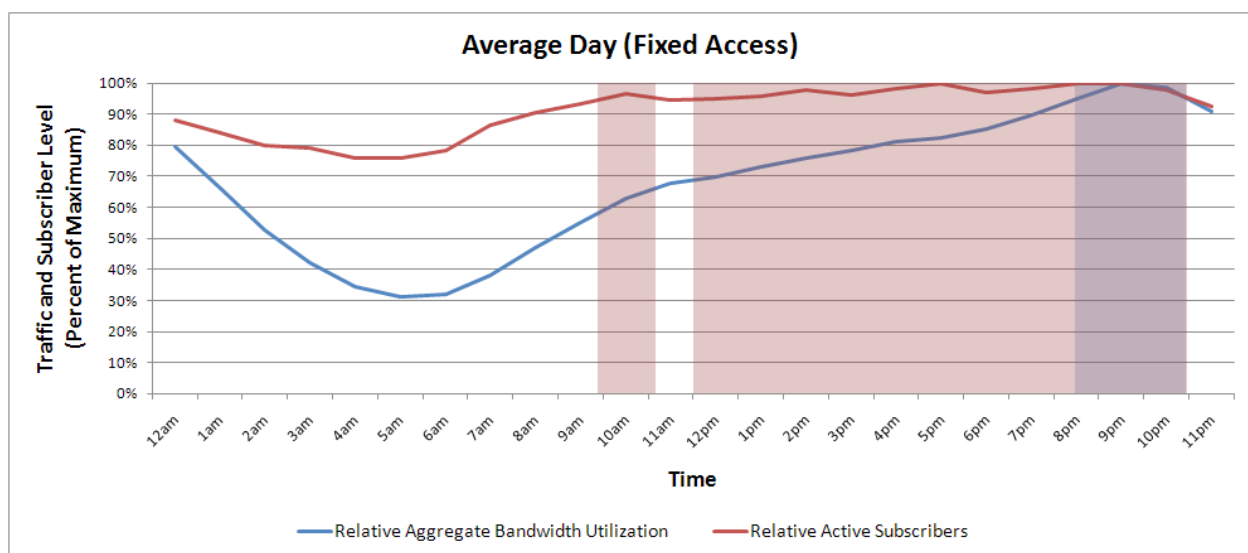
Figure 1 - North America - Average Day (Fixed Access)

1. Shiels, Maggie. "BBC News - Google and Verizon Outline Vision for 'open Internet'" BBC - Homepage. 10 Aug. 2010. Web. <http://www.bbc.co.uk/news/technology-10920871>.
2. Fitchard, Kevin. "AT&T: Industry Must Reassess Mobile Data Billing Models." Connected Planet Online |. 21 Apr. 2010. Web. <http://connectedplanetonline.com/3g4g/news/att-mobile-billing-models-0421/>.
3. "Sprint's Virgin Mobile To Debut Unlimited Broadband Plans - WSJ.com." Business News & Financial News - The Wall Street Journal - WSJ.com. 24 Aug. 2010. Web. <http://online.wsj.com/article/BT-CO-20100824-705192.html>.

On mobile access networks, the subscriber curve shows a similar shape but exhibits greater variation. Likewise, the traffic curve is roughly the same shape on mobile networks as it is on fixed networks, although it rises more rapidly in the late morning before levelling off and slowly rising to the peak reached at 10pm (although at 8pm and 9pm the curve is at 99.3% and 99.2% of peak, respectively). The peak period on the mobile networks is very protracted, much more-so than that observed in other regions.
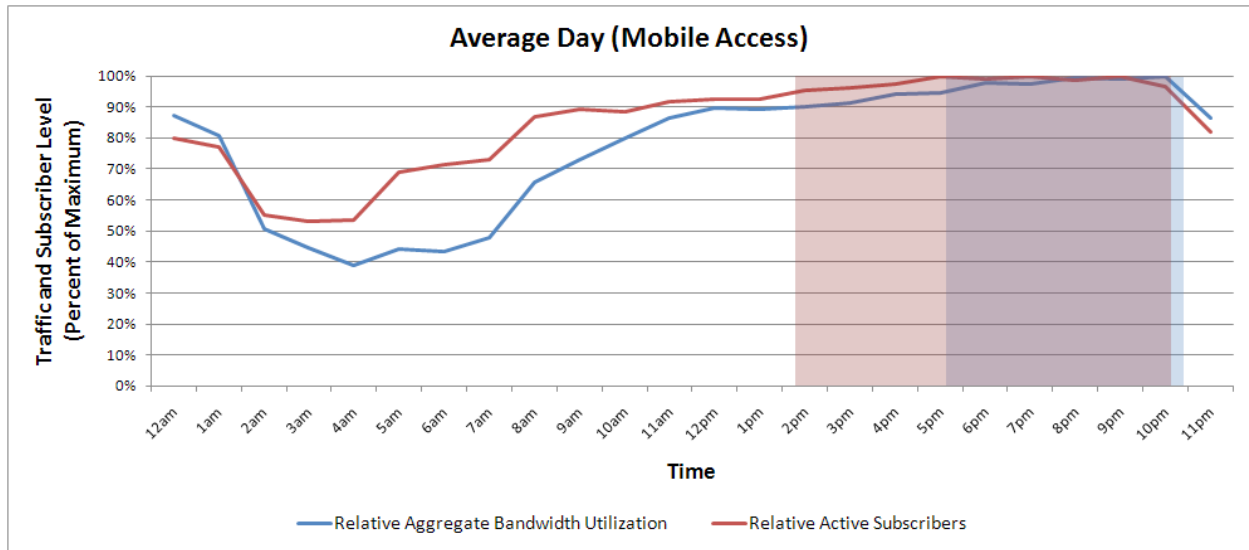
Figure 2 - North America - Average Day (Fixed Access)

Upstream capacity on fixed networks in North America is mostly P2P Filesharing, which accounts for 53.3% of total bytes. In a distant second place, with 16.3%, is Real-Time Entertainment, followed by Web Browsing at 11.0%. Interestingly, Real-Time Communications represents 5.5% of upstream traffic, likely due to the prevalence of branded voice-over-IP services in the United States.

Figure 3 - North America - Network Upstream Traffic Profile (Fixed Access)

North America's mobile networks are much less influenced by P2P Filesharing, although it still has significant presence at 23.5% of bytes, signifying the impact of aircard-enabled laptops. Web Browsing holds the dominant position at 26.8% of daily traffic. This percentage is higher during the peak period, where it rises to 30.7%. Real-Time Entertainment, at 15.2%, is the third largest contributor to daily upstream data consumption.
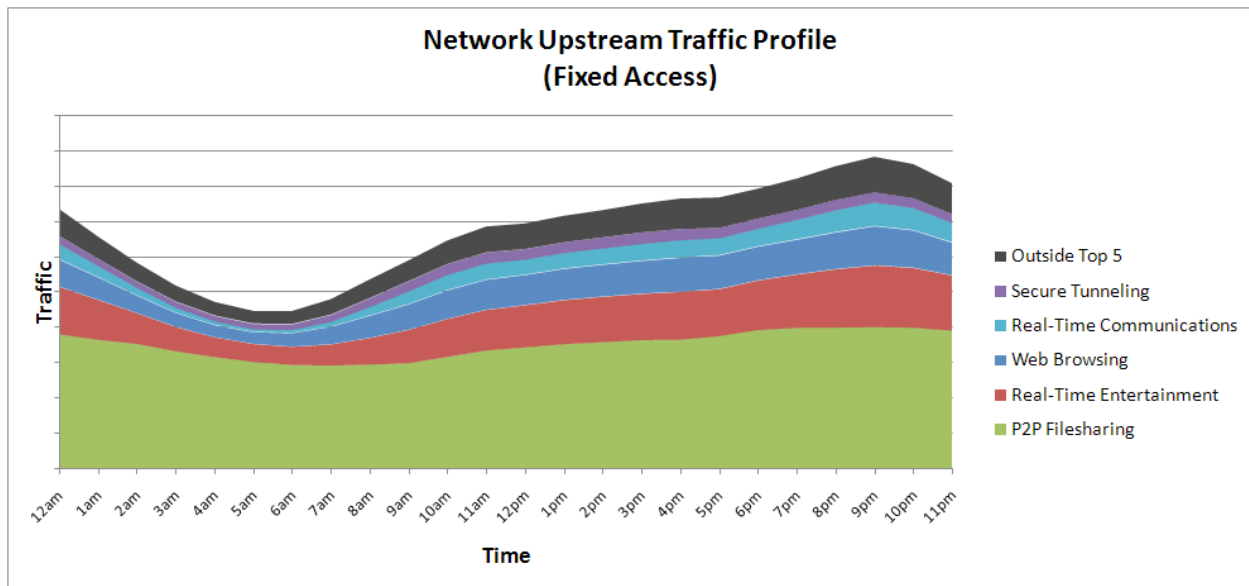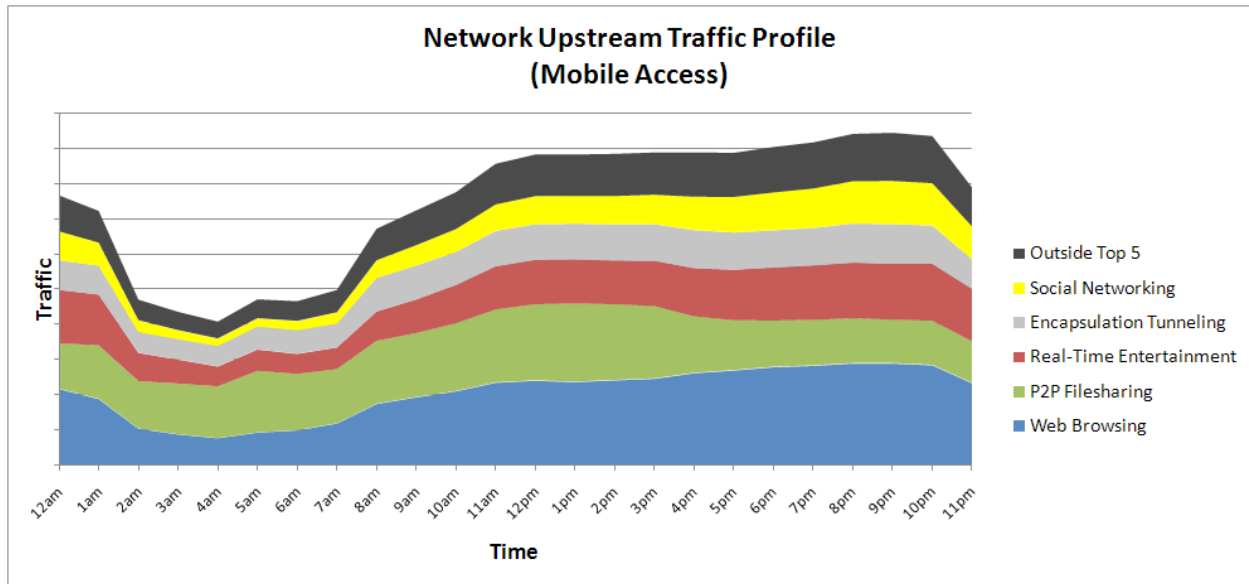

Figure 4 - North America - Network Upstream Traffic Profile (Mobile Access)

On fixed networks, the downstream belongs to Real-Time Entertainment, which accounts for 45.7% of data consumption. Web Browsing sits at 24.3%, while P2P Filesharing is the third largest category with 13.2%. Together, the top three categories are responsible for more than 83% of total downstream traffic on North America's fixed networks. Rounding out the top five categories, Social Networking and Gaming both account for 2.4% of traffic, with most of this traffic attributed to content downloads (demos, add-ons, game trailers) instead of actual game-play (which tends to be very light, although exceptionally sensitive to network conditions).

Figure 5 - North America - Network Downstream Traffic Profile (Fixed Access)

Like fixed networks, mobile networks are characterized by very high levels of Real-Time Entertainment traffic, which accounts for 44.8% of traffic (almost identical to its contribution on fixed networks). Web browsing is a larger contributor on mobile networks, coming in at 31.2% of bytes, and is followed by P2P Filesharing (7.8%) and Social Networking (5.7%) as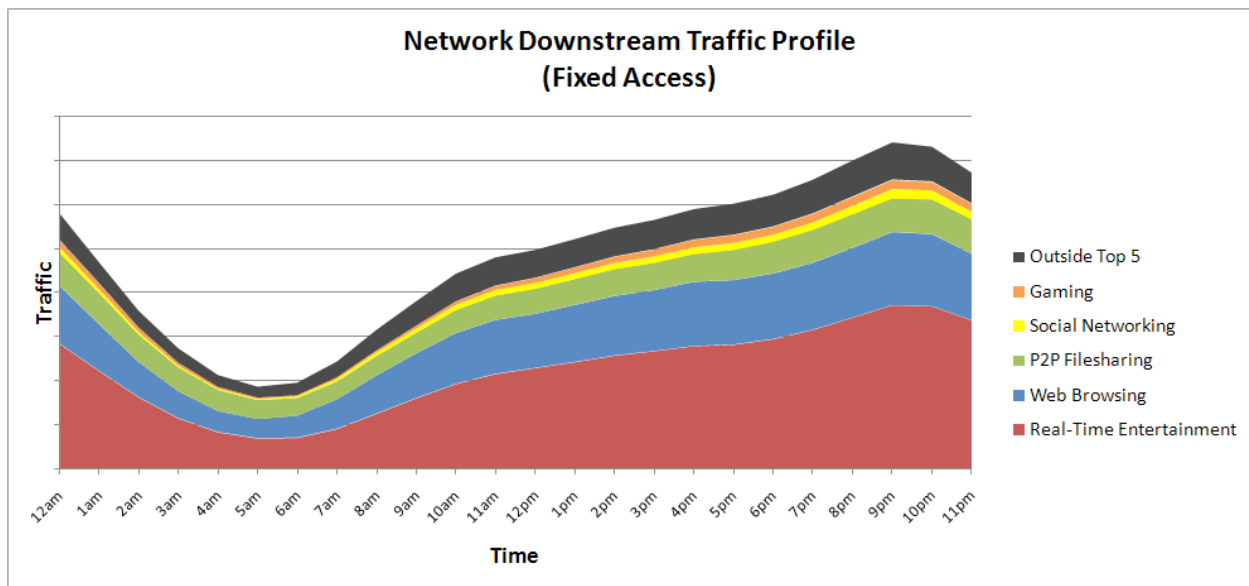 the major categories on mobile access networks. Visual inspection of Figure 6 shows that P2P is fairly constant all day, whereas Social Networking is more prominent during traditional waking hours.

The Stats for North America

45.7: percent of downstream traffic on North American fixed access networks attributable to Real-Time Entertainment

44.8: percent of downstream traffic on North American mobile access networks attributable to Real-Time Entertainment

Figure 6 - North America - Network Downstream Traffic Profile (Mobile Access)
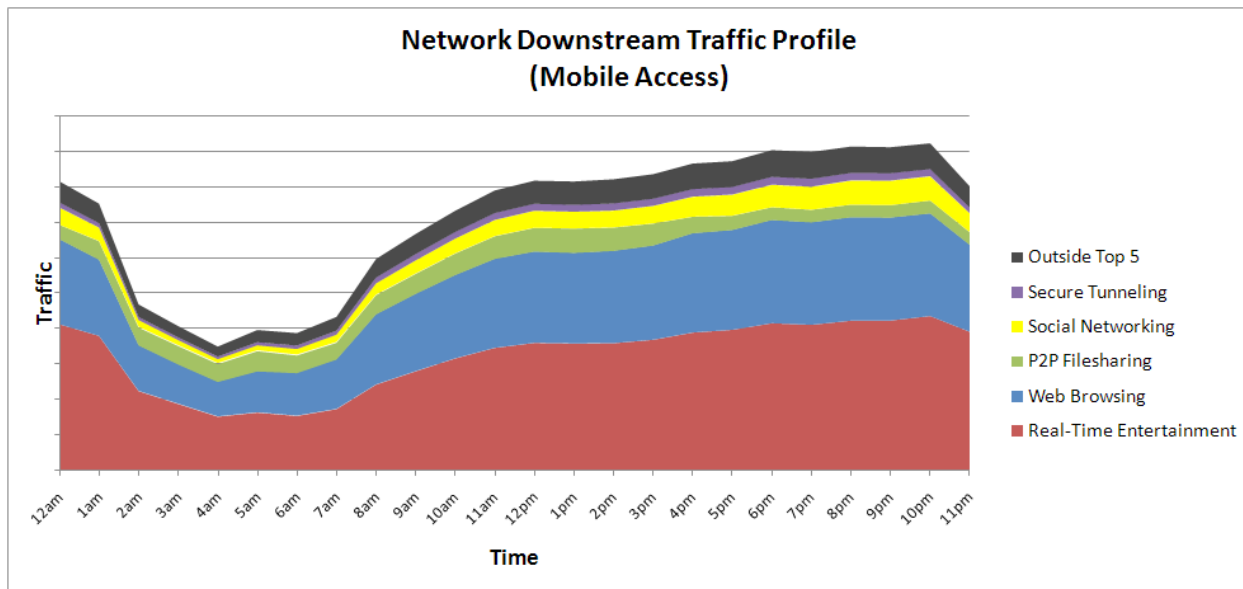
Spotlight On: 2010 FIFA World Cup

How the world's most popular sporting event demonstrated the future of broadband services

This is an excerpt from an article that appeared in CED Magazine[1].

"This figure depicts a snapshot of a large Canadian service provider's rankings of the top 25 websites from June 14. Traffic tagged akamaihd.net had surged onto the list since the start of the World Cup on June 11. Traffic tagged in this manner derives from Akamai Technologies, a company that provides a distributed computing platform for Internet content and application delivery. Akamai is extremely popular for distributing streaming video because it transparently mirrors multimedia content (video, images, audio) from content providers' servers, then redistributes it to subscribers based on their proximity to Akamai's servers and the quality of available connections. The report shows akamaihd.net was the 12th-largest website on this network by total bytes. We can also see that day-over-day, akamaihd.net traffic had increased by more than 80 percent, which coincides with popular matches of both Italy and Germany that took place within that timeframe. Clearly, Akamai emerged from the crowd to become a significant generator of traffic on this provider's network. Indeed, by June 18, akamaihd. net had risen to second place, behind only YouTube in popularity, and was still increasing its byte usage at an astonishing rate of more than 80% day-over-day through the course of the tournament."

In fact, during the most popular matches, World Cup streaming accounted for roughly 20% of downstream bandwidth.

Top 25 Websites		T	Y	LM	Change
youtube.com	--	1	1	1	0.2%
megavideo.com	--	2	2	3	0.9%
windowsupdate.com	--	3	3	2	0.9%
apple.com	--	4	4	6	1.4%
fbcdn.net	--	5	5	5	1.6%
megaupload.com	--	6	6	4	-1.5%
rapidshare.com	--	7	7	7	0.4%
facebook.com	--	8	8	8	0.7%
msn.com	--	9	9	9	1.1%
googlevideo.com	--	10	10	13	1.9%
	--	11	11	11	1.0%
akamaihd.net	↑	12	19		82.9%
google.com	↓	13	12	10	-0.5%
playstation.net	--	14	14	19	4.3%
symantecliveupdate.com	↓	15	13	12	-1.1%
	↓	16	15	16	2.0%
llnwd.net	↓	17	16	14	1.0%
zshare.net	↓	18	17	15	2.9%
xbox.com	↓	19	18	17	1.4%
farmville.com	--	20	20	21	-0.1%
microsoft.com	--	21	21	20	-1.7%
edgesuite.net	--	22	22	24	-0.4%
hotfile.com	--	23	23	31	3.3%
	--	24	24	23	0.2%
adobe.com	--	25	25	18	0.6%

1.   Donnelly, Tom. "The FIFA World Cup." CED Magazine. 1 Sept. 2010. Web. <http://www. cedmagazine.com/article.aspx?id=171288>.

Peak Period

From 2009 to 2010, the major changes to the peak period composition of North America's fixed networks is the increasing presence of Real-Time Entertainment, and a slight rebound in the levels of P2P Filesharing traffic (which has increased to 19.2%). Real-Time Entertainment now accounts for 42.6% of total peak period bytes, up significantly from less than 30% a year ago. In turn, Web Browsing has suffered the largest decline, now only accounting for 20.2% of total traffic.

Figure 7 - North America - Normalized Aggregate Traffic Profile Comparison (Peak Hours, Fixed Access)

From January to September 2010, the level of Real-Time Entertainment traffic that drives peak period mobile consumption has risen substantially: from about 25% to 41.3%, while P2P Filesharing has experienced a major decline, dropping to represent only 5.6% of peak period bytes on mobile networks. Web Browsing remained fairly constant, dropping only slightly to 31.7%. Social Networking is still on the rise, presently generating 8.3% of mobile bytes during the network's peak period.

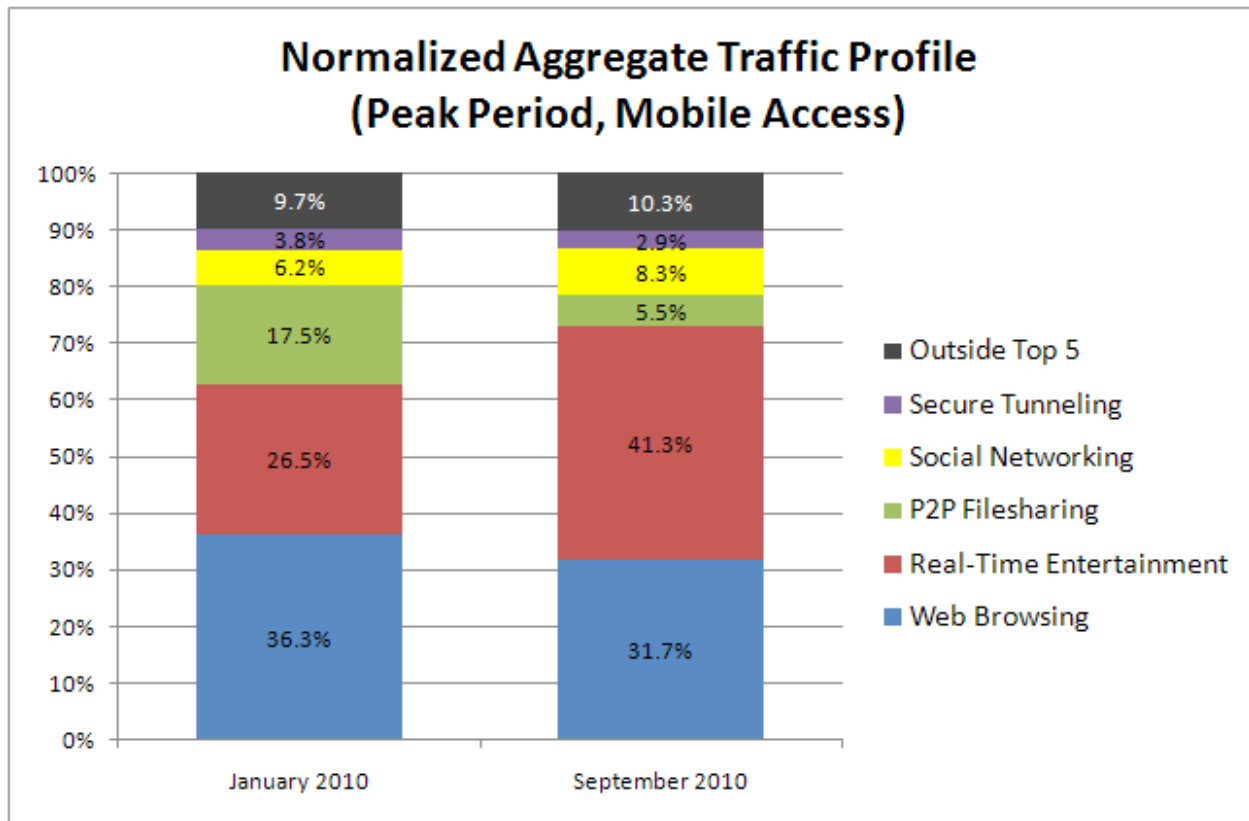**Normalized Aggregate Traffic Profile (Peak Period, Mobile Access)**

Figure 8 - North America - Normalized Aggregate Traffic Profile Comparison (Peak Hours, Mobile Access)

Examination of the individual applications being used on North America's networks reveals some fascinating insights.

First, fixed networks in North America continue to carry significant amounts of Gnutella, which has all but disappeared elsewhere. Second, on the upstream list we can see MGCP, a communications protocol used in VoIP applications. Third, the upstream list also includes PPStream, showing that P2P streaming applications (particularly PPStream and PPLive) have truly global appeal – if you look at the top ten lists for fixed access networks in the other regions examined in this study, you'll spot one or both of those applications in every one.

Did you know?

20.6% of all peak period bytes downloaded on fixed access networks in North America are Netflix.

Fourth, and perhaps most importantly for North American service providers, we see Netflix features prominently, particularly in the downstream direction. Netflix is a video-on-demand service that competes directly with the pay video-on-demand services offered by many Internet providers. The news is full of stories[1] about subscribers dropping their TV packages and using fewer pay-for-on-demand services in North America now that services like Hulu and Netflix can fulfill much the same needs for significantly less monthly investment.

For service providers, this is a double-whammy: not only are they losing revenue to these over-the-top offerings, but they are losing network capacity delivering these services.

1.   For one example, see: http://www.cnbc.com/id/39213429/

BitTorrent, HTTP, Gnutella, Netflix, YouTube and Facebook are all in the top ten list for both upstream and downstream in North America's fixed networks.

Rank	Upstream		Downstream	
	Application	Percent of Traffic	Application	Percent of Traffic
1	BitTorrent	34.31 %	HTTP	22.70 %
2	HTTP	12.36 %	Netflix	20.61 %
3	Gnutella	11.18 %	YouTube	9.85 %
4	Netflix	4.34 %	BitTorrent	8.39 %
5	Skype	3.28 %	Flash Video	6.14 %
6	SSL	2.99 %	RTMP	6.13 %
7	YouTube	2.47 %	iTunes	2.58 %
8	MGCP	2.46 %	Facebook	2.44 %
9	PPStream	2.41 %	Gnutella	2.12 %
10	Facebook	2.28 %	Xbox Live	1.61 %
Total		78.08 %		82.57 %

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

Spotlight On: Netflix

Netflix is a company headquartered in Los Gatos, California, that offers rental-by-mail and online video streaming in the United States. On September 22nd, Netflix expanded into Canada with a streaming-only service. Netflix uses a subscription model, and has forged partnerships with a long list of consumer device manufacturers including television and gaming console makers.

Within a few days of launch in Canada, Netflix had attained shocking levels of success, and has no doubt caused alarm among the country's service provider community. The images below, exported from a Network Analytics deployment, show the success of Netflix less than a week after its expansion into Canada.
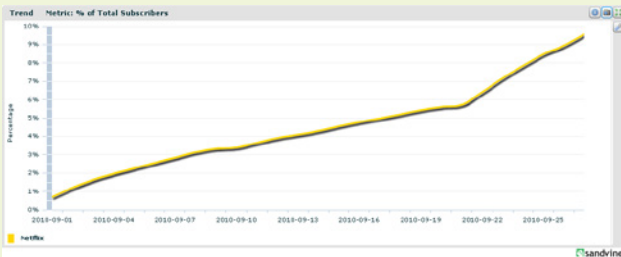
The percentage of subscribers who visited Netflix.com in the past month – within a week of launch, more than 10% of subscribers had visited
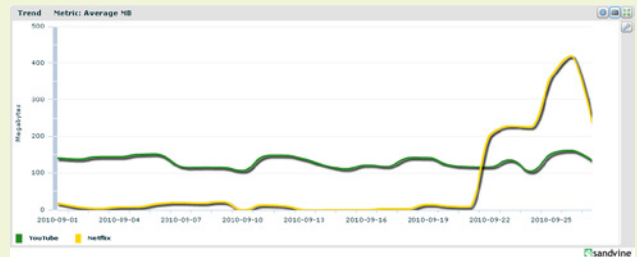
Per-subscriber Netflix usage overlaid with YouTube usage for reference
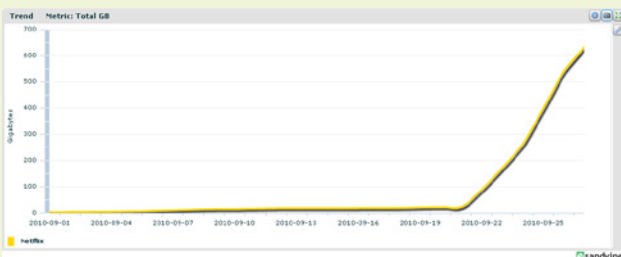
The total amount of bytes originating from Netflix.com – the launch on September 22nd, 2010 is clearly evident

An average day for Netflix on this network, peaking at 9:30pm

Examining the top applications on North America's mobile networks and comparing these lists to Table 9 in our 2010 Mobile Internet Phenomena report, reveals some shifting subscriber trends. On the upstream, Facebook has increased substantially, rising from 3.6% to 10.6%. Conversely, BitTorrent has dropped from 21.1% to 7.2% (and has fallen off the downstream list entirely – possibly showing tha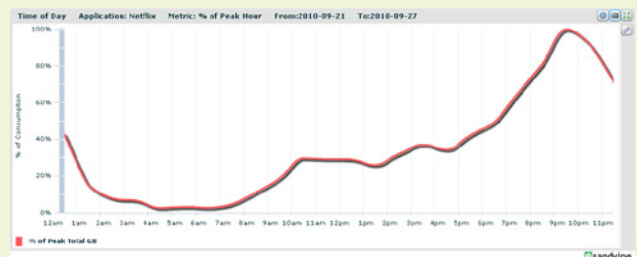t streaming applications are delivering an acceptable quality of experience on North America's mobile access networks). Skype is the only application to fall off the upstream list altogether, and has been replaced by RTMP.

On the downstream, YouTube has risen noticeably from 12.3% to almost 19%, while HTTP has declined slightly from 36.5% to 30.9%. Facebook has risen from 3.7% to 5.8%, but MySpace has fallen from the list (it is joined by BitTorrent, Windows Update, and iTunes as other applications that have disappeared from the top ten). The newcomers to the list are RTMP, Google Video, Shockwave Flash and, perhaps surprisingly, Netflix. Subscribers in North America are embracing streaming applications in mobile environments (to the extent shown in Table 2). This is a testament to the quality of experience that North American network providers are delivering.

Rank	Upstream		Downstream	
	Application	Percent of Traffic	Application	Percent of Traffic
1	HTTP	33.90 %	HTTP	30.88 %
2	Facebook	10.63 %	YouTube	18.88 %
3	BitTorrent	7.19 %	Flash Video	10.04 %
4	YouTube	7.08 %	Facebook	5.76 %
5	SSL	5.97 %	RTMP	4.97 %
6	Gnutella	5.94 %	Google Video	3.12 %
7	Flash Video	4.65 %	SSL	2.38 %
8	MySpace	3.62 %	Gnutella	2.37 %
9	RTMP	2.36 %	Shockwave Flash	2.33 %
10	Ares	1.75 %	Netflix	2.08 %
Total		83.09 %		82.81 %

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

Fixed networks in North America have the highest prime time ratio of any network examined in this report. The ratio of 1.42 shows that subscribers are not only being more active in the evening, but the ability of the network to deliver the capacity needed for this increased subscriber activity. Listing the categories prime time ration in descending order reveals the motivations behind evening subscriber activity: Bulk Entertainment, Social Networking, Gaming, Real-Time Communications and Real-Time Entertainment all have ratios higher than the network as a whole.

Mobile networks paint a similar picture. The ratio of 1.13 reveals that subscribers are still able to increase their individual bandwidth consumption despite the loads placed on the network, and the increases are led by Social Networking and Real-Time Communications.
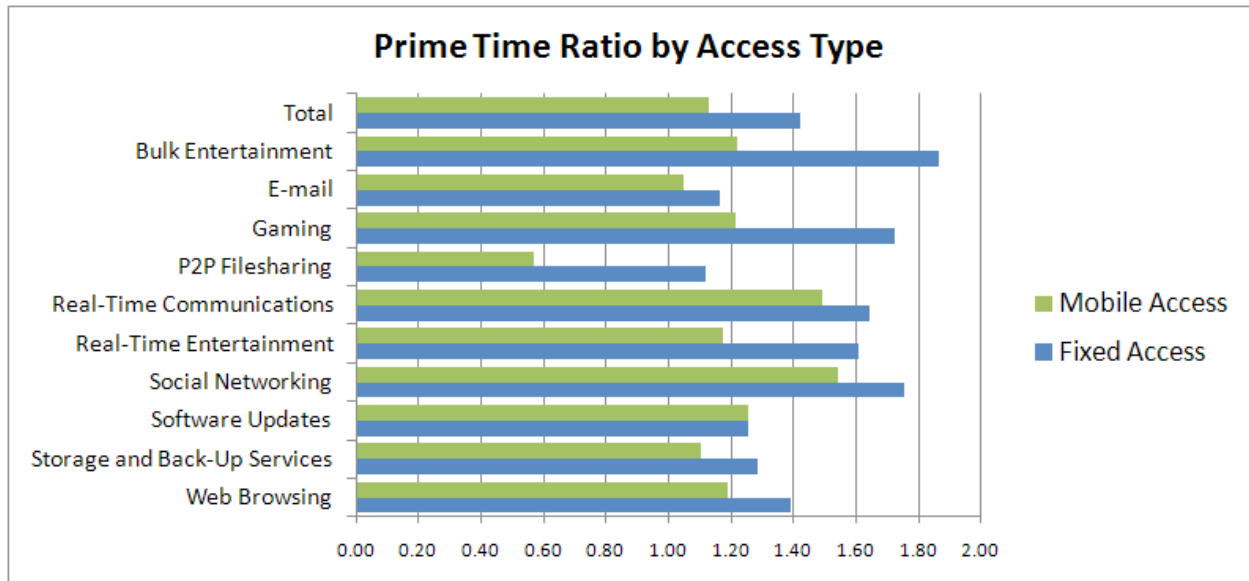
Figure 9 - North America - Prime Time Ratios (Fixed and Mobile Access)

Subscriber Analysis

The prevalence of media coverage surrounding Internet billing models has made more subscribers aware of the inequities that exist in usage across the subscriber base as a whole. Industry members have long been aware of the impact that heavy users have on network usage. Still, observing that the 1% of heaviest upstream users account for 40% of upstream bytes (as shown in Figure 10) remains sobering.

Figure 10 - North America - Percentile Byte Contribution (Monthly, Fixed Access)

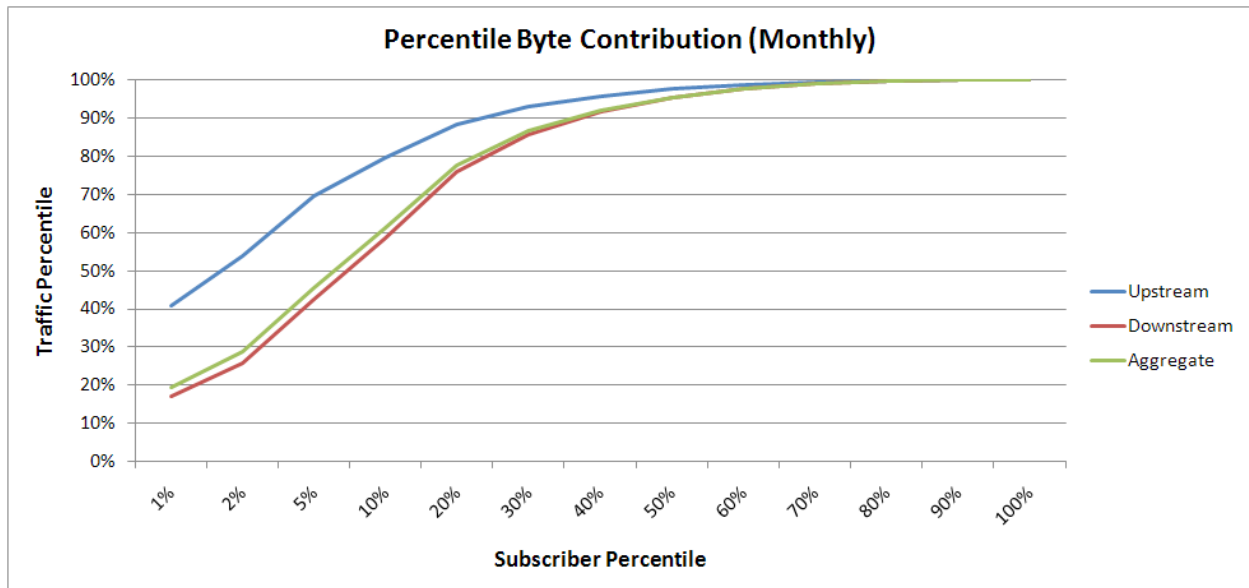| Subscriber Percentile	Day			Week			Month		
	Upstream	Downstream	Aggregate	Upstream	Downstream	Aggregate	Upstream	Downstream	Aggregate
1	54.40%	24.61%	26.42%	46.01%	18.54%	21.26%	40.95%	17.18%	19.38%
2	66.73%	35.35%	37.73%	59.12%	27.74%	31.03%	53.88%	25.96%	28.71%
5	78.34%	52.96%	55.37%	73.43%	44.60%	47.95%	69.73%	42.58%	45.54%
10	85.18%	68.12%	69.81%	81.80%	60.34%	63.02%	79.76%	58.62%	61.12%
20	91.45%	83.02%	83.76%	89.17%	76.99%	78.57%	88.52%	76.09%	77.64%
30	94.81%	90.49%	90.71%	93.14%	86.05%	86.89%	93.03%	85.72%	86.59%
40	96.90%	94.72%	94.71%	95.67%	91.64%	92.00%	95.81%	91.62%	92.05%
50	98.24%	97.22%	97.14%	97.39%	95.18%	95.29%	97.61%	95.32%	95.49%
60	99.09%	98.67%	98.61%	98.55%	97.44%	97.43%	98.77%	97.61%	97.65%
70	99.61%	99.48%	99.45%	99.31%	98.82%	98.79%	99.46%	98.95%	98.96%
80	99.89%	99.87%	99.86%	99.76%	99.60%	99.58%	99.82%	99.66%	99.66%
90	99.99%	99.99%	99.99%	99.97%	99.95%	99.94%	99.98%	99.96%	99.96%
100	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 3 – North America - Cumulative Usage by Subscriber Percentile (Fixed Access)

On fixed access networks in North America, the median usage is almost exactly 4 gigabytes per month, while the mean is almost 15 gigabytes. While analyzing the data, it wasn't uncommon to encounter top users who had consistently exceeded 5 terabytes of monthly usage. Finally, the average North American fixed access Internet user is online for almost 97 hours per month.

Mobile access networks paint a slightly different picture: median usage of just over 125 megabytes and mean usage of slightly more than 420 megabytes. Mobile users were active (in terms of data, rather than voice) for an average of 23 hours 47 minutes per month.

Did you know?

The average user of a fixed access network in North America is active online for almost 97 hours per month. On mobile networks the average is significantly lower, only 23 hours 47 minutes per month

Latin America

As a region, Latin America is experiencing massive growth as operators roll out coverage and battle for market share. Two conglomerates in particular are vying for dominance: America Movil and Telefonica. Combined, these powers hold a combined market share of 67% in mobile access and 52% in fixed access.

The region is interesting not only for its huge growth, but also because of the replacement versus augmentation analysis being made by many subscribers. In our 2010 Mobile Internet Phenomena Report, we stated that due to the "…relatively low levels of wired broadband penetration, a wireless connection might be the first Internet service for many subscribers" and added that "this presents an opportunity for service providers to influence the services and applications that make up the mobile Internet."

Now, we are in a position to make a comparison between subscriber usage characteristics on fixed and mobile access networks in Latin America, and we do so below. It should be noted that while the 2010 Mobile Internet Phenomena data included "Caribbean and Latin America", the influence of the Caribbean nations was so minimal that we feel it is not inappropriate to compare Latin America of this report with Caribbean and Latin America of the previous iteration.

The analysis that follows leads to the following observations and conclusions:

- In Latin America, networks are experiencing significant congestion during periods of peak usage: fixed access networks have a prime time ratio of 0.97, while mobile access networks are even lower, at 0.89, indicating that subscribers are each receiving a smaller slice of bandwidth when the network is busiest
- Latin America remains a very healthy market for P2P Filesharing (36.7% of peak period traffic on fixed access networks), particularly the Ares network
- The reign of P2P Filesharing in Latin America is coming to an end, as Real-Time Entertainment is emerging as the dominant source of content (26.7% of peak period traffic on fixed networks and 34.8% on mobile networks), showing a shift in subscriber behaviour towards favouring on-demand applications

Did you know?

In November 2009 we launched The Better Broadband Blog[1]. The goal of this site is to provide timely information, analysis and commentary that pertain to the goal of making the Internet better.

Since launch, a myriad of subjects have been discussed, including:

- Entertainment Wars Heat Up
- The Wireless Data Crunch
- Measuring the Quality of the Internet

1. You can find the blog at: http://www.betterbroadbandblog.com

Average Day

The average day profiles for fixed and mobile access in Latin America are very similar: the subscriber curve for each begins a steady climb from 5am to a point in the midday where it slows down, though still rises, to a peak around 8pm. Similarly, the traffic curve closely matches the subscriber curve, although traffic lags the subscriber curve on the descent and crosses over to lead it on the ascent to peak.

The similarities between the two figures below suggest that, behaviorally, subscribers in Latin America make no differentiation between their fixed and mobile connections and suggests that Latin America is a replacement market. If this hypothesis is true, then we should expect to see consistency with the actual breakdown of traffic categories, with the primary differences being due to network capacity rather than subscriber behavior.
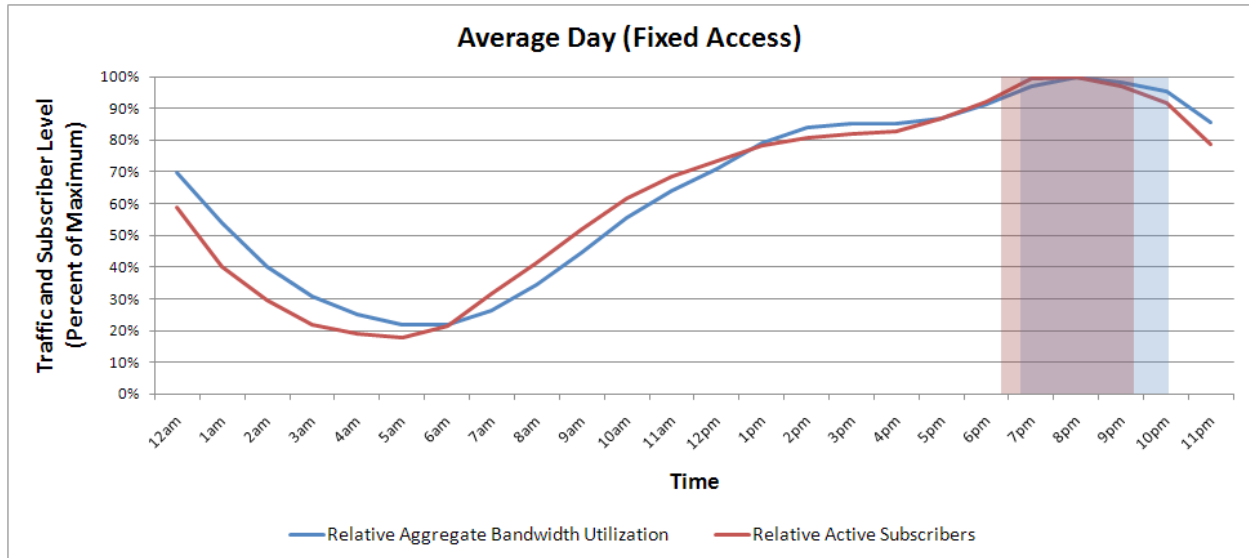

Figure 11 - Latin America - Average Day (Fixed Access)
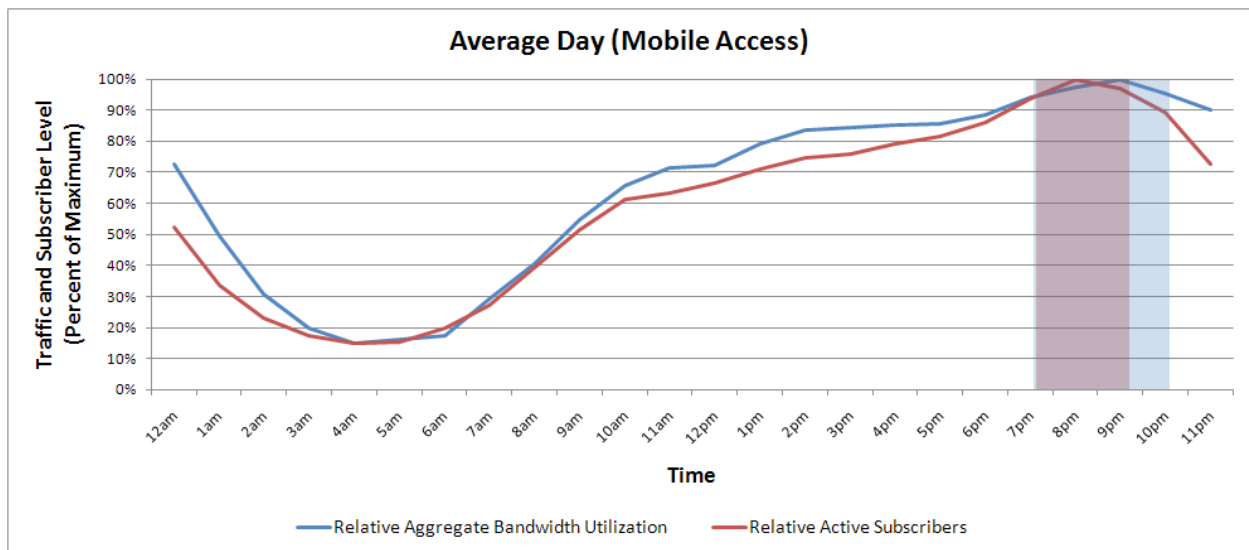
Figure 12 - Latin America - Average Day (Mobile Access)

The figures below show the upstream traffic profile for an average fixed access network (Figure 13) and for an average mobile access network (Figure 14) in Latin America.

On fixed access networks, P2P Filesharing is exceptionally dominant, accounting for 73.3% of total upstream bytes. Real-Time Entertainment is in a very distant second-place at 10.6%. Web Browsing is in third place with 6.8%, followed by Social Networking at 2.7%.

Network Upstream Traffic Profile (Fixed Access)

Legend: Outside Top 5, Network Administration, Social Networking, Web Browsing, Real-Time Entertainment, P2P Filesharing. X-axis: Time (12am–11pm). Y-axis: Traffic.
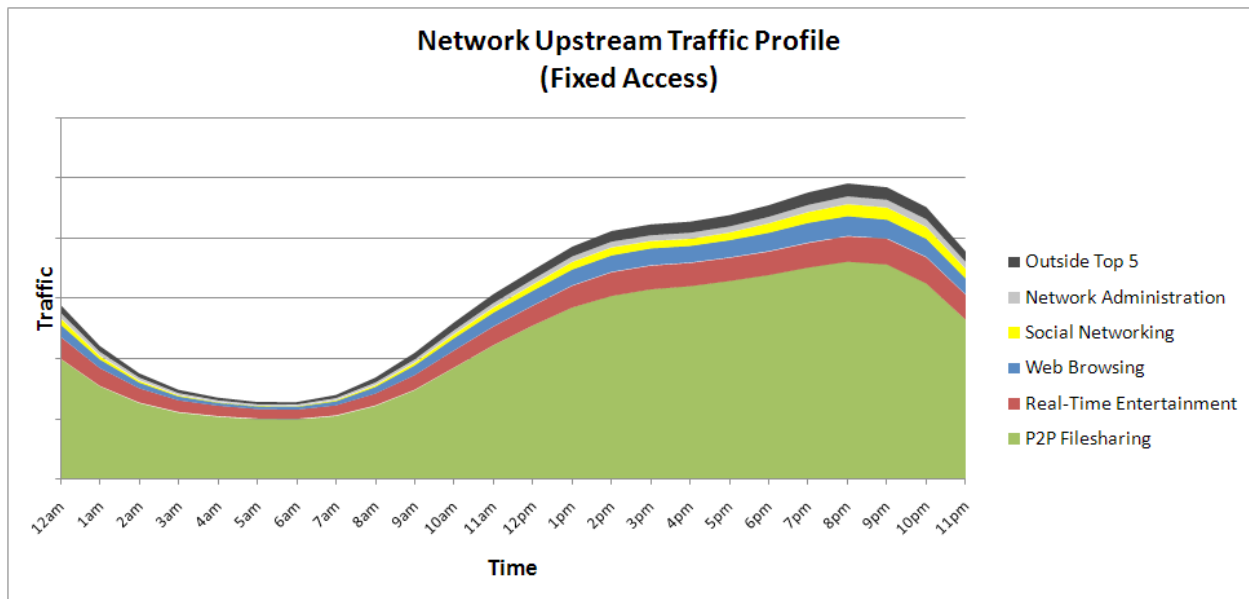
Figure 13 - Latin America - Network Upstream Traffic Profile (Fixed Access)

On mobile access networks, the influence of P2P Filesharing is much less significant (although its mere presence surprises many readers) at 16.9%. Real-Time Entertainment emerges as the major traffic generator, accounting for more than 43.9% of total bytes. Web Browsing is also a large contributor, responsible for 20.7% of upstream traffic on Latin America's mobile networks. As with fixed access, Social Networking takes fourth place, accounting for 7.6% of upstream traffic.

Network Upstream Traffic Profile (Mobile Access)

Legend: Outside Top 5, Software Updates, Social Networking, P2P Filesharing, Web Browsing, Real-Time Entertainment. X-axis: Time (12am–11pm). Y-axis: Traffic.
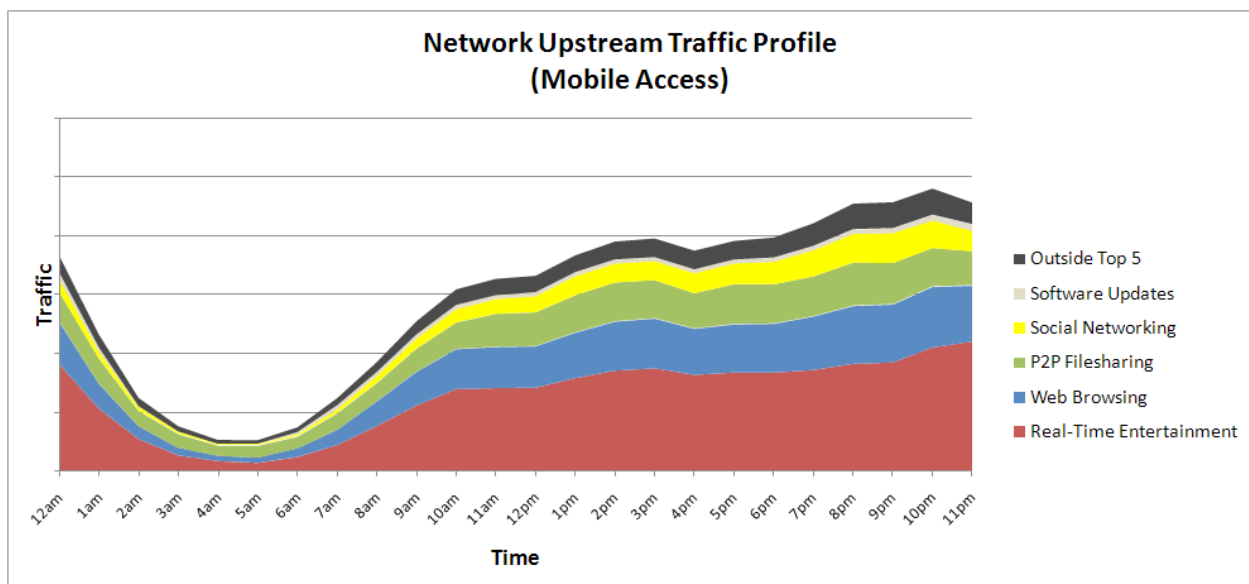
Figure 14 - Latin America - Network Upstream Traffic Profile (Mobile Access)

Do the differences in the traffic profiles between fixed and mobile access networks disprove the theory that a subscriber in Latin America will make much the same use of the network regardless of access technology? Not necessarily. While the disparities in levels of P2P Filesharing are enormous, they're also potentially explained by the network's available capacity. The primary factor limiting or allowing P2P Filesharing is generally the network (P2P clients don't need an active subscriber, they can function in the background), whereas the primary factor influencing levels of Web Browsing, Social Networking, and Real-Time Entertainment is the subscriber's capacity to use such

services (in other words, these applications only get used when the subscriber is engaged). With that in mind, the profiles of the two networks aren't so dissimilar after all – the levels of traffic that reflect subscriber activity are comparable.

Now let's shift our focus to the downstream direction. There are definite similarities between the fixed and mobile profiles, particularly with the three largest categories. With fixed access, Real-Time Entertainment is the largest category with 35.2% of total downstream bytes, not far above the 29.1% of bytes for which it is responsible on mobile networks. Similarly, Web Browsing accounts for 28.3% of downstream traffic in the fixed profile, versus 29.9% in mobile. Even the levels of P2P File-sharing aren't all that disparate: 23.1% in fixed and 18.7% in mobile. These observations definitely support the assertion that subscribers in Latin America treat mobile connections in much the same way as they treat fixed Internet connections.

Once we move beyond the three major contributing categories, we encounter a few differences. In fixed access networks, Social Networking (4.4%) and Storage and Back-Up Services (4.3%) round out the top five. When we look at the mobile access profile, however, we see that the impact of Social Networking is much larger – 10% of daily downstream traffic is attributable to this category, highlighting how subscribers use their mobile devices to stay in the social loop. Perhaps surprisingly, Software Updates occupy fifth place on mobile networks, indicating the presence of laptops (the bulk of the Software Updates category is comprised of updates to PC operating systems). The prevalence of laptops also explains why P2P Filesharing traffic is significant, even on mobile access networks. The 2010 Mobile Internet Phenomena Report explained why even a small penetration of laptops can heavily influence mobile traffic profiles[1].
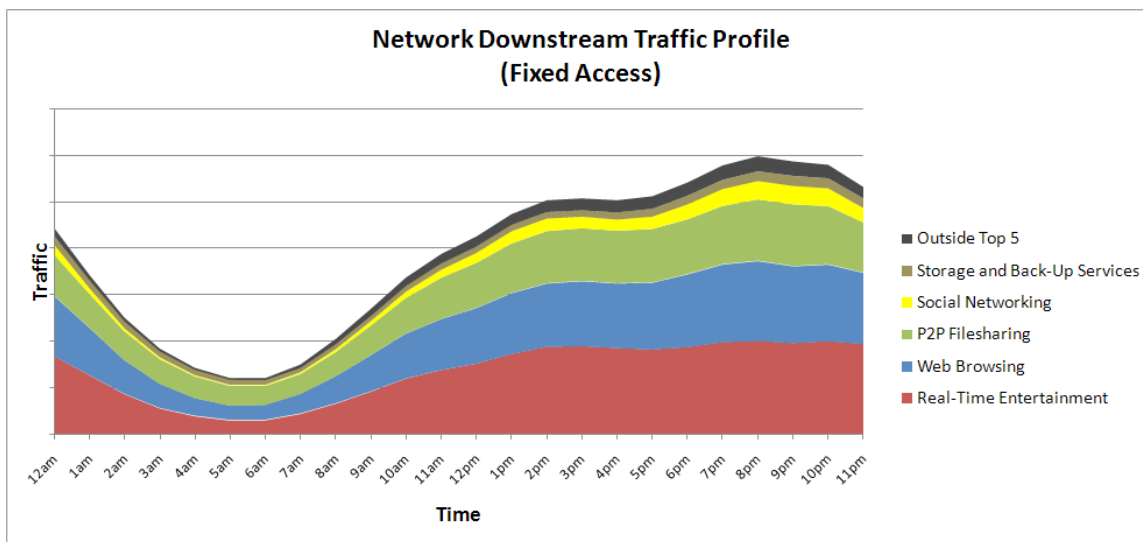

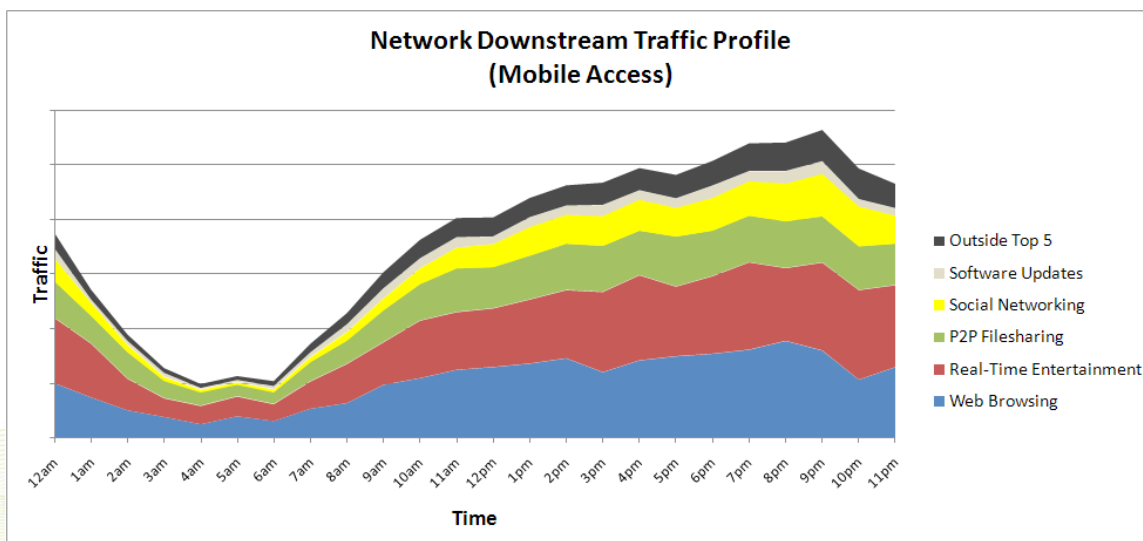Figure 15 - Latin America - Network Downstream Traffic Profile (Fixed Access)

Figure 16 - Latin America - Network Downstream Traffic Profile (Mobile Access)

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1.   In particular, the "Device Influence" section on page 31 of the 2010 Mobile Internet Phenomena Report

Peak Period

Since last year's report, fixed access networks have experienced some subtle, yet significant, shifts in how subscribers make use of the network during the peak evening hours. The percentage of traffic attributable to Real-Time Entertainment and P2P Filesharing has increased (to 26.7% and 36.7%, respectively), largely making up for a decrease in Web Browsing activity. Social Networking makes up almost 6% of the 2010 profile, but this doesn't mean it wasn't as prevalent last year – in the 2009 report, Social Networking was included in the Web Browsing category, so this is likely just a reclassification.

The decrease in Storage and Back-Up Services, however, is very real. It seems that subscribers in Latin America are satisfied with P2P Filesharing and Real-Time Entertainment as sources of content. If these trends continue, we can expect to see even larger portions of P2P Filesharing and Real-Time Entertainment in 2011. Although, it would not be surprising to see P2P Filesharing level off at around 30-35% of traffic while Real-Time Entertainment continues to take share from Web Browsing.
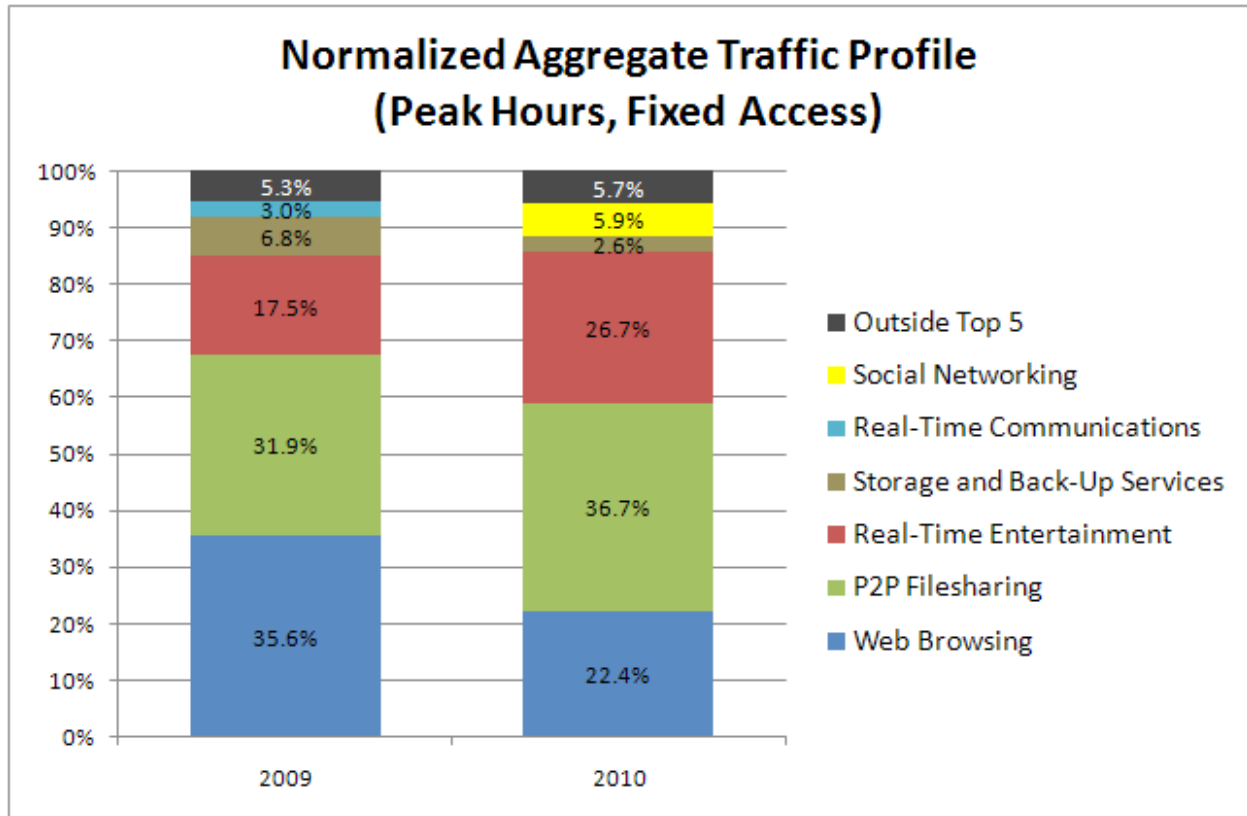
Figure 17 – Latin America - Normalized Aggregate Traffic Profile Comparison (Peak Hours, Fixed Access)

In the 8 months since the 2010 Mobile Internet Phenomena report was issued, we have seen some significant changes in the make-up of peak period mobile traffic in Latin America. While the percent of bytes attributable to Web Browsing has remained fairly constant, Real-Time Entertainment has increased substantially (rising to 34.8%) while P2P Filesharing has decreased (falling to 15.4%). Social Networking has risen to account for 12.1% of total peak period bytes, while Storage and Back-Up Services have all but disappeared.

Did you know?

PPStream and PPLive are examples of streaming applications that use a peer-to-peer architecture to distribute load. In other words, rather than a central source streaming content to many destinations, each destination helps to pass content along in real-time, as it arrives. These are also sometimes referred to as peercasting applications and are distinct from P2P Filesharing applications.
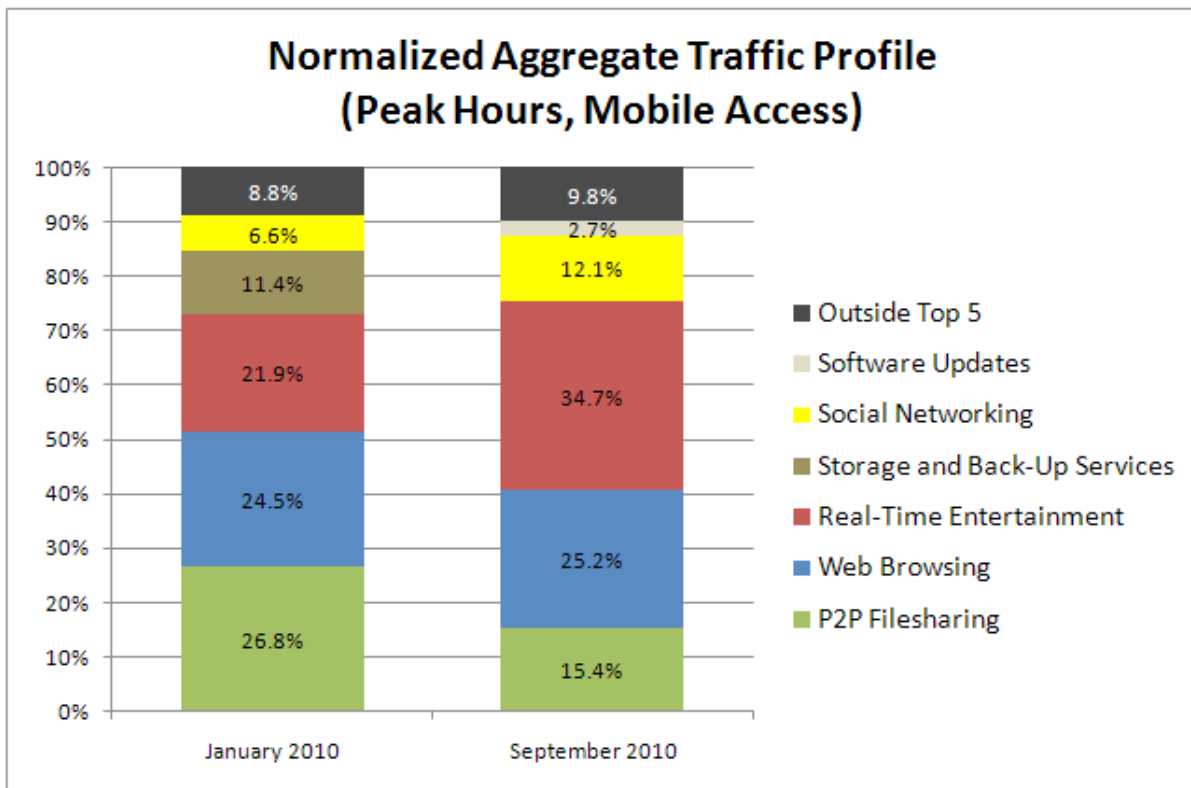
Figure 18 – Latin America - Normalized Aggregate Traffic Profile Comparison (Peak Hours, Mobile Access)

Breaking the categories down further, we observe that during the heaviest hours, fixed networks in Latin America are still very much influenced by P2P Filesharing. While most regions have seen BitTorrent emerge as the unquestioned dominant filesharing client, subscribers in Latin American have chosen Ares as their network of choice. The upstream and downstream lists have seven names in common: Ares, BitTorrent, HTTP, eDonkey, Facebook, PPLive and YouTube.

| Rank | Upstream | | Downstream | |
	Application	Percent of Traffic	Application	Percent of Traffic
1	Ares	54.74 %	HTTP	28.63 %
2	BitTorrent	11.91 %	YouTube	18.23 %
3	HTTP	6.76 %	Ares	12.98 %
4	eDonkey	6.29 %	Flash Video	8.17 %
5	Facebook	4.08 %	BitTorrent	6.80 %
6	PPLive	3.36 %	Facebook	6.47 %
7	YouTube	1.76 %	RapidShare	3.37 %
8	PPStream	1.76 %	PPLive	2.15 %
9	DNS	1.10 %	RTMP	2.00 %
10	SSL	0.97 %	eDonkey	1.82 %
Total		92.73 %		90.62 %

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

Since the 2010 Mobile Internet Phenomena report was issued, a number of applications have fallen off Latin America's top-ten lists. The upstream list has lost BitTorrent and eDonkey, and has welcomed RTMP and Shockwave Flash – demonstrating changing subscriber behavior that is favoring on-demand streaming applications over the traditional P2P Filesharing services. The downstream list no longer features MegaUpload or MySpace, but now includes Hotmail and MSN Messenger.

On the upstream, YouTube accounts for almost a quarter of all bytes – a significant increase over the 2.5% of bytes it accounted for in January – showing that subscribers in Latin America are not shy to upload their experiences to the video sharing service. Ares has fallen from 44.6% of upstream in January to merely 13.6% in this study, which is representative of the shifting subscriber preferences.

Eight names appear on both the upstream and downstream lists: YouTube, HTTP, Ares, Facebook, Flash Video, Hotmail, MSN Messenger and SSL.

| Rank | Upstream | | Downstream | |
---	Application	Percent of Traffic	Application	Percent of Traffic
1	YouTube	24.72 %	HTTP	28.32 %
2	HTTP	21.35 %	YouTube	14.49 %
3	Ares	13.56 %	Ares	13.91 %
4	Facebook	10.51 %	Facebook	13.23 %
5	Flash Video	9.39 %	Flash Video	10.67 %
6	RTMP	2.66 %	Windows Update	3.11 %
7	Shockwave Flash	2.23 %	SSL	1.98 %
8	Hotmail	1.66 %	Hotmail	1.77 %
9	MSN Messenger	1.62 %	MSN Messenger	1.66 %
10	SSL	1.58 %	RapidShare	1.26 %
Total		89.28 %		90.40 %

Table 5 - Latin America - Top Applications by Bytes (Peak Period, Mobile Access)

Finally, let's compare the prime time ratio in Latin America's fixed and mobile networks. In each network type, we see a ratio less than one (0.94 in fixed access and 0.91 in mobile), a potential sign that networks in Latin America are facing congestion issues.

While it's not odd to see P2P Filesharing have a low ratio, it is unexpected that Web Browsing (0.97 ratio in fixed access and 0.89 ratio in mobile) and Real-Time Entertainment (0.92 and 0.89) are decreasing. Usually, these two categories are significantly above 1.0. It should be noted that Real-Time Communications and Social Networking have high ratios on both access types, but these categories generally account for only a relatively small percentage of traffic. Unless the low ratios for Web Browsing and Real-Time Entertainment are due to some cultural factor, it is difficult to make any other conclusion than networks in Latin America are experiencing significant congestion during peak hours.

The Stats for Latin America

0.94: the prime time ratio for fixed access networks in Latin America

0.91: the prime time ratio for mobile access

These ratios indicate the possibility of significant congestion.

Did you know?

Sandvine's Network Analytics includes the Prime Time Ratio as a default metric calculated for each network, category and individual application.
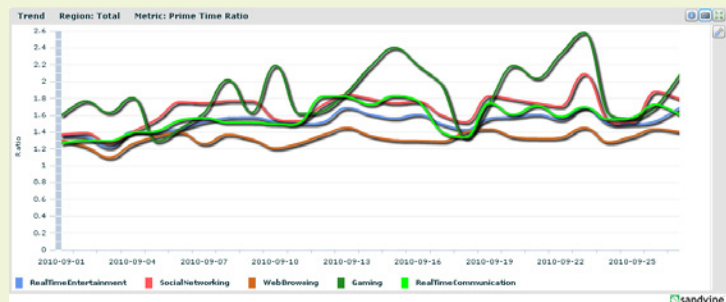
Network Analytics graph showing the prime time ratio for different application categories
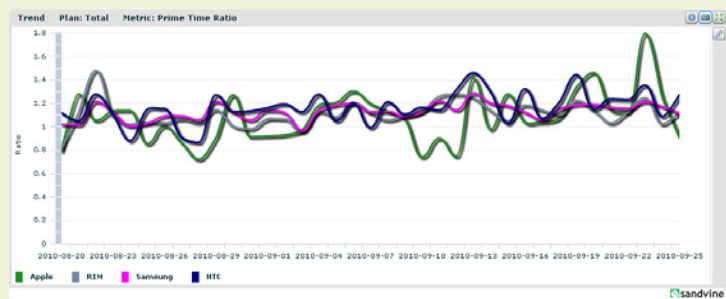
Network Analytics graph showing the prime time ratio for mobile handsets from different manufacturers
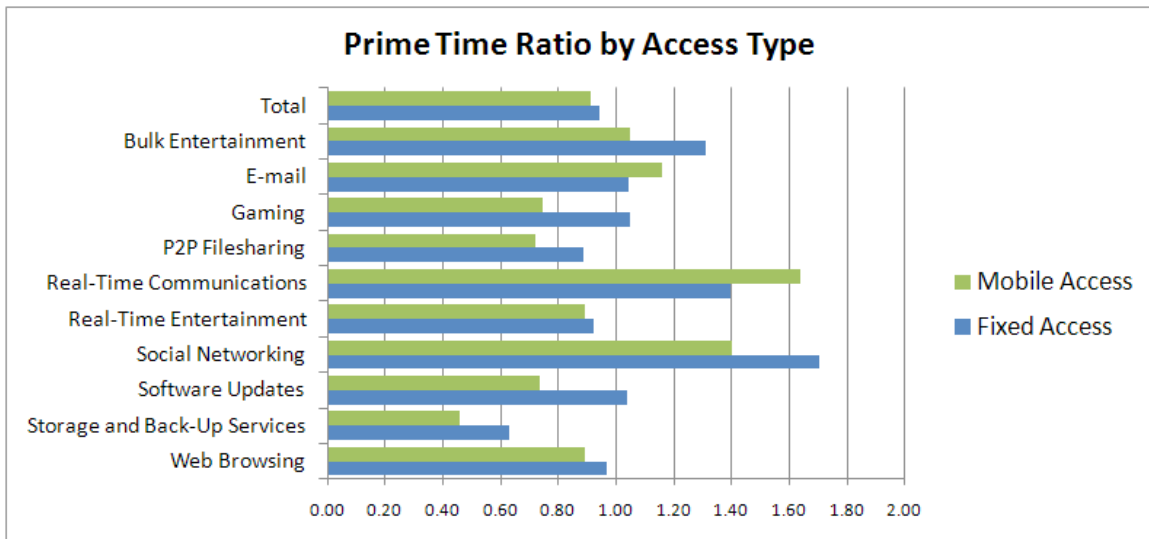
Figure 19 – Latin America - Prime Time Ratios (Fixed and Mobile Access)

Spotlight On: Handsets and Devices

In the 2010 Mobile Internet Phenomena Report, we highlighted the importance of understanding the mix of devices operating on mobile networks stating that, "The devices that subscribers use to connect to the network exert a huge influence on the levels and make-up of traffic", particularly highlighting the impact of laptops on mobile networks.

With the introduction of our Network Analytics product, we're helping service providers worldwide to understand the characteristics of each device on the network. Detailed metrics are available to show how usage varies by specific device model or manufacturer. This information can be linked to service plans to paint a very vivid picture of how many factors combine to influence network usage. Of course, if a service provider just wants to see the number of active handsets of a particular type, then that's possible too.
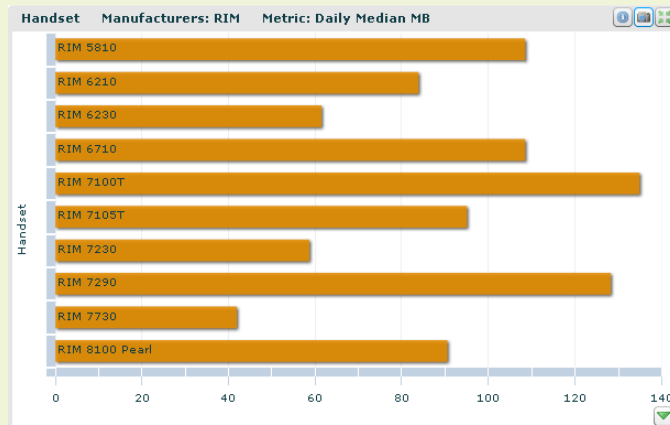
Network Analytics bar chart showing daily median consumption for different Blackberry models.
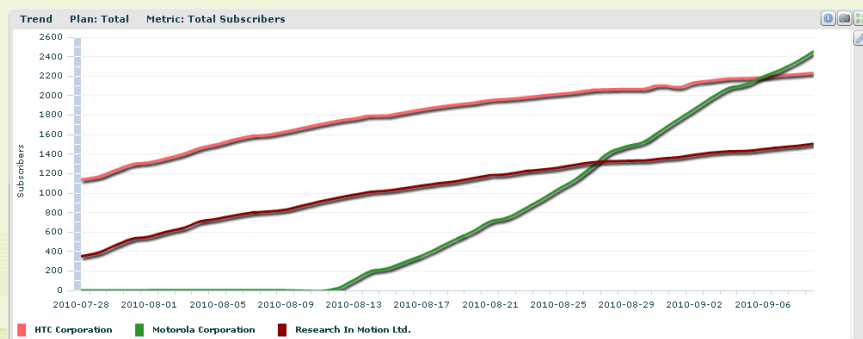
Network Analytics graph showing that Motorola handsets have rapidly overtaken RIM and HTC devices on this mobile network, despite being introduced later. Will the Samsung devices prove as popular?

Asia-Pacific

As a region for analysis, Asia-Pacific offers interesting perspective. When projecting the future, the rest of the globe often points to South Korea and Japan as examples of mature Internet markets characterized by high penetration, fibre-optic access, and advanced handsets. However, much of the Asia-Pacific region is still emerging: India, China and Indonesia are projected to contribute 2.8 billion additional mobile connections by 2015[1].

The analysis below is based entirely on fixed access technologies and is heavily influenced by the mature markets, by virtue of their high numbers of subscribers. It includes data from service providers operating in countries at various stages of growth. The following conclusions and observations can be drawn:

- Real-Time Entertainment has grown to be the dominant application category in Asia-Pacific, particularly during the evening hours, and exerts significant influence on the upstream due to the success of the peercasting applications PPStream and PPLive
- Median monthly data consumption on fixed access networks in Asia-Pacific is roughly 12 gigabytes, and the average fixed broadband connection in Asia-Pacific is active for almost 5.5 hours per day
- P2P Filesharing remains a major component of traffic and exhibits remarkably consistent upstream levels throughout the day – over a 24 hour period, P2P Filesharing traffic accounts for 37.4% of all bytes carried
- BitTorrent is, by far, the dominant P2P Filesharing application, representing almost 38% of upstream bytes during peak period and nearly 17% of downstream bytes

Average Day

Networks in Asia-Pacific experience "wake up" around 5am, as the number of active subscribers and the level of network traffic begin a steady climb before peaking in the mid-evening, between 8pm and 9pm. These peaks are earlier than the late-evening peaks reported in 2009, showing shifting subscriber behavior. The number of active subscribers drops off after 8pm, and there is a lag of 2-3 hours before the traffic levels start to decline significantly. This behavior is similar to that observed in 2009, with the main difference being that overnight traffic levels in 2010 bottomed out around 50% of peak, versus the trough of around 30% shown in 2009.
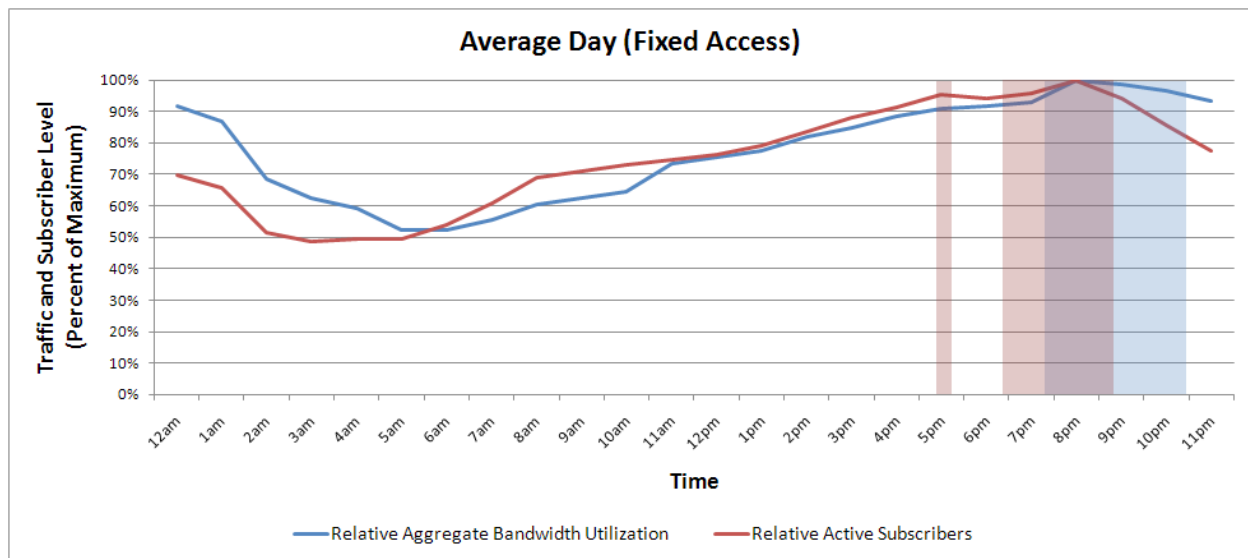

Figure 20 - Asia-Pacific - Average Day (Fixed Access)

1.   Hartley, Steven, and Ovum. "Global Mobile Market to Be worth $1tr by 2015 | Telecom Asia." News and Analysis for Asia's Telecom Operators | Telecom Asia. 13 Sept. 2010. Web. <http://www.telecomasia.net/content/global-mobile-market-be-worth-1tr-2015>

Upstream traffic in Asia-Pacific exhibits a remarkably consistent absolute amount of P2P Filesharing traffic, which is the dominant category in this traffic direction. Real-Time Entertainment is also significant on the upstream, no doubt due to the peercasting load-sharing architectures favored by many of the most popular streaming applications.
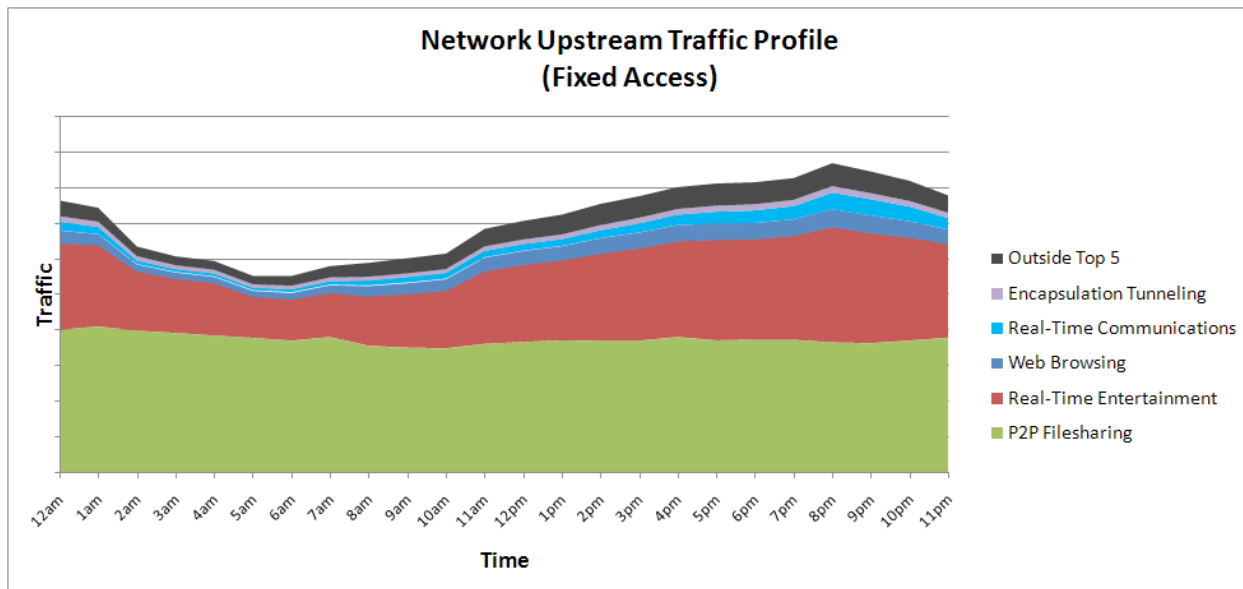
Figure 21 - Asia-Pacific - Network Upstream Traffic Profile (Fixed Access)

The influence of P2P Filesharing is much less significant in the downstream, where Real-Time Entertainment is unquestionably the dominant application category. Web Browsing emerges throughout the day to be the second-largest category during the evening hours, and the influence of Storage and Back-Up Services is apparent.
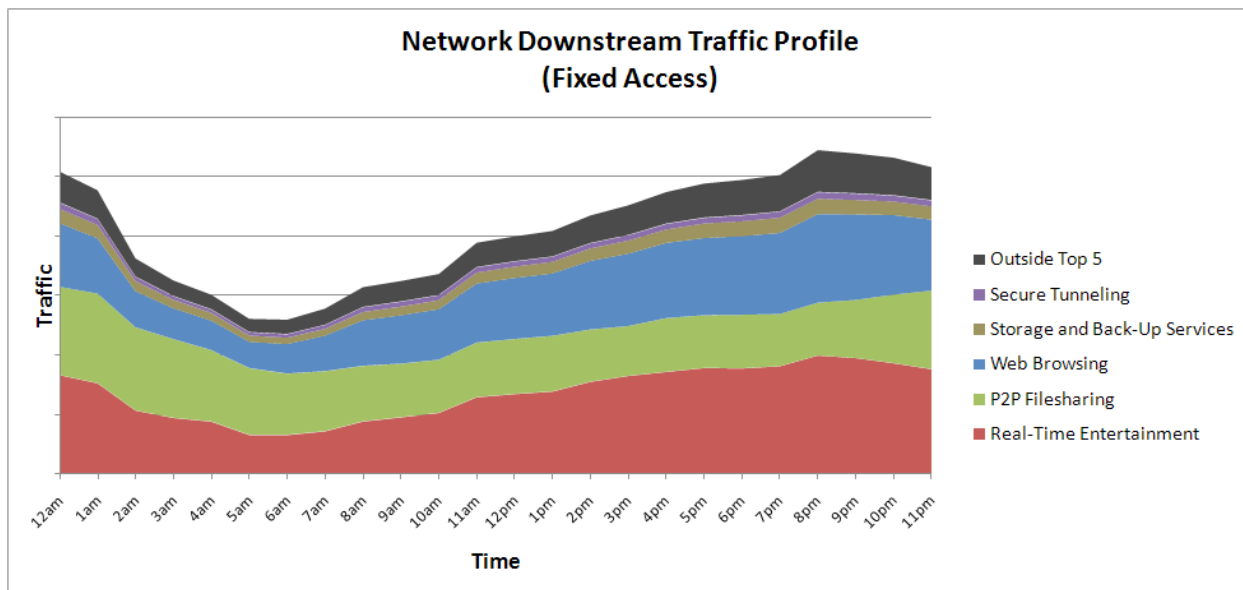
Figure 22 - Asia-Pacific - Network Downstream Traffic Profile (Fixed Access)

Peak Period

Comparing the peak hours traffic composition from 2009 to 2010 reveals some interesting and almost contradictory changes. First, it is clear that Real-Time Entertainment is being heavily adopted by subscribers (up to 36.0% from barely 25.0% a year ago), while the impact of Web Browsing has lessened considerably (dropping from more than 40.0% to 20.7%). This shift suggests that subscribers are increasingly turning to on-demand entertainment options. It may come as a surprise then, that the proportion of P2P Filesharing traffic has increased significantly from 2009 to 2010, up to 25.7%, as this observation would seem to contradict the previous statement. However, when the traffic from P2P Filesharing is combined with that of Storage and Back-Up Services (which, it can be argued, address the same subscriber use-cases), we see that the overall proportion of traffic from these two categories is almost unchanged. For whatever reason, subscribers in Asia-Pacific seem to be favouring P2P Filesharing over Storage and Back-Up Services, while at the same time increasingly turning to Real-Time Entertainment as a source of content.

It is also worth noting that the percentage of traffic attributable to categories outside of the Top 5 has increased, revealing a diversification in subscriber habits that wasn't seen last year.
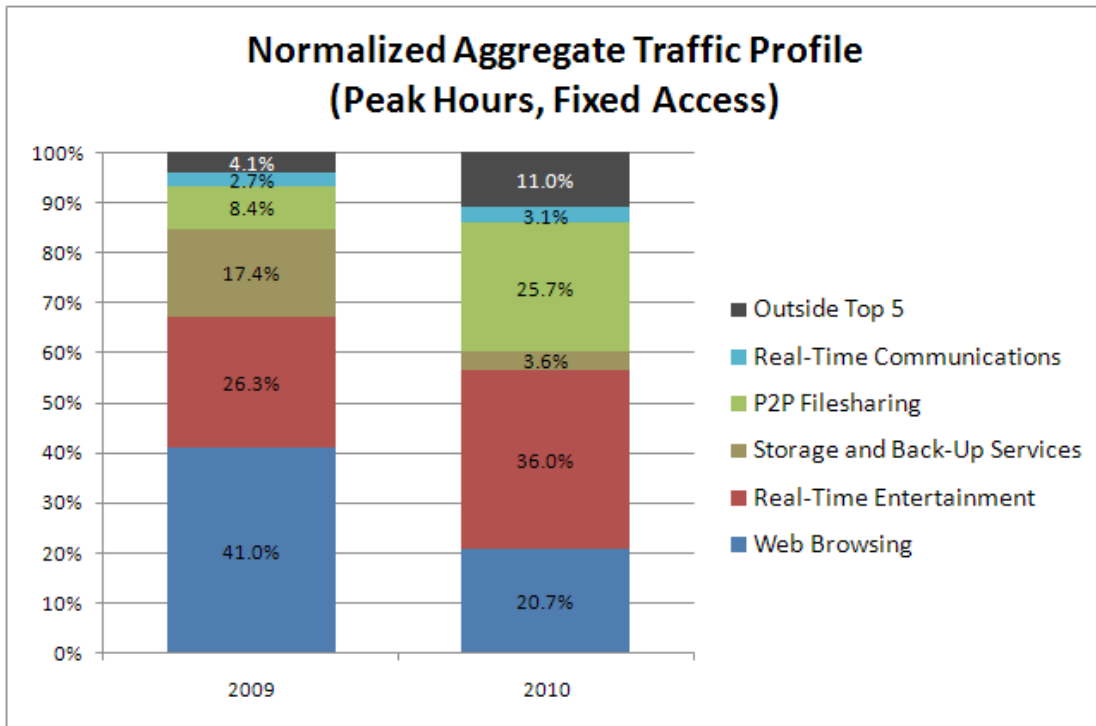
Figure 23 - Asia-Pacific - Normalized Aggregate Traffic Profile Comparison (Peak Hours, Fixed Access)

What contributes to the dominance of particular categories? Table 6 lists the top services, protocols, and applications in the upstream and downstream, and shows the percentage of traffic attributable to each.

Upstream traffic in Asia-Pacific is largely composed of three applications: BitTorrent, PPStream, and PPLive. In fact, these three applications alone represent two-thirds of total upstream traffic. The presence of PPStream and PPLive explain why the Real-Time Entertainment category was so prominent in the upstream, when it's generally thought of as a particularly downstream-dominated category.

In the downstream direction, BitTorrent is still a significant portion of traffic (roughly one-sixth), but HTTP is the larger player, representing more than 27% of total bytes. Flash Video comprises 11%, and the downstream components of PPLive and PPStream round out the top 5. It's interesting to note that while PPLive and PPStream have roughly equivalent levels on the downstream, PPStream's upstream is significantly higher than that of PPLive's.

The following applications cracked the top ten list in both traffic directions: BitTorrent, PPStream, PPLive, HTTP, Facebook and Flash Video.

	Upstream		Downstream	
Rank	Application	Percent of Traffic	Application	Percent of Traffic
1	BitTorrent	37.63 %	HTTP	27.25 %
2	PPStream	18.83 %	BitTorrent	16.91 %
3	PPLive	11.06 %	Flash Video	11.04 %
4	HTTP	5.92 %	PPLive	7.90 %
5	Skype	3.99 %	PPStream	7.14 %
6	Thunder	2.80 %	iTunes	2.88 %
7	eDonkey	2.39 %	Facebook	2.23 %
8	Facebook	1.50 %	YouTube	2.17 %
9	Teredo	1.40 %	MegaUpload	2.05 %
10	Flash Video	1.39 %	RTMP	2.02 %
Total		86.91 %		81.59 %

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

The prime time ratio in Asia-Pacific is 0.97, indicating that subscribers who are active during the network's peak hours have a slightly smaller share of traffic than those who are active during off-peak hours. However, the roughly equivalent per-subscriber bandwidth is not the complete story – it is very instructive to see how subscribers actually make use of that available bandwidth.

P2P Filesharing experiences a significant relative drop during the network's busiest hours, decreasing to about two-thirds of its off-peak levels. This decrease might be the result of management policies on the network, or it might be the result of the P2P clients themselves detecting less capacity in the network and reigning themselves in. Whatever the actual cause, the decrease in P2P Filesharing makes a significant amount of bandwidth available for other applications, and they take great advantage. Real-Time Communications is the biggest winner, with a ratio of 1.72. While significant, the over-all amount of Real-Time Communications on the network remains relatively small. Bulk Entertainment (predominantly iTunes) and Social Networking (largely Facebook) both have ratios of about 1.55, but once again both aren't huge bandwidth users. Gaming, Web Browsing and Real-Time Entertainment all have ratios significantly above 1, and the latter two categories are responsible for more than 55% of total peak period traffic.

A unifying characteristic of each of the categories with a high prime time ratio (although arguably less significant for Bulk Entertainment) is that these categories are interactive, supporting the assertion first made several years ago that subscriber activity during the network's heaviest periods is driven by the need to interact and be entertained.
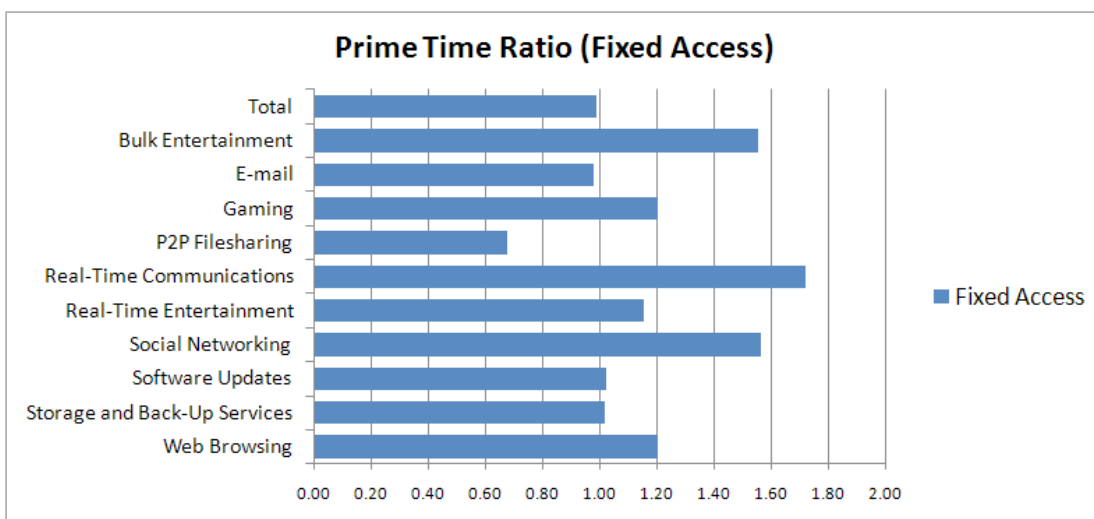
Figure 24 - Asia-Pacific - Prime Time Ratios (Fixed Access)

Subscriber Analysis

In Asia-Pacific, the top 1% of subscribers who make the heaviest use of the network are responsible for almost 18% of total monthly network traffic. In the upstream direction, their influence is even more pronounced, with the top 1% generating more than 25% of upstream traffic.
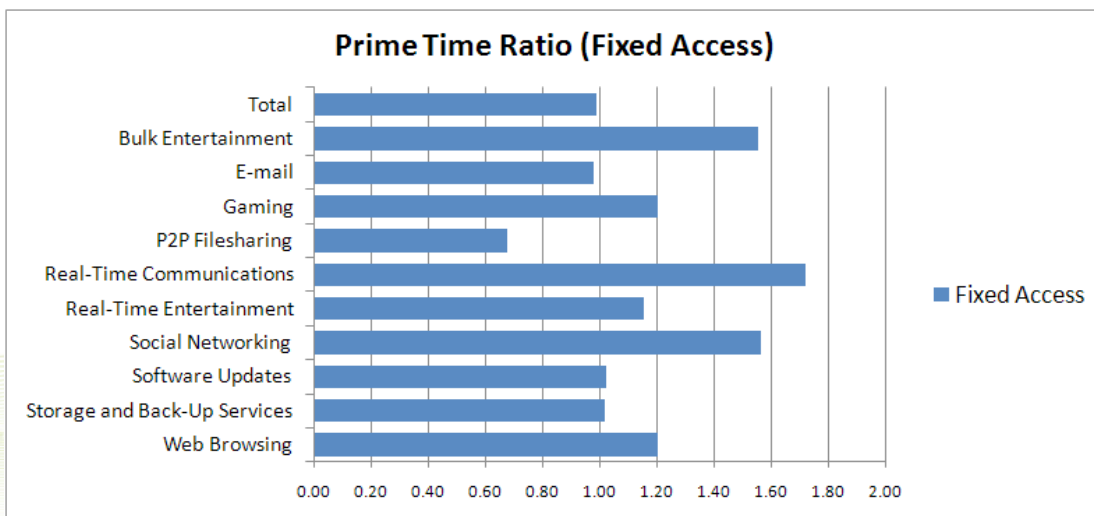

Figure 25 - Asia-Pacific - Percentile Byte Contribution (Monthly, Fixed Access)

As shown in previous studies, as the window of analysis is shortened from one month to one week to one day, the influence of heavier users increases. This influence is seen in Table 7 below, where the numbers increase as examination moves from right to left to shrink the period from month to week to day.

Subscriber Percentile	Day			Week			Month		
	Upstream	Downstream	Aggregate	Upstream	Downstream	Aggregate	Upstream	Downstream	Aggregate
1	29.88 %	22.47 %	21.78 %	25.75 %	18.11 %	18.22 %	25.03 %	17.13 %	17.66 %
2	42.04 %	31.12 %	30.98 %	36.31 %	25.42 %	26.13 %	35.08 %	24.04 %	25.14 %
5	62.95 %	46.96 %	48.15 %	55.60 %	39.80 %	41.68 %	53.60 %	37.79 %	40.04 %
10	79.72 %	61.92 %	64.17 %	72.93 %	54.64 %	57.47 %	70.64 %	52.36 %	55.48 %
20	92.54 %	78.12 %	80.43 %	88.65 %	72.11 %	75.22 %	86.87 %	70.13 %	73.45 %
30	96.56 %	87.03 %	88.72 %	94.73 %	82.47 %	85.00 %	93.71 %	81.01 %	83.74 %
40	98.16 %	92.48 %	93.55 %	97.29 %	89.15 %	90.95 %	96.77 %	88.17 %	90.14 %
50	98.99 %	95.88 %	96.49 %	98.54 %	93.57 %	94.73 %	98.29 %	92.96 %	94.24 %
60	99.48 %	97.95 %	98.26 %	99.24 %	96.48 %	97.14 %	99.12 %	96.13 %	96.87 %
70	99.76 %	99.14 %	99.27 %	99.64 %	98.32 %	98.64 %	99.60 %	98.14 %	98.52 %
80	99.92 %	99.74 %	99.78 %	99.87 %	99.40 %	99.51 %	99.86 %	99.32 %	99.46 %
90	99.99 %	99.97 %	99.98 %	99.98 %	99.90 %	99.92 %	99.98 %	99.89 %	99.91 %
100	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %

Table 7 – Asia-Pacific - Cumulative Usage by Subscriber Percentile (Fixed Access)

The networks examined in this study produced a per-subscriber median monthly aggregate usage of almost 12 gigabytes, and a mean of more than 35 gigabytes. Astonishingly, the average Internet connection in Asia-Pacific is active for more than 164 hours per month, or roughly 5.5 hours per day!

Spotlight On: Reasonable Network Management

Sandvine believes that in today's regulator conditions and environment of public opinion, there are five criteria that must be met by an effective traffic management solution:

1. Narrowly-tailored: operate only where and when it is needed

2. Proportional and reasonable: the impact to a user or an application must be in-line with the impact the user or application is having on the network, and the impact must be reasonable to achieve the goal

3. Legitimate and demonstrable technical need: operate to achieve the targeted goals of congestion management and improved subscriber quality of experience

4. Transparent: disclose in a simple and predictable manner so that the consumer can understand how the network will operate under a variety of conditions

5. Auditable: able to demonstrate, on-demand, that conditions one through four were met

For more information on these principles and how they relate to the Network Neutrality discussion, please see "Facing Network Neutrality Head On"[1].

The Stats for Asia-Pacific

11 964 megabytes monthly aggregate median usage

35 234 megabytes monthly aggregate mean usage

164 hours average monthly Internet activity

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1.   Located at: http://www.betterbroadbandblog.com/2010/08/facing-network-neutrality-head-on/

Europe

Like Asia-Pacific, Europe contains an interesting mix of networks covering countries at different stages of broadband adoption. A related characteristic is that Europe can be broken into regions where mobile Internet is seen as a replacement for fixed access and regions where a mobile connection augments a fixed connection.

Total mobile broadband subscribers in the major European markets are projected to be almost double those in 2009, rising to over 43 million in 2011[1].

The analysis below examines fixed access networks (a 2010 view of mobile networks in Europe is available in our 2010 Mobile Internet Phenomena Report). The analysis herein leads to the following conclusions:

Web Browsing accounts for more byte usage than any other category, almost 45% of aggregate bytes during the peak evening hours

BitTorrent is the dominant P2P Filesharing protocol, representing almost 30% of upstream peak period traffic and slightly more than 8% of downstream peak period traffic

zSHARE has displaced MegaUpload and Rapidshare as the favored Storage and Back-Up Service in Europe and now accounts for 3.2% of downstream traffic during the peak period, showing that dominance on the Internet can be fleeting

Average Day

The average day for a European network in 2010 is very similar to that observed in 2009. The subscriber curve leads the traffic curve, with both curves rising to a peak in the 7pm to 8pm range. The curves then both drop fairly steeply until the early morning hours when the minimum is reached. Perhaps the most significant difference between the 2009 chart and the 2010 chart is that the overnight bandwidth levels reach a lower minimum, bottoming out at about 16% of peak in 2010, versus more than 30% in 2009.
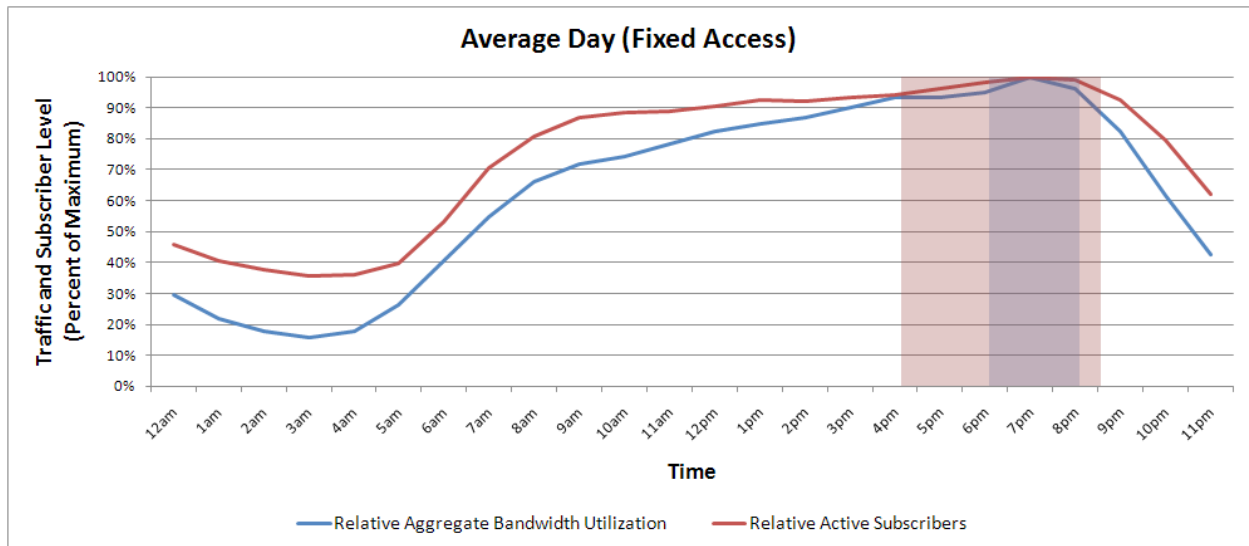
Figure 26 - Europe - Average Day (Fixed Access)

Did you know?

Sandvine Network Analytics includes "Average Day" graphs based on the ones included in our Internet Phenomena reports – our customers loved seeing them in these studies and now they can see them for their own networks!
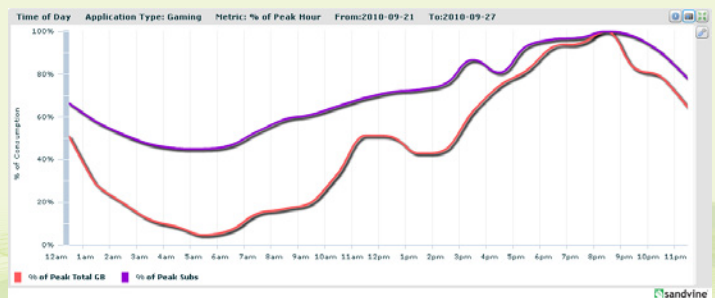
Network Analytics graph showing how the Gaming category varies through the day

1.   "Broadband Wireless News." Converge! Network Digest. 12 Aug. 2010. Web. <http://www.convergedigest.com/Bandwidth/newnetworksarticle.asp?ID=31173>.

Upstream traffic in Europe is shared between three major application categories: P2P Filesharing, Web Browsing, and Real-Time Entertainment. Upstream traffic drops off rapidly after peaking at 7pm, with the decrease driven mainly by steep declines in Web Browsing, Real-Time Entertainment and Real-Time Communications. The influence of P2P Filesharing can be felt all day long, and it actually increases during the late afternoon and early evening as more peers come online and request content.
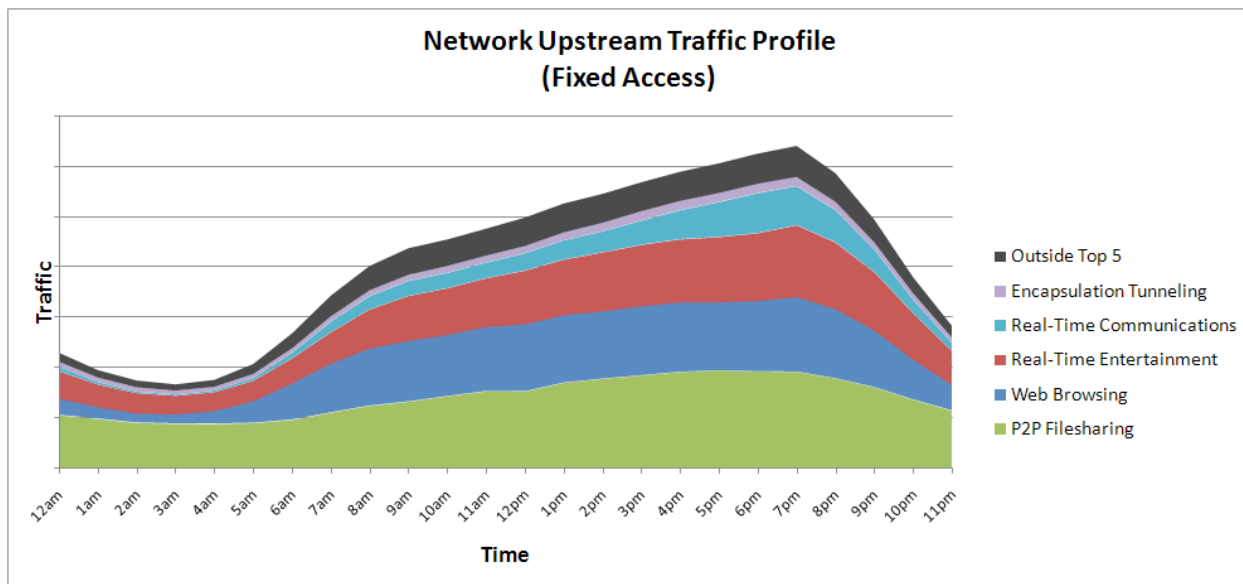
Figure 27 - Europe - Network Upstream Traffic Profile (Fixed Access)

In the downstream direction, Web Browsing and Real-Time Entertainment dominate; third place (P2P Filesharing) isn't even close. The peak period bump caused by a mini surge in Real-Time Entertainment traffic is apparent between 6pm and 9pm, while Web Browsing experiences a bump of similar duration but smaller magnitude. Like upstream traffic, downstream traffic drops off very quickly after attaining its peak, and reaches its minimum value at 3am.
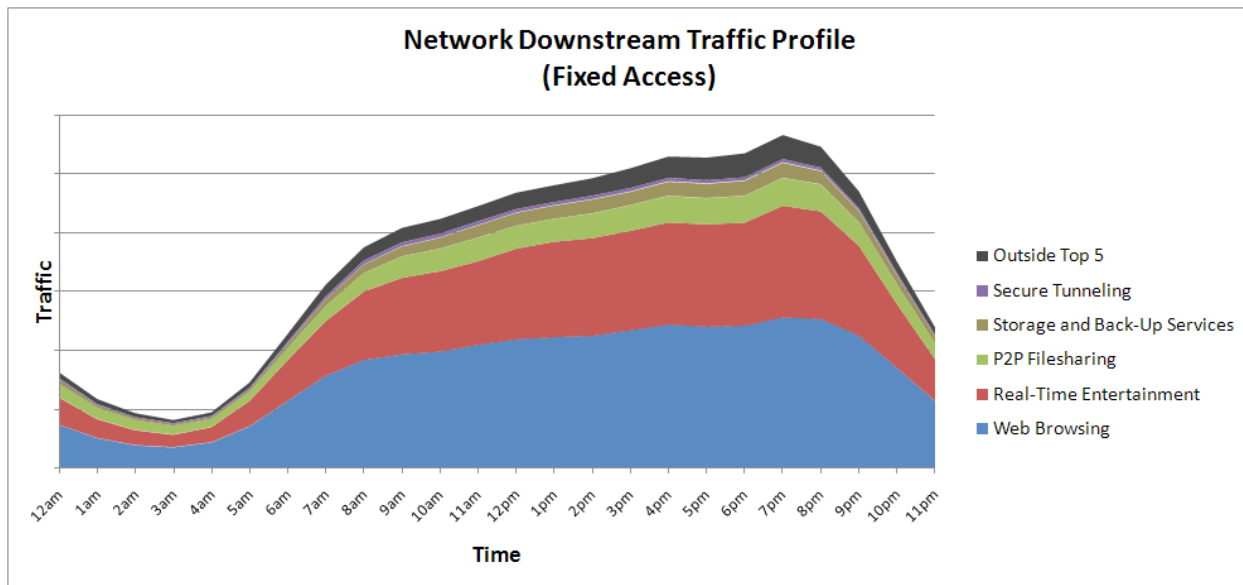
Figure 28 - Europe - Network Downstream Traffic Profile (Fixed Access)

Peak Period

Comparing peak period composition in 2010 to that observed in 2009 reveals some interesting, although curious, developments. The percentage of traffic attributable to Real-Time Entertainment has remained relatively unchanged, increasing only very slightly to 32% in 2010. The share of P2P Filesharing has decreased substantially, falling to 11% this year. On the other end of the spectrum, Web Browsing traffic jumped massively, and now accounts for almost 45% of total bytes in Europe, while Storage and Back-Up Services broke into the top 5 list with just less than 4%.

By contrast, in the 2010 Mobile Internet Phenomena Report, we reported that Web Browsing traffic accounted for 32.6% of peak period bytes, and Real-Time Entertainment was responsible for 31.0%. Interestingly, this comparison suggests that subscribers have a similar taste for Real-Time Entertainment regardless of access medium, but when it comes to Web Browsing they favor fixed access networks.
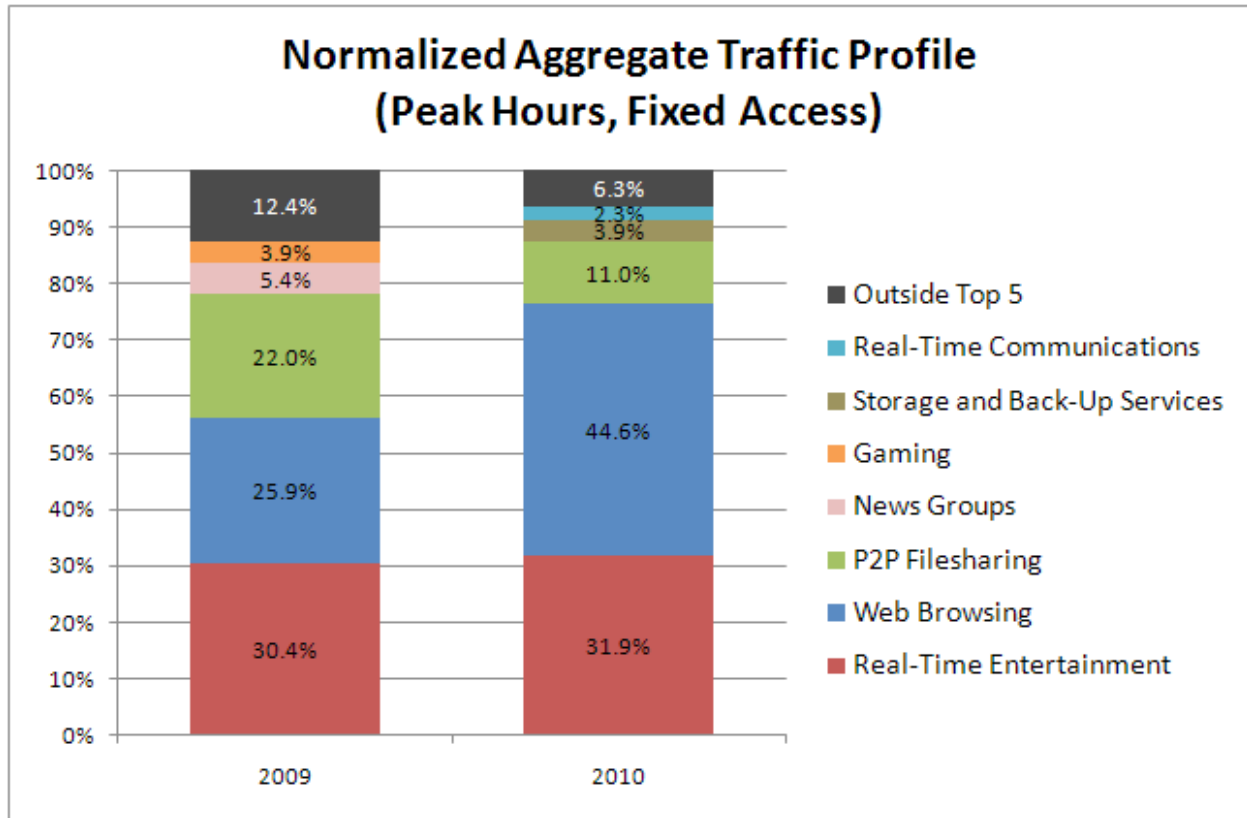
Figure 29 - Europe - Normalized Aggregate Traffic Profile Comparison (Peak Hours, Fixed Access)

If we look a little more deeply at the traffic, we can see which applications and services are driving data usage. In the upstream direction, BitTorrent is dominant, while HTTP is significant. PPLive and Skype round out the top four, and the presence of each in this tier is interesting. In Asia-Pacific, PPLive and PPStream had significant contributions to upstream traffic, but PPStream was significantly higher. In Europe, the situation is reversed: PPLive is about four times higher than PPStream. Skype, while known to be popular in Europe (it accounted for more than 5% of mobile upstream traffic), typically isn't thought of as being particularly bandwidth intensive, so its contribution of more than 9% comes as a bit of a surprise. A possible explanation is that upstream traffic in Europe is relatively lower per-subscriber, so the relative influence of Skype is higher.

The downstream direction belongs to HTTP, with more than 47% of total bytes, although YouTube and miscellaneous Flash Video account for almost 20% combined. BitTorrent is slightly more than 8%, highlighting the relative lack of influence from P2P Filesharing. zSHARE, a file hosting service, accounts for more than 3% of downstream bytes in Europe, perhaps signalling a shift away from the traditional storage powerhouses like Rapidshare and MegaUpload.

The following applications cracked the top ten list in both traffic directions: BitTorrent, HTTP, PPLive, Skype, YouTube, Facebook and Flash Video.

Rank	Upstream		Downstream	
	Application	Percent of Traffic	Application	Percent of Traffic
1	BitTorrent	29.97 %	HTTP	47.07 %
2	HTTP	23.07 %	YouTube	10.39 %
3	PPLive	11.76 %	Flash Video	9.24 %
4	Skype	9.06 %	BitTorrent	8.29 %
5	YouTube	3.30 %	PPLive	4.41 %
6	Teredo	2.84 %	Windows Media	3.28 %
7	Facebook	2.53 %	zSHARE	3.18 %
8	Flash Video	2.45 %	RTMP	2.94 %
9	PPStream	2.42 %	Skype	1.38 %
10	SSL	1.74 %	Facebook	1.25 %
Total		89.14 %		91.43 %

Table 8 - Europe - Top Applications by Bytes (Peak Period, Fixed Access)

The prime time ratio for Europe is 1.17, signalling subscribers are more active in terms of data usage during the peak evening hours. This ratio indicates that service providers in Europe are doing a good job of ensuring networks have the necessary capacity to deliver services. As we observed in Asia-Pacific, the categories with the highest ratios are associated with interaction and entertainment. Real-Time Communications tops the list at 1.7, with Bulk Entertainment (1.47) and Gaming (1.43) also experiencing very high evening increases. With ratios above 1.24, Social Networking and Real-Time Entertainment round out the top five categories. Only three categories experienced decreases: P2P Filesharing (0.99), E-mail (0.82), and Software Updates (0.64).

The Stats for Europe

1.17: total prime time ratio

1.7: prime time ratio for Real-Time Communications, the highest of any category in Europe

3.18: percent of total peak period downstream bytes attributable to zSHARE, marking the first time the service has cracked a top-ten list in a Sandvine Internet Phenomena Report
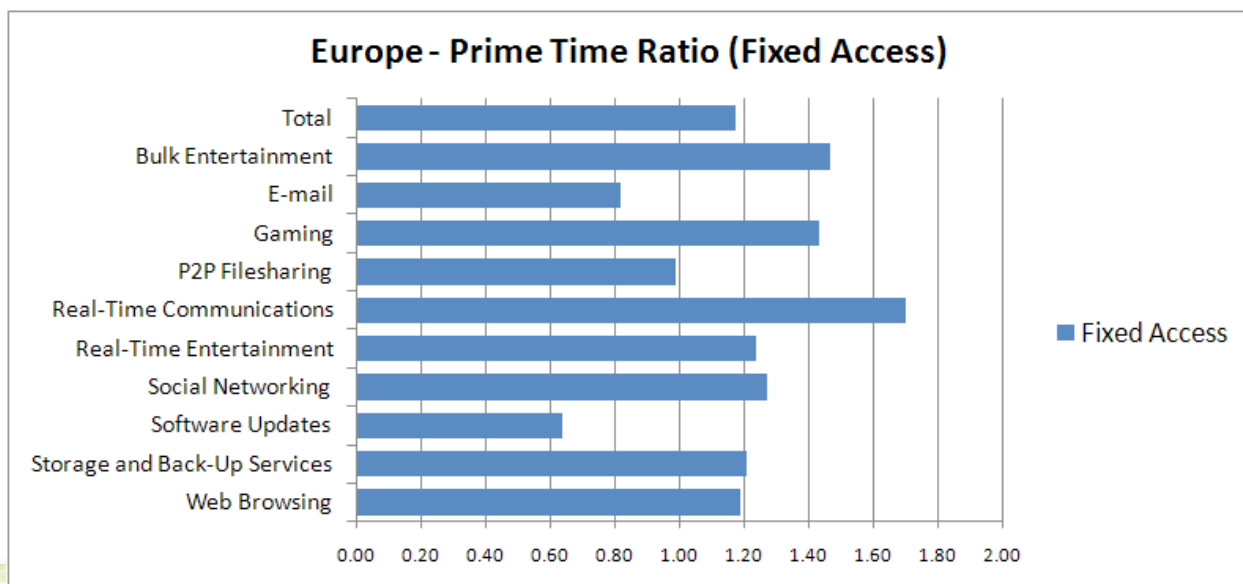

Figure 30 - Europe - Prime Time Ratios (Fixed Access)

Study Details

Sandvine's Fall 2010 Global Internet Phenomena study examines a representative cross-section of the world's leading fixed and mobile data providers and is 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.
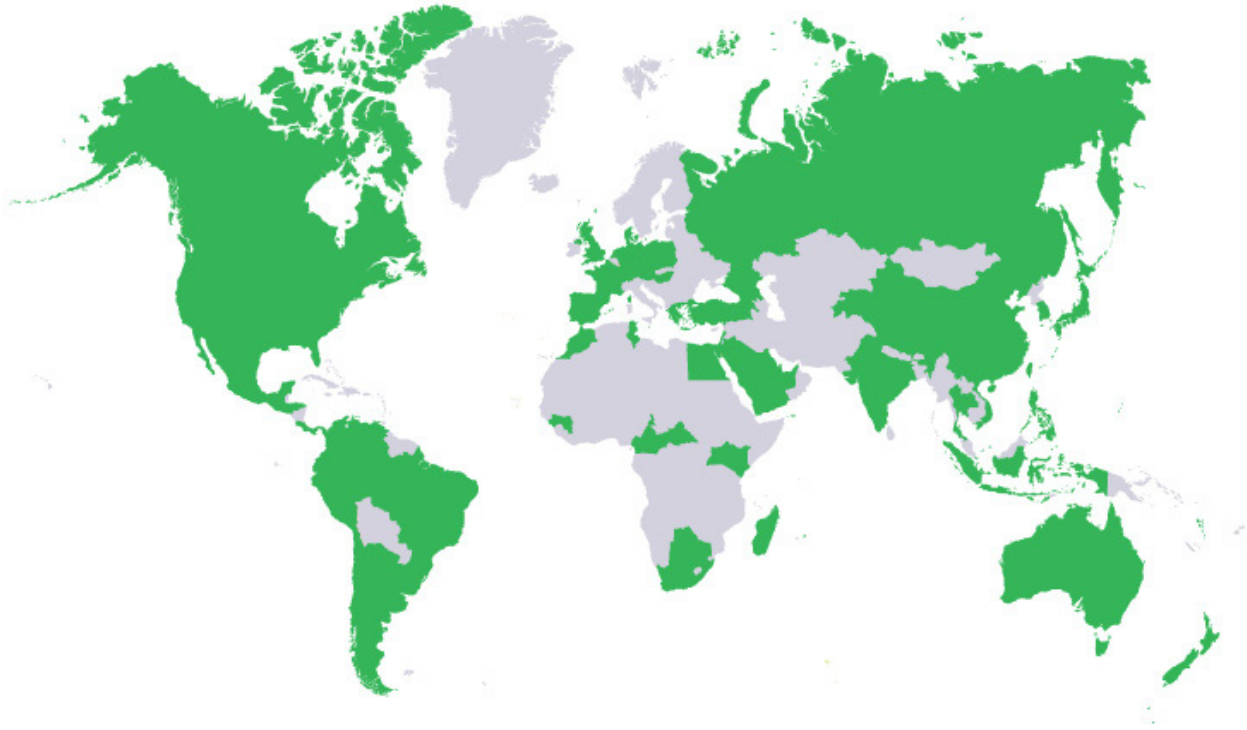
The data gathered in Sandvine's Internet report is completely subscriber-anonymous. No information regarding specific content or subscriber identity (including IP or MAC addresses) was collected during this study

The study itself examined data from four regions:

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

This study reflects the traffic profiles of real service providers, including the impact of any network management policies that may be in place.

The data collected included the bits per second per protocol and the number of active hosts per protocol on the network at each hour. Data also included 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 data sets 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.

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 many parts of the study 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.

Explanation of Categories

The table below describes each of the categories used in the Fall 2010 Internet Phenomena study. There are no differences between the categorization for this study and the categorization used in 2010 Mobile Internet Phenomena report.

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	iTunes, 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)
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
Real-Time Communications	Applications and protocols that allow interactive chat, voice, and video communications	Skype, MSN Messenger, ICQ, SIP, MGCP, AOL Instant Messenger (AIM), IRC, Oovoo, Jabber, Gadu-Gadu
Real-Time Entertainment	Applications and protocols that allow "on-demand" entertainment that is consumed (viewed or heard) as it arrives	Streamed or buffered audio and video (RTSP, RTP, RTMP, Flash), peercasting (PPStream, Octoshape), placeshifting (Slingbox, home media servers)
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
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
Web Browsing	Web protocols and specific websites	HTTP, WAP browsing

Glossary

3G (3rd Generation): A family of standards for mobile telecommunications which includes GSM EDGE, UMTS, CDMA200, DECT and WiMAX.

ARPU (Average Revenue Per User): The total revenue divided by the number of subscribers, to measure the revenue created by one customer per unit of time.

Backhaul: The portion of a telecommunications network that links the core network to the subscriber/service edge.

CapEx (Capital Expenditure): An expenditure to create future benefit, usually to purchase a fixed asset or to add to the value of an existing asset.

Congestion: Defined on a per-application category basis as the variability in delay or packet loss beyond what the application can withstand without the user noticing.

Congestion is a function of the buffering in networking equipment. When there is contention for an output link (i.e. instantaneously more packets want to be transmitted than there is capacity for), the buffer starts to fill. This buffering increases and adds variability to latency, and thus can create quality problems for interactive applications. As the buffers increase in depth eventually they overflow and cause packet loss. Packet loss is a normal part of a network since it is the mechanism by which TCP governs its throughput. Thus for the loss part of congestion we would define it as the situation in which an increase in data transmissions results in a proportionally smaller or even a reduction in throughput.

A non-congested network is one in which the latency (end-to-end delay) is relatively constant, and has little packet loss.

Congestion is also important to be framed by the user experience. A situation of congestion which causes an instant message to be delivered 500ms later is irrelevant to the average user. The same delay on a gaming packet or VoIP packet is perceived as a full loss by the consumer.

DPI (Deep Packet Inspection): The act of any network equipment which is not an endpoint of a communication using any field other than the Layer 3 destination IP address for any purpose.

DSL (Digital Subscriber Line): A family of technologies that provides digital data transmission over the telephone network.

EVDO (Evolution-Data Optimized): A telecommunications standard for the wireless transmission of data through radio signals.

Fixed Access: An Internet connection that is not portable, meaning it can only be used on one location. Traditional cable, DSL and fibre access lines are common examples, although Fixed WiMAX is equally valid.

FTTx (Fiber to the x): A term for telecommunications network architectures relying on optical fiber for the last mile of connectivity. X refers to the termination point (for example, FTTH is Fiber to the Home).

HSPA (High Speed Packet Access): A family of mobile telecommunications technologies that extends and improves the performance of existing protocols.

LTE (Long Term Evolution): The project name for a beyond-3G air interface for mobile telecommunications networks.

Mobile Access: An Internet connection that is portable; in other words, a subscriber may access the same connection from many different locations. A typically cellular network is an example of a mobile access network.

Network Business Intelligence: The tools and information to understand the interrelationship network information and business systems. The objective of network business intelligence is to improve business decision making.

Network Policy Control: The mechanism by which network elements implement the coordinated service policies that comprise today's innovative network management solutions.

Off-Peak: The hours in the day outside of the peak period.

OpEx (Operational Expenditure): An ongoing cost for running a product or service.

Overage: An amount exceeding a standard or prescribed level; in the telecommunications industry, overage refers to

billed charges that apply against usage beyond the limit, typically on a per-unit basis. It might also refer directly to the amount by which the limit was exceeded.

Peak Period: Service providers are particularly concerned about the make-up of traffic during the period when bandwidth utilization is heaviest. Usually lasting 3-5 hours, this period typically occurs in the evening and is known as the peak period or peak hours. The remaining hours in the day are referred to as being off peak.

QoE (Quality of Experience): A subjective measure of achieved quality, typically measured from the end consumer's perspective.

QoS (Quality of Service): Control mechanisms to deliver a desired level of quality (as opposed to a measurement of the achieved level of quality).

RAN (Radio Access Network): The part of a telecommunications network that implements a radio access technology, sitting between the mobile device and the core network.

WAP (Wireless Application Protocol): A standard for application-layer communication in a wireless telecommunications network.

WiMAX (Worldwide Interoperability for Microwave Access): A telecommunications technology providing wireless data (fixed and mobile) based on the IEEE 802.16 standard.

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