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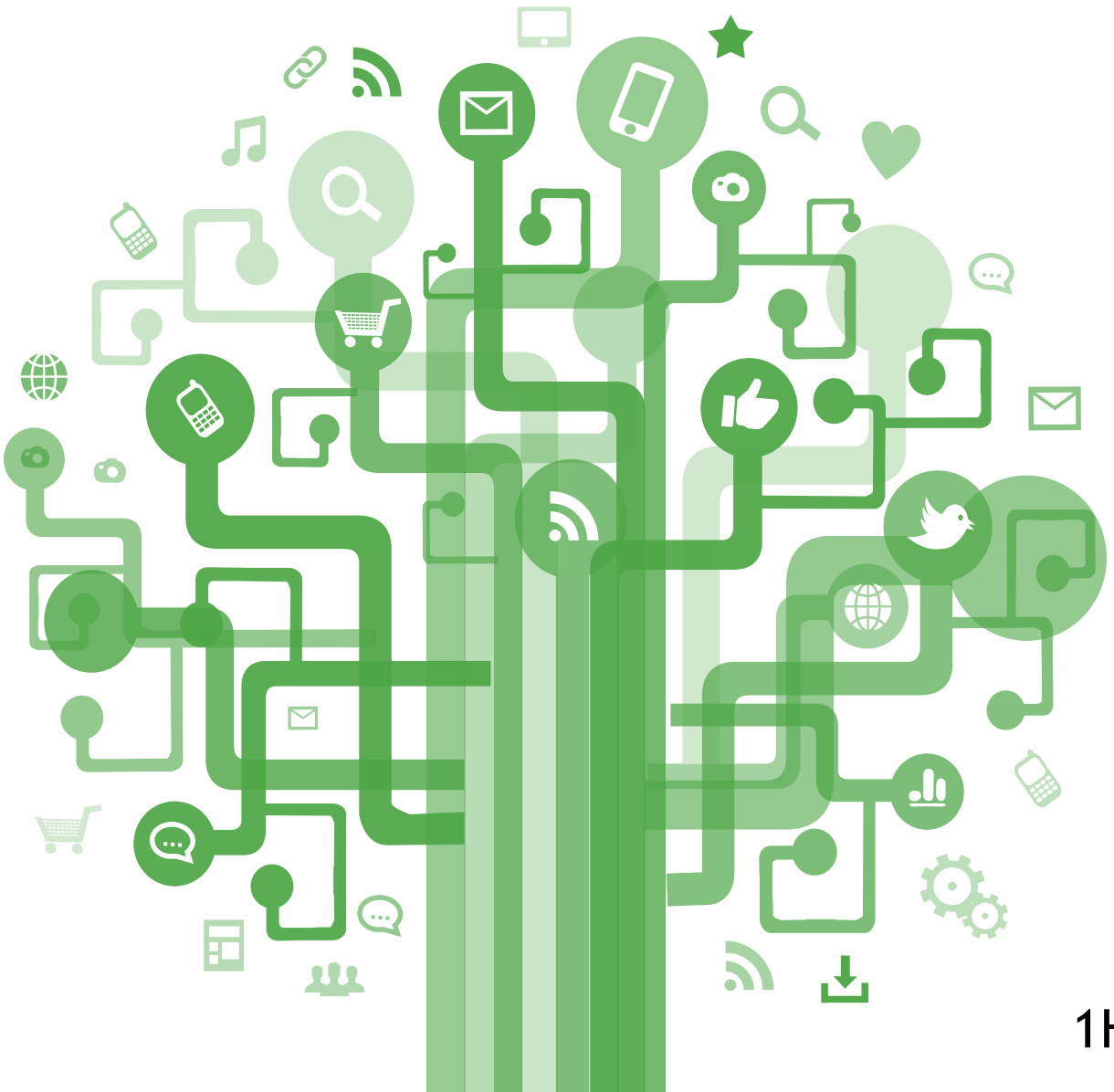
Intelligent Broadband Networks

Global Internet Phenomena Report



1H 2013

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Executive Summary

The Global Internet Phenomena Report: 1H 2013 shines a light on fixed and mobile data networks around the world, identifying facts, fads, and the future trends that will shape the Internet's future. In this report, we present a mix of high-level observations, regional-focused analysis, deep-dives into specific subjects, and educational tidbits. Communications service providers (CSPs) in particular are in the position to act on this information, but we believe that the findings will be of interest to a wide range of readers.

At the highest level, Real-Time Entertainment (comprised of streaming video and audio) continues to be the largest traffic category on virtually every network we examined, and we expect its continued growth to lead to the emergence of longer form video on mobile networks globally in 2013.

In North America, the dominance of Real-Time Entertainment is due in large part to the continued market leadership of Netflix, which accounts for almost a third of peak downstream traffic on fixed networks and has seen its share on mobile networks double in the past year. In other regions, YouTube continues to be largest single source of Real-Time Entertainment traffic on both fixed and mobile access networks, which makes it the leading source of Internet traffic in the entire world.

Home roaming, the concept of subscribers voluntarily off-loading mobile traffic onto Wi-Fi networks, continues to grow globally, with over 20% of all traffic on fixed networks in North America being generated by a smartphone or tablet. Apple manufactured devices (iPads, iPhones, iPods, AppleTVs, and Mac computers) in particular generate significant traffic in North America, with these devices accounting for over 35% of all streaming audio and video on fixed access networks.

Rich Communication Services, which are applications that allow subscribers to use their mobile data plan to send messages, continue to grow in popularity with WhatsApp being one of the leading services in many regions. On one tier-1 mobile network in Europe it was observed that for every subscriber there is an average of 10 WhatsApp messages sent and received each day. The continued growth of these services represents a significant threat to the stability of the service provider business model who have long relied on revenue from SMS messaging.

In addition to detailed analysis of global networks, this report includes focused spotlights that examine a particular emerging trend or observation. Interspersed among regional summaries, readers will find sections that tackle numerous topics including:

- Examination of innovative service plans from operators across the globe
- Predictions on fixed and mobile growth in the US
- Impact of sporting events like the Super Bowl and MLB opening day on North American networks
- Explanation of SPDY is and why it may impact network operators

This 1H 2013 Global Internet Phenomena Report includes summaries of findings from 8 regional snapshots, all of which are available on www.sandvine.com:

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

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North America, Fixed Access

For 1H 2013, mean usage was 44.7 GB, which represents a 39% year-over-year (yoy) increase from 32.1 GB observed in our 1H 2012 report. Over the same period, median monthly usage increased at an even greater pace (56.5%), jumping from 10.3 GB to 18.2 GB.

Monthly Consumption - North America, Fixed Access		
	Median	Mean
Upstream	1.3 GB	6.0 GB
Downstream	16.0 GB	38.6 GB
Aggregate	18.2 GB	44.7 GB

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Table 1 - Monthly Consumption Figures - North America, Fixed Access

Consistent with all of our recent reports, the bulk of total usage growth comes from Real-Time Entertainment traffic. Maintaining its status as the dominant traffic category in the region, Real-Time Entertainment is responsible for over 68% of downstream bytes during peak period, compared to 65% six months ago.

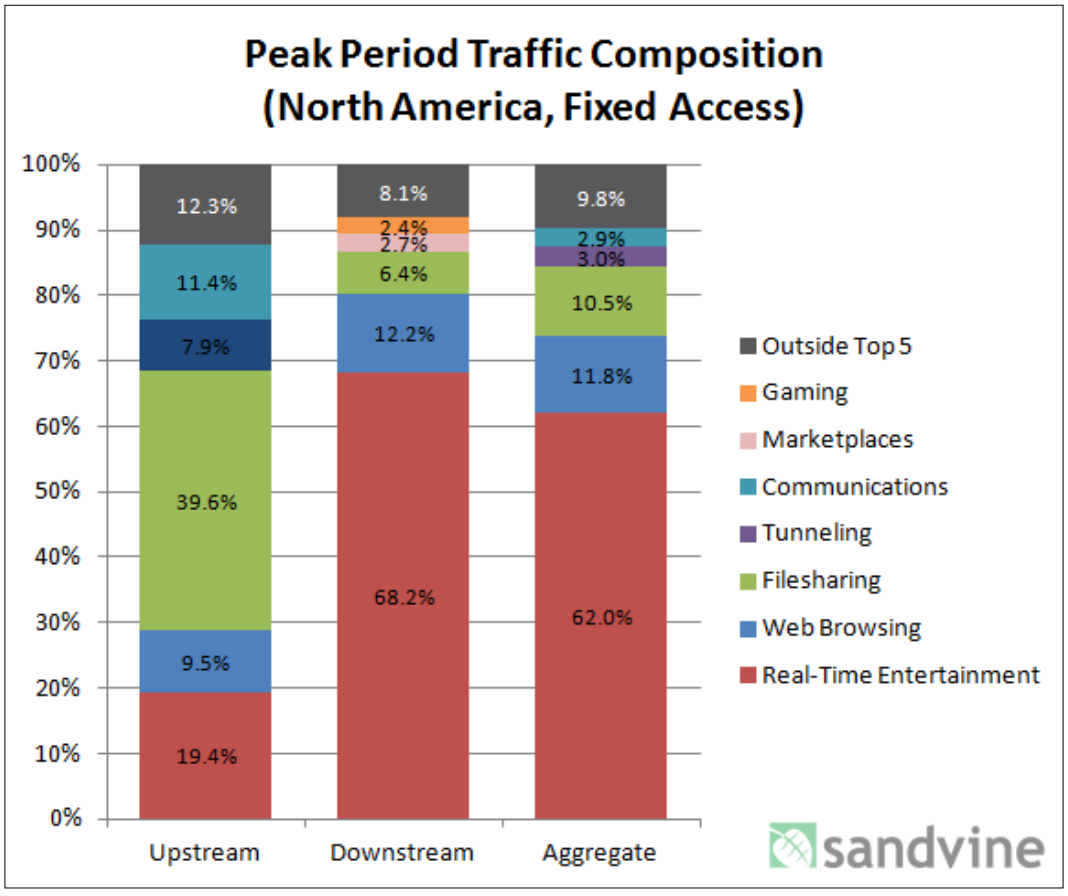

Figure 1 - Peak Period Traffic Composition - North America, Fixed Access

Netflix continues to be the unchallenged leader for traffic, accounting for 32.3% of downstream traffic during peak period. While we observed that their share of traffic decreased by a fraction of a percent since our 2H 2012 study, it should not be interpreted as a decline in the popularity of the service at the expense of their competitors. In fact, competing pay-video services such as Amazon (1.31%) and HBO Go (0.34%) saw their relative share decline greater than Netflix.

One application that has seen a noticeable increase in usage share is YouTube. In our 1H 2012 study, YouTube accounted for 13.8% of downstream traffic and has now grown to 17.1% in 1H 2013. While YouTube has been dabbling in offering longer form videos and streaming live events, we believe none of those have played a major impact in its rise in traffic share. Instead, we believe the increase is attributed to the continued growth of smartphone and tablet use within the home (i.e. "Home Roaming"). As observed in this study, such devices consume over a quarter of all streaming audio and video on fixed access networks.

In our last report we predicted that by 2015, BitTorrent would account for less than 10% of all traffic on North American fixed access networks but it appears that the 10% threshold may be crossed even sooner. BitTorrent now accounts for just 9.2% of traffic during peak period and 11.1% of total daily traffic. This demonstrates a sharp decline in share; just 18 months ago BitTorrent accounted for 18.9% of total daily traffic in North America.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	34.81%	Netflix	32.25%	Netflix	28.88%
2	HTTP	7.53%	YouTube	17.11%	YouTube	15.43%
3	SSL	5.81%	HTTP	11.11%	HTTP	10.66%
4	Netflix	5.38%	BitTorrent	5.57%	BitTorrent	9.23%
5	Skype	4.88%	MPEG	2.58%	SSL	2.39%
6	YouTube	3.71%	Hulu	2.41%	MPEG	2.30%
7	Facebook	1.71%	iTunes	1.90%	Hulu	2.16%
8	Apple Photostream	1.34%	SSL	1.89%	iTunes	1.71%
9	Dropbox	1.21%	Flash Video	1.72%	Flash Video	1.53%
10	Carbonite	0.99%	Facebook	1.48%	Facebook	1.52%
Top 10		**67.38%**		**78.03%**		**75.82%**

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Table 2 - Top 10 Peak Period Applications - North America, Fixed Access

With many cable and DSL providers considering implementing usage based billing, an examination of usage distribution is of interest to many. In North America, the top 1% of subscribers who make the heaviest use of the network's upstream resources account for over a third (34.2%) of total upstream traffic. The comparable downstream users account for 10.1% of downstream bytes. At the opposite end of the usage spectrum, the network's lightest 50% of users account for only 6.4 % of total monthly traffic.

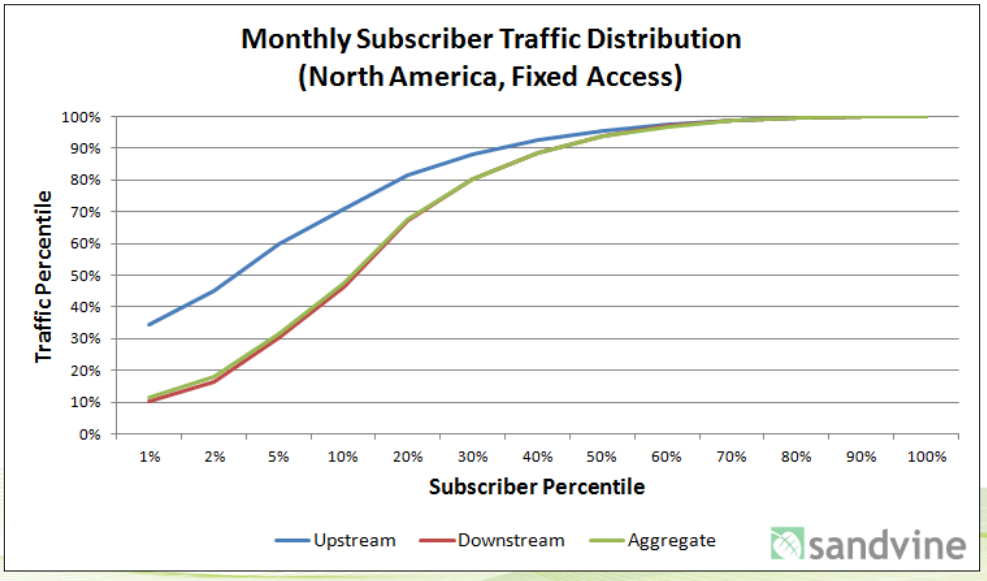

Figure 2 - Monthly Subscriber Traffic Distribution - North America, Fixed Access

Home Roaming Keeps on Rolling

In our 1H 2012 report, we revealed that Real-Time Entertainment applications on mobile devices (smartphone and tablets) accounted for 9% of all fixed network traffic in North America and in our last report we predicted that by 2015, the phenomena will be even more profound, with mobile devices accounting for 20% of all traffic on North American fixed access networks.

It turns out 2015 came a little early, and based on data collected smartphones and tablets now account for 20% of total traffic. This accelerated growth is due in large part to the rapid adoption rates of larger screen devices (e.g. tablets) combined with the growing number of Real-Time Entertainment sources offering higher resolution video.

Home Roaming is an enormous contributor to Real-Time Entertainment traffic consumption with over 25% of all streaming audio and video bytes being delivered to mobile devices being used in the home.

So what single home roaming device consumes the most Real-Time Entertainment traffic at over 10%? It's the iPad. In fact, Apple devices as a whole play a large role in the consumption of Real-Time Entertainment. If you add up all Apple manufactured devices (e.g. iPads, iPhones, iPods, AppleTVs, Mac computers), they consume over 35% of all streaming audio and video on North American fixed access networks.

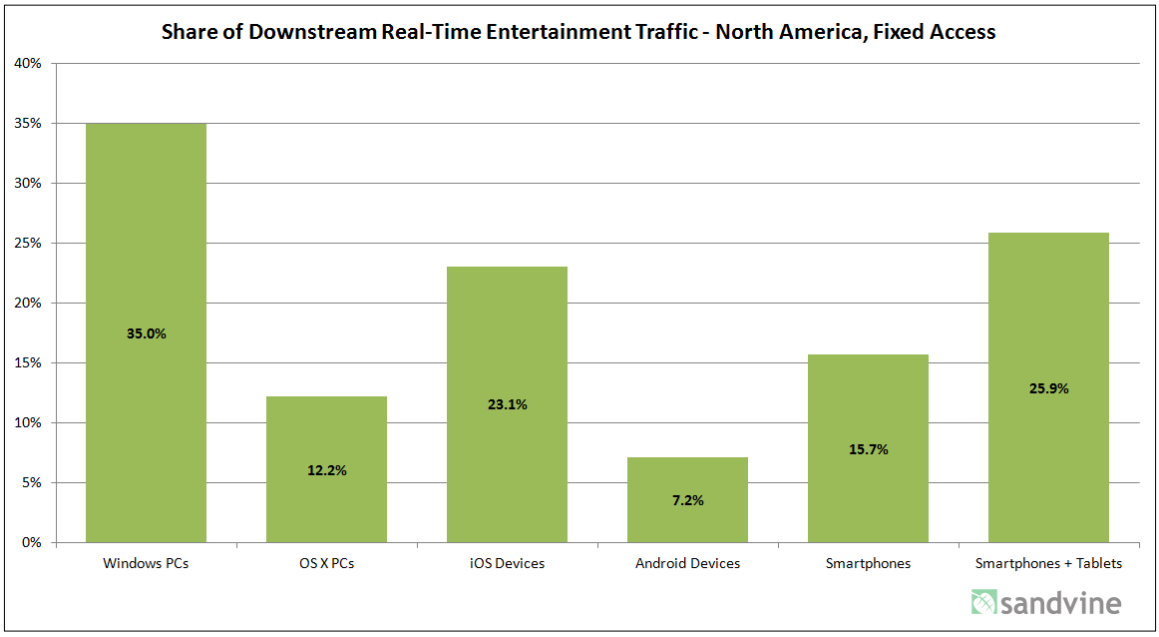

Figure 3 - Device Share of Downstream Real-Time Entertainment Traffic

North America, Mobile Access

Much like our examination of fixed access networks in North America, mobile networks have seen only minor changes in traffic composition in the past six months. Overall usage however has grown substantially. Over the past year, mean monthly usage increased from 312.8 MB to 390.1 MB – a jump of approximately 25%. Even more substantially, median usage more than doubled from 25.5 MB to 58.7 over the past year. This significant increase in median usage is a phenomenon we have been tracking over the past several years. We believe it is closely tied to increase in first-time adoption of smartphones by subscribers whose usage is well below that of smartphone power users. Moving forward we expect that median usage growth will switch to being driven more by increasing individual usage, as smartphone adoption rates begin to slow.

	Median	Mean
Upstream	9.5MB	43.4MB
Downstream	46.8 MB	346.7 MB
Aggregate	58.7 MB	390.1 MB

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Table 3 - Monthly Consumption Figures - North America, Mobile Access

During peak period, Real-Time Entertainment traffic is by far the most dominant traffic category, accounting for almost half of the downstream bytes on the network. As observed in past reports, Social Networking applications continue to be very well represented on the mobile network. This speaks to their popularity with subscribers as these applications typically generate far less traffic than those that stream audio and video.

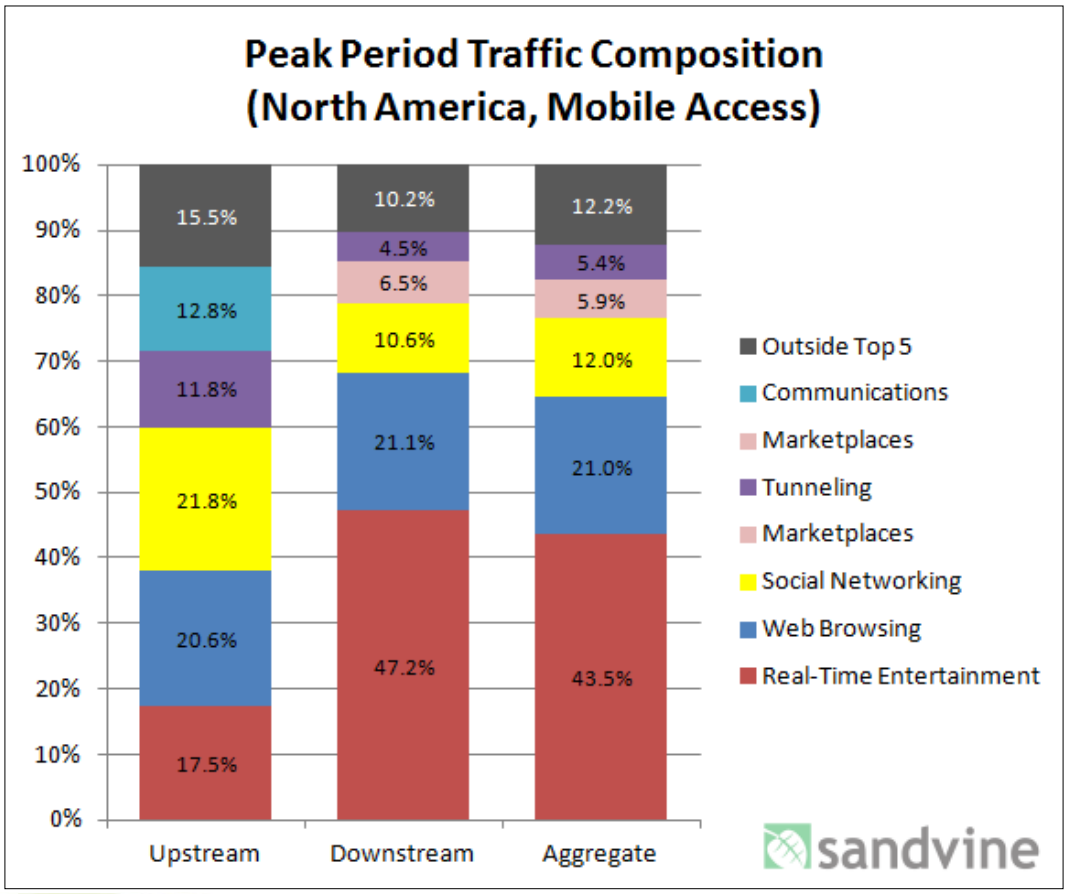

Figure 4 - Peak Period Traffic Composition - North America, Mobile Access

YouTube continues to entrench itself as the dominant application on mobile networks, accounting for essentially a quarter of all traffic on the network during peak period. In our 2H 2012 study, YouTube accounted for 31.0% of peak downstream traffic, but has now declined slightly to 27.3%. Interestingly, while we observed YouTube making some inroads on fixed access networks, we noticed Netflix gaining more and more momentum on mobile networks. While watching a full length movie or a 22 minute sitcom on a 4-inch smartphone screen may not be the ideal viewing experience, for many subscribers it is becoming a viable one. Netflix's downstream traffic share in North America almost doubled from 2.2% to 4.0% in just 12 months time. We believe that this number will increase going forward as longer form video as a whole becomes more commonplace on mobile networks in North America.

As for streaming audio, Pandora Radio continues to lead. Interestingly, its share of downstream traffic over a 24-hour period (3.62%) is actually higher than during peak period (3.35%). This phenomenon is likely due to subscribers using the service consistently throughout the day, while some other applications might have their usage concentrated during peak period.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	Facebook	17.22%	YouTube	27.33%	YouTube	24.89%
2	HTTP	14.66%	HTTP	19.16%	HTTP	18.60%
3	SSL	9.78%	Facebook	8.67%	Facebook	9.71%
4	YouTube	7.36%	MPEG	7.32%	MPEG	6.61%
5	Netflix	2.76%	Google Play	4.37%	SSL	4.88%
6	Skype	2.70%	SSL	4.20%	Google Play	3.97%
7	BitTorrent	2.35%	Netflix	3.98%	Netflix	3.83%
8	BlackBerry	1.87%	Pandora Radio	3.35%	Pandora Radio	3.00%
9	MPEG	1.80%	BlackBerry	1.61%	BlackBerry	1.61%
10	Dropbox	1.52%	Flash Video	1.51%	Flash Video	1.37%
Top 10		**62.02%**		**81.50%**	Top 10	**78.48%**

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Table 4 - Top 10 Peak Period Applications - North America, Fixed Access

From a traffic distribution standpoint, the top 1% of subscribers who make the heaviest use of the network's upstream resources account for 22.6% of total upstream traffic. The comparable downstream users account for 19.4% of downstream bytes. At the opposite end of the usage spectrum, the network's lightest 50% of users account for only 1.4% of total traffic in large part due to the number of feature phones still in use by subscribers.

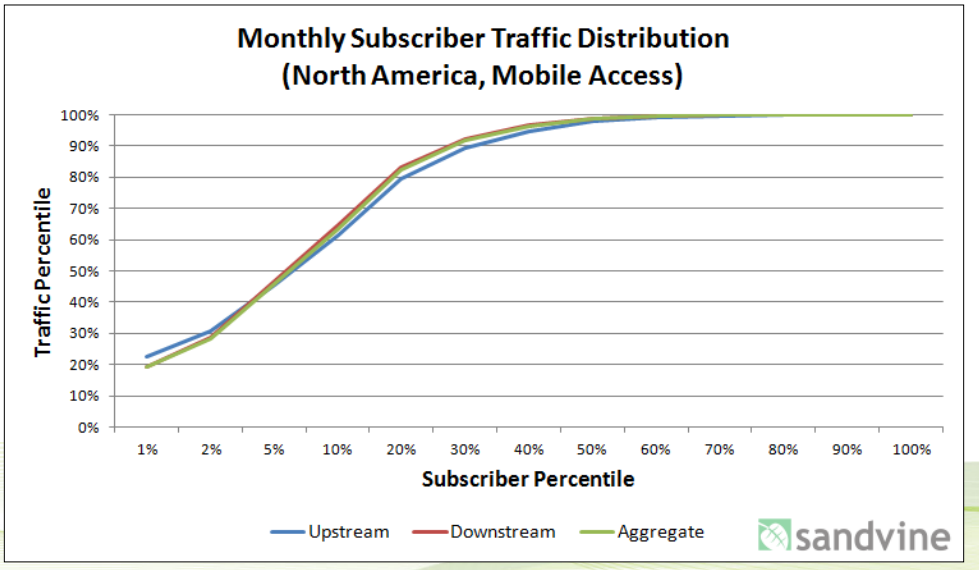

Figure 5 - Monthly Subscriber Traffic Distribution - North America, Mobile Access

Projecting Mobile Traffic Trends in the United States

What traffic will mobile networks in the United States carry in the future? It's always both fun and informative to take a look, and we've done in Figure 6. These projections have been revised for this report and are based on a bottom-up analysis of measured traffic profiles, observed traffic trends, device usage characteristics, device market share, and a number of informed assumptions:

- The vast majority of tablet traffic will not be carried on mobile networks
- Smartphone market share will continue to grow[1], but feature phones will continue to make up a significant part of the North American subscriber base
- Machine-to-Machine traffic will slowly, but eventually, emerge (but much slower than many are predicting)
- Home roaming, the concept of subscribers voluntarily offloading mobile traffic onto Wi-Fi networks is a very real phenomena

After finishing all of the number-crunching, a number of interesting projections appear:

- Video and audio streaming applications will account for over 60% of mobile usage by 2018
- Web Browsing, including traffic generated by mobile applications, will continue to make up a significant portion of the network
- Social Networking will account for more traffic than we had previously predicted thanks to adoption of tiered service plans which allow users to purchase low cost data plans that give them access to the social applications they value most

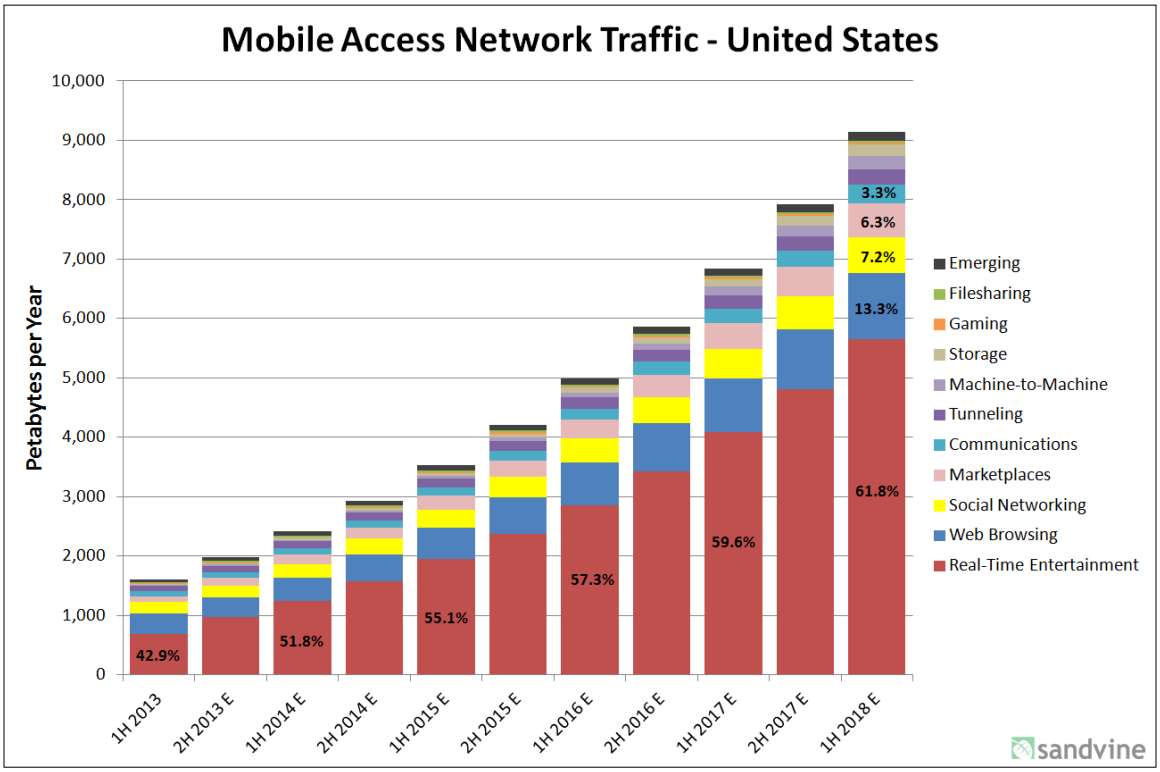

Figure 6 - Projection of Mobile Access Network Traffic in the United States

1. "Smartphones Expected to Outship Feature Phones for First Time in 2013, According to IDC | Business Wire." Press Release Distribution, Financial Disclosure, Online Newsrooms, PR, Public Relations, Investor Relations, EDGAR filing, XBRL, Breaking News, Business News, Financial News | Business Wire. N.p., n.d. Web. 1 May 2013. <http://www.businesswire.com/news/home/20130304005403/en/Smartphones-Expected-Outship-Feature-Phones-Time-2013>.

Service Creation Made Simple with ServiceDesigner

In the drive to effectively monetize mobile data and save network resources, CSPs are increasingly moving to a personalized, tiered, or usage-based model in order to appeal to the broadest possible range of subscribers. CSPs have some major challenges in delivering these services in a short time span:

- Service creation tools that CSPs are using are complex and require professional service engagement to enable services
- The flexibility to augment these plans with temporary bolt-ons that users can access in real time when they need them
- The ability to rapidly deliver a variety of flexible service tiers based on volume, time and application usage

Sandvine's ServiceDesigner is a dedicated interface within Control Center (Sandvine's unified GUI) that over comes these challenges and provides a simple and easy to use graphical interface for defining new services suitable for operations, product and network planning professionals.

ServiceDesigner bridges the gap between the product team that creates the services and the network team that implements them. Using ServiceDesigner the network team can create lower-level features that become a part of a service offering. From there, the product team uses ServiceDesigner to drag and drop those features and chargeable bolt-ons to create personalized innovative service offerings for their subscribers.

ServiceDesigner allows CSPs to significantly reduce the time to market new service offerings and create innovative personalized services that address the wants and needs of the customer. These tailored plans are sticky delivering exactly what subscribers really want coverting them into loyal subscribers and in turn reduces overall churn.

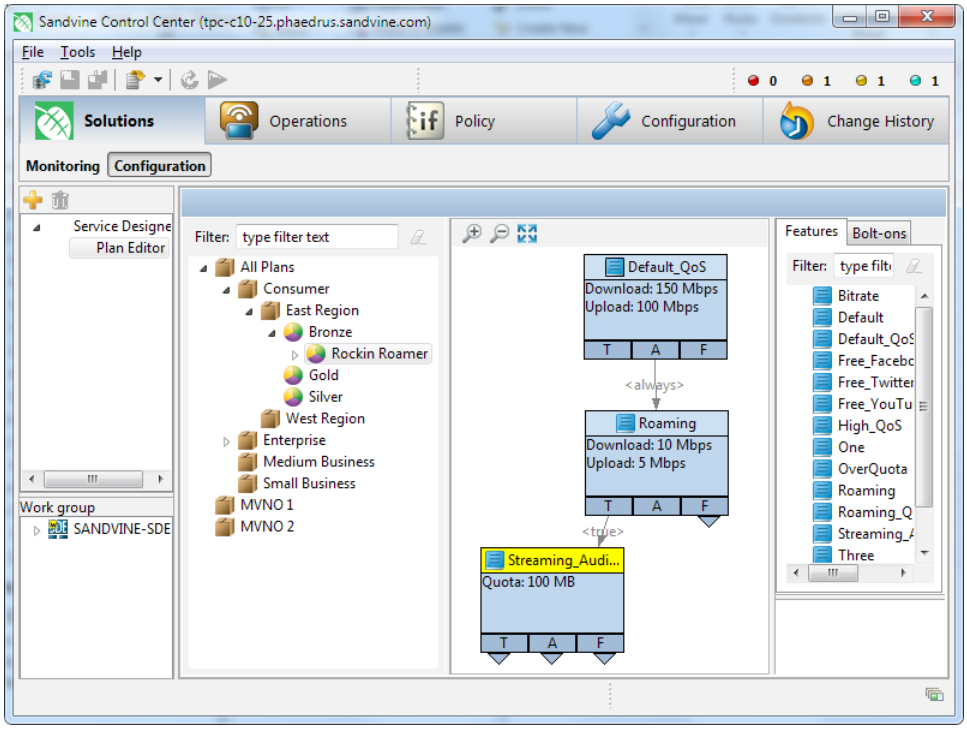

Figure 7 - Sandvine's ServiceDesigner

Europe, Fixed Access

As discussed in our previous reports, Europe presents a mix of mature and emerging markets, with cultural, economic, technological, and linguistic diversities that combine to create traffic patterns that can prove to be challenging to roll-up. Regional analysis is intricate, as different applications can vary in penetration and availability depending on the country.

Monthly Consumption - Europe, Fixed Access		
	Median	Mean
Upstream	485.7 MB	2.5 GB
Downstream	5.3 GB	10.9 GB
Aggregate	6.0 GB	13.4 GB

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Table 5 - Monthly Consumption - Europe, Fixed Access

"…by continually innovating, a service provider can keep ahead of its competition. And, by personalizing services to the wants and needs of the customer, these services get "stickier"—who would leave something that feels designed "just for them," especially if the price is right for the benefit received?" - Frost & Sullivan

Sandvine did not report on European monthly usage in the previous report, therefore growth figures are unavailable, but the figures are interesting to examine on their own. Europe's mean monthly usage of 13.4 GB and median monthly usage of 6.0 GB is significantly lower than that observed in North America. The growth of these figures, especially the comparision of the usage growth rate to other regions around the world, will be interesting to analyze in future reports.

One aspect that all countries examined in Europe have in common is a thirst for streaming audio and video, which has once again made Real-Time Entertainment the top traffic category, responsible for 40.4% of peak downstream traffic. Depending on the specific country however, this percentage ranges anywhere from 35% to over 50% of downstream traffic. This fluctuation in share is due in large part to the availability of over-the-top (OTT) video services in varying countries. Based on our observations in this report and previous ones, countries with access to paid services like Netflix or BBC iPlayer typically had a higher share of Real-Time Entertainment traffic on their network.

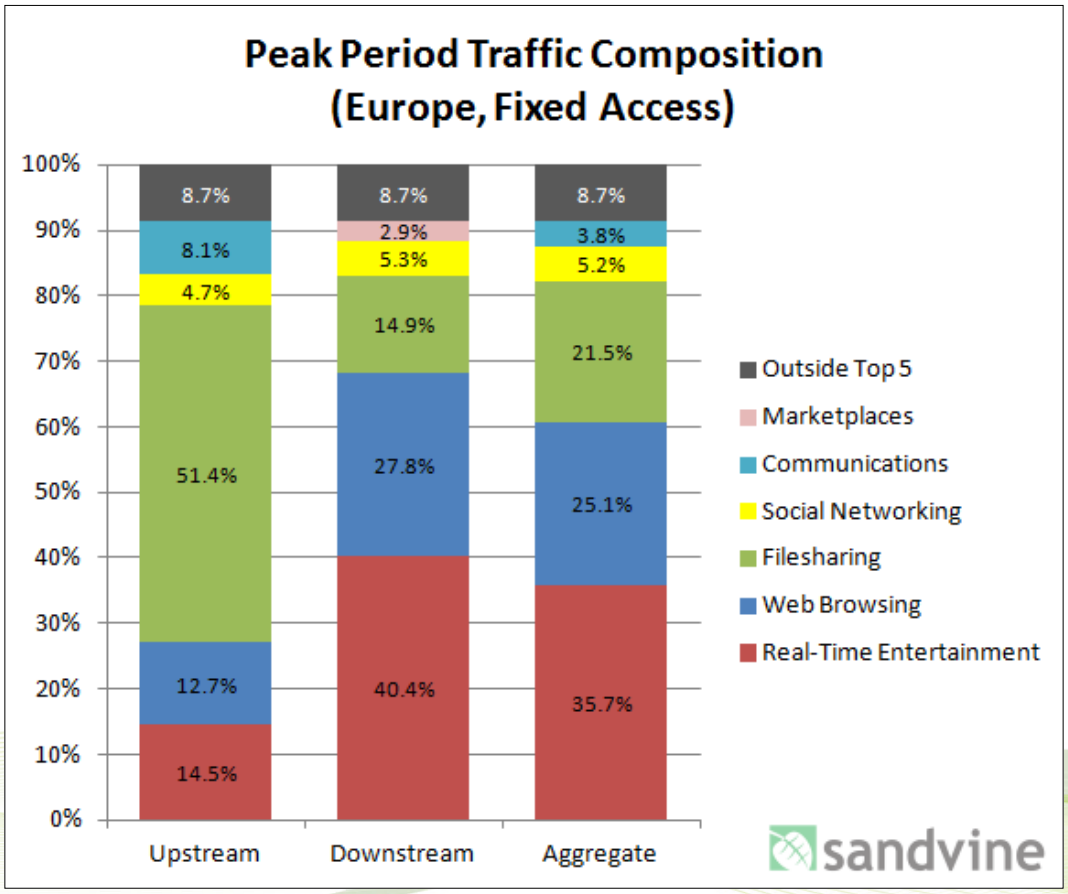

Figure 8 - Peak Period Traffic Composition - Europe, Fixed Access

As highlighted in our last report, European countries with lower Real-Time Entertainment share typically have higher Filesharing traffic, which has lead us to believe that subscribers are likely using applications like BitTorrent to procure audio and video content not available in their region. We believe that Filesharing's share of traffic may have finally reached its peak in terms of traffic share and will begin to experience a steady and significant decline, as paid OTT video services continue to expand their availability throughout the European region.

Generally, European networks have a consistent set of dominant applications and services that are available in each region which account for 80-85% of all traffic and a set of localized websites and region-restricted applications that make up the remainder. This can be seen in the list of top 10 applications for the region, all of which have global availability.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	40.63%	HTTP	26.15%	HTTP	23.34%
2	HTTP	10.70%	YouTube	24.25%	YouTube	21.27%
3	YouTube	7.79%	BitTorrent	12.22%	BitTorrent	17.36%
4	eDonkey	6.45%	RTMP	4.16%	Facebook	3.95%
5	Skype	5.86%	MPEG	4.03%	RTMP	3.67%
6	Facebook	3.79%	Facebook	3.97%	MPEG	3.48%
7	SSL	2.20%	Flash Video	2.98%	eDonkey	2.59%
8	RTMP	1.21%	eDonkey	1.74%	Flash Video	2.59%
9	MPEG	1.11%	Skype	1.65%	Skype	2.41%
10	Flash Video	0.94%	iTunes	1.54%	SSL	1.47%
	Top 10	80.67%	Top 10	82.69%	Top 10	82.12%

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Table 6 - Top 10 Peak Period Applications - Europe, Fixed Access

From a traffic distribution standpoint, the top 1% of subscribers in Europe who make the heaviest use of the network's upstream resources account for 30.7% of total upstream traffic. The comparable downstream users account for 10.7% of downstream bytes. At the opposite end of the usage spectrum, the network's lightest 50% of users account for only 9.5% of total traffic.

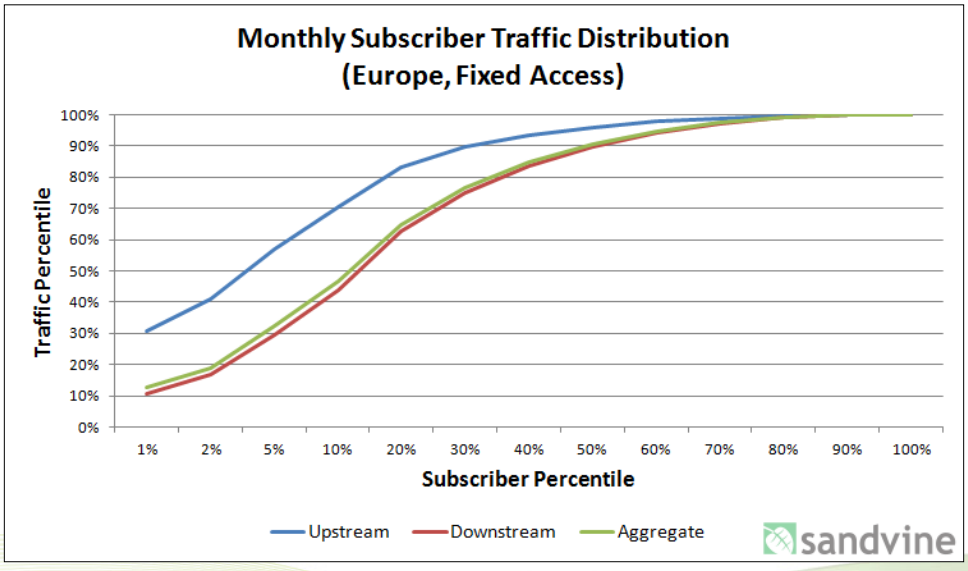

Figure 9 - Monthly Subscriber Traffic Distribution - Europe, Fixed Access

Coming Soon to your Network: Third-Party Partnerships

Vox Telecom, a South African communications service provider (CSP) with DSL operations wanted to increase subscriber revenue and achieve competitive differentiation. They knew they had built a network that was capable of providing a great experience for subscribers, so they began to seek partnerships with companies that could help bring awareness to their services.

After some internal research, Vox Telecom believed that subscribers who were gaming enthusiasts formed a market segment that would respond positively to a tailored service plan and promotion. Their research suggested that quality of experience (QoE) was both understood by and important to the gaming population.

After studying the business intelligence gathered from the network to identify opportunities, the ideal solution described by this customer consisted of a service promotion that was tailored to the needs of gamers which included the following features:

- Increased download and upload speeds over standard service plans
- Increased monthly quota over standard service plans
- Prioritization of all gaming ports to ensure that gaming traffic is completely unshaped and quality will not be interrupted during periods of congestion

Once the plan was defined, Vox Telecom formed a partnership with Look & Listen, a leading retailer in South Africa, to provide subscribers with a unique code when they purchased Call of Duty. Subscribers could then login to their self-service portal, enter their unique code, and their service plan would automatically be upgraded to a trial of the new gaming focused service plan.

Slices of the iTunes Pie

Most statisticians generally regard pie charts as a poor method of displaying information, so despite the pun in the title, this section will avoid using any kind of circular or pie shaped image[2].

Apple's iTunes is consistently among the top ranked marketplaces on both fixed and mobile networks in most regions examined. Over the years, iTunes itself has grown from being a simple local music player to a store that sells music, videos, books, ringtones, and applications, and also allows users to stream their previously purchased content.[3]

So how does the iTunes pie get sliced on North American fixed access networks? Surprisingly, pretty evenly.

The biggest chunk of iTunes traffic is generated by their App store which accounts for 38.1% of traffic.With millions of iOS devices (iPhones, iPads, and iPods) sold and over 45 billion global app downloads[4] (ranging from a couple megabytes to a couple gigabytes), it is easy to understand the significant volume of traffic mobile apps can generate.

The second largest chunk at 36.15% comes from iTunes Streaming, which may actually come as a surprise to some. iTunes Streaming consists of not only the snippets of a music or video file a user can preview before buying, but to a greater extent the use of iTunes Match, which allows users to stream their music and video purchases to their mobile device and Apple TVs.

The third largest chunk of iTunes (20.47%) comes in the form of Media Downloads which are non-application purchases such as music, movies, and books made through the iTunes store.

The smallest chunk, iTunes Browsing, comes from traffic generated as users surf around the pages of the various app and media stores contained within iTunes.

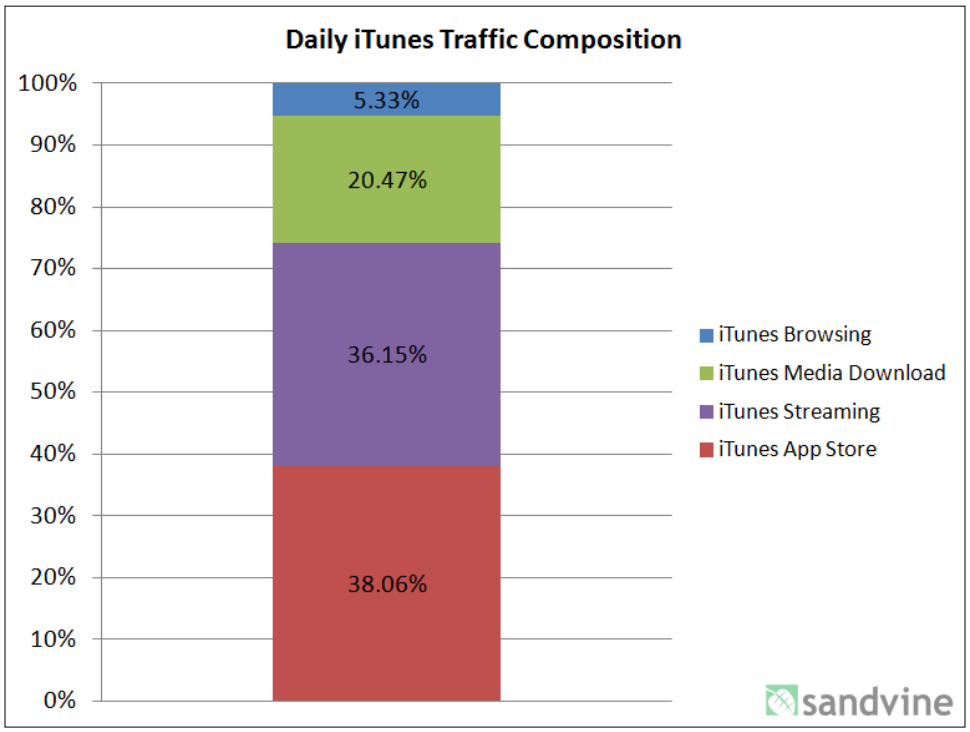

Figure 10 - North American 24-Hour Aggregate iTunes Traffic Composition

2. "Pie Charts Are Bad - Steve Fenton."Home - Steve Fenton. N.p., n.d. Web. 1 May 2013. <http://www.stevefenton.co.uk/Content/Pie-Charts-Are-Bad/>.
3. "iTunes Store at 10: how Apple built a digital media juggernaut | The Verge."The Verge. N.p., n.d. Web. 1 May 2013. <http://www.theverge.com/2013/4/26/4265172/itunes-store-at-10-how-apple-built-a-digital-media-juggernaut>.
4. "Apple Reaches 45B App Downloads With $9B Paid to Developers - Mac Rumors."Mac Rumors: Apple Mac iOS Rumors and News You Care About. N.p., n.d. Web. 1 May 2013. <http://www.macrumors.com/2013/04/23/apple-reaches-45b-app-downloads-with-9b-paid-to-developers/>.

Europe, Mobile Access

As discussed earlier, examining mobile networks in Europe provides the same set of challenges for regional analysis as fixed networks due to the diversity in each country's culture, economy, languages, and deployed network technologies.

One metric that may not be impacted too significantly by some of these factors is monthly subscriber consumption. It's not unreasonable to expect that subscribers will use their devices in a similar way; the only difference is that they will simply substitute the services that are most popular or only available in their country. In our analysis, subscriber usage was relatively consistent across several of the southern and western European countries who participate in this report. Mean monthly usage for Europe was observed to be 311.0 MB, an increase of over 25% from 239.9 MB observed six months ago. Unsurprisingly, over that same time period, median usage saw very similar gains increasing over 23% from 10.7 MB to 13.2 MB.

Monthly Consumption - Europe, Mobile Access		
	Median	Mean
Upstream	2.0 MB	41.1 MB
Downstream	10.5 MB	269.9 MB
Aggregate	13.2 MB	311.0 MB

Table 7 - Monthly Consumption - Europe, Mobile Access

Much like other mobile networks, during peak period Real-Time Entertainment traffic is the clear traffic category leader. Web Browsing and Social Networking, as seen commonly in other regions, round out the second- and third-most popular traffic categories. What is most noticeable in Europe (and consistent with previous reports) is the popularity of Communications applications, which account for 21.9% of upstream traffic and 6.5% of total traffic during peak period.

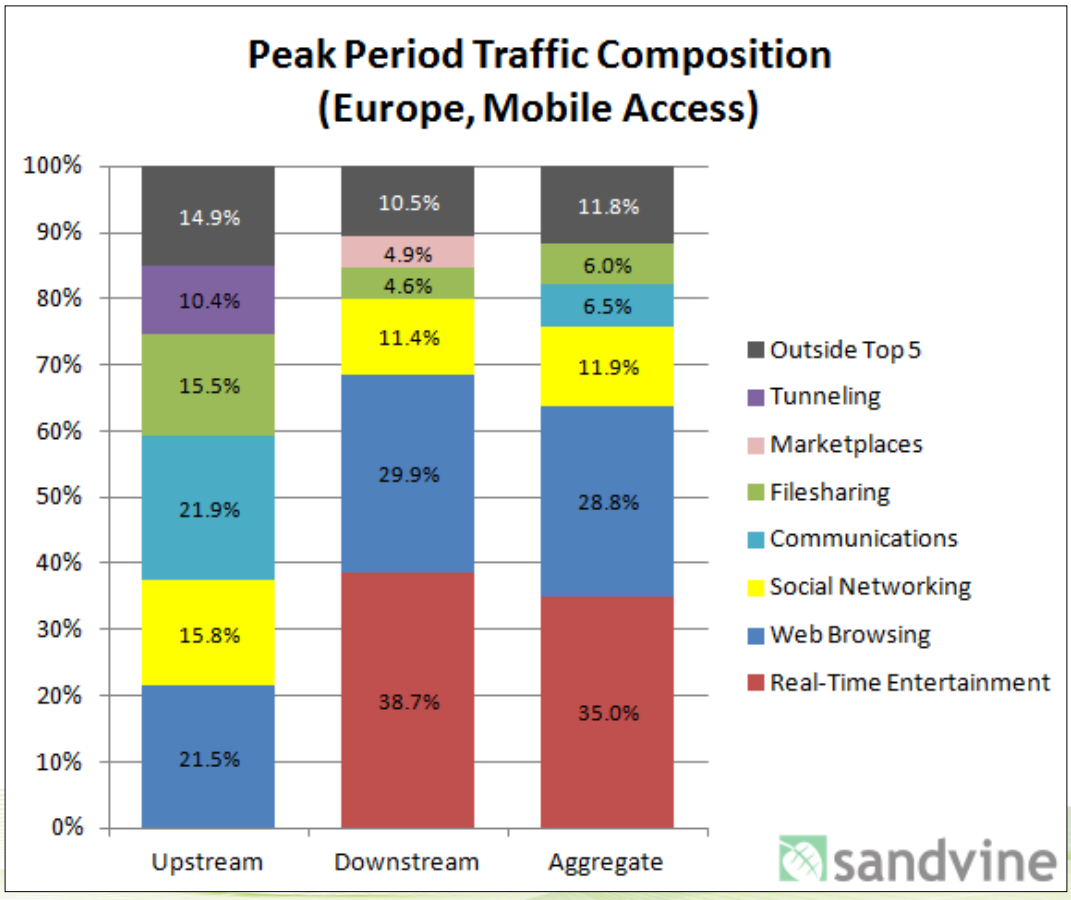

Figure 11 - Peak Period Traffic Composition - Europe, Mobile Access

Skype is the Communications application that drives the majority of this traffic, accounting for over two-thirds of the category's traffic. The remaining top applications vary from country to country, but we have observed continued growth of WhatsApp and other over-the-top (OTT) messaging application in many European countries.

Interestingly, HTTP is the application that generates the most bandwidth both in peak period and the entire day, slightly edging out YouTube which is often the top ranked application on the mobile networks we study. The appearance of BitTorrent and Windows Update on the list indicates that the use of aircards or dongles is a popular practice in Europe, possibly as fixed line replacement, since running these applications on a smartphone or tablet is for the most part is impractical.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	HTTP	17.77%	HTTP	27.61%	HTTP	26.38%
2	Skype	14.59%	YouTube	21.85%	YouTube	19.71%
3	Facebook	13.78%	Facebook	10.13%	Facebook	10.59%
4	BitTorrent	12.34%	Flash Video	5.22%	BitTorrent	4.99%
5	SSL	6.64%	MPEG	4.14%	Flash Video	4.66%
6	YouTube	4.65%	BitTorrent	3.94%	Skype	3.88%
7	Hotmail	1.25%	SSL	2.94%	MPEG	3.70%
8	Dropbox	1.21%	RTMP	2.90%	SSL	3.40%
9	Ares	1.18%	Skype	2.37%	RTMP	2.65%
10	SPDY	1.07%	Windows Update	1.81%	Windows Update	1.63%
	Top 10	74.48%	Top 10	82.90%	Top 10	81.58%

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Table 8 - Top 10 Peak Period Protocols - Europe, Mobile Access

Additional evidence that suggests the use of aircards or tethering on the participating networks is demonstrated in the distribution of monthly usage by subscribers. The top 1% of subscribers account for 46.0% of upstream traffic, and 30.3% of all traffic. At the opposite end of the usage spectrum, the network's lightest 50% of users account for only 0.31% of total traffic which much like on North American networks is likely caused by the number of feature phones still in use by subscribers.

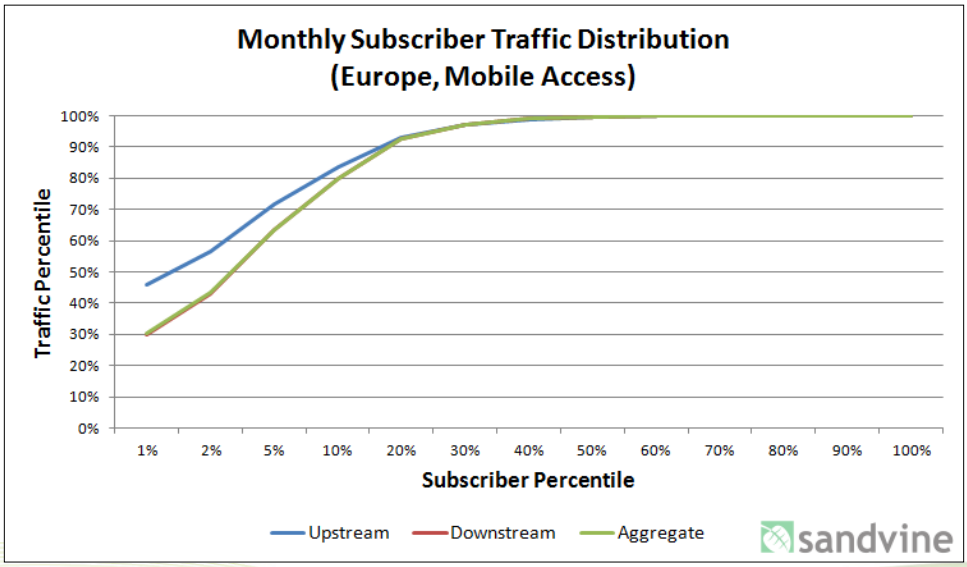


Figure 12 - Monthly Subscriber Traffic Distribution - Europe, Mobile Access

WhatApp-ening

Messaging applications, referred to as rich communications services by many, allow subscribers to use their data plans to send messages to each other instead of using a SMS message. These services have been growing in popularity in recent quarters to the point that some now believe we have reached the tipping point and the volume of messages sent by these applications now outnumbers SMS messages.[5]

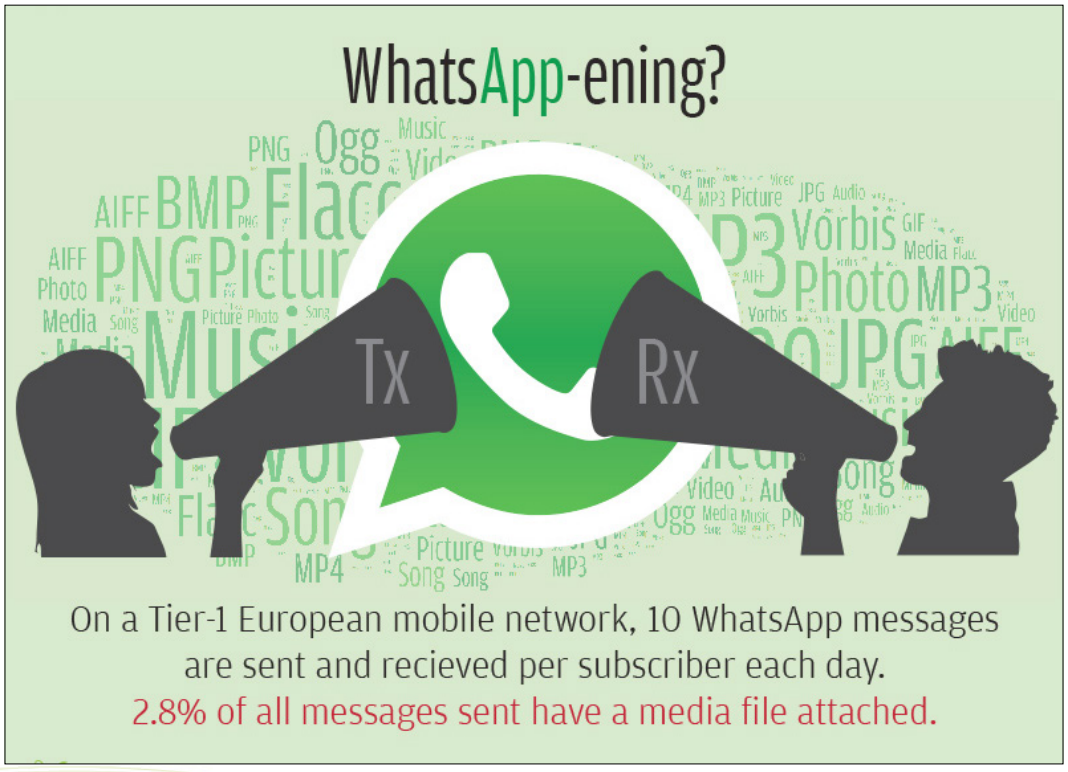
For mobile operators, the subscriber shift to over-the-top messenging services is threatening the stability of the service provider business model. This adoption means that the average revenue per delivered byte is dropping, as SMS bytes, estimated to be generally $30,000/GB, is being replaced by over-the-top bytes that deliver revenue at approximately $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[6], impacting all subscribers.

There are numerous applications available in mobile marketplace today that offer these services and the popularity can vary from country to country. The unquestioned global leader based on our observation is WhatsApp indicating that it is the messaging app of choice subscribers.

Leveraging our industry-leading business intelligence solutions, Sandvine provides mobile operators with the ability to better understand the impact of WhatsApp. Measurements available to operators go beyond just counting bytes, and allows them to see the exact quantity of both text and picture/video messages sent and received by subscribers on their network.

Based on data from a tier-1 European network, approximately 10 WhatsApp messages are sent and received per subscriber each day. Of these messages, 2.8% of all messages sent have a media file such as a photo or video attached.

For mobile operators, this type of insight allows them to better understand the impact these messaging applications have on their bottom line which in turn helps them craft more tailored service plans that meet the changing demands of subscribers.



5. http://gigaom.com/2013/04/29/chat-apps-have-overtaken-sms-by-message-volume/
6. http://www.thecommentator.com/article/319/leading_dutch_telecom_raises_rates_after_net_neutrality_enforcement

Projecting Fixed Traffic Trends in the United States

What type of traffic can we expect US fixed networks to carry in the future? It's always both fun and informative to take a look, and we've done so again in Figure 13. These projections have been revised using 1H 2013 data and are based on a bottom-up analysis of measured household traffic profiles, observed traffic trends, and a number of informed assumptions:

- Home roaming will play a prominent role in fixed access network profiles, (currently it accounts for 20% of traffic)
- Legal streaming sites and services from Netflix, Amazon, HBO, and the major sporting leagues will remain active and well-stocked with compelling content
- Filesharing, while slowly declining in share, is here to stay, even if only within a dedicated community and as a legal distribution mechanism for content such as software updates

Emerging trends to look forward to:

- Real-Time Entertainment applications will dominate fixed access networks, accounting for two-thirds of total data usage in 2018, driven largely by ubiquitous integration between devices (e.g. smart TVs, set-tops, game consoles) and streaming services
- Web Browsing will continue be the second-largest source of traffic, partly driven by the number of mobile devices at use in the home
- Tunneling traffic will become a major player in the traffic mix as more critical and privacy sensitive applications go online (security cameras, banking) and as subscribers seek ways to protect their identity online and access content restricted to them because of their geographic location

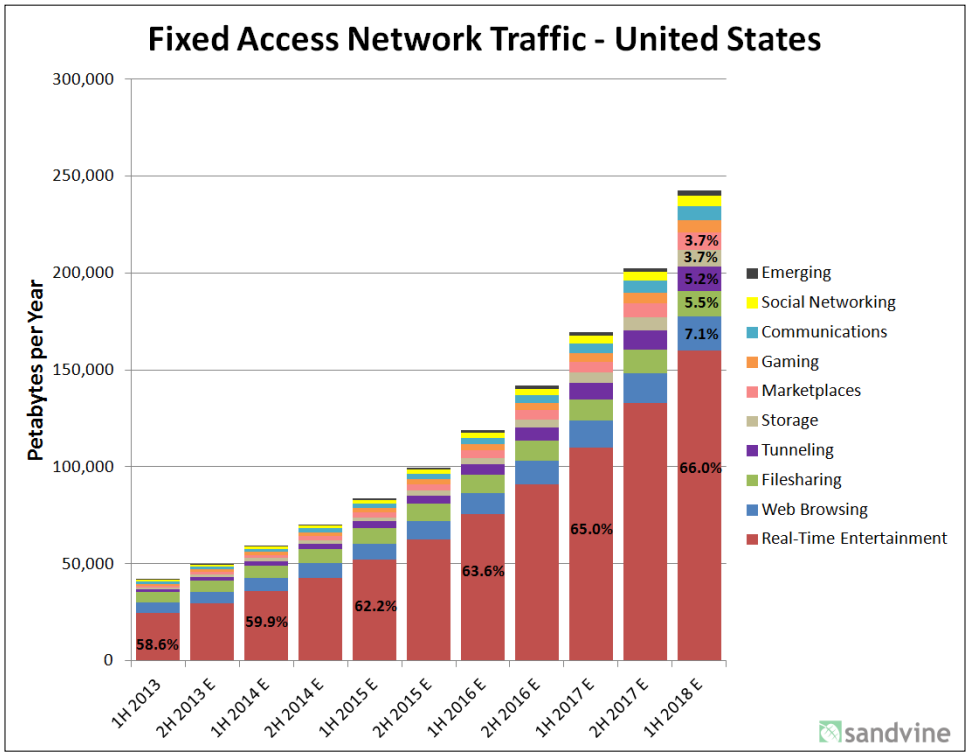


Figure 13 - Projection of Fixed Access Network Traffic in United States

How Does Usage Based Billing Impact Subscriber Usage?

Around the globe, usage based billing (UBB) is becoming continually more commonplace on fixed access networks. Sandvine has helped more than 80 CSPs introduce innovative new services around UBB. Depending on which CSP you talk to they all have their own reasons for choosing to implement such plans. Some cite the desire to create new revenue streams, others want to differentiate themselves in the markets, and some cling to the belief that UBB will help alleviate congestion on the network.

At Sandvine, we've long argued that implementing UBB would likely have minimal (if any) impact on network congestion and subscriber quality of experience (QoE) during peak, as subscribers are unlikely to stop using their favorite applications during the peak evening hours. CSPs that are actually seeking to manage network congestion need to put effective traffic management mechanisms in place in order to proactively ensure high subscriber QoE for real-time sensitive applications during peak hours.

A number of our Global Internet Phenomena report participants have implemented UBB over the past 18 months, in particular US-based fixed access CSPs. Therefore we've decided to compare how subscribers behave on networks that have implemented UBB versus behavior on unlimited usage networks.

Figure 14 shows a comparison of usage between the two types of networks during peak period - one with UBB and one without. Interestingly, and perhaps unsurprisingly, peak period on both networks is of similar length and occurs between the hours of 7 pm and 10 pm.

What stands out most clearly is the fact that Real-Time Entertainment's traffic share is almost identical on both networks. This indicates that high bandwidth streaming audio and video traffic is of such high value to all subscribers that they are unwilling to stop or alter the way the consume it, even though they have a cap placed on their monthly usage.

What is interesting is how much lower the share of Filesharing traffic is on networks with UBB compared to those without. This demonstrates that subscribers may be mindfully limiting their use of Filesharing applications, which often generate traffic in both the upstream and downstream direction. Additionally, aside from being a good peer (which is likely of little importance to occasional Filesharing users), there is little direct benefit to uploading content, so that might well be the first activity that is stopped. It may even be possible that Real-Time Entertainment has a slightly higher share on networks with UBB due to subscribers getting more of their content via Real-Time Entertainment sources which are typically more efficient (if you consider the value proposition to be "equal entertainment for less aggregate usage") than Filesharing, since there is relatively little upstream traffic associated with streaming.

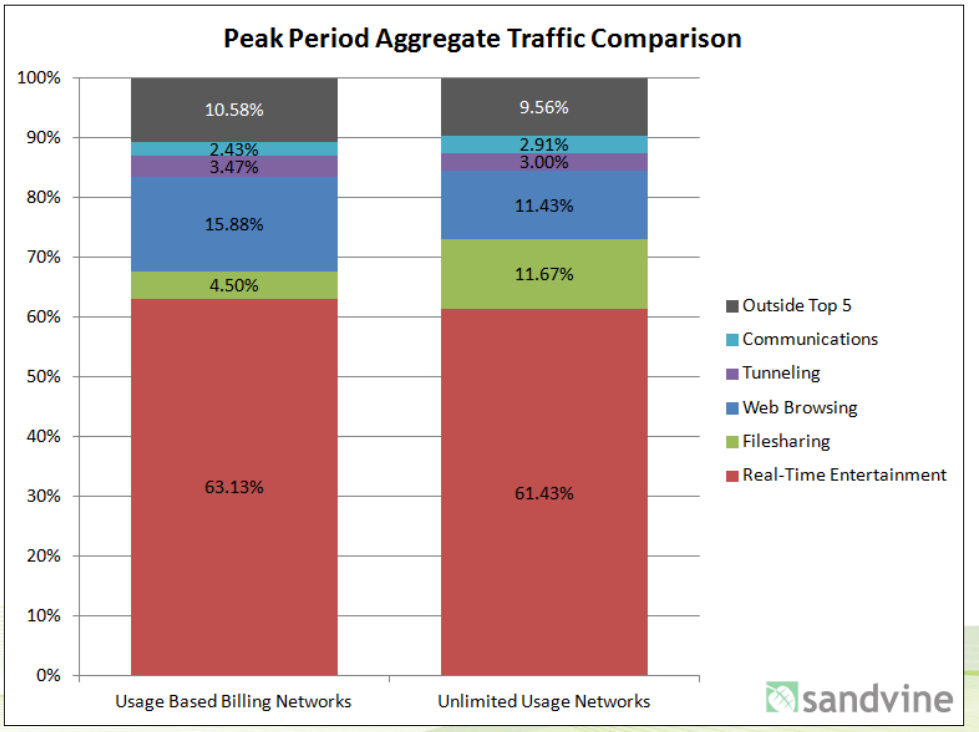


Figure 14 - Usage Based Billing Peak Period Aggregate Traffic Comparison

But what about the traffic profile during off peak hours? Figure 15 shows that when comparing the two types of networks, the overall make-up has little difference than peak hours. The disparity between the share of Filesharing traffic actually increases slightly. This is to be expected since Filesharing applications typically run continuously throughout the night when other application usage drops off substantially – since subscribers are sleeping.

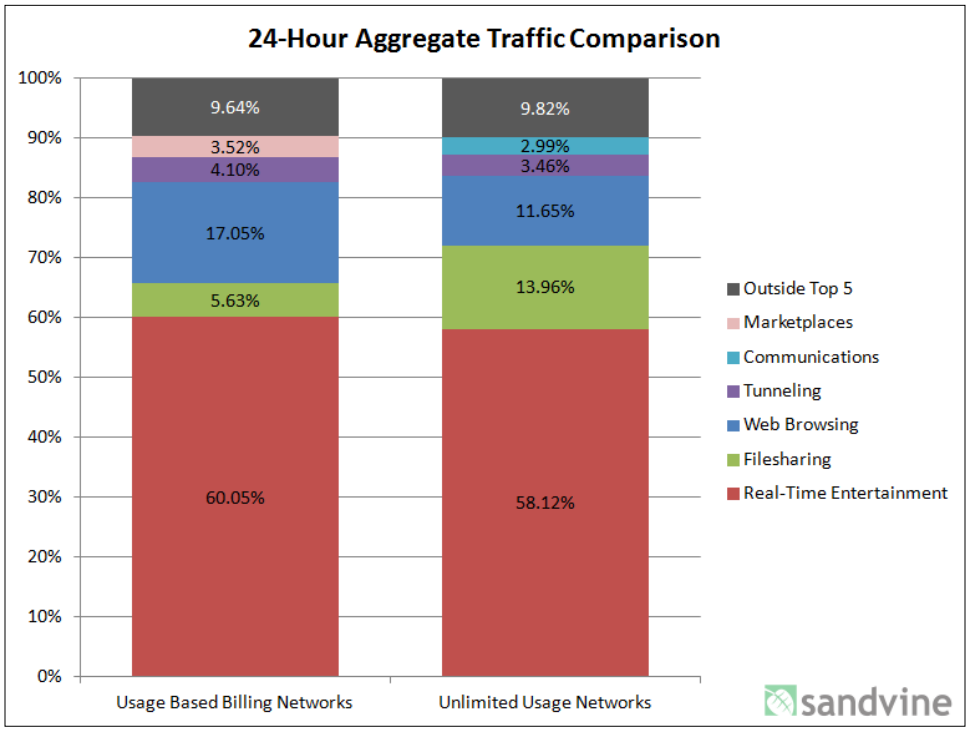


Figure 15 - Usage Based Billing Peak Period 24-Hour Traffic Comparison

It should be made clear, that this comparison did not look at the volume of traffic generated by the two types of networks. A direct comparison proved difficult as each CSP offers various levels of speed tiers and usage caps which can greatly impact overall usage. However, what this comparison does demonstrate is that subscribers seem unwilling to curb their usage of Real-Time Entertainment, and that operators will need to proactively ensure high subscriber QoE for streaming audio and video whether they institute UBB or not.

Asia-Pacific, Fixed Access

As observed in other regions across the globe, consumption in Asia-Pacific is driven by the use of Real-Time Entertainment, which accounts for more than half (51.2%) of total downstream traffic during peak period.

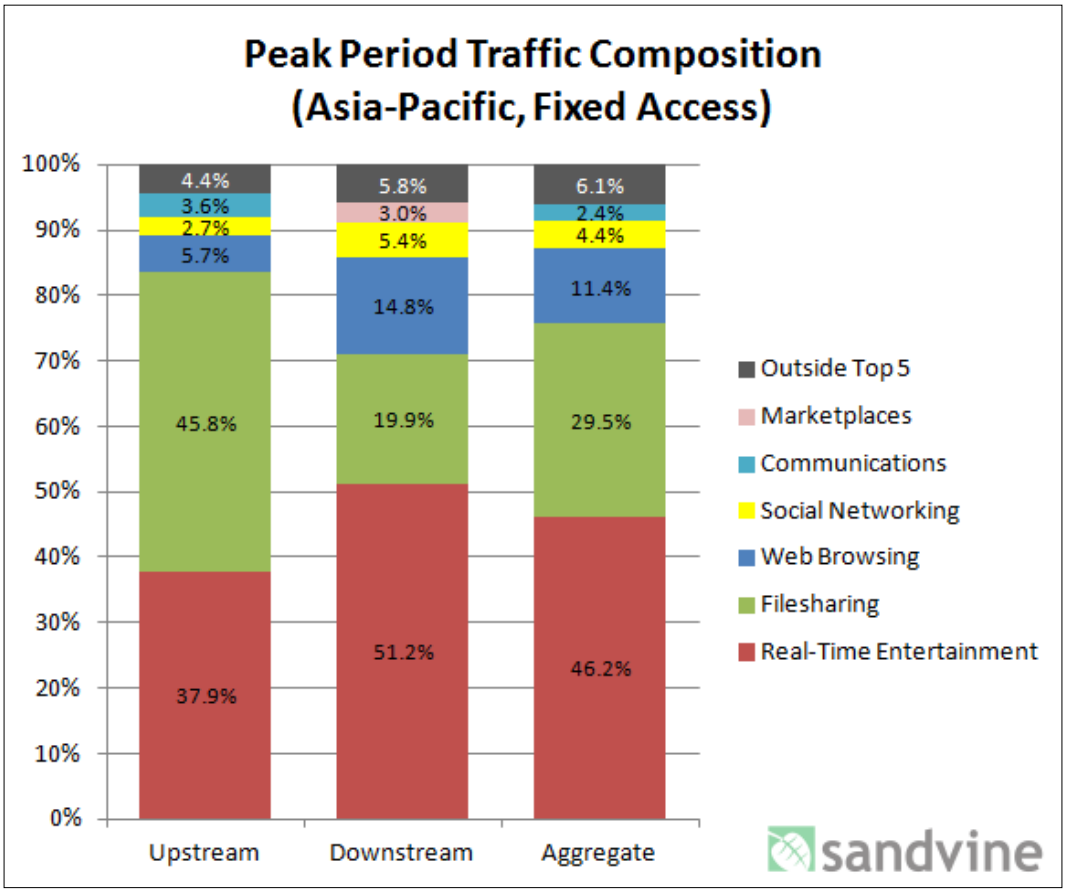


Figure 16 - Peak Period Traffic Composition - Asia- Pacific, Fixed Access

A unique characteristic of the Asia-Pacific region is the popularity of peercasting applications, particularly PPStream and QVoD. These applications allow users to stream live events while simultaneously helping to distribute the stream to other viewers, which is why they drive so much upstream traffic. Additionally, Asia-Pacific is the only region we observed in this report where BitTorrent was the top application during peak period. In many other regions Filesharing applications have seen a decline in share over recent reports, and that is a phenomenon we have begun to observe in Asia-Pacific as well. The decline in share has been somewhat less significant, although we believe as more over-the-top Real-Time Entertainment sources are made available to subscribers in the future, the rate of decline will begin to accelerate.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	32.03%	YouTube	22.14%	BitTorrent	21.66%
2	PPStream	8.08%	BitTorrent	15.55%	YouTube	16.83%
3	QVoD	7.85%	HTTP	13.17%	HTTP	9.91%
4	YouTube	7.81%	PPStream	5.35%	PPStream	6.36%
5	Thunder	6.61%	Facebook	4.38%	QVoD	5.47%
6	HTTP	4.39%	QVoD	4.06%	Thunder	3.98%
7	RTSP	3.13%	MPEG	3.86%	Facebook	3.54%
8	Facebook	2.12%	Thunder	2.42%	MPEG	2.72%
9	Skype	2.10%	Flash Video	2.22%	RTSP	2.33%
10	Funshion	1.56%	RTSP	1.85%	Flash Video	1.57%
	Top 10	75.67%	Top 10	75.01%	Top 10	74.36%

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Table 9 - Top 10 Peak Period Applications - Asia-Pacific, Fixed Access

As mentioned, Asia-Pacific is the global region where Filesharing applications still have the greatest share of traffic. Led by the BitTorrent and Thunder, accounting for 21.66% and 3.98% of total traffic during peak respectively.

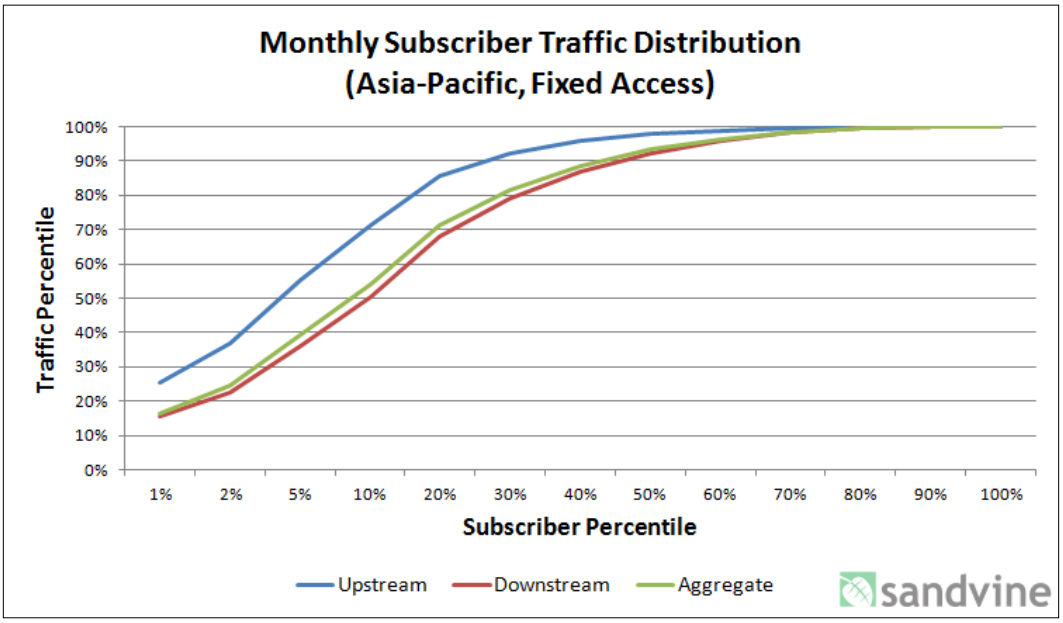

Figure 17 - Monthly Subscriber Traffic Distribution - Asia-Pacific, Fixed Access

From a traffic distribution standpoint, the top 1% of subscribers in Asia-Pacific who make the heaviest use of the network's upstream resources account for 25.5% of total upstream traffic. The comparable downstream users account for 15.6% of downstream bytes. At the opposite end of the usage spectrum, the network's lightest 50% of users account for only 6.7% of total traffic. These figures are very much in line with what has been observed globally.

The Importance of Routing Efficiently

Have you ever thought about how content reaches you after you have keyed in that URL or requested a YouTube video?

Global broadband networks are made up of a series of interconnected switches, routers and smaller networks that send and receive data to one another for pre-negotiated prices based on data volumes. A requested piece of content can take many 'hops' through the network using these peer networks before reaching its final destination.

In order to meet network demands and deliver content to subscribers efficiently and at the lowest cost, operators create peering relationships with other CSPs. These interconnect relationships carry operational costs for CSPs defined by upstream and downstream rates at peak, as well as total traffic sent across international and domestic routing links.

In the absence of a Content Delivery Network (CDN) or cache, this means that the content you request from a particular website actually comes across many different networks before making it to your device. It also means that quality issues might actually be the result of something happening on an entirely different network than the one provided by your CSP. Nevertheless, CSPs are not powerless when it comes to improving subscriber quality of experience even when the ultimate cause of the problems is external.

By studying how quality of experience varies depending upon the network path, operators can optimize their transit and peering relationships for quality.

A glimpse at Sandvine's Routing Efficiency Dashboard reveals analytics based on the Border Gateway Protocol (BGP) which is used by networks to establish routing links between each other. With the insight gained through Routing Analysis and Application Analysis Scorecards, operators can access granular views into domestic and international transit links including:

- Autonomous System (AS) Name & Number
- Peak Rate Upstream (Mbps)
- Peak Rate Downstream (Mbps)
- Video QoE
- 2nd Hop AS drill-down
- Origin AS drill-down

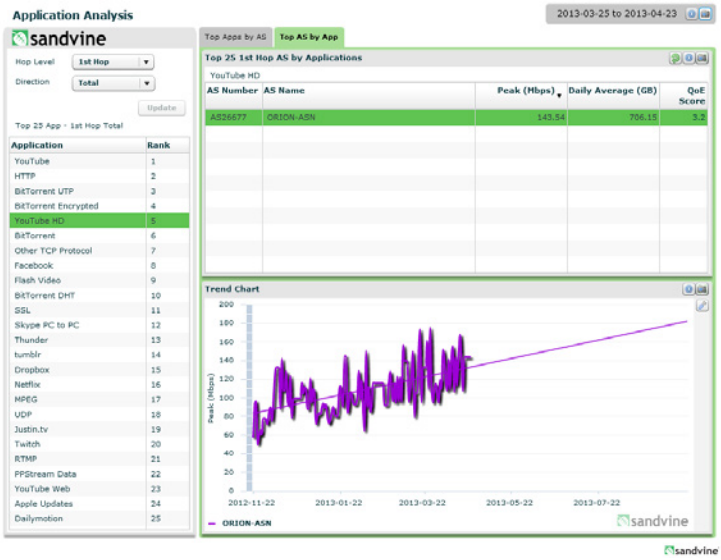

Figure 18 - Routing Efficiency Dashboard – Application Analysis Scorecard, YouTube HD 1st Hop Analysis, North American Fixed Network

This insight allows CSPs to avoid routes that are adversely impacting their own subscribers. With Real-Time Entertainment applications accounting for the largest proportion of downstream data on fixed and mobile networks, understanding the paths that this high-value traffic takes through the network is valuable insight. This understanding can be leveraged to optimize peer and transit relationships to reduce operational costs and improve quality of service.

The same insight can also help operators objectively assess the value of transit links, the equality of peering arrangements, and the business case for a CDN or caching solution. Some web services who are large content providers (including Google and Netflix) offer their own dedicated CDNs, or a CSP can work with vendors like Akamai or Limelight, who deliver a wide range of content. The key in any objectives assessment is to have the right visibility.

Asia-Pacific, Mobile Access

As we observed on North American mobile networks, mean monthly usage in Asia-Pacific has made a small but noticeable gain, increasing from 659.3 MB to 700.4 MB in the six months. Asia-Pacific mobile subscribers have traditionally shown the highest consumption numbers among users in the Global Internet Phenomena Report and we expect this consumption leadership to continue in our future reports.

Monthly Consumption - Europe, Mobile Access		
	Median	Mean
Upstream	19.2 MB	76.9 MB
Downstream	133.2 MB	623.5 MB
Aggregate	157.0 MB	700.4 MB

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Table 10 - Monthly Consumption - Asia-Pacific, Mobile Access

Real-Time Entertainment is the dominant category on the upstream and the downstream, accounting for half of total downstream traffic during peak period. What is unique to the Asia-Pacific region is that Real-Time Entertainment is the top upstream category accounting for 28.0%. As documented in several of our previous reports, the primary driver behind the popularity of Real-Time Entertainment in Asia-Pacific is the use of the popular peercasting application PPStream (available on PC, tablets, and smartphones) which sends and transmits video simultaneously over the network.

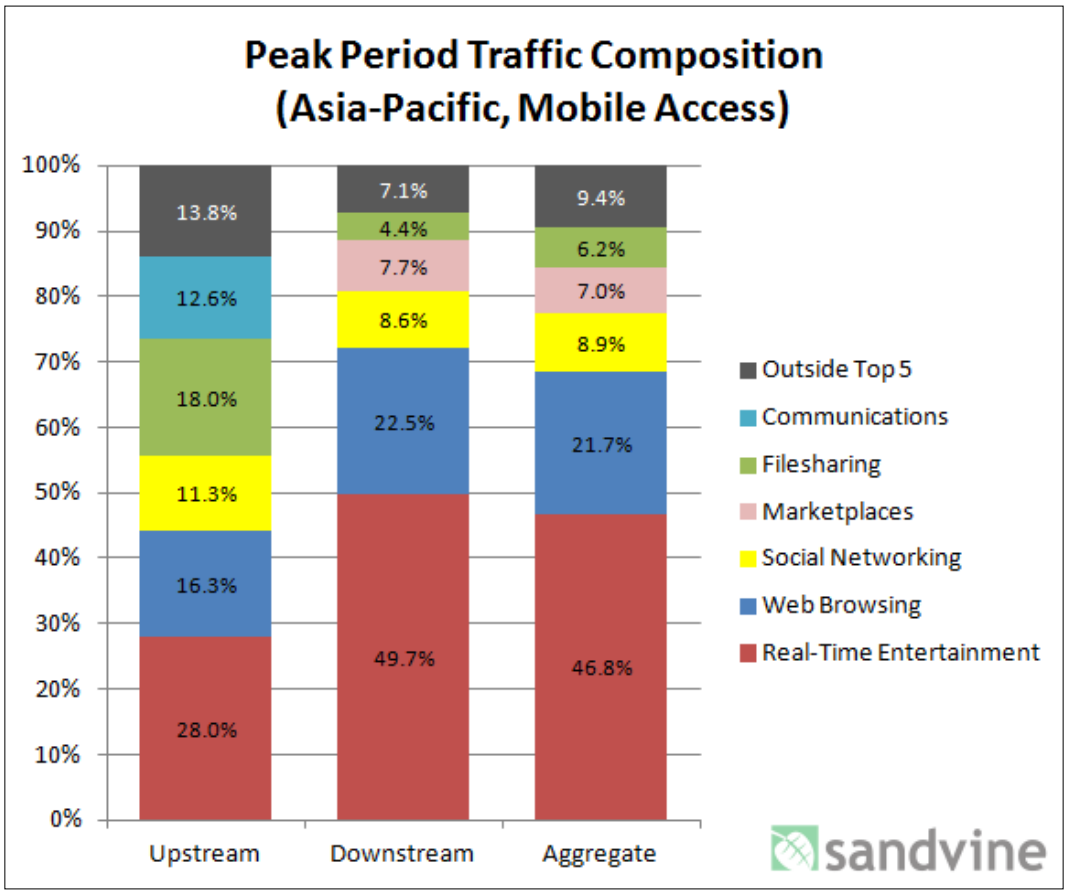

Figure 19 - Peak Period Traffic Composition - Asia-Pacific, Mobile Access

Other than the appearance of peercasting applications in the list of top applications, Asia-Pacific's traffic is for the most part similar in composition to that of leading networks in Europe and North America. The one difference that may be present is the popularity of marketplaces in the region. When combining the traffic share of iTunes and Google Play, subscribers in Asia-Pacific are the highest consumers of apps, music, and movie downloads than any region in the world.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	HTTP	12.93%	HTTP	20.97%	HTTP	19.91%
2	PPStream	11.24%	YouTube	16.64%	YouTube	14.90%
3	BitTorrent	10.20%	PPStream	9.90%	PPStream	10.06%
4	Facebook	9.19%	MPEG	8.63%	MPEG	7.63%
5	SSL	5.32%	Facebook	6.97%	Facebook	7.27%
6	Skype	4.06%	iTunes	4.45%	iTunes	4.01%
7	Thunder	3.83%	Google Play	2.66%	BitTorrent	3.54%
8	YouTube	3.18%	BitTorrent	2.50%	SSL	2.63%
9	Funshion	2.89%	HTTP Live Streaming	2.41%	Google Play	2.39%
10	Dropbox	1.38%	SSL	2.24%	HTTP Live Streaming	2.14%
Top 10		**58.32%**		**77.38%**		**74.47%**

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Table 11 - Top 10 Peak Period Applications - Europe, Fixed Access

In Asia-Pacific, the 1% of subscribers who make the heaviest use of the network's upstream resources account for 41.1% of upstream, 23.2% of downstream, and 24.2% of aggregate bytes each month. As observed in Europe, this high concentration of users is likely due to the presence of a laptop air cards or the use of tethering which typically allows subscribers to consume significantly more data than a smartphone. This is supported by the fact that BitTorrent is 10% of total upstream traffic during peak period, and an application typically not run on a smartphone or tablet. At the opposite end of the usage spectrum, the network's lightest 50% of users account for only 4.7% of total traffic.

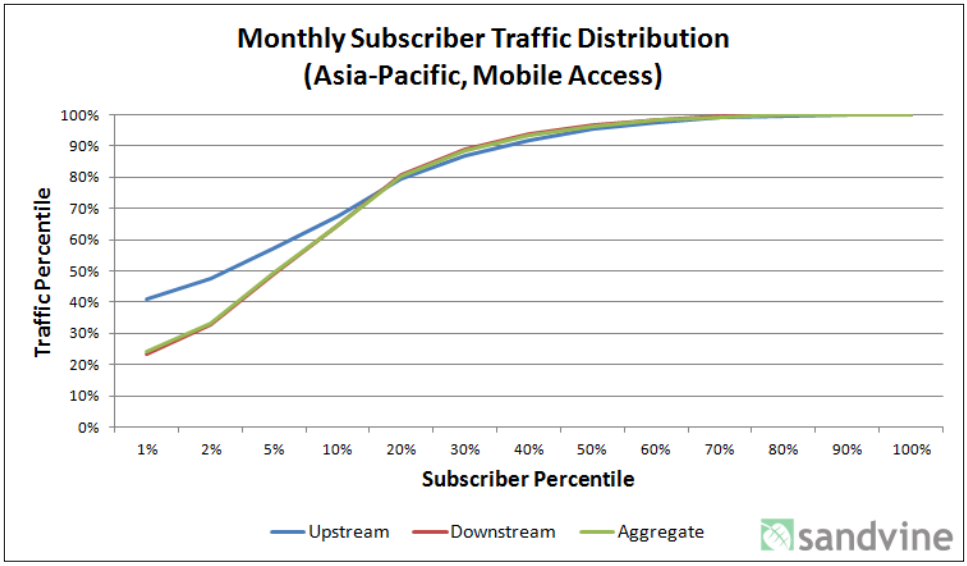

Figure 20 - Monthly Subscriber Traffic Distribution - Asia-Pacific, Mobile Access

Acronym Newcomers: Virtualizing the Internet

There are some new acronyms in town, as CSPs seek to increase ROI by reducing TTM, CAPEX and OPEX via SDN and NFV.

Building (capital expenses, or CAPEX) and operating (operating expenses, or OPEX) a network is expensive, and CSPs must always consider return on investment (ROI) for every penny spent. Additionally, because of the massive amounts of equipment and specialized expertise necessary to run that equipment, getting new innovations and services to market takes a long time. An important metric that most all businesses monitor is time-to-market (TTM), as it measures how quickly they can start receiving a return for the investments made.

In the world of providing Internet connectivity, service providers are always looking for cost-effective ways to meet the growing subscriber demand for bandwidth, and many are exploring the promising subjects of Software-Defined Networking (SDN) and Network Functions Virtualization (NFV). These distinct, but related, technologies have the potential to dramatically lower CAPEX, OPEX and TTM by abstracting network infrastructure from the network control and application layers, and thereby enabling centralized auto-provisioning of network resources.

This abstraction would allow a service provider to expand the bandwidth capacity and geographic reach of the network, flexibly and easily, across a multi-vendor network of devices, from a centralized management center.

Subscribers would benefit by gaining a better experience as a result of rapid network adaptation to demand and the introduction of new services which previously might not have provided sufficient return to justify the investment.

NFV drives further economies of scale by proposing virtualization of network infrastructure elements, and their respective application functions, on commodity high-volume servers, eliminating the need for vendor-specific hardware (and all the associated costs that come with installing and maintaining this specialized equipment).

How could this really work in practice? Let's consider the example of Managed Services, which have been gaining traction especially in fast growing mobile markets. SDN, combined with NFV, takes this notion one step further, by enabling Infrastructure as a Service (IaaS), whereby infrastructure vendors provide 'a network in a box' to new mobile virtual network operator (MVNO) entrants. A number of CSPs at the forefront of SDN are considering pilot overlay networks to try out the technology.

But there are some challenges if you're exploring the Wild West of innovation:

- How to steer traffic across the available network elements to maximize resource utilization?
- How to apply policy rules dynamically to traffic flows?
- How to juggle between multiple different virtual units, performing multiple different functions, each of which has a unique (and often mutually contradictory) set of dimensioning guidelines?

The operators with whom we've spoken about SDN and NFV range from those who are just starting to explore the promise (and haven't yet even considered the challenges) to those who have full test labs and are coupling their entire network architecture strategy to the technologies.

Regardless of the stage of investigation, CSPs can benefit from partnering with pioneers like Sandvine (we built elements of SDN and NFV into our architecture many years ago), the Open Network Foundation, and the European Standards Institute.

For more information, download the "Policy Control & SDN: A Perfect Match?" whitepaper at Sandvine.com

Saving You Bytes – Zero-Rating Device Traffic

When selecting a mobile service provider, subscribers weigh a number of factors before making a selection. Service plan diversity, pricing, and coverage, are just a few of the factors that can influence a subscriber, but in recent years device selection has played an increasingly important role in winning new subscribers.

Devices such as Apple's iPhone or Samsung's Galaxy series phones are just two of the smartphones in huge demand by subscribers, and if they are not offered for sale by a service provider, some subscribers may not even consider purchasing their monthly services from that particular operator.

Recognizing the growing influence that device manufacturers have in the minds of subscribers, one of the leading manufacturers of smartphones in the world now requires traffic to many of their services, such as software updates, to be zero-rated as part of the business terms required for some operators to offer their devices.

While zero-rating traffic might sound like a simple task, in reality it is very complicated. Real-time metering is a pivotal requirement in order to prevent the under-counting of zero-rated bytes which would result in overcharging subscribers, or the over-counting usage which would results in revenue leakage for the operators.

Sandvine's provides CSPs with the real-time metering required by operators, and has proven success in doing so through deployments in multiple networks with the specific purpose of assisting these operators zero-rate software updates from a large mobile device manufacturer.

A Quick Lesson in SPDY

To reduce web page load times, many applications and CSPs are experimenting with, trialing or implementing technologies to increase efficiency. For instance, transparent content delivery networks (CDNs), formerly called caches, seek to decrease latency by moving content closer to subscribers, while other technologies focus on optimizing for other factors.

One such technology being developed primarily at Google is SPDY. SPDY (pronounced “speedy”), is an open networking protocol designed for transporting web content faster and more efficiently over the Internet. SPDY is similar to HTTP with common goals to reduce web page load times and provide increased security. SPDY does not replace HTTP, rather it modifies the way HTTP traffic is sent over the Internet. In this manner, it is similar to features available in Opera Mini and Amazon’s Silk browser.

When HTTP traffic is sent over SPDY, web page requests are processed, tokenized, simplified, compressed and sent through an encrypted SSL tunnel created between the proxy server and the requestor. This encryption can improve the subscriber’s web browsing experience and bang-for-the-usage-buck while making it more secure. But this encryption can also introduce additional latency at the transport layer, which negatively impacts subscriber quality of experience. Depending on your perspective, one downside of sending everything through a proxy is that the provider of the proxy gets complete visibility into your activities.

For many online services, the pros outweigh the cons, and SPDY is already being embraced by Internet heavyweights Facebook and Twitter, among others. As early as March 2013, those using Chrome beta on Android devices could enable SPDY by overriding the startup switches, but there is little doubt that SPDY enablement will appear in the more accessible options in the near future.

How prevalent is SPDY today? In this report, you can see that SPDY appears to be less than 1% of total traffic on most global broadband networks. While that may not seem like much, on some networks, it is already a top-15 application. Also, if you currently run Google Chrome, you can view the live SPDY sessions that your computer is currently running by typing in: chrome://net-internals/#SPDY into your Chrome browser.

New applications like SPDY are just one of the latest examples of the how the make-up of Internet traffic is evolving as faster networks and powerful devices drive dynamic shifts in consumer behavior.

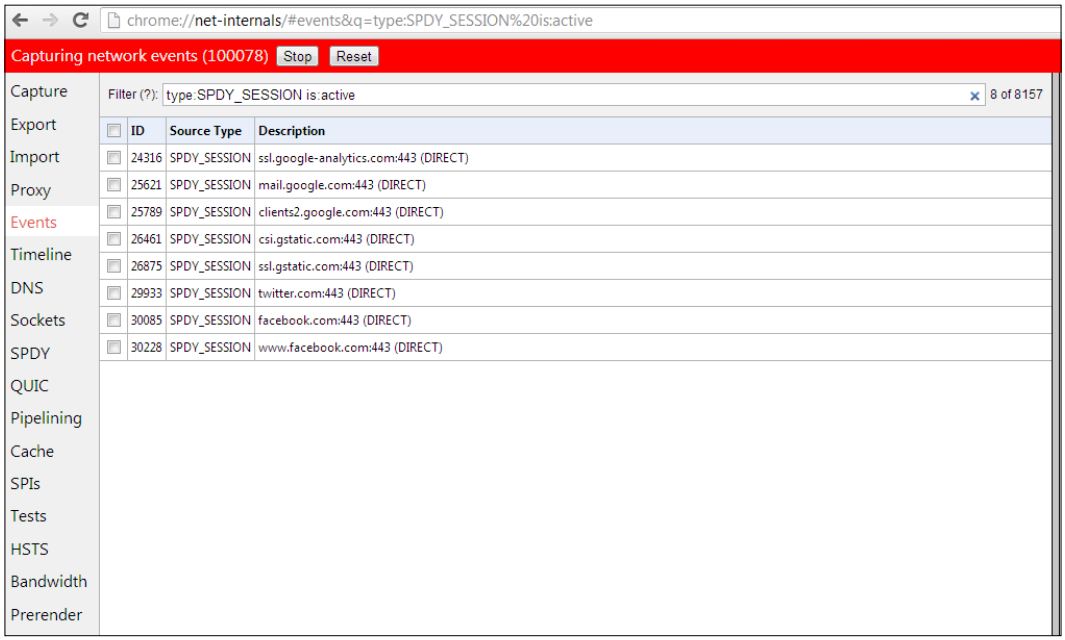

Figure 21 - Example of Applications Running SPDY Sessions in Google Chrome

Latin America, Fixed Access

As a market where mobile networks are subscribers' primary way of accessing the Internet, an examination of fixed access networks in Latin America reveals some interesting findings.

One of the first findings is that monthly fixed-access usage in Latin America is significantly lower than what has been observed in other regions around the globe. Mean monthly usage is 10.0 GB, and median monthly usage is 4.7 GB. When comparing these numbers to North America, which has leading consumption in the globe, subscribers on Latin America's fixed access network use less than a quarter of the data per month than those in North America do.

Monthly Consumption - Latin America, Fixed Access		
	Median	Mean
Upstream	413.6 MB	1.4 GB
Downstream	4.0 GB	8.6 GB
Aggregate	4.7 GB	10.0 GB

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Table 12 - Monthly Consumption - Latin America, Fixed Access

Despite this lower usage, the consumption habits of subscribers in the region are very similar to that observed around the globe. Unsurprisingly, Real-Time Entertainment is the leading source of traffic; accounting for over half of the downstream bytes during peak period, while Web Browsing and Filesharing round out the top three traffic categories. These numbers are broadly in line with what we observed in 1H 2012, with Real-Time Entertainment increasing its share at a rate that is line with other regions in the world.

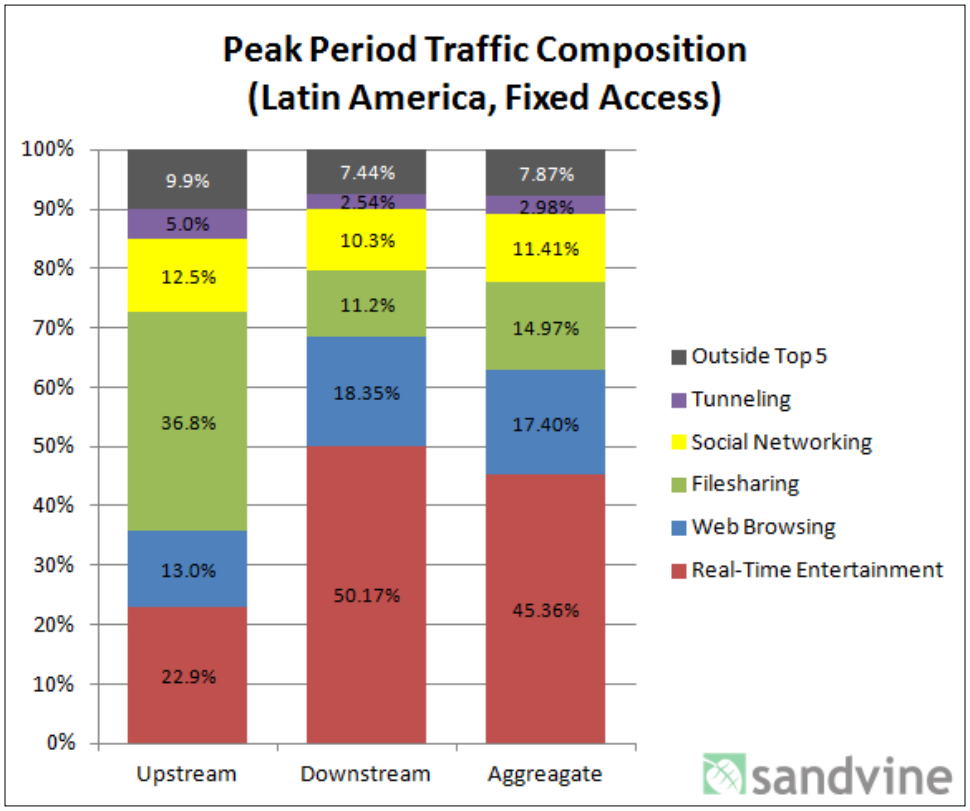

Figure 22 - Peak Period Traffic Composition - Latin America, Fixed Access

Upstream		Downstream		Aggregate	
Application	Share	Application	Share	Application	Share
BitTorrent	23.31%	YouTube	35.61%	YouTube	31.73%
YouTube	13.61%	HTTP	17.19%	HTTP	16.17%
HTTP	11.43%	Facebook	9.07%	BitTorrent	10.19%
Facebook	10.74%	BitTorrent	7.39%	Facebook	9.37%
Ares	9.77%	Flash Video	3.97%	Flash Video	3.79%
Flash Video	3.00%	RTMP	2.18%	Ares	3.29%
Skype	2.80%	MPEG	2.05%	RTMP	1.97%
Teredo	2.26%	Netflix	1.94%	MPEG	1.86%
SSL	2.17%	Ares	1.90%	SSL	1.80%
eDonkey	1.14%	SSL	1.72%	Netflix	1.71%
Top 10	80.24%	Top 10	83.01%	Top 10	81.88%

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Table 13 - Top 10 Peak Period Applications - Latin America, Fixed Access

Looking at the top applications, YouTube at 35.61% of peak downstream traffic is the clear leader in traffic share, more than doubling the second ranked application (HTTP). Making an appearance in our top 10 applications list for the first time is Netflix, which accounts for 1.94% of peak downstream traffic. When we last provided Latin America usage numbers in our 1H 2012 report, Netflix accounted for only 0.8% of peak downstream traffic. In just 12 months time, their share has more than doubled, and while not yet at the same levels observed on North America networks, Netflix is the clear bandwidth share leader in paid-streaming video services in Latin America.

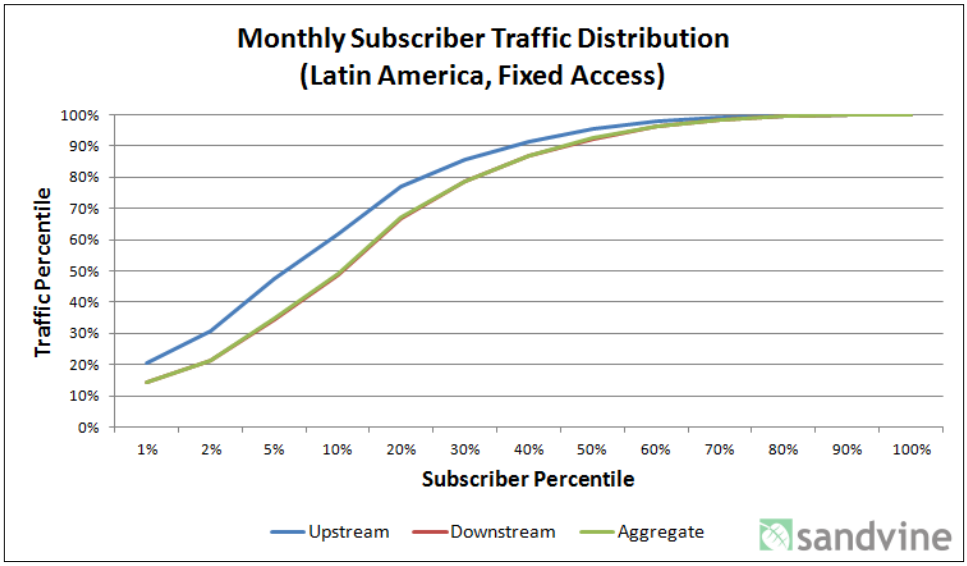

Figure 23 - Monthly Subscriber Traffic Distribution - Latin America, Fixed Access

From a traffic distribution standpoint, the top 1% of subscribers in Latin America who make the heaviest use of the network's upstream resources account for 20.6% of total upstream traffic. The comparable downstream users account for 14.2% of downstream bytes. At the opposite end of the usage spectrum, the network's lightest 50% of users account for only 7.5% of total traffic. These figures are very much in line with what has been observed elsewhere around the globe.

Super Bowl XLVII: The Return of the Super Dip

For the second year in a row, the Super Bowl was streamed online for viewers in the US. While many might think the big game might cause big demand on fixed access networks, the truth is while everyone is watching the game on television they are actually giving the network a break from usage. Last year Sandvine dubbed this phenomena, "The Super Dip", and as you can see in the chart below (taken from an Eastern US network), overall network usage was down roughly 15% during the game once again.

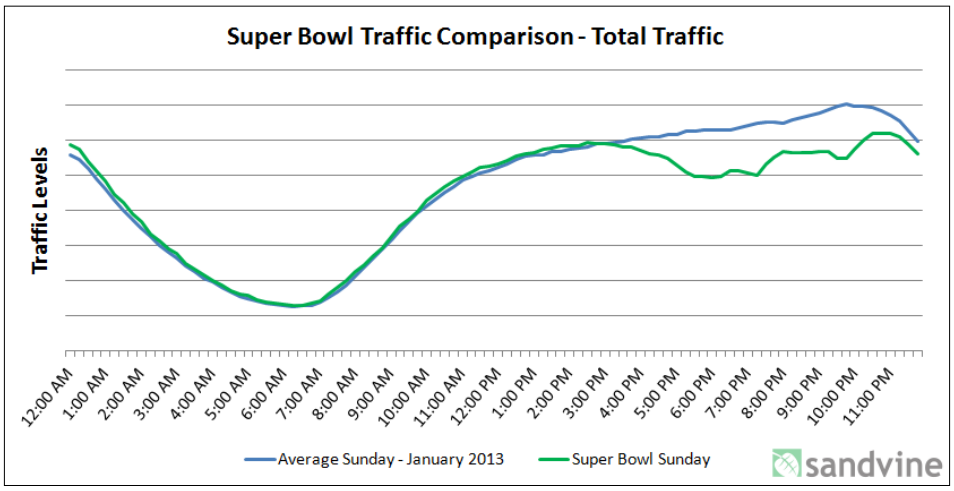

Figure 24 - Super Bowl Traffic Comparison

We've long maintained that the biggest screen is always the favored screen to consume content, and for the Super Bowl it makes sense that most people would prefer to watch the game on their large HDTV. Since the only option to stream the game was via a web browser, getting the game streaming to their TV would have been a challenge for most people, so unsurprisingly the Super Bowl stream accounted for over 3% of total network traffic for the evening.

Interestingly, much like we observed during the 2012 Summer Olympics[7], specific events in the game can drive spikes in usage. The chart below maps observed spikes in Super Bowl streaming traffic with that of major in game events. The big highlights from the game was the kick-off and the San Francisco 49ers' final drive to try and win the game.

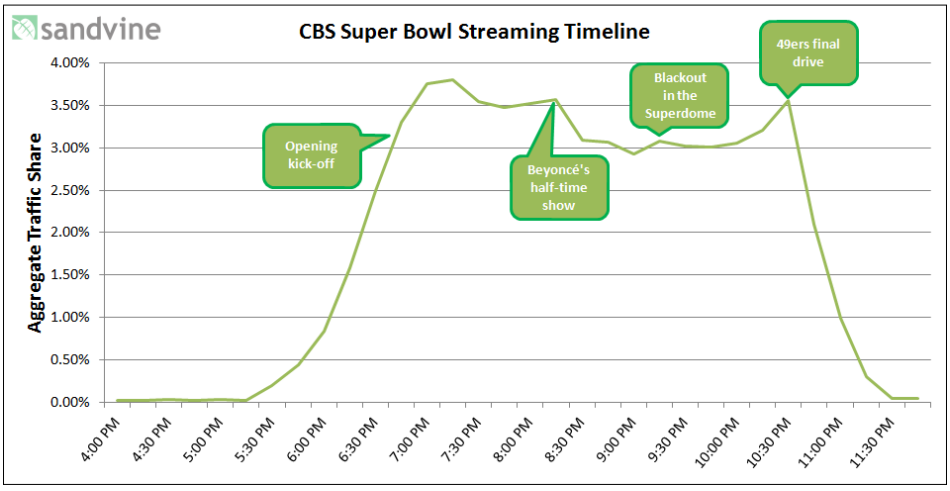

Figure 25 - CBS Super Bowl Streaming Timeline

Sandvine's traffic statistics have shown continued growth in adoption of live streamed sports events, but for the time being such streaming is no threat to replace viewing via traditional broadcast methods, provided the event is widely available[8]. It is clear however that live streaming is only going to get more popular, and if free streaming is being provided for the biggest television event of the year, then users will soon start expecting it to be offered for everything they watch.

7. Deeth, Dan. "Sandvine's Better Broadband Blog : Olympic Update: What Events Owned the Podium?" Sandvine's Better Broadband Blog : Olympic Update: What Events Owned the Podium? Sandvine, 12 Aug. 2012.
8. We continue to see "localized" spikes in content popular with specific demographics (e.g. soccer matches, cricket matches, of an international or derby nature) when television coverage is limited or unavailable

Service Innovation in Latin America – Application-Based Service Plans

Sandvine helped a Telefónica mobile property in Latin America provide affordable, high-value service options by enabling bolt-on services built around subscribers' favorite Layer-7 applications, including Facebook, Twitter, and YouTube.

Before Sandvine, subscribers purchased data in 200 MB blocks, and all data usage counted against this pre-paid quota. In practice, subscribers were fearful of rapidly consuming the data block, and were hesitant to use data. Sandvine introduced the peace of mind that comes with unlimited usage. For a small fee, a subscriber could choose a bolt-on service pack that included unlimited usage of a designated set of applications. No matter how much a subscriber used the applications in the set, the usage was zero-rated. Only applications outside the designated list counted against the regular data block.

These new service options proved to be important competitive differentiators for Telefónica, and subscribers embraced the new services. Telefónica gained new subscribers, experienced higher subscriber retention, and enjoyed significantly increased ARPU. As a result of this success, the implementation was recognized with a Broadband Traffic Management Award and similar plans have been brought to over 10 additional markets across Latin America.

Latin America, Mobile Access

Latin America is a region that has great variation in the types of mobile network, and because of this usage varies greatly from country to country. Most networks in the region are 2G/3G networks, however with the rollout of LTE in some countries, mobile networks have begun to offer an experience that is equivalent and in some cases even better than that of fixed access networks in the region.

In our analysis, we observed a mean monthly usage of 355.8 MB, a modest increase over the 344.1 MB we observed a year ago. It should be made clear however that there is wide variation in usage from country to country and network to network. For example, in one Latin America country we observed mean monthly usage on a 3G network to be 343MB, while on an LTE network in the same country it was 2.7 GB. This wide disparity means that operators, particularly those in emerging markets with low fixed access penetration, should prepare themselves for drastic changes in the usage of their networks as subscribers are sure to take full advantage of the speed and quality of experience benefits provided by LTE.

Monthly Consumption - Latin America, Mobile Access		
	Median	Mean
Upstream	10.1 MB	60.0 MB
Downstream	95.0 MB	295.8 MB
Aggregate	109.1 MB	355.8 MB

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Table 14 - Monthly Consumption - Latin America, Mobile Access

Because of limited fixed access network penetration, mobile networks in Latin America offer a mix of personal handsets and air cards that serve as a household's primary Internet connection. This mix results in interesting traffic profiles. Applications and traffic categories that are typically popular on both mobile devices and PCs are usually the most significant.

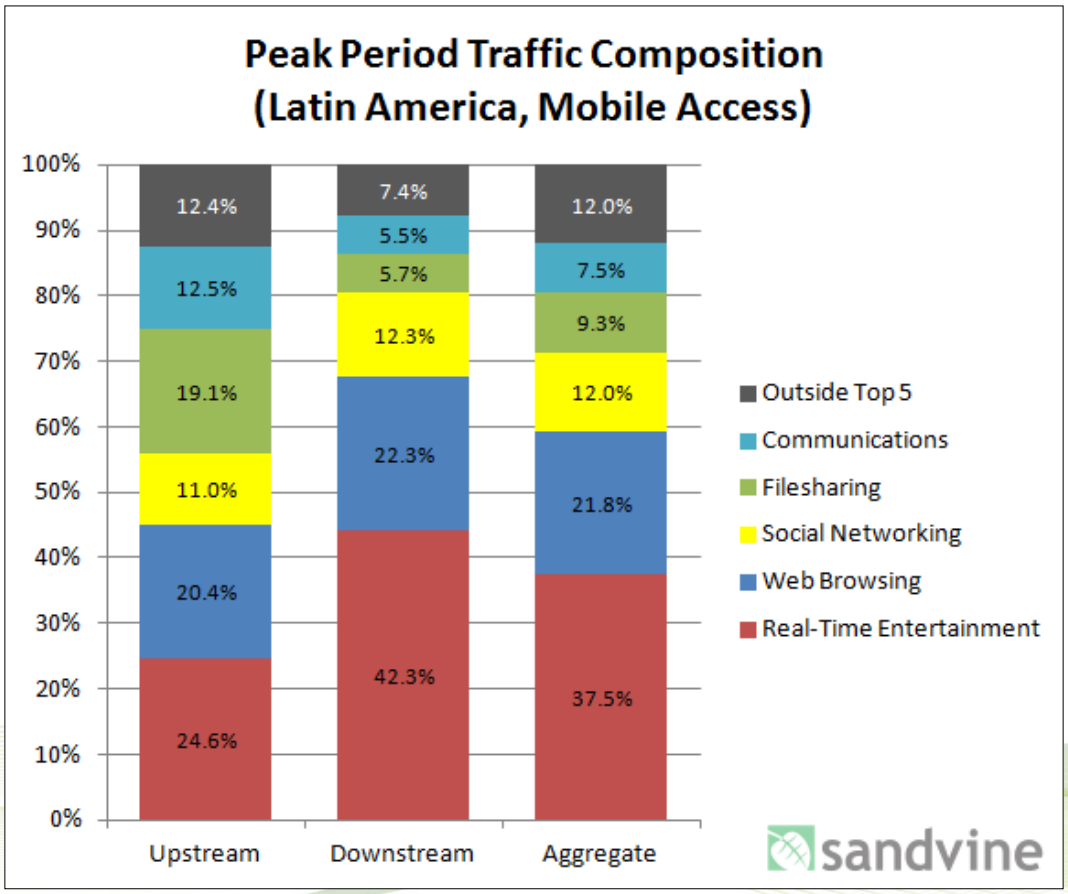

Figure 26 - Peak Period Aggregate Traffic Composition - Latin America, Mobile Access

In Latin America, like most regions across the world, Real-Time Entertainment is the largest driver of mobile traffic, accounting for 42.3% of peak downstream traffic. Much like on fixed access networks in the region, YouTube is the largest source of that downstream traffic, accounting for 26.05%.

Application	Share	Application	Share	Application	Share
HTTP	17.11%	YouTube	26.05%	YouTube	22.87%
YouTube	14.32%	HTTP	19.30%	HTTP	18.70%
BitTorrent	12.69%	Facebook	9.99%	Facebook	9.71%
Facebook	8.86%	Flash Video	4.26%	BitTorrent	5.97%
Skype	8.58%	BitTorrent	3.41%	Skype	4.54%
Ares	3.31%	MPEG	3.33%	Flash Video	3.72%
SSL	3.00%	Skype	3.13%	MPEG	2.99%
Flash Video	2.42%	SSL	2.20%	SSL	2.43%
MPEG	2.17%	iTunes	1.70%	Ares	1.78%
iTunes	1.40%	Windows Update	1.39%	iTunes	1.62%
Top 10	73.87%	Top 10	74.77%	Top 10	74.32%

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Table 15 - Top 10 Peak Period Applications - Latin America, Mobile Access

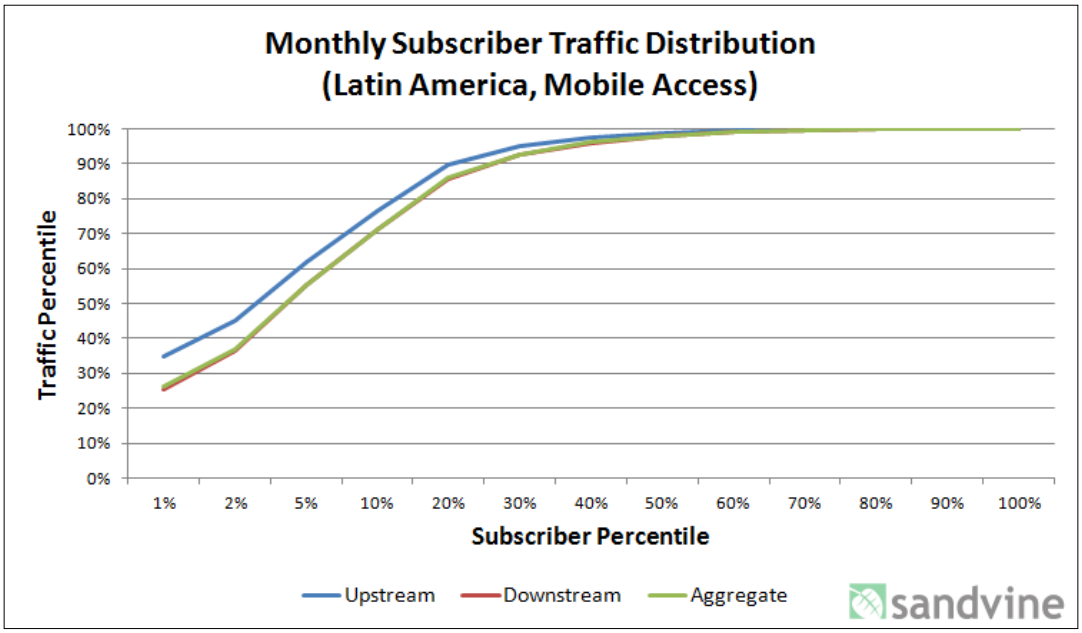

Figure 27 - Monthly Subscriber Traffic Distribution - Latin America, Mobile Access

In Latin America, the 1% of subscribers who make the heaviest use of the network's upstream resources account for 35.0% of upstream, 25.5% of downstream, and 26.1% of aggregate bytes each month. Much like observed in Europe and Asia-pacific, this high concentration among the top 1% of users is likely due to the use of computers as opposed to just smartphones on the network. This is supported by the fact that Filesharing is over 19% of total upstream traffic during peak period, and that is an application typically not run on a smartphone or tablet.

Why is My Video Choppy, and How Can it Be Improved?

Network congestion is defined as the situation in which an increase in data transmissions results in a proportionally smaller or even a reduction in throughput. In other words, when a network is congested, the more data you try to send the less data you succeed in sending.

Congestion occurs on any shared resource (consider city streets, popular restaurants, the line-up for a washroom at intermission, electrical grid brown-outs) and is the result of economic realities. It is financially impossible to scale something to be available for all users all the time. Securing your own Internet connection with a completely guaranteed speed and availability would cost literally tens or hundreds of times what you currently pay (for mission-critical applications, businesses indeed are forced to pay such amounts).

However, the economics behind affordable ubiquitous Internet are likely not at the forefront of our thoughts when we are starting at a swirling "loading" sign on a video, or are frustrated by compression artifacts, choppiness, or bitrate downshifts. Behind the scenes, what's happening is that some link between you and the server is congested, and this congestion is causing an increase in latency, which in turn is wreaking havoc on your video.

In practice, degradations in subscriber quality of experience (QoE) that are ultimately caused by network congestion are proximately caused by a phenomenon known as congestive collapse. As throughput increases on a node or router, latency increases due to the growing queue delay and the 'bursty' nature of TCP. The increase is rather marginal, but proportional to the increase in bandwidth. As the throughput approaches capacity, latency begins to increase exponentially until it reaches a final tipping point where the element experiences congestive collapse. When an access node is near or at capacity, subscribers experience the greatest deterioration of QoE. Looking at our definition another way, congestive collapse is the point at which latency no longer grows proportionally to throughput.

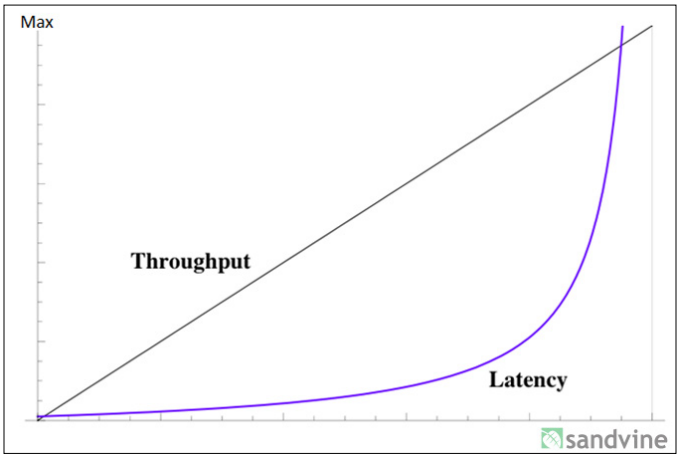

Figure 28 - Relationship between Throughput and Latency

It is also worth considering that the actual capacity of a network resource is dynamic (i.e. it is not constant). This reality is true of both mobile networks and fixed networks and causes many complications for network operators who are fervently trying to deliver a high-quality service.

To combat congestion, CSPs must be able to determine when congestion is occurring or better yet, when it is about to occur. In a world without dynamic resource capacity (that is, a make-believe world), detecting congestion would be a relatively straightforward affair: simply define (based on manufacturer specifications or lab tests) the maximum capacity of every resource, then make sure you have ubiquitous real-time insight into the instantaneous throughput or load of every resource. Alas, the realities of dynamic capacity render this solution a pipe dream. With dynamic capacity, the point at which a resource begins to dive rapidly into congestive collapse changes constantly, which makes using static bandwidth thresholds to detect congestion completely ineffective.

The figure above provides the answer – a precursor of congestion is an acceleration in the increase of packet latency. By measuring the round-trip time (RTT) from when a packet enters the network to the time at which the response packet passes the same point, CSPs can determine exactly when and where (provided the measurements are link-aware) network congestion is about to impact subscriber QoE. Note that the access network is where operators have the most influence over latency - there isn't much that an operator can do about the health of the Internet beyond their borders (although as we saw in The Importance of Routing Efficiently, they do have some control over the routes the traffic takes). For this reason, when measuring per-resource subscriber QoE for congestion management it's important to isolate access round-trip time (aRTT) from total round trip time.

Overall then, solving the access network congestion problem requires the ability to detect congestion at the exact time it is occuring (i.e. real-time) and in a manner that is not dependent on guessing the tipping point in advance for the congestive collapse of the access resource.

Assuming a CSP has the technology in place to detect congestion, we should now explore what actions they could take to ensure a high QoE for subscribers. The simplest approaches act high up in the network hierarchy and reduce the amount of traffic on the network. Such approaches are woefully ineffective because there's no guarantee they'll even impact the congested resource. Instead there's every likelihood that they'll negatively impact subscribers on other parts of the network that aren't anywhere near congestion.

A second approach, one that is resource-aware, might be to limit the total amount of traffic going through the resource until the congestion disappears. This unfortunately won't actually achieve anything that the congestion wouldn't have acting alone.

We must then assume that some sort of differentiation is required; that is, to resolve the congestion we must limit some traffic so that other traffic can "get through". Let's consider the simple case of "high value" traffic and "low value" traffic. An ideal solution would preserve the quality of experience for high value traffic by prioritizing it over low value traffic. Keep in mind however, that it is important that low value traffic still be assured of some minimum level of quality of experience to avoid starvation.

In the real world, this ideal congestion management solution is characterized by a few features, primarily:

- Link awareness
- Real-time congestion awareness based on access round-trip time
- Real-time feedback loop to trigger congestion management policies
- The absence of any fixed thresholds

In the real world, this congestion management solution is called Sandvine Fairshare Traffic Management, which includes the QualityGuard congestion response system. QualityGuard detects congestion by measuring aRTT in real-time and then works continuously to protect the quality of experience for high-value traffic while still guaranteeing other traffic does not starve. Once the resource returns to a non-congested state, the congestion management policies cease.

Importantly, QualityGuard ensures that Sandvine's congestion management solutions are applied only when and where congestion exists, as close to the affected subscribers as possible. This focus on maintaining the subscriber quality of experience is a major differentiator, because competitive offerings suffer from fatal flaws (e.g. they only manage aggregate traffic patterns, or they lack an effective QoE measure and rely on static thresholds). For subscribers, this means that the Sandvine approach is the best way of preserving quality of experience.

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

Explanation of Traffic Categories

The table below describes each of the categories used in the Global Internet Phenomena Report: 1H 2013.

Traffic Category	Description	Examples
Administration	Applications and services used to administer the network	DNS, ICMP, NTP, SNMP
Communications	Applications, services and protocols that allow email, chat, voice, and video communications; information sharing (photos, status, etc) between users	Skype, WhatsApp, iMessage, FaceTime, MSN Messenger
Filesharing	Filesharing applications that use peer-to-peer or Newsgroups as a distribution models	BitTorrent, eDonkey, Gnutella, Ares, Newsgroups
Gaming	Console and PC gaming, console download traffic, game updates	Nintendo Wii, Xbox Live, Playstation 2, Playstation 3, PC games
Marketplaces	Marketplaces where subscribers can purchase and download media including applications, music, movies, books, and software updates	Google Android Marketplace, Apple iTunes, Windows Update
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 Video, MPEG), peercasting (PPStream, Octoshape), specific streaming sites and services (Netflix, Hulu, YouTube, Pandora)
Social Networking	Websites and services focused on enabling interaction (chat, communication) and information sharing (photos, status, etc.) between users	Facebook, Twitter, LinkedIn, Instagram, Google+
Storage	Large data transfers using the File Transfer Protocol (FTP). Services that provide file-hosting, network back-up, and one-click downloads	FTP, Rapidshare, Mozy, zShare, Carbonite, Dropbox, Backblaze, Apple Photostream
Tunneling	Protocols and services that allow remote access to network resources, mask application identity, or provide encapsulation	Remote Desktop, VNC, PC Anywhere, SSL, SSH,
Web Browsing	Web protocols and specific websites	HTTP, WAP browsing

Table 16 - Traffic Categories

Study Details

Sandvine's Global Internet Phenomena Reports examine a representative cross-section of the world's leading fixed and mobile communications service providers in March 2013 and are made possible by the voluntary participation of our customers. Collectively, Sandvine's customers provide Internet and data service to hundreds of millions of subscribers worldwide.

In the Global Internet Phenomena Report: 1H 2013, we examined four regions:

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

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

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

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

The 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 and access technology market share.

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

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

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