



2008 Analysis of Traffic Demographics in North- American Broadband Networks

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Summary and Highlights

The results of our 2008 North American study highlight the increasing diversity of application traffic on residential broadband networks today. File-sharing traffic, whether using peer-to-peer networks or news groups, continues to increase in absolute terms while maintaining its relative position as the leading application with traffic levels similar to our study last year. Digital media traffic, broadly describing web browsing and media streaming, has increased noticeably with richer website content now widespread while video playback and streaming becomes a routine Internet activity for subscribers. At the same time, interactive applications from VoIP to online gaming remain popular with strict network requirements as real-time traffic although lower traffic levels. Looking beyond our focus on broad application trends, we observed the peak usage period for these various residential applications during late evenings, as expected, suggesting the need to balance network usage fairly in order to preserve the online experience for subscribers.

In the downstream direction, the rich web experiences that have come to characterize today's Internet, specifically web browsing and streaming, have combined to overtake file-sharing in terms of traffic levels. However, as a stand-alone category, peer-to-peer file sharing is still the leader. The three biggest traffic generators in the downstream direction are:

- Peer-to-peer file sharing (35.6%)
- Web browsing (31.6%)
- Streaming (17.9%)

In the upstream direction, peer-to-peer file sharing still dominates consuming more than twice as much traffic as all other traffic combined. This reality presents opportunity for service providers as they seek to manage their networks to enable the evolving needs of their subscribers and the broad range of applications they value. The three biggest traffic generators in the upstream direction are:

- Peer-to-peer file sharing (75%)
- Tunneling (9.9%)
- Web browsing (9.1%)

Focusing on the aggregate view, web browsing and streaming combined to generate 42% of Internet traffic, which is consistent with the 42.7% found in last fall's study. This level is roughly equal to that consumed by P2P. Note that, in absolute terms, the three leading categories all experienced growth over last year.

In a study published last year, Sandvine presented an aggregate view of consumer broadband usage in which peer-to-peer file sharing applications represented 40.5% of all consumer Internet traffic. This year's results show a slight increase up to 44%, indicating that peer-to-peer file sharing continues to play a major role in the lives of today's broadband subscribers. The three biggest generators in the aggregate are:

- Peer-to-peer file sharing (43.5%)
- Web browsing (27.3%)
- Streaming (14.8%)

Study Background

In May of 2008, Sandvine completed a study of a number of leading North American service providers in order to examine the usage trends of broadband consumers. These providers have collectively deployed a range of service offerings, so the results presented are not unique to a particular access technology or subscriber demographic. The large scope of the study, in both period and breadth of providers, was chosen so that the data would accurately represent consumer Internet usage and would not suffer from biases resulting from temporary application surges or localized network conditions.

While the results presented in this paper are based on a study restricted to North American service providers, the observations are consistent with our experiences globally. For instance, peer-to-peer file sharing remains a popular bandwidth consumer worldwide, even though the dominant applications may change from continent to continent, or even from country to country based on local preferences and available content. Likewise, the websites driving the social media revolution in North America are largely different from those with leading positions elsewhere, but the collective bandwidth consumed is comparable. Finally, those applications or online services that are truly unique to a particular region tend to consume a relatively small amount of bandwidth, so once again the broad conclusions remain applicable even in a global context.

Traffic Inspection Location

All data included in this study was gathered at the subscriber access network to ensure the findings paint a complete picture of subscriber habits. Studies based on examination of traffic at the peering or transit links are significantly impacted by the omission of locally-routed traffic. This is an important point, as many of today's most popular applications such as peer-to-peer file sharing and video streaming are designed to find the fastest routes and will therefore favor local nodes with all other factors being equal. Additionally, a large number of popular websites employ the services of content distribution networks (CDN), which often means that traffic can be served without crossing peering or transit borders.

Identification Techniques

Sandvine's technology has won numerous industry awards, and the success of the platform is directly related to the accuracy of the traffic reports that are generated. Sandvine's stateful inspection and platform intelligence ensures accurate reporting of the most evasive Internet applications, even in the asymmetrically routed networks that are commonplace in service provider deployments. As a result, the numbers presented in this report include encrypted peer-to-peer applications, and don't suffer from the large amounts of unidentified or misidentified traffic that plague sampling-based techniques, often relying on little more than source or destination port as a classification mechanism.

Previously Published Results

In a similar study conducted in the late summer of 2007, Sandvine presented an aggregate view (upstream and downstream) of consumer broadband usage in which peer-to-peer file sharing applications represented 40.5 % of all consumer Internet traffic, and web activities and streaming consumed 31.5% and 11.2% respectively. It is useful to note that the breakdown between web and streaming could well change if examined by today's more refined inspection technologies. For example, what was once reported as web traffic may now be known to be Flash streaming from a popular website. For the purposes of comparison with the March 2008 results, consider the collective view of these categories, in which the combination of web and streaming accounted for 42.7% of Internet traffic.

Downstream Results

Figure 1, below, shows the traffic consumption, by category, in the downstream direction; that is, from the service provider to the subscriber.

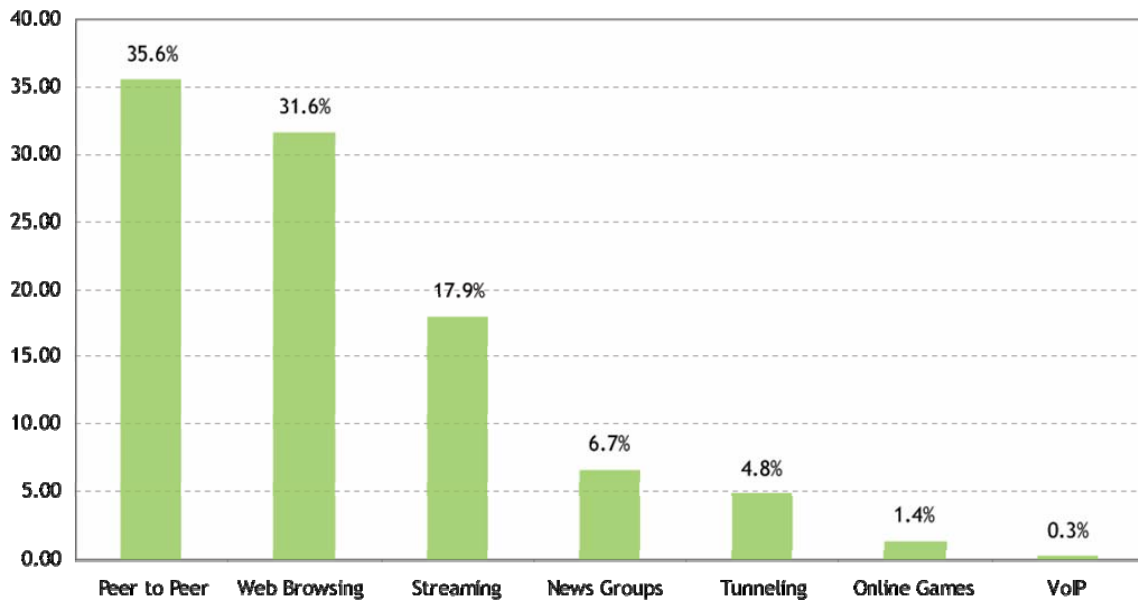


Figure 1 - Downstream Usage, by Category

Downstream consumption trends have exhibited more pronounced changes than their upstream counterparts. Peer-to-peer file sharing accounts for 35.6% of network traffic, which is consistent with past surveys in spite of an absolute increase in traffic levels.

However, observations show that web HTTP in the form of casual and user-generated interactive browser activity has declined relatively, while video content delivery over the same HTTP transport has increased significantly. Web browsing accounts for 31.6% of downstream consumption, and is largely attributable to the broad user-base of websites and the sustained or increasing popularity of high-traffic social networking sites such as Facebook and MySpace.

Web-based video and audio delivery is now firmly established as the third-heaviest consumer of downstream traffic measured by bandwidth, at roughly 18%. This observation can be explained when one considers the plethora of video and audio websites and services that are available. From YouTube and JumpTV, to Last.fm and Jango, to Joost and Babelgum, there is no shortage of services that take advantage of broadband's capacity to deliver entertainment.

While similar in their presentation to the end user audience, there is a large amount of variation in how these services operate behind the scenes. Some services maintain the traditional client-server model in which many subscribers are connected to a single server or CDN. However, many new applications have employed lessons learned from the growth of peer-to-peer file sharing. These services frequently employ peer-based models that take advantage of the load balancing, resilience, and performance improvements available when local nodes are able to serve desired content.

There are even differences between services that share a common basic design. For example, while YouTube is often regarded as a video streaming service, in reality YouTube employs a download model in which the videos are buffer-based. In other words, the entire video is downloaded and buffered locally while the user is watching, as opposed to streaming in real-time. This is an important distinction as the bursty nature of these transmissions leads to traffic behavior that is closer to bandwidth intensive file-sharing, creating a combined threat to the consistent quality needed for true streaming video applications as well as real-time VoIP and gaming applications.

Upstream Results

The upstream findings, from subscriber to service provider, are presented below in Figure 2.

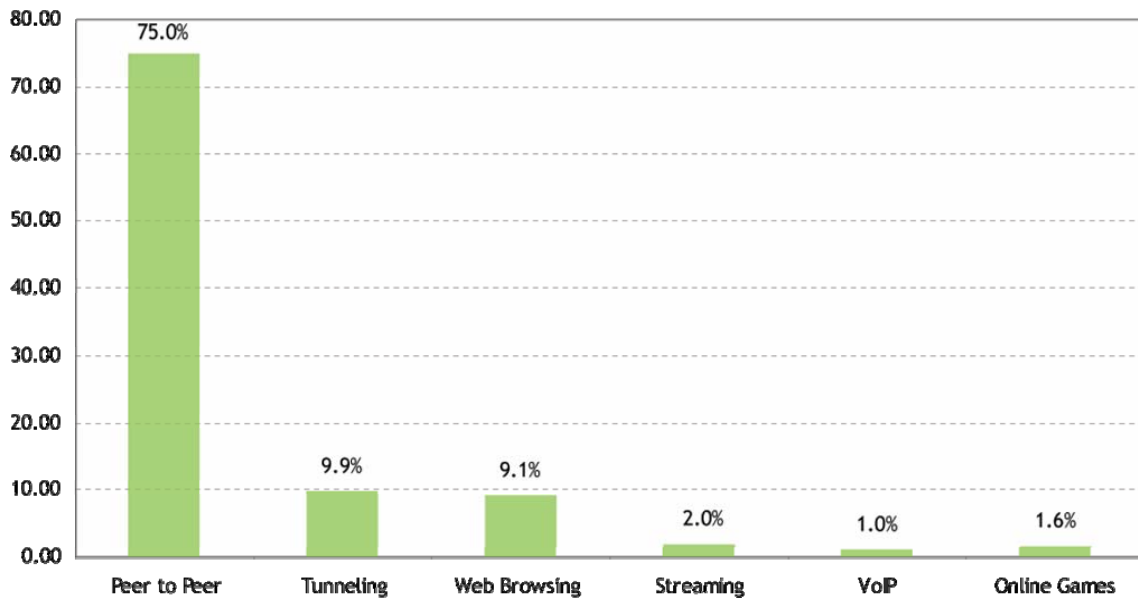


Figure 2 - Upstream Usage, by Category

In recent years, by far the top consumer of upstream traffic has been peer-to-peer file sharing applications, and that trend has continued. Even today, despite the growth of bi-directional applications, the bulk of upstream traffic consumption in consumer broadband networks is attributable to file-sharing applications. In Figure 2, it is clear that at 75.0%, P2P traffic dwarfs the second-place category (tunneling protocols) which comes in at just 9.9%.

The leading P2P application contributors in North America continue to be BitTorrent, Gnutella, and Gnutella2, which account for an overwhelming 50% of all upstream traffic, and almost 70% of all upstream P2P traffic. In other parts of the world, networks such as eDonkey and applications such as Winny or Share typically take the place of one or more of the applications that dominate North America.

The absolute rise in file-sharing traffic on the upstream is largely attributable to increased upload levels per user, as over all subscriber penetration levels for P2P remain consistent with previous results. This increase is a result of two main factors. First, there are ever-growing numbers of media files available, as more companies and independent content producers look to P2P as an efficient distribution mechanism. Second, the average file size continues to rise as users demand higher quality audio and video content. Another potential reason is a change in subscriber behavior in that it is increasingly common for subscribers to leave their computers turned on and connected for extended periods of time. These computers, while unattended, are free to serve and consume content.

Moving beyond tunneling, web applications are a close third at 9.1%, and an increasing amount of this traffic is consumed by websites relying on user-generated content.

It is clear that real-time traffic, from tunneling to VoIP and online gaming, is extremely vulnerable to upstream congestion caused by bandwidth intensive P2P applications. Subscribers may perceive poorer performance and quality for these important applications that are sensitive to packet delay, jitter and loss while competing for limited shared resources. As a result, traffic optimization techniques are critical in order for broadband service providers to ensure a quality online experience across the increasingly broad range of applications that subscribers value today.

Aggregate Results

By combining the downstream and upstream observations, it is possible to create an aggregate view of bandwidth consumption patterns. This view is useful to gain an appreciation for the absolute traffic levels and eliminates bias associated with upstream- or downstream-dominant applications. Note that

Figure 3 below reflects the unequal downstream-to-upstream traffic ratios present rather than simply averaging the percentages that we have already presented.

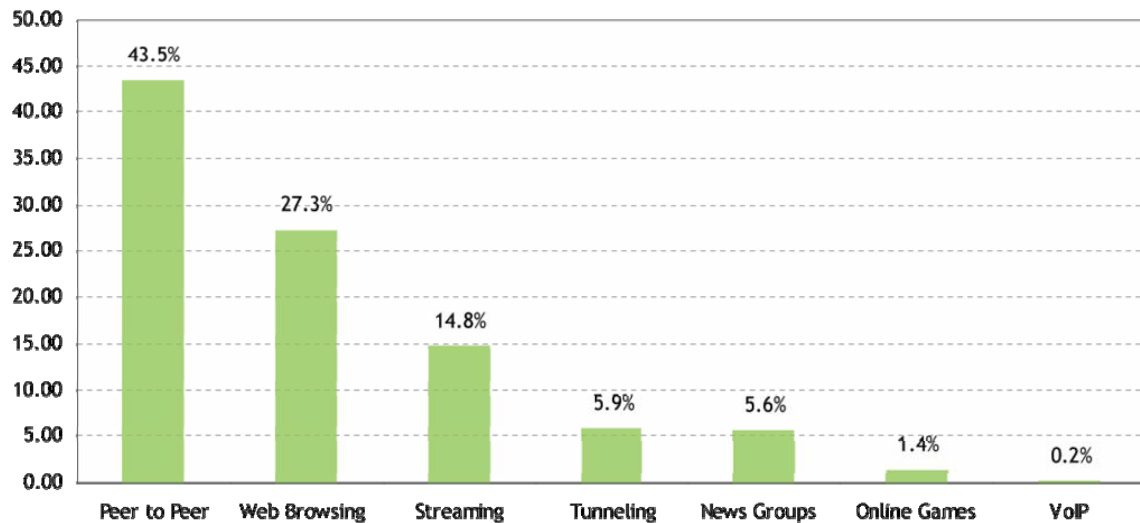


Figure 3 - Aggregate Usage, by Category

Even in an aggregate view, peer-to-peer file sharing remains the leading contributor to Internet traffic levels, at 43.5%. Web browsing (27.3%) and audio/video applications (14.8%) are second and third, respectively. Combined, these two activities generate just over 42% of Internet traffic, consistent with the 43% found in last fall's study and roughly equal to that consumed by P2P. Note that, in absolute terms, the three leading categories all experienced growth over last year.

Tunneling protocols such as those used for VPN applications, including remote access by employees who connect to a corporate network, remain a significant category at roughly 6%. Finally, Newsgroups consumed a notable 5.6% of all Internet traffic (essentially entirely in the downstream direction) as a minority of users continue to satisfy their content needs by subscribing to news sites. In fact, observations indicate that NNTP (network news transfer protocol) traffic is used by only 0.1% of consumer broadband users, which indicates that a very small number of subscribers are consuming disproportionate amounts of network resources.

Conclusions

From the observations presented, a number of broad insights can be made.

Peer-to-peer file sharing traffic, despite some recent media reports, continues to increase in absolute terms. In relative terms, P2P traffic levels are consistent with those seen during Sandvine's last study when compared to the combination of web browsing, media streaming and other media downloads. Even as social media and the Web 2.0 phenomenon continue to grow, the subscriber appetite for file sharing is keeping pace.

Dramatic increases in broadband capacity have created an environment where subscribers have an increasingly wide range of choices to satisfy their demand for rich media content. While file sharing remains the largest single category of residential broadband traffic, its rate of growth has moderated relative to streaming media and web browsing.

In the upstream direction, peer-to-peer file sharing still dominates, consuming more than twice as much traffic as everything else combined. Upstream bandwidth is, by design, more limited than downstream bandwidth and is considered a limited resource. DSL, cable, and wireless networks have historically been guided by design assumptions that no longer reflect the evolution towards much more symmetrical bandwidth usage. The design of these networks, which dictates that downstream traffic has more

available bandwidth than upstream traffic, was originally based on usage patterns and usage behavior from early content-consuming applications such as web-browsing. However, the continual evolution of applications from content-consuming to always-on content-supplying means that current traffic patterns and usage behavior no longer fit these bandwidth assumptions.

Finally, with peer-to-peer traffic typically running 24/7 and having peaks that correspond with the peak times of real-time multimedia applications, there is a high probability that subscribers will experience network congestion when they most want to use the Internet.

Closing Remarks

Broadband networks continue to experience exciting and rapid growth as millions of new subscribers around the world connect to the Internet. Users are driven by popular applications like peer-to-peer file sharing, voice-over-IP services like Skype, online gaming and increasingly popular digital media such as YouTube.

Each application has its own unique characteristics and delivery demands for the best performance, so broadband and mobile data providers alike are seeking to understand the traffic going through their networks. With a detailed understanding of subscriber and application traffic, service providers can then ensure a quality online experience for their subscribers by balancing the competing service demands with reasonable network management practices. As a result, Sandvine believes that traffic optimization technology will continue to play a critical role in broadband networks, benefiting service providers and subscribers alike.