

2010 Mobile Internet Phenomena Report

Consumers worldwide are embracing a new generation of mobile data applications. Service providers, in turn, are responding with aggressive rollouts of 3G, HSPA, EVDO, WiMAX and LTE networks to attract consumers with an experience comparable to their residential broadband service.

Sandvine's 2010 Mobile Internet Phenomena study examines a representative cross-section of the world's leading mobile data providers and is made possible by the voluntary participation of our customers. With customers in more than 70 countries, representing over 300 million fixed and mobile subscribers, "Sandvine is the worldwide market leader for standalone DPI product revenue".¹

Enabling rapid service creation for the world's largest 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 their subscribers and understand network trends; offer new services; mitigate malicious traffic; manage network congestion; and deliver QoS-prioritized multimedia services.

1. Infonetics. Service Provider Deep Packet Inspection Product Market Outlook.

Executive Summary - Connecting Lives with The Everywhere Internet

Currently, the vast majority of mobile subscribers rely on second-generation mobile technologies, but service providers are investing billions of dollars into aggressive rollouts of 3G, HSPA, EVDO, WiMAX and LTE to deliver a fully-featured wireless Internet. With subscriber numbers projected to triple and exploding data traffic, it is critical that service providers maximize their return on investment for the massive capital expenditures that are underway.

The “wireless Internet” is a term that refers to a range of technologies and applications. People who read web pages on WAP browsers or with Opera on their smartphones are participants in the wireless Internet; more specifically, they likely have a data subscription with their mobile phone provider and are surfing what’s known as the “mobile Internet”. A stranger in the park using a 3G wireless aircard (or USB “dongle”) to connect her laptop to the Internet is also using the mobile Internet.

To subscribers, the Internet is the Internet, whether it’s accessed through a wire or over wireless spectrum. Many subscribers don’t differentiate between cable and DSL, and history suggests that subscribers will view wireless technologies as one.

With network convergence becoming a closer reality with each passing day, the requirements placed upon each part of the network are gradually shifting. Subscriber habits will hugely influence the capital investments required to deliver a quality experience, and the notion of one Internet has massive ramifications for service providers.

Network operators are making infrastructure investments to satisfy the growing appetite of subscribers, pressuring the bottom line. Furthermore, mobile service providers are grappling with falling voice ARPU (average revenue per user) and are exploring ways to offset those declines by introducing usage-based plans that increase data ARPU. Additionally, many operators are trimming operational expenses by improving network efficiencies. With mobile video rapidly becoming a necessity in the same manner as mobile voice did just a few years ago, it promises to be a major piece of the puzzle for service providers.

Because so many subscribers currently rely on second-generation mobile technologies, there is a long way to go before 3.5G+ and LTE networks are the norm. With such major distance left on the path to an everywhere broadband Internet, there is a great deal of opportunity remaining for service providers worldwide.

Sandvine’s analysis of global mobile Internet traffic identified a number of high-level findings that will influence how wireless operators prioritize their investments:

- Mobile data networks are experiencing congestion: service providers must investigate the cause and location (for example, radio access network, aggregation or backhaul) to formulate effective network management policies
- Flat-rate billing does not align with subscriber usage, which is hugely disproportionate: the top 5 percent of subscribers account for 50 percent of traffic
- Subscriber behavior is extremely variable: there is a major opportunity for service providers to introduce personalized services that incorporate consumption-, event- and time-based parameters
- Time-sensitive traffic is a major component of mobile data, but it competes with bulky applications: YouTube and generic Flash video are the dominant forms of on-demand entertainment, but P2P filesharing is prevalent
- The mobile Internet connects lives: social networking is massively popular, accounting for up to 9 percent of utilized bandwidth during periods of peak bandwidth utilization

At the core of successful mobile Internet strategy is sufficient data to make informed decisions regarding service plans, management policies, capital investments and premium services. Service providers have long since had access to detailed information from billing and operations systems, but only recently is that information being combined with application-level awareness of per-subscriber Internet usage.

Sandvine calls this level of insight “network business intelligence”, and with it service providers can combine application-level, subscriber-aware network data with financial objectives, assumptions and data from billing systems to accurately model network operation at a business level.

Accurate application-level information is useful in and of itself, but it becomes extraordinarily powerful when combined with business and subscriber data already available to service providers. By understanding the data on the network, service providers can make more informed business decisions. When information such as usage characteristics, element utilization, and subscriber demographics is readily available, service providers are able to

implement optimized network management policies and can introduce new revenue streams such as premium services while satisfying the diverse needs of a growing subscriber base.

A network business intelligence solution can help network operators to answer questions like:

- Where is the optimal place to spend each dollar of available CapEx?
- What is the definition of subscription packages that maximizes revenue while having no more than 5 percent of subscribers experience overage charges?
- Where are the sectors experiencing the most concurrent sessions, and which of those have the most subscribers?

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

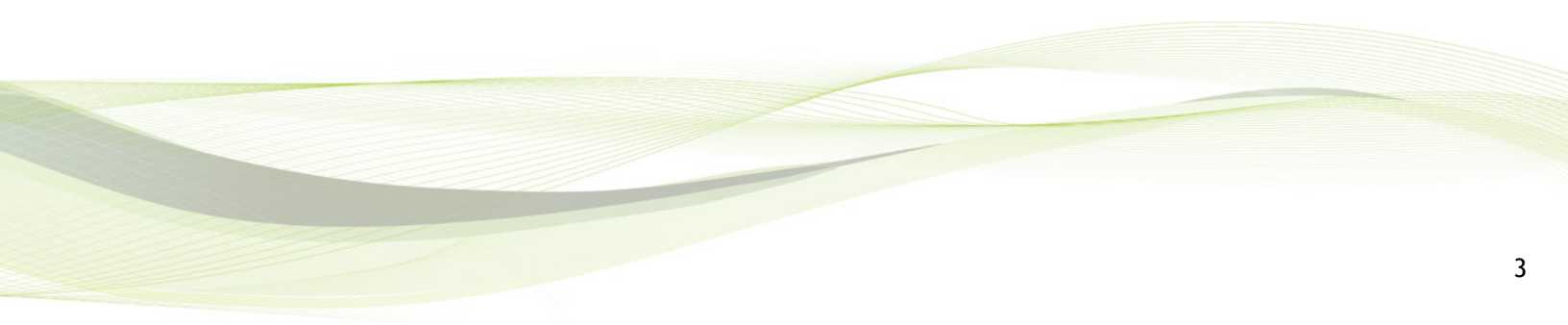


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Connecting Lives - The Everywhere Internet

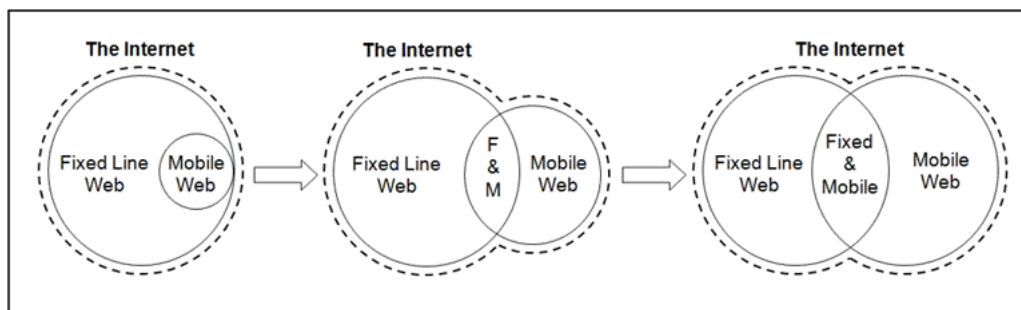
The “wireless Internet” is a term that refers to a range of technologies and applications. People who read web pages on WAP browsers or with Opera on their smartphones are participants in the wireless Internet; more specifically, they likely have a data subscription with their mobile phone provider and are surfing what’s known as the “mobile Internet”. A stranger in the park using a 3G wireless aircard (or USB “dongle”) to connect her laptop to the Internet is also using the mobile Internet. Providers of WiMAX (802.16-2004 - “fixed WiMAX”) typically identify more with cable and DSL providers than mobile data providers, but the Internet service is still delivered through the air. The same is true for providers of satellite Internet, who are known for servicing areas where laying wires is cost-prohibitive, but have increasing presence in traditional broadband strongholds. Providers of WiMAX (802.16e-2005 - “mobile WiMAX”) have a great deal in common with traditional mobile data providers, although mobile WiMAX networks typically have much larger proportions of laptops, which has a huge influence on the traffic and usage profiles.

Confusing matters further, many devices are able to connect to different wireless standards, blurring the lines between networks. Additionally, the emergence of femtocells and the prevalence of WiFi hotspots continue to increase the options for subscribers. While providers are fully aware of the inter-operability and limitations of each technology, many users remain oblivious to the differences. 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 Internet on Mobile” and “The Mobile Internet”²

Beyond the physical infrastructure defining the network hardware, there’s the fuzzier concept of the bits and bytes that make up the network in a content-sense. Informa describes the modern Internet as the superset of the “Mobile Web” and the “Fixed Line Web”³. The distinction between the two is significant, and can also be described as the Mobile Internet versus the Internet on Mobile.

The Evolution of the Internet as Mobile Content Increases



Source: Informa Telecoms & Media

Figure 1 - The Evolution of the Internet as Mobile Content Increases⁴

While the Mobile Internet is comprised of services and applications specifically targeted at mobile devices (and typically optimized accordingly), the Internet on Mobile is just that - the traditional Internet (in all its high resolution bandwidth-intensive and jitter-sensitive glory) delivered over a wireless network to a mobile device with limited processing power and display capabilities.

Morgan Stanley, in their “Mobile Internet Report” identified five trends that are converging to define the mobile Internet⁵:

- 3G and LTE networks
- Social Networking
- Video
- Voice-over-IP
- Impressive mobile devices

2. Ross, Jamie. The Mobile Internet Is 10 Year Old: It's Time for a Reality Check. Informa Telecoms & Media.
3. Ross, Jamie. The Mobile Internet Is 10 Year Old: It's Time for a Reality Check. Informa Telecoms & Media.
4. Ross, Jamie. The Mobile Internet Is 10 Year Old: It's Time for a Reality Check. Informa Telecoms & Media.
5. Morgan Stanley Mobile Internet Report.

Of the five trends, social networking and video⁶ also exert huge influence on traditional broadband networks, with real-time entertainment emerging as the dominant form of traffic on the Internet⁷. With a common use case, in this case video, being a primary driver of increasing data levels on both wired and wireless networks, the lines separating wired from wireless will quickly be washed away by a sea of on-demand entertainment.

The rapid evolution of mobile devices is also a major factor that is defining the traffic make-up on wireless networks. Modern smartphones offer a browsing experience approaching that found on a traditional computer, and the competition between hardware, software, and operating system manufacturers is driving innovation. The most popular devices will find a balance between quality and convenience that delivers a “good enough” Internet experience combined with the added features (such as locality) of the mobile age.

With network convergence becoming a closer reality with each passing day, the requirements placed upon each part of the network are gradually shifting. Subscriber habits will hugely influence the capital investments required to deliver a quality experience, and the notion of one Internet has massive ramifications for service providers. While mobile devices are used on the go, they are increasingly used at home - why get up and walk to your laptop when you can get a comparable browsing experience on your mobile phone? In Cisco’s most recent Visual Networking Index report, they stated that “a significant amount of traffic will migrate from mobile to fixed networks” but cautioned that “a much greater amount of traffic will migrate from fixed to mobile networks”⁸. This is a sentiment that is widely accepted - in February 2010, Xchange Mag published an article in which they stated that “The launch of e-readers, the Apple iPad⁹ and other embedded mobile broadband devices is set to transform the way users access the Web and personal content at home”¹⁰. They added that “Even when they’re at home, people increasingly like to use their connected devices over WiFi and 3G networks for mobile entertainment.”

Growing Mobile Internet Opportunities amid Declining Voice Revenues

It is important to maintain perspective when discussing the mobile Internet - for all we’ve seen, heard and experienced history will remember these years as the infancy of wireless broadband. Estimates vary based upon the exact classifications (for example, “users” versus “subscriptions”), but it’s generally accepted that in 2009 there were between 300 million¹¹ and 600 million¹² people experiencing the Internet on a mobile device, accounting for roughly \$60 billion¹³ in data revenues.

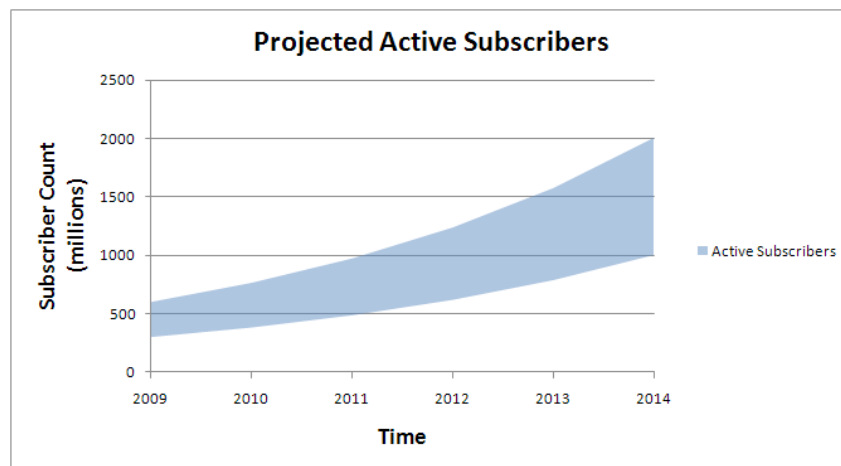


Figure 2 - Projected Active Mobile Internet Subscribers

While significant, these numbers are dwarfed by projections suggesting between 1 billion¹⁴ and 2 billion¹⁵ users by 2014, and revenues well in excess of \$100 billion¹⁶. And therein is one of the points of concern for wireless providers - while the number of users is expected to triple or even quadruple in the next five years, revenue is predicted to only double.

6. These two characteristics are combined in Chatroulette (<http://www.chatroulette.com/>), a website that pairs random users for webcam-based conversations. Only launched in November 2009, it gained popularity after being profiled in the mainstream media.

7. Sandvine Inc. 2009 Global Broadband Phenomena.

8. Cisco. Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2009-2014.

9. The iPad gets the most media attention, but there is also a plethora of devices from other manufacturers: Vaughan- Nichols, Steven J. "Here Comes Linux's iPad Clones." Computerworld Blogs.

10. Seals, Tara. "Billing 'Better Broadband'". Xchange.

11. Strategy Analytics. Connected Devices Fuel 1 Billion New Mobile Broadband Subs by 2014.

12. Ross, Jamie. The Mobile Internet Is 10 Year Old: It's Time for a Reality Check. Informa Telecoms & Media.

13. Ross, Jamie. The Mobile Internet Is 10 Year Old: It's Time for a Reality Check. Informa Telecoms & Media.

14. Strategy Analytics. Connected Devices Fuel 1 Billion New Mobile Broadband Subs by 2014.

15. Ross, Jamie. The Mobile Internet Is 10 Year Old: It's Time for a Reality Check. Informa Telecoms & Media.

16. Ross, Jamie. The Mobile Internet Is 10 Year Old: It's Time for a Reality Check.

At the same time, network operators are making infrastructure investments to satisfy the growing appetite of subscribers, pressuring the bottom line. Furthermore, mobile service providers are grappling with falling voice ARPU (average revenue per user) and are exploring ways to offset those declines by introducing usage-based plans that increase data ARPU. Additionally, many operators are trimming operational expenses by improving network efficiencies.

According to analyst firm ABI Research, mobile voice revenue will peak in 2010, at \$580 billion, before starting to contract from 2011 onwards¹⁷. Additionally, global end-user ARPU dropped globally between 6 percent and 9 percent from Q3 2008 to Q3 2009¹⁸. In the United States, from Q3 2009 to Q4 2009, voice ARPU declined by \$0.98 and was only partially offset by a \$0.53 increase in data ARPU¹⁹. Figure 3 plots the ARPU attributable to voice and data in the United States from 2004 through 2009. If these trends continue unabated, voice ARPU and data ARPU will intersect in 2013 at roughly \$23 each.

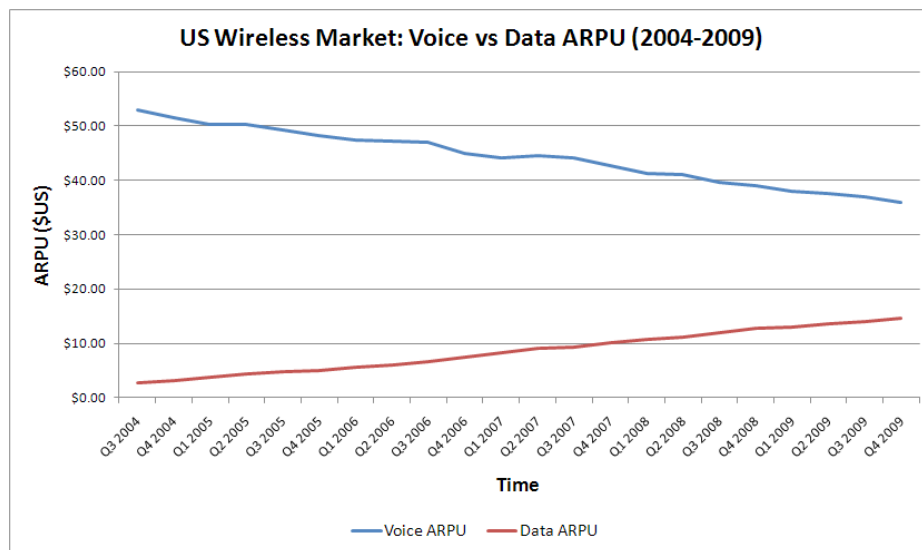


Figure 3 - US Wireless Market - Voice vs Data ARPU (2004-2009)²⁰

By leveraging the enormous demand for data, service providers can at least partially make up for declining voice revenues - but in areas where subscribers are accustomed to unlimited usage for a flat rate, network operators will face challenges. Nevertheless, with mobile video rapidly becoming a necessity in the same manner as mobile voice did just a few years ago, there remain plenty of opportunities for service providers to recoup their investments.

In the United States, mobile providers attribute on average 29 percent of overall ARPU to mobile data. Projections indicate mobile data service revenue will increase by 20 percent in 2010, to a total of \$53 billion. Of this data revenue, non-messaging services are responsible for 60-65 percent. Softbank, a mobile operator in Japan, is expected to be the first major provider outside of the Philippines with more revenue from data services than from voice²¹.

Of the massive increase in subscriber numbers worldwide, LTE is expected to make up the bulk, with 84 percent of new additions using this technology by 2014²². WiMAX is also projected to be a powerful driver, being responsible for 11 percent of new subscribers²³. Keep in mind that mobile WiMAX has already exceeded fixed WiMAX in terms of number of subscribers worldwide²⁴. While the more than 200 WiMAX providers worldwide currently provide service to only 5 million subscribers, that number represents an 80 percent increase over a 12-month period²⁵, so the technology is experiencing strong growth.

Currently, the vast majority of subscribers rely on second-generation mobile technologies, with the figure dropping to 70 percent by the end of 2010²⁶, so there is a long road to travel before 3.5G+ and LTE networks are the norm.

With such major distance to an everywhere Internet, there is a great deal of opportunity remaining for service providers worldwide. The remainder of this report analyses network data and draws important conclusions about the strategies and factors that will determine the relative success of service providers worldwide.

17. ABI Research. "Mobile Voice Service Revenues to Decline in 2010." Softpedia.
 18. ABI Research. "ARPU's Continue to Fall Globally as Mobile Voice Usage Nears Saturations, Says ABI Research." Tekrati: The Industry Analyst Reporter.
 19. Chetan Sharma Consulting. US Wireless Data Market - Q4 2009 and 2009 Update.
 20. Produced with data from Chetan Sharma Consulting. US Wireless Data Market - Q4 2009 and 2009 Update.
 21. Chetan Sharma Consulting. US Wireless Data Market - Q4 2009 and 2009 Update.
 22. Strategy Analytics. Connected Devices Fuel 1 Billion New Mobile Broadband Subs by 2014. Strategy Analytics: Insights for Success.
 23. Strategy Analytics. Connected Devices Fuel 1 Billion New Mobile Broadband Subs by 2014. Strategy Analytics: Insights for Success.
 24. Ashai, Basharat. Strong Growth for Mobile WiMAX Subscriber Base. Rep. 11th ed. Vol. 5. Maravedis.
 25. Ashai, Basharat. Strong Growth for Mobile WiMAX Subscriber Base. Rep. 11th ed. Vol. 5. Maravedis.
 26. Harnick, Chris. "Mobile Service Revenue to Exceed \$1 Trillion by 2013: Informa." Mobile Marketer.

Analysis of Daily Network Traffic Profiles

With mobile operators worldwide expected to spend up to \$72 billion on mobile broadband technologies in 2010²⁷, an accurate understanding of the daily application-level network traffic composition is critical to ensure efficient use of this investment. The analysis in this section leads to some general conclusions:

- Mobile data networks are experiencing congestion: service providers must investigate the cause and location (for example, radio access network, aggregation or backhaul) to formulate effective network management policies

This section also yields the following high-level observations:

- Web browsing and real-time entertainment dominate the wireless Internet, and globally account for between 52 percent and 63 percent of the network's peak usage
- Social networking applications represent between 4 percent and 9 percent of the network's peak bandwidth
- P2P filesharing and other bulk data categories are responsible for about 15 percent of peak period traffic in Europe and North America, and almost 30 percent in Caribbean and Latin America

Caribbean and Latin America

As a region, the Caribbean and Latin America has relatively low levels of wired broadband penetration; a wireless connection might be the first Internet service for many subscribers. This presents an opportunity for service providers to influence the services and applications that make up the mobile Internet - subscribers won't have preconceived notions of what to expect and relatively few will have wired broadband as a basis for comparison.

Even though traditional broadband penetration is low, mobile devices have enjoyed great success; many people in the region don't have a smartphone, but many do have mobile phones. Consequently, many subscribers will be choosing between two primary alternatives:

- Keep the mobile phone, and purchase a laptop (or other portable computer) to use with a wireless aircard
- Upgrade from a mobile phone to a smartphone

While 2.5G CDMA subscriptions are in decline in this region, EVDO maintains strong growth. At the same time, interest in WiMAX is increasing but faces pressure from faster versions of EVDO²⁸. The region has roughly equal numbers of UMTS and EVDO subscriptions²⁹.

All forms of wireless Internet will find success in Caribbean and Latin America, but the split between laptops and smartphones might well determine how much network investment is required.

As was the case in the 2009 Global Broadband Phenomena study³⁰, this region has the highest relative levels of P2P filesharing, but unlike that study P2P is not the largest category on the network. Caribbean and Latin America exhibits a mix of traffic that is led by web browsing and real-time entertainment, which combine to account for more than half of utilized bytes during the peak evening period. Of the three regions examined in detail in this study, Caribbean and Latin America has the highest proportion of social networking traffic, at just under 9 percent of peak hours bandwidth and 7.2 percent off peak.

During peak evening hours, the average network in Caribbean and Latin America carries 31.4 percent more traffic than during off-peak time, but the normalized share per active subscriber decreases by 21.8 percent - a possible indicator that parts of the network are reaching capacity.

Experience and studies of cable and DSL networks suggest that, so long as resources allow it, subscribers typically increase their personal bandwidth utilization during the evening. The fact that the per-subscriber share of total bandwidth drops in this region suggests that network congestion is occurring.

Terminology: 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.

Terminology: 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**.

27. "Mobile Broadband Investment Set to Soar as HSPA Connections Pass 200 Million," cellular-news.

28. Business News Americas. Telecom Stats 1Q09- Statistics and Analysis Latin American Telecommunications 1st Quarter 2009.

29. 3G Americas: Business News Americas. Telecom Stats 1Q09- Statistics and Analysis Latin American Telecommunications 1st Quarter 2009.

30. Available at http://www.sandvine.com/news/global_broadband_trends.asp

Determining in what part of the network capacity is being reached requires a hierarchical analysis of traffic. If congestion is limited to specific locales (say at the RAN level), then it might not be impacting a large number of subscribers, but the impact to the affected subscribers might be significant. If congestion is occurring on the network's backhaul links, then it has the potential to impact all subscribers, but perhaps to a lesser extent. Determining an effective strategy to address this issue is critical to the goal of maintaining subscriber quality of experience.

Did you know?

During the peak period, bandwidth utilization in Caribbean and Latin America is 31.4 percent higher than the off-peak average, but the per-subscriber share of bandwidth drops by 21.8 percent.

The data suggests that networks in this region are not as dominated by laptops as their global counterparts, as the monthly average data consumption is only about 600 MB. However, there is a wide variation by country that correlates very strongly to the age of the network. In countries where mobile Internet deployments began earliest, average monthly consumption is about 1.5 GB. We can expect to see monthly data consumption rapidly grow as network speeds increase, coverage expands, and subscribers become accustomed to using the Internet on the go. Service providers have a narrow window in which to educate subscribers and to influence usage through innovative billing strategies that appropriately align usage and cost.

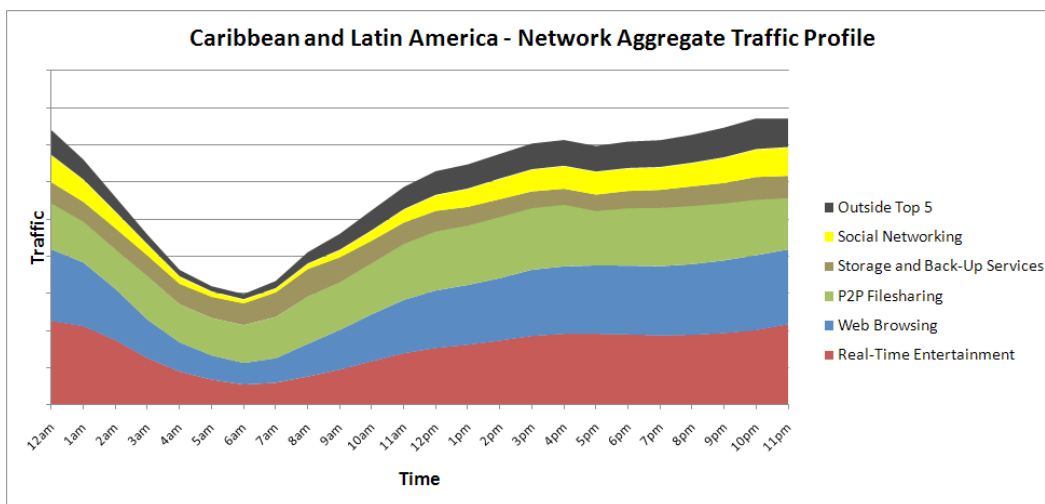


Figure 4 - Caribbean and Latin America - Network Aggregate Traffic Profile

Did you know?

In regions where wired broadband penetration is low, many subscribers are skipping straight to mobile broadband.

Caribbean and Latin America - Network Aggregate Peak Hours

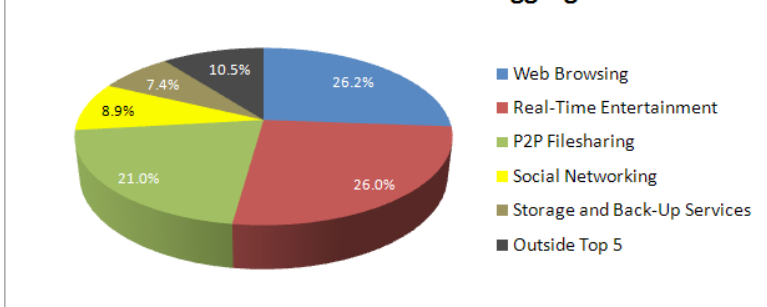


Figure 5 - Caribbean and Latin America - Network Aggregate Top Categories by Bytes (Peak Period)

Europe

Europe contains an interesting mix of networks covering countries at different stages of broadband adoption. The mobile Internet market has more than 20 million subscribers, and data indicates that the number will nearly double by 2011³¹. Revenue will increase significantly but the rate will lag that of subscriber growth, rising from €6 billion to in excess of €11 billion in the same period.

In much of Western Europe, where broadband penetration is high, subscribers will compare mobile Internet to the fixed line broadband offerings with which they are familiar. This reality puts an especially high performance bar on the networks, and operators are planning aggressive HSPA+ and LTE deployments to compete with fixed line offerings.

31. EARTHtimes.org. "GSMA: New Report Predicts Explosive European Growth for Mobile Broadband." EARTHtimes.org

In Eastern Europe, where traditional broadband technologies have relatively lower penetration, many consumers will be turning to mobile plans as their first Internet subscriptions. Expectations for performance might well be lower in these regions, but adoption could outpace the rest of the continent, causing a race to keep network capacity ahead of data levels.

Compounding the issues, while subscribers in Western Europe might maintain a wired connection for data-intensive applications like streaming video and P2P filesharing, consumers in Eastern European subscribers are more likely to have a single connection that is relied upon for everything. Service providers will be forced to develop time-dependent usage-based incentives to limit peak-time congestion. Currently, the most common usage allowances in Europe are 1 GB, 3 GB, and 5 GB a month³², but the average cable or DSL subscriber regularly exceeds these limits³³.

The daily traffic composition of Europe’s mobile networks differs significantly from the wired broadband networks. While P2P filesharing is the largest category on cable and DSL networks, it is a distant third in the wireless world, accounting for only 13.4 percent of traffic. On mobile networks, P2P lags far behind real-time entertainment and web browsing, each of which represents almost a third of utilized bandwidth. Network traffic during peak hours is a 72.4 percent increase over the off-peak average, but the share of that bandwidth available to each active subscriber actually decreases by 14.3 percent. This decrease could indicate that portions of the network are operating at or near capacity and should be a point of concern for service providers due to the popularity of real-time entertainment and its sensitivity to network conditions.

Did you know?
 During the peak period, bandwidth utilization in Europe is 72.4 percent higher than the off-peak average, but the per-subscriber share of bandwidth drops by 14.3 percent.

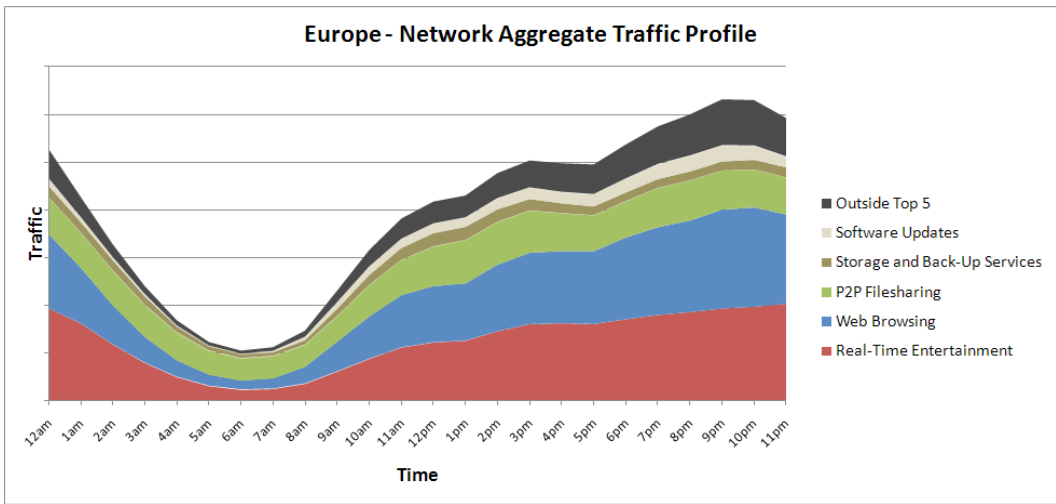


Figure 6 - Europe - Network Aggregate Traffic Profile

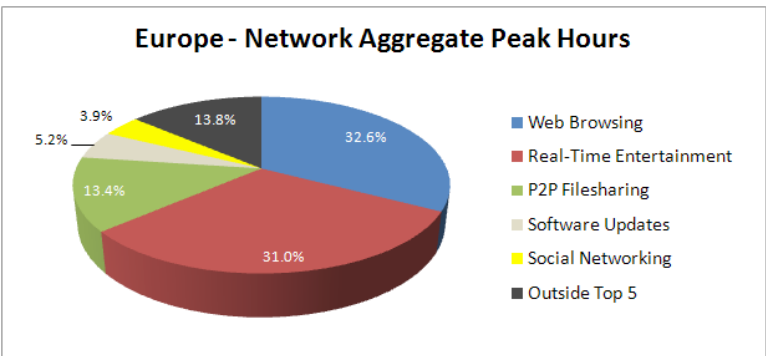


Figure 7 - Europe - Network Aggregate Top Categories by Bytes (Peak Period)

Did you know?
 The popularity of different devices can have a huge impact on not only the composition of traffic, but also on the overall amount of traffic on mobile networks.

32. EARTHtimes.org. "GSMA: New Report Predicts Explosive European Growth for Mobile Broadband." EARTHtimes.org
 33. Many broadband studies have confirmed this observation, including Sandvine’s own research.

North America

North America looks set to make substantial investments in wireless and mobile technology. From 2009 to 2010, capital spending is projected to increase from just under \$20 billion to almost \$30 billion³⁴. One result of this investment is a huge increase in the number of wireless towers, which is expected to eclipse 300 000 by 2012, far beyond the 228 000 in existence today³⁵. Even with this level of investment, the next generation of networks will only cover a small percentage of US markets by 2013³⁶. Greater coverage and larger backhaul capacity hold the tantalizing promise of increased data revenue, but for now operators must develop ways to maximize the return on the investments they have already made on the networks that exist today. Innovative personalized billing models and network efficiencies are two options being explored by many service providers.

Service packages and billing models that provide incentives for subscribers to move usage off-peak help to alleviate congestion³⁷. Technical means can achieve the same objective - many carriers are investigating mechanisms that cache or pre-load content as a means by which spectrum capacity can be conserved. Regardless of the mechanisms in place, transparency and education are the key success factors. Subscribers need to embrace, or at the very least, be aware of network management policies and billing structures. Operators are definitely embarking down this path - after seeing its data levels surge by 5000 percent and discovering that 3 percent of its smartphone users account for 40 percent of its data traffic, AT&T has already begun education campaigns to help subscribers become more aware of their data usage³⁸.

The daily aggregate traffic profile for an average North American wireless network is shown below. The profile closely matches the cable and DSL traffic profile presented in Sandvine's 2009 Global Broadband Phenomena, although the overnight minimum is relatively lower on the wired broadband networks. North Americans make much the same use of their mobile networks as they do of their cable, DSL, and fibre networks. This fact is of critical importance to mobile data providers, as it implies that North American subscribers will have similar expectations of Internet performance regardless of the technology through which the network is accessed.

Did you know?

During the peak period, bandwidth utilization in North America is 43.4 percent higher than the off-peak average, and the per-subscriber share of bandwidth actually increases by 16 percent. North America is the only region in this study where the per-subscriber share of bandwidth increases during peak hours.

During the peak evening hours, networks in North America carry 43.4 percent more traffic than off peak, and the share of available bandwidth used by each subscriber actually increases by 16 percent, suggesting that North American service providers have managed to keep network capacity outpacing data growth. However, given the explosion in data levels following the debut of popular devices like the iPhone and Android-based handsets, data levels may well be rapidly closing the gap on network capacity.

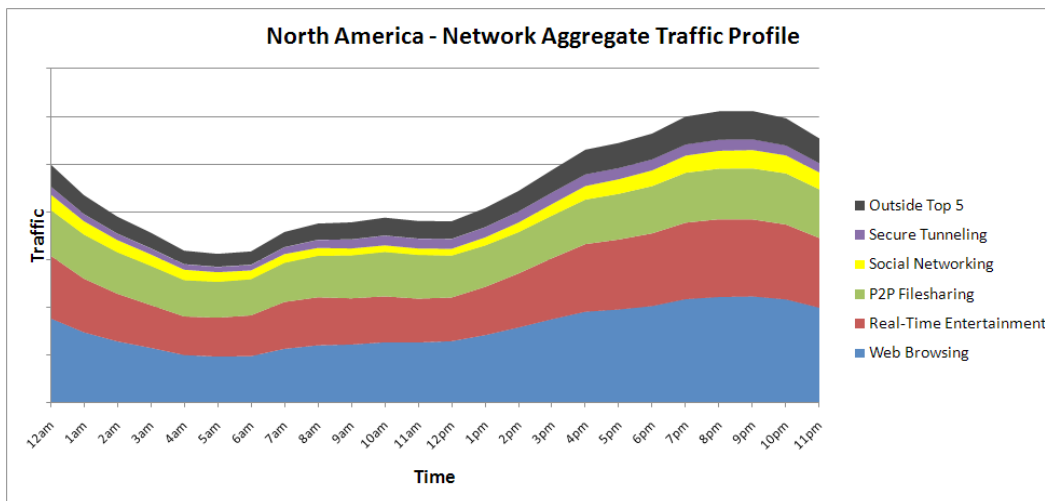


Figure 8 - North America - Network Aggregate Traffic Profile

34. Kharif, Olga. "Managing the Wireless Data Deluge." Bloomberg BusinessWeek.

35. Kharif, Olga. "Managing the Wireless Data Deluge." Bloomberg BusinessWeek.

36. Kharif, Olga. "Managing the Wireless Data Deluge." Bloomberg BusinessWeek.

37. Sandvine's experience is that localized congestion management armed with recent usage information is the optimal approach

38. Morgan Stanley Mobile Internet Report.

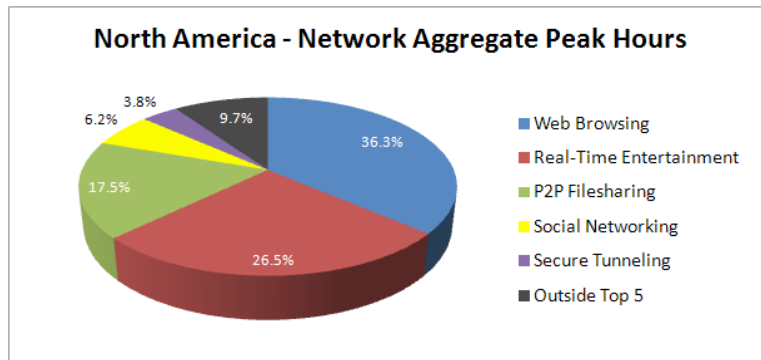


Figure 9 - North America - Network Aggregate Top Categories by Bytes (Peak Period)

The table below summarizes some key statistics presented in this section.

Region	Network Bandwidth Peak Period Average vs Off-Peak Average	Normalized Per-Subscriber Bandwidth Peak Period Average vs Off-Peak Average
North America	+43.4%	+16%
Caribbean and Latin America	+31.4%	-21.8%
Europe	+72.6%	-14.3%

Table 1 - Regional Comparison of Key Statistics

Network Policy Control Strategies

Effective network management policies decrease operational expenses, defer capital investments and preserve or even increase the subscriber quality of experience. Not only must service providers have the tools in place to implement such policies, but they need to carefully consider the exact mix of management techniques used - what is appropriate on a particular network in a particular geography may not be as effective elsewhere.

Selecting Appropriate Network Management Policies

Policies being explored and implemented by service providers worldwide include practices that help to alleviate backhaul and radio access network congestion during peak hours. Aggregate network management can often address backhaul capacity issues, but successfully preventing incidences or limiting the impact of RAN congestion is better addressed by localized efforts armed with recent usage information and awareness of subscriber entitlement. With this contextual information, service providers can define exactly how congestion manifests on their network - are all subscribers on a particular access site impacted in the same way, or can the experience of the majority be protected?

Sandvine believes that in today's regulatory 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 on 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

Terminology: Network Policy Control

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

Maintaining Transparency Regarding Network Policy Control

On September 21st, 2009 the Chairman of the United States' Federal Communications Commission, Julius Genachowski unveiled a sixth principle that guides the FCC's case-by-case enforcement of communications laws. This principle states that "providers of broadband Internet access must be transparent about their network management practices"³⁹. Other countries are adopting or considering similar guidelines.

One motivation behind the FCC's sixth principle is to allow subscribers to evaluate competitive offerings with the confidence that they understand the service. Ultimately, no one wins when a subscriber is shocked that a service is not what they expected, regardless of the reason for the confusion. In a transparent world, service providers are able to implement reasonable network management policies, and make these policies readily available to the subscriber base. Since network policies generally exist to protect the experience of the vast, vast majority of subscribers, network operators providers who make this justification clear have everything to gain.

Transparency can mean many things to many different stakeholders. A service provider that invites and enables subscribers to indicate their personal preferences (see Figure 10) can empower subscribers to influence personalized network policy control. During periods of congestion, the traffic of highest priority to each individual subscriber can be protected, while their lower priority traffic can be scaled back to maintain the overall experience.

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Current Settings | Current Attributes | **Priorities** | Quotas | Current Usage | UDR File | Change Subscriber

Drag and Drop the icons in the order of importance to you.

1 WebBrowsing 2 P2P 3 Streaming 4 Admin 5 Email 6 Tunneling 7 Other

Update Priorities

I want to...

- ▶ View my bill.
- ▶ Check my usage.
- ▶ Be alerted when I go over quota.
- ▶ Edit my application priorities.
- ▶ Save on my next months bill.
- ▶ Be alerted when my computer has a virus.

Support

- ▶ Email Us.
- ▶ Fill out a support request.
- ▶ Have a Live Chat.
- ▶ Call Support.

F.A.Q.

- ▶ What are the Quota Tier plans?
- ▶ How do I update my billing info?
- ▶ How do I upgrade my Internet?
- ▶ Can I switch routers?
- ▶ How do I change my DNS?
- ▶ How do I test my internet connection?

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Figure 10 - "Manage My Priorities" Personalized Service Interface

A network business intelligence solution can fulfill the auditability requirement introduced previously. Service providers can demonstrate to regulatory bodies the need for reasonable network policy control by showing real network conditions, trending and projections, and by providing measurements that indicate the potential risk to subscriber quality of experience.

39. Genachowski, Julius. "Preserving a Free and Open Internet: A Platform for Innovation, Opportunity, and Prosperity".

Analysis of Subscriber Usage

This section investigates how data consumption varies across the subscriber base. Thorough knowledge of this distribution is valuable to service providers who are exploring pricing plans that contain a usage component. At a high level, the following conclusions can be made:

- Flat-rate billing does not align with subscriber usage, which is hugely disproportionate: the top 5 percent of subscribers account for 50 percent of traffic
- Subscriber behavior is extremely variable: there is a major opportunity for service providers to introduce personalized services

How Top-Heavy are Mobile Networks?

In Sandvine’s 2009 Global Broadband Phenomena study, we discovered that the top 20 percent of subscribers, measured by total monthly data usage, account for 80 percent of the data on cable and DSL networks. By performing the same analysis on mobile data, we can determine whether mobile networks are more or less “top-heavy” than their wired counterparts. The analysis shows that:

- Wireless networks are more top heavy than wired networks
- North America is the most top heavy, with 20 percent of subscribers accounting for 90 percent of total network usage (measured in bytes)

The graph below shows the relationship between subscriber percentile and traffic percentile. That is, it makes it simple to see what percentage of total network traffic is attributable to the Top X percent of subscribers. When examining the graph, keep in mind that:

- The earlier a curve rises, the more “top-heavy” the network; that is, the higher the amount of traffic attributable to the top subscribers
- The steeper a curve rises at a particular point, the larger the amount of data attributable to a particular group of subscribers (for example, subscribers ranked in the 10th to 30th percentiles)

It is immediately apparent that in all three regions the top 5 percent of subscribers account for 50 percent of network traffic (recall that AT&T has observed that the top 3 percent of its smartphone users generate 40 percent of its data traffic). It seems that this phenomenon is not unique to AT&T’s networks and supports the assertions of many service providers worldwide that a flat-rate billing model is simply not appropriate.

While the top 2 percent of subscribers in Europe consume more bytes (40 percent) relative to the rest of the network than any other region, outside of the top 2 percent North America has the most disproportionate usage. Almost 90 percent of all bytes on North American wireless networks originates from, or is destined to, a subscriber who ranks in the top 20 percent in terms of consumption.

For ease of comparison to cable and DSL networks, Figure 11 includes the curve calculated in Sandvine’s 2009 Global Broadband Phenomena study. From a visual inspection, we can conclude that wireless networks have a greater disparity in data consumption between the heaviest and lightest users.

Did you know?

Globally, the top 5 percent of subscribers account for 50 percent of network traffic. In Europe, the top 2 percent of subscribers account for more than 40 percent of network traffic.

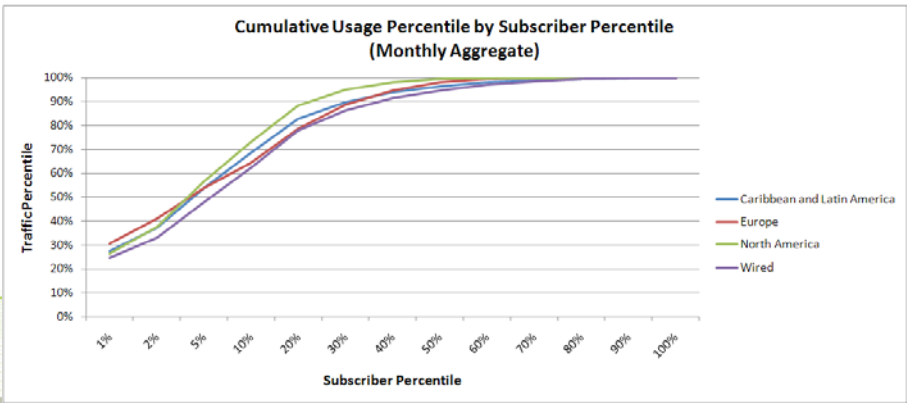


Figure 11 - Cumulative Usage by Subscriber Percentile

In each region, the upstream component of the network was influenced the most by the top users, as evidenced in the table below that shows the monthly usage statistics for each region. The highlighted cells indicate instances where the upstream traffic percentile is more than 10 percent higher than the downstream percentile.

Subscriber Percentile	Caribbean and Latin America			Europe			North America		
	Upstream	Downstream	Aggregate	Upstream	Downstream	Aggregate	Upstream	Downstream	Aggregate
1	36.26%	27.46%	27.40%	39.16%	30.51%	30.67%	46.60%	24.68%	26.33%
2	46.63%	37.37%	37.39%	50.14%	40.81%	41.04%	58.10%	35.71%	37.48%
5	63.19%	53.57%	53.90%	65.08%	53.03%	53.79%	72.24%	55.14%	56.55%
10	76.96%	67.81%	68.39%	76.16%	63.55%	64.47%	83.11%	72.19%	73.03%
20	89.66%	82.06%	82.79%	86.89%	78.25%	78.74%	92.88%	88.14%	88.48%
30	95.06%	89.14%	89.78%	92.86%	88.32%	88.55%	97.05%	95.01%	95.13%
40	97.50%	93.37%	93.81%	96.56%	94.54%	94.62%	98.89%	98.13%	98.15%
50	98.70%	96.13%	96.39%	98.66%	98.05%	98.06%	99.64%	99.46%	99.45%
60	99.34%	97.88%	98.03%	99.63%	99.50%	99.50%	99.91%	99.91%	99.90%
70	99.70%	98.86%	98.96%	99.89%	99.87%	99.87%	99.97%	99.99%	99.99%
80	99.89%	99.48%	99.52%	99.97%	99.98%	99.97%	99.99%	100.00%	100.00%
90	99.98%	99.84%	99.86%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
100	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 2 - Cumulative Usage by Subscriber Percentile

Analysis of Subscriber Usage Distribution

The raw numbers in Table 2 highlight the fact that subscribers do not make equal use of shared network resources. However, it is instructive to take the analysis deeper by inspecting the shape of the subscriber usage distribution curve. This section presents three examples from real networks to illustrate the variation from network-to-network. The analysis demonstrates that it is imperative that service providers have network business intelligence tools in place to understand their unique networks.

Each of the graphs below has the following structure:

- The horizontal axis has a logarithmic scale and shows monthly byte usage per subscriber
- The blue area is plotted against the left vertical axis and shows the percent of the total subscriber base that has a particular monthly byte usage
- The red area is plotted against the right vertical axis and shows the cumulative percent of total network usage
- The mean, median, and important local peaks are labelled

The first example network has a bell-shape when plotted logarithmically. On this network, the median monthly usage is about 725 MB, but the mean monthly usage is roughly 1 600 MB. The half of the subscriber base that falls below the median usage cumulatively account for only 8 percent of total network usage, meaning that the top half is responsible for 92 percent of traffic. Also, while the mean usage is only double the median usage, it significantly pushes the cumulative usage towards the top end of the subscriber base. The 30 percent of subscribers who have monthly usage higher than the mean account for 77 percent of total network usage.

This example demonstrates that there is more to subscriber usage analysis than simply computing the mean and median across the subscriber base.

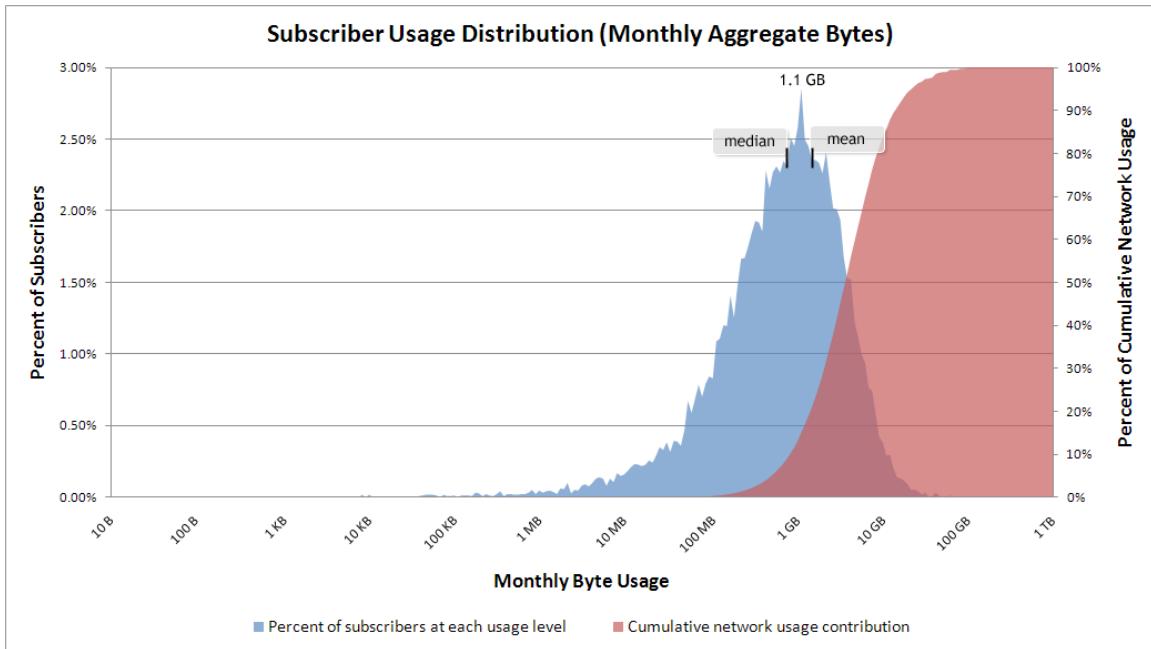


Figure 12 - Example #1 Subscriber Usage Distribution

Median	725 MB
Cumulative consumption of bottom 50%	~8 %
Cumulative consumption of top 50%	~92 %
Mean	1 600 MB
Percent of subscribers below mean	~70 %
Percent of subscriber above mean	~30 %
Cumulative consumption of subscribers below mean	~23 %
Cumulative consumption of subscribers above mean	~77 %

Table 3 - Example #1 - Key Facts

The second example plots a usage distribution that includes fixed wireline and mobile wireless subscribers, and highlights the dangers in analysis that doesn't distinguish between important characteristics like access technology.

The presence of wireline subscribers in the dataset massively skews the mean and the cumulative distribution function. In this plot, the bottom 50 percent of subscribers account for less than one-tenth of 1 percent of total network usage, and the 20 percent of subscribers who have a "higher than average" monthly usage account for 90 percent of the cumulative network traffic.

It is critical that a service provider be able to separate subscriber sets when analyzing network usage distribution.

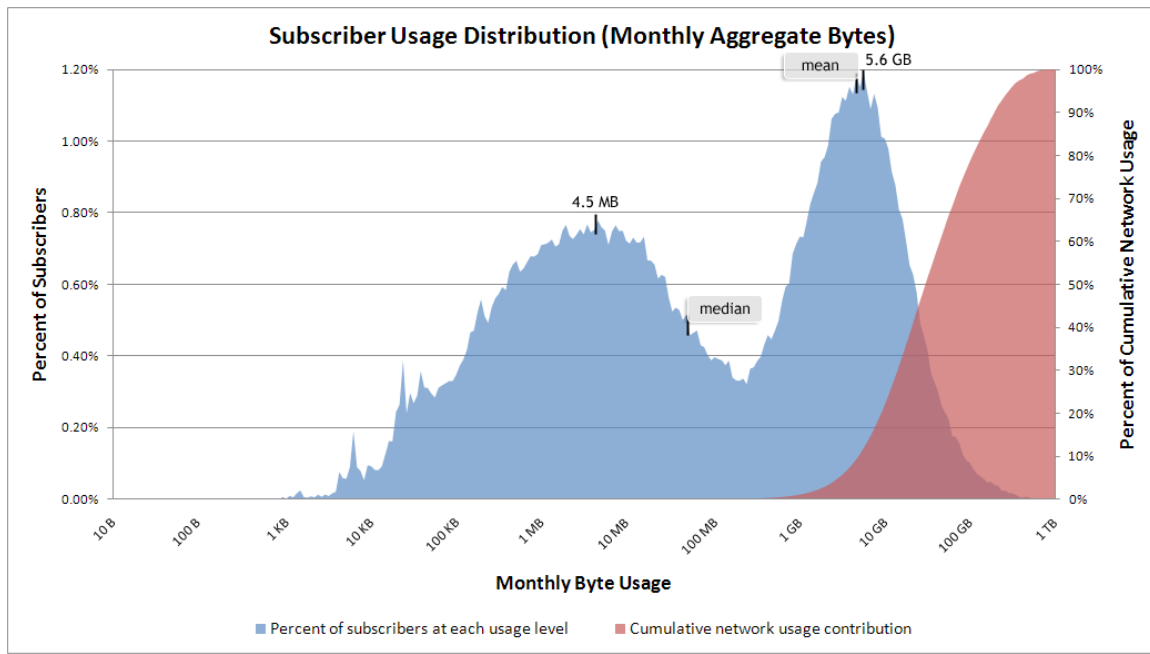


Figure 13 - Example #2 - Subscriber Usage Distribution

Median	54 MB
Cumulative consumption of bottom 50%	< 0.1 %
Cumulative consumption of top 50%	> 99.9 %
Mean	4 950 MB
Percent of subscribers below mean	~80 %
Percent of subscriber above mean	~20 %
Cumulative consumption of subscribers below mean	~10 %
Cumulative consumption of subscribers above mean	~ 90 %

Table 4 - Example #2 - Key Facts

This final example shows a mobile data network. The subscriber usage distribution curve exhibits two bumps towards the high end of the usage spectrum. These bumps represent users who share some common characteristic that causes their monthly usage to cluster.

Without further investigation of the subscriber information, it is impossible to conclude the reason for these local peaks; however, we can speculate two possible explanations for the usage curve on this network:

1. The first peak is subscribers using older mobile devices, the second peak is subscribers with 3G smartphones, and the third peak is subscribers using aircard-equipped laptops
2. Each peak represents a different service tier, with a correspondingly different monthly data allowance

Of course, the real explanation might well be a combination of the two posited above. No matter the case, a usage curve like this represents an opportunity for the service provider. If service is currently billed as a flat-rate, then there is an opportunity to introduce a tiered model. If a tiered model is already in place, then detailed analysis can lead to optimizations that maximize ARPU.

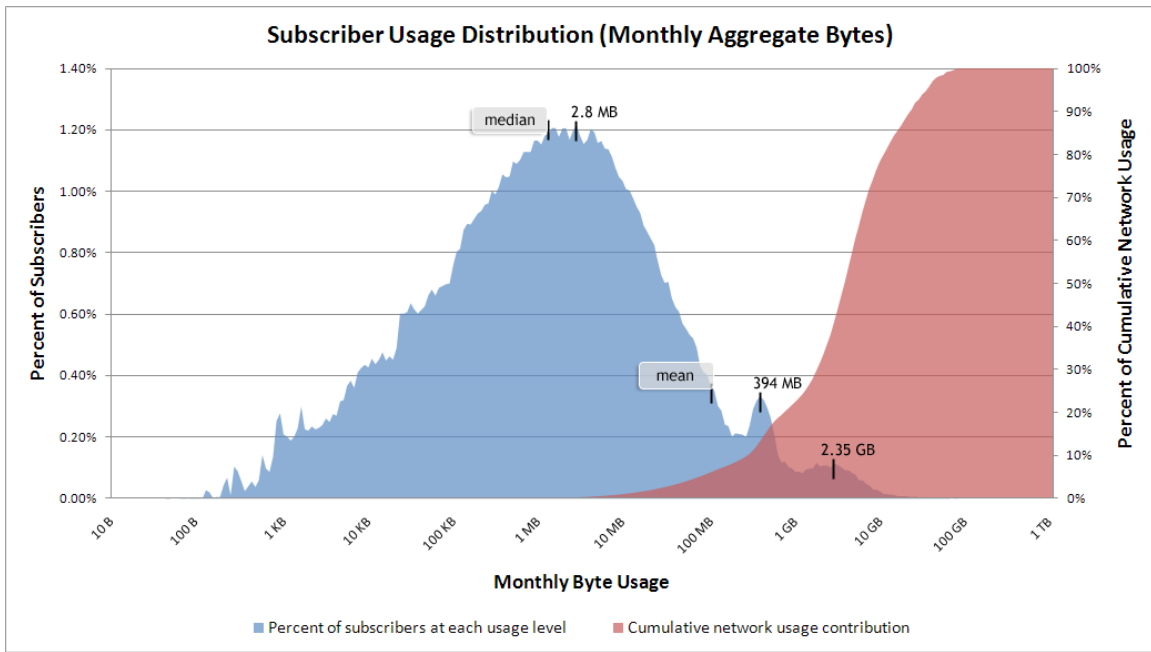


Figure 14 - Example #3 - Subscriber Usage Distribution

Median	1.2 MB
Cumulative consumption of bottom 50%	~ 0.1 %
Cumulative consumption of top 50%	~ 99.9 %
Mean	110 MB
Percent of subscribers below mean	~93 %
Percent of subscriber above mean	~7 %
Cumulative consumption of subscribers below mean	~6.5 %
Cumulative consumption of subscribers above mean	~ 93.5 %

Table 5 - Example #3 - Key Facts

A first step towards introducing a simple tiered service model based purely on monthly data usage might first identify the proportion of the subscriber base that would fall into different tiers of consumption. In the figure below, we have taken data from a service provider and compared it against the most common European monthly data allowances (1 GB, 3 GB, and 5 GB per month).

On this network, almost 40 percent of subscribers would exceed the maximum monthly data allowance and would be subject to overage charges, and number of subscribers in the middle and high tier are almost equivalent.

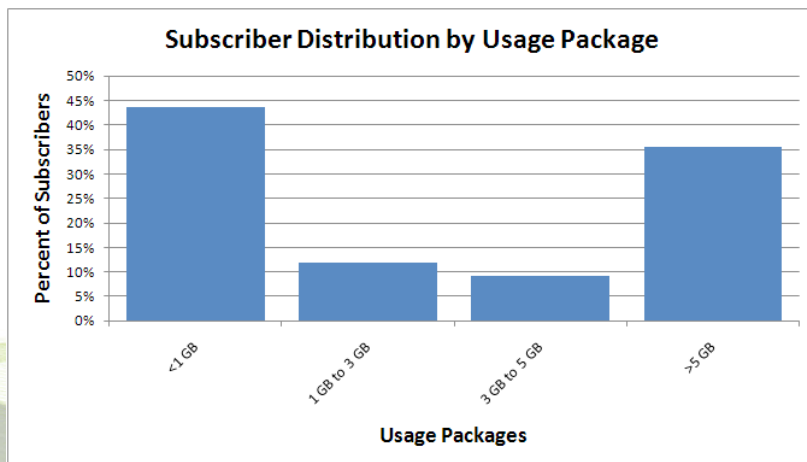


Figure 15 - Existing Usage Packages

Terminology: 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.

Suppose that this service provider wanted to update the tiering model, subject to some governing parameters:

- No more than 50 percent of subscribers should be in any single service package
- No more than 5 percent of subscribers should be subject to overage

The graph below shows the same subscriber distribution as before, but against proposed usage limits of 2 GB, 10 GB, and 25 GB. Exactly 5 percent of subscribers fall into the basic tier, and about 2.5 percent will exceed the 25 GB monthly allowance of the premium tier, leaving another 2.5 percent of subscribers in the other tiers who can be charged overage without exceeding the 5 percent-overage objective.

Terminology: Bill Shock
 The negative reaction experienced when a bill has unexpected charges.

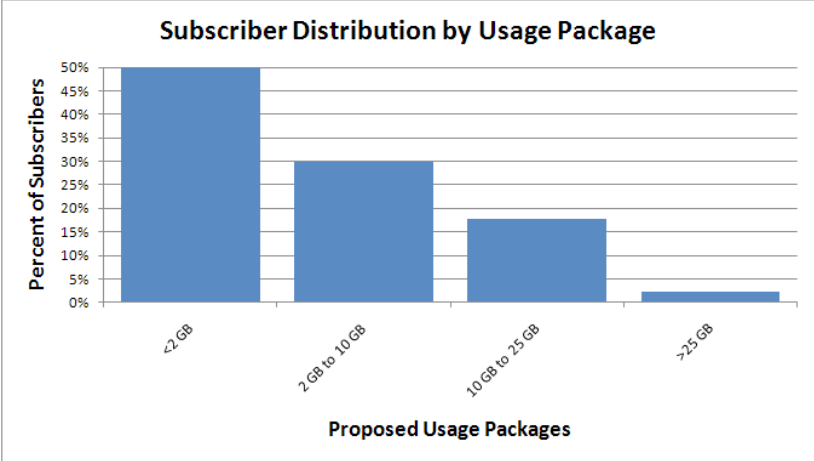


Figure 16 - Proposed Usage Packages

Of course, true optimization of the tiering model would include factors like the ARPU per tier, projections of per-subscriber data growth and an assumed rate of addition for new subscribers. It would also have to account for the introduction of new handset models and capital investment plans.

Evaluating the effectiveness of a tiered service model might also involve calculating the profitability per subscriber of each tier. While the ARPU per tier is relatively straightforward, the cost of actually delivering the service involves accounting for the bytes attributable to each tier. A network business intelligence solution can help determine this number by providing detailed reporting on the byte distribution across tiers. For example, the figure below shows the percentage of total subscribers who fall into particular levels of data usage per day, and further breaks that information down by service tier. Not accounting for overage charges, the gold subscribers who average less than 500 MB of use per day are no doubt the network’s most profitable active subscribers.

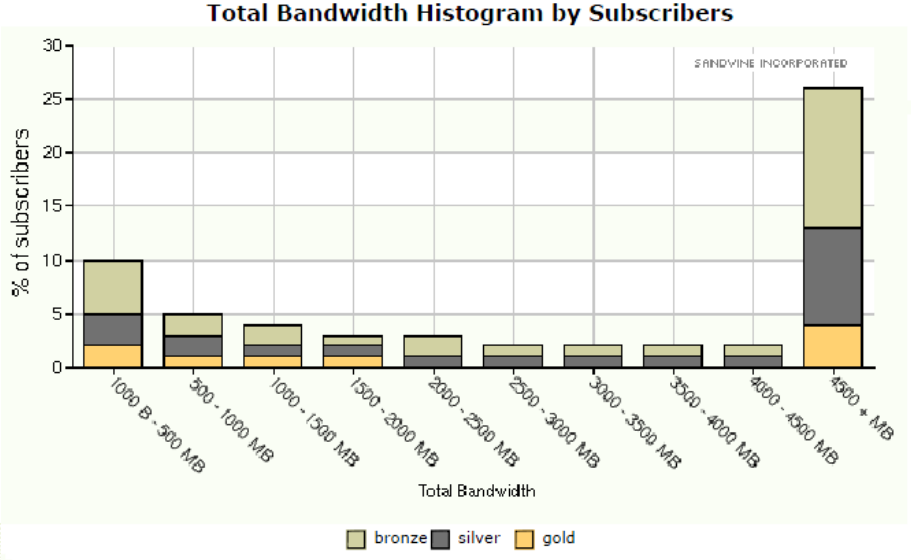


Figure 17 - Total Bandwidth Histogram by Subscribers by Service Tier

Introducing Personalized Services into Your Network

The most influential factor in determining relative success for wireless Internet providers will be the ability to align billing models with subscriber usage expectations. Effectively doing so will enable service providers to fully maximize the value of the soaring amount of data traversing their networks. In much the same way that mobile handset success is dependent upon a combination of interface design, application ecosystem, pricing and availability, the traffic composition of wireless networks is a function of device (including handsets, laptops, netbooks and e-readers), geography, service availability and pricing.

Linking Applications and Data

The value of the data to a subscriber will vary by category and quality. However, the strongest factor in determining the intrinsic value of data is a subscriber's personal preferences.

<p>Subscriber A - "Alice" Mobile Device: Aircard-equipped laptop Mobile Plan: \$75/month for 5 GB of data Overage: \$0.05 / MB Favorite application: BitTorrent Second-favorite: iTunes</p>	<p>Subscriber B - "Bob" Mobile Device: 3G smartphone Mobile Plan: \$40/month for 150 minutes of voice and 500 MB of data Overage: \$0.05 / MB Favorite application: Facebook Second-favorite: YouTube</p>
---	---

Table 6 - Example Subscriber Profiles

For Alice, a fast download is the most important factor in determining a positive Internet experience, whether it's a BitTorrent file or an iTunes purchase. Bob is a habitual Facebook user who has recently started using YouTube, but like most users has no idea that an average YouTube video is more than 10 MB.

A challenge facing mobile providers worldwide is trying to help subscribers to link application usage and byte usage⁴⁰. Furthermore, most usage-based billing plans are purely byte-driven, rather than event-driven. Subscribers have an easier time quantifying "200 YouTube minutes per month" than "1 GB of data". Successful data pricing models will strike a balance between the simplicity of consumption with the intuitiveness of discrete events.

Service providers now offer messaging plans that have expanded beyond text messages to include parameters governing the number of photo transfers and video chats, and most operators have a web-page providing guidance on application and byte usage.

The next stage in evolution of this type of service plan might be one in which a subscriber is empowered to design a personalized plan featuring per-category usage allowances through a "Design My Plan" interface like the one below.

40. This issue is explored in a blog post: "New Metrics...We Used to Walk a Mile, Pour a Pint and Send a Byte." The Better Broadband Blog.

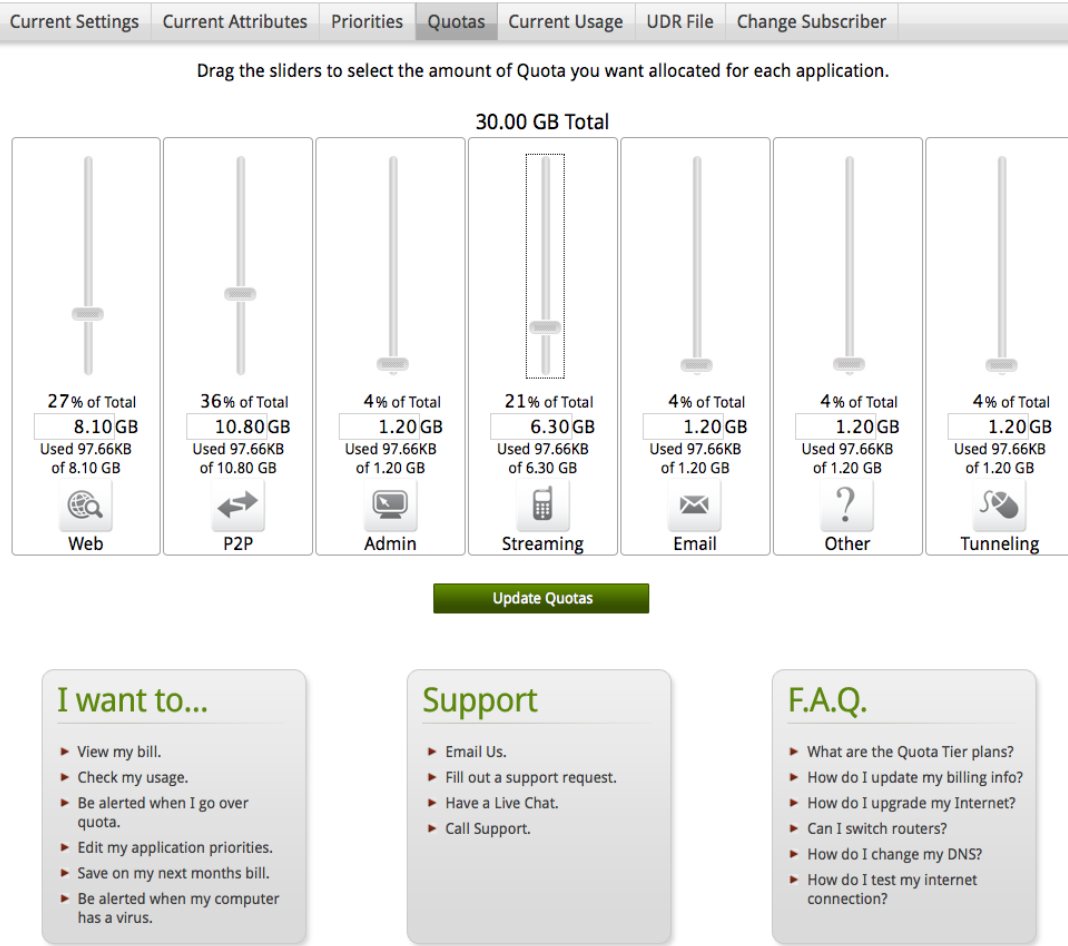


Figure 18 - "Design My Plan" Personalized Service Interface

From here, the next step could be a page in which the slider bars aren't measured in bytes, but in parameters that are more intuitive to subscribers, like minutes of video, number of songs or movies, and number of photos.

It is important to note that service providers relying on aggregations of measurements from multiple vendors and multiple devices must be confident that every byte of every protocol is counted in the exact same way. Any discrepancies will lead to operational headaches when subscribers notice inconsistencies.

Moving Beyond Counting Bytes

The cost incurred by service providers to transmit data varies by time. Network cost is tied to peak load, and bandwidth levels below a comfortable operating margin (say, 80 percent of capacity) essentially equate to wasted capacity and contribute to network inefficiencies. While providers are exploring ways to move some usage off-peak, subscribers typically don't consider time-of-day as a factor when deciding what to do with their mobile device. Two primary approaches have emerged to shift usage: caching or pre-loading content based on expectation models, and monetary incentives to encourage off-peak usage (with the assumption that peak usage will decline as a consequence).

Handset and infrastructure vendors are working together to investigate the feasibility and effectiveness of pre-loading or caching content, while service providers are somewhat alone in applying billing models as a motivator to shift usage. Time-based billing, similar to how many utilities are billed today⁴¹, holds a great deal of promise but is dependent upon the active participation and support of subscribers.

Many service providers offering prepaid billing models are investigating or introducing usage plans that have a time component. While few are venturing as far as charging for data differently depending upon the time of day, as a first step many are exploring plans that offer a time limit as well as a data limit (this is reminiscent of automotive warranties like, "100 000 miles or 10 years"). For instance, a prepaid plan might include one week of Internet access or 5 GB of data usage, with the option to "top up" the plan when limits are being approached.

41. This parallel is explored in a blog post: "Metering Those Leaky Household Bandwidth Pipes." The Better Broadband Blog

Simplifying Personalized Services with Subscriber Self-Management

Mobile network operators are in the unique position of being able to offer services personalized to an incredible degree, including by location and device. To a subscriber, these use-cases are conceptually very simple; however, to a service provider they require a great deal of back-end device and system integration across a range of vendors supplying sophisticated measurement and enforcement devices.

When combined with subscriber self-prioritization functions and other personalized services, subscriber self-management has the potential to address a number of functions currently carried out manually by customer service representatives.

In a Frost & Sullivan survey of service provider senior executives in North America and Europe, respondents cited the need for a self-service customer experience as a high priority⁴². As billing models become more personalized, there is potential for a corresponding, dramatic increase in operational complexity to manage them. Consequently, service providers are excited about solutions like the one in Figure 19 that can facilitate subscriber self-management of common functions such as modifying service plans, looking up usage information and topping up usage allowance.

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Current Settings | Current Attributes | Priorities | Quotas | Current Usage | UDR File | Change Subscriber

Your current Service Tier is **Gold**.

If you would like to upgrade your service please visit the [Update Account](#) section.

Your current Quota is **30GB**.

This billing cycle you have used 10.00% of your Quota and 97.66KB of usage has not been applied to your Quota.
If you would like to upgrade your service please visit the [Update Account](#) section.

Priority and Quota Settings

1 Web 100MB | 2 P2P 100MB | 3 Voip 100MB | 4 Admin 100MB | 5 Email 100MB | 6 Tunneling 100MB | 7 Other 100MB

I want to...

- ▶ View my bill.
- ▶ Check my usage.
- ▶ Be alerted when I go over quota.
- ▶ Edit my application priorities.
- ▶ Save on my next months bill.
- ▶ Be alerted when my computer has a virus.

Support

- ▶ Email Us.
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F.A.Q.

- ▶ What are the Quota Tier plans?
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- ▶ Can I switch routers?
- ▶ How do I change my DNS?
- ▶ How do I test my internet connection?

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Figure 19 - "Summary of Services" Personalized Service Interface

The Importance of Real-Time Usage Information and Notification

A particularly challenging aspect of this scenario is the availability of real-time usage information. A subscriber who receives notification that he has reached 80 percent of his allowable data consumption will be calling the support desk if he later finds out that by the time the notification was sent (perhaps 48 hours after the threshold had been passed) he had already exceeded quota and will subsequently be charged. On the flipside, a subscriber receiving a real-time SMS notification that she is approaching a limit will have enough information to decide whether or not to go to a self-service portal to top-up her usage allowance.

The availability of real-time usage information, whether pushed out via notification or looked up in a portal like the "Manage My Usage" interface in Figure 20, is very important for preventing bill-shock. In fact, bill shock has become

42. Ford, Tracy. "More Devices, More Traffic Mean More Complexity in Managing the Network." RCR Wireless.

such a hot-button issue that beginning March 1st, 2010, European mobile phone operators are obliged under European Union (EU) roaming rules to offer their customers a cut-off limit facility to protect them from bill shocks while travelling in other EU countries⁴³. Under these rules, a customer will receive a warning that data usage is approaching a specified limit, and the Internet connection will subsequently be disconnected if the usage exceeds the limit.

While the mainstream media is rife with examples of roaming users getting an enormous bill after a vacation⁴⁴, a far more common situation is that of a subscriber only slightly exceeding the monthly usage limit and being charged for the overage.

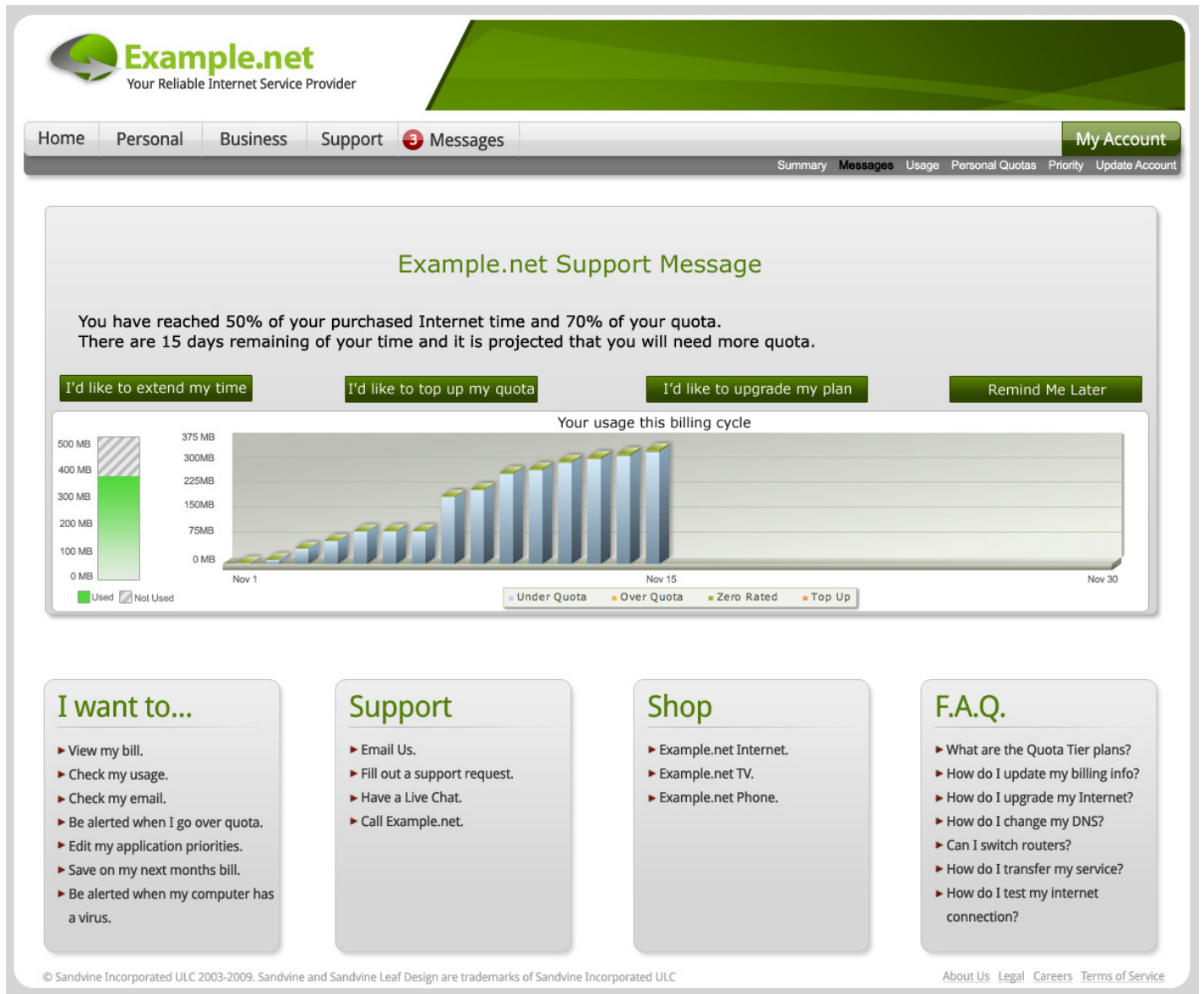


Figure 20 - "Manage My Usage" Personalized Service Interface

Recall the example subscriber, "Bob", introduced earlier - he is a perfect example of a subscriber who might encounter overage charges on his next bill. Having just discovered YouTube, Bob might go on a binge, not knowing that just 50 videos could exhaust his monthly data allowance. A service provider who has real-time network data and notification capability can contact Bob when he approaches his usage limit, giving him the opportunity to alter his behavior preemptively or to go to a self-management portal (Figure 20) to upgrade his plan.

With a network business intelligence solution, a service provider can optimize service plans to maximize ARPU (by balancing subscription packages and subscriber overage) and minimize churn.

43. European Commission. Telecoms: Mobile Phone Customers Entitled to Protection from Data-roaming "bill shock" as from 1st March 2010. Europa Press Releases.

44. Or after a prolonged period of tethering a laptop to a mobile phone - "New Metrics...We Used to Walk a Mile, Pour a Pint and Send a Byte." The Better Broadband Blog.

Applications and Protocols

The mix of traffic flowing across the mobile Internet bears many similarities to the traffic on traditional broadband networks. This is no surprise, as subscribers typically don't consider the network when deciding what applications to use. However, owing to the special circumstances of the mobile experience, mobile Internet traffic does exhibit unique characteristics. Obviously, there are some applications that are only available on mobile devices; consequently, there will be some traffic that only appears on mobile networks. Additionally, mobile experiences create circumstances that favour the use of social applications. Video uploads to YouTube, photo uploads to Facebook, Twitter updates - we can expect that these applications will be more prevalent on mobile networks.

At a global level, there are some clear conclusions that can be drawn regarding the traffic that makes up the wireless Internet:

- YouTube specifically (between 10 and 15 percent of total bytes), and miscellaneous Flash video (an additional 8 to 11 percent), are the dominant forms of on-demand entertainment on wireless networks - recall that YouTube accounted for roughly 5 percent of total bytes on cable and DSL networks in 2009
- Social Networking is massively popular - Facebook is anywhere from 3 to 6 percent of peak period traffic, while MySpace accounts for between 1.5 and 2.5 percent (by contrast, Facebook accounted for about 1.5 percent of cable and DSL Internet traffic in 2009), and roughly one in five mobile data subscribers regularly uses Facebook
- There is virtually no gaming traffic, which is expected since console use would prove exceedingly difficult on mobile networks
- P2P remains a factor globally - BitTorrent leads the way at around 10 percent of peak period bandwidth in Europe and North America, while Ares maintains its dominance in Caribbean and Latin America at more than 17 percent

By carefully monitoring the composition of data traffic, not only can service providers make more informed decisions about capital investments, but also they can spot opportunities to partner with popular application providers.

Skype, long seen as a threat to mobile voice revenues, is now being embraced by some providers as a competitive differentiator. At the recent Mobile World Congress in Barcelona, Verizon unveiled a partnership with Skype, proclaiming, "Put the planet in your pocket. Introducing unlimited Skype-to-Skype calls and IM with anyone, anywhere in the world."⁴⁵ This study reveals that Skype is consistently in the top 15 applications on wireless networks, and in Europe accounts for as much as 5.4 percent of utilized upstream bandwidth during peak hours and 1.9 percent overall.

The regional analysis below explores the peak period composition of wireless Internet traffic.

Caribbean and Latin America's Top Applications

In this region, the Ares filesharing service is the top generator of upstream traffic on the mobile Internet. That Ares is popular in this region is no surprise⁴⁶, the availability of clients with local language support has ensured Ares is the top P2P application in Caribbean and Latin America for quite some time; however, it is worth noting that of the nine "top application" lists in this section, upstream traffic in Caribbean and Latin America is the only list in which HTTP does not hold the top spot. This indicates that the number of laptops in this region is sufficient to significantly impact the local traffic composition.

On-demand entertainment in the form of Flash video, and in particular YouTube, is a major force on wireless networks in Caribbean and Latin America. YouTube and Flash alone account for 83 percent of all Real-Time Entertainment during peak hours, and the category itself is responsible for more than a quarter of the network's data.

The impact of portable computers can also be seen in the presence of MegaUpload, Windows Update, BitTorrent and RapidShare - applications and websites that favour a laptop computing environment. In an observation that is repeated in the other regions, the top 10 applications, protocols and web services account for the vast majority of traffic on these networks.

Did you know?

Almost 30 percent of mobile subscribers in Caribbean and Latin America use Facebook in any given hour - the highest percentage of any region. In North America, the figure is roughly 25 percent, and in Europe it is about 20 percent.

45. Version Wireless with Skype Mobile." Verizon Wireless.

46. It's also #1 in cable and dsl networks, as per 2009 Global Broadband Phenomena

Rank	Upstream		Downstream		Aggregate	
1	Ares	44.6%	HTTP	28.2%	HTTP	26.2%
2	HTTP	17.0%	YouTube	16.2%	Ares	17.55
3	Facebook	7.7%	Ares	11.6%	YouTube	13.8%
4	BitTorrent	4.7%	Flash	9.1%	Flash	7.9%
5	SSL	2.6%	MegaUpload	6.6%	Facebook	6.3%
6	YouTube	2.5%	Facebook	5.9%	MegaUpload	5.6%
7	eDonkey	2.4%	Windows Update	3.1%	Windows Update	2.7%
8	MSN Messenger	2.1%	MySpace	3.1%	MySpace	2.6%
9	Flash Video	1.8%	RapidShare	1.8%	BitTorrent	2.0%
10	Hotmail	1.8%	SSL	1.7%	SSL	1.7%
Total		87.3%		87.4%		86.1%

Table 7 - Caribbean and Latin America - Top Applications by Bytes (Peak Period)

Europe's Top Applications

Almost one-third of the bytes on European mobile networks are HTTP. Again, we see the influence of portable computers, as Windows Update and MegaUpload both cracked the top 10, although they are well behind the levels of the top few services.

Europe is the only region in which Skype appears on the aggregate data Top 10 list, as subscribers look to save on voice minutes by making Skype calls (as an application, Skype will apply against data plans).

BitTorrent is significant in this region, particularly on the upstream, and RTMP (a video protocol) joins YouTube and generic Flash video on all three lists. When we combine the total traffic from real-time entertainment and real-time communications, more than a third of the data flowing across the wireless Internet in Europe is for sensitive, real-time applications.

Did you know?

More than one third of the data flowing across the wireless Internet in Europe is for sensitive, real-time applications.

Rank	Upstream		Downstream		Aggregate	
1	HTTP	25.9%	HTTP	33.6%	HTTP	32.4%
2	BitTorrent	22.9%	YouTube	17.3%	YouTube	15.2%
3	eDonkey	5.9%	Flash	12.5%	Flash	11.1%
4	Skype	5.4%	BitTorrent	7.1%	BitTorrent	9.5%
5	Facebook	3.8%	Windows Update	5.4%	Windows Update	4.7%
6	YouTube	3.2%	Facebook	3.2%	Facebook	3.3%
7	SSL	3.0%	MegaUpload	2.5%	MegaUpload	2.1%
8	Flash	2.9%	RTMP	1.6%	eDonkey	2.0%
9	RTMP	2.8%	SSL	1.5%	Skype	1.9%
10	Gnutella	2.2%	eDonkey	1.3%	RTMP	1.8%
Total		78.0%		86.0%		83.9%

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

North America's Top Applications

North America has the highest amounts of HTTP traffic in the world, which could be the result of a relatively lower number of laptops on these networks. We still see applications that correlate highly with these devices, such as BitTorrent, Gnutella and Windows Update, but the “laptop influence” is lower in North America than in the other regions.

Did you know?
North America is the only region in which iTunes appears in a top 10 list.

If North American wireless networks do have larger percentages of mobile phones than elsewhere, we would expect to see high levels of social networking and real-time entertainment. Indeed, analysis shows that YouTube and generic Flash have a higher share of bandwidth in North America than they do elsewhere. Oddly, Caribbean and Latin America actually has higher relative levels of Facebook and MySpace traffic.

North America is the only region in which iTunes appears on any list, which makes sense given that the service is available everywhere in North America but not everywhere in the world.

Rank	Upstream		Downstream		Aggregate	
1	HTTP	32.8%	HTTP	36.5%	HTTP	35.6%
2	BitTorrent	21.1%	YouTube	12.3%	Flash	10.6%
3	Flash	6.6%	Flash	11.9%	YouTube	10.5%
4	Gnutella	6.5%	BitTorrent	7.1%	BitTorrent	10.4%
5	YouTube	4.9%	Gnutella	5.2%	Gnutella	5.5%
6	SSL	4.7%	Facebook	3.7%	Facebook	3.7%
7	Facebook	3.6%	SSL	3.0%	SSL	3.4%
8	MySpace	2.8%	MySpace	2.3%	MySpace	2.5%
9	Ares	1.7%	Windows Update	2.2%	Windows Update	1.8%
10	Skype	1.1%	iTunes	1.9%	iTunes	1.6%
Total		85.8%		86.0%		85.6%

Table 9 - North America - Top Applications by Bytes (Peak Period)

Leveraging Application Popularity for Increased ARPU

Perhaps the most obvious of the key success factors, the ability to offer and subsequently charge for premium services will have a direct impact on the average revenue per user. Even in environments where pricing is especially competitive, simply offering these services will be a powerful competitive differentiator.

The premium services that a provider can offer will be determined by a variety of factors, including:

- Device partnerships
- Availability of content
- Partnerships with websites, application creators and software publishers
- Market characteristics

When operators are assessing potential content and website partners, they can do so armed with data like the number of sessions and bytes attributable to each service, how those figures are trending, and how they vary by subscriber package.

Did you know?
For many Internet users, Facebook has replaced instant messaging and e-mail as the preferred means of communication - will it challenge text messaging in the mobile realm?

RootDomain	TopDomainByHTTPBytes
youtube.com	6,099,383
megaupload.com	2,359,765
rapidshare.com	1,559,320
facebook.com	1,359,972
fcdn.net	976,895

Figure 21 - Top Domains by Bytes

In April, thirty US stations are consumer-testing a new mobile television standard (ATSC-M/H) that allows television stations to put live broadcasts on mobile devices. Mobile TV has had mixed success globally, but anecdotal evidence suggests there is a huge market for must-see-live television, such as major sports events⁴⁷. A partner ecosystem that enables the quality delivery of live World Cup games to mobile devices as a premium service would no doubt be successful in a range of global markets. A network business intelligence solution could help determine the exact ROI by calculating the cost per byte to deliver the live television traffic based on real network data.

Top Subscribers and Normalization

This section compares the traffic profiles of a Top Subscriber (determined by averaging the profiles of the top subscribers on each network) with the normalized per-subscriber average (computed by dividing the network’s total utilized bandwidth by the number of active subscribers at each measurement point). The normalized average represents the bandwidth profile under the simplified case that all active subscribers exhibit identical network usage.

Previous analysis has already shown that the top subscribers on a network are responsible for a disproportionate amount of data traffic, and we now take that analysis a step further to explore the application categories responsible for high network usage.

Comparison of the Top Subscriber profile with the normalized average leads to some important conclusions:

- Laptop users are the network’s Top Subscribers
- Top subscribers make extensive use of P2P filesharing applications - more than 75 percent of a Top Subscriber’s peak period upstream traffic is P2P filesharing
- Top Subscribers make use of real-time communications applications, particularly Skype, more-so than average subscribers

The graphs below show the upstream traffic profiles in Europe for the normalized case and the Top Subscriber. Europe was chosen as an example, but the general observations are consistent across the other regions. The vertical axes share a common scale, so direct visual comparison is legitimate. It is immediately evident that not only do top subscribers have a much higher upstream utilization, but also that the upstream is dominated by P2P filesharing applications. Obviously, this type of usage is almost certainly associated with a laptop equipped with a wireless aircard (in fact, the term “Top Subscriber” might as well be a euphemism for “Laptop User”). Likewise, the use of a portable computer is no doubt responsible for the higher levels of real-time communications traffic (almost entirely Skype) on the Top Subscriber profile.

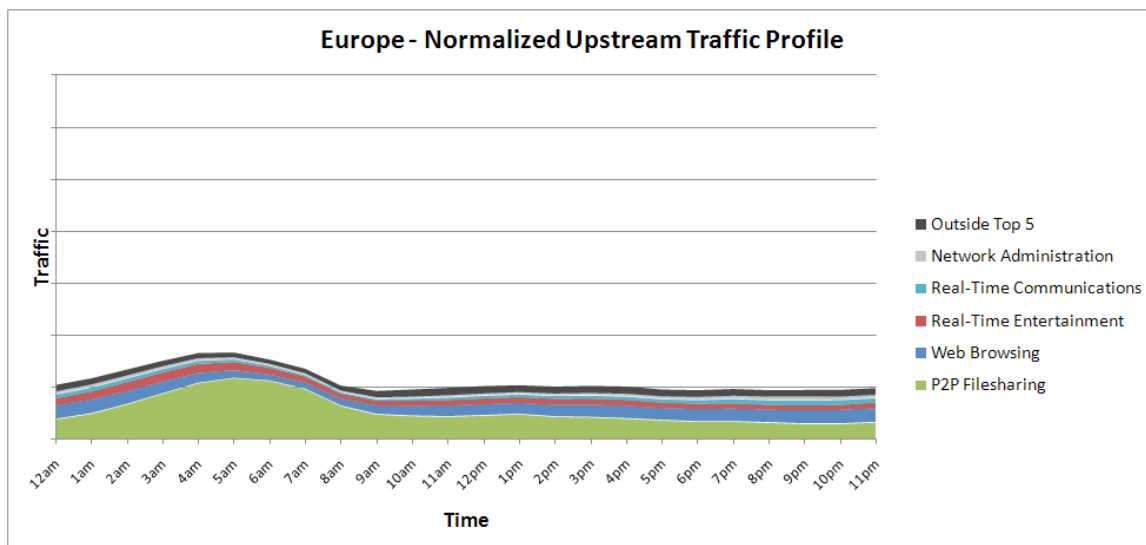


Figure 22 - Europe - Normalized Upstream Traffic Profile

47. Hartvig, Nicolai. "Changing Channels: Who Will Switch on to Mobile TV?" CNN Tech.

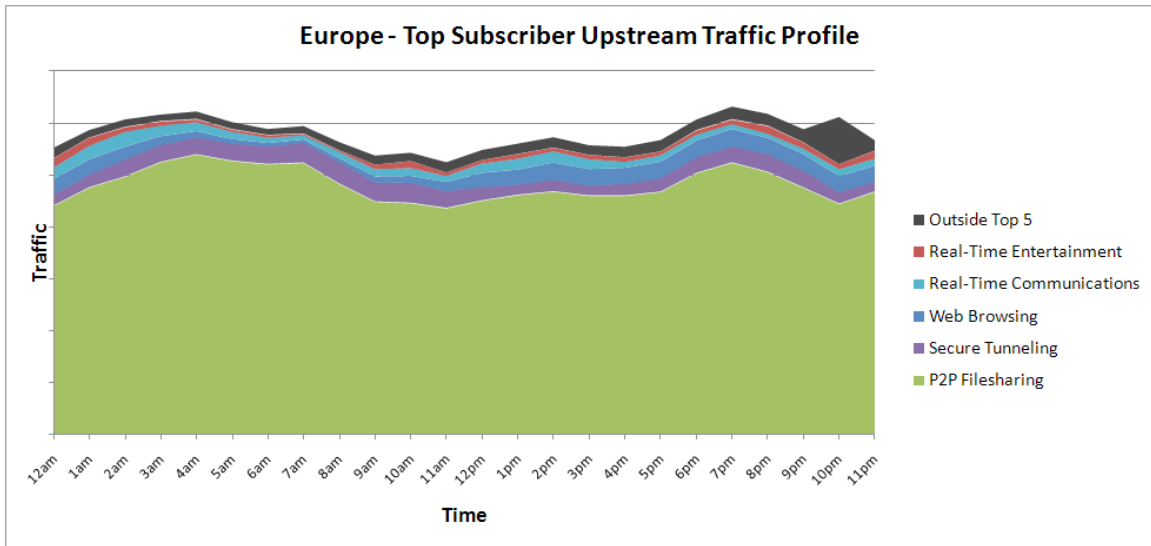


Figure 23 - Europe - Top Subscriber Upstream Traffic Profile

The “hump” in the early morning on the normalized profile is the result of a much lower number of active subscribers on the network. The graph below illustrates the relationship between the number of active subscribers and the aggregate bandwidth in Europe, with the shaded portion representing the periods within 5 percent of maximum for each curve.

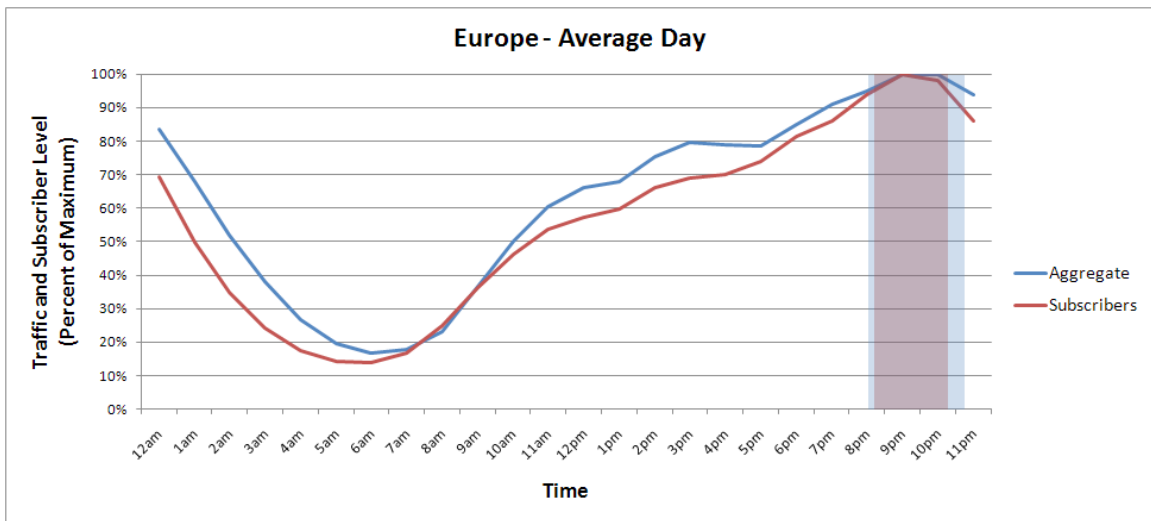


Figure 24 - Europe - Average Day

Zooming in on the composition of traffic during periods of peak network utilization helps service providers to optimize network management policies and capital investments. The pie charts below show the peak hours category share in Europe for the top subscribers and the normalized average.

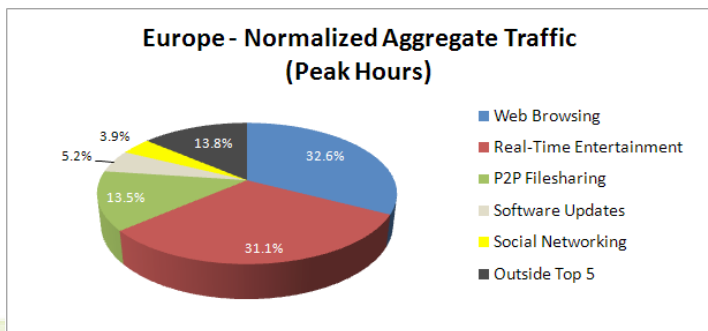


Figure 25 - Europe - Normalized Aggregate Traffic (Peak Period)

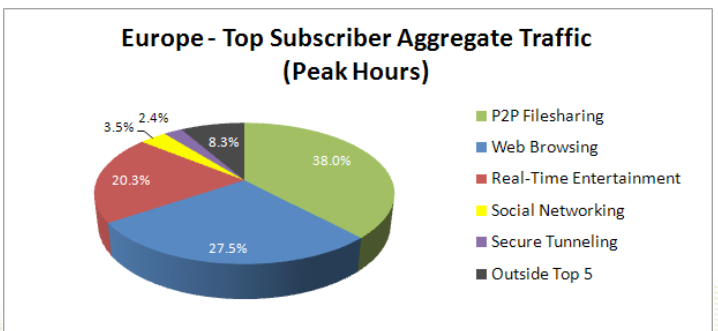


Figure 26 - Europe - Top Subscriber Aggregate Traffic (Peak Period)

Both profiles show the growing impact of social networking services and the significance of web and real-time entertainment. However, the Top Subscriber's profile differs from the normalized average in one significant way - the high levels of P2P filesharing traffic. Service providers who assume that subscribers will not use P2P applications on wireless networks will be dismayed to see that subscriber behavior is fairly consistent regardless of the network technology being used.

The tables below summarize these results for each region.

Caribbean and Latin America			
Normalized		Top Subscriber	
Category Name	Percent of Traffic	Category Name	Percent of Traffic
Web Browsing	26.2%	Web Browsing	39.8%
Real-Time Entertainment	26.0%	P2P Filesharing	27.2%
P2P Filesharing	21.0%	Storage and Back-Up Services	12.9%
Social Networking	8.9%	Real-Time Entertainment	11.5%
Storage and Back-Up Services	7.4%	Encapsulation Tunneling	4.7%
Outside Top 5	10.5%	Outside Top 5	3.7%

Table 10 - Caribbean and Latin America - Top Categories by Bytes - Normalized and Top Subscriber

Europe			
Normalized		Top Subscriber	
Category Name	Percent of Traffic	Category Name	Percent of Traffic
Web Browsing	32.6%	P2P Filesharing	38.0%
Real-Time Entertainment	31.1%	Web Browsing	27.5%
P2P Filesharing	13.5%	Real-Time Entertainment	20.3%
Software Updates	5.2%	Social Networking	3.5%
Social Networking	3.9%	Secure Tunneling	2.4%
Outside Top 5	13.8%	Outside Top 5	8.3%

Table 11 - Europe - Top Categories by Bytes - Normalized and Top Subscriber

North America			
Normalized		Top Subscriber	
Category Name	Percent of Traffic	Category Name	Percent of Traffic
Web Browsing	36.3%	Web Browsing	40.0%
Real-Time Entertainment	26.5%	P2P Filesharing	29.6%
P2P Filesharing	17.5%	Storage and Back-Up Services	11.1%
Social Networking	6.2%	Real-Time Entertainment	10.1%
Secure Tunneling	3.8%	Encapsulation Tunneling	3.2%
Outside Top 5	9.7%	Outside Top 5	5.9%

Table 12 - North America - Top Categories by Bytes - Normalized and Top Subscriber

In every region, web browsing and P2P filesharing are the largest categories in Top Subscriber profiles, and combine to account for two-thirds of a Top Subscriber's traffic. Also, while social networking appears in the top categories list in the normalized profile in every region, it only appears in one Top Subscriber profile (Europe).

Device Influence

In their “Mobile Broadband Opportunities” report, Strategy Analytics states that they expect “the new generation of smartphones, including handsets like iPhone, Droid and Nexus One, to be the main category of devices used for mobile broadband data services, while notebooks and netbooks will follow closely”⁴⁸.

The devices that subscribers use to connect to the network exert a huge influence on the levels and make-up of traffic. A single laptop can easily account for 100 times the byte usage of an average smartphone, and this reality has major implications for service providers. Using this conservative estimate, and assuming that an active subscriber is either using a laptop or a smartphone (and not both), it is possible to illustrate the significant impact of laptops on wireless networks.

The table below shows how traffic originating from laptops can quickly come to dominate a network, even with relatively small penetration. These devices will not only dictate the make-up of the traffic online, rapidly driving up the amounts of P2P Filesharing, but they will cause the levels of traffic to soar.

Percent Smartphone Users	100%	99%	95%	90%	80%
Percent Laptop Users	0%	1%	5%	10%	20%
Percent Smartphone Data	100%	90.8%	65.5%	47.4%	28.6%
Percent Laptop Data	0%	9.2%	34.5%	52.6%	71.4%
Percent Data Increase	N/A	+9 %	+45%	+90%	+180%

Table 13 - Influence of Aircard-Enabled Laptops on Network Traffic

Even with only a 5 percent penetration of aircard-enabled laptops, network traffic increases by almost 50 percent, and laptops make up one-third of that traffic.

Initially, this phenomenon is primarily a local concern (for instance, at the RAN level), where it can quickly come to impact service quality for individual sectors, but gradually it will influence network policies at a higher level (say, backhaul link capacity).

While the example above is unrealistically simple, it is still instructive and shows the fine line service providers must walk between encouraging aircard use to drive revenue, and carefully monitoring the network to prevent overload conditions. As Morgan Stanley stated in their “Mobile Internet Report”, providers must maintain the “flow of new and improved handsets”, but face “a careful balance between making sure they can support the data influx, while also encouraging it to grow ARPU’s.”⁴⁹

The graph below shows the cumulative data usage by device manufacturer from one of the networks examined in this report. On this network, Nokia devices are responsible for more data than the iPhone, but to get a more complete picture of the per-device impact on the network, this data should be normalized by the number of devices of each type.

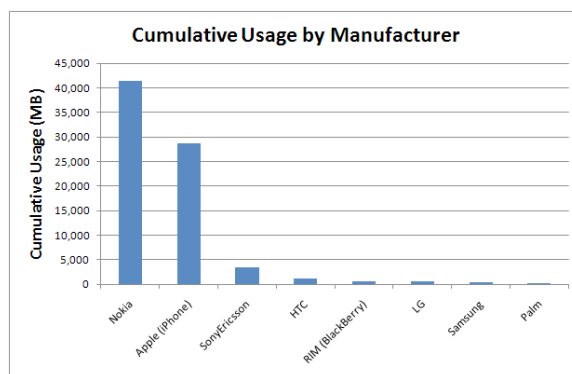


Figure 27 - Cumulative Data Usage by Device Manufacturer

Products and solutions exist that show not only the number of active devices of each type, but also show in vivid detail how the traffic profiles of each type of device differ. Imagine the accurate growth projections possible when service providers know not only the absolute numbers of each handset or portable computer on the network, but can combine that information with accurate application-level traffic profiles for each.

48. Strategy Analytics. Connected Devices Fuel 1 Billion New Mobile Broadband Subs by 2014. Strategy Analytics: Insights for Success.

49. Morgan Stanley Mobile Internet Report.

Study Details

Sandvine's 2010 Mobile Internet Phenomena study examines a representative cross-section of the world's leading wireless data providers and is made possible by the voluntary participation of our customers. Collectively, Sandvine's 40+ wireless service provider customers account for more than 200 million subscribers worldwide.

The data gathered in Sandvine's global wireless 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:

- Caribbean and Latin America
- Europe
- Middle East and Africa
- North America

The report includes an analysis of all regions except for the Middle East and Africa, as we did not feel data was sufficient to guarantee statistical integrity. 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. The same data was gathered for the top users on each network, which was then averaged to create a profile of a "Top Subscriber". 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 by region with weights based on regional 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 readily available 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 2010 Mobile Internet Phenomena study. There is one difference between the categorization for this study versus the categories used in 2009 Global Broadband Phenomena: to reflect the growing influence and pervasiveness of social networking services and applications, we have introduced a category specifically for this traffic. Previously, the vast majority of this traffic was included in the Web category.

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.

Bill Shock: The negative reaction experienced when a bill has unexpected charges.

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.

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.

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.

References

- ABI Research. "ARPU's Continue to Fall Globally as Mobile Voice Usage Nears Saturations, Says ABI Research." Tekrati: The Industry Analyst Reporter. 4 Mar. 2010. Web. <<http://telecom.tekrati.com/research/10783/>>.
- ABI Research. "Mobile Voice Service Revenues to Decline in 2010." Softpedia. Web. <<http://news.softpedia.com/news/Mobile-Voice-Service-Revenues-to-Decline-in-2011-127633.shtml>>.
- Ashai, Bashar. "Strong Growth for Mobile WiMAX Subscriber Base." Rep. 11th ed. Vol. 5. Maravedis. 24 Feb. 2010. Web. <<http://www.maravedis-bwa.com/Issues/5.20/AshaiReadmore.html>>.
- Business News Americas. "Telecom Stats 1Q09- Statistics and Analysis Latin American Telecommunications 1st Quarter 2009." Rep. Print.
- Chetan Sharma Consulting. "US Wireless Data Market - Q4 2009 and 2009 Update." Rep. Mar. 2010. Web. <<http://www.chetansharma.com/US%20Wireless%20Market%20Q4%202009%20Update%20-%20Mar%202010%20-%20Chetan%20Sharma%20Consulting.pdf>>.
- Cisco. "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2009-2014." Rep. 9 Feb. 2010. Web. <http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf>.
- Donnelly, Tom. "New Metrics...we Used to Walk a Mile, Pour a Pint and Send a Byte." Web Log post. Sandvine The Better Broadband Blog. 6 Nov. 2009. Web. <<http://www.betterbroadbandblog.com/2009/11/calling-all-providers-please-educate-your-subscribers/>>.
- EARTHtimes.org. "GSMA: New Report Predicts Explosive European Growth for Mobile Broadband." EARTHtimes.org. 12 Jan. 2010. Web. <<http://www.earthtimes.org/mobilepr/1115566.xhtml>>.
- European Commission Roaming. "Telecoms: Mobile Phone Customers Entitled to Protection from Data-roaming "bill shock" as from 1st March 2010." Europa Press Releases. 1 Mar. 2010. Web. <<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/215&format=HTML&aged=0&language=EN&guiLanguage=en>>.
- Ford, Tracy. "More Devices, More Traffic Mean More Complexity in Managing the Network." RCR Wireless. 19 Jan. 2010. Web. <<http://www.rcrwireless.com/article/20100119/FACILITATORS/100119942/more-devices-more-traffic-mean-more-complexity-in-managing-the->>.
- Genachowski, Julius. "'Preserving a Free and Open Internet: A Platform for Innovation, Opportunity, and Prosperity'." Speech. The Brookings Institution. Washington, DC. 21 Sept. 2009. Hraunfoss. Web. <http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-293568A1.pdf>.
- Harnick, Chris. "Mobile Service Revenue to Exceed \$1 Trillion by 2013: Informa." Mobile Marketer. 19 Jan. 2010. Web. <<http://www.mobilemarketer.com/cms/news/research/5125.html>>.
- Hartvig, Nicolai. "Changing Channels: Who Will Switch on to Mobile TV?" CNN Tech. 25 Feb. 2010. Web. <<http://www.cnn.com/2010/TECH/02/24/mobile.tv/index.html?hpt=Sbin>>.
- Infonetics. "Service Provider Deep Packet Inspection Product Market Outlook." Rep. Jan. 2010. Web.
- Kharif, Olga. "Managing the Wireless Data Deluge." Bloomberg BusinessWeek. 23 Dec. 2009. Web. <http://www.businessweek.com/technology/content/dec2009/tc20091223_992099.htm>.
- "Mobile Broadband Investment Set to Soar as HSPA Connections Pass 200 Million." Cellular-news. 10 Feb. 2010. Web. <<http://www.cellular-news.com/story/41877.php>>.
- Morgan Stanley Mobile Internet Report. Rep. 15 Dec. 2009. Web. <http://www.morganstanley.com/institutional/techresearch/pdfs/2SETUP_12142009_RI.pdf>.
- Ross, Jamie. "The Mobile Internet Is 10 Year Old: It's Time for a Reality Check." Informa Telecoms & Media. 25 Feb. 2010. Web. <<http://telecoms.msgfocus.com/q/1gKKNDYTFXVU3kna/wv>>.
- Sandvine Inc. "2009 Global Broadband Phenomena." Rep. 1 Jan. 2010. Web. <<http://www.sandvine.com/downloads/documents/2009%20Global%20Broadband%20Phenomena%20-%20Full%20Report.pdf>>.
- Seals, Tara. "Billing 'Better Broadband'." Xchange. 4 Feb. 2010. Web. <<http://www.xchangemag.com/articles/billing-better-broadband.html>>.
- Strategy Analytics. "Connected Devices Fuel 1 Billion New Mobile Broadband Subs by 2014." Strategy Analytics: Insights for Success. 6 Jan. 2010. Web. <<http://strategyanalytics.com/default.aspx?mod=PressReleaseViewer&a0=4854>>.
- Tooley, Matt. "Metering Those Leaky Household Bandwidth Pipes." Web Log post. Sandvine The Better Broadband Blog. 20 Nov. 2009. Web.
- Vaughan-Nichols, Steven J. "Here Comes Linux's iPad Clones." Web Log post. Computerworld Blogs. 12 Mar. 2010. Web. <http://blogs.computerworld.com/15742/here_comes_linuxs_ipad_clones>.
- "Version Wireless with Skype Mobile." Verizon Wireless. 2010. Web. <<http://phones.verizonwireless.com/skypemobile/>>.