Akamai
FASTER FORWARD

VOLUME 5, NUMBER 4

The State of the Internet

4TH QUARTER, 2012 REPORT

INCLUDES INSIGHT ON MOBILE TRAFFIC AND CONNECTED DEVICES FROM ERICSSON

Letter From the Editor

This issue of the *State of the Internet Report* marks the end of five years of publication — the near equivalent of an eternity in Internet time. Over this half-decade period, we have seen:

- The rapid rise of mobile phones and tablets using Apple's iOS and Google's Android operating systems as the primary devices for accessing Web content
- The exhaustion of IANA's central pool of IPv4 address space, and the ongoing depletion of available IPv4 address space across the Regional Internet Registries
- Growth in IPv6 adoption across major backbone networks, end-user networks, major Web sites, and leading content delivery networks, including Akamai
- The development of "national broadband plans" in countries around the world, laying out target connection speeds and adoption/availability targets for the next several years
- "Internet disruptions" used as a means of control in some countries during periods of political unrest, where international Internet connectivity is severely limited, or severed entirely
- Growth in Denial-of-Service (DoS) attacks as a means of protest, targeting government, financial services, commerce, and other enterprise Web sites and applications

The *State of the Internet Report*, over its twenty-issue history, has covered all of these topics in some way. In addition to the expected fourth-quarter coverage of these areas, we have also taken the opportunity to look back at trends we have seen throughout 2012, as well as the five years that the report has been published. These historical perspectives can be found in Section 9 of the report. In addition, historical data for the key connectivity metrics can be found in a custom graphing tool at *www.akamai.com/stateoftheinternet*.

With its roots in a brief conversation with, and short PowerPoint deck of ideas from, Akamai CMO Brad Rinklin, the *State of the Internet Report* has grown into a well-respected and highly anticipated publication, and based on the e-mails, Tweets, and general comments that I receive, it provides value for companies and customers across various industries, as well as people and organizations involved in developing and influencing broadband policies in countries around the world. In addition, based on the comment threads accompanying articles covering the report, the data within it appears to strike both national and personal nerves – that is, commenters inevitably comparing the published speeds for their country to (usually higher) speeds seen in others, as well as comparing the speed of their own connections to those of their country as a whole.

Looking ahead into 2013 and beyond, we will continue to enhance the report to include more comprehensive information on attack traffic observed by Akamai, additional insight into mobile usage, and more Akamai-sourced information on IPv6 usage and adoption. In addition, we plan to add an "Americas" section, providing additional insight into connectivity metrics across countries in Latin and South America.

Beyond the data that we currently include in the report and the data we plan to add, what other data sets would you like to see included? Let us know via e-mail at *stateoftheinternet@akamai.com* or via Twitter at @akamai_soti.

– David Belson

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Executive Summary

Akamai's globally-distributed Intelligent Platform allows us to gather massive amounts of information on many metrics, including connection speed, attack traffic, network connectivity/availability/latency problems, and IPv6 growth/transition progress, as well as traffic patterns across leading Web sites and digital media providers. Each quarter, Akamai publishes the *State of the Internet Report*.

This quarter's report includes data gathered from across the Akamai Intelligent Platform during the fourth quarter of 2012 about attack traffic, broadband adoption, and mobile connectivity, as well as trends seen in this data over time. In addition, this report includes insight into the second phase of the "Operation Ababil" attacks, the state of IPv6 adoption as measured by Hurricane Electric, Internet disruptions seen during the quarter, and observations from Akamai partner Ericsson regarding how mobile data traffic varies by device type. In addition, as the final report for 2012, it also includes historical perspectives on DDoS attacks, IPv4 exhaustion and IPv6 adoption, and key connectivity metrics.

Security

During the fourth quarter of 2012, Akamai observed attack traffic originating from source IP addresses in 177 unique countries/regions. Note that our methodology captures the source IP address of an observed attack, and cannot determine attribution of an attacker. Already far and away the top source of observed attack traffic, China saw its share increase further during the quarter, growing to 41%. The United States and Turkey held the second and third place spots respectively, together accounting for just under 15% of observed attack traffic combined. Attack traffic concentration increased very slightly from the third quarter of 2012, with the top 10 ports seeing 60% of observed attack traffic. Throughout the course of 2012, Akamai's customers reported being targeted by 768 DDoS attacks, more than three times as many as in 2011. Over a third of these attacks targeted customers in the Commerce sector. In addition, the second phase of attacks from Operation Ababil commenced in December, targeting Web sites with volumetric and SSL resource attack vectors.

Internet and Broadband Adoption

Akamai observed a 2.4% quarterly increase in the number of unique IPv4 addresses connecting to the Akamai platform, growing to just under 700 million, or nearly 16 million more than were seen in the third quarter. Looking at connection speeds, the global average connection speed increased 5.0% to 2.9 Mbps, and the global average peak connection speed grew 4.6% to 16.6 Mbps. At a country level, South Korea had the highest average connection speed at 14.0 Mbps (down 4.8% quarter-over-quarter), while Hong Kong continued to have the highest average peak connection speed at 57.5 Mbps (up 6.2% quarter-over-quarter). Globally, high broadband (>10 Mbps) adoption grew 2.7% in the fourth quarter, remaining at 11%, and South Korea remained the country with the highest level of high broadband adoption, at 49% (down 5.7% quarter-over-quarter). Global broadband (>4 Mbps) adoption grew 2.1% but remained at 41%, with South Korea leading this metric as well, with a broadband adoption level of 86% (down 0.5% quarter-over-quarter). Note that we are no longer including figures for narrowband (<256 kbps) adoption nor city-level data.

Mobile Connectivity

In the fourth quarter of 2012, average connection speeds on surveyed mobile network providers ranged from a high of 8 Mbps down to 345 kbps. Average peak connection speeds for the quarter ranged from 44 Mbps down to 2.7 Mbps. Based on data collected by Ericsson, the volume of mobile data traffic grew 28% between the third and fourth quarter of 2012, and doubled from the fourth quarter of 2011 to the fourth quarter of 2012.

Analysis of Akamai IO data collected across the fourth quarter of a sample of requests to the Akamai Intelligent Platform indicates that for users of mobile devices on cellular networks, the largest percentage of requests (35.3%) came from Android Webkit, with Apple Mobile Safari close behind (32.6%). However, for users of mobile devices across all networks (not just cellular), Apple Mobile Safari accounted for an average of 58.7% of requests, with Android Webkit responsible for just 21.7%.

SECTION 1:
Security

Akamai maintains a distributed set of agents deployed across the Internet that monitor attack traffic. Based on data collected by these agents, Akamai is able to identify the top countries from which attack traffic originates, as well as the top ports targeted by these attacks. Note that the originating country as identified by the source IP address is not attribution— for example, a criminal in Russia may be launching attacks from compromised systems in China. This section provides insight into port-level attack traffic, as observed and measured by Akamai, during the fourth quarter of 2012. It also includes insight into DDoS attacks that targeted Akamai customers across 2012, as well as insight into Phase II of Operation Ababil. Due to changes in the back-end data gathering systems, insight into client-side SSL ciphers as observed by Akamai is once again absent from the report — we expect that this data will return in the 2013 editions of the report.

1.1 Attack Traffic, Top Originating Countries

During the fourth quarter of 2012, Akamai observed attack traffic originating from 177 unique countries/regions, down from 180 in the prior quarter. As shown in Figure 1, China once again overwhelmingly remained the source of the largest volume of attack traffic, accounting for two-fifths of the total, up from a third in the prior quarter. Observed attack traffic volume originating from the United States dropped to 10% from 13% in the third quarter, and it remained in second place globally. The top 10 countries/regions remained mostly unchanged quarter-over-quarter, with a single exception – South Korea ceded the bottom spot to Hungary, though the traffic volumes from the two countries differed by less than a hundredth of a percent. In terms of quarterly changes among the top 10, China's increase was clearly the most significant, though Turkey and Romania also saw slight increases, and the United States saw the most significant decline quarter-over-quarter. Examining the source data set, we once again find that for most countries among the top 10, attack counts decline sharply after the top one or two ports, whereas for attacks observed to be originating in China, attack counts remain fairly high across the top five to ten ports and then tail off very gradually.

In examining the regional distribution of observed attack traffic in the fourth quarter, we find that 56% originated in the Asia Pacific/Oceania region, up from 51% in the third quarter, likely due to the significant increase seen in China. Europe once again accounted for just less than 25%, while North and South America originated just over 18%. Africa remained consistent, responsible for 1% of observed attack traffic.

	Country	Q4 '12 % Traffic	Q3 '12 %
1	China	41%	33%
2	United States	10%	13%
3	Turkey	4.7%	4.3%
4	Russia	4.3%	4.7%
5	Taiwan, Province of China	3.7%	4.5%
6	Brazil	3.3%	3.8%
7	Romania	2.8%	2.7%
8	India	2.3%	2.5%
9	Italy	1.6%	1.7%
10	Hungary	1.4%	1.4%
–	Other	25%	28%

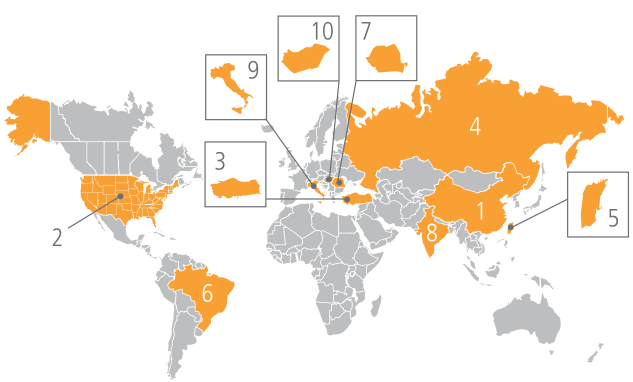

Figure 1: Attack Traffic, Top Originating Countries (by source IP address, not attribution)

Port	Port Use	Q4 '12 % Traffic	Q3 '12 %
445	Microsoft-DS	29%	30%
23	Telnet	7.2%	7.6%
3389	Microsoft Terminal Services	5.7%	4.9%
1433	Microsoft SQL Server	5.3%	4.9%
80	WWW (HTTP)	2.8%	3.0%
22	SSH	2.5%	2.3%
135	Microsoft-RPC	2.2%	2.0%
443	SSL (HTTPS)	2.1%	1.1%
3306	MySQL	1.6%	1.3%
8080	HTTP Alternate	1.5%	1.7%
Various	Other	40%	–

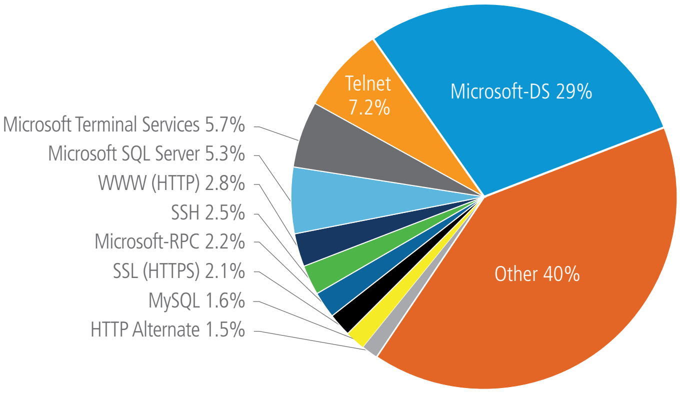

Figure 2: Attack Traffic, Top Ports

Looking at the full year, China has clearly had the most variability (and growth) across the top countries/regions, originating approximately 16% of observed attack traffic during the first half of 2012, doubling into the third quarter, and growing further in the fourth quarter. Russia also saw significant variability throughout the year, though in the opposite direction, declining from originating 7.2% of observed attacks in the first quarter to just 4.3% in the fourth quarter. In contrast, the United States ranged between 10% and 13% during 2012, with these bookends seen in the latter half of the year. Similarly limited shifts were also observed across other top countries/regions. Clearly, it would be most interesting to understand why such significant changes were seen in China and Russia. These shifts could be due to a variety of reasons, but unfortunately, we have insufficient insight into specific causes.

1.2 Attack Traffic, Top Ports

As shown in Figure 2, attack traffic among the top 10 targeted ports increased slightly during the fourth quarter of 2012, with these ports targeted by 60% of observed attacks, up from 59% in the third quarter, but down from the second and first quarters. The percentage of attacks targeting port 445 dropped very slightly quarter-over-quarter, though not as significantly as the declines seen earlier in the year.

Port 445 remained the most targeted port in seven of the top 10 countries/regions, accounting for as many as 67 times as many attacks as the next most targeted port. (One again, this massive gap was observed in Romania, though it was smaller than the 109x difference seen in the third quarter.) In both Turkey and Taiwan, the largest number of attacks targeted Port 23. Interestingly, while Port 445 was the second-most targeted port in Turkey, it did not even make the top 10 list in Taiwan — there Port 135 came in second. China saw 1.4 times as many attacks targeting Port 1433 as Port 3389 — this concentration was down slightly from the third quarter. Looking at the distribution of second-most targeted ports for the fourth quarter, both Ports 3389 and 135 came in second in three countries/regions (3389: China, United States, Brazil; 135: Taiwan, Italy, Hungary), while Port 23 came in second in both Romania and India.

1.3 Observations on DDoS Attacks

The number of Distributed Denial of Service (DDoS) attacks that Akamai saw in 2012 grew significantly from 2011. While 250 attacks were reported in 2011, 2012 saw 768 attacks reported by our customers, a year-over-year increase of more than 200%. Note that this is the first time Akamai is reporting on these attacks, and we are using this opportunity to set a baseline against which to measure future attack volume. At this point in time, Akamai is only counting the attacks that rose to the level of requiring human interaction to combat them. Owing to the nature of the Akamai Intelligent Platform, many attacks against our clients are mitigated automatically with little or no interaction from Akamai or our customers. This includes lower layer attacks such as SYN floods, UDP floods and many other common types of volumetric attacks. Higher level attacks that target the application layer, such as massive amounts of HTTP GET traffic, are combatted using Akamai's KONA Web Application Firewall, and require human interaction to create, implement, and update the rules to stop them.

In many ways, DDoS has become the weapon of choice for multiple types of attackers, from political activists to criminals, and potentially even nation-states. In the case of activists, the attacks are aimed at gaining notoriety and making a political statement. The biggest example of this has been the attacks attributed to Anonymous that started in 2010, and that continue to this day. When criminals are involved, the goal is often to distract the targeted business while the criminals commit fraud or simply extort money from their victim. Over the Christmas holiday, one financial services institution (not an Akamai customer) was attacked by criminals who were committing fraud and using the DDoS attack to cover their tracks.[1]

As illustrated in Figure 3, of the 768 attacks where customers engaged Akamai for assistance, over a third (269 or 35%) of the attacks targeted companies in the Commerce sector. An additional 164 attacks (22%) targeted Media and Entertainment companies, followed closely by companies classified as Enterprise, which were targeted by 155 attacks, accounting for 20% of the total. High Tech companies were targeted by 110 attacks (14%), while Public Sector agencies were the target of 70 attacks (9%) last year. The 768 attacks were reported by 413 unique organizations, meaning that many organizations were targeted more than once—some significantly more.

It is telling that the Commerce sector by itself accounted for more attacks in 2012 than were seen in 2011 in total. Figure 4 shows that the retail vertical was the target of 186 attacks (24% of total), by far the largest number of attacks suffered by any vertical. Retailers make tempting targets because of the financial impact that an attack on their Web site can have, especially if the attacks come during the holiday season when many retailers make the majority of their money. Hotel and travel companies saw a moderate number (59) of attacks, and Akamai believes that some of these attacks were related to extortion attempts. Targeted companies would receive an e-mail or online support chat message telling them to pay up or the attacks would continue—these notifications from the attackers were either preceded or followed by a short DDoS attack, essentially sending the message "Pay up or we'll be back".

Akamai's Enterprise customers suffered DDoS attacks over a much broader spectrum than commerce, as illustrated in Figure 5. The Financial Services vertical suffered 72 individual attacks, with many of these directly related to the Operation Ababil attacks that started in September; these were discussed in detail in the 3rd *Quarter, 2012 State of the Internet Report*. Business Services companies were targeted by 40 attacks, while utilities, health care companies and a number of other enterprise verti-

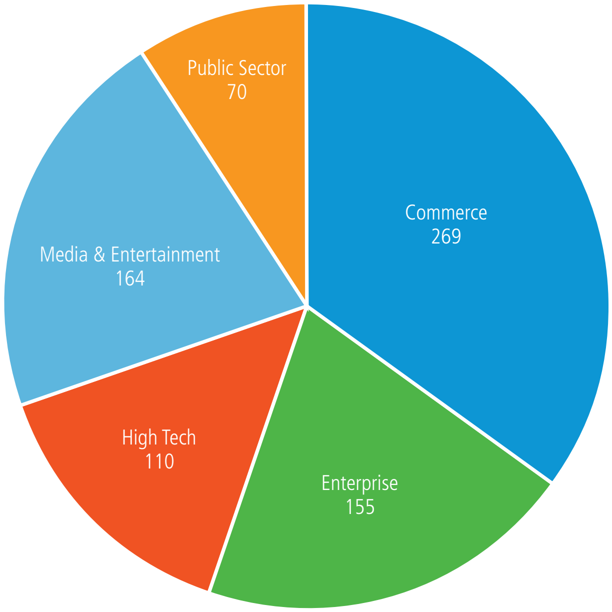

Figure 3: 2012 DDoS Attacks by Sector

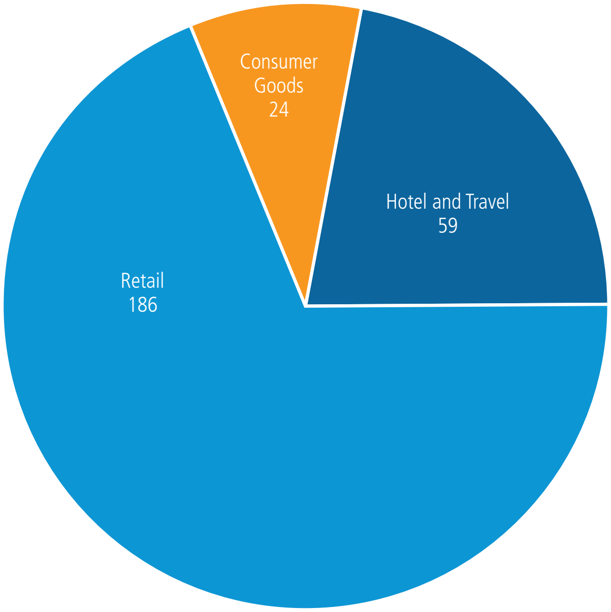

Figure 4: 2012 DDoS Attacks in the Commerce Sector

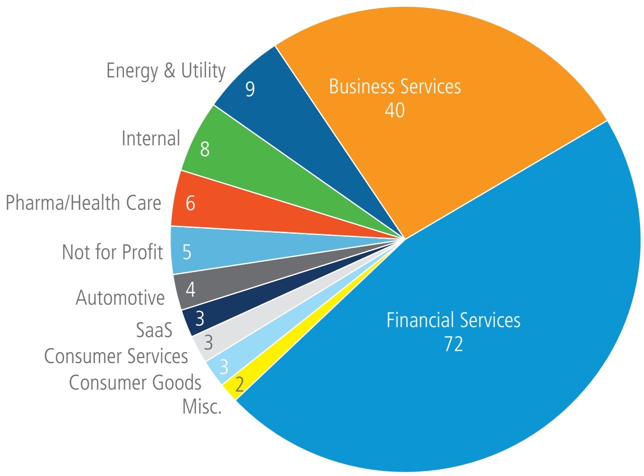

Figure 5: 2012 DDoS Attacks in the Enterprise Sector

DID YOU KNOW?

Web sites can mitigate the impact of DDoS attacks by taking steps to:

- Ensure uninterrupted availability of their DNS
- Protect against network-layer flooding
- the default page through caching
- Protect redirect or splash pages through caching
- Protect dynamic sites through rate controls or user validation

cals were each targeted a smaller number of times. Interestingly, Akamai's own corporate sites were the target of attacks 8 times during the year. Several of these were ongoing attacks that were blocked but continued despite a lack of effectiveness.

The Media and Entertainment sector, which includes gaming and streaming media companies, suffered more attacks (164) in total than Enterprise companies, in large part because they have been moving many of their services online in response to public demand. Additionally, when the Web site of a media company is impacted by an attack, it often becomes newsworthy much more quickly than when a corporate Web site is brought down. Companies in the High Tech sector were the target of 110 reported attacks in 2012. Surprisingly, attacks targeting Public Sector agencies accounted for less than 10% of the overall attacks. Despite this number, government sites are tempting targets for DDoS, since interfering with such a site gains the attackers an outsized level of attention.

Distributed Denial of Service attacks have existed since the Internet was created. In recent years, they have been gaining in popularity in large part because the technical barriers to creating such an attack are small and because it is difficult and time consuming to track an attack back to its true source. The fact that Akamai saw a three-fold increase in attacks since 2011 is indicative of this ease. They also tend to be relatively easy to defend against, since the majority of attacks are volumetric in nature, whether SYN floods or HTTP GET floods. However, the attacks associated with Operation Ababil indicate that this won't always be the case; attackers are developing new methodologies and tools to make their DDoS efforts more effective.

1.4 Operation Abibil, Phase II

Overview

From December 10, 2012 through the week of January 11, 2013, several financial institutions were targeted by large DDoS attacks. This was the second phase of the Operation Ababil campaign waged by the hacktivist group known as Izz ad-Din al-Qassam Cyber Fighters (QCF for short).[2] The BroBot botnet is being leveraged by QCF to launch these attacks, and Akamai has been actively defending customers against this attack campaign.

Below, we provide a summary of information Akamai is able to share, including techniques that have worked to mitigate the impacts of the BroBot/QCF Phase II attacks. Information regarding this attack may have changed since the writing of this summary (January 2013).

Motivation

The QCF claims to be launching these attacks in an effort to have the "Innocence of Muslims" video, considered to contain anti-Islamic rhetoric, removed from YouTube. The Hilf-ol-Fozoul (The Global Movement) site[3] documents apparent snapshots of multiple U. S. banking sites made unavailable by these attacks while implying a QCF quote of "Attacks will be over only if film is removed."

The US Office of the Comptroller of the Currency (OCC) has issued an alert related to these attacks.[4, 5] It is interesting to note that the OCC maintains the view that there may be criminal motivations for these attacks.

Ababil Phase I (September – November 2012)
In September 2012, U.S. banks started to experience a range of DDoS attacks impacting online application availability. The attacks used various techniques to disrupt site availability and performance.

Observed attack vectors include:

- Volumetric DNS DDoS
- Volumetric Layer 3/4 DDoS
- Volumetric Layer 5-7 DDoS
- SSL resource attacks

As a recipient of some of the first attack traffic during Operation Ababil Phase I, Akamai immediately noticed that the attack patterns were heterogeneous in nature, which is very unlike the highly-diversified attack traffic seen with other hacktivist attacks. At the same time, Akamai also noted the lack of English-language recruitment—flyers, Facebook, Twitter, Internet relay chat (IRC), and bulletin boards—which is often seen associated with hacktivist-related DDoS attacks.

The QCF used the BroBot botnet extensively throughout Operation Ababil Phase I. BroBot consists of compromised Virtual Private Servers (VPS) and cloud servers running vulnerable versions of WordPress and Joomla content management systems (CMS) and related plugins that have been compromised. The effectiveness of BroBot is increased in comparison to other botnets due to a high amount of bandwidth per server (100 Mbps vs. 1 Mbps for home users) and a seemingly endless supply of vulnerable servers.

Ababil Phase II (late December 2012 – January 2013)
The attacks resumed on Christmas Day (December 25), after a pause lasting from the beginning of November through the first 3 weeks of December. The QCF have continued to use BroBot and have varied the attacks to evade filtering, primarily through the use of altering query strings, user-agents, and targeted URLs.

During Phase II of the campaign, BroBot nodes were observed sending high volume bursts of traffic (as many as 10,000 requests per minute per node), and were observed sending as many as 18 million aggregate attack requests per second. These volumetric attacks typically burst for a short period of time and then go dormant, sometimes for hours or days, before resuming.

Mitigation Details
Effective mitigation techniques for this attack have included, but are not limited to:

- IP Blacklisting - The most recent iteration of this list is available for Akamai customers as part of their security configuration or through the FS-ISAC.
- IP Rate Controls – Rate controls count the number of requests per IP address and block additional requests when one of a set of thresholds is exceeded.

Internet Penetration

2.1 Unique IPv4 Addresses

Through its globally-deployed Intelligent Platform, and by virtue of the approximately two trillion requests for Web content that it services on a daily basis, Akamai has unique visibility into levels of Internet penetration around the world. In the fourth quarter of 2012, over 699 million IPv4 addresses, from 240 countries/regions, connected to the Akamai Intelligent Platform – 4.2% more than in the third quarter of 2012 and 13% more than in the fourth quarter of 2011. Although we see nearly 700 million unique IPv4 addresses, Akamai believes that we see well over one billion Web users. This is because, in some cases, multiple individuals may be represented by a single IPv4 address (or a small number of IPv4 addresses), because they access the Web through a firewall or proxy server. Conversely, individual users can have multiple IPv4 addresses associated with them due to their use of multiple connected devices. Unless otherwise specified, the use of "IP address" within Section 2.1 refers to IPv4 addresses.

As shown in Figure 6, the global unique IP address count ended 2012 on a positive note, growing 2.4% quarter-over-quarter, adding over 16 million addresses. Quarterly growth was also seen among all of the top 10 countries, ranging from 1.1% in Japan to 5.1% in Russia. Looking at the full set of countries/regions around the world, 75% saw a quarterly increase in unique IP address counts. As expected, some of the largest gains were seen in small countries, where the addition of just a few unique IP addresses can account for a significant percentage change.

Looking at year-over-year changes, the global unique IP address count increased by nearly 10%, or over 71 million, as compared to the fourth quarter of 2012. Among the top 10 countries, growth levels ranged from under 1% in South Korea and Japan (0.2% and 0.8% respectively) to double digit growth rates seen in Russia (13%), China (19%), Italy, (21%), and Brazil (33%). On a global basis, 79% of countries/regions had higher unique IP address counts year-over-year. Among those countries that saw IP address counts decline, several EMEA countries saw double digit percentage losses. However, those that saw the largest percentage losses had comparatively smaller address counts – low enough that the countries do not qualify for inclusion in subsequent sections.

	Country/Region	Q4'12 Unique IP Addresses	QoQ Change	YoY Change
–	Global	699,682,878	2.4%	9.8%
1	United States	146,874,246	1.3%	1.7%
2	China	101,661,860	2.7%	19%
3	Japan	40,726,690	1.1%	0.8%
4	Germany	37,047,360	1.4%	3.0%
5	United Kingdom	27,139,729	2.7%	7.6%
6	France	26,073,000	1.9%	4.3%
7	Brazil	23,503,804	4.2%	33%
8	South Korea	20,242,185	2.4%	0.2%
9	Italy	18,750,460	3.1%	21%
10	Russia	16,875,757	5.1%	13%

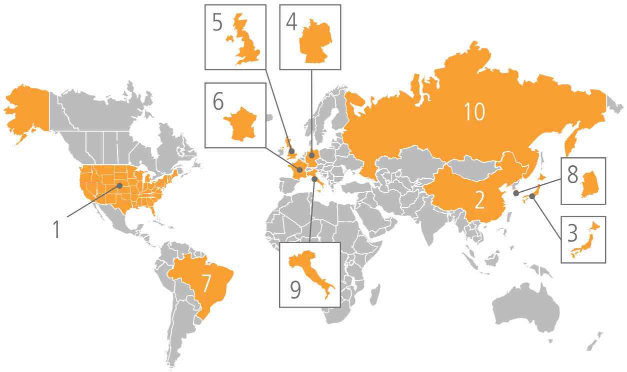

Figure 6: Unique IPv4 Addresses Seen By Akamai

DID YOU KNOW?

In the fourth quarter of 2012, 27 countries/regions had fewer than 1,000 unique IP addresses connect to Akamai. Of those, eleven had fewer than 100 unique IP addresses connect to Akamai.

2.2 IPv4 Exhaustion

The number of available IPv4 addresses continued to decline as 2012 drew to a close, as Regional Internet Registries continued to allocate/assign blocks of address space to requesting organizations within their respective territories.[6] Based on data published by the RIRs,[7] Figure 7 compares IPv4 address assignment/allocation activity by RIR for the fourth quarter of 2012.

Looking at Figure 7, it is obvious that activity has slowed significantly in both Europe and the Asia Pacific regions, where the RIRs (RIPE & APNIC respectively) are both distributing IP addresses from their final "/8" blocks of IPv4 address space. Upon reaching that threshold, both RIRs implemented more restrictive/limited policies for ongoing assignments, as has been discussed in previous issues of the *State of the Internet Report*.

It is interesting to note that in the fourth quarter, IPv4 address space was consumed more aggressively in Latin/South America (LACNIC) and Africa (AFRINIC) than in North America (ARIN). However, the growth in LACNIC appears to have been driven largely by two rather significant allocations to mobile network providers – one of just over two million IPv4 addresses (a "/11") on November 13 to Vivo S.A.[8] in Brazil and another of just over one million IPv4 addresses (a "/12") on December 3 to Comcel S.A.[9] in Colombia. The growth in AFRINIC was driven by a number of sizable allocations as well – the two most significant ones illustrated in the graph occurred on October 9, when just over one million IPv4 addresses (a "/12") were allocated to South African mobile network provider MTN,[10] and two allocations of just over half a million IPv4 addresses (a "/13") each to Unitel,[11] a mobile network provider in Angola, and Safaricom,[12] a mobile network provider in Kenya. Using IPv4 address space allocation as a proxy for growth in Internet usage and adoption, it is not too surprising to see this growth occurring on mobile, especially in Africa. Within North America, the biggest jump in activity was ARIN's allocation of just over one million IPv4 addresses[13] (a "/12") to Windstream Communications, a provider of wired/fixed business and residential Internet services.

2.3 IPv6 Adoption

As Akamai continues to roll out IPv6 support across its solution portfolio, we will endeavor to include data in the *State of the Internet Report* on IPv6 adoption based on the analysis of IPv6 requests to, and traffic delivered by, the Akamai Intelligent Platform. However, until such time as we can include comprehensive Akamai data on IPv6 adoption, we continue to supplement with third-party data.

For the last year, we have included insight into IPv6 adoption over time based on data from network service provider Hurricane Electric, which provides Internet transit, Web hosting, and collocation services and notes that it is "considered the largest IPv6 backbone in the world as measured by number of networks connected."[14] A white paper[15] available from Hurricane Electric notes that it has operated IPv6 network elements since 2000 and that it implemented extensive native IPv6 peering in early 2006 as a result of a core router and backbone upgrade.

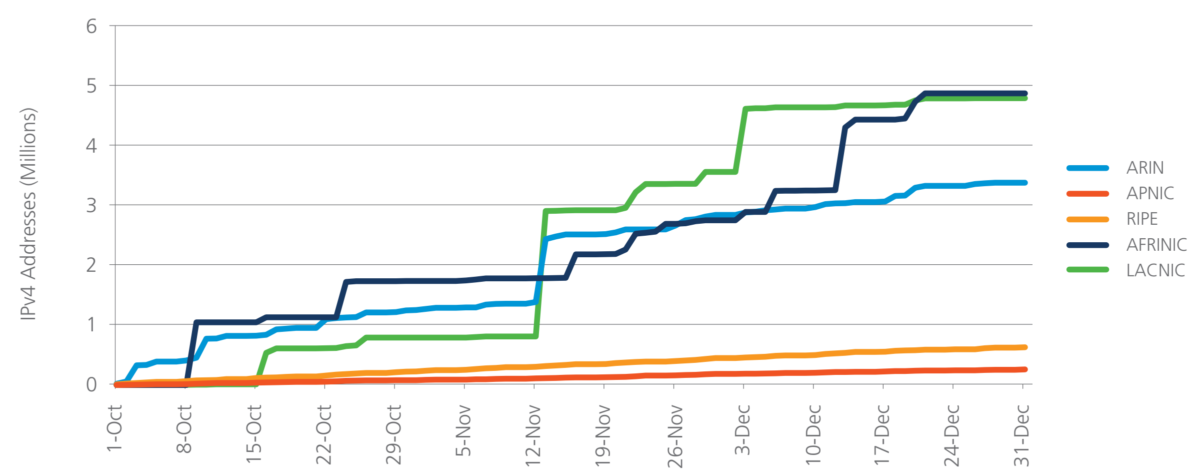

Figure 7: Total Number of IPv4 Addresses Assigned/Allocated by RIRs, Q4 2012

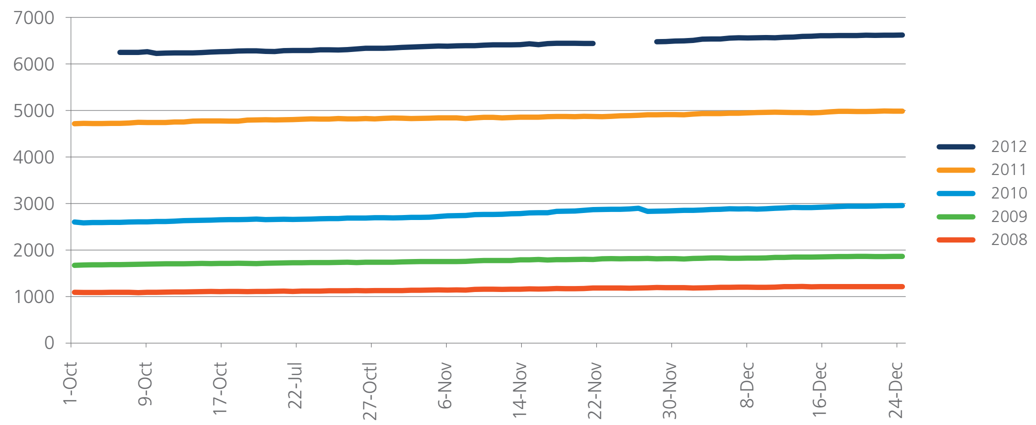

Figure 8: Total Number of Autonomous Systems in the IPv6 Routing Table

Hurricane Electric also publishes the output of a set of measurement tools on its "Global IPv6 Deployment Progress Report" page, available at http://bgp.he.net/ipv6-progress-report.cgi.

As noted in the *Third Quarter, 2012 State of the Internet Report*, issues with the data collection system at Hurricane Electric led to incomplete data being available for the quarter – the issue was resolved about a week into the fourth quarter, as evidenced by the "2012" line in Figure 8. Using October 6, 2012 as a starting point for the fourth quarter, we find that at least 373 ASes were added to the global IPv6 routing table, which ended the year containing 6603 ASes. Growth in the fourth quarter of 2012 (6.0%) was slightly higher than that seen in 2011 (5.7%), and significantly lower than the growth rates seen in 2010, 2009, and 2008 (13.7%, 11.4%, and 10.8% respectively). However, these figures may be a bit misleading, as higher growth rates become harder to maintain when the starting point is larger. To that end, more ASes were added to the global IPv6 routing table in the fourth quarter of 2012 than in the fourth quarter of the preceding four years.

As we have noted previously, while the metric reviewed provides some perspective around IPv6 adoption, it is also important to recognize that not all autonomous systems are equivalent. That is, IPv6 adoption on an autonomous system that is associated with a large number of end users/subscribers is ultimately more meaningful and impactful for measuring the ultimate success of IPv6 than adoption by an autonomous system that is not directly associated with end user connectivity/traffic.

DID YOU KNOW?

- On October 9, 2012, APNIC announced that a "/24" block of IPv4 addresses has been transferred from the ARIN region to an APNIC Member under the inter-RIR transfer process, and that this transfer marked the first inter-RIR IPv4 transfer case since APNIC's transfer policy was implemented. *[Source: http://www.apnic.net/publications/news/2012/apnic-processes-first-inter-rir-ipv4-transfer-from-arin]*
- According to an APNIC study, the top 5 Asian markets in IPv6 adoption were Japan, which led with 2.4 percent, followed by China at 0.67 percent. Australia had 0.42 percent, while Taiwan had 0.19 percent and Singapore 0.17 percent. Estimated IPv6 users in Hong Kong and South Korea as a percentage of the country's overall Internet population were 0.02 percent and 0.01 percent, respectively. *[Source: http://www.zdnet.com/hong-kong-south-korea-lag-in-ipv6-adoption-7000005913/]*

While we do not yet have comprehensive Akamai data on IPv6 adoption, including unique IPv6 address counts similar to the data in Section 2.1, one metric that we have been tracking throughout the second half of 2012 is IPv6 traffic to the Akamai Intelligent Platform. The data shown in Figure 9 is taken from http://www.akamai.com/IPv6, which provides both 24-hour and historical views of IPv6 request volume seen by Akamai (in hits/second). While it appears that IPv6 traffic to Akamai during the fourth quarter exhibits something of a cyclical pattern, with a peak early each week, and then a smaller peak later in the week, overall growth across the quarter was ultimately flat, at approximately 80,000 hits/second. Interestingly, though, the first half of December saw IPv6 traffic peak over 100,000 hits/second for the first time. This traffic peak is roughly coincident with the time during which online retailers generally experience increased holiday shopping activity, so it could be indicative of an increase in shopping activity over IPv6. In addition, the peak is most evident in IPv6 traffic from North America, so it could point to increased shopping done via mobile devices/networks, as a number of major mobile providers have rolled out IPv6 within their networks. Although overall growth across the fourth quarter was relatively flat, IPv6 request volume was up approximately a third across the second half of the year, growing from approximately 60,000 hits/second to approximately 80,000 hits/second. Request volume has continued to grow into 2013 as well, regularly peaking above 100,000 hits/second.

Looking across the Web, Google's measurements[16] showed that in November 2012, they first surpassed 1% of users accessing Google over IPv6. In addition, a paper[17] presented at the Internet Measurement Conference[18] in November 2012 concluded, in part, that "the IPv6 network is indeed maturing, and while the increasing pace of IPv6 uptake over the last two years is an encouraging sign, IPv6 adoption is distinctly non-uniform, both topologically and geographically." The authors note that "IPv6 deployment is ahead in the core of the network, driven by transit and content providers, while it lags at the edges, which mostly consist of enterprise customers" and further highlight that IPv6 adoption is higher in Europe and the Asia Pacific region, conjecturing that adoption in the Asia-Pacific region was spurred by IPv4 address exhaustion and that a big push toward IPv6 by network operators in the European region could explain why Europe is ahead of North America.

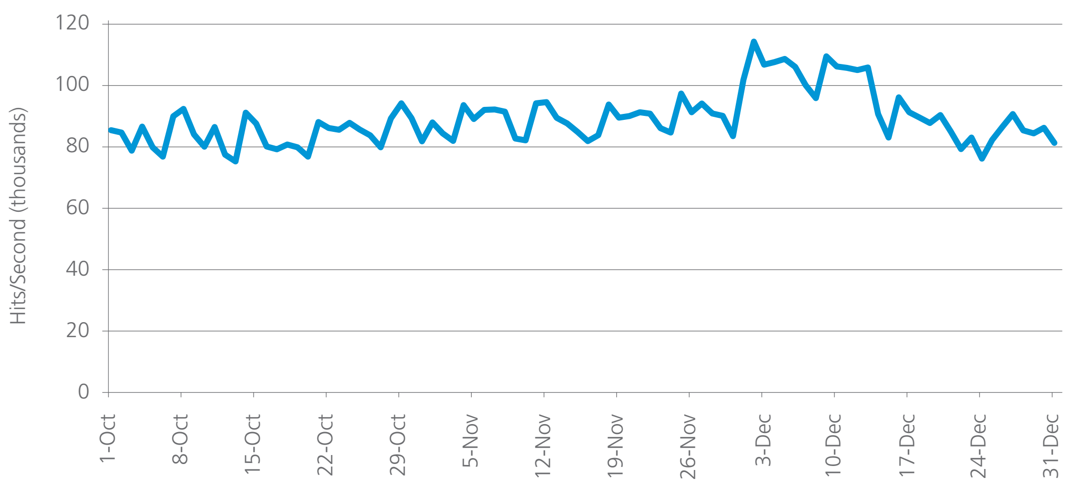

Figure 9: IPv6 Traffic to the Akamai Intelligent Platform, Q4 2012

Geography – Global

By virtue of the approximately two trillion requests for Web content that it services on a daily basis through its globally deployed Intelligent Platform, Akamai has a unique level of visibility into the speeds of end-user connections and, therefore, into broadband adoption around the globe. Because Akamai has implemented a distributed platform model, deploying servers within edge networks, it can deliver content more reliably and consistently than centralized providers that rely on fewer deployments in large data centers. For more information on why this is possible, please see Akamai's *How Will The Internet Scale?* white paper[19] or the video explanation at http://www.akamai.com/whytheedge.

The data presented within this section was collected during the fourth quarter of 2012 through Akamai's globally-deployed Intelligent Platform and includes all countries that had more than 25,000 unique IP addresses make requests for content to Akamai during the quarter. For purposes of classification within this report, the "high broadband" data included below is for connections at greater than 10 Mbps, and "broadband" is for connections of 4 Mbps or greater. As noted in previous reports, these definitions have been updated to reflect an overall trend toward greater availability of higher speed connections. Similarly, as noted in previous issues, the *State of the Internet Report* will no longer include "narrowband" (connections of 256 kbps or less) data, nor will it include city-level data.

In addition to providing insight into high broadband and broadband adoption levels, the report also includes data on average and average peak connection speeds — the latter provides insight into the peak speeds that users can likely expect from their Internet connections.

Finally, traffic from known mobile networks will be analyzed and reviewed in a separate section of the report; mobile network data has been removed from the data set used to calculate the metrics in the present section, as well as subsequent regional "Geography" sections.

3.1 Global Average Connection Speeds

The global average connection speed rebounded in the fourth quarter of 2012, posting a 5.0% gain, and growing to 2.9 Mbps. As shown in Figure 10, fairly nominal increases in average connection speeds were seen in nine of the top 10 countries in the fourth quarter. Growth ranged from an increase of just 0.1% in the Netherlands to 7.4% in Sweden. South Korea saw a 4.8% decline quarter-over-quarter, though it still led the list with an average connection speed of 14.0 Mbps. Globally, a total of 98 countries/regions that qualified for inclusion saw average connection speeds increase from the third quarter of 2012, ranging from 0.1% growth in the Netherlands and Lux-

	Country/Region	Q4 '12 Avg. Mbps	QoQ Change	YoY Change
–	Global	2.9	5.0%	25%
1	South Korea	14.0	-4.8%	-13%
2	Japan	10.8	2.7%	19%
3	Hong Kong	9.3	3.4%	5.4%
4	Latvia	8.9	2.3%	20%
5	Switzerland	8.7	0.5%	20%
6	Netherlands	8.6	0.1%	3.3%
7	Czech Republic	8.1	7.0%	21%
8	United States	7.4	2.3%	28%
9	Sweden	7.3	7.4%	29%
10	Finland	7.1	4.3%	20%

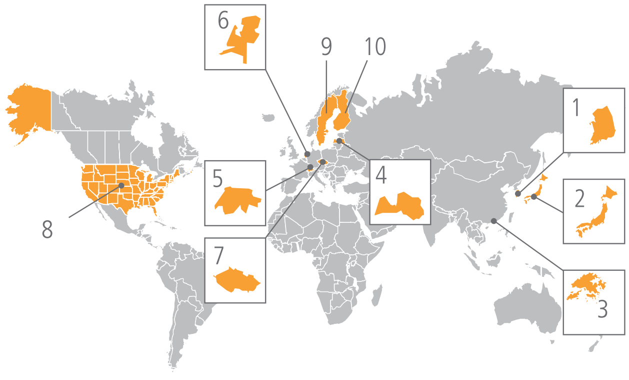

Figure 10: Average Measured Connection Speed by Country/Region

embourg to 23% growth in Côte d'Ivoire. (Côte d'Ivoire also had the highest level of quarterly growth in the third quarter.) Quarterly losses across qualifying countries/regions ranged from 0.1% in the Bahamas to a surprising large 39% decline in Guatemala — this was also the only country to see a quarterly loss of more than 10%.

Looking at longer term trends, the global average connection speed grew by a very healthy 25% year-over-year, with nine of the top 10 countries growing year-over-year as well. Only the Netherlands and Hong Kong saw yearly growth rates below 10%, adding 3.3% and 5.4% respectively. Japan was the only other country that grew by less than 20% year-over-year, just missing it with a 19% growth rate — the remainder of the countries grew by 20% or more. Among the top 10, South Korea was the only country to lose ground year-over-year, ending 2012 with an average connection speed 13% lower than at the end of 2011. Around the rest of the world, a total of 125 qualifying countries/regions saw a yearly increase in average connection speeds, from 0.8% in Italy and Portugal to 239% in Kenya. Year-over-year declines were seen in just a dozen qualifying countries/regions, with losses ranging from just 0.1% in Turkey to a 23% decline in Oman.

In the fourth quarter, 18 qualifying countries/regions had average connection speeds of 1 Mbps or less — the lowest count across 2012, which points to improving broadband connectivity across even the poorest performing countries. Libya remained the country with the lowest average connection speed, growing 7.4%, but only reaching 0.6 Mbps.

3.2 Global Average Peak Connection Speeds

The average peak connection speed metric represents an average of the maximum measured connection speeds across all of the unique IP addresses seen by Akamai from a particular geography. The average is used to mitigate the impact of unrepresentative maximum measured connection speeds. In contrast to the average connection speed, the average peak connection speed is more representative of Internet connection capacity. (This includes the application of so-called speed boosting technologies implemented within a network to deliver faster download speeds for some larger files.)

Similar to the average connection speed metric, the global average peak connection speed also saw a nice quarter-over-quarter increase, growing 4.6% to 16.6 Mbps. As shown in Figure 11, all of the top 10 countries/regions, as well as the United States, had average peak connection speeds increase in the fourth quarter. Growth ranged from 1.0% in South Korea to a very solid 14% in Romania (which clearly reversed the slight decline seen in the third quarter). The United States added 6.2% quarter-over-quarter to end 2012 with an average peak connection speed of 31.5 Mbps. Globally, 111 countries/regions around the world that qualified for inclusion also saw quarterly increases in average peak connection speeds, ranging from Macedonia's 0.1% growth to Indonesia's 22% growth. Indonesia, Iraq, Sudan, and Libya were the only countries to see quarterly growth above 20% in the fourth quarter. Twenty-four qualifying countries/regions saw quarter-over-quarter declines, with Paraguay and Guatemala the only two posting losses greater than 10%, dropping 17% and 28% respectively.

	Country/Region	Q4 '12 Peak Mbps	QoQ Change	YoY Change
–	Global	16.6	4.6%	35%
1	Hong Kong	57.5	6.2%	25%
2	South Korea	49.3	1.0%	7.8%
3	Japan	44.8	6.2%	32%
4	Romania	42.6	14%	20%
5	Latvia	39.4	4.9%	34%
6	Singapore	34.5	12%	44%
7	Switzerland	34.2	5.4%	33%
8	Bulgaria	33.6	4.6%	41%
9	Belgium	33.4	2.1%	21%
10	Israel	32.2	4.4%	54%
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13	United States	31.5	6.2%	25%

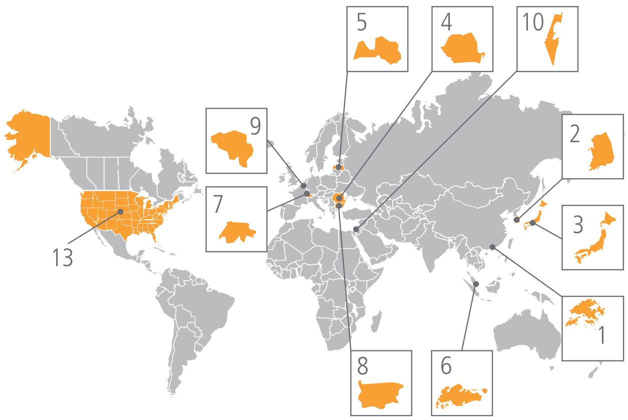


Figure 11: Average Peak Connection Speed by Country/Region

Looking at year-over-year changes, the global average peak connection speed once again increased significantly, growing 35%. Strong yearly changes were seen across all of the top 10 countries/regions, as well as the United States, with growth of 20% or more seen in all countries except for South Korea, which showed a still very respectable 7.8% yearly growth rate. The largest change was seen in Israel, which added 54% year-over-year, while Singapore and Bulgaria also both grew more than 40% from the end of 2011. Globally, all but six qualifying countries (Iran, Tanzania, Cameroon, Guatemala, Oman, and Australia) experienced yearly increases in average peak connection speeds, ranging from just 0.8% growth in Saudi Arabia to the massive increases seen in Indonesia (up 153%) and Kenya (up 143%). Of the countries that saw yearly declines, losses ranged from just 1.3% in Iran to a surprisingly large 28% drop in Australia.

3.3 Global High Broadband Connectivity

As was noted in the *1st Quarter, 2012 State of the Internet Report*, the term "high broadband" (as used within the report) was redefined to include connections to Akamai of 10 Mbps or greater.

Though it saw a nominal 2.7% quarterly increase, the global high broadband adoption rate remained at 11% in the fourth quarter of 2012. As shown in Figure 12, quarterly increases were also seen in eight of the top 10 countries/regions, ranging from 1.8% in Switzerland to 16% growth in both Sweden and the Czech Republic. Finland joined the latter two countries in having a quarter-over-quarter growth rate above 10%. Only South Korea and the Netherlands saw high broadband adoption rates decline from the third quarter, losing 5.7% and 0.7% respectively. On a global basis, 35 countries/regions that qualified for inclusion saw high broadband rates increase on a quarterly basis, ranging from Switzerland's aforementioned 1.8% increase to an impressive 77% jump in Thailand. Thirteen qualifying countries/regions saw high broadband adoption rates decline, ranging from a scant 0.4% loss in Turkey to an unexpectedly high 20% loss in South Africa. Overall, India unseated China as the country with the lowest level of high broadband adoption, though it grew 45% quarter-over-quarter to 0.2%. (Readers will notice that in Section 5.3, both India and China are listed as having 0.2% high broadband adoption—this is due to rounding – China's high broadband adoption rate is, in fact, 0.009% higher than India's.)

Looking at year-over-year changes, the global high broadband adoption rate once again saw a very solid increase, growing 31% from the fourth quarter of 2012. Among the top 10 countries/regions, nine also grew high broadband adoption rates year-over-year, with only the Netherlands and Hong Kong growing less than 10%. Yearly increases among the others on the list ranged from 26% in Latvia to an impressive 90% increase in the United States. Switzerland, Sweden, and the Czech Republic also grew more than 50% year-over-year, while Finland fell just shy, growing 49%. Globally, a total of 44 qualifying countries/regions saw a yearly increase in high broadband adoption. Growth in excess of 100% was seen in nine countries/regions, ranging from Mexico's 102% year-over-year increase to a massive 490% increase in South Africa. Yearly declines were seen in just four countries (Portugal, Lithuania, South Korea, and Australia), with Australia's surprisingly high 56% loss the largest.

	Country/Region	% Above 10 Mbps	QoQ Change	YoY Change
–	Global	11%	2.7%	31%
1	South Korea	49%	-5.7%	-13%
2	Japan	39%	4.3%	28%
3	Hong Kong	28%	3.9%	7.9%
4	Latvia	27%	1.9%	26%
5	Switzerland	23%	1.8%	58%
6	Netherlands	21%	-0.7%	1.1%
7	Sweden	19%	16%	72%
8	United States	19%	5.5%	90%
9	Finland	18%	13%	49%
10	Czech Republic	17%	16%	60%

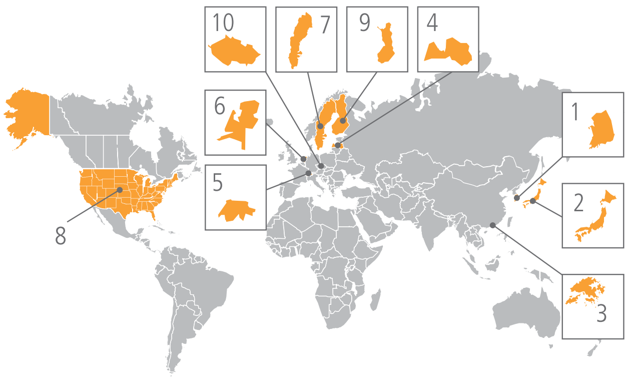


Figure 12: High Broadband (>10 Mbps) Connectivity

3.4 Global Broadband Connectivity

As was noted in the *1st Quarter, 2012 State of the Internet Report*, the term "broadband" (as used within the report) was redefined to include connections to Akamai of 4 Mbps or greater.

In the fourth quarter, the global broadband adoption rate grew slightly, increasing 2.1% to 42%, as shown in Figure 13. Among the top 10 countries, seven also saw quarterly increases in broadband adoption, ranging from Denmark's 0.8% increase to a 6.2% increase in the Czech Republic. Of the three countries (South Korea, the Netherlands, Latvia) that saw lower broadband adoption rates quarter-over-quarter, all lost less than 1%. The United States (#13 globally) saw growth slow as compared to the third quarter, growing just 1.9% to 64% adoption. Globally, 55 countries/regions that qualified for inclusion saw higher broadband adoption levels than in the third quarter, with Egypt more than doubling, increasing 158% quarter-over-quarter. The lowest quarterly growth rates were seen in Russia and Hungary – both added just 0.1%. Eighteen qualifying countries/regions saw quarterly declines in broadband adoption rates, ranging from a drop of 0.1% in the Netherlands, France, and Lithuania, to a loss of 27% in Saudi Arabia. Overall, 60 qualifying countries/regions around the world had broadband adoption rates greater than 10%, while Saudi Arabia continued to have the lowest level of broadband adoption, at 0.8%.

Looking at year-over-year changes, global broadband adoption increased a solid 15%, while all of the top 10 countries/regions also saw broadband levels grow as compared to the end of 2011. South Korea and Belgium had the smallest increases, growing 0.7% and 0.8% respectively, while Denmark's adoption level was up by 26%. Globally, 67 countries/regions that qualified for inclusion saw broadband adoption levels increase year-over-year, with Kenya seeing another epic increase, growing 2971%, and Ecuador turning in another quarter of year-over-year growth above 800%. Ten additional qualifying countries more than doubled broadband adoption year-over-year, while 42 additional countries grew by 10% or more. As noted previously, South Korea had the lowest level of yearly growth. Among the six countries that qualified for inclusion that saw yearly declines in broadband adoption levels, losses ranged from 0.2% in Turkey and Italy to a 73% decline in Saudi Arabia.

Kenya's aggressive broadband growth levels have not gone unnoticed, as an October 2012 article[20] in UK publication *The Guardian* noted that "If there is such a thing as an African version of California's Silicon Valley, the country that is arguably leading the race to the future is Kenya. … Household tech names such as Google, Intel, Microsoft, Nokia and Vodafone all have a presence here, and IBM recently chose Nairobi for its first African research lab." Additionally, the article highlights that "the government plans to build a $7B USD (£4.36B), 5,000-acre technology city that is already being branded Africa's 'Silicon Savannah'." The improvement in Internet connectivity within Kenya is, in large part, attributed to the completion of submarine cables[21] such as Seacom and the Eastern Africa Submarine Cable System, which link countries in East Africa to networks in Europe and India.

	Country/Region	% Above 4 Mbps	QoQ Change	YoY Change
–	Global	42%	2.1%	15%
1	South Korea	86%	-0.5%	0.7%
2	Switzerland	82%	1.3%	18%
3	Netherlands	82%	-0.1%	1.1%
4	Japan	76%	1.1%	13%
5	Hong Kong	74%	4.8%	8.8%
6	Czech Republic	72%	6.2%	14%
7	Canada	72%	2.3%	17%
8	Latvia	72%	-0.2%	16%
9	Belgium	71%	3.5%	0.8%
10	Denmark	69%	0.8%	26%
…				
13	United States	64%	1.9%	16%

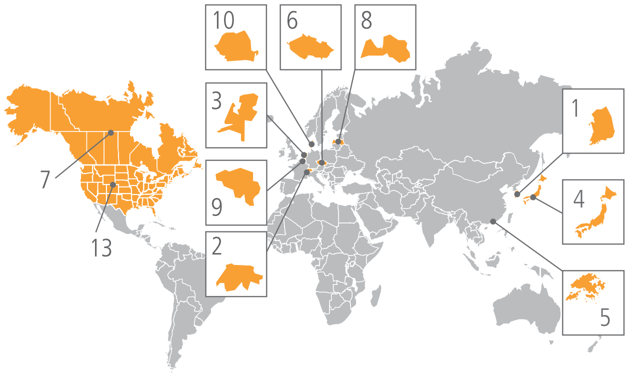


Figure 13: Broadband (>4 Mbps) Connectivity

Geography – United States

The metrics presented here for the United States are based on a subset of data used for Section 3 and are subject to the same thresholds and filters discussed within that section. The subset used for this section includes connections identified as coming from networks in the United States, based on classification by Akamai's EdgeScape geolocation tool. As was noted in the introduction to Section 3, this section no longer includes city-level data nor data on narrowband (<256 kbps) connections, and the "new" definitions of high broadband (>10 Mbps) and broadband (>4 Mbps), put into place starting with the first quarter's report, are used here as well.

4.1 United States Average Connection Speeds

In the fourth quarter of 2012, a nominal increase in Vermont's average connection speed, and another decline in Delaware's, allowed Vermont to move to the top of the list, becoming the state with the highest average connection speed, at 10.8 Mbps. As shown in Figure 14, despite quarterly declines seen in Delaware, the District of Columbia, and New Hampshire, they, along with Vermont, all closed out the year with average connections speeds above 10 Mbps. The other six states in the top 10 all saw nominally positive quarter-over-quarter changes, and all ended the year with average connection speeds over 9 Mbps. Across the whole country, 36 states saw average connections speeds grow, from a slight 0.1% bump in Ohio to Maryland's 5.8% increase. (Note that an anomalously high quarterly increase was seen in Kentucky, but it was also accompanied by unusually significant growth in unique IP address counts observed among leading network providers within the state. This may be indicative of network providers shifting IP address blocks around their networks, which can impact geolocation of those addresses.) Among the remaining states that saw lower average connection speeds quarter-over-quarter, declines ranged from a 0.7% drop in Washington to an 8.3% loss in South Dakota. Arkansas once again maintained its position as the state with the lowest average connection speed, growing 0.8% quarter-over-quarter to 3.8 Mbps.

Looking at year-over-year trends, all of the top 10 states once again saw average connection speeds increase, with very strong growth seen among the states on the list. Among the group, the smallest yearly growth rate was seen in New Hampshire and Rhode Island, which both added 25% year-over-year, while the highest was seen in New Jersey, which added 45% year-over-year. Across the whole country, all 50 states and the District of Columbia saw increased average connection speeds as compared to the fourth quarter of 2011. Year-over-year changes ranged from 16% in Nevada to 86% in Kansas.

	State	Q4 '12 Avg. Mbps	QoQ Change	YoY Change
1	Vermont	10.8	3.8%	38%
2	Delaware	10.6	-3.0%	29%
3	District Of Columbia	10.2	-5.1%	37%
4	New Hampshire	10.1	-2.5%	25%
5	Utah	9.5	4.5%	26%
6	Maryland	9.3	5.8%	44%
7	Rhode Island	9.3	2.2%	25%
8	Massachusetts	9.3	1.9%	29%
9	Connecticut	9.2	1.4%	31%
10	New Jersey	9.1	4.3%	45%

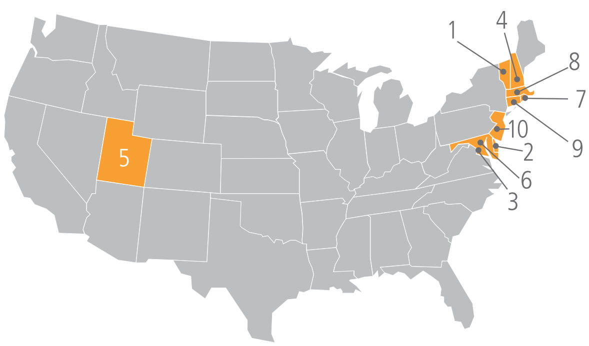


Figure 14: Average Measured Connection Speed by State

It is interesting to note that Kansas' strong year-over-year change in the fourth quarter comes on the heels of even stronger growth seen in third quarter. In last quarter's report, we noted that Google was starting to deploy its Google Fiber service to users in Kansas City, and posited that the extremely high speeds offered by the service may ultimately impact the average and average peak connection speeds calculated for the state. In examining data for the autonomous system (AS) associated with Google Fiber for the fourth quarter of 2012, we do find that the average connection speed for users on that network is over twice that seen for Kansas as a whole, and that the average peak connection speed is nearly five times that seen for the whole state. However, these observations come with a significant caveat for the fourth quarter – the number of unique IP addresses observed for the Google Fiber AS comprised less than one-tenth of one percent of the state's total, so Google Fiber's higher speeds are unlikely to have had a meaningful impact on the average and average peak connection speeds observed in Kansas during the quarter. However, this influence may become more significant in future quarters, as deployment continues, and as adoption grows.

4.2 United States Average Peak Connection Speeds

As shown in Figure 15, the District of Columbia once again continued its trend of quarterly increases, growing its average peak connection speed by 1.7% in the fourth quarter, to 43.1 Mbps. With a solid 6.8% increase to 41.4 Mbps, Vermont pushed former first-place state Delaware down to third place, although Delaware grew 3.0% quarter-over-quarter to 40.4 Mbps. Among the rest of the top 10 states, all saw quarterly increases — overall quarterly growth rates among the top 10 states ranged from 1.7% in the District of Columbia and New Hampshire to 7.9% in Maryland. After half of the top 10 states saw quarterly growth rates above 10% in the third quarter, it is interesting to see that growth moderated in the fourth quarter, with none of the top 10 seeing quarterly growth above 10%. Across the whole country, however, both Kentucky and Utah saw greater than 10% quarter-over-quarter growth in average peak connection speeds, while all states except for Mississippi and South Dakota saw increased speeds. Mississippi declined 1.2% and South Dakota lost 2.7% from the third quarter, while growth rates among the other states ranged from 0.7% in Idaho to 23% in Kentucky. (Note that the caveat highlighted in Section 4.1 applies to Kentucky's

	State	Q4 '12 Peak Mbps	QoQ Change	YoY Change
1	District Of Columbia	43.1	1.7%	37%
2	Vermont	41.4	6.8%	31%
3	Delaware	40.4	3.0%	8.7%
4	New York	38.6	7.4%	34%
5	New Jersey	38.5	7.3%	40%
6	Massachusetts	38.3	6.3%	31%
7	New Hampshire	37.7	1.7%	25%
8	Maryland	37.6	7.9%	38%
9	Virginia	37.0	4.5%	23%
10	Rhode Island	36.7	6.2%	24%

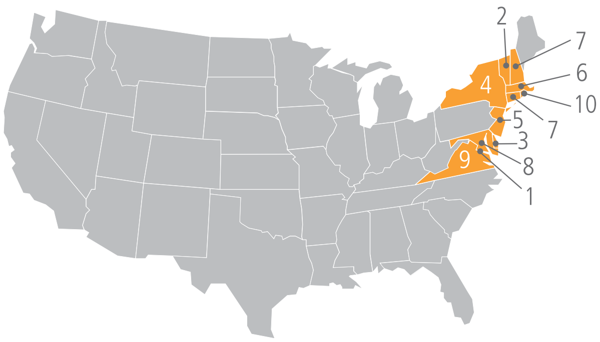


Figure 15: Average Peak Connection Speed by State

DID YOU KNOW?

In the fourth quarter of 2012, states in the Northeast and Mid-Atlantic regions of the U.S. overwhelmingly dominated the top 10 lists for key connectivity metrics, with Utah and Florida the only two out-of-region states to place in the top 10 lists.

increase for this metric as well.) Similar to the average connection speed metric, Arkansas remained the state with the lowest average peak connection speed, growing 1.3% to 17.6 Mbps. It was also the only U.S. state in the fourth quarter with an average peak connection speed below 20 Mbps.

Year-over-year changes among the top 10 states were very strong, with only Delaware posting a growth rate below 10%. (However, its 8.7% increase from the end of 2011 is still very respectable.) Among the other nine states, yearly growth ranged from 23% in Virginia to 40% in New Jersey. Across the whole country, Kansas and Wyoming were the only two states to grow in excess of 50% year-over-year (89% and 51% respectively), while Kentucky and New Jersey both increased average peak connection speeds by 40% or more. Another 18 states and the District of Columbia grew by more than 30%, and with the exception of Delaware, all of the remaining states saw average peak connection speeds more than 10% higher than in the same period a year earlier. Delaware's 8.7% year-over-year change was the smallest seen across the whole country.

4.3 United States High Broadband Connectivity

As was noted in the *1st Quarter, 2012 State of the Internet Report*, the term "high broadband" (as used within the report) has been redefined to include connections to Akamai of 10 Mbps or greater.

Quarterly changes in high broadband adoption among the top 10 U.S. states in the fourth quarter were somewhat mixed, with nominal increases observed in six of the 10 states, and slight declines seen in New Hampshire, the District of Columbia, Vermont, and Delaware. As shown in Figure 16, quarterly increases ranged from 2.2% in Connecticut to 12% in New Jersey, while the declines ranged from 1.9% in Delaware to 8.0% in Vermont. In the fourth quarter of 2012, across the whole country, 42 states and the District of Columbia had 10% or more of their connections to Akamai at speeds of 10 Mbps or greater, while only eight had high broadband adoption rates below 10%. Thirty-eight states saw quarter-over-quarter growth in high broadband adoption rates, ranging from 0.7% in Wisconsin to 31% in Kentucky. (Note that the Kentucky caveat mentioned in the prior sections applies here as well.) Arkansas found itself at the bottom of the list for this metric as well, with a high broadband adoption rate of 3.4% in the fourth quarter, after a 2.8% quarter-over-quarter increase.

The levels of year-over-year change in high broadband adoption rates across the top 10 states were again extremely significant, with five of the states seeing adoption rates more than double from the end of 2011, including an increase of more than 200% in New Jersey. Impressively, the lowest year-over-year change among the top 10 states was seen in New Hampshire, at 71%. Across the whole country, all states saw high broadband adoption rates increase year-over-year, with a total of 21 more than doubling, led by New Jersey's 203% increase. The lowest year-over-year change was seen in Nebraska, which grew a solid 30%, and was one of only three states (including Alaska and Idaho) that saw high broadband adoption rates in the fourth quarter of 2012 that were less than 50% higher than in the fourth quarter of 2011.

While Washington State currently ranks just outside the top 10 states, we may see it move up in the rankings in the future as a gigabit network planned for Seattle is deployed. In December 2012, a post[22] to industry blog GigaOM noted "Seattle, which has its own city-owned fiber network, and Gigabit Squared have signed a Memorandum of Understanding and a Letter of Intent that will allow Gigabit Squared to begin raising the capital needed

	State	% Above 10 Mbps	QoQ Change	YoY Change
1	New Hampshire	34%	-4.0%	71%
2	District Of Columbia	33%	-3.2%	87%
3	New Jersey	33%	12%	203%
4	Massachusetts	32%	2.7%	89%
5	Rhode Island	32%	3.9%	102%
6	Vermont	32%	-8.0%	78%
7	Delaware	32%	-1.9%	95%
8	Maryland	31%	8.1%	146%
9	New York	28%	9.2%	141%
10	Connecticut	27%	2.2%	101%

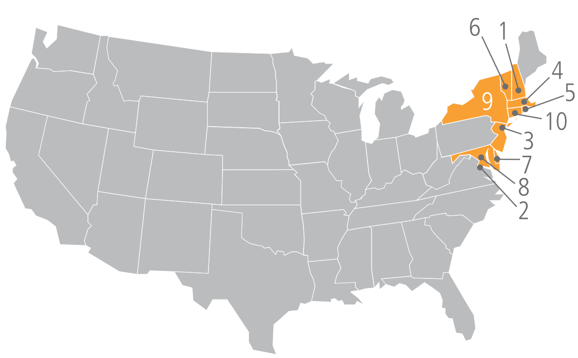


Figure 16: High Broadband (>10 Mbps) Connectivity, U.S. States

to conduct engineering work and to build out the demonstration fiber network." The planned gigabit connectivity will have a wired component, delivered via fiber-to-the-home, as well as a wireless element — the post goes on to note "To provide initial coverage beyond the 12 demonstration neighborhoods, Gigabit Seattle intends to build a dedicated gigabit broadband wireless umbrella to cover Seattle providing point-to-point radio access up to one gigabit per second. This will be achieved by placing fiber transmitters on top of 38 buildings across Seattle. These transmitters can beam fiber internet to multifamily housing and offices across Seattle, even those outside the twelve demonstration neighborhoods, as long as they are in a line of sight."

4.4 United States Broadband Connectivity

As was noted in the *1st Quarter, 2012 State of the Internet Report*, the term "broadband" (as used within the report) has been redefined to include connections to Akamai of 4 Mbps or greater.

Posting a quarterly gain of 2.6%, Delaware grew its broadband adoption rate to 87%, and nudged New Hampshire out of first place, as New Hampshire's adoption remained flat quarter-over-quarter. As shown in Figure 17, quarter-over-quarter changes in broadband adoption rates among the top 10 states were fairly muted in the fourth quarter, with changes ranging from an increase of less than a tenth of a percent in New Hampshire to just 2.9% in Maryland; four states grew less than one percent quarter-over-quarter. Vermont was the only state among the top 10 to see its broadband adoption rate decline from the third quarter. Across the whole country, 34 states and the District of Columbia saw higher adoption rates ranging from the scant increase in New Hampshire to just 6.8% growth in Utah. (Kentucky's quarter-over-quarter change was higher than Utah's but anomalously so.) Among the states that saw quarterly losses, the observed declines in broadband adoption ranged from drops of just 0.1% in Indiana and Montana to 11% in Iowa — the only quarterly loss greater than 10% across the whole country. As with the other metrics covered within the report, Arkansas was at the bottom of the list for this metric as well, with just 27% of connections to Akamai at speeds above 4 Mbps in the fourth quarter, up just 1.1% from the prior quarter.

Looking at year-over-year changes among the top 10 states, six saw strong double-digit yearly growth rates, ranging from 12% in Massachusetts to 20% in New York. Solid yearly increases were also observed in New Hampshire, Rhode Island, and Vermont, while Delaware surprisingly had a lower broadband adoption level as compared to the end of 2011. Delaware was also the only state in the whole country to see a negative year-over-year change — observed yearly changes across all states ranged from the 5.9% increase in New Hampshire to 123% in Kansas. Kentucky and Kansas both saw year-over-year changes greater than 100%, while Arkansas and New Mexico had growth rates in excess of 40%. An additional six states grew by 30% or more, and another 17 states saw yearly increases of at least 20%. South Dakota joined Vermont, Rhode Island, and New Hampshire as the only other state with year-over-year growth of less than 10% — it saw an 8.2% increase in the fourth quarter of 2012.

	State	% Above 4 Mbps	QoQ Change	YoY Change
1	Delaware	87%	2.6%	-3.4%
2	New Hampshire	87%	<0.1%	5.9%
3	Rhode Island	83%	0.6%	6.5%
4	Vermont	82%	-1.8%	6.8%
5	New Jersey	80%	2.1%	16%
6	Maryland	79%	2.9%	19%
7	New York	78%	1.5%	20%
8	Connecticut	77%	0.6%	17%
9	Massachusetts	74%	2.7%	12%
10	Florida	72%	0.8%	16%

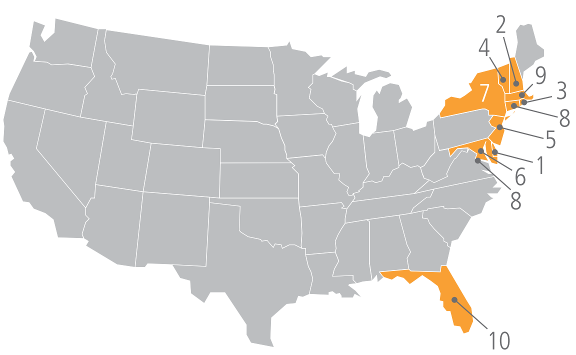


Figure 17: Broadband (>4 Mbps) Connectivity, U.S. States

SECTION 5:

Geography – Asia Pacific Region

The metrics presented here for the Asia Pacific region are based on a subset of data used for Section 3 and are subject to the same thresholds and filters discussed within that section. The subset used for this section includes connections identified as coming from networks in the Asia Pacific region, based on classification by Akamai's EdgeScape geolocation tool. As was noted in the introduction to Section 3, this section no longer includes city-level data nor data on narrowband (<256 kbps) connections, and the "new" definitions of high broadband (>10 Mbps) and broadband (>4 Mbps), put into place starting with the first quarter's report, are used here as well.

5.1 Asia Pacific Average Connection Speeds

In the fourth quarter of 2012, the top three countries/regions in the Asia Pacific region (and in the world) with the highest average connection speeds were once again South Korea, Japan, and Hong Kong, as shown in Figure 18. Both Japan and Hong Kong saw minor quarterly increases in average connection speeds, while South Korea saw a slight decline. South Korea and Japan continued to have average connection speeds in the "high broadband" range, above 10 Mbps. Quarter-over-quarter changes among the others in the region were generally positive, with increases ranging from 2.7% in the Philippines to 19% in India. Singapore, Thailand, Indonesia, and India all saw speeds grow in excess of 10% quarter-over-quarter. Australia and Taiwan joined South Korea in experiencing a quarterly loss in average connection speeds, dropping 2.3% and 9.5% respectively. Both China and India continued to show progress as well — China's average connection speed grew 7.5% quarter-over-quarter to 1.8 Mbps, and India's grew an impressive 19% to 1.2 Mbps.

Year-over-year changes were generally positive and fairly strong as well, with eight of the surveyed countries/regions seeing double-digit percentage yearly growth. Indonesia led the region with an 86% yearly increase, while Malaysia, China, and India all grew 30% or more. Hong Kong, Taiwan, and Thailand had the lowest rates of growth, all increasing just over 5%. Three of the surveyed countries saw average connection speeds decline year-over-year – Vietnam lost 6.5%, South Korea lost 13%, and Australia lost 23%. Australia's decline is unexpectedly high, especially given the progress[23] being made on the National Broadband Network (NBN). Although there have been some challenges[24] in keeping up with demand for service, these deployment delays should not be driving such a significant decline in average connection speeds.

Global Rank	Country/Region	Q4 '12 Avg. Mbps	QoQ Change	YoY Change
1	South Korea	14.0	-4.8%	-13%
2	Japan	10.8	2.7%	19%
3	Hong Kong	9.3	3.4%	5.4%
26	Singapore	5.5	12%	21%
41	Australia	4.2	-2.3%	-23%
42	New Zealand	4.0	3.0%	16%
46	Taiwan, Province Of China	3.9	-9.5%	5.6%
52	Thailand	3.3	11%	5.7%
70	Malaysia	2.3	3.7%	30%
91	China	1.8	7.5%	30%
103	Vietnam	1.5	17%	-6.5%
109	Indonesia	1.4	21%	86%
113	Philippines	1.3	2.7%	23%
116	India	1.2	19%	48%

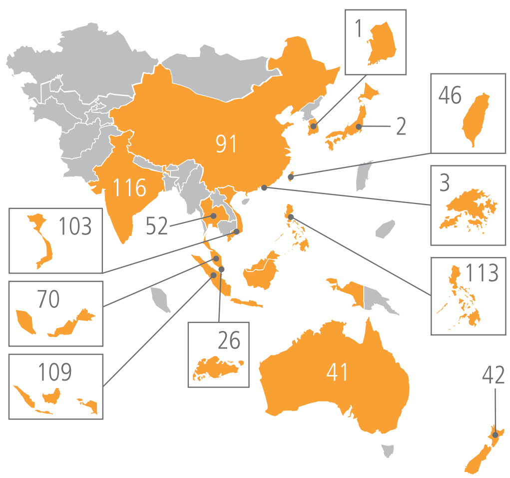


Figure 18: Average Connection Speed by Asia Pacific Country/Region

5.2 Asia Pacific Average Peak Connection Speeds

As shown in Figure 19, Hong Kong remained far and away the Asia Pacific country/region with the highest average peak connection speed, which increased to 57.5 Mbps in the fourth quarter. It remained well ahead of South Korea, which managed just a 1.0% increase to 49.3 Mbps in the fourth quarter, and Japan, which grew 6.2% to 44.9 Mbps. At the other end of the scale, Vietnam, India, and China were the only surveyed Asia Pacific countries/regions with average peak connection speeds below 10 Mbps, though all three saw quarterly increases greater than 10%. Indonesia had the highest rate of growth within the region, adding 22% to 16.8 Mbps. Taiwan was the only surveyed country/region to have its average peak connection speed decline quarter-over-quarter, losing 1.7%. Despite a solid 14% quarterly increase, China continued to have the lowest average peak connection speed among surveyed Asia Pacific countries/regions.

In looking at year-over-year changes in average peak connection speeds, strong changes were again seen across most of the surveyed countries/regions. South Korea was the only country to grow less than 10%, and similar to the average connection speed metric, Australia saw an unusually large yearly decline. Among the remaining countries/regions, yearly growth ranged from 12% in Vietnam to an impressive 153% in Indonesia. A total of 10 surveyed countries/regions saw year-over-year changes of 25% or more, while Taiwan came close, growing 23% from the end of 2011.

5.3 Asia Pacific High Broadband Connectivity

As was noted previously, starting with the *1st Quarter, 2012 State of the Internet Report*, the term "high broadband", as used within the report, has been redefined to include connections to Akamai of 10 Mbps. As was also highlighted in previous 2012 editions of the report, with the redefinition of "high broadband," a number of surveyed Asia Pacific countries/regions no longer qualify to be included as part of the global ranking, as they had fewer than 25,000 unique IP addresses connecting to Akamai at speeds above 10 Mbps. However, the high broadband adoption rates for those countries are still listed in Figure 20 for the sake of completeness.

The gap observed in high broadband adoption observed in the third quarter closed just slightly in the fourth quarter. As illustrated in Figure 20, South Korea and Japan were separated by just 10% (down from 14% last quarter), and India and Thailand moved into the global ranks, thanks to strong quarterly growth in both countries. (The fourth quarter marks the first time in 2012 that India had more than 25,000 unique IP addresses connect to Akamai at speeds above 10 Mbps.) Among the other qualifying countries/regions, strong quarter-over-quarter growth was also seen in China and Singapore, while more muted increases were noted in Japan, Hong Kong, and New Zealand. Nominal quarterly declines in high broadband adoption were observed in South Korea, which dropped 5.7%, and Australia, which dropped 6.9%, while Taiwan's loss was more significant, at 18%. Among the four Asia Pacific

Global Rank	Country/Region	Q4 '12 Peak Mbps	QoQ Change	YoY Change
1	Hong Kong	57.5	6.2%	25%
2	South Korea	49.3	1.0%	7.8%
3	Japan	44.8	6.2%	32%
6	Singapore	34.5	12%	44%
19	Taiwan, Province Of China	28.0	-1.7%	23%
34	Thailand	23.6	17%	31%
37	Australia	23.4	2.6%	-28%
45	Malaysia	19.5	7.1%	39%
49	New Zealand	19.2	8.2%	25%
59	Indonesia	16.8	22%	153%
85	Philippines	12.5	5.3%	33%
106	Vietnam	9.6	11%	12%
109	India	9.2	15%	60%
116	China	8.1	14%	49%

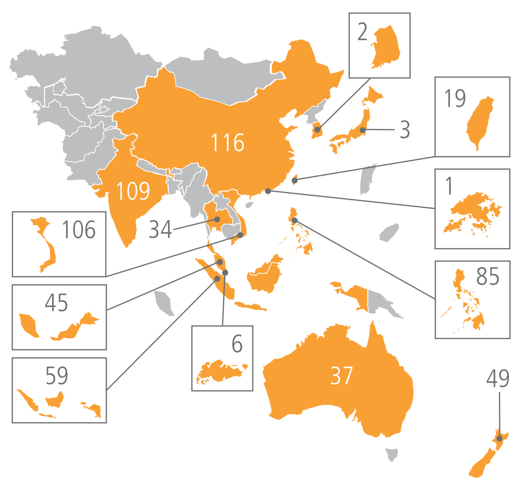


Figure 19: Average Peak Connection Speed by Asia Pacific Country/Region

countries that did not qualify for inclusion, Malaysia and Indonesia saw slight increases in high broadband adoption, while Vietnam grew by 48%, though its adoption rate is still not high enough to even register. The Philippines saw a 25% decline, though with so few unique IP addresses connecting to Akamai at speeds above 10 Mbps, changes in a relatively small number can result in a much larger percentage shift.

Year-over-year changes among the qualifying countries/regions were generally positive in the fourth quarter, with increases seen in eight of the ten. Yearly growth rates in high broadband adoption ranged from 7.9% in Hong Kong to increases in excess of 100% in Taiwan (up 105%) and India (up 171%). Japan, Singapore, New Zealand, Thailand, and China also saw strong growth year-over-year, all increasing more than 10%. Only South Korea and Australia saw high broadband adoption rates decline year-over-year. These negative trends are of concern, but high broadband adoption in South Korea remains strong, and the decline in Australia is out of character, as it saw positive year-over-year changes for this metric throughout the balance of 2012. Furthermore, as referenced in Section 5.1, ongoing NBN deployment in Australia should help to turn the trend positive again going forward. Among the countries that did not qualify for inclusion in the global rankings, Malaysia, Indonesia, and the Philippines all saw solid yearly increases, while Vietnam declined 40% year-over-year.

5.4 Asia Pacific Broadband Connectivity

As was noted previously, starting with the 1st *Quarter, 2012 State of the Internet Report*, the term "broadband", as used within the report, has been redefined to include connections to Akamai of 4 Mbps or greater.

As Figure 21 shows, quarterly changes in broadband adoption across the qualifying Asia Pacific countries/regions were mostly positive in the fourth quarter. The lowest growth rate was seen in Japan, which grew just 1.1%, while India jumped 80% quarter-over-quarter. Strong quarterly increases were also seen in Singapore, Thailand, China, Indonesia, and Vietnam, which all had double-digit percentage growth. A slight quarterly decline in broadband adoption was seen in leader South Korea, which lost just 0.5% and stayed at 86% adoption. In line with what was observed across the other metrics, Australia dropped 5.4% and Taiwan declined 20% from the prior quarter. The Philippines continued to have an insufficient number of unique IP addresses connecting to Akamai at speeds above 4 Mbps, so it did not qualify for inclusion in the global ranking, but saw its broadband adoption rate decline slightly quarter-over-quarter, losing just over 5%.

Among the qualifying Asia/Pacific regions, long term trends were generally positive in the fourth quarter, with only two seeing year-over-year declines in broadband adoption levels

Global Rank	Country/Region	% Above 10 Mbps	QoQ Change	YoY Change
1	South Korea	49%	-5.7%	-13%
2	Japan	39%	4.3%	28%
3	Hong Kong	28%	3.9%	7.9%
25	Singapore	8.1%	18%	63%
36	Taiwan, Province Of China	3.9%	-18%	105%
37	Australia	3.8%	-6.9%	-56%
39	New Zealand	2.4%	2.6%	65%
42	Thailand	1.0%	77%	12%
47	China	0.2%	32%	69%
48	India	0.2%	45%	171%
–	Malaysia	0.9%	3.1%	89%
–	Indonesia	0.2%	8.5%	11%
–	Philippines	0.1%	-25%	38%
–	Vietnam	0.0%	48%	-40%

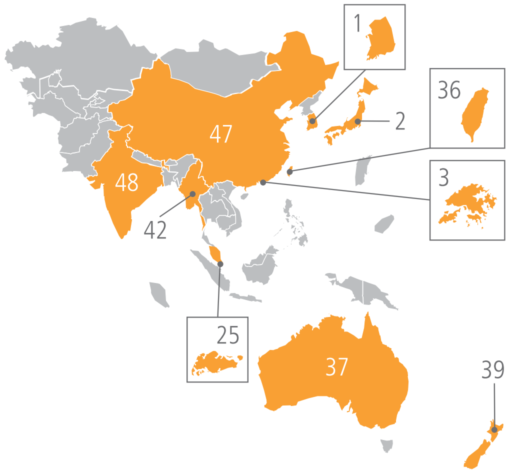


Figure 20: High Broadband (>10 Mbps) Connectivity, Asia Pacific Countries/Region

—Taiwan dropped 14% and Vietnam lost 40%. However, among those that saw adoption levels increase, there was a significant range of changes. The smallest yearly increase was seen in South Korea, which was up less than 1% year-over-year. China, however, saw broadband adoption levels increase 122% from the end of 2011, while India saw a massive 265% increase during the year. We may see more growth of similar magnitude in India in the future if 1 Gbps connections such as those being promoted by network infrastructure firm Radius Infratel[25] become widely available at affordable prices. These gigabit plans would join 100 Mbps plans available to residential consumers already available from Bharti Airtel and Tata Teleservices. Among the other Asia Pacific countries/regions that saw positive year-over-year changes, double-digit percentage increases were seen in Japan, Singapore, New Zealand, Australia, Thailand, Malaysia, and Indonesia. The Philippines also saw strong quarterly growth in broadband adoption, but didn't qualify to be included in the global rankings.

DID YOU KNOW?

In October 2012, the ITU issued a set of general guidelines for national wireless broadband masterplans for the Asia Pacific region, building on strong wired broadband in the region, as well as on masterplan pilots in Myanmar, Nepal, Samoa, and Vietnam.

[Source: http://www.itu.int/ITU-D/tech/broadband_networks/WirelessBDMasterPlans_ASP/Masterplan%20guidelines%20EV%20BAT1.pdf]

Global Rank	Country/Region	% Above 4 Mbps	QoQ Change	YoY Change
1	South Korea	86%	-0.5%	0.7%
4	Japan	76%	1.1%	13%
5	Hong Kong	74%	4.8%	8.8%
23	Singapore	52%	24%	16%
40	New Zealand	37%	5.4%	29%
41	Australia	36%	-5.4%	12%
42	Taiwan, Province Of China	31%	-20%	-14%
46	Thailand	26%	52%	38%
54	Malaysia	13%	9.9%	91%
66	China	5.4%	38%	122%
69	India	2.8%	80%	265%
70	Indonesia	2.5%	38%	89%
71	Vietnam	1.8%	58%	-40%
–	Philippines	1.2%	-5.4%	43%

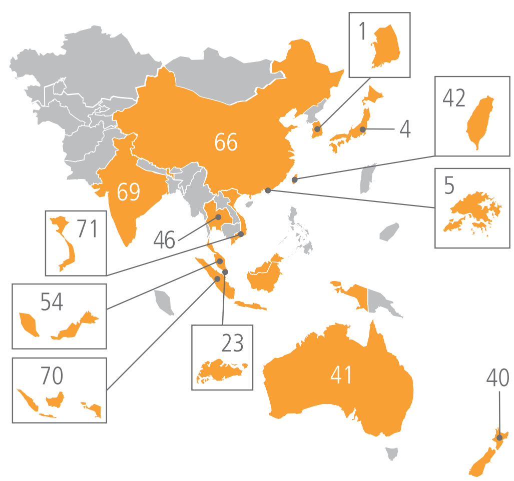


Figure 21: Broadband (>4 Mbps) Connectivity, Asia Pacific Countries/Region

Geography – Europe/Middle East/Africa (EMEA)

The metrics presented here for the Europe/Middle East/Africa (EMEA) region are based on a subset of data used for Section 3 and are subject to the same thresholds and filters discussed within that section.

The subset used for this section includes connections identified as coming from networks in the EMEA region, based on classification by Akamai's EdgeScape geolocation tool. As was noted in the introduction to Section 3, this section no longer includes city-level data nor data on narrowband (<256 kbps) connections, and the "new" definitions of high broadband (>10 Mbps) and broadband (>4 Mbps), put into place starting with the first quarter's report, are used here as well.

6.1 EMEA Average Connection Speeds

Switzerland again held the top spot among EMEA countries in the fourth quarter for average connection speeds, narrowly edging out the Netherlands, though both saw minor quarterly increases. As shown in Figure 22, quarter-over-quarter changes across the EMEA region were somewhat mixed in the fourth quarter of 2012, and in general, were relatively minor in nature – the largest change was the 11% increase seen in Romania. Behind Romania, the next highest rate of growth was seen in Sweden, which grew 7.4% quarter-over-quarter. Among the other surveyed countries that saw quarterly increases, the Netherlands, Belgium, Austria, the United Arab Emirates, and France all grew by less than 1%. Nearly a quarter of the surveyed countries saw average connection speeds decline quarter-over-quarter, with losses ranging from 0.6% in Russia to 3.3% in Turkey. At 2.1 Mbps, including a quarterly decline of less than 1%, South Africa continued to have the lowest average connection speed among the surveyed EMEA countries.

Year-over-year changes in average connection speeds across surveyed EMEA countries were overwhelmingly positive, with only Ireland and Turkey ending 2012 lower than at the end of 2011. Among the remainder of the countries, the largest yearly increases were seen in Israel and South Africa, which both grew in excess of 40%. Yearly growth rates of 20% or more were seen in eleven countries, including Switzerland, the Czech Republic, Sweden, Finland, Denmark, Norway, Austria, the United Kingdom, Poland, Russia, and Spain, reflecting ongoing improvements in Internet connectivity across the EMEA region. Italy and Portugal both had the lowest rates of yearly change, growing just 0.8%, and were the only two surveyed countries in the region to post a year-over-year growth rate of less than 1%.

Global Rank	Country/Region	Q4 '12 Avg. Mbps	QoQ Change	YoY Change
5	Switzerland	8.7	0.5%	20%
6	Netherlands	8.6	0.1%	3.3%
7	Czech Republic	8.1	7.0%	21%
9	Sweden	7.3	7.4%	29%
10	Finland	7.1	4.3%	20%
11	Romania	7.0	11%	11%
12	Denmark	7.0	-3.2%	25%
14	Belgium	6.7	0.4%	6.0%
15	Ireland	6.6	-1.2%	-6.8%
16	Norway	6.6	6.5%	29%
17	Austria	6.6	0.5%	24%
18	United Kingdom	6.5	2.7%	27%
19	Germany	6.0	2.1%	18%
21	Hungary	5.9	1.1%	4.7%
22	Israel	5.8	2.7%	43%
23	Slovakia	5.8	-1.2%	8.2%
24	United Arab Emirates	5.7	0.3%	18%
25	Poland	5.6	4.4%	32%
32	Russia	5.1	-0.6%	34%
33	Portugal	5.0	3.3%	0.8%
34	Spain	4.9	2.1%	24%
36	France	4.8	0.2%	18%
44	Italy	4.0	1.8%	0.8%
60	Turkey	2.8	-3.3%	-0.1%
72	South Africa	2.1	-0.8%	41%

Figure 22: Average Measured Connection Speed by EMEA Country/Region

6.2 EMEA Average Peak Connection Speeds

As Figure 23 highlights, Romania's fourth quarter average peak connection speed of 42.6 Mbps, bolstered by a 14% quarter-over-quarter increase, continues to place it solidly ahead of the remaining surveyed countries in the EMEA region, leading Switzerland by over 8 Mbps. Average peak connection speeds across the region remained relatively high as well, with only South Africa coming in below 10 Mbps, and only Denmark and Turkey seeing speeds decline from the third quarter (and only dropping slightly at that). Alongside Romania, the Czech Republic was the only other surveyed country to see quarter-over-quarter growth of more than 10%; growth rates across the other countries ranged from 1.2% in Italy to 8.3% in the United Kingdom. South Africa remained the country with the lowest average peak connection speed in the Asia Pacific region, ranking 125th globally, and continuing to be over 12

Mbps slower than Italy, which had the next lowest average peak connection speed. (We continue to exclude the United Arab Emirates from the list in Figure 23 due to anomalies in the data that we believe are due to the network architecture within the country.)

In the fourth quarter, all of the surveyed EMEA countries saw positive year-over-year changes in average peak connection speeds, with growth in excess of 10% seen in all countries. Israel grew the most aggressively during 2012, seeing its average peak connection speed increase 54%. Five countries (Spain, Austria, United Kingdom, Poland, Russia) grew in excess of 40%, while another five (Switzerland, Norway, Czech Republic, Denmark, South Africa) grew in excess of 30%. Ten more countries saw average peak connection speeds increase by 20% or more year-over-year, while the remaining three (Ireland, Turkey, and Italy) all increased by more than 10%. Ireland had the smallest year-over-year change, at 12%.

Global Rank	Country/Region	Q4 '12 Peak Mbps	QoQ Change	YoY Change
4	Romania	42.6	14%	20%
7	Switzerland	34.2	5.4%	33%
9	Belgium	33.4	2.1%	21%
10	Israel	32.2	4.4%	54%
11	Netherlands	31.9	4.2%	23%
12	Portugal	31.5	5.9%	23%
14	Hungary	31.0	3.2%	25%
15	United Kingdom	30.5	8.3%	44%
16	Czech Republic	30.4	12%	35%
18	Sweden	28.4	5.3%	27%
20	Spain	27.8	6.9%	40%
21	Germany	27.0	3.8%	27%
22	Slovakia	27.0	3.2%	25%
23	Ireland	27.0	2.0%	12%
24	Poland	26.8	7.1%	44%
25	Finland	26.5	6.3%	29%
26	Denmark	26.1	-1.3%	36%
27	Austria	25.9	5.1%	40%
32	Norway	24.8	7.3%	34%
33	Russia	24.7	3.3%	47%
42	France	21.1	7.3%	24%
47	Italy	19.4	1.2%	18%
48	Turkey	19.2	-1.7%	15%
125	South Africa	7.1	4.9%	36%

Figure 23: Average Peak Connection Speed by EMEA Country/Region

6.3 EMEA High Broadband Connectivity

As was noted previously, starting with the *1st Quarter, 2012 State of the Internet Report*, the term "high broadband", as used within the report, has been redefined to include connections to Akamai of 10 Mbps.

Similar to the average connection speed metric, Switzerland finds itself ranked just ahead of the Netherlands for high broadband adoption across surveyed EMEA countries, leading the list with 23% adoption. As shown in Figure 24, more than half of the countries within the region saw greater than 10% of connections to Akamai occur at speeds above 10 Mbps during the fourth quarter. Turkey remained the country with the lowest level of high broadband adoption, and the only one below 1%, dropping 0.4% quarter-over-quarter to a 0.5% adoption rate. In terms of quarterly changes, two-thirds of the surveyed countries saw high broadband adoption rates grow quarter-over-quarter. Increases ranged from just 1.8% in Switzerland to an impressive 39% jump in Romania. Of the countries that saw higher adoption rates as compared to the third quarter, thirteen grew less than 10%. Among the seven surveyed countries that saw quarterly declines in high broadband adoption rates, losses ranged from the previously mentioned 0.4% drop seen in Turkey to a 14% drop in Denmark and a surprisingly large 20% drop in South Africa.

Looking at year-over-year changes, Portugal was the only country across the EMEA region to see its high broadband adoption rate decline over the course of 2012, with the 1.8% loss marking the third consecutive quarter of negative year-over-year changes seen in the country. Among the remaining surveyed countries, four (the Netherlands, Slovakia, Ireland, Hungary) had yearly growth rates under 10%, with the 1.1% increase in the Netherlands the lowest in the region. At the other end of the spectrum, five countries (Israel, United Kingdom, Spain, Poland, South Africa) saw their high broadband adoption rates grow more than 100% compared to the end of 2011, with the nearly 500% increase in South Africa the highest in the region. The remaining countries grew from 20-96% year-over-year.

6.4 EMEA Broadband Connectivity

As was noted previously, starting with the *1st Quarter, 2012 State of the Internet Report*, the term "broadband", as used within the report, has been redefined to include connections to Akamai of 4 Mbps or greater.

Broadband adoption levels remained extremely strong across surveyed EMEA countries at the close of 2012, with adoption rates exceeding 25% in all countries except Turkey and South

Africa, which had adoption levels of 8.5% and 8.0% respectively. As seen in Figure 25, Switzerland had a slight quarterly increase, while the Netherlands had a slight quarterly decline, leading them to swap places in the global rankings, though both achieved 82% broadband adoption in the fourth quarter. In addition to these two countries, another 16 had half or more of their connections to Akamai in the fourth quarter at speeds of 4 Mbps or more. Looking at quarterly changes, growth was fairly nominal across the 20 countries where increases were seen, ranging from the 0.1% increases in Hungary and Russia to the 9.5% increase seen in Italy. Among the other five countries that saw adoption rates decline quarter-over-quarter, the losses were similarly as nominal, ranging from 0.1% in France and the Netherlands to 9.1% in South Africa. South Africa also continued to have the lowest broadband adoption rate among surveyed countries in the EMEA region, at 8.0%.

Year-over-year changes were generally positive across surveyed countries in the EMEA region, with only Turkey and Italy seeing yearly declines. (While both countries also saw declines in the third quarter, the rate of decline may be slowing, which could point to a return to long-term growth in 2013.) Among the other countries, there was a tremendous range of growth rates, ranging from Belgium's tiny 0.8% increase during the course of 2012, to the 102% increase seen in South Africa. (To be fair, however, it was arguably easier for South Africa to show significant yearly growth, having exited 2011 with a 4% adoption rate, than for Belgium to markedly increase its year-end 2011 adoption rate of 70%.) Portugal, Ireland, and Romania all joined Belgium in seeing yearly growth below 10%, while Israel's 91% increase approached the doubling seen in South Africa. Going into 2013, South Africa may continue to see strong long-term growth trends, as additional capacity becomes available once the country is connected to the Africa Coast to Europe (ACE) submarine cable.[26] The second phase of the cable deployment will connect South Africa, along with a number of other countries on the west coast of Africa to landings in Portugal and France.

Global Rank	Country/Region	% Above 10 Mbps	QoQ Change	YoY Change
5	Switzerland	23%	1.8%	58%
6	Netherlands	21%	-0.7%	1.1%
7	Sweden	19%	16%	72%
9	Finland	18%	13%	49%
10	Czech Republic	17%	16%	60%
11	Norway	17%	14%	96%
12	Belgium	16%	2.1%	39%
13	Romania	16%	39%	25%
14	Denmark	15%	-14%	59%
15	Austria	12%	2.3%	37%
17	United Kingdom	11%	5.7%	129%
19	Ireland	11%	-2.9%	6.2%
20	Poland	10%	8.9%	154%
21	United Arab Emirates	9.5%	-1.5%	51%
23	Hungary	9.1%	8.0%	6.7%
24	Germany	8.8%	4.6%	45%
28	Slovakia	8.0%	4.9%	4.0%
31	Israel	7.5%	7.7%	110%
32	Russia	7.2%	-7.4%	87%
33	Spain	5.4%	7.1%	134%
34	Portugal	5.1%	5.7%	-1.8%
35	France	4.3%	4.4%	60%
38	Italy	2.8%	6.2%	20%
41	South Africa	1.6%	-20%	490%
44	Turkey	0.5%	-0.4%	37%

Figure 24: High Broadband (>10 Mbps) Connectivity, EMEA Country/Region

Global Rank	Country/Region	% Above 4 Mbps	QoQ Change	YoY Change
2	Switzerland	82%	1.3%	18%
3	Netherlands	82%	-0.1%	1.1%
6	Czech Republic	72%	6.2%	14%
9	Belgium	71%	3.5%	0.8%
10	Denmark	69%	0.8%	26%
11	Romania	66%	3.2%	7.2%
12	United Kingdom	64%	4.4%	26%
14	Finland	62%	4.7%	21%
15	Germany	62%	3.3%	28%
16	Hungary	62%	0.1%	12%
18	United Arab Emirates	57%	2.3%	26%
19	Israel	57%	1.2%	91%
20	Portugal	56%	6.8%	1.7%
21	Austria	55%	-4.9%	28%
24	Russia	52%	0.1%	60%
26	Sweden	51%	3.2%	19%
27	Ireland	50%	0.6%	3.1%
28	Poland	50%	6.6%	38%
29	Spain	48%	4.9%	42%
30	France	47%	-0.1%	41%
32	Norway	47%	4.6%	14%
34	Slovakia	46%	-5.6%	29%
45	Italy	28%	9.5%	-0.2%
62	Turkey	8.5%	6.1%	-0.2%
63	South Africa	8.0%	-9.1%	102%

Figure 25: Broadband (>4 Mbps) Connectivity, EMEA Country/Region

Mobile Connectivity

Building on the data presented in previous editions of the *State of the Internet Report*, Akamai continues to attempt to identify additional mobile networks for inclusion in the report, as well as filtering out networks subsequently identified as having proxy/gateway configurations that could skew results. The source data in this section encompasses usage not only from smartphones, but also laptops, tablets, and other devices that connect to the Internet through these mobile networks. In addition, this edition of the *State of the Internet Report* once again includes insight into mobile traffic growth and data traffic patterns contributed by Ericsson, a leading provider of telecommunications equipment and related services to mobile and fixed network operators globally.

As has been noted in prior quarters, the source data set for this section is subject to the following constraints:

- A minimum of 1,000 unique IP addresses connecting to Akamai from the network in the fourth quarter of 2012 was required for inclusion in the list.
- In countries where Akamai had data for multiple network providers, only the top three are listed, based on unique IP address count.
- The names of specific mobile network providers have been made anonymous, and providers are identified by a unique ID.
- Data is included only for networks where Akamai believes that the entire Autonomous System (AS) is mobile – that is, if a network provider mixes traffic from fixed/wireline (DSL, cable, etc.) connections with traffic from mobile connections on a single network identifier, that AS was not included in the source data set.
- Akamai's EdgeScape database was used for the geographic assignments.

7.1 Connection Speeds on Mobile Networks

In the fourth quarter of 2012, Austrian mobile provider AT-2 posted a nearly 9% quarter-over-quarter increase in average connection speed, growing to just over 8.0 Mbps, and taking over the top spot as the mobile network provider with the highest average connection speed. Russian provider RU-1, which previously ranked as the fastest, grew just under 2% from the third quarter, but remained just 45 kbps behind AT-2. In reviewing the full list of providers shown in Figure 26, we find that there are eight providers (AT-2, RU-1, UA-1, CZ-3, DE-2, GR-1, ES-1, US-2) that had average connection speeds in the "broadband" (>4 Mbps) range. An additional 64 providers had average connection speeds greater than 1 Mbps in the fourth quarter, including Brazilian provider BR-1, which was just 11 kbps over the threshold. Nigerian provider NG-1 remained the mobile provider with the lowest average connection speed, at 345 kbps (up 21 kbps from the third quarter). Including NG-1, a total of 10 providers had average connection speeds below 1 Mbps in the fourth quarter.

Examining the average peak connection speed data for the fourth quarter of 2012, we find that Spanish provider ES-1 displaced former leader RU-1, with an impressive 32% quarter-over-quarter increase to 44 Mbps. The average peak connection speed for RU-1 grew just 3.2% to 40 Mbps in the fourth quarter, placing it solidly in second place. For the quarter, ES-1 and RU-1 were the only two providers to see average peak connection speeds over 40 Mbps, while AT-2 (Austria) and HK-1 (Hong Kong) were the only two to see average peak connection speeds above 30 Mbps. An additional eight mobile providers (DE-2, TH-1, UK-1, NO-1, MY-2, GR-1, UA-1, LT-1) had average peak connection speeds above 20 Mbps, while 35 more had speeds above 10 Mbps. Of the remaining 35 providers that had average peak connection speeds below 10 Mbps, the lowest speeds were seen in Canada (CA-2) and South Africa (ZA-1) — South African provider ZA-1 once again had the lowest average peak connection speed, dropping 3.6% quarter-over-quarter to 2.7 Mbps.

Looking at year-over-year changes in average connection speeds, we find that five providers (TH-1, SK-1, US-2, GT-2, BE-3) saw these speeds more than double as compared to the end of 2011, while 21 providers saw a year-over-year decline. For the average peak connection speed metric, nine providers (TH-1, SK-1, US-2, HK-1, BE-3, NO-1, AU-3, GT-2, ES-1) saw these

Country	ID	Q4 '12 Avg. kbps	Q4 '12 Peak kbps
AFRICA			
Egypt	EG-1	939	5360
Morocco	MA-1	1265	9993
Nigeria	NG-1	345	4893
South Africa	ZA-1	554	2686
ASIA			
China	CN-1	2043	6196
Hong Kong	HK-2	2165	12158
Hong Kong	HK-1	2323	30364
Indonesia	ID-1	812	11970
Kuwait	KW-1	1292	9871
Malaysia	MY-3	1429	9195
Malaysia	MY-2	2324	21168
Malaysia	MY-1	766	6904
Pakistan	PK-1	1179	6730
Qatar	QA-1	1306	13210
Saudi Arabia	SA-1	1148	5660
Singapore	SG-3	1654	9150
Sri Lanka	LK-1	1253	11220
Taiwan, Province Of China	TW-1	1656	9657
Taiwan, Province Of China	TW-2	1100	5582
Thailand	TH-1	1149	24298
EUROPE			
Austria	AT-1	3685	15563
Austria	AT-2	8032	31204
Belgium	BE-3	1904	11424
Czech Republic	CZ-1	1667	5658
Czech Republic	CZ-3	5416	17328
Czech Republic	CZ-2	1274	7989
Estonia	EE-1	1643	8251
France	FR-2	2641	10195
Germany	DE-1	1317	6260
Germany	DE-2	5390	26244
Greece	GR-1	5061	20645
Hungary	HU-2	2237	10770
Hungary	HU-1	1564	7950
Ireland	IE-1	2987	16192
Ireland	IE-2	1891	18152
Ireland	IE-3	2246	18954
Israel	IL-1	1375	6552
Italy	IT-2	2981	16943
Italy	IT-3	3198	16900
Italy	IT-4	1712	13423
Lithuania	LT-2	2268	18285
Lithuania	LT-1	3237	20033
Moldova	MD-1	2375	10430
Netherlands	NL-2	1638	4174
Netherlands	NL-1	2034	5073
Norway	NO-1	3712	22589
Poland	PL-1	2497	14871
Poland	PL-2	1802	9502
Poland	PL-3	1796	11843
Romania	RO-1	1129	6396
Russia	RU-1	7988	40432
Russia	RU-4	3275	17896
Russia	RU-3	877	7233
Slovakia	SK-1	1769	9903
Slovenia	SI-1	2275	10044
Spain	ES-1	4846	44014
Turkey	TR-1	1927	11700
Ukraine	UA-1	5866	20365
United Kingdom	UK-3	2937	15560
United Kingdom	UK-2	3087	14793
United Kingdom	UK-1	2727	24181
NORTH AMERICA			
Canada	CA-2	1065	2758
El Salvador	SV-2	1852	12315
El Salvador	SV-1	1779	10711
El Salvador	SV-3	839	4357
Guatemala	GT-2	2487	14599
United States	US-1	2641	8602
United States	US-2	4609	17016
United States	US-3	1365	4568
OCEANIA			
Australia	AU-3	2453	17132
New Zealand	NZ-2	2044	12637
SOUTH AMERICA			
Argentina	AR-1	850	5299
Argentina	AR-2	2205	18456
Bolivia	BO-1	627	4738
Brazil	BR-1	1011	8113
Brazil	BR-2	1398	10745
Chile	CL-3	1987	14727
Chile	CL-4	1304	12476
Colombia	CO-1	1393	7970
Paraguay	PY-2	1068	7321
Uruguay	UY-1	1754	14216
Venezuela	VE-1	832	7294

Figure 26: Average and Average Peak Connection Speeds by Mobile Provider

speeds more than double as compared to the end of 2011, with Thai provider TH-1 growing more than 1300%. Sixteen providers around the world saw year-over-year declines in average peak connection speeds.

7.2 Mobile Browser Usage Data

In June 2012, Akamai launched the "Akamai IO" destination site (http://www.akamai.com/io), with an initial data set that highlights browser usage across PC and mobile devices, connecting via fixed and mobile networks. Note that the data set used for the figures below comes from sampling traffic across several hundred top-tier sites delivering content through Akamai, and that most of these sites are focused on a U.S. audience, so the data presented below is biased in favor of U.S. users. Back-end data collection and processing work is ongoing to expand the sample set, which will allow us to provide more global and geo-specific views of the data, as well as more granular insight into browser versions. An initial release of this updated data source occurred in mid-February 2013, and we will look to begin leveraging it starting with the *1st Quarter, 2013 State of the Internet Report*, although any major changes in adoption percentages that were manifested by this mid-quarter update will need to be addressed.

Figure 27 highlights observations made from traffic to Akamai during the fourth quarter of 2012 from users of mobile browsers identified to be on cellular networks.[27] The graph shows that once again, Android Webkit accounted for the largest percentage of requests, though usage of Apple Mobile Safari remained fairly close behind. In looking at overall average usage[28] across the quarter, Android Webkit was responsible for 35.3% of requests, while Apple Mobile Safari drove 32.6% of requests. Figure 27 shows that Opera Mini usage generally remained above 20% across the quarter, with the exception of the last two weeks of December. However, across the whole quarter, it was responsible for an average of 21.9% of requests. The Blackberry browser and Microsoft Mobile Explorer had the lowest usage among the top five, averaging 5.6% and 2.6% respectively across the fourth quarter. All other observed browsers accounted for a combined average of just 2% of usage.

When the scope is expanded to all networks[29] (not just those identified as "cellular"), the distribution is markedly different. As shown in Figure 28, Apple Mobile Safari remained responsible for the vast majority of requests, exhibiting a fairly cyclical weekly usage pattern, peaking above 60% each Sunday during the fourth quarter (and hitting a low point on Wednesday or Thursday), with an average across the quarter of 58.7%.[30] Android Webkit remains solidly in second place across most of the quarter, with average usage of 21.7%, although Microsoft Mobile Explorer usage appeared to see sharp growth during the latter half of December, though it only averaged 12.6% usage for the fourth quarter. Opera Mini and Nokia browsers rounded out the top five, though both had fairly erratic usage patterns across the quarter, accounting, on average, for 4.5% and 1.1% of usage respectively.

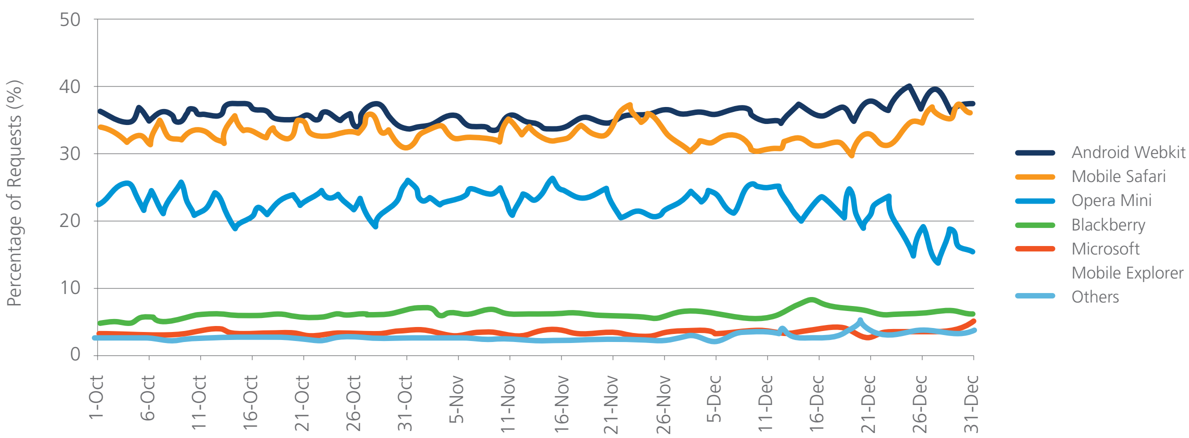


Figure 27: Mobile Browsers Seen Across Cellular Networks, Q4 2012

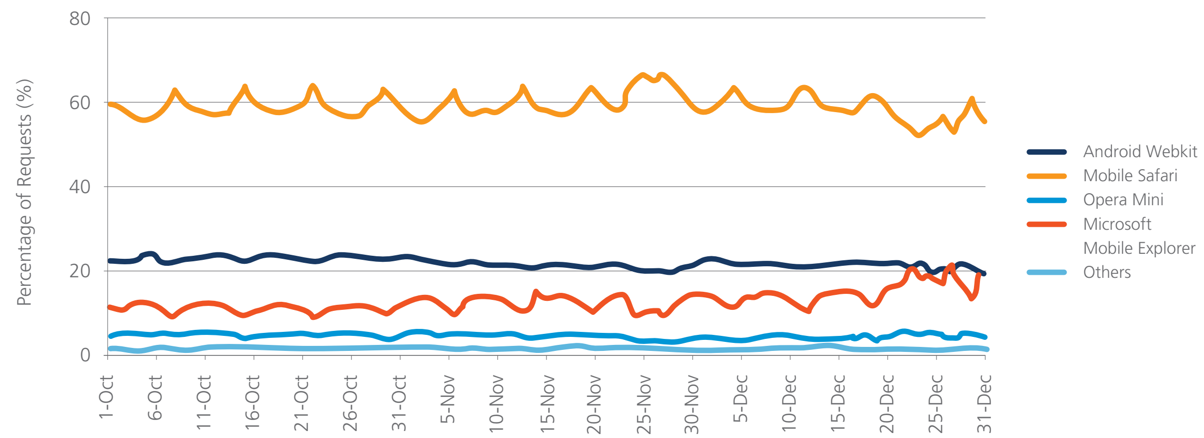


Figure 28: Mobile Browsers Seen Across All Networks, Q4 2012

The updated data set, referenced above, is now based on sampled traffic from most Akamai customers, resulting in a more global distribution, enough to remove the prior US-centric bias. The new data set is also significantly bigger, including over one billion requests each day, and uses a newer version of Akamai's device characterization engine. For more information on this revised data set, notable changes noticed in the data, and forward-looking plans, please see the blog post at https://blogs.akamai.com/2013/03/akamai-io-going-global.html.

7.3 Mobile Traffic Growth As Observed By Ericsson

In mobile networks, the access medium (spectrum) is being shared by different users in the same cell. It is important to understand traffic volumes and usage patterns in order to enable a good customer experience. Ericsson's presence in more than 180 countries and its customer base representing more than 1,000 networks enables Ericsson to measure mobile voice and data volumes. The result is a representative base for calculating world total mobile traffic in 2G, 3G, and 4G networks (not including DVB-H, WiFi, and Mobile WiMax).

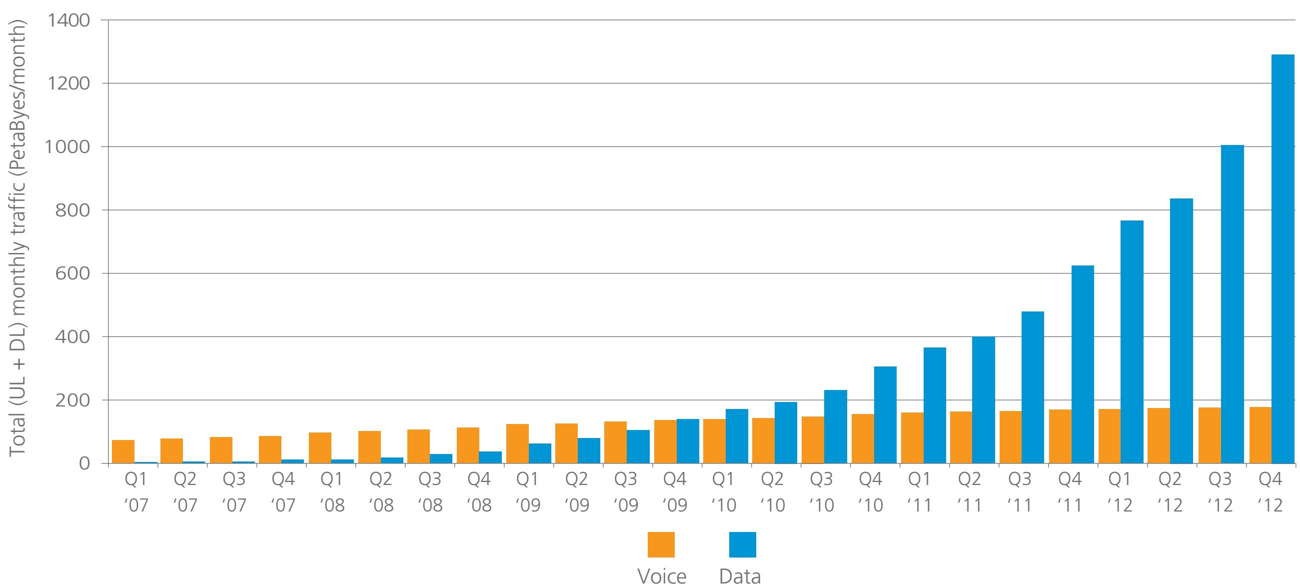


Figure 29: Total Monthly Mobile Voice and Data as Measured by Ericsson

DID YOU KNOW?

Across all networks in the fourth quarter, Apple Mobile Safari, Android Webkit, and Microsoft Mobile Explorer were the only mobile browsers consistently responsible for more than 5% of requests. Looking at mobile networks, the list include the Blackberry browser as well.

[Source: http://bit.ly/XEKtW2, http://bit.ly/14tHoh1]

These measurements have been performed for several years. It is important to note that the measurements of data and voice traffic in these networks (2G, 3G, 4G/LTE) around the world show large differences in traffic levels between markets and regions, and also between operators due to their different customer profiles.

As illustrated in Figure 29, the volume of mobile data traffic doubled from the fourth quarter of 2011 to the fourth quarter of 2012, and grew 28% between the third and fourth quarter of 2012. Note that mobile voice traffic continues to grow as well, though at a slower rate, increasing 3% from the fourth quarter of 2011 to the fourth quarter of 2012.

7.4 Mobile Data Traffic Variation Per Device Type

There are major differences in how much traffic various devices generate in different mobile networks. In this section, we analyze traffic and subscription distribution of mobile data subscribers with different device types and operating systems. Analysis is based on measurements from different mobile broadband networks all over the world between Q2 2012 and Q1 2013. Only mobile data subscriptions with 3G or 4G capable devices are included, devices without data subscription or devices without 3G radio capability were excluded from the analysis. Likewise, WiFi-only devices without 3G or 4G modems (quite common for tablets) are also excluded. Mobile traffic figures include 2G, 3G and 4G traffic from these devices but do not include traffic offloaded to WiFi.

Figure 30 shows the penetration and share of total traffic volume for different device types (see the legend for information on how to read the graph). Mobile data traffic volume from mobile phones accounts for ~50% of total mobile broadband data traffic volume in the measured networks. However, there are large regional differences: in many European networks, traffic from mobile PCs still dominates with up to 10-30% mobile PC subscriber share (among data subscriptions with 3G/4G devices) and 50%–80%volume shares. In contrast, in North America, smartphone traffic is typically predominant, with only a few percent PC subscription shares. One reason for this large variation is the different focus operators have had on PC and smart-

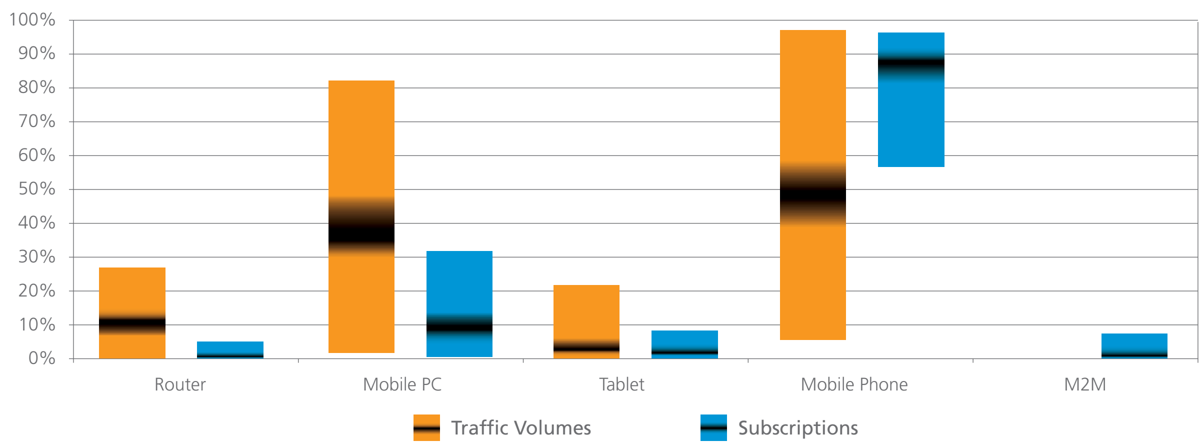


Figure 30: Penetration and Share of Total Mobile Traffic Volume (In Bytes) Per Device In the Measured Networks

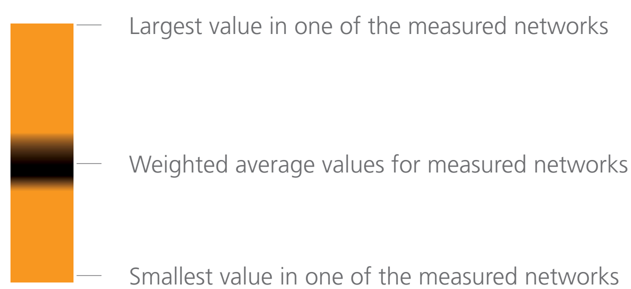
phone segments. Operators that launched mobile broadband early, typically successful in selling dongle subscriptions, often have a large share of PC subscribers. In some markets it is still the dominant segment due to late proliferation of smartphones and a general strategy to target households with DSL replacement offerings. In some networks, router and tablet traffic volume shares can also be significant. Note that most M2M devices are still 2G-only, and these are not included in Figure 30.

Figure 31 further drills down mobile phones by operating system. Android phones already dominate both in terms of subscriptions (~30% of all 3G or 4G capable mobile phones with data subscription) and traffic volume (>50%). Some Symbian phones, many older Blackberry phones and most feature phones (with proprietary OS) are not 3G capable and hence are not included within this chart. Similarly, most feature phones, many Symbian smartphones and also some low-end Android smartphones do not have data subscriptions; these are also excluded from the chart.

Finally, Figure 32 summarizes the spread of average per subscription monthly data traffic volumes in the measured networks per device type and mobile phone OS. The largest average values had been measured on router devices (4–14 GB) followed by mobile PCs (0.7–7 GB) and tablets (0.2–1.7 GB).

Per subscription traffic volumes for mobile phones vary within a wide range both per OS and per network. The largest average per subscription traffic volumes can be measured on Android smartphones ranging up to 2.2 GB / month on average in the

In order to also reflect the large variations between networks, graphs show the entire spread of value across measured networks



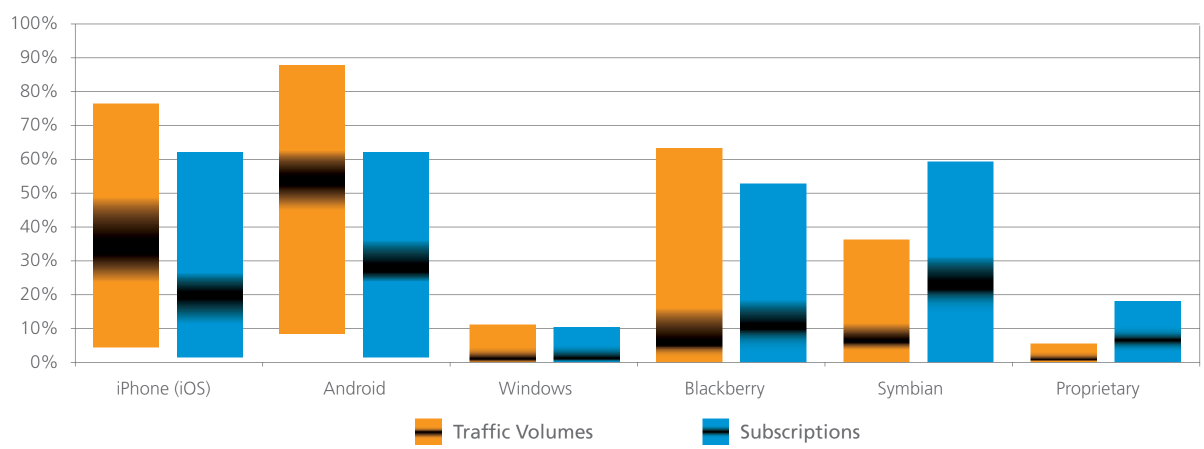


Figure 31: Penetration and Share of Total Mobile Traffic Volume (In Bytes) Per Mobile Phone OS In the Measured Networks

network with the heaviest smartphone usage. One reason for the wide spread is the difference in data plans offered to the subscribers. Android models have a greater variance due to a larger diversity of device models. In networks where high-end models dominate, average usage on Android devices exceeds average iPhone usage. However, when operators focus on the low-end Android segment the average usage is usually smaller than for iPhones. There are large differences between traffic volumes of phones with different versions of Windows OS, hence average values might increase significantly in the future when Windows 8 devices outnumber older Windows Mobile and Windows Phone 7 devices.

Note that Figure 32 is based on average values for both 3G and LTE capable devices of the given device category in each measured network. Measuring only LTE capable devices will usually result in significantly higher values. Data plans have a similarly strong impact on per subscription traffic volumes: measuring only devices with the highest data allowance or unlimited plan will usually result in significantly higher values.

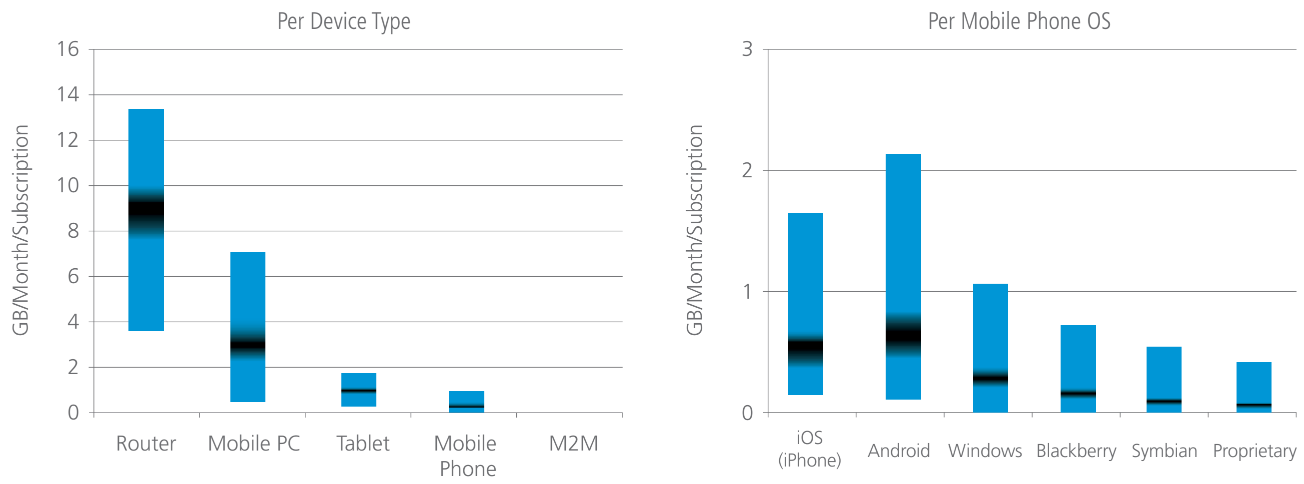


Figure 32: Spread of Average Per Subscription Monthly Traffic Volumes Per Device Type In the Measured Networks (Note the Different Scale For the "Per Device Type" and "Per Mobile Phone OS" Charts)

LEGEND:

Router: WLAN router with built-in HSPA or LTE uplink interface rather than a connection to a fixed network.

Mobile PC: Laptop or desktop PC devices with built in 3G/4G modem or external USB dongle.

Tablet: Portable tablet computers with touch screen display (e.g. iPad, Galaxy Tab).

Mobile Phone: Any mobile phone, including both smartphones and feature phones.

M2M: Machine to machine devices (e.g. vehicle tracking, fleet management, security surveillance, remote monitoring).

NOTE: Categorization of devices is performed based on the IMEI TAC (International Mobile Station Equipment Identity - Type Allocation Code) identifier of the device. Therefore, router devices without a built in HSPA/LTE modem using an external pluggable USB dongle are classified as mobile PC devices.

8.1 Syria

After experiencing a brief disruption on July 19, which followed similar disruptions in prior quarters, Internet availability in Syria saw several more major disruptions in the fourth quarter of 2012. As illustrated in Figure 33, HTTP traffic delivered by Akamai to users in Syria dropped to zero between 10:00 and 11:00 UTC on November 28. This disruption was also observed by Internet monitoring firm Renesys, which posted a blog entry[31] that noted "Starting at 10:26 UTC on Thursday, 29 November (12:26pm in Damascus), Syria's international Internet connectivity shut down. In the global routing table, all 84 of Syria's IP address blocks have become unreachable, effectively removing the country from the Internet."

Figure 33 shows that the disruption lasted for several days, with traffic starting to flow to Syrian users again during the afternoon of December 1. The restoration of Internet access was also noted in the Google Transparency Report,[32] as well as in a follow-up blog post from Renesys.[33]

According to a Reuters report,[34] "Syria's minister of information said that 'terrorists', not the state, were responsible for a countrywide Internet outage on Thursday, a pro-government TV station said." Beyond this claim, however, no additional details were ever made available regarding the cause of the outage.

Just a few days later, an Internet disruption approximately ten minutes[35] long was experienced on December 3, and eight days later, another outage occurred on December 11. As Figure 34 shows, HTTP traffic delivered by Akamai to users in Syria dropped to zero just after 16:00 UTC. The outage lasted for just over a half hour, and was also reported in Twitter posts from Renesys[36] and Internet monitoring firm BGPMon,[37] as well as a blog post[38] from Internet security firm Arbor Networks. It is also unclear what caused these two brief outages.

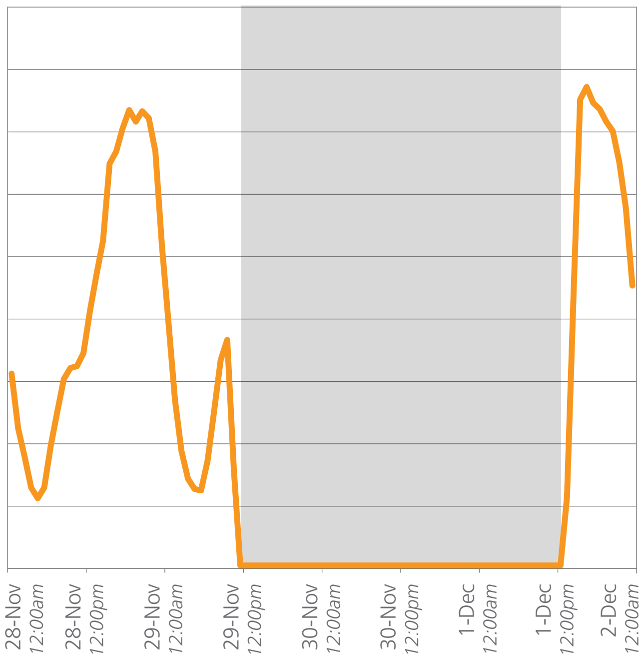


Figure 33: HTTP Traffic Served to Syria, 11/28/2012 – 12/1/2012

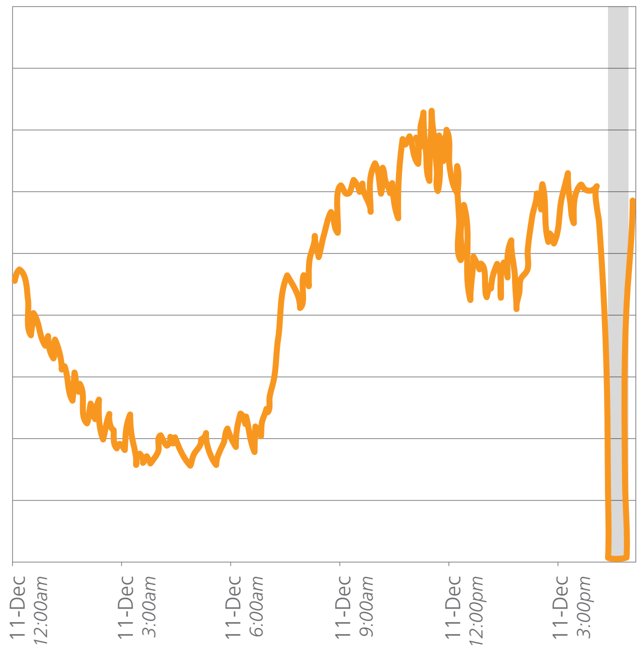


Figure 34: HTTP Traffic Served to Syria, December 11, 2012

8.2 Bangladesh

On November 15, HTTP traffic delivered by Akamai to users in Bangladesh began its diurnal decline at around 18:00 UTC. However, approximately two hours later, traffic dropped off completely, with the country experiencing an Internet disruption lasting approximately 90 minutes, as shown in Figure 35. Further research indicates[39] that the disruption was apparently related to Bangladesh's connection to the Sea-Me-We 4 (SMW4) submarine cable being taken offline for planned maintenance. The SMW4 cable has historically been a single point of failure for Bangladesh's connection to the Internet. In December, however, it was announced[40] that Bangladesh had turned up additional international connections via terrestrial cable, which should help increase the reliability of the country's Internet service.

8.3 Senegal

Just after 10:00 UTC on December 19, HTTP traffic delivered by Akamai to users in Senegal declined significantly. As shown in Figure 36, this disruption was not a complete Internet outage and lasted for approximately 11 hours, with traffic starting to return in a meaningful way around 21:30 UTC. Further investigation showed that Internet connectivity in Senegal is primarily through a single provider—Sonatel Dakar (ASN 8346), and that increased increased activity in routing announcements from ASN 8346 may be related to the observed disruption. Network latency testing[41] by cloud hosting provider OVH.com to an IP address in Sonatel Dakar's autonomous system appeared to show a brief spike in latency coincident with this observed service disruption as well.

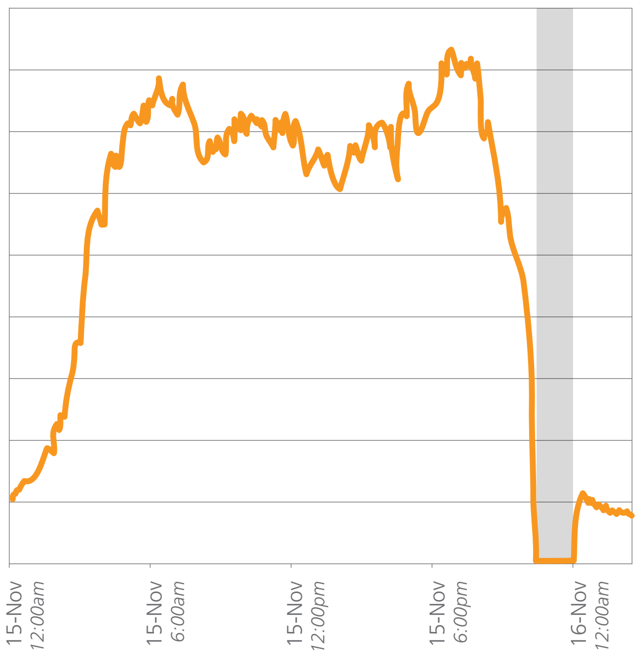


Figure 35: HTTP Traffic Served to Bangladesh, November 15, 2012

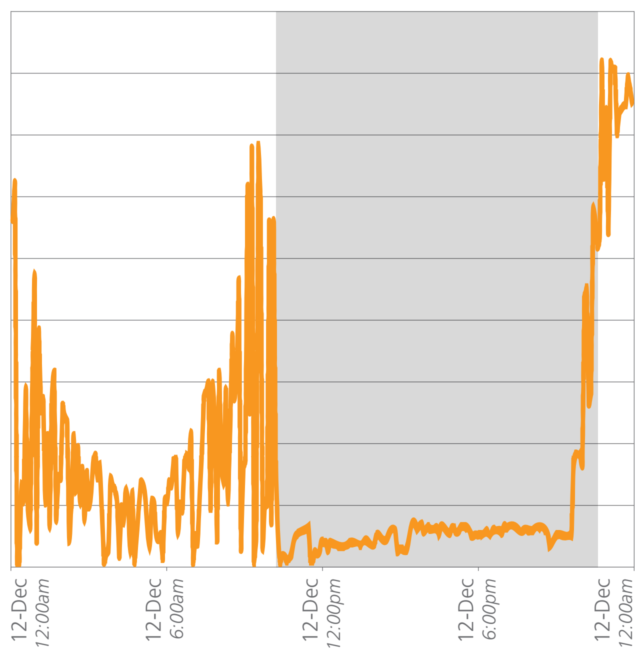


Figure 36: HTTP Traffic Served to Senegal, December 19, 2012

DID YOU KNOW

Internet monitoring firm Renesys classified 61 countries as being at "severe risk of Internet disconnection". These countries, which include Syria and Libya, have only one or two network providers at their "international frontier".

[Source: http://www.renesys.com/blog/2012/11/could-it-happen-in-your-countr.shtml]

SECTION 9: Historical Perspective

9.1 IPv4 Address Exhaustion

IPv4 address space exhaustion continued to be an ongoing issue throughout 2012, as RIPE (European RIR) joined APNIC (Asia Pacific RIR) in implementing so-called austerity measures for IPv4 address space distribution upon reaching their last "/8" of address space in September. As Figure 37 clearly illustrates, the rate of assignment/allocation from APNIC remained extremely low throughout the year, with the volume of requests comparatively low, and the number of addresses distributed in response to a request fairly small. The rate of assignment/allocation from RIPE took on a similar slope in mid-September as the final "/8" was reached – prior to that, distribution activity grew at a fairly steady rate throughout the first three quarters of the year.

ARIN (North American RIR) had the greatest amount of activity during 2012, distributing about five million more addresses worth of IPv4 space than RIPE. The first half of the year was marked by two periods in which over ten million IPv4 addresses were assigned/allocated — this activity was covered in the *State of the Internet* reports for the first and second quarters of 2012. Several similar, but much smaller, large allocations/assignments occurred in the second half of the year and, as the graph below shows, the growth rate clearly slowed near the end of the year. According to a Twitter post[42] from @TeamARIN, the RIR started 2013 with "2.68 /8s of available #IPv4 address space", placing it squarely in Phase 2 of its Countdown Plan.[43]

At LACNIC (Latin American and Caribbean RIR) and AFRINIC (African RIR), activity throughout 2012 was somewhat moderate, with both registries seeing several instances where comparatively large distributions of address space were made. It is interesting to note that in comparison to 2011, both AFRINIC and LACNIC assigned about three times as much IPv4 address space in 2012.

It is worth noting that, based on the source data made available by the RIRs, there were a number of countries/regions around the world that did not have any IPv4 address space assigned/allocated to them during 2012. According to the data, 62 countries/regions did not receive any new IPv4 address space allocations or assignments — many are extremely small, remote island nations/territories, while others, such as Aruba, the Bahamas, and Saint Lucia, are more renowned as locales where visitors go to "unplug" and relax, likely meaning that Internet usage in these places is growing minimally, if at all.

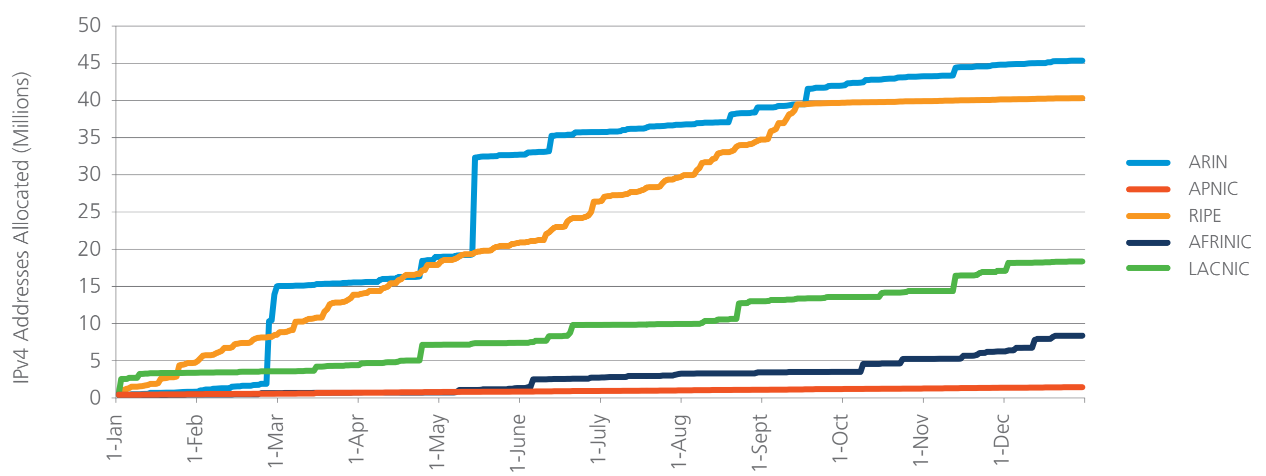


Figure 37: Cumulative Number of IPv4 Addresses Allocated/Assigned During 2012

9.2 IPv6 Adoption

As the available pools of IPv4 address space continued to shrink across all of the RIRs throughout 2012, IPv6 adoption remained a priority. As shown in Figure 38, the total number of ASes in the global routing table grew by just under a third in 2012, ending the year with just over 6600. After accelerating significantly in the previous year, the overall growth rate in 2012 (32.9%) was just under half of what was seen in 2011 (68.2%), as well as being significantly lower than the growth rates seen in 2010 (58.4%) and 2009 (53.4%).

It is not clear that the World IPv6 Launch event in June 2012 drove quite the same sort of accelerated growth as was seen around the World IPv6 Day event in June 2011; however, in looking at Figure 39, the growth rate in the latter half of 2012 does appear to be slightly higher than in the first half despite several gaps in the source data due to Hurricane Electric's data collection issues. The lower year-over-year overall growth rate (as compared to prior year's) and the moderated rate of growth throughout the year could potentially be due to adoption to date – that is, as more and more active autonomous systems (networks) support IPv6, the number that do not yet (and still need to) would be commensurately lower. In addition, as is noted in Section 2.3, while the "IPv6 ASes" metric provides some perspective around IPv6 adoption, it is also important to recognize that not all autonomous systems are equivalent. That is, IPv6 adoption on an autonomous system that is associated with a large number of end users/subscribers is ultimately more meaningful and impactful for measuring the ultimate success of IPv6 than adoption by an autonomous system that is not directly associated with end user connectivity/traffic.

It will be interesting to watch both the overall growth rate of, as well as the absolute number of, ASes added to the IPv6 routing table throughout 2013 to see how adoption as represented by this metric changes in comparison to growth in IPv6 end user traffic percentages, as well as growth in the number of Web sites that are available via IPv6.

The United States National Institute of Standards and Technology (NIST) tracks the adoption of IPv6 within the U.S. government, estimating IPv6 deployment across government agency domains[44] for e-mail, DNS, and Web services. Regarding their measurements, NIST notes "We are trying to estimate the extent of deployment on public facing services. Currently we only focus on DNS, WWW, and Email. When measuring IPv6, we use heuristics to determine if a domain intends to provide Email or WWW services at all. The fact that such a service is not operational over IPv6 is definitive, the statistics that try to estimate the percentage of domain completion take into consideration that many of these services are not available by design."

NIST checked approximately 1,400 domains during 2012. Figure 40 is based on data[45] provided to Akamai by NIST, and illustrates that

- Domains with operational IPv6 DNS services grew from 180 to 766
- Domains with operational IPv6 e-mail services grew from 2 to 123
- Domains with operational IPv6 Web services grew from 25 to 470

NIST's full list of IPv6 enabled U.S. government Web sites can be found at http://usgv6-deploymon.antd.nist.gov/cgi-bin/generate-all.www

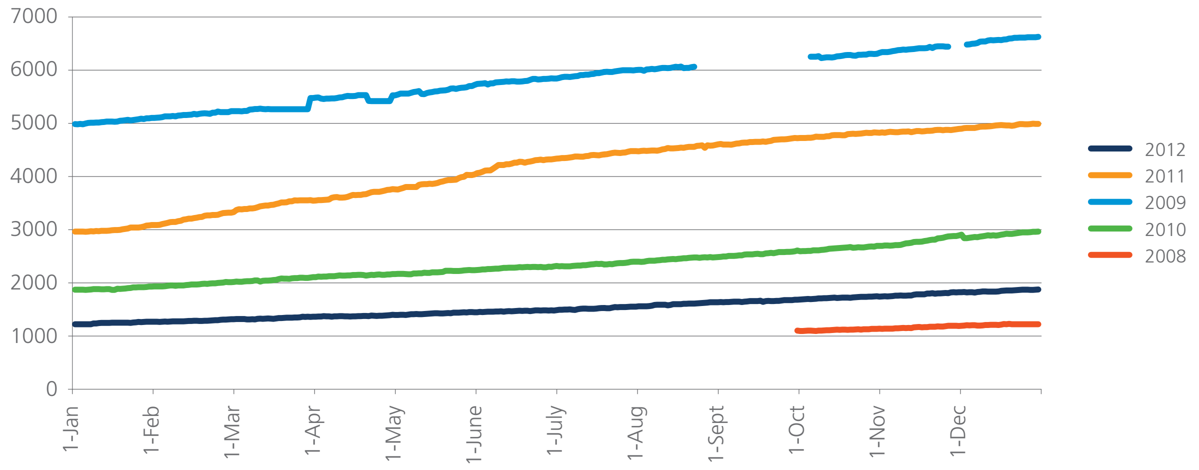


Figure 38: Total Number of Autonomous Systems in the IPv6 Routing Table, 2008 – 2012

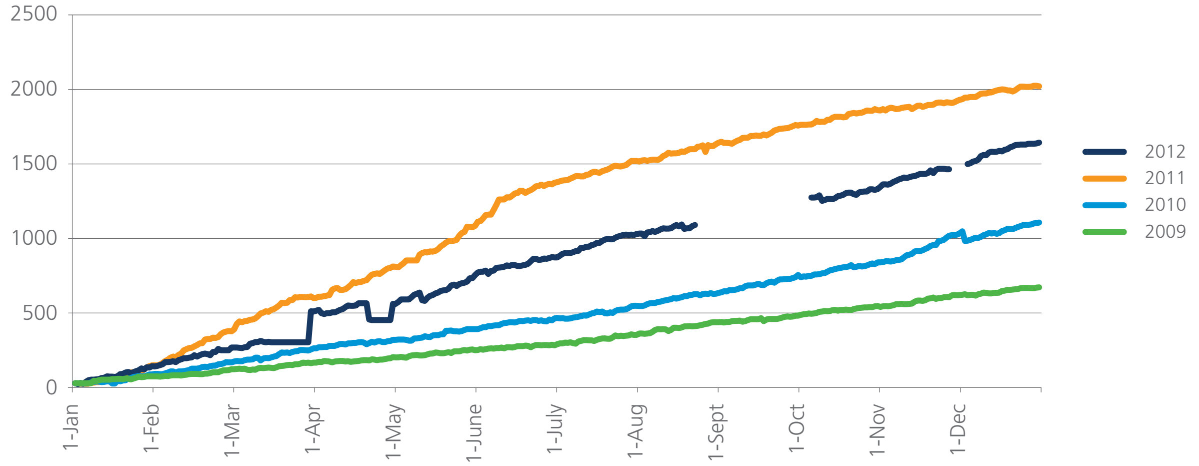


Figure 39: Change in the Number of Autonomous Systems in the IPv6 Routing Table, 2009–2012

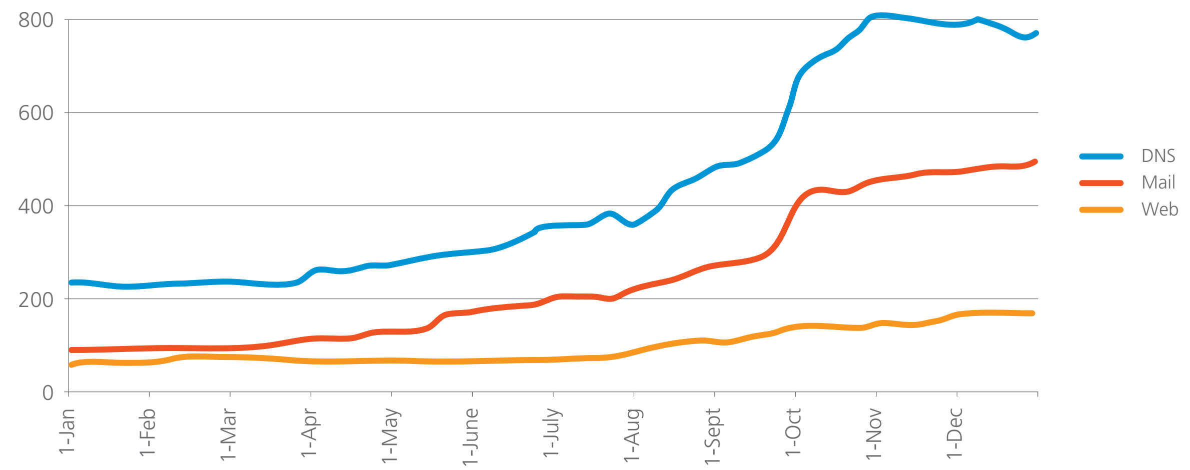


Figure 40: U.S. Government IPv6 Operational Service Domains for 2012

9.3 Average Connection Speeds

In looking at the weighted average connection speeds, aggregated at a continental level, over the five-year history of the *State of the Internet Report*, it is apparent that the average connection speed has increased over this period across every continent except Asia, as shown in Figure 41. In both Africa and Oceania (Australia and New Zealand), the weighted average connection speed nearly doubled, while in South America, it was up 143%. Europe and North America also saw extremely strong growth over the last five years. However, in Asia, the weighted average connection speed saw a 2% decline from the fourth quarter of 2007 through the fourth quarter of 2012.

While Asia has several countries/regions, including South Korea, Hong Kong, and Japan, that have some of the highest average connection speeds in the world, it also has large countries such as India and China that have some of the lowest average connection speeds. These larger, slower countries may have had a greater influence on the weighted average calculation, which would limit the observed growth. This is likely what occurred at the end of 2011, when very slight growth was observed over the prior four years. However, the slight decline that occurred over the last year is likely due to lower year-over-year average connection speeds observed across several "mid-sized" countries that are categorized as being part of Asia.

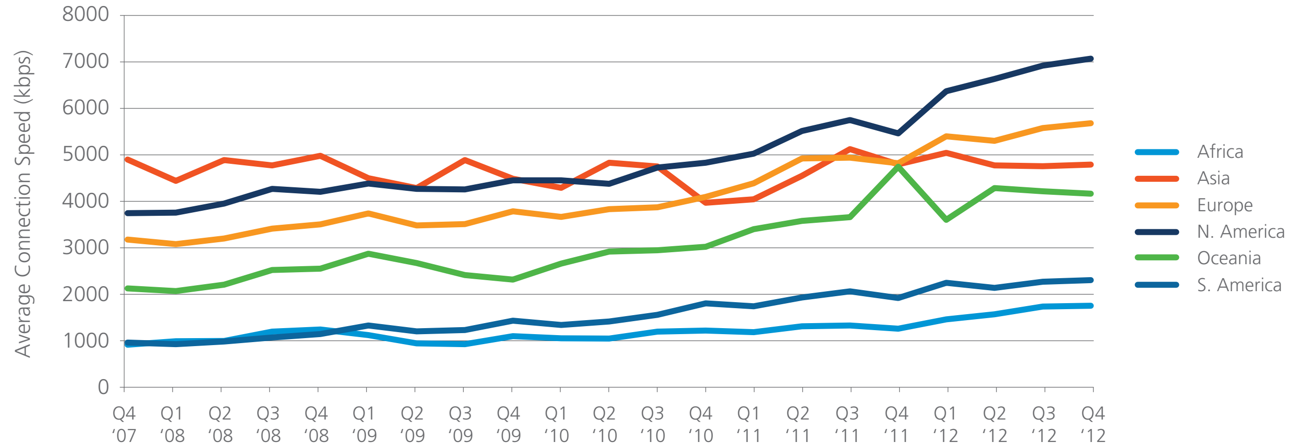


Figure 41: Weighted Average Connection Speed, Q4 2007 – Q4 2012

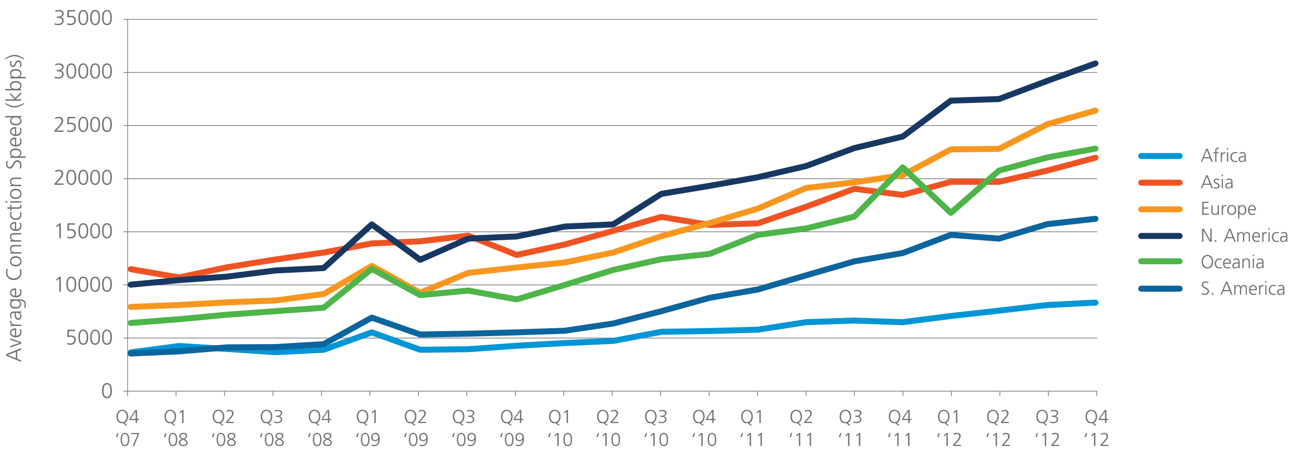


Figure 42: Weighted Average Peak Connection Speed, Q4 2007 – Q4 2012

9.4 Average Peak Connection Speeds

Average peak connection speeds, which more closely represent the peak speed that an Internet connection is capable of reaching, saw significant growth over the last five years across all continents, as illustrated in Figure 42. The lowest rate of growth over the period was seen in Asia, where the weighted average peak connection speed almost doubled. Strong improvements in connectivity in Africa led the weighted average peak connection speed to grow by 136%, while growth of over 200% was seen in Europe (238%), North America (212%), and Oceania (263%) between 2007 and 2012. Africa's strong growth remains impressive, especially as Internet connectivity is still poor across many countries, and since Internet disruptions as a means of political control remain all too frequent. The most impressive improvements over the last five years, however, were seen in South America, where the weighted average peak connection speed increased an astounding 378%. During the five-year history of the *State of the Internet Report*, countries around the world have recognized the value of reliable high-speed Internet connectivity. Many of these nations have made great strides in increasing the deployment of broadband connections, and improving the speed of existing connections, and these efforts are clearly reflected here.

9.5 High Broadband Connectivity

In looking at Figure 43, it is not immediately obvious that either Africa or South America saw significant increases in high broadband adoption levels between the fourth quarter of 2007 and the fourth quarter of 2012. However, Africa's weighted average high broadband adoption was actually up over 600% during the last five years, while South America's increased 174%. Unfortunately, both still have extremely low levels of high broadband adoption on a weighted average basis — both fall below 1%. Among the other continents, Europe, North America, and Oceania all experienced growth in excess of 300% between 2007 and 2012. As shown in the graph, North America notably saw a significant acceleration over the last year, with a near-doubling, likely driven by very strong year-over-year growth seen in the United States, Canada, and Mexico. Unfortunately, Asia's long term growth rate was not nearly as high as seen across the other continents — its weighted average high broadband adoption rate grew by only 4% over the last five years. However, even this slight increase is encouraging — though China and India's size and low adoption rates influence the weighted average, these countries, as well as others, are continuing to see high broadband adoption rates grow over time.

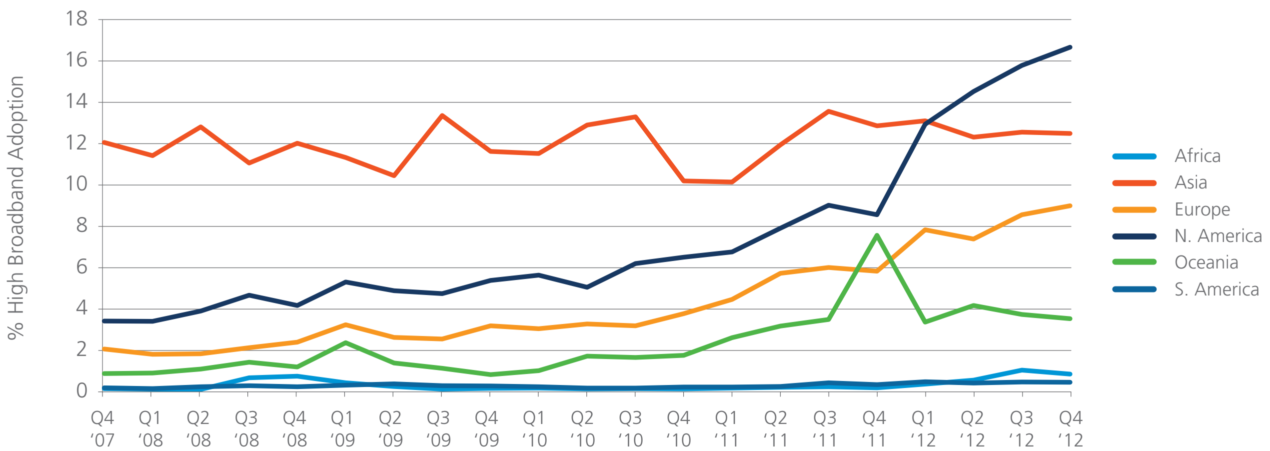


Figure 43: Weighted Average High Broadband Adoption, Q4 2007 – Q4 2012

9.6 Broadband Connectivity

Even though its overall weighted average broadband adoption rate is significantly lower than a number of other continents, the growth seen over the last five years in South America is exceptional, with an increase of over 1300% seen across the continent. (Of course, with a starting adoption rate of just 0.7%, significant growth rates are arguably easier to achieve than for continents with much higher starting adoption rates.) As shown in Figure 44, South America ended the five-year period with a weighted average broadband adoption rate of just over 10%, while Africa's adoption rate was just under half of that, at 4.8%. Africa's long-term increase was the lowest as well, at just 31%. Between the fourth quarter of 2007 and the fourth quarter of 2012, both Europe and Oceania posted increases of more than 100%, growing 212% and 169% respectively, while North America fell just short of doubling, increasing 95%. Asia was the lone outlier during the period, with its weighted average broadband adoption rate declining by 11%. However, as countries across the continent continue to execute on national broadband plans, resulting in higher speed connectivity becoming more widely available and more affordable throughout the region, we expect that the weighted average broadband adoption level will return to long-term growth in the future.

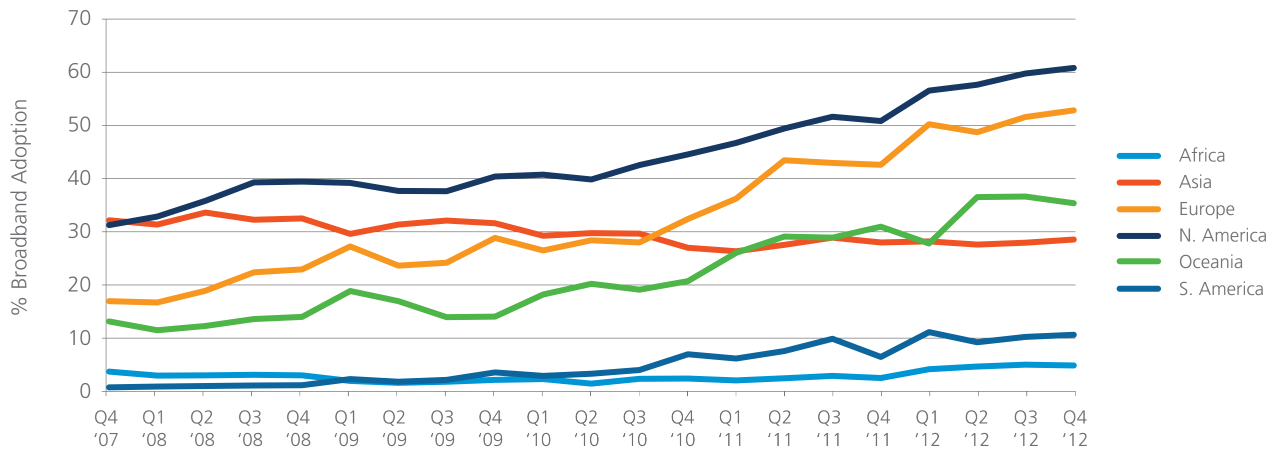


Figure 44: Weighted Average Broadband Adoption, Q4 2007 – Q4 2012

Region	% Attack Traffic	Unique IP Addresses	Avg. Connection Speed (Mbps)	Peak Connection Speed (Mbps)	% Above 10 Mbps*	% Above 4 Mbps*
Europe						
Austria	0.1%	2,507,304	6.6	25.9	12%	55%
Belgium	0.1%	4,561,434	6.7	33.4	16%	71%
Czech Republic	0.3%	2,129,425	8.1	30.4	17%	72%
Denmark	<0.1%	2,799,796	7.0	26.1	15%	69%
Finland	<0.1%	2,748,803	7.1	26.5	18%	62%
France	0.7%	26,073,000	4.8	21.0	4.3%	47%
Germany	1.3%	37,047,360	6.0	27.0	8.8%	62%
Greece	0.1%	3,021,716	4.0	22.2	1.8%	30%
Hungary	1.4%	2,810,081	5.9	31.0	9.1%	62%
Iceland	<0.1%	154,656	5.4	25.2	6.5%	38%
Ireland	<0.1%	1,690,911	6.6	27.0	11%	50%
Italy	1.6%	18,750,460	4.0	19.4	2.8%	28%
Luxembourg	<0.1%	172,032	4.7	18.9	3.6%	43%
Netherlands	0.3%	8,866,233	8.6	31.9	21%	82%
Norway	<0.1%	3,588,904	6.6	24.8	17%	47%
Poland	0.9%	8,712,238	5.6	26.8	10%	50%
Portugal	0.2%	3,224,526	5.0	31.5	5.1%	56%
Romania	2.8%	2,819,286	7.0	42.6	16%	66%
Russia	4.3%	16,875,757	5.1	24.7	7.2%	52%
Slovakia	<0.1%	996,175	5.8	27.0	8.0%	46%
Spain	0.7%	13,458,196	4.9	27.8	5.4%	48%
Sweden	0.2%	6,962,118	7.3	28.4	19%	51%
Switzerland	0.1%	3,319,498	8.7	34.2	23%	82%
Turkey	4.7%	9,184,417	2.8	19.2	0.5%	8.5%
United Kingdom	0.9%	27,139,729	6.5	30.5	11%	64%
Asia/Pacific						
Australia	0.2%	9,229,638	4.2	23.4	3.9%	36%
China	41%	101,661,860	1.8	8.1	0.2%	5.4%
Hong Kong	1.2%	2,922,058	9.3	57.5	28%	74%
India	2.3%	14,278,593	1.2	9.2	0.2%	2.8%
Indonesia	0.7%	3,667,474	1.4	16.8	0.2%	2.5%
Japan	1.3%	40,726,690	10.8	44.8	40%	76%
Malaysia	0.2%	2,202,604	2.3	19.5	0.9%	13%
New Zealand	0.1%	1,985,858	4.0	19.2	2.4%	37%
Singapore	0.2%	1,406,851	5.5	34.5	8.1%	52%
South Korea	1.4%	20,242,185	14.0	49.3	49%	86%
Taiwan, Province of China	3.7%	12,042,415	3.9	28.0	3.9%	31%
Vietnam	0.8%	4,968,024	1.5	9.6	<0.1%	1.8%
Middle East & Africa						
Egypt	0.7%	2,581,037	1.3	8.1	<0.1%	1.6%
Israel	0.4%	2,338,836	5.8	32.2	7.5%	57%
Kuwait	0.1%	990,909	1.9	14.1	0.6%	4.0%
Saudi Arabia	0.2%	3,905,262	1.6	9.5	<0.1%	0.9%
South Africa	0.1%	6,361,326	2.1	7.1	1.6%	8.0%
Sudan	<0.1%	160,282	0.9	7.0	<0.1%	0.3%
Syria	<0.1%	580,956	1.8	6.9	<0.1%	2.9%
United Arab Emirates (UAE)	0.2%	1,278,961	5.7	–	9.5%	57%
Latin & South America						
Argentina	0.9%	7,291,771	2.1	14.9	0.4%	9.0%
Brazil	3.3%	23,503,804	2.3	17.1	0.5%	13%
Chile	0.3%	3,694,319	2.9	20.1	0.8%	13%
Colombia	0.5%	5,116,172	2.7	14.7	0.3%	11%
Mexico	0.6%	11,755,327	2.9	15.1	0.6%	13%
Peru	0.4%	1,089,227	2.0	13.5	<0.1%	1.6%
Venezuela	0.8%	2,697,362	1.0	8.0	<0.1%	1.0%
North America						
Canada	0.5%	13,969,842	6.8	28.7	12%	72%
Costa Rica	<0.1%	389,987	2.1	11.7	0.5%	2.9%
United States	10%	146,874,246	7.4	31.5	19%	64%

Endnotes

[1] http://krebsonsecurity.com/2013/02/ddos-attack-on-bank-hid-900000-cyberheist/
[2] http://pastebin.com/u/QassamCyberFighters
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ftp://ftp.ripe.net/pub/stats/ripencc/delegated-ripencc-latest
ftp://ftp.afrinic.net/pub/stats/afrinic/delegated-afrinic-latest
ftp://ftp.lacnic.net/pub/stats/lacnic/delegated-lacnic-latest
[8] http://lacnic.net/cgi-bin/lacnic/whois?lg=EN, search for "179.224.0.0"
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