White Paper

Entering the Zettabyte Era

June 1, 2011

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 see Cisco VNI: Forecast and Methodology, 2010–2015.

Executive Summary

Annual global IP traffic will reach the zettabyte threshold (966 exabytes or nearly 1 zettabyte) by the end of 2015. In 2015, global IP traffic will reach 966 exabytes per year or 80.5 exabytes per month.

Global IP traffic has increased eightfold over the past 5 years, and will increase fourfold over the next 5 years. Overall, IP traffic will grow at a compound annual growth rate (CAGR) of 32 percent from 2010 to 2015.

In 2015, the gigabyte equivalent of all movies ever made will cross the global Internet every 5 minutes. The global Internet networks will deliver 7.5 petabytes every 5 minutes in 2015.

The "terabyte club" will reach 6 million by 2015. In 2015, there will be 6 million Internet households worldwide generating over a terabyte per month in Internet traffic, up from just a few hundred thousand in 2010. There will be over 20 million households generating half a terabyte per month in 2015.

The number of devices connected to IP networks will be twice as high as the global population in 2015. There will be two networked devices per capita in 2015, up from one networked device per capita in 2010. Driven in part by the increase in devices and the capabilities of those devices, IP traffic per capita will reach 11 gigabytes per capita in 2015, up from 3 gigabytes per capita in 2010.

A growing amount of Internet traffic is originating with non-PC devices. In 2010, only 3 percent of consumer Internet traffic originated with non-PC devices, but by 2015 the non-PC share of consumer Internet traffic will grow to 13 percent. PC-originated traffic will grow at a CAGR of 33 percent, while TVs, tablets, smartphones and machine-to-machine (M2M) modules will have traffic growth rates of 101 percent, 216 percent, 144 percent, and 258 percent, respectively.

Traffic from wireless devices will exceed traffic from wired devices by 2015. In 2015, wired devices will account for 46 percent of IP traffic, while Wi-Fi and mobile devices will account for 54 percent of IP traffic. In 2010, wired devices accounted for the majority of IP traffic at 63 percent.

Busy-hour traffic is growing more rapidly than average traffic. Busy-hour traffic will increase fivefold by 2015, while average traffic will increase fourfold. During an average hour in 2015, the traffic will be equivalent to 200 million people streaming a high-definition video continuously. During the busy hour in 2015, the traffic will be equivalent to 500 million people streaming a high-definition video continuously.

Five major traffic milestones:

- **2012**: Internet video will surpass 50 percent of consumer Internet traffic.
- **2012**: The number of households generating over 1 terabyte per month of Internet traffic will reach 1 million.
- **2014**: One-fifth of Internet video traffic will come from TVs, handsets, and other non-PC devices.
- **2015**: Internet traffic from wireless devices will surpass the volume of traffic from wired devices.
- **2015**: The annual run rate of global IP traffic will reach the zettabyte threshold (966 exabytes).

Three major traffic generator milestones:

- **2011**: By the end of the year there will be more networked devices than people on earth.
- **2011**: Digital screen surface area will reach 1 square foot per capita.
- **2015**: There will be twice as many networked devices as people on earth.

Global Internet Video Highlights

Global Internet video traffic surpassed global peer-to-peer (P2P) traffic in 2010, and by 2012 Internet video will account for over 50 percent of consumer Internet traffic. As anticipated, as of 2010 P2P traffic is no longer the largest Internet traffic type, for the first time in 10 years. Internet video was 40 percent of consumer Internet in 2010 and will reach 50 percent by year-end 2012.

It would take over 5 years to watch the amount of video that will cross global IP networks every second in 2015. Every second, 1 million minutes of video content will cross the network in 2015.

Internet video is now 40 percent of consumer Internet traffic, and will reach 61 percent by the end of 2015, not including the amount of video exchanged through P2P file sharing. The sum of all forms of video (TV, video on demand [VoD], Internet, and P2P) will continue to be approximately 90 percent of global consumer traffic by 2015.

Internet video to TV tripled in 2010. Internet video to TV will continue to grow at a rapid pace, increasing 17-fold by 2015. Internet video to TV will be over 16 percent of consumer Internet video traffic in 2015, up from 7 percent in 2010.

Video-on-demand traffic will triple by 2015. The amount of VoD traffic in 2015 will be equivalent to 3 billion DVDs per month.

High-definition video-on-demand will surpass standard-definition VoD by the end of 2011. By 2015, high-definition Internet video will comprise 77 percent of VoD.

Global Mobile Highlights

Globally, mobile data traffic will increase 26 times between 2010 and 2015. Mobile data traffic will grow at a CAGR of 92 percent between 2010 and 2015, reaching 6.3 exabytes per month by 2015.

Global mobile data traffic will grow three times faster than fixed IP traffic from 2010 to 2015. Global mobile data traffic was 1 percent of total IP in 2010, and will be 8 percent of total IP traffic in 2015.

Regional Highlights

IP traffic is growing fastest in Latin America, followed closely by the Middle East and Africa. Traffic in Latin America will grow at a CAGR of 50 percent between 2010 and 2015.

Summary of regional growth rates:

- IP traffic in North America will reach 22 exabytes per month by 2015 at a CAGR of 30 percent.
- IP traffic in Western Europe will reach 19 exabytes per month by 2015 at a CAGR of 32 percent.
- IP traffic in Asia Pacific will reach 17 exabytes per month by 2014 at a CAGR of 35 percent.
- IP traffic in Japan will reach 5 exabytes per month by 2015 at a CAGR of 27 percent.
- IP traffic in Latin America will reach 4.7 exabytes per month by 2015 at a CAGR of 48 percent.
- IP traffic in Central and Eastern Europe will reach 3.7 exabytes per month by 2015 at a CAGR of 39 percent.
- IP traffic in the Middle East and Africa will reach 2 exabytes per month by 2015 at a CAGR of 52 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: see the Cisco VNI Highlights tool and the Cisco VNI Forecast tool.

Global Business Highlights

Business IP traffic will grow at a CAGR of 24 percent from 2010 to 2015. Increased adoption of advanced video communications in the enterprise segment will cause business IP traffic to grow by a factor of 2.7 between 2010 and 2015.

Business Internet traffic will grow at a faster pace than IP WAN. IP WAN will grow at a CAGR of 18 percent, compared to a CAGR of 19 percent for fixed business Internet and 79 percent for mobile business Internet.

Business video conferencing will grow sixfold over the forecast period. Business videoconferencing traffic is growing significantly faster than overall business IP traffic, at a CAGR of 41 percent from 2010–2015.

Web-based video conferencing will reached 50 percent of total business video conferencing traffic in 2010. Web-based video conferencing will grow faster than average business video conferencing, at a CAGR of 45 percent.

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 30 percent, a faster pace than the global average of 24 percent. In volume, North America will have the largest amount of business IP traffic in 2015 at 2.9 exabytes per month. Western Europe will be a close second to North America at 2.7 exabytes per month.

Five Milestones by 2015

In 2005, when Cisco began forecasting network traffic, YouTube had just launched, the average broadband speed was under 1 Mbps, and P2P file sharing was nearly two-thirds of consumer Internet traffic. Five years later, in 2010, Internet video has surpassed P2P as the largest consumer Internet traffic category, YouTube traffic has already been surpassed by new forms of Internet video, and the global average broadband speed has reached 7 Mbps.

What can we expect in the next five years? Video will continue to gain traffic share and will transform the nature of the network in new ways as the video mix evolves towards real-time video content and applications. In addition to video, there is now evidence of a second transformation that will bolster growth and alter the dynamic of network traffic. This second transformation is not to be found in the network application mix, but rather in how we interface with the network, through a rapidly increasing and diversifying body of network devices.

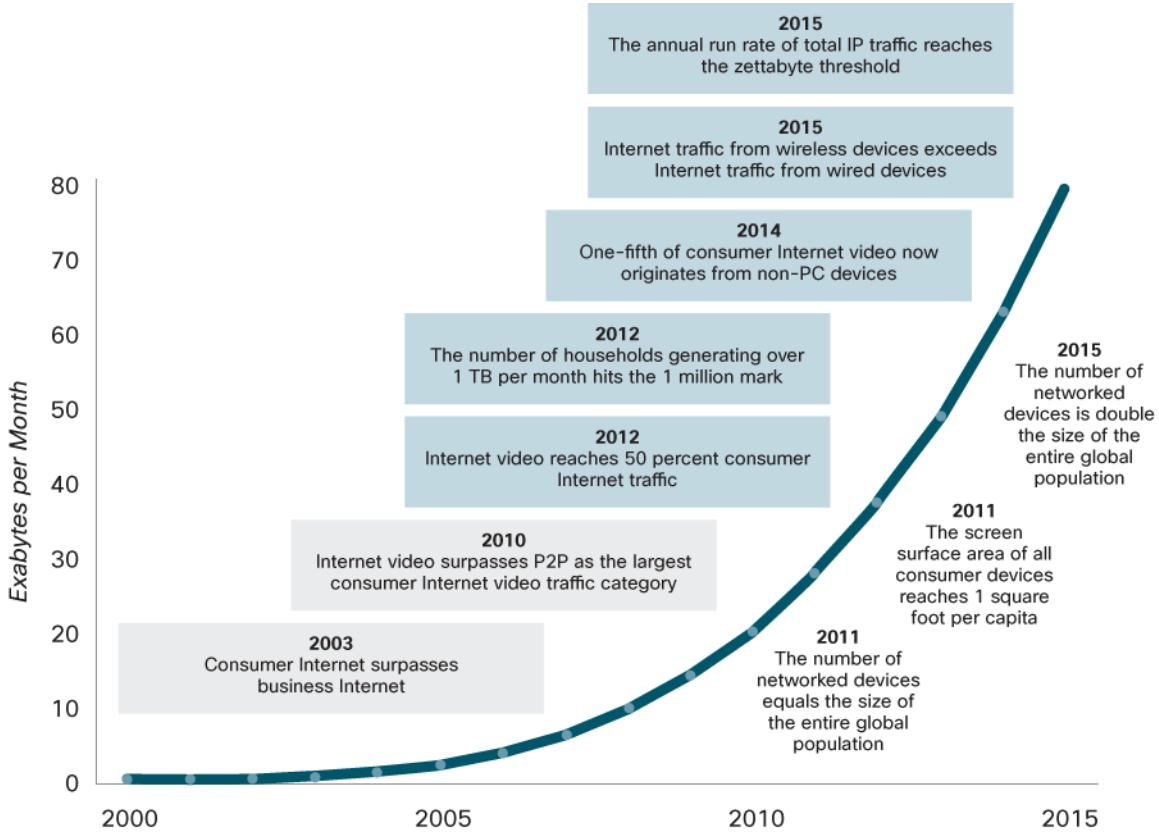
The following five milestones (illustrated in Figure 1) measure overall traffic growth and mark major shifts in the global IP application and device mix.

- **2012**: Internet video will surpass 50 percent of consumer Internet traffic.
- **2012**: The number of households generating over 1 terabyte per month of Internet traffic will reach 1 million.
- **2014**: One-fifth of Internet video traffic will come from TVs, handsets, and other non-PC devices.
- **2015**: Internet traffic from wireless devices will surpass the volume of traffic from wired devices.
- **2015**: The annual run rate of global IP traffic will reach the zettabyte threshold (966 exabytes).

In addition to the five traffic milestones, three milestones are related to crucial traffic generators.

- **2011**: By the end of the year there will be more networked devices than people on earth.
- **2011**: Digital screen surface area will reach 1 square foot per capita
- **2015**: There will be twice as many networked devices as people on earth.

Figure 1. Five Traffic Milestones and Three Traffic Generator Milestones by 2015



Source: Cisco VNI, 2011

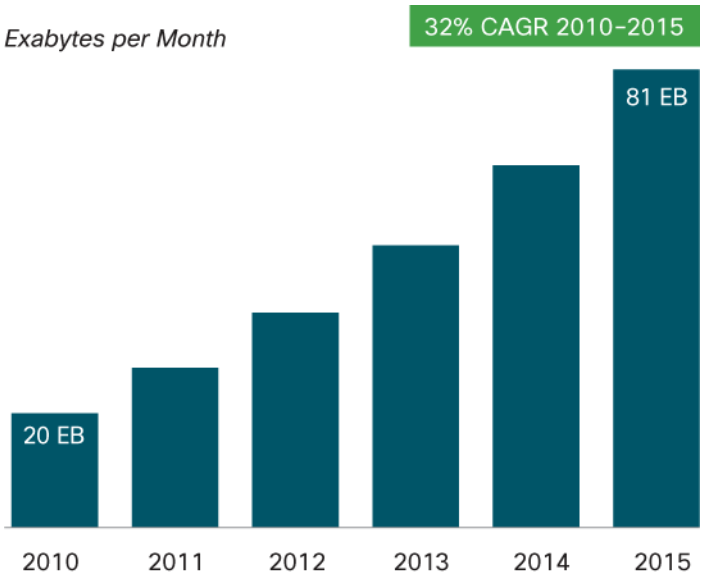
There will be an unprecedented increase in the number of devices on the network, and the traffic balance will begin to shift away from traditional PCs and towards TVs, phones, tablets, and other devices. In a related trend, the device mix is becoming increasingly portable, and traffic originating from Wi-Fi devices will surpass traffic from wired devices in 2015. The volume of traffic will continue to grow, generated largely by video, and Internet video will officially reach the 50 percent mark in 2012.

After a brief introduction to the main conclusions of this year's forecast, each of the five milestones will be discussed in turn.

Forecast Overview

The current Visual Networking Index forecast projects global IP traffic to quadruple from 2010 to 2015. As Figure 2 shows, overall IP traffic is expected to grow to 81 exabytes per month by 2015, up from 20 exabytes per month in 2010, a CAGR of 32 percent.

Figure 2. Cisco VNI Forecasts 81 Exabytes per Month of IP Traffic in 2015



Source: Cisco VNI, 2011

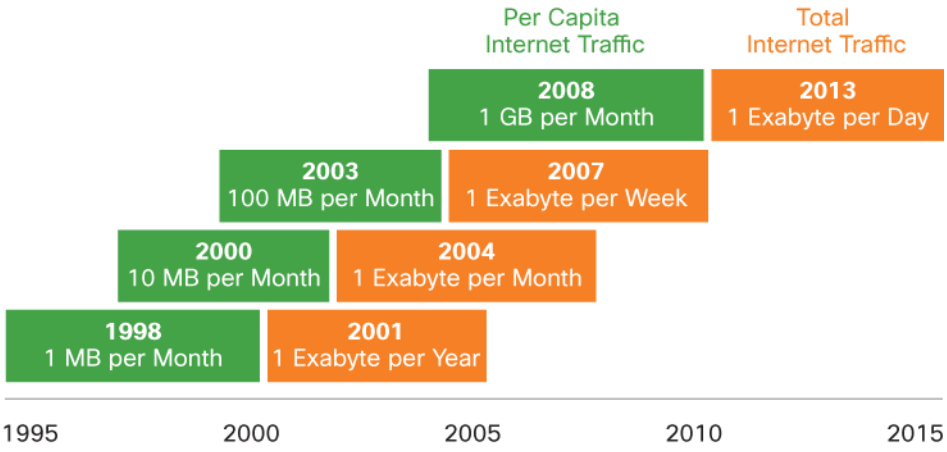
For more details on Cisco's forecasting methodology, see the paper entitled "Cisco VNI: Forecast and Methodology, 2010–2015."

Aggregate IP traffic volumes have gone far beyond the realm of personal experience. To appreciate the magnitude of these numbers, it helps to put them in more familiar terms.

- In 2015, the gigabyte equivalent of all movies ever made will cross Global IP networks every 4 minutes.
- In 2015, the gigabyte equivalent of all movies ever made will cross the Global Internet every 5 minutes.
- Globally, IP traffic will reach 245 Tbps in 2015, the equivalent of 204,100,000 people streaming Internet high-definition video simultaneously, all day, every day.
- Global IP traffic in 2015 will be equivalent to 241 billion DVDs per year, 20 billion DVDs per month, or 28 million DVDs per hour.

Globally, Internet traffic will reach 9 gigabytes per capita in 2015, up from 2 gigabytes per capita in 2010. 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. Figure 3 provides a view of the historical benchmarks for per capita Internet traffic.

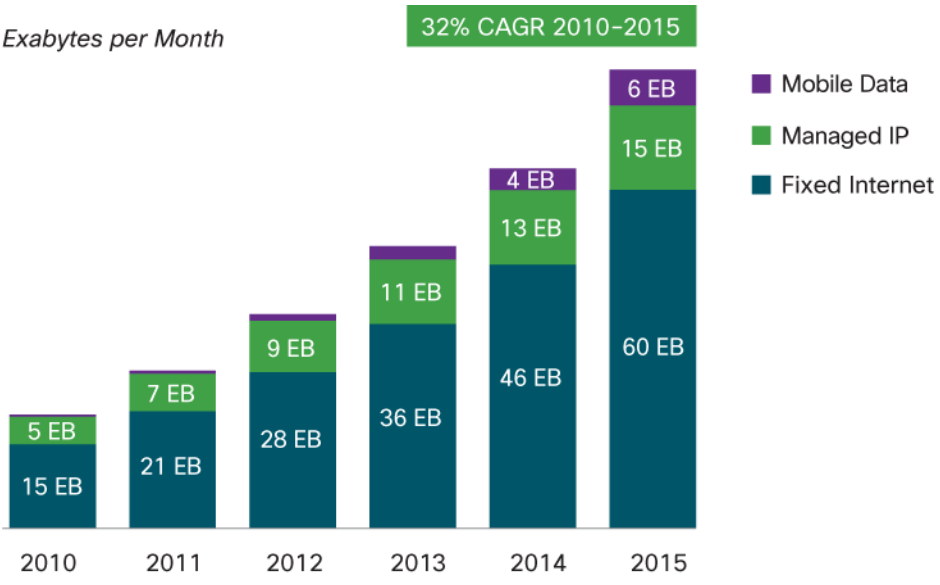
Figure 3. The VNI Forecast Within Historical Context



Source: Cisco VNI, 2011

Most IP traffic growth results from growth in Internet traffic, compared to managed IP traffic. Of the 80.5 total exabytes, 60 are due to fixed Internet and 6 are due to mobile Internet. Fixed and mobile Internet traffic, in turn, are propelled by video.

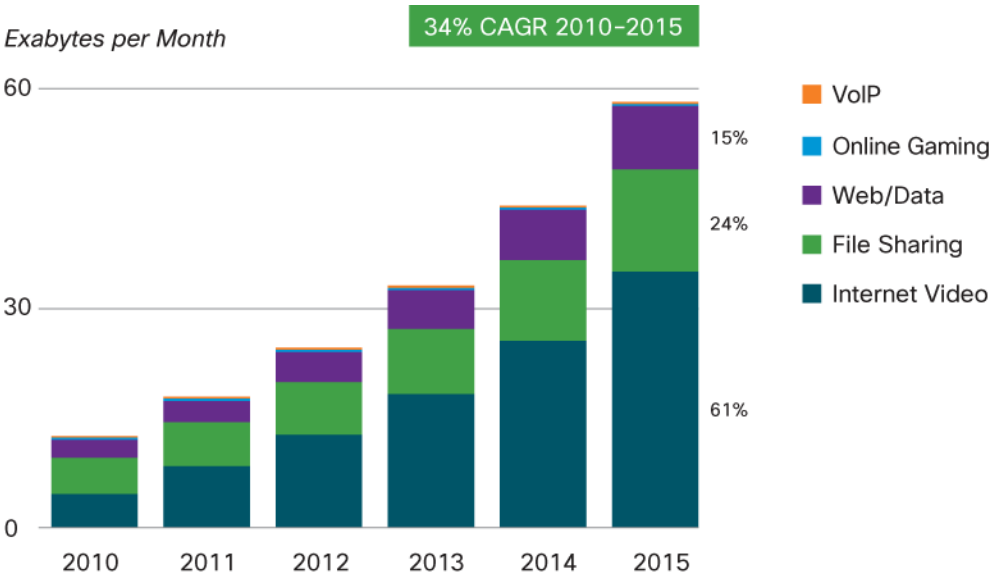
Figure 4. Cisco VNI Global IP Traffic Forecast



Source: Cisco VNI, 2011

As in previous forecasts, the sum of all forms of IP video (Internet video, IP VoD, video files exchanged through file sharing, video-streamed gaming, and video conferencing) will ultimately reach 90 percent of total IP traffic. Taking a more narrow definition of Internet video that excludes file sharing and gaming, Internet video will account for 61 percent of consumer Internet traffic in 2015 (Figure 5).

Figure 5. Global Consumer Internet Traffic



Online gaming and VoIP forecast to be 0.79% of all consumer Internet traffic in 2015.
Source: Cisco VNI, 2011

Internet video will reach 50 percent of consumer Internet traffic by year end 2012, which brings us to our first milestone.

Traffic Milestone 1: Internet Video Will Surpass 50 Percent of Consumer Internet Traffic (2012)

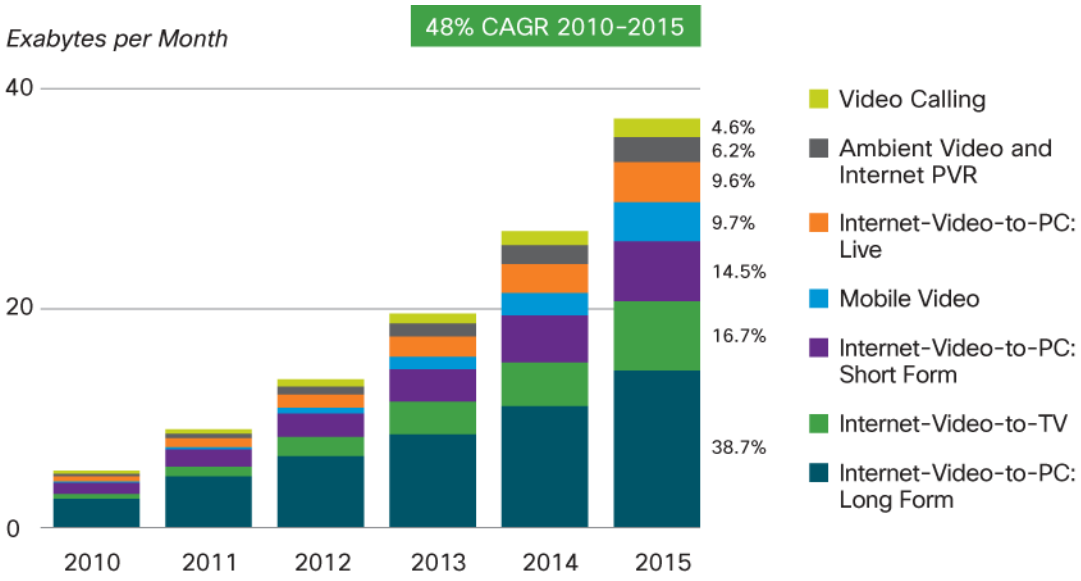
Internet video will officially reach the halfway mark of consumer Internet traffic by the end of 2012. The implications of video growth would be difficult to overstate. With video growth, Internet traffic is evolving from a relatively steady stream of traffic (characteristic of P2P[1]) to a more dynamic traffic pattern.

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. With video, the Internet now has a much busier busy hour. The growing gap between peak and average traffic is amplified further by the changing composition of Internet video. As shown in Figure 6, real-time video such as live video, ambient video, and video calling are taking an ever greater share of video traffic. Real-time video has a peak-to-average ratio that is higher than on-demand video.

Busy-hour Internet traffic will quintuple between 2010 and 2015, while average Internet traffic will quadruple. Busy-hour Internet use will grow at a CAGR of 39 percent, compared to 34 percent for average Internet traffic. Average Internet traffic will be the equivalent of 165 million people streaming Internet high-definition video simultaneously and continuously throughout the month, while busy-hour traffic will be the equivalent of 430 million people streaming Internet high-definition video simultaneously and continuously throughout the hour.

[1] Peer-to-peer, by definition, is highly symmetric traffic, with between 40 to 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).

Figure 6. Global Consumer Internet Video Traffic



Source: Cisco VNI, 2011

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.

It appears likely that residential Internet traffic will remain asymmetric for the next few years. However, there are a number of scenarios that could result in a move toward increased symmetry.

- 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, this will move traffic toward symmetry again.

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

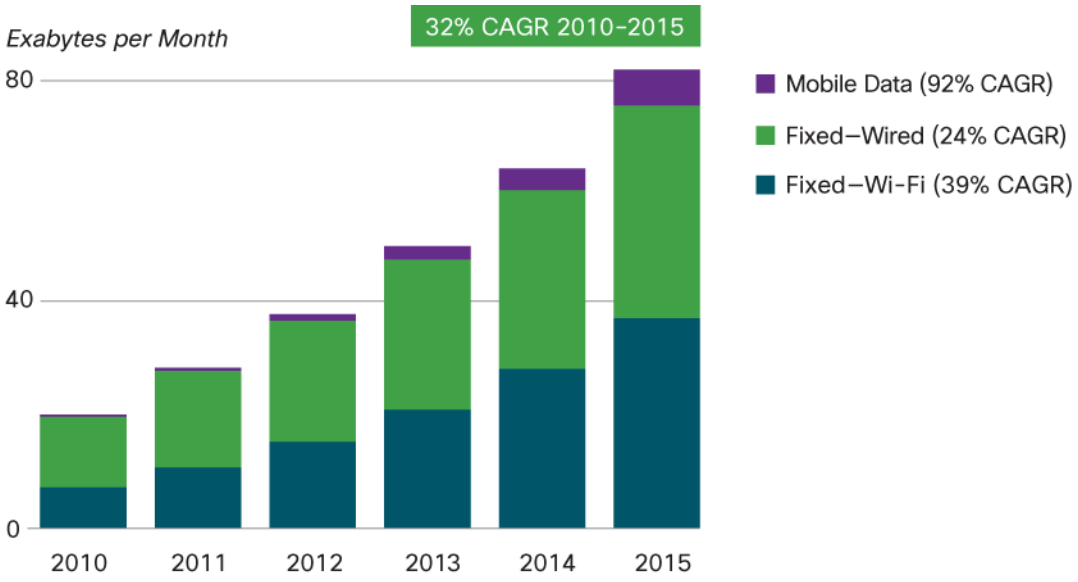
Traffic Milestone 2: One-Fifth of Internet Video Traffic Will Come from TVs, Handsets, and Other Non-PC Devices (2014)

At the end of 2010, 92 percent of Internet video traffic originated from PCs. By 2014, one-fifth of Internet video traffic will originate from non-PC devices, and by 2015 the proportion of traffic from PCs will be 79 percent. 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.

Traffic Milestone 3: Internet Traffic from Wireless Devices Will Surpass the Volume of Traffic from Wired Devices (2015)

The rapid growth of mobile data traffic has been widely recognized and reported. The trend towards 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 7 shows the growth of wireless and mobile traffic in relation to traffic from wired devices.

Figure 7. Global IP Traffic, Wired and Wireless



Source: Cisco VNI, 2011

The increasing use of portable devices, even those not currently providing mobile access, creates even greater potential for traffic migration from fixed to mobile devices. Portable devices also increase overall traffic by increasing the contact time with the network.

Traffic Milestone 4: The Number of Households Generating over 1 Terabyte per Month of Internet Traffic Will Reach 1 million (2012)

Globally, the average Internet household will generate 62 gigabytes of Internet traffic per month in 2015, up from 17 gigabytes per month in 2010. There is no such thing as an average household when it comes to Internet traffic, however. The top 1 percent of broadband connections generate over 20 percent of the traffic, and the top 10 percent generate over 60 percent of the traffic. The remaining 90 percent have a lower usage profile, creating 8 gigabytes per month of Internet traffic in 2010 and 27 gigabytes per month in 2015.

As service providers attempt to control traffic through the use of traffic limits and tiered packages, it is important to understand how many households will fall into various tiers. Extrapolating from current usage, a hypothetical tier of 50 gigabytes per month would affect over 20 percent of households in 2015. Even in 2010, such a tier would affect over 9 percent of Internet households. A hypothetical tier of 200 gigabytes per month would affect over 8 percent of households in 2015. A tier of 1 terabyte per month would affect the top 1 percent of households.

It is striking that the top 1 percent will be generating 1 terabyte per month in 2015, up from 250 gigabytes per month in 2010. Table 1 shows the number of Internet households that will fall above various benchmarks of average use.

Table 1. Internet Households by Traffic per Month, 2010–2015

Households by Average Traffic per Month							
	2010	2011	2012	2013	2014	2015	CAGR
Number of Households by Traffic per Month (Millions of Households)							
Households generating more than 50 GB per month	62	79	105	126	150	175	23%
Households generating more than 100 GB per month	35	49	61	77	103	125	29%
Households generating more than 200 GB per month	9	19	33	44	58	72	52%
Households generating more than 500 GB per month	3	4	6	8	11	21	48%
Households generating more than 1 TB per month	–	–	2	3	5	6	–
Number of Households as a Percentage of Total Internet Households							
Households generating more than 50 GB per month	9.4%	11.2%	14.1%	16.3%	18.9%	21.5%	–
Households generating more than 100 GB per month	5.3%	6.9%	8.2%	10.0%	13.0%	15.3%	–
Households generating more than 200 GB per month	1.4%	2.7%	4.4%	5.8%	7.4%	8.8%	–
Households generating more than 500 GB per month	0.4%	0.6%	0.8%	1.0%	1.4%	2.6%	–
Households generating more than 1 TB per month	0.0%	0.0%	0.2%	0.4%	0.6%	0.7%	–

Source: Cisco VNI, 2011

Traffic Milestone 5: The Annual Run Rate of IP traffic Will Nearly Reach 1 Zettabyte per Year (2015)

At the end of 2015, global IP traffic will reach an annual run rate of 966 exabytes per month, and is poised to cross the zettabyte threshold (1,000 exabytes) shortly thereafter.

Promoters of IP Traffic Growth

Several essential factors are creating a technology landscape conducive for IP traffic growth.

- **Increasing number and diversity of devices**: The number of networked devices will reach 1 per capita in 2011 and 2 per capita in 2015.
- **Increasing screen space**: Multiscreen surface area will increase to 8 billion square feet by 2015.
- **Increasing broadband speed**: The average global residential Internet connection download speed will grow fourfold from 2010 to 2015, from 7.0 Mbps to 28 Mbps.
- **Increasing computing power**: Multicore systems continue to increase their share of computing platforms, and each core has the potential to generate as much traffic as a single PC.

Networked Devices

The proliferation of networked devices will lead the network to reach two major milestones during the forecast period.

- **2011**: By the end of the year there will be more networked devices than people on earth.
- **2015**: There will be twice as many networked devices as people on earth.

Each new device increases the potential amount of time and number of ways a user can connect to the network. Tablets are being used as secondary personal television screens, both in the home and on the move. Televisions, set-top boxes, and other consumer electronics are increasingly web-enabled. Specialized devices such as Internet-enabled digital picture frames can draw content directly from the network. In some parts of the world, mobile devices are used as mobile hotspots, allowing any number of devices to connect to the network.

The cumulative effect of new devices and the diversification of network devices is to increase network usage and traffic, but also to increase the complexity of network operations and business models. Service providers are faced with the task of managing, authenticating, securing, and delivering content to a bewildering array of devices. Service providers also encounter the opportunity to create new broadband and content packages tailored to the multidevice user.

Screen Space

With the cost of large LCD screens continuing to decline, consumers and businesses alike can afford to expand the number and size of their digital screens. The increased global adoption of flat-panel screens also allows residential consumers and business users to expand their screen surface area without sacrificing floor space.

In addition to acquiring more and larger TV and PC screens, digital screens are proliferating along with other consumer devices: e-book readers, handheld gaming consoles, large-screen mobile handsets, in-vehicle GPS display screens, digital picture frames, picoprojectors, videoconferencing screens, IP phone screens, and digital advertising and sales displays. The total surface area of all digital screens across the world in 2015 will be 1.4 times what it was at the end of 2010. There will be 1.3 square feet of screen space per capita in 2015.

Table 2. Growing Screen Surface Area, 2009–2015

Households by Broadband Speed							
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Total screen surface area (in millions of square feet)	6,262	6,853	7,475	7,883	8,478	9,112	9,876
Total screen surface area (in millions of square meters)	582	637	694	732	788	846	918
Screen surface area per capita (in square feet)	0.90	0.98	1.05	1.10	1.17	1.24	1.33
Screen surface area per capita (in square centimeters)	839	908	979	1,020	1,084	1,152	1,236

The screen space forecast shown above is for all devices with screens, including devices that are not network-connected. Network-connected screen space grows faster than the total screen space.

Source: Cisco VNI, 2011

Broadband Speed

Broadband speed is another 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 quadruple from 2010 to 2015, from 7.0 Mbps to 28 Mbps. In addition, 3 percent of households in 2015 will have broadband speeds greater than 100 Mbps. 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 number of households with broadband speeds above various benchmarks.

Table 3. Households by Broadband Speed, 2010–2015

Households by Broadband Speed							
	2010	2011	2012	2013	2014	2015	CAGR
Number of Households by Average Traffic per Month (Millions of Households)							
Households with greater than 5 Mbps	272	321	375	432	491	553	15%
Households with greater than 10 Mbps	162	191	222	257	292	328	15%
Households with greater than 50 Mbps	26	32	38	45	52	60	18%
Households with greater than 100 Mbps	5	7	9	12	16	21	33%
Number of Households as a Percentage of Total Internet Households							
Households with greater than 5 Mbps	41%	45%	50%	56%	62%	68%	–
Households with greater than 10 Mbps	24%	27%	30%	33%	37%	40%	–
Households with greater than 50 Mbps	4%	4%	5%	6%	7%	7%	–
Households with greater than 100 Mbps	1%	1%	1%	2%	2%	3%	–

Source: Cisco VNI, 2011

Trends to Watch

Cisco's approach to forecasting IP traffic is conservative, and there are certain emerging trends that 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 2010 or 2011. 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 0.03 percent of the total information content associated with online and offline gameplay[2]. If cloud gaming takes hold, gaming could quickly become one of the largest Internet traffic categories.

[2] Total gameplay (online and offline) in the United States represents an estimated 166 exabytes per month, according to the University of California, San Diego's "How Much Information?" study. (See http://hmi.ucsd.edu/howmuchinfo.php for the full report, published in 2009.) The VNI estimate for online gaming traffic in the U.S. is 47 petabytes per month at the end of 2010.

- **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.

For More Information

For more information on Cisco's IP traffic forecast, please see Cisco VNI: Forecast and Methodology, 2010–2015 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: see the Cisco VNI Highlights tool and the Cisco VNI Forecast tool. Inquiries can be directed to traffic-inquiries@cisco.com.

[3] Alexandre Gerber and Robert Doverspike, "Traffic Types and Growth in Backbone Networks."

Appendix A: Cisco's Global IP Traffic Forecast

Table 4 shows the summary of Cisco's global IP traffic forecast. For more information and additional tables, please see Cisco VNI: Forecast and Methodology, 2010–2015.

Table 4. Global IP Traffic, 2010–2015

IP Traffic, 2010–2015							
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**CAGR 2010–2015**
By Type (PB per Month)							
Fixed Internet	14,955	20,650	27,434	35,879	46,290	59,354	32%
Managed IP	4,989	6,839	9,014	11,352	13,189	14,848	24%
Mobile data	237	546	1,163	2,198	3,806	6,254	92%
By Segment (PB per Month)							
Consumer	16,221	23,130	31,592	42,063	54,270	70,045	34%
Business	3,930	4,894	6,011	7,357	8,997	10,410	22%
By Geography (PB per Month)							
North America	6,998	9,947	12,978	16,116	18,848	22,274	26%
Western Europe	4,776	6,496	8,819	11,774	15,187	18,858	32%
Asia Pacific	5,368	7,317	9,847	13,341	18,060	24,150	35%
Japan	1,414	1,923	2,540	3,283	4,019	4,762	27%
Latin America	665	993	1,465	2,158	3,238	4,681	48%
Central and Eastern Europe	708	1,004	1,413	1,955	2,700	3,713	39%
Middle East and Africa	253	366	550	802	1,235	2,019	52%
Total (PB per Month)							
Total IP traffic	20,151	28,023	37,603	49,420	63,267	80,456	32%

Source: Cisco VNI, 2011

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

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at **www.cisco.com/go/offices.**

Printed in USA

FLGD 09748 06/11