White Paper

The Zettabyte Era—Trends and Analysis

May 29, 2013

This document is part of the Cisco® Visual Networking Index (VNI), an ongoing initiative to track and forecast the impact of visual networking applications. The document presents some of the main findings of Cisco's global IP traffic forecast and explores the implications of IP traffic growth for service providers. For a more detailed look at the forecast and the methodology behind it, please visit Cisco VNI: Forecast and Methodology, 2012–2017.

Executive Summary

Annual global IP traffic will pass the zettabyte threshold by the end of 2015, and will reach 1.4 zettabytes per year by 2017. In 2015, global IP traffic will reach 1.0 zettabytes per year or 83.8 exabytes per month, and by 2017, global IP traffic will reach 1.4 zettabytes per year or 120.6 exabytes per month.

Global IP traffic has increased fourfold over the past 5 years, and will increase threefold over the next 5 years. Overall, IP traffic will grow at a compound annual growth rate (CAGR) of 23 percent from 2012 to 2017.

Busy-hour Internet traffic is growing more rapidly than average Internet traffic. Busy-hour Internet traffic increased 41 percent in 2012, compared to 34 percent growth in average traffic. Busy-hour Internet traffic will increase by a factor of 3.5 between 2012 and 2017, while average Internet traffic will increase 2.9-fold. Busy-hour Internet traffic will reach 865 Tbps in 2017, the equivalent of 720 million people streaming a high-definition video continuously.

Metro traffic will surpass long-haul traffic in 2014, and will account for 58 percent of total IP traffic by 2017. Metro traffic will grow nearly twice as fast as long-haul traffic from 2012 to 2017. The higher growth in metro networks is due in part to the increasingly significant role of content delivery networks, which bypass long-haul links and deliver traffic to metro and regional backbones.

Content delivery networks (CDNs) will carry more than half of Internet traffic in 2017. Fifty-one percent of all Internet traffic will cross content delivery networks in 2017 globally, up from 34 percent in 2012.

Nearly half of all IP traffic will originate with non-PC devices by 2017. In 2012, only 26 percent of consumer IP traffic originated with non-PC devices, but by 2017 the non-PC share of consumer IP traffic will grow to 49 percent. PC-originated traffic will grow at a CAGR of 14 percent, while TVs, tablets, mobile phones, and machine-to-machine (M2M) modules will have traffic growth rates of 24 percent, 104 percent, 79 percent, and 82 percent, respectively.

Traffic from wireless and mobile devices will exceed traffic from wired devices by 2017. By 2017, wired devices will account for 45 percent of IP traffic, while Wi-Fi and mobile devices will account for 55 percent of IP traffic. In 2012, wired devices accounted for the majority of IP traffic at 59 percent.

In 2017, the gigabyte equivalent of all movies ever made will cross the global Internet every 3 minutes. The global Internet networks will deliver 13.8 petabytes every 5 minutes in 2017.

The number of devices connected to IP networks will be nearly three times as high as the global population by 2017. There will be nearly three networked devices per capita in 2017, up from nearly two networked devices per capita in 2012. Accelerated in part by the increase in devices and the capabilities of those devices, IP traffic per capita will reach 16 gigabytes per capita by 2017, up from 6 gigabytes per capita in 2012.

Global Internet Video Highlights

It would take an individual more than 5 million years to watch the amount of video that will cross global IP networks each month in 2017. Every second, nearly a million minutes of video content will cross the network by 2017.

Globally, IP video traffic will be 73 percent of all IP traffic (both business and consumer) by 2017, up from 60 percent in 2012. This percentage does not include the amount of video exchanged through peer-to-peer (P2P) file sharing. The sum of all forms of video (TV, video on demand [VoD], Internet, and P2P) will continue to be in the range of 80 and 90 percent of global consumer traffic by 2017.

Internet video to TV doubled in 2012. It will continue to grow at a rapid pace, increasing fivefold by 2017. Internet video to TV will be 14 percent of consumer Internet video traffic in 2017, up from 9 percent in 2012.

VoD traffic will nearly triple by 2017. The amount of VoD traffic in 2017 will be equivalent to 6 billion DVDs per month.

Content Delivery Network (CDN) traffic will deliver almost two-thirds of all Internet video traffic by 2017. By 2017, 65 percent of all Internet video traffic will cross content delivery networks in 2017, up from 53 percent in 2012.

Global Mobile Highlights

Globally, mobile data traffic will increase 13-fold between 2012 and 2017. Mobile data traffic will grow at a CAGR of 66 percent between 2012 and 2017, reaching 11.2 exabytes per month by 2017.

Global mobile data traffic will grow three times faster than fixed IP traffic from 2012 to 2017. Global mobile data traffic was 2 percent of total IP traffic in 2012, and will be 9 percent of total IP traffic by 2017.

Regional Highlights

IP traffic is growing fastest in the Middle East and Africa, followed by Asia Pacific. Traffic in the Middle East and Africa will grow at a CAGR of 38 percent between 2012 and 2017.

Summary of regional growth rates:

- IP traffic in North America will reach 40.7 exabytes per month by 2017 at a CAGR of 23 percent.
- IP traffic in Western Europe will reach 16.8 exabytes per month by 2017 at a CAGR of 17 percent.
- IP traffic in Asia Pacific will reach 43.4 exabytes per month by 2017 at a CAGR of 26 percent.
- IP traffic in Latin America will reach 7.4 exabytes per month by 2017 at a CAGR of 17 percent.
- IP traffic in Central and Eastern Europe will reach 8.8 exabytes per month by 2017 at a CAGR of 21 percent.
- IP traffic in the Middle East and Africa will reach 3.5 exabytes per month by 2017 at a CAGR of 38 percent.

Note: Several interactive tools are available to allow users to create custom highlights and forecast charts by region, by country, by application, and by end-user segment (refer to the Cisco VNI Forecast Highlights tool and the Cisco VNI Forecast Widget tool).

Global Business Highlights

Business IP traffic will grow at a CAGR of 21 percent from 2012 to 2017. Increased adoption of advanced video communications in the enterprise segment will cause business IP traffic to grow by a factor of 3 between 2012 and 2017.

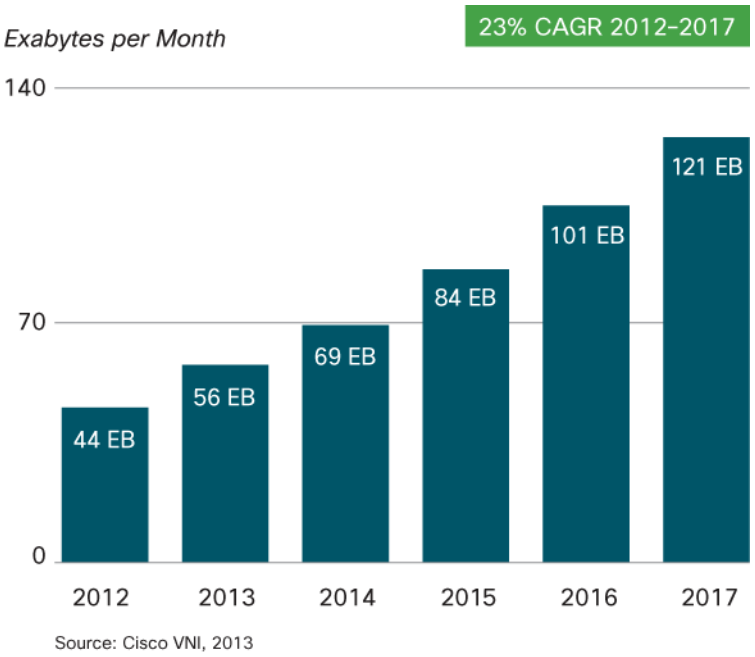
Business Internet traffic will grow at a faster pace than IP WAN. IP WAN will grow at a CAGR of 13 percent, compared to a CAGR of 21 percent for fixed business Internet and 59 percent for mobile business Internet.

Business IP traffic will grow fastest in the Middle East and Africa. Business IP traffic in the Middle East and Africa will grow at a CAGR of 29 percent, a faster pace than the global average of 21 percent. In volume, Asia Pacific will have the largest amount of business IP traffic in 2017 at 8.3 exabytes per month. North America will be the second at 5.4 exabytes per month.

Forecast Overview

The current Visual Networking Index forecast projects global IP traffic to triple from 2012 to 2017. See Appendix A for a detailed summary. As Figure 1 shows, overall IP traffic is expected to grow to 120.6 exabytes per month by 2017, up from 43.6 exabytes per month in 2012, a CAGR of 23 percent.

Figure 1. Cisco VNI Forecasts 120.6 Exabytes per Month of IP Traffic in 2017



Source: Cisco VNI, 2013

For more details about Cisco's forecasting methodology, refer to the paper entitled "Cisco VNI: Forecast and Methodology, 2012–2017."

To appreciate the magnitude of IP traffic volumes, it helps to put the numbers in more familiar terms:

- In 2017, the gigabyte equivalent of all movies ever made will cross the global Internet every 4 minutes.
- Globally, IP traffic will reach 367 Tbps in 2017, the equivalent of 306 million people streaming Internet high-definition video simultaneously, all day, every day.
- Global IP traffic in 2017 will be equivalent to 362 billion DVDs per year, 30 billion DVDs per month, or 41 million DVDs per hour.

Total Internet traffic has experienced dramatic growth over time. Twenty years ago, in 1992, global Internet networks carried approximately 100 Gigabytes of traffic per day. Ten years later, in 2002, global Internet traffic amounted to 100 Gigabytes per second. And last year, in 2012, global Internet traffic reached 12,000 Gigabytes per second. Table 1 provides a view of the historical benchmarks for total Internet traffic.

Table 1. The VNI Forecast Within Historical Context

Year	Global Internet Traffic
1992	100 Gigabytes per Day
1997	100 Gigabytes per Hour
2002	100 Gigabytes per Second
2007	2,000 Gigabytes per Second
2012	12,000 Gigabytes per Second
2017	35,000 Gigabytes per Second

Source: Cisco VNI, 2013

Per capita IP and Internet traffic growth has followed a similarly steep growth curve over the past decade. Globally, IP traffic will reach 16 gigabytes per capita in 2017, up from 6 gigabytes per capita in 2012, and Internet traffic will reach 12 gigabytes per capita in 2017, up from 5 gigabytes per capita in 2012. Not long ago, in 2008, per capita Internet traffic was 1 gigabyte per month. In 2000, per capita Internet traffic was 10 megabytes per month.

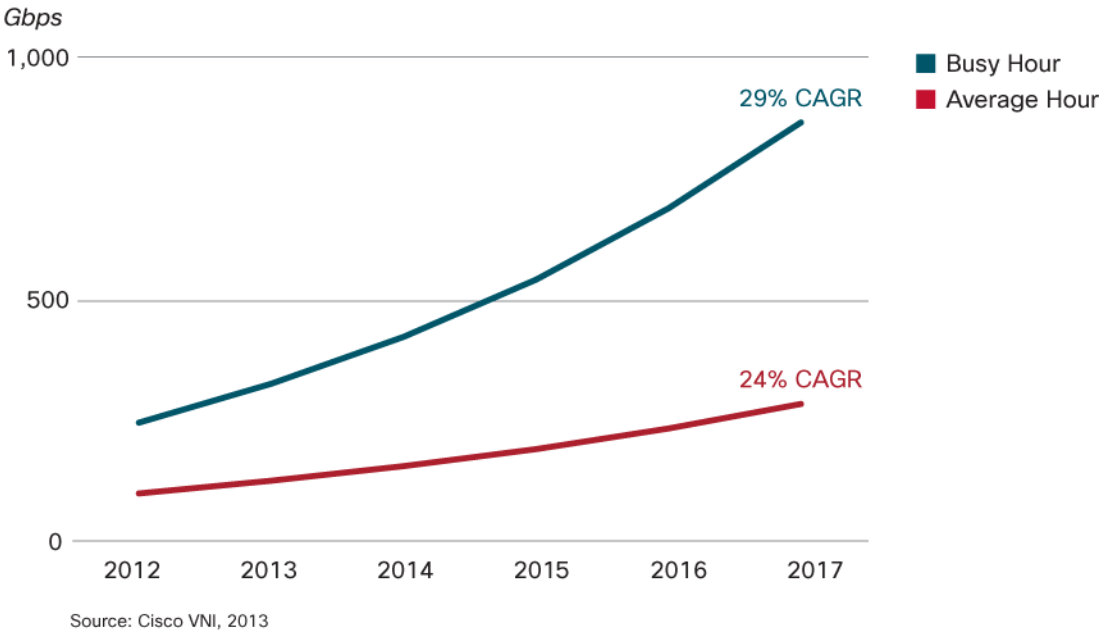
The sections that follow explore the trends contributing to the continued growth of global IP traffic.

Trend 1: Busy-Hour Traffic Will Grow Faster Than Average Traffic

While average Internet traffic has settled into a steady growth pattern, busy-hour traffic continues to grow more rapidly than average traffic. Service providers plan network capacity according to peak growth, rather than average. In 2012, busy-hour Internet traffic grew 41 percent, while average traffic grew at 36 percent. The difference between busy-hour and average Internet growth was particularly pronounced in Japan, where busy-hour growth was 56 percent in 2012 (compared to average-hour growth of 38 percent), and in India, where busy-hour growth was 90 percent in 2012 (compared to average-hour growth of 71 percent). Between 2012 and 2017, global busy-hour Internet use will grow at a CAGR of 29 percent, compared to 24 percent for average Internet traffic, as shown in Figure 2.

Video is the underlying reason for accelerated busy-hour traffic growth. Unlike other forms of traffic that are spread evenly throughout the day (such as web browsing and file sharing), video tends to have a “prime time”. Because of video consumption patterns, the Internet now has a much busier busy hour. Because video has a higher peak-to-average ratio than data or file sharing, and because video is gaining traffic share, peak Internet traffic will grow faster than average traffic. The growing gap between peak and average traffic is amplified further by the changing composition of Internet video. Real-time video such as live video, ambient video, and video calling has a peak-to-average ratio that is higher than on-demand video.

Figure 2. Busy Hour vs. Average Internet Traffic Growth

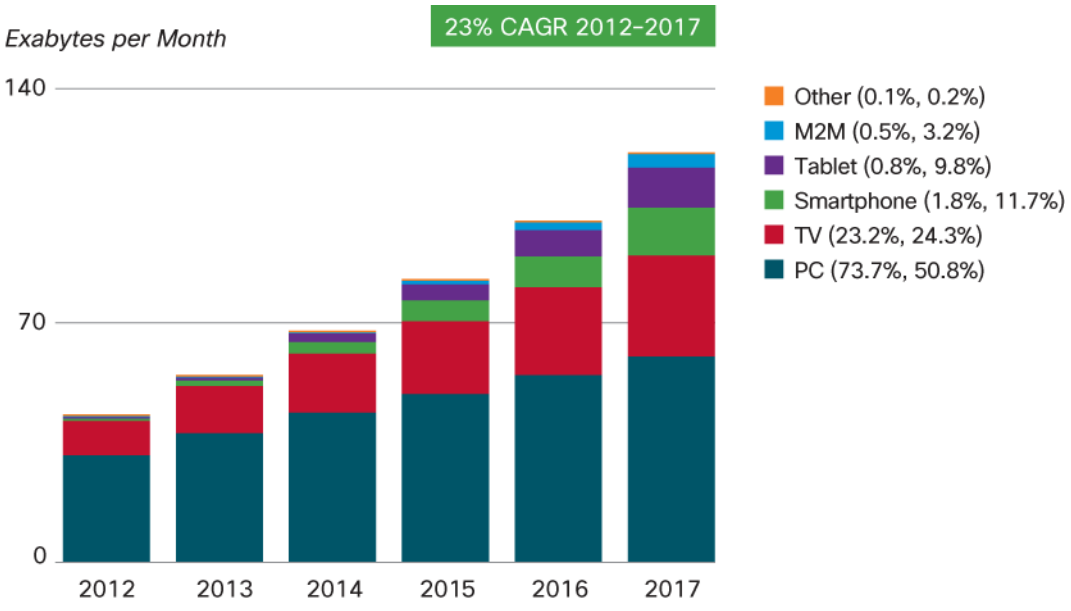


Source: Cisco VNI, 2013

Trend 2: Nearly One-Half of IP Traffic Will Come from TVs, Handsets, and Other Non-PC Devices by 2017

At the end of 2012, 74 percent of IP traffic and 94 percent of consumer Internet traffic originated from PCs. By 2017, 49 percent of IP traffic and 39 percent of consumer Internet traffic will originate from non-PC devices (Figure 3). As in the case of mobile networks, video devices can have a multiplier effect on traffic. An Internet-enabled high-definition television that draws 30 minutes of content per day from the Internet would generate as much Internet traffic as an entire household today.

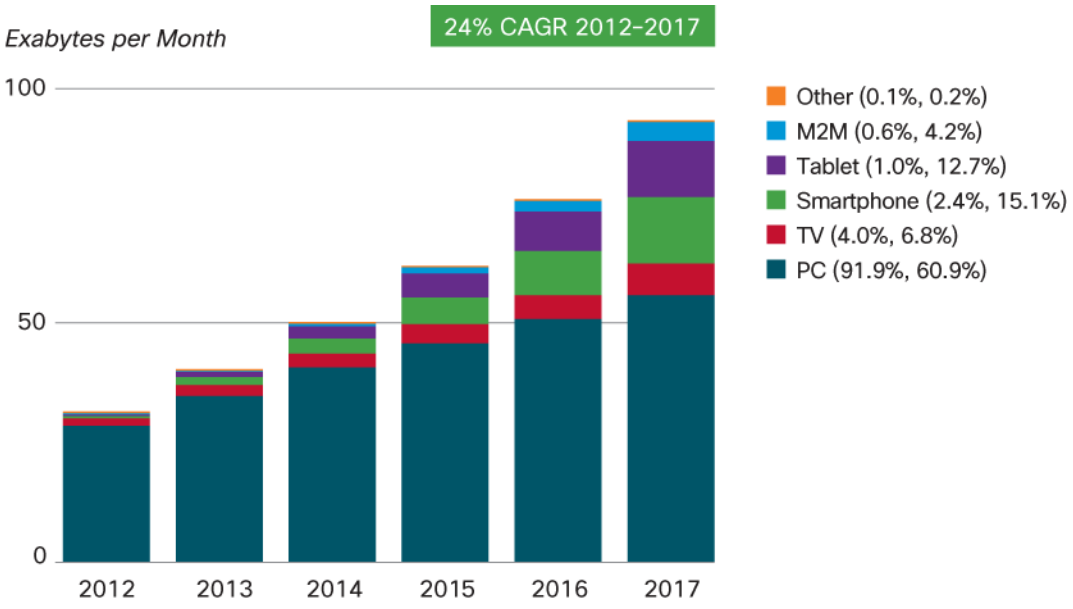
Figure 3. Global IP Traffic by Device Type



Source: Cisco VNI, 2013
The percentages within parenthesis next to the legend denote the relative traffic shares in 2012 and 2017.

Much of the IP traffic associated with TVs is IP VoD traffic, which is carried over a service-provider managed IP network. However, unmanaged Internet video traffic to TVs is growing as a percentage of total Internet traffic. Internet video traffic to TVs will account for 7 percent of total global Internet traffic in 2017, up from 4 percent in 2012 (Figure 4).

Figure 4. Global Internet Traffic by Device Type

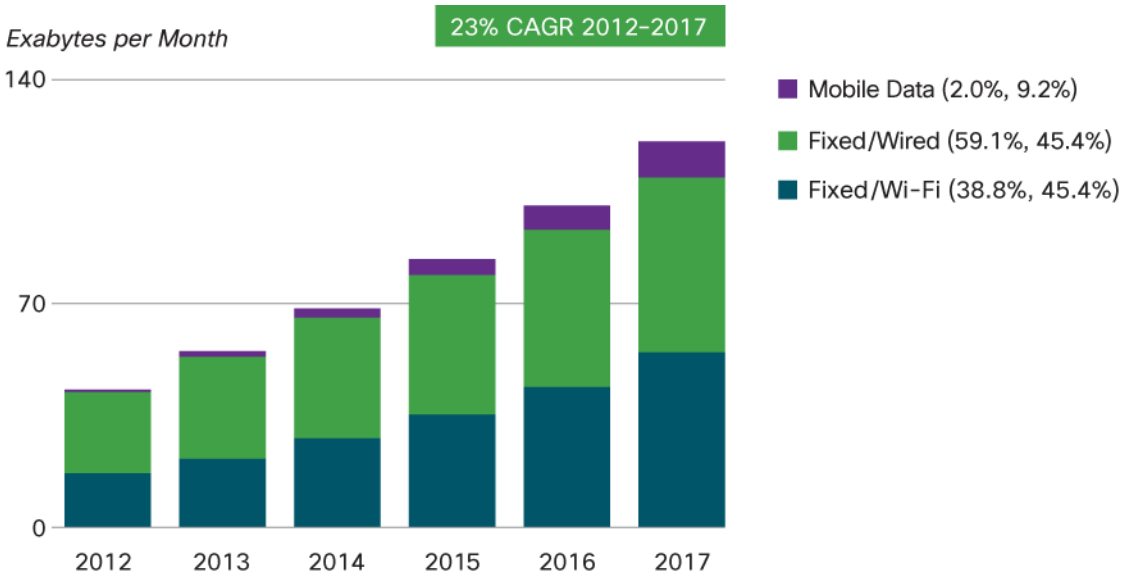


Source: Cisco VNI, 2013
The percentages within parenthesis next to the legend denote the relative traffic shares in 2012 and 2017.

Trend 3: Internet Traffic from Wireless and Mobile Devices Will Surpass the Volume of Traffic from Wired Devices by 2017

The rapid growth of mobile data traffic has been widely recognized and reported. The trend toward mobility carries over into the realm of fixed networks as well, in that an increasing portion of traffic will originate from portable or mobile devices. Figure 5 shows the growth of wireless and mobile traffic in relation to traffic from wired devices. By 2017, wired devices will account for 45 percent of IP traffic, while Wi-Fi and mobile devices will account for 55 percent of IP traffic. In 2012, wired devices accounted for the majority of IP traffic at 59 percent.

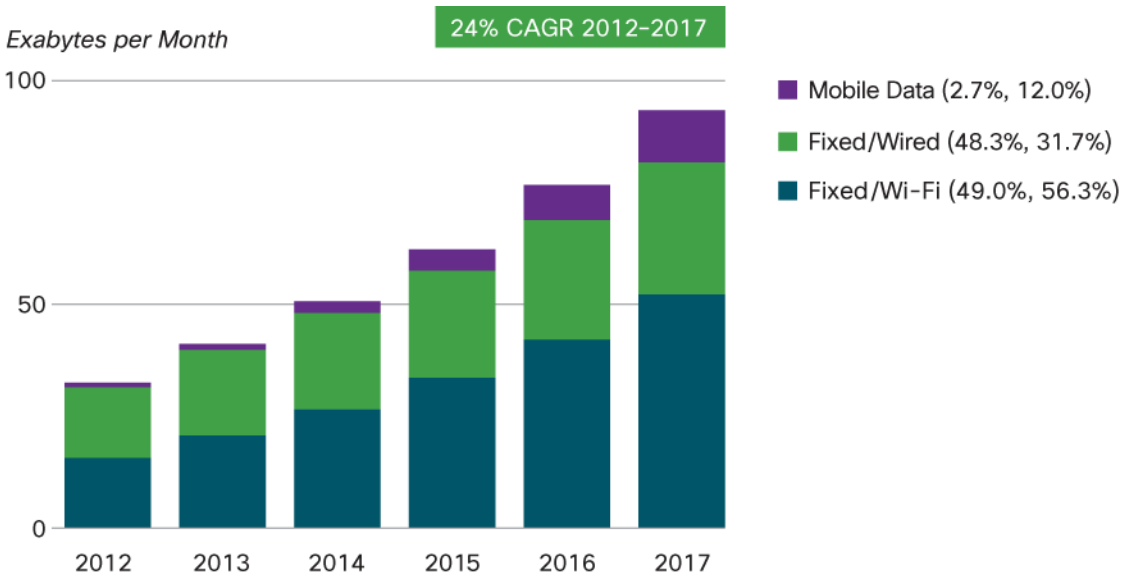
Figure 5. Global IP Traffic, Wired and Wireless



Source: Cisco VNI, 2013
The percentages within parenthesis next to the legend denote the relative traffic shares in 2012 and 2017.

Narrowing the focus to Internet traffic and excluding managed IP traffic yields a more pronounced trend. By 2017, wired devices will account for 32 percent of Internet traffic, while Wi-Fi and mobile devices will account for 68 percent of Internet traffic (Figure 6). In 2012, wired devices accounted for a little less than half of Internet traffic at 48 percent.

Figure 6. Global Internet Traffic, Wired and Wireless



Source: Cisco VNI, 2013
The percentages within parenthesis next to the legend denote the relative traffic shares in 2012 and 2017.

Trend 4: Fixed Broadband Speeds Will Nearly Quadruple by 2017

Fixed Speeds

Broadband speed is a crucial promoter of IP traffic. Broadband speed improvement results in increased consumption and use of high-bandwidth content and applications. The global average broadband speed continues to grow and will nearly quadruple from 2012 to 2017, from 11.3 Mbps to 39 Mbps. Table 2 shows the projected broadband speeds from 2012 to 2017. Several factors influence the fixed broadband speed forecast, including the deployment and adoption of fiber to the home (FTTH), high-speed DSL and cable broadband adoption, as well as overall broadband penetration. Countries such as Japan, South Korea, and Australia lead in terms of broadband speed because of their wide deployment of FTTH.

Table 2. Fixed Broadband Speeds, 2012–2017

Broadband Speed by Region (Mbps)							
	2011	2012	2013	2014	2015	2016	CAGR
Global	11	15	19	25	32	39	28%
Asia Pacific	11	14	19	25	33	41	31%
Latin America	5	6	7	9	11	13	21%
North America	13	16	20	25	31	38	24%
Western Europe	13	17	21	28	36	43	27%
Central and Eastern Europe	13	16	20	26	32	40	25%
Middle East and Africa	4	4	5	6	7	8	17%

Source: Cisco VNI, 2013

Consider how long it takes to download a high-definition movie at these speeds: at 5 Mbps, it would take 41 minutes to download the movie; at 10 Mbps, it would take 20 minutes; but at 100 Mbps, it would take only 2 minutes. High-bandwidth speeds will be an essential support for consumer cloud storage, making the download of large multimedia files as fast as a transfer from a hard drive. Table 3 shows the percentage of broadband connections that will be faster than 5 Mbps, 10 Mbps, and 100 Mbps by region.

Table 3. Broadband Greater than 5 Mbps, 2012–2017

Broadband Speed by Region (Mbps)	Greater than 5 Mbps		Greater than 10 Mbps		Greater than 100 Mbps	
	2012	2017	2012	2017	2012	2017
Global	53%	83%	35%	55%	1%	2%
Asia Pacific	47%	77%	30%	49%	1%	2%
Latin America	36%	50%	18%	25%	0%	0.3%
North America	64%	94%	48%	71%	1%	2%
Western Europe	63%	97%	41%	64%	1%	3%
Central and Eastern Europe	22%	33%	11%	16%	0%	0.4%
Middle East and Africa	57%	75%	39%	51%	1%	1%

Source: Cisco VNI, 2013

Mobile Speeds

Globally, the average mobile network connection speed in 2012 was 526 kbps. The average speed will grow at a CAGR of 49 percent, and will exceed 3.9 Mbps in 2017. Smartphone speeds, generally third-generation (3G) and higher, are currently almost four times higher than the overall average. Smartphone speeds will triple by 2017, reaching 6.5 Mbps.

There is anecdotal evidence to support the idea that usage increases when speed increases, although there is often a delay between the increase in speed and the increased usage, which can range from a few months to several years. The Cisco VNI forecast relates application bit rates to the average speeds in each country. Many of the trends in the resulting traffic forecast can be seen in the speed forecast, such as the high growth rates for developing countries and regions relative to more developed areas (Table 4).

Table 4. Projected Average Mobile Network Connection Speeds (in kbps) by Region and Country

	2012	2013	2014	2015	2016	2017	CAGR 2012–2017
Global							
Global speed: All handsets	526	817	1,233	1,857	2,725	3,898	49%
Global speed: Smartphones	2,064	2,664	3,358	4,263	5,284	6,528	26%
Global speed: Tablets	3,683	4,811	6,082	7,624	9,438	11,660	26%
By Region							
Middle East and Africa	219	371	640	1,101	1,837	2,898	68%
Central and Eastern Europe	551	909	1,458	2,288	3,426	4,760	54%
Latin America	200	349	586	956	1,492	2,207	62%
Western Europe	1,492	2,233	3,124	4,168	5,429	7,013	36%
Asia-Pacific	316	506	806	1,318	2,039	3,036	57%
North America	2,622	4,083	5,850	8,023	10,793	14,399	41%

Source: Cisco VNI Mobile, 2013

Current and historical speeds are based on data from Cisco's Global Internet Speed Test (GiST) application and Ookla's Speedtest. Forward projections for mobile data speeds are based on third-party forecasts for the relative proportions of 2G, 3G, 3.5G, and 4G among mobile connections through 2017. For more information about Cisco GIST, please visit http://ciscovni.com/gist/index.html.

A crucial factor promoting the increase in mobile speeds over the forecast period is the increasing proportion of 4G mobile connections. The impact of 4G connections on traffic is significant, because 4G connections, which include mobile WiMAX and Long-Term Evolution (LTE), generate a disproportionate amount of mobile data traffic.

Wi-Fi Speeds (from Mobile Devices)

Globally, Wi-Fi connection speeds originated from dual-mode mobile devices will increase threefold by 2017. The average Wi-Fi network connection speed (7.7 Mbps in 2012) will exceed 20.3 Mbps in 2017. North America will experience the highest Wi-Fi speeds of 23.2 Mbps in 2017, and the Asia Pacific will have the highest threefold growth by 2017 with Wi-Fi speeds of nearly 18.7 Mbps.

Wi-Fi speeds inherently depend on the quality of the broadband connection to the premises. Also dependent on the speeds is the Wi-Fi standard in the customer-premises-equipment (CPE) device. The latest standard, 802.11ac, is considered a true wired complement and can enable higher-definition video streaming and services with use cases that require higher data rates. Also a key factor in the usage of the Wi-Fi technology is the number and availability of hotspots. Globally, there will be nearly 10 million hotspots by 2017, up from 6 million hotspots in 2012, a twofold increase. The Asia Pacific region will have the highest number of hotspots by 2017. Asia Pacific has the highest growth in Wi-Fi speeds from 2012 to 2017 with a CAGR of 26 percent, while North America and Central and Eastern Europe will have the highest Wi-Fi speeds (Table 5).

Table 5. Projected Average Wi-Fi Network Connection Speeds (in kbps) by Region and Country

Wi-Fi Speeds from Dual Mode Mobile Devices by Region (Mbps)							
	2012	2013	2014	2015	2016	2017	CAGR
Global	8	10	12	14	17	20	21%
Asia Pacific	6	8	10	13	16	19	26%
Latin America	5	6	7	8	9	11	18%
North America	11	14	16	18	21	23	15%
Western Europe	9	11	12	14	17	18	14%
Central and Eastern Europe	10	12	15	17	20	23	19%
Middle East and Africa	3	3	3	4	4	4	8%

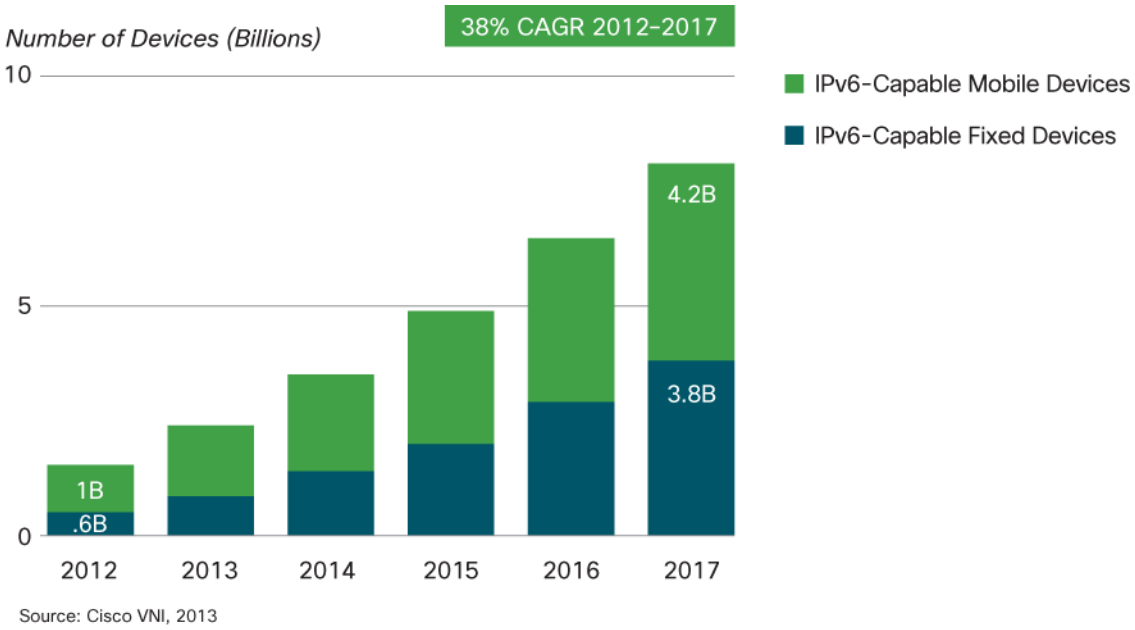
Source: Cisco VNI, 2013

Trend 5: IPv6 Devices, Connections, and Traffic

The transition to an IPv6 networking environment continues to make strides in IPv6 device capability, content enablement of IPv6, and operators implementing IPv6 in their networks. These developments are particularly important as IPv4 addressing depletion is occurring globally, with Asia and Europe having already exhausted their IPv4 allotment, and North America, Africa, and Latin America expected to allocate their remaining IPv4 addresses between 2014 and 2017.

Building upon the VNI IPv6-capable devices analysis initiated last year, the forecast estimates that globally, 42 percent of fixed and mobile devices and connections (8 billion) will be IPv6-capable in 2017, up from 14 percent (1.6 billion) in 2012, a CAGR of 38 percent (Figure 7). This estimate is based on the capability of the device and the network connection to support IPv6, and is not a projection of active IPv6 connections.

Figure 7. IPv6-Capable Devices and Connections Forecast 2012–2017



Source: Cisco VNI, 2013

Leading IPv6-capable device segments include:

- Seventy-three percent of smartphones are projected to be IPv6-capable in 2017, reaching 2.1 billion.
- Seventy-four percent of tablets are projected to be IPv6-capable in 2017, reaching 520 million.
- Seventy-nine percent of laptops will be IPv6-capable in 2017, reaching 717 million.
- Twenty-four percent of M2M connections will be IPv6-capable in 2017, reaching 1.4 billion.

Content providers are also moving to increase the IPv6 enablement of the sites and services. Cisco's IPv6 Lab reports that nearly 10 percent (4,500) of the websites tracked are IPv6-enabled, a tenfold increase from last year. As these 10 percent of web sites tend to be in the top providers of content and applications globally (Google, Facebook, YouTube, Netflix, etc.) they represent an average 40 percent of content and web activities reachable over IPv6. There can be, however, a variation depending on the popularity of these web sites across regions and countries. In addition, there have been specific country initiatives and cloud provider deployments that have had a positive impact on local IPv6 content reachability.

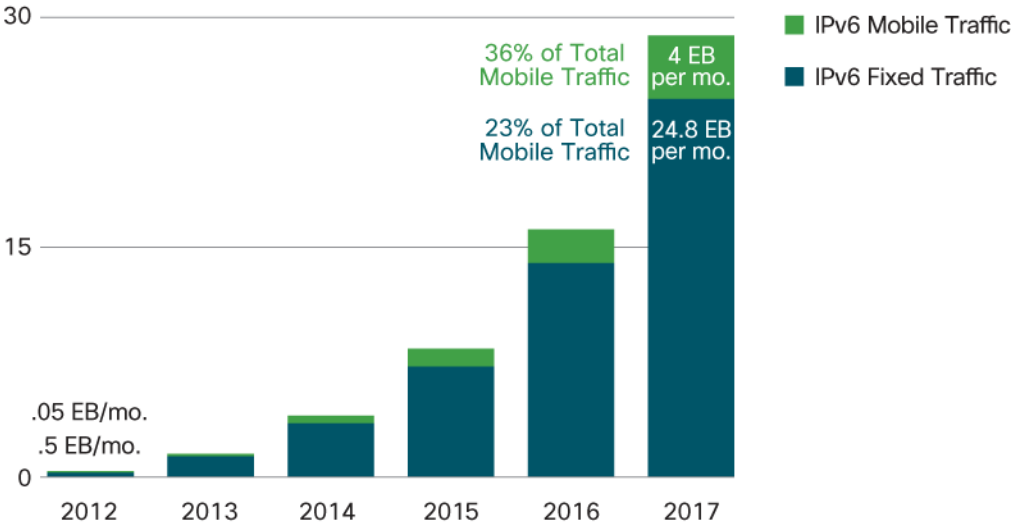
In addition, according to the World IPv6 Launch Organization, fixed and mobile network operators globally are deploying IPv6 and starting to see notable IPv6 traffic generation, ranging from several percent of network traffic to upward of 10 percent (AT&T, 8 percent; KDDI, 9 percent) and higher (Romania's RCS & RDS, 16 percent; France's Free Telecom, 17 percent; Verizon Wireless, 26 percent.) (as of April, 2013)

Amid these industry developments, this year's VNI forecast is undertaking an effort to estimate the potential IPv6 network traffic that could be generated if a percentage of IPv6-capable devices become actively connected to an IPv6 network, given the estimated global average for monthly traffic per device type.

For example, assuming that 10 percent of IPv6-capable fixed and mobile devices and connections were actively connected to an IPv6 network in 2012, the forecast estimates that globally, IPv6 traffic amounted to 0.6 exabytes per month or 1.4 percent of total Internet traffic. Given the 2012 World IPv6 Day goal generating 1 percent of global traffic over IPv6, this estimation can be viewed as in-line with those aspirations.

Looking to 2017, if 50 percent of IPv6-capable devices are actively connected to an IPv6 network, the forecast estimates that globally, IPv6 traffic would amount to 28.8 exabytes per month or 24 percent of total Internet traffic. Segmenting fixed and mobile IPv6 traffic, the forecast estimates that globally, IPv6 fixed traffic would reach 24.8 exabytes per month or 23 percent of total fixed traffic in 2017. Mobile IPv6 traffic would reach 4 exabytes per month or 36 percent of total mobile traffic in 2017 (Figure 8).

Figure 8. Projected Fixed and Mobile IPv6 Traffic Forecast 2012–2017



Source: Cisco VNI, 2013

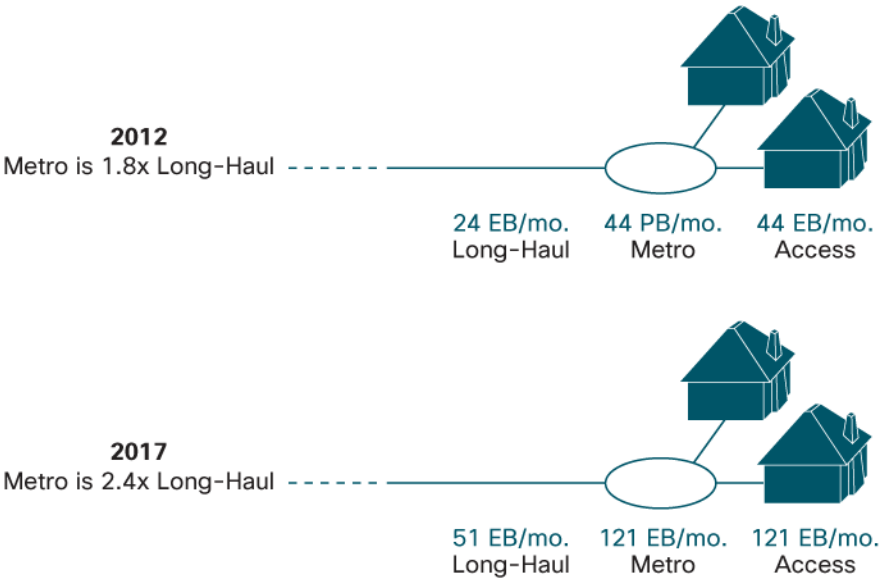
This initial estimation of potential IPv6 traffic is based on the assumptions that IPv6 device capability, IPv6 content enablement, and IPv6 network deployment will keep pace with current trends and may even accelerate during the forecast period. Considering the interdependence of these variables, forecast assumptions could be subject to refinement as our analysis continues.

However, the outlook for a measurable portion of Internet traffic being generated over IPv6 networks holds considerable opportunity for network operators, content providers, and end users seeking to realize the scalability and performance benefits of IPv6.

Trend 6: Metro Traffic Will Grow Faster Than Long-Haul Traffic

Metro-only traffic (traffic that traverses only the metro and bypasses long-haul traffic links) will surpass long-haul traffic in 2014, and will account for 58 percent of total IP traffic by 2017. Metro-only traffic will grow nearly twice as fast as long-haul traffic from 2012 to 2017. Long-haul traffic is also deposited onto metro networks, so that total metro traffic already exceeds long-haul traffic. In 2012, total metro traffic was 1.8 times higher than long-haul traffic, and by 2017, metro traffic will be 2.4 times higher than long-haul (Figure 9).

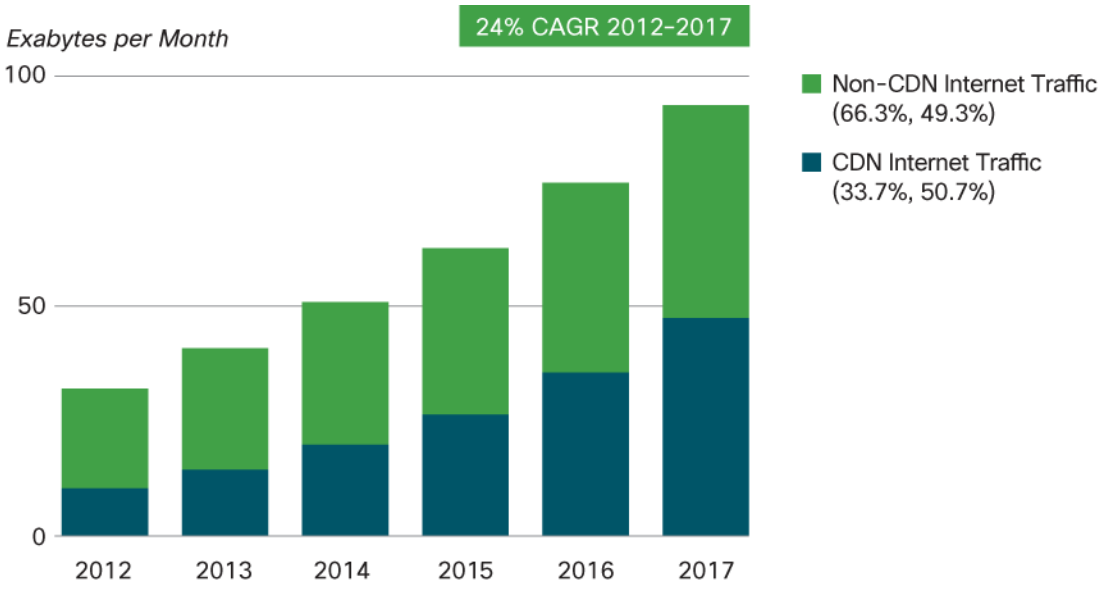
Figure 9. Metro versus Long-Haul Traffic Topology, 2012 and 2017



Source: Cisco VNI, 2013

The faster growth of metro traffic compared to long-haul is due in part to content delivery networks, which will carry over half of total Internet traffic by 2017 (Figure 10). Much of the traffic delivered by CDNs is video traffic, and two-thirds of all Internet video traffic will be carried by CDNs by 2017. While network performance is usually attributed to the speeds and latencies offered by the service provider, the delivery algorithms used by content delivery networks have an equal if not more significant bearing on video quality.

Figure 10. Content Delivery Network Internet Traffic, 2012–2017

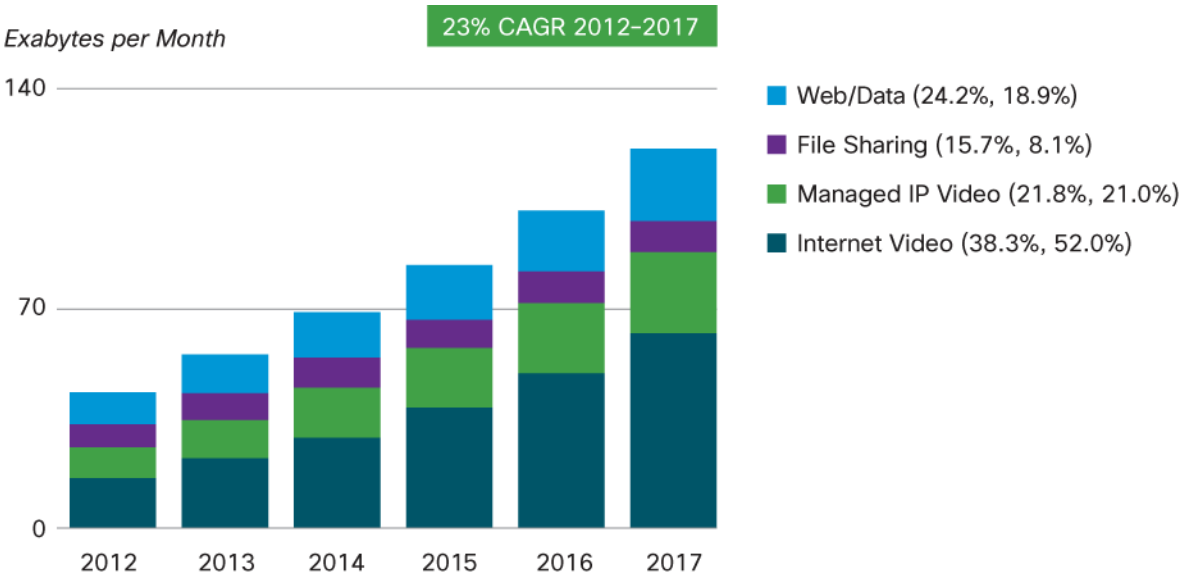


Source: Cisco VNI, 2013
The percentages within parenthesis next to the legend denote the relative traffic shares in 2012 and 2017.

Trend 7: IP Video Will Accelerate IP Traffic Growth Through 2017

The sum of all forms of IP video (Internet video, IP VoD, video files exchanged through file sharing, video-streamed gaming, and videoconferencing) will continue to be in the range of 80 to 90 percent of total IP traffic. Globally, IP video traffic will account for 73 percent of traffic in 2017. Taking a more focused definition of Internet video that excludes file sharing and gaming, Internet video will account for 52 percent of consumer IP traffic in 2017 (Figure 11).

Figure 11. Global Consumer IP Traffic



Source: Cisco VNI, 2013
The percentages within parenthesis next to the legend denote the relative traffic shares in 2012 and 2017.

The implications of video growth would be difficult to overstate. With video growth, Internet traffic is evolving from a relatively steady stream of traffic (characteristic of P2P[1]) to a more dynamic traffic pattern.

Impact of Video on Traffic Symmetry

With the exception of short-form video and video calling, most forms of Internet video do not have a large upstream component.

As a result, traffic is not becoming more symmetric as many expected when user-generated content first became popular. The emergence of subscribers as content producers is an extremely important social, economic, and cultural phenomenon, but subscribers still consume far more video than they produce. Upstream traffic has been flat as a percentage for several years, according to data from the participants in the Cisco VNI Usage program.

[1] Peer-to-peer, by definition, is highly symmetric traffic, with between 40 and 60 percent of P2P traffic consisting of upstream traffic. For every high-definition movie downloaded, approximately the same amount of traffic is uploaded to a peer. Now, with increased video traffic most of the video streams that cross the network have a highly asymmetric profile, comprised mostly of downstream traffic, except in areas where P2P TV is prevalent (in China, for example).

It appears likely that residential Internet traffic will remain asymmetric for the next few years. However, numerous scenarios could result in a move toward increased symmetry; for example:

- Content providers and distributors could adopt P2P as a distribution mechanism. There has been a strong case for P2P as a low-cost content delivery system for many years, yet most content providers and distributors have opted for direct distribution, with the exception of applications such as PPStream and PPLive in China, which offer live video streaming through P2P, and have had great success. If content providers in other regions follow suit, traffic could rapidly become highly symmetric.
- High-end video communications could accelerate, requiring symmetric bandwidth. PC-to-PC video calling is gaining momentum, and the nascent mobile video calling market appears to have promise. If high-end video calling becomes popular, traffic will move toward symmetry again.

Generally, if service providers provide ample upstream bandwidth, applications that use upstream capacity will begin to appear.

Other Trends to Watch

Cisco's approach to forecasting IP traffic is conservative, and certain emerging trends have the potential to increase the traffic outlook significantly. The most rapid upswings in traffic occur when consumer media consumption migrates from offline to online or from broadcast to unicast.

- **Applications that might migrate from offline to online (cloud)**: The crucial application to watch in this category is gaming. Gaming-on-demand and streaming gaming platforms have been in development for several years, with many newly released in 2012 or 2013. With traditional gaming, graphical processing is done locally on the gamer's computer or console. With cloud gaming, game graphics are produced on a remote server and transmitted over the network to the gamer. Currently, online gaming traffic represents only 0.04 percent of the total information content associated with online and offline game play[2]. If cloud gaming takes hold, gaming could quickly become one of the largest Internet traffic categories.
- **Behavior that might migrate from broadcast to unicast**: Live TV is currently distributed by means of a broadcast network, which is highly efficient in that it carries one stream to many viewers. Live TV over the Internet would carry a separate stream for each viewer. AT&T estimates that a shift from multicast or broadcast to over-the-top unicast "would multiply the IP backbone traffic by more than an order of magnitude".[3]
- **New consumer behavior**: The adoption of three-dimensional TV (3DTV) would fall into the category of new consumer behavior. The most likely scenario for home 3DTV is that it will take 3 to 5 years to gain momentum. However, 3DTV on the PC may gain momentum earlier, because it requires only a software decoder rather than a hardware decoder and, therefore, does not require any purchase or subscription beyond what is already paid for PC Internet access.

[2] Total game play (online and offline) in the United States represents an estimated 166 exabytes per month, according to the University of California, San Diego, study, "How Much Information?" (Visit http://hmi.ucsd.edu/howmuchinfo.php for the full report.)
[3] Alexandre Gerber and Robert Doverspike, "Traffic Types and Growth in Backbone Networks".

For More Information

For more information about Cisco's IP traffic forecast, please refer to "Cisco VNI: Forecast and Methodology, 2012–2017" and visit the other resources and updates at www.cisco.com/go/vni. Several interactive tools are available to allow users to create custom highlights and forecast charts by region, by country, by application, and by end-user segment: refer to the Cisco VNI Highlights tool and the Cisco VNI Forecast Widget tool. Inquiries can be directed to traffic-inquiries@cisco.com.

Appendix A: Cisco Global IP Traffic Forecast

Table 6 shows the summary of Cisco's global IP traffic forecast. For more information and additional tables, please refer to "Cisco VNI: Forecast and Methodology, 2012–2017."

Table 6. Table A-1 Global IP Traffic, 2012–2017

IP Traffic, 2011–2016							
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**CAGR 2012–2017**
By Type (PB per Month)							
Fixed Internet	31,339	39,295	47,987	57,609	68,878	81,818	21%
Managed IP	11,346	14,679	18,107	21,523	24,740	27,668	20%
Mobile data	885	1,578	2,798	4,704	7,437	11,157	66%
By Segment (PB per Month)							
Consumer	35,047	45,023	56,070	68,418	82,683	98,919	23%
Business	8,522	10,530	12,822	15,417	18,372	21,724	21%
By Geography (PB per Month)							
Asia Pacific	13,906	18,121	22,953	28,667	35,417	43,445	26%
North America	14,439	18,788	23,520	28,667	34,457	40,672	23%
Western Europe	7,722	9,072	10,568	12,241	14,323	16,802	17%
Central and Eastern Europe	3,405	4,202	5,167	6,274	7,517	8,844	21%
Latin America	3,397	4,321	5,201	5,975	6,682	7,415	17%
Middle East and Africa	701	1,049	1,483	2,013	2,659	3,465	38%
Total (PB per Month)							
Total IP traffic	43,570	55,553	68,892	83,835	101,055	120,643	23%

Source: Cisco VNI, 2013

Definitions

- **Consumer**: Includes fixed IP traffic generated by households, university populations, and Internet cafés
- **Business**: Includes fixed IP WAN or Internet traffic, excluding backup traffic, generated by businesses and governments
- **Mobile**: Includes Internet traffic that travels over 2G, 3G, or 4G mobile access technology
- **Internet**: Denotes all IP traffic that crosses an Internet backbone
- **Non-Internet IP**: Includes corporate IP WAN traffic, IP transport of TV and VoD, and mobile "walled-garden" traffic

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