Exhibit E: The Zettabyte Era—Trends and Analysis—Cisco

Visual Networking Index (VNI)

The Zettabyte Era—Trends and Analysis

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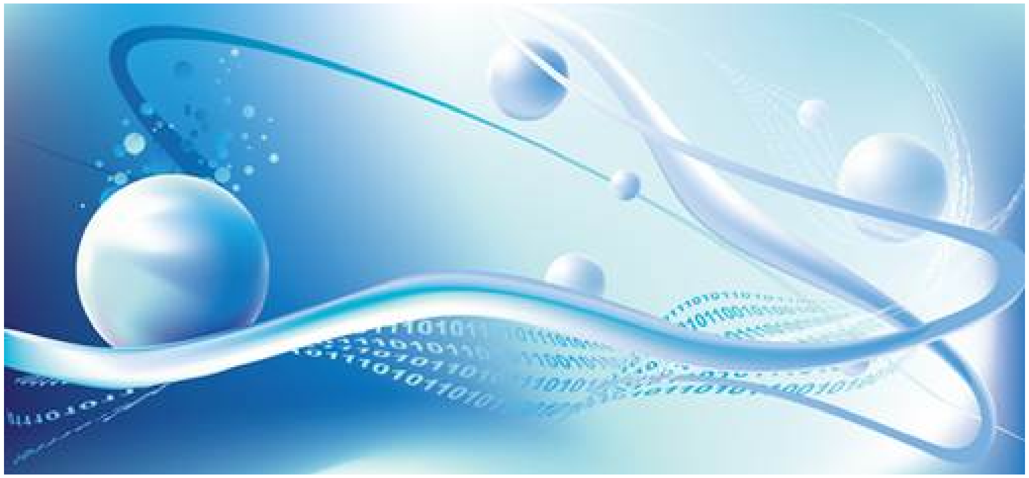


June 10, 2014

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, visit Cisco VNI: Forecast and Methodology,

2013–2018.

Executive Summary

Annual global IP traffic will pass the zettabyte (1000 exabytes) threshold by the end of2016, and will reach1.6 zettabytes per year by 2018. In 2016, global IP traffic will reach 1.1 zettabytes per year or 91.3 exabytes (one billion gigabytes) per month, and by 2018, global IP traffic will reach 1.6 zettabytes per year or 131.9exabytes per month.

Global IP traffic has increased fivefold over the past 5 years, and will increase threefold over thenext 5years. Overall, IP traffic will grow at a compound annual growth rate (CAGR) of 21 percent from 2013to2018.

Busy-hour Internet traffic is growing more rapidly than average Internet traffic. Busy-hour (or the busiest 60-minute period in a day) Internet traffic increased 32 percent in 2013, compared with 25 percent growth in average traffic. Busy-hour Internet traffic will increase by a factor of 3.4 between 2013 and 2018, while average Internet traffic will increase 2.8-fold. Busy-hour Internet traffic will reach 1.0 petabits per second (Pbps) in 2018, while average Internet traffic will reach 311 terabits per second.

Metro traffic will surpass long-haul traffic in 2015, and will account for 62 percent of total IP traffic by 2018.Metro traffic will grow nearly twice as fast as long-haul traffic from 2013 to 2018. The higher growth in metronetworks 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 will carry more than half of Internet traffic by 2018. Fifty-five percent of allInternet traffic will cross content delivery networks by 2018 globally, up from 36 percent in 2013.

Over half of all IP traffic will originate with non-PC devices by 2018. In 2013, only 33 percent of total IPtraffic originated with non-PC devices, but by 2018 the non-PC share of total IP traffic will growto 57percent. PC-originated traffic will grow at a CAGR of 10 percent, while TVs, tablets, smartphones, andmachine-to-machine (M2M) modules will have traffic growth rates of 35 percent, 74 percent, 64 percent, and84percent, respectively.

Traffic from wireless and mobile devices will exceed traffic from wired devices by 2016. By 2016, wired devices will account for 46 percent of IP traffic, while Wi-Fi and mobile devices will account for 54 percent of IPtraffic. In 2013, wired devices accounted for the majority of IP traffic at 56 percent.

Global Internet traffic in 2018 will be equivalent to 64 times the volume of the entire global Internet in 2005. Globally, Internet traffic will reach 14 gigabytes (GB) per capita by 2018, up from 5 GB per capita in 2013.

The number of devices connected to IP networks will be nearly twice as high as the global population by2018. There will be nearly three networked devices per capita by 2018, up from nearly two networked devices per capita in 2013. Accelerated in part by the increase in devices and the capabilities of those devices, IP traffic percapita will reach 17 GB per capita by 2018, up from 7 GB per capita in 2013.

Broadband speeds will nearly triple by 2018. By 2018, global fixed broadband speeds will reach 42 Mbps, upfrom 16 Mbps in 2013.

Global Internet Video Highlights

It would take an individual more than 5 million years to watch the amount of video that will cross global IPnetworks each month in2018. Every second, nearly a million minutes of video content will cross the network by 2018.

Globally, IP video traffic will be 79 percent of all IP traffic (both business and consumer) by 2018, up from 66 percent in 2013. This percentage does not include the amount of video exchanged through peer-to-peer (P2P) filesharing. The sum of all forms ofvideo (TV, video on demand [VoD], Internet, and P2P) will continue to be in the range of 80 to 90 percent ofglobal consumer traffic by 2018.

Internet video to TV grew 35 percent in 2013. It will continue to grow at a rapid pace, increasing fourfoldby 2018. Internet video to TV will be 14 percent of consumer Internet video traffic in 2018, up from 11 percent in2013.

Consumer VoD traffic will double by 2018. The amount of VoD traffic in 2018 will be equivalent to 6 billion DVDsper month.

Content delivery network traffic will deliver over half of all Internet video traffic by 2018. By2018, 67 percent of all Internet video traffic will cross content delivery networks, up from 53 percent in2013.

Global Mobile Highlights

Globally, mobile data traffic will increase 11-fold between 2013 and 2018. Mobile data traffic will grow at aCAGR of 61 percent between 2013 and 2018, reaching 15.9 exabytes per month by 2018.

Global mobile data traffic will grow three times faster than fixed IP traffic from 2013 to 2018. Global mobile data traffic was 3 percent of total IP traffic in 2013, and will be 12 percent of total IP traffic by 2018.

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 2013 and 2018.

Summary of regional growth rates:

- IP traffic in North America will reach 40.5 exabytes per month by 2018 at a CAGR of 20 percent.
- IP traffic in Western Europe will reach 19.3 exabytes per month by 2018 at a CAGR of 18 percent.

- IP traffic in Asia Pacific will reach 47.3 exabytes per month by 2018 at a CAGR of 21 percent.
- IP traffic in Latin America will reach 8.9 exabytes per month by 2018 at a CAGR of 21 percent.
- IP traffic in Central and Eastern Europe will reach 10.2 exabytes per month by 2018 at a CAGR of23percent.
- IP traffic in the Middle East and Africa will reach 5.3 exabytes per month by 2018 at a CAGR of 38 percent.

Note: Several interactive tools are available to allow you 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 andthe Cisco VNI Forecast Widget tool).

Global Business Highlights

Business IP traffic will grow at a CAGR of 18 percent from 2013 to 2018. Increased adoption of advanced video communications in the enterprise segment will cause business IP traffic to grow by a factor of two between 2013 and2018.

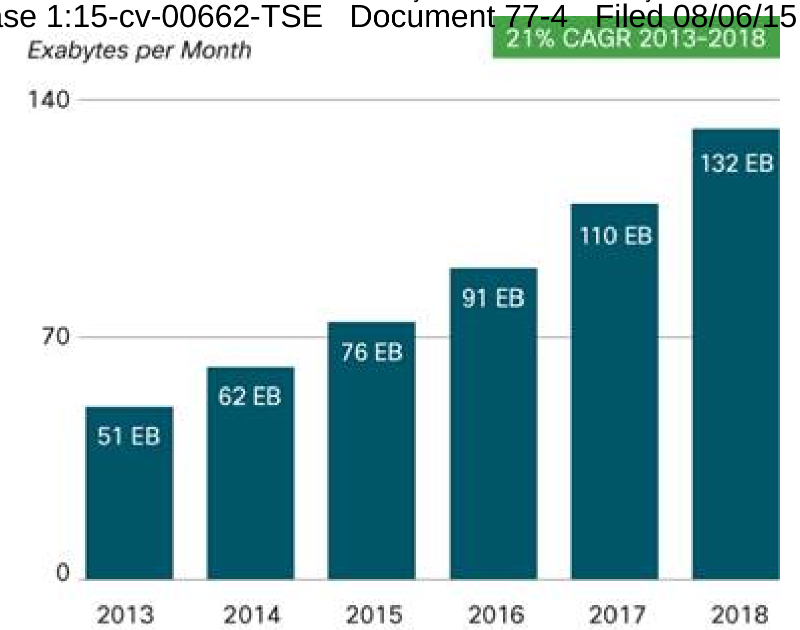
Business Internet traffic will grow at a faster pace than IP WAN. IP WAN will grow at a CAGR of 10 percent, compared with a CAGR of 18 percent for fixed business Internet and 55 percent for mobile business Internet.

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 23 percent, a faster pace than the global average of 18 percent. In volume, Asia Pacific will have the largest amount of business IP traffic in 2018 at 8.5 exabytes per month. North America willbethe second at 6.2 exabytes per month.

Forecast Overview

The current Visual Networking Index forecast projects global IP traffic to nearly triple from 2013 to 2018. SeeAppendixA for a detailed summary. Overall IP traffic is expected to grow to 132 exabytes per month by2018,up from 51 exabytes per month in 2013, a CAGR of 21 percent (Figure 1).

Figure 1. Cisco VNI Forecasts 132 Exabytes per Month of IP Traffic by 2018



Source: Cisco VNI, 2014

For more details about Cisco's forecasting methodology, refer to the paper entitled "Cisco VNI: Forecast and Methodology, 2013–2018."

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

- By 2018, the gigabyte equivalent of all movies ever made will cross the global Internet every 3 minutes.
- Globally, IP traffic will reach 400 terabits per second (Tbps) in 2018, the equivalent of 148 million people streaming Internet HD video simultaneously, all day, every day.
- Global IP traffic in 2018 will be equivalent to 395 billion DVDs per year, 33 billion DVDs per month, or45million DVDs per hour.

Total Internet traffic has experienced dramatic growth the past two decades. More than twenty years ago, in 1992, global Internet networks carried approximately 100 GB of traffic per day. Ten years later, in 2002, global Internet traffic amounted to 100 gigabytes per second (GBps). In 2012, global Internet traffic reached 12,000 GBps. Table1provides a view of the historical benchmarks for total Internet traffic.

Table 1. The Cisco VNI Forecast Within Historical Context

Year	Global Internet Traffic
1992	100 GB per Day

1997	100 GB per Hour
2002	100 GBps
2007	2000 GBps
2013	28,875 GBps
2018	50,000 GBps

Source: Cisco VNI, 2014

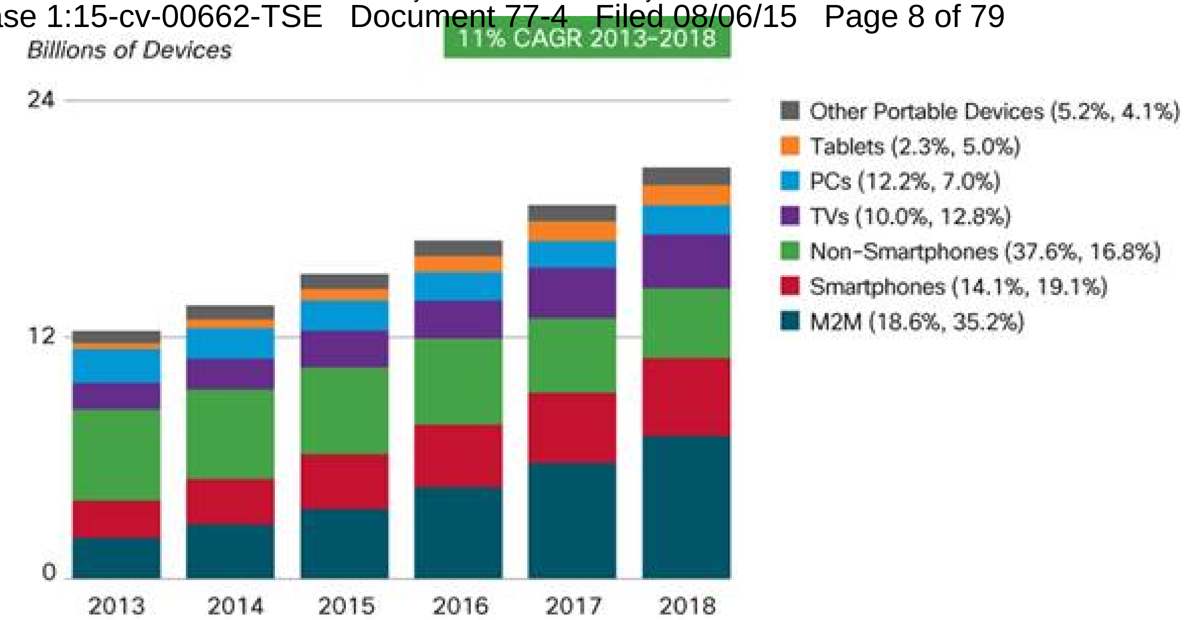
Per capita IP and Internet traffic growth has followed a similarly steep growth curve over the past decade. Globally, IP traffic will reach 17 GB per capita by 2018, up from 7 GB per capita in 2013, and Internet traffic will reach 14 GB per capita by 2018, up from 5 GB per capita in 2013. Not longago, in 2008, percapita Internet traffic was 1 GB per month. In 2000, per capita Internet traffic was 10megabytes (MB) per month.

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

Trend 1: Device Transitions Alter Network Demand or Use

Globally, devices and connections (10.7 percent CAGR) are growing faster than both the population (1.1 percent CAGR) and Internet users (9.2 percent CAGR). See Figure 2. This trend is accelerating the increase in the average number of devices and connections per household and per Internet user. Each year, various new devices in different form factors with increased capabilities and intelligence are introduced and adopted in the market. Agrowing number of M2M applications, such as smart meters, video surveillance, healthcare monitoring, transportation, and package or asset tracking, also are causing connection growth.

Figure 2. Global Devices and Connections Growth



Source: Cisco VNI, 2014
The percentages in parentheses next to the legend denote the device share for the years 2013 and 2018, respectively.

Tablets are the fastest-growing device category with 29 percent CAGR (3.6-fold growth) over the forecast period, followed by machine-to-machine (M2M) connections with 26 percent CAGR (threefold growth). Device categories such as non-smartphones are actually going to start seeing a decline over the forecast period, increasingly being replaced by smartphones, which will more than double at 18 percent CAGR over the forecast period. Connected TVs, which includes flat-panel TVs, set-top boxes, digital media adapters, Blu-ray disc players, and gaming consoles) will double to 2.6 billion by 2018. PCs will also decline by 1 percent CAGR over the forecast period. Thisdecline is more pronounced in Western Europe and North America. More tablets than laptops will be in use bythe end of 2018.

Consumer share of the total devices, including the fixed and the mobile, is going to be about 80 percent, withbusiness claiming the remaining 20 percent. Consumer share is going to grow slightly faster, at an 11percentCAGR relative to the business segment, which is going to grow at a 9 percent CAGR. For more detailsabout devices and connections growth by residential, consumer mobile, and business segments, refer tothe Cisco VNI Service Adoption Forecast, 2013–2018.

Globally, the average number of devices and connections per capita is going to grow from 1.7 in 2013 to 2.7 by2018 (Table 2).

Table 2. Average Number of Devices and Connections per Capita

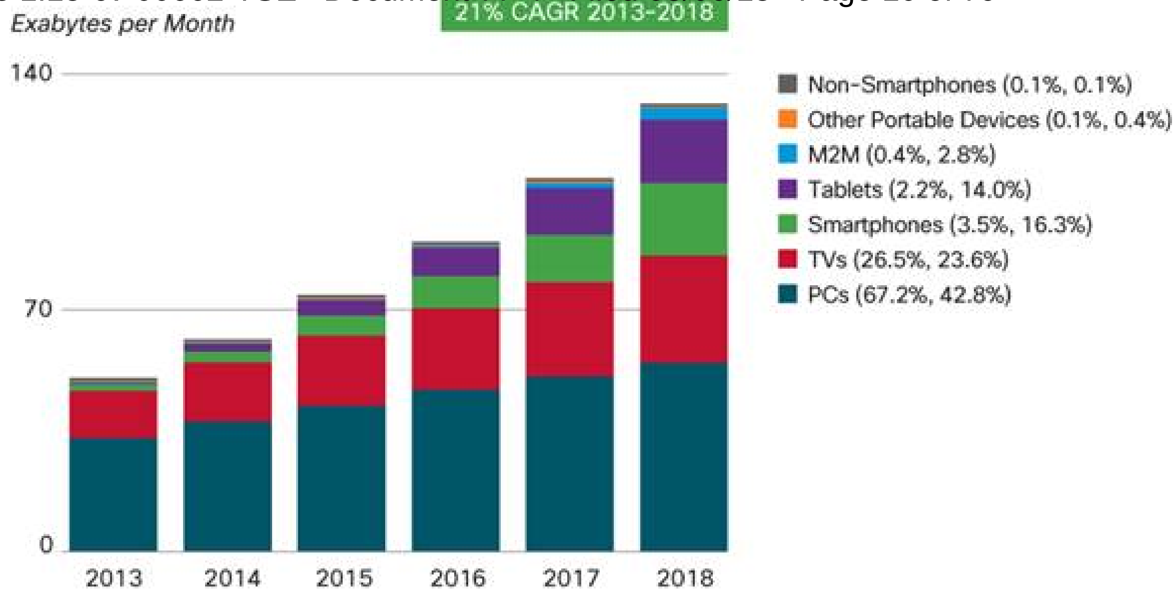
	2013	2018	CAGR

Asia Pacific	1.41	2.24	9.7%
Central and Eastern Europe	2.10	3.39	10.1%
Latin America	1.75	2.58	8.1%
Middle East and Africa	0.92	1.28	6.7%
North America	5.34	9.26	11.7%
Western Europe	3.89	6.52	10.9%
Global	1.73	2.73	9.5%

Source: Cisco VNI, 2014

The changing mix of devices and connections and growth in multidevice ownership affects traffic and can be seen in the changing device contribution to total IP traffic. At the end of 2013, 33 percent of IP traffic and 15 percent ofconsumer Internet traffic originated from non-PC devices. By 2018, 57 percent of IP traffic and 52 percent of consumer Internet traffic will originate from non-PC devices (Figure 3).

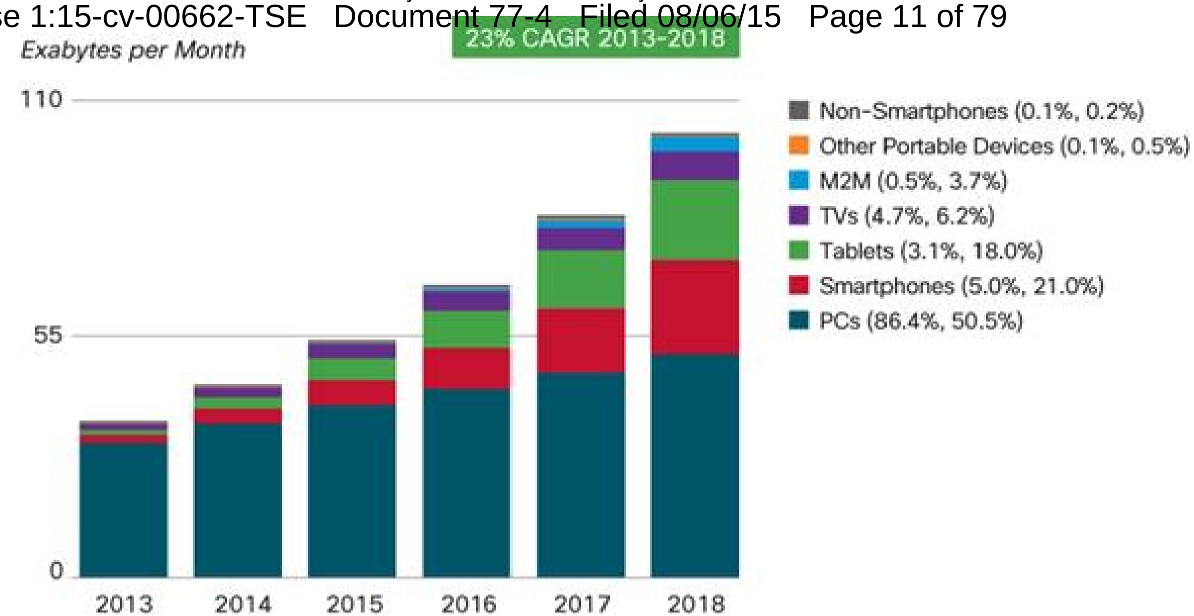
Figure 3. Global IP Traffic by Devices



Source: Cisco VNI, 2014
The percentages in parentheses next to the legend denote the device traffic shares for the years 2013 and 2018, respectively.

As in the case of mobile networks, video devices can have a multiplier effect on traffic. An Internet-enabled HD television that draws 50 minutes of content per day from the Internet would generate as much Internet traffic as an entire household today. With the growth of video viewing on tablets, traffic from tablets is growing as a percentage of total internet traffic. Tablets will account for 18 percent of total global internet traffic by 2018, up from 3 percent in2013 (Figure 4).

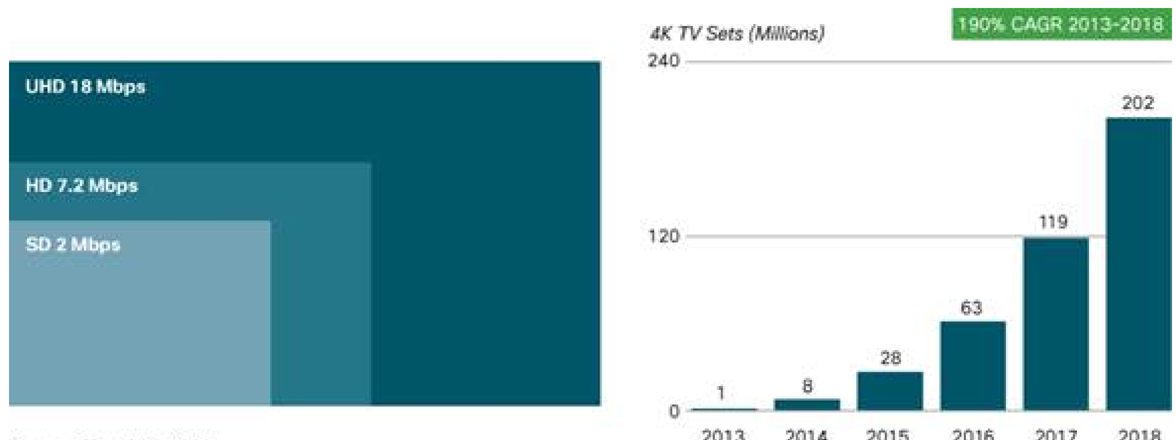
Figure 4. Global Internet Traffic by Device Type



Source: Cisco VNI, 2014
The percentages in parentheses next to the legend denote the device traffic shares for the years 2013 and 2018, respectively.

The video impact of the devices on the traffic is more pronounced due to the introduction of ultra-high-definition (UHD) or 4K video streaming. This is because the bit rate for 4K video at about 18 Mbps is more than double theHD video bit rate and nine times more than standard-definition (SD) video bit rate. We estimate that by 2018, 21percent of the installed flat-panel TV sets will be UHD, up from 0.4 percent in 2013 (Figure 5).

Figure 5. Increasing Video Definition: By 2018, More than 20 Percent of Connected Flat-Panel TV Sets Will Be 4K

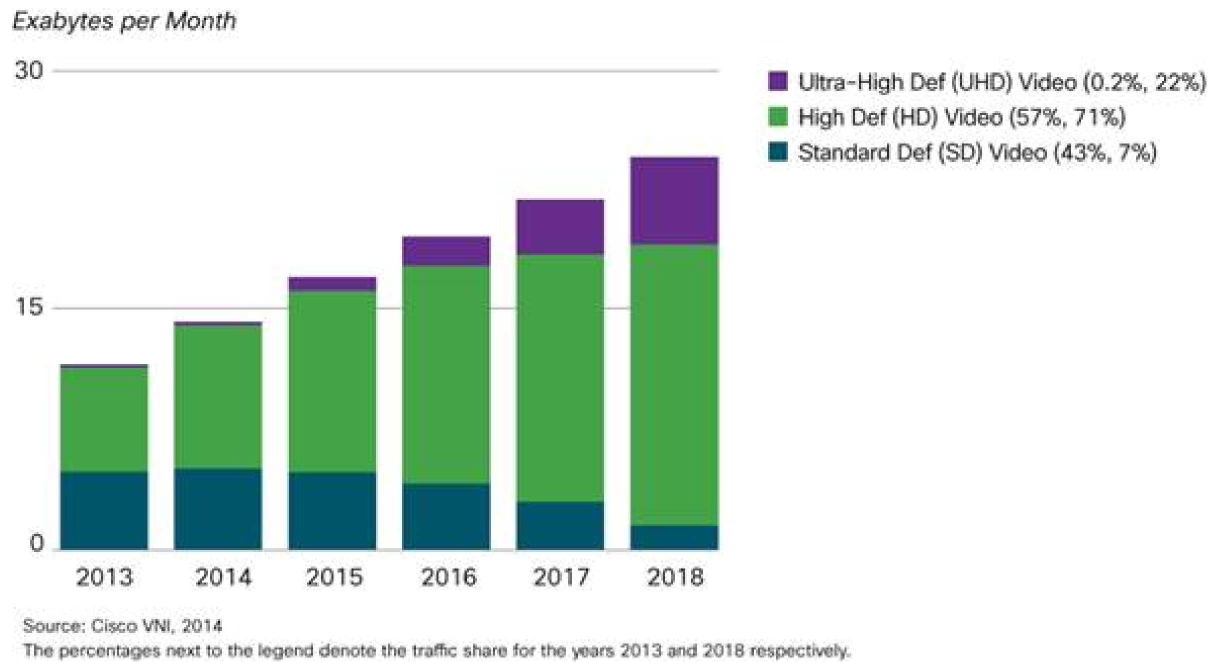


Source: Cisco VNI, 2014

Ultra-HD (or 4K) IP VOD Will Account for 22% of global VOD Traffic in 2018, per

Figure 6.

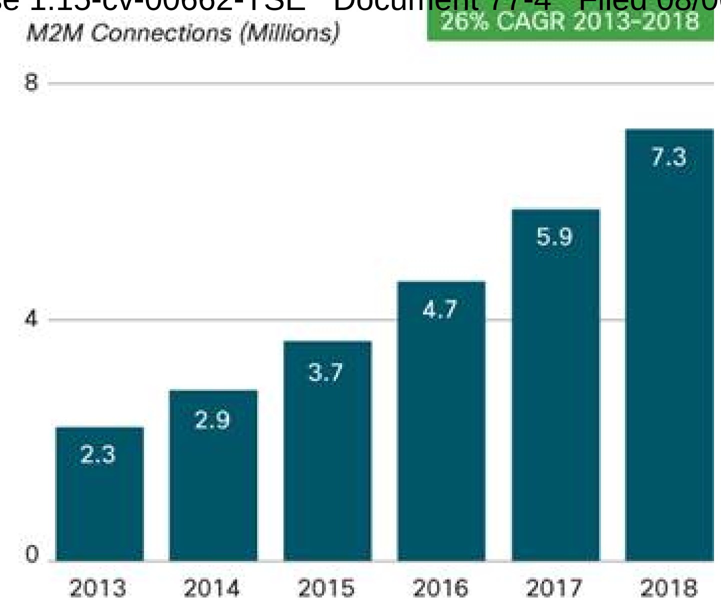
Figure 6. 4K Video Traffic



Trend 2: M2M Growth Drives the Reality of Internet of Everything

The Internet of Everything (IoE) phenomenon, or the next wave of the Internet in which people, processes, data, and things connect to the Internet and each other, is showing tangible growth. Globally, M2M connections will growthreefold from 2.3 billion in 2013 to 7.3 billion by 2018 (Figure 7). There will be nearly one M2M connection for each member of the global population by 2018.

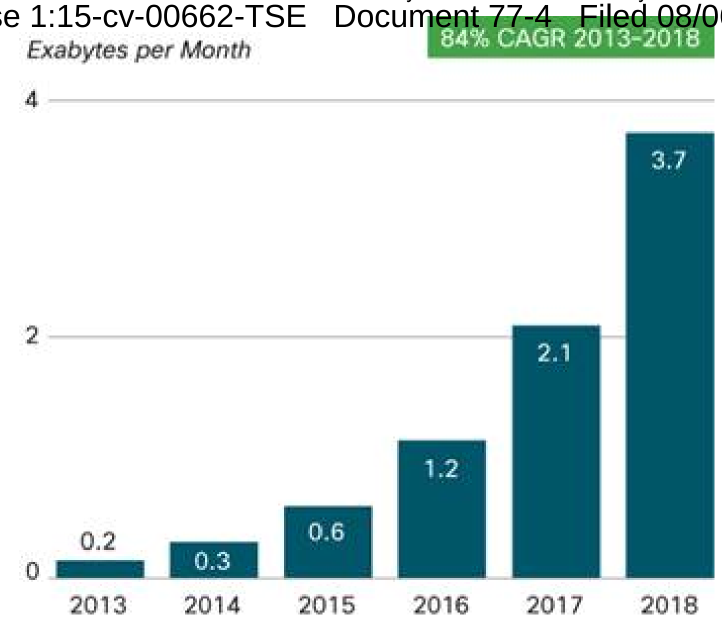
Figure 7. M2M Growth



Source: Cisco VNI, 2014

Applications such as video surveillance, smart meters, smart cars, asset and package tracking, chipped pets and livestock, digital health monitors, and a host of other next-generation M2M services are driving this growth.

Figure 8. M2M Traffic Growth



Source: Cisco VNI, 2014

While the number of connections is growing threefold, global M2M IP traffic will grow 11-fold over this same period, from 179 petabytes in 2013 (0.4 percent of global IP traffic) to 3.7 exabytes by 2018 (2.8 percent of global IP traffic). See Figure 8. The higher traffic growth than connections growth is due to more video applications being deployed on M2M connections as well as the use of applications, such as telemedicine and smart car navigation, that require higher bandwidth and lower latency.

Trend 3: Fixed Broadband Speeds Will Nearly Triple by 2018

Fixed Speeds

Broadband speed is a crucial enabler of IP traffic. Broadband speed improvements result in increased consumption and use of high-bandwidth content and applications. The global average broadband speed continuesto grow and will nearly triple from 2013 to 2018, from 16.1 Mbps to 42.2 Mbps. Table 3 shows the projected broadband speeds from 2013 to 2018. Several factors influence the fixed broadband speed forecast, including the deployment andadoption of fiber to the home (FTTH), high-speed DSL, and cable broadband adoption, as well as overall broadband penetration. Among the countries covered by this study, Japan, South Korea, and Sweden lead interms of broadband speed largely because of their wide deployment of FTTH.

Table 3. Fixed Broadband Speeds, Mbps, 2013–2018

Region	2013	2014	2015	2016	2017	2018	CAGR

Global	11.3	16.1	20.3	25.6	31.1	36.7	42.2
Asia Pacific	10.4	18.0	23.2	29.7	36.4	42.5	48.1
Latin America	5.4	6.4	7.8	9.6	11.6	13.9	16.4
North America	12.9	17.6	21.8	27.0	32.3	37.7	43.2
Western Europe	13.0	19.3	23.8	29.3	35.4	42.1	48.9
Central and Eastern Europe	12.3	17.5	22.2	28.3	34.6	40.0	45.3
Middle East and Africa	2.5	5.7	7.1	8.8	10.8	12.8	14.9

Source: Cisco VNI, 2014

Consider how long it takes to download aHD movie at these speeds: at 5 Mbps, it takes 41minutes to download the movie; at10 Mbps, it takes 20 minutes; but at 100 Mbps, it takes only 2minutes. High-bandwidth speeds will bean essential support for consumer cloud storage, making the download of large multimedia files as fast as a transfer from a hard drive. Table 4 shows the percentage of broadband connections that will be faster than 5 Mbps, 10 Mbps, and 100 Mbps by region.

Table 4. Broadband Speed Greater than 10 Mbps, 2013–2018

Region	Greater than 10 Mbps		Greater than 50 Mbps		Greater than 100 Mbps	
	2013	2018	2013	2018	2013	2018
Global	45%	55%	12%	22%	2%	3%
Asia Pacific	43%	53%	13%	23%	2%	4%

Latin America	24%	34%	3%	5%	1%	2%
North America	57%	62%	12%	20%	2%	4%
Western Europe	50%	52%	14%	24%	4%	6%
Central and Eastern Europe	47%	73%	12%	25%	1%	3%
Middle East and Africa	18%	23%	2%	4%	0.3%	1%

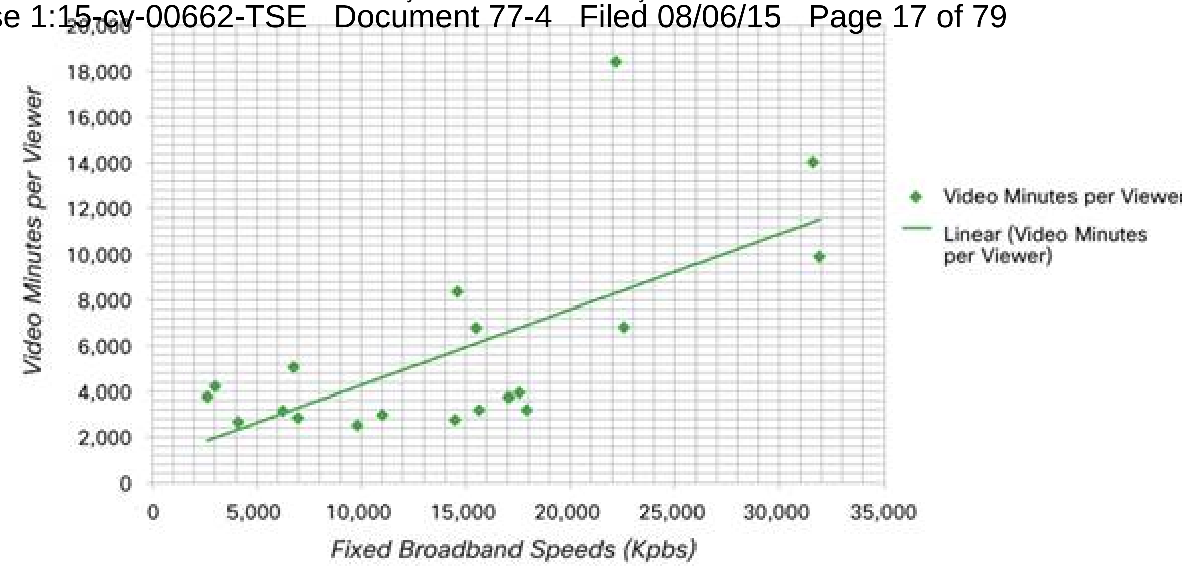
Source: Cisco VNI, 2014

Mobile Speeds

Globally, the average mobile network connection speed in 2013 was 1.4 Mbps. The average speed will nearly double, and will exceed 2.5 Mbps by 2018. Smartphone speeds, generally third-generation (3G)andhigher, are currently almost three times higher than the overall average. Smartphone speeds will nearly double by2018, reaching 7.0 Mbps.

There is a strong correlation between experienced speeds and number of video minutes viewed per viewer (Figure9). As speeds increase in each country covered in the study, the number of video minutes per viewer alsoincreases.

Figure 9. Increase in Experienced Speeds (Kbps) Increases Internet Video Viewership (Minutes)



Source: Cisco VNI, 2014

Anecdotal evidence supports the idea that overall usage increases when speed increases, although there is often adelay between the increase in speed and the increased usage, which can range from a few months to several years. The reverse can also be true with the burstiness associated with the adoption of tablets and smartphones, where there is a delay in experiencing the speeds that the devices are capable of supporting. The Cisco VNI Forecast relates application bit rates to the average speeds in each country. Many ofthe 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 5).

Table 5. Projected Average Mobile Network Connection Speeds (in Kbps) by Region and Country

	2013	2014	2015	2016	2017	2018	CAGR 2013–2018
Global							
Global speed: All handsets	1,387	1,676	1,908	2,147	2,396	2,509	13%
Global speed: Smartphones	3,983	4,864	5,504	6,132	6,756	7,044	12%

Global speed: Tablets	4,591	5,384	6,298	6,483	8,018	8,998	14%
By Region							
Asia Pacific	1,327	1,492	1,617	1,728	1,863	1,992	8%
Latin America	684	734	793	856	924	999	8%
North America	1,728	2,010	2,304	2,620	2,988	4,549	21%
Western Europe	1,585	1,735	1,946	2,183	2,452	3,003	14%
Central and Eastern Europe	1,351	1,446	1,711	1,945	2,128	2,269	11%
Middle East and Africa	529	605	675	753	832	900	11%

Source: Cisco VNI Mobile, 2014

Current and historical speeds are based on data from the Cisco 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 2018. For more information about Cisco GIST, visit http://gistdata.ciscovni.com/.

A crucial factor promoting the increase in mobile speeds over the forecast period is the increasing proportion offourth-generation (4G)mobile connections. The impact of 4G connections on traffic is significant, because 4Gconnections, 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 more than double by 2018. Theaverage Wi-Fi network connection speed (9.9 Mbps in 2013) will exceed 21 Mbps in 2018. North America will experience the highest Wi-Fi speeds of 22.6 Mbps by 2018, and Central and Eastern Europe will have the highest growth by 2018 with Wi-Fi speeds increasing 17 percent over the forecast period (Table 6).

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, isconsidered a true wired complement and can enable higher-definition video streaming and services 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 53 million hotspots by 2018, up from 22 million hotspots in 2013, a fourfold increase. The Asia Pacific region will have the highest number of hotspots by 2018.

Table 6. Projected Average Wi-Fi Network Connection Speeds (in Mbps) by Region and Country

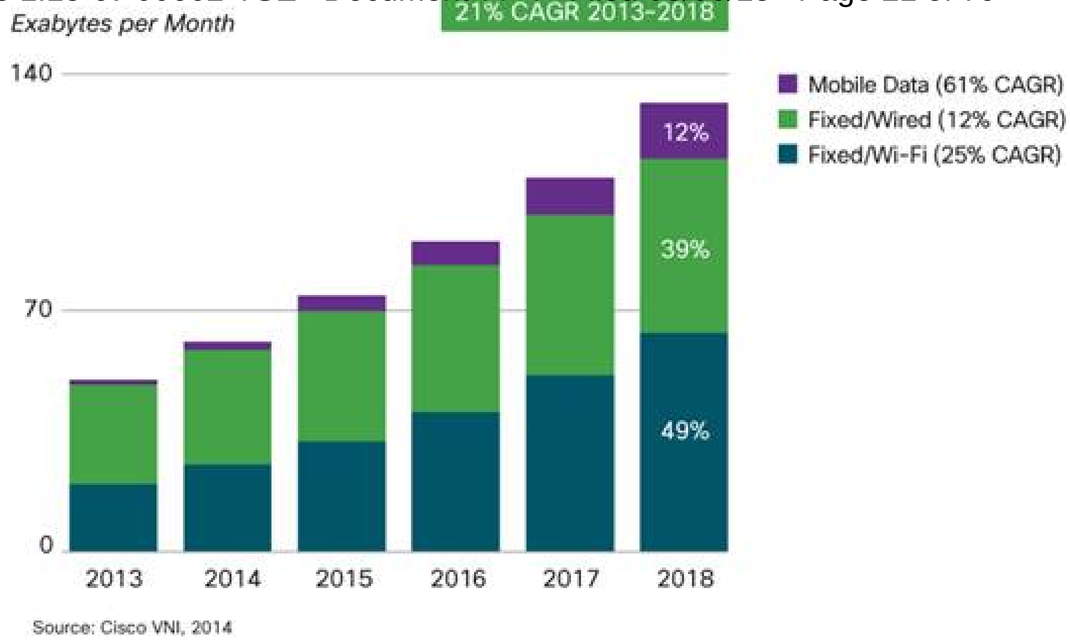
Region	2013	2014	2015	2016	2017	2018	CAGR
Global	9.9	12.6	14.9	17.3	19.3	21.4	16%
Asia Pacific	10.3	13.3	15.8	18.2	20.1	21.9	16%
Latin America	4.7	5.8	6.6	7.5	8.4	9.6	15%
North America	11.6	14.3	16.5	18.5	20.6	22.6	14%
Western Europe	10.6	13.0	14.9	16.9	19.1	21.4	15%
Central and Eastern Europe	9.2	11.7	14.1	16.3	18.5	20.6	17%
Middle East and Africa	4.0	4.9	5.7	6.6	7.4	8.4	16%

Source: Cisco VNI, 2014

Trend 4: Wi-Fi Dominates Access Technology

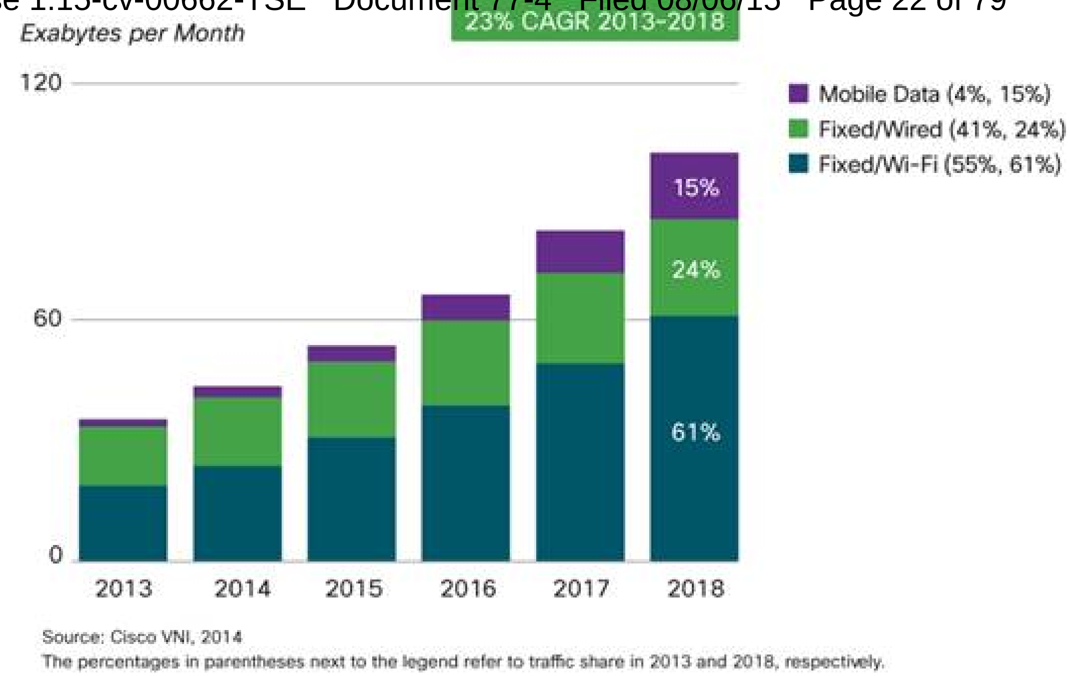
The rapid growth of mobile data traffic has been widely recognized and reported. The trend toward mobility carries over into the realm of fixed networks as well, in that an increasing portion of traffic will originate from portable or mobile devices. Figure 10 shows the growth of Wi-Fi and mobile traffic in relation to traffic from wired devices. By2018, wired networks will account for 39 percent of IP traffic, while Wi-Fi and mobile networks will account for61percent of IP traffic. In 2013, wired networks accounted for the majority of IP traffic at 56 percent, Wi-Fi accounted for 41 percent, and mobile or cellular networks accounted for 3 percent of total global IP traffic.

Figure 10. Global IP Traffic, Wired and Wireless



Narrowing the focus to Internet traffic and excluding managed IP traffic yields a more pronounced trend. By 2018, wired devices will account for 24 percent of Internet traffic, while Wi-Fi and mobile devices will account for 76percent of Internet traffic (Figure 11). In 2013, wired devices accounted for a little less than half of Internet trafficat41 percent.

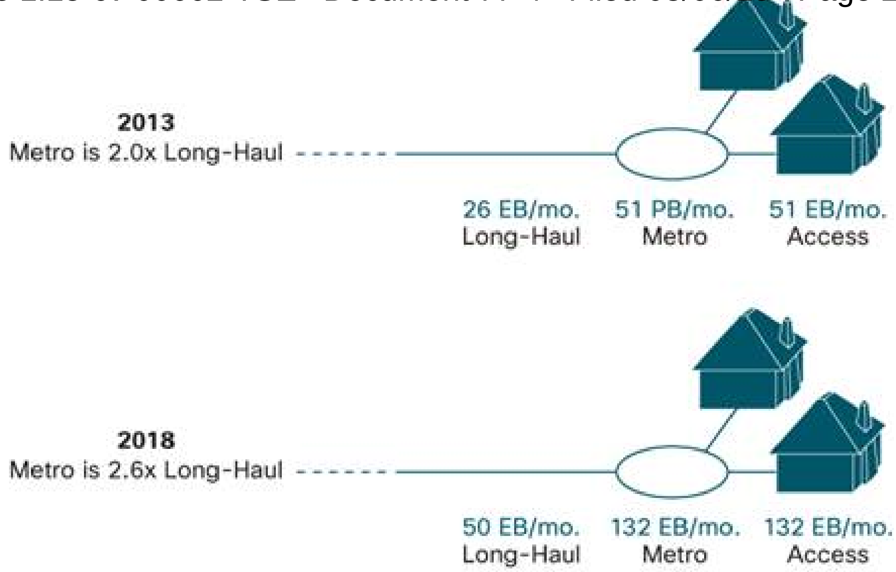
Figure 11. Global Internet Traffic, Wired and Wireless



Trend 5: Metro Traffic Will Grow Faster than Long-Haul Traffic

Metro-only traffic (traffic that traverses only the metro and bypasses long-haul traffic links) surpasses long-haul traffic in 2013, and will account for 62 percent of total IP traffic by 2018. Metro-only traffic will grow nearly twice asfast as long-haul traffic from 2013 to 2018. Long-haul traffic is also deposited onto metro networks so that total metro traffic already exceeds long-haul traffic. In 2013, total metro traffic was 2.0 times higher than long-haul traffic,and by 2018, metro traffic will be 2.6 times higher than long-haul (Figure 12).

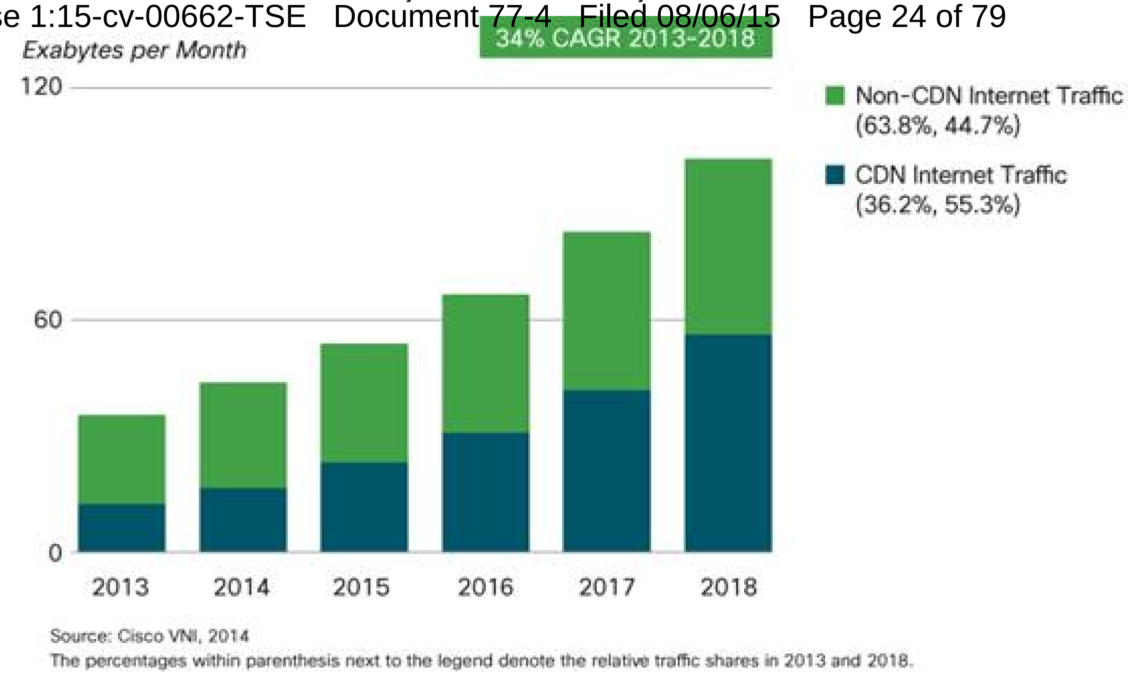
Figure 12. Metro Compared with Long-Haul Traffic Topology, 2013 and 2018



Source: Cisco VNI, 2014

The faster growth of metro traffic compared with long-haul is due in part to content delivery networks, which will carry 55 percent of total Internet traffic by 2018 (Figure 13). 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.

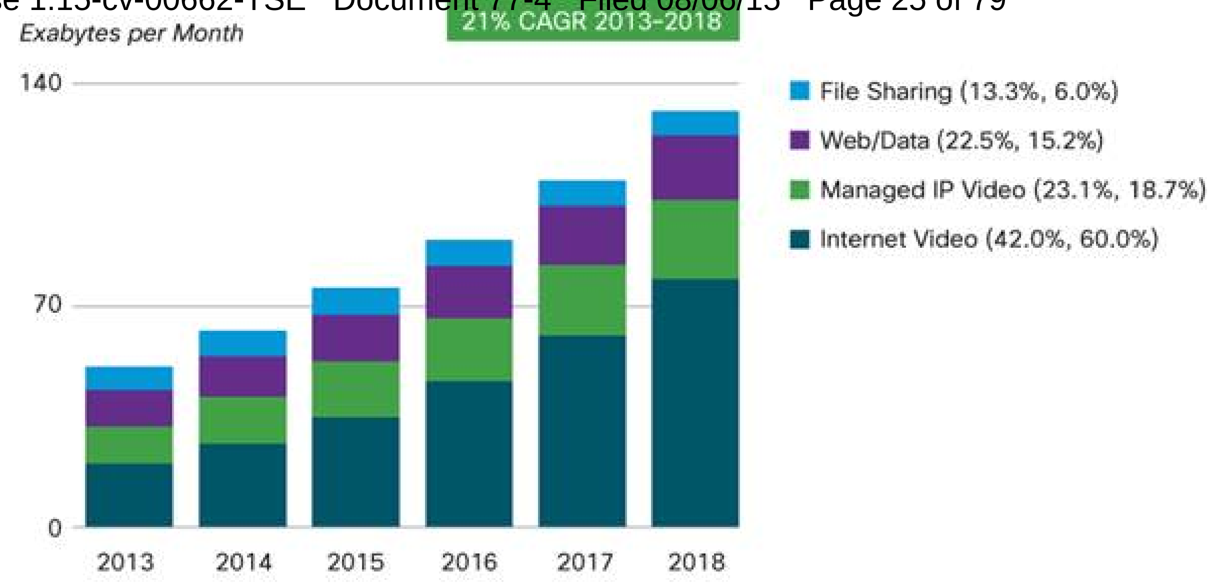
Figure 13. Content Delivery Network Internet Traffic, 2013 and 2018



Trend 6: IP Video Will Accelerate IP TrafficGrowth Through 2018

The sum of all forms of IP video, which includes 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, IPvideo traffic will account for 79 percent of traffic by 2018 (Figure 14).

Figure 14. Global IP Traffic by Application Category



Source: Cisco VNI, 2014
The percentages within parentheses next to the legend denote the relative traffic shares in 2013 and 2018, respectively.

The implications of video growth would be difficult to overstate. With video growth, Internet traffic is evolving from arelatively 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 upstreamcomponent.

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 anextremely important social, economic, and cultural phenomenon, but subscribers still consume far more video thanthey 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, 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 videocalling isgaining momentum, and the nascent mobile video calling market appears to have promise. Ifhigh-end video calling becomes popular, traffic could move toward greater symmetry.

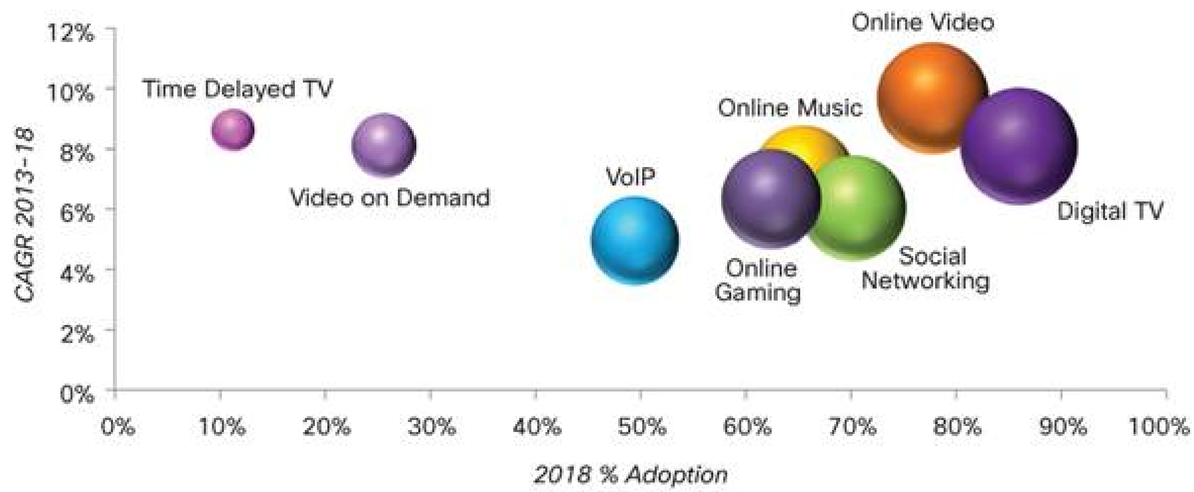
Generally, if service providers provide ample upstream bandwidth, applications that use upstream capacity willbegin to appear.

Trend 7: Residential, Business, and Consumer Mobile Service Adoption

Residential Services: Video Continues to Grow

Between 2012 and 2013, the highest growth happened on the Internet side in online video with 16 percent year-over-year growth. On the TV side, VoD grew 17 percent and digital TV and personal video recorder (PVR) services grew at 15 percent. See Figure 15.

Figure 15. Residential Services Adoption and Growth



Source: Cisco VNI Service Adoption Forecast, 2013-2018
Note: By 2018, the global residential fixed Internet population will be 2.5 billion; the number of global TV households will be 1.8 billion.

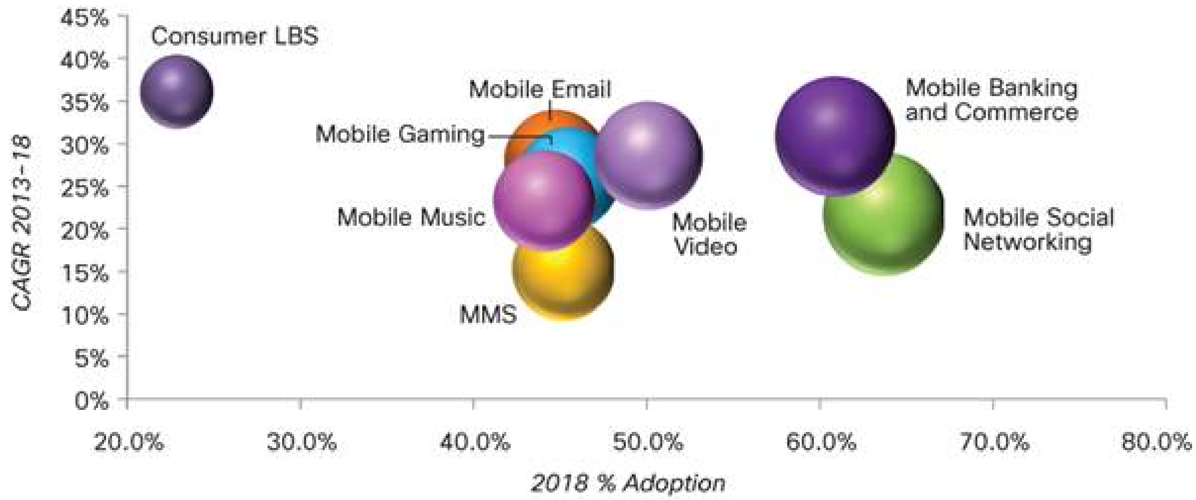
By 2018, digital TV and online video will be the two most highly penetrated services, 86 percent and 78 percent respectively. The fastest growth will come from online video (10 percent CAGR). Online music and video are both driven by cloud-based personal storage and sharing sites, in addition to both copyrighted and user-generated content use.

Among the digital TV services, time-delayed or digital video recorder (DVR)/PVR service will grow the fastest at 9percent CAGR.

Consumer Mobile Services

Between 2012 and 2013, all the services in this segment grew more than 20 percent year over year. The highest growth was in consumer location-based services (LBS) with year-over-year growth of 81 percent, although from avery small base of 130 million users in 2012 to 236 million in 2013. Other significant year-over-year growth was inmobile banking and commerce (61 percent) followed by mobile video (59 percent). Middle East and Africa hadthe largest growth at 112 percent, more than doubling the online video users from 14 million to 30 million. SeeFigure 16.

Figure 16. Consumer Mobile Services Adoption and Growth



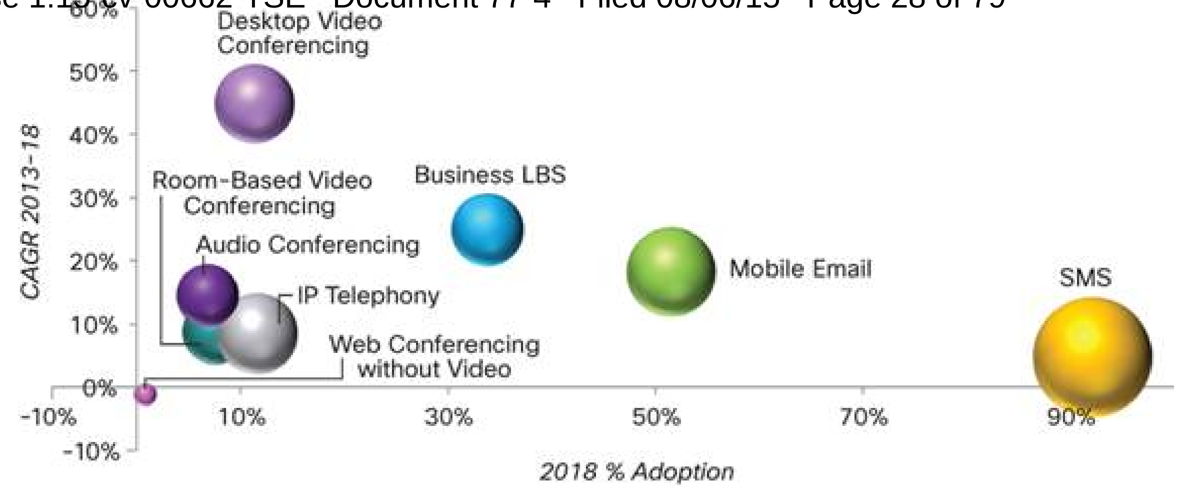
Source: Cisco VNI Service Adoption Forecast, 2013-2018
Note: By 2018, the global consumer mobile population will be 4.8 billion.

From 2013 to 2018, seven out of eight consumer mobile services will grow at more than 20 percent CAGR, and two will grow at more than 30 percent CAGR. The fastest growth will be in consumer LBS (36 percent) followed bymobile commerce (31 percent). Regions that are really driving mobile commerce growth are Latin America, AsiaPacific, and Middle East and Africa, which have been historically underserved (or not reached) by traditional brick-and-mortar financial institutions.

Business Services

Between 2012 and 2013, the highest year-over-year growth was in business LBS with a 47 percent increase, from44 million users in 2012 to 65 million in 2013. Other significant year-over-year growth was in desktop videoconferencing (44 percent). See Figure 17.

Figure 17. Business Services Adoption and Growth



Source: Cisco VNI Service Adoption Forecast, 2013-2018
Note: By 2018, the global business Internet population will be 2.1 billion; the number of business mobile users will be 582 million.

Business LBS includes services used by corporate subscribers in which the subscription is generally paid by the employer. As such, it includes but is not limited to services such as salesforce and field-force automation, fleet management, etc.

This year's study suggests lower growth in room-based videoconferencing users. Single-codec videoconferencing systems grew, but with the exception of Latin America, all regions experienced a decline in executive conferencing systems and multicodec systems. Multicodec systems are typically fully managed and as such are expensive to keep and operate. As unit sales drop, so does the network of units to connect to, and therefore, usage may be limited. Low-use systems are decommissioned over time due to the high fixed cost of managing these systems.

From 2013 to 2018, the fastest-growing business service is expected to be desktop or personal videoconferencing. The growth of personal videoconferencing, specifically unified communications-based videoconferencing, has recently accelerated due to the higher quality and lower price of new services and products, and also due to the availability of desktop videoconferencing offers, which can stand alone or be integrated. Also, the growth of mobile clients is going to support videoconferencing growth. Conversely, the use of web conferencing without video will show a decline of 1 percent CAGR over the forecast period.

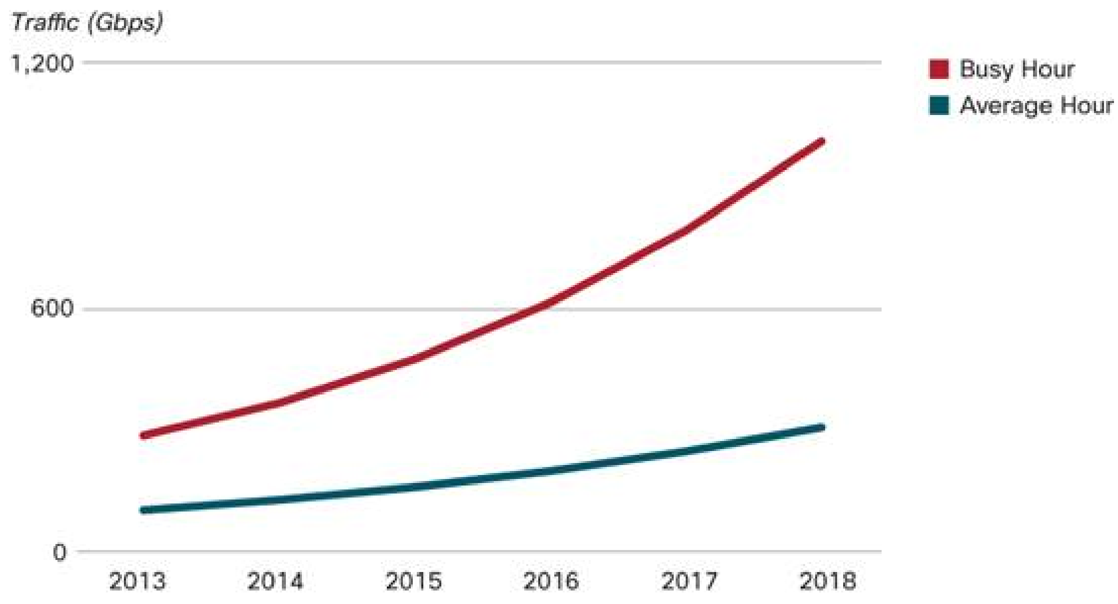
For details on all aspects of the service adoption study, use the Cisco VNI SA highlights tool.

Trend 8: Busy-Hour Traffic Will Grow Faster than Average Traffic

While average Internet traffic has settled into a steady growth pattern, busy-hour (or the busiest 60-minute period of the day) traffic continues to grow more rapidly than average traffic. Service providers plan network capacity according to peak growth, rather than average. In 2013, busy-hour Internet traffic grew 32 percent, while average traffic grew at 25 percent. The difference between busy-hour and average Internet growth was particularly pronounced in Saudi Arabia, where busy-hour growth was 65 percent in 2013 (compared with average-hour growth of 58 percent), and in India, where busy-hour growth was 66 percent in 2013 (compared with average-hour growth of 54 percent). Between 2013 and 2018, global busy-hour Internet use will grow at a CAGR of 28 percent, compared with 23 percent for average Internet traffic (Figure 18).

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 18. Busy-Hour Compared with Average Internet Traffic Growth



Source: Cisco VNI, 2014

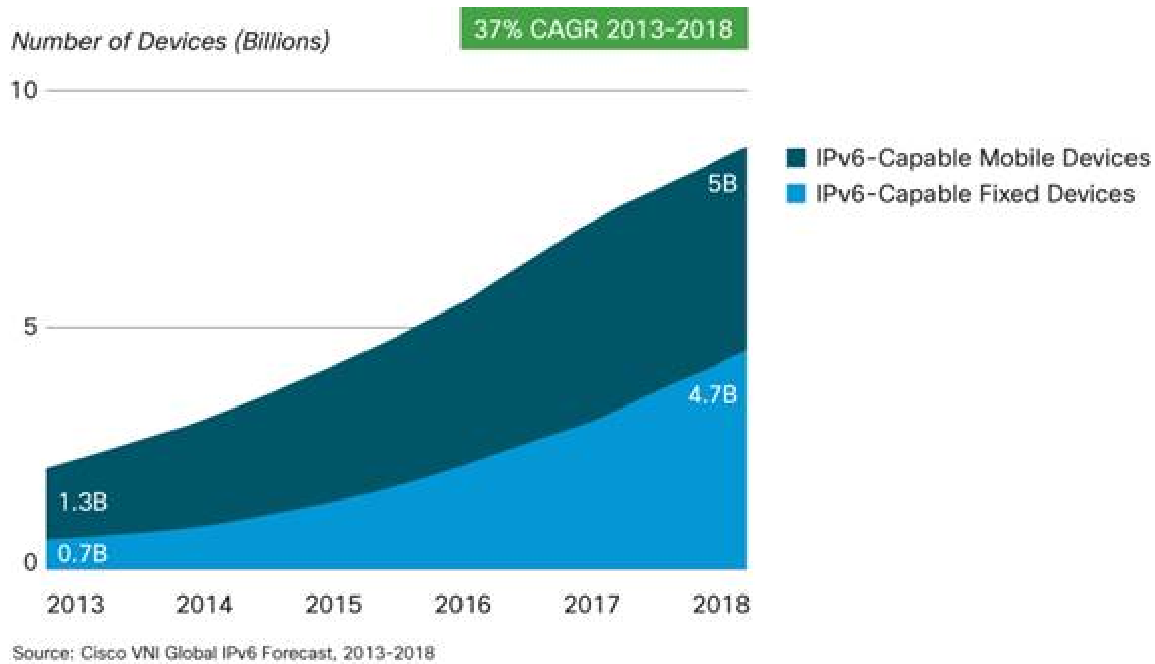
Trend 9: IPv6 Devices and Connections

The transition from an IPV4 environment to an IPV6 environment is making great progress in IPv6 device capability, content enablement, and operators implementing IPv6 in their networks. These developments are particularly important because Asia and Europe have already exhausted their IPv4 allotment, and North America, Africa, and Latin America expect to allocate their remaining IPv4 addresses between 2015 and 2017.

Building upon the VNI IPv6-capable devices analysis initiated in 2012, the forecast estimates that globally, there will be 10 billion IPv6-capable fixed and mobile devices by 2018, up from 2 billion in 2013, a CAGR of 37 percent. In terms of percentages, 47 percent of all fixed and mobile networked devices will be IPv6-capable in 2018, up from 16 percent in 2013. See Figure 19. What that means is that by 2018, about 50 percent of all fixed and mobile devices and connections will be IPv6 capable.

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. Mobile-device IPv6 capability is assessed based on OS support of IPv6 aswell as by estimating the type of mobile network infrastructure the device is capable of connecting to (3.5G or higher.) Fixed-device IPv6 capability is assessed on device support of IPv6 as well as an estimation of residential CPE or business router capability to support IPv6, depending on the device end-user segment.

Figure 19. IPv6-Capable Devices and Connections Forecast 2013–2018



Leading IPv6-capable device segments include:

- Globally, 80 percent of smartphones and tablets will be IPv6-capable by 2018, up from 43 percent in 2013.
- Globally, there will be 3.9 billion IPv6-capable smartphones and tablets by 2018, up from 882 million in2013.
- 94 percent of laptops will be IPv6-capable by 2018, reaching 797 million.

- 34 percent of M2M connections will be IPv6-capable by 2018, reaching 2.4 billion.

According to the World IPv6 Launch Organization in April 2014, fixed and mobile network operators worldwide aredeploying IPv6 and starting to report notable IPv6 traffic generation, ranging up to 49 percent ofnetwork trafficwith Verizon Wireless at 48.71 percent, France’s Free Telecom at 37.52 percent, Romania’s RCSand RDSat 24.86 percent, AT&T at 17.88 percent and KDDI at 11.41 percent.

Trend 10: Tiered Pricing: Comparing Mobile and Fixed Data Caps

Speeds influence application use and user behavior and user behaviors are what operators want to manage, optimize and monetize; which looks into the behavior of the top usage subscribers and the institution of usage based tiered pricing.

On the mobile networks, based on the usage of over 33,000 lines from a few Tier 1 mobile operators from 2010 to2013, we found that the Top 1% usage of monthly traffic is down to 10% of overall usage compared to 52% in 2010; showing the effects of tiered pricing. With mobile penetration reaching a saturation point in many countries across all regions, the trend has been moving towards tiered plans as a way to monetize data and effectively manage/throttle the top users of traffic. On the fixed networks, data caps continue to increase to match subscribers growing appetite for video. In the US, Tier 1 carriers are considering 500 GB as a possible monthly limit by the 2018 timeframe from a variety of offerings today. A large provider in Japan has a 30 GB per day upload cap per day. In several countries around the world, Netflix has a sizeable of the internet video minutes and traffic. Wild cardtraffic generators such as Twitch.TV, a live streaming service where video gamers watch each other play hasestablished itself on many fixed networks across the globe.

Data caps impact a larger percentage of mobile users than fixed. With Tier 1 carriers, approximately 4 percent of mobile users consume more than 2 GB per month (a common mobile data cap); while only 2 percent of fixed users consume more than 250 GB per month (a common fixed data cap).

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 2013 or 2014. With traditional gaming, graphical processing isdone locally on the gamer’s computer or console. With cloud gaming, game graphics are produced on aremote 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 abroadcast network, which is highly efficient in that it carries one stream to many viewers. Live TV over theInternet would carry a separate stream for each viewer. AT&T in the past estimated that a shift from multicast orbroadcast to over-the-top unicast "would multiply the IP backbone traffic by more than an orderofmagnitude".[3]
- **New consumer behavior**: The adoption of UHD TV would fall into the category of newconsumer behavior. UHD is already growing tangible in terms of supporting devices and content Video providers are preparing to broadcast and stream UHD. Higher resolution and network requirements to stream UHD will create traffic multiplier effects. This nascent traffic type can cause surprises that have network design implications.

For More Information

For more information about Cisco's IP traffic forecast, refer to "Cisco VNI: Forecast and Methodology, 2013–2018" and visit the other resources and updates at www.cisco.com/go/vni. Several interactive tools allow you to createcustom highlights and forecast charts by region, by country, by application, andby end-user segment. RefertotheCisco VNI Highlights tool and the Cisco VNI Forecast Widget tool. Inquiriescan be directed totraffic-inquiries@cisco.com.

Appendix A: Cisco Global IP Traffic Forecast

Table 7 shows the summary of Cisco's global IP traffic forecast. For more information and additional tables, refer to"CiscoVNI: Forecast and Methodology, 2013–2018."

Table 7. Table A-1 Global IP Traffic, 2013–2018

IP Traffic, 2011–2016							
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**CAGR 2013–2018**
By Type (Petabytes [PB] per Month)							
Fixed Internet	34,952	42,119	50,504	60,540	72,557	86,409	20%
Managed IP	14,736	17,774	20,898	23,738	26,361	29,305	15%
Mobile data	1,480	2,582	4,337	6,981	10,788	15,838	61%
By Segment (PB per Month)							
Consumer	40,905	50,375	61,439	74,361	89,689	107,958	21%
Business	10,263	12,100	14,300	16,899	20,016	23,595	18%
By Geography (PB per Month)							
Asia Pacific	17,950	22,119	26,869	32,383	39,086	47,273	21%
North America	16,607	20,293	24,599	29,377	34,552	40,545	20%
Western Europe	8,396	9,739	11,336	13,443	16,051	19,257	18%
Central and	3,654	4,416	5,443	6,666	8,332	10,223	23%

Eastern Europe							
Latin America	3,488	4,361	5,318	6,363	7,576	8,931	21%
Middle East and Africa	1,074	1,546	2,174	3,027	4,108	5,324	38%
Total (PB per Month)							
Total IP traffic	51,168	62,476	75,739	91,260	109,705	131,553	21%

Source: Cisco VNI, 2014

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 andgovernments
- **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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[1] Peer-to-peer (P2P), 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 video streams that cross the network have a highly asymmetric profile, consisting mostly of downstream traffic, except in areas where P2P TV is prevalent (in China, for example).

[2] Total game play (online and offline) in the United States represents an estimated 166 exabytes per month, according totheUniversity of California, San Diego, study, “ How Much Information?”

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

Exhibit F: Email Statistics Report 2013-2017
Executive Summary

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Email Statistics Report, 2013-2017

Editor: Sara Radicati, PhD; Principal Analyst: Justin Levenstein

SCOPE

This report brings together statistics and forecasts for Email, Instant Messaging (IM), Social Networking, Mobile Email, and Mobile IM usage. It includes data on both business and consumer usage.

All figures in this report represent a 'snap shot' of key statistics in 2013. If a discrepancy occurs between numbers in this report and any numbers in our annual market research studies, the annual report should be considered the final authoritative source. For a full list of our annual reports which contain in-depth quantitative and qualitative analysis of each industry segment we cover, please refer to our list of publications at http://www.radicati.com.

All of the numbers in this study represent worldwide figures, unless otherwise indicated. All financial data is expressed in $USD.

Installed base numbers throughout this report represent *active* accounts, which have been actually installed (vs. shipped) and accessed at least once within the last 3 months.

METHODOLOGY

The information and analysis in this report are based on primary research conducted by The Radicati Group, Inc. Our proprietary methodology combines information derived from three principal sources:

a. Our Worldwide Database which tracks user population, seat count, enterprise adoption and IT use from 1993 onwards.
b. Surveys conducted on an on-going basis in all market areas which we cover.
c. Market share, revenue, sales and customer demand information derived from vendor briefings.

Forecasts are based on historical information as well as our in-depth knowledge of market conditions and how we believe markets will evolve over time.

Finally, secondary research sources have also been used, where appropriate, to cross-check all the information we collect. These include company annual reports and other financial disclosures, industry trade association material, published government statistics and other published sources.

Our research processes and methodologies are proprietary and confidential.

EXECUTIVE SUMMARY

- The total number of worldwide email accounts is expected to increase from nearly 3.9 billion accounts in 2013 to over 4.9 billion accounts by the end of 2017. This represents an average annual growth rate of about 6% over the next four years.

- Email is remains the go-to form of communication in the Business world. In 2013, Business email accounts total 929 million mailboxes. This figure is expected grow at an average annual growth rate of about 5% over the next four years, and reach over 1.1 billion by the end of 2017. The majority of Business email accounts are currently deployed on-premises. However adoption of Cloud

Business email services, particularly Google Apps and Microsoft Office 365, is expected to rapidly increase over the next four years.

- Consumer email accounts currently make up the vast majority of worldwide email accounts, accounting for 76% of worldwide email accounts in 2013. Consumer email accounts are typically available as free offerings. Consumer email accounts' market share is expected to steadily increase over the next four years, as more people come online on a worldwide basis and email continues to be a key component of the online experience. Email accounts are required for users to sign up for social networking sites, such as Facebook and Twitter, instant messaging, and more.

	2013	2014	2015	2016	2017
Worldwide Email Accounts (M)	**3,899**	**4,116**	**4,353**	**4,626**	**4,920**
Business Email Accounts (M)	**929**	**974**	**1,022**	**1,078**	**1,138**
% Business Email Accounts	*24%*	*24%*	*23%*	*23%*	*23%*
Consumer Email Accounts (M)	**2,970**	**3,142**	**3,331**	**3,548**	**3,782**
% Consumer Email Accounts	*76%*	*76%*	*77%*	*77%*	*77%*

Table 1: Business vs. Consumer Email Accounts (M), 2013–2017

- In 2013, the majority of email traffic comes from business email, which accounts for over 100 billion emails sent and received per day. Email remains the predominant form of communication in the business space. This trend is expected to continue, and business email will account for over 132 billion emails sent and received per day by the end of 2017.
    - Consumer email traffic, on the other hand, is expected to decrease over the next four years. Despite a growing number of Consumer email accounts and users, Consumers are now opting to use social networking sites, instant messaging, Mobile IM, and text messaging for instantaneous communication with family and friends.

Daily Email Traffic	2013	2014	2015	2016	2017
Total Worldwide Emails Sent/Received Per Day (B)	**182.9**	**191.4**	**196.4**	**201.4**	**206.6**
% Growth		*5%*	*3%*	*3%*	*3%*
Business Emails Sent/Received Per Day (B)	**100.5**	**108.8**	**116.2**	**123.9**	**132.1**
% Growth		*8%*	*7%*	*7%*	*7%*
Consumer Emails Sent/Received Per Day (B)	**82.4**	**82.6**	**80.2**	**77.5**	**74.5**
% Growth		*0%*	*-3%*	*-3%*	*-4%*

Table 2: Worldwide Daily Email Traffic (B), 2013-2017

- Instant Messaging (IM) is also showing slower growth due to increased usage of social networking, text messaging, Mobile IM, and other forms of communication by both Business and Consumer users. In 2013, the number of worldwide IM accounts totals over 2.9 billion.
    - Mobile IM, however, is expected to show strong growth over the next four years, primarily due to increased mobile adoption by Consumers on a worldwide basis. In 2013, worldwide Mobile IM is expected to total 460 million accounts.
- Social Networking will grow from about 3.2 billion accounts in 2013 to over 4.8 billion accounts by the end of 2017. The majority of social networking accounts still come from the Consumer space, however, business-oriented Enterprise Social Networks are also showing strong adoption.

	2013	2014	2015	2016	2017
Worldwide Social Networking Accounts (M)	**3,190**	**3,615**	**4,078**	**4,459**	**4,861**
%Growth		*13%*	*13%*	*9%*	*9%*
Worldwide Social Networking Users* (M)	**1,091**	**1,202**	**1,319**	**1,443**	**1,573**
% Growth		*10%*	*10%*	*9%*	*9%*
Average Accounts Per User	2.9	3.0	3.1	3.1	3.1

Table 3: Worldwide Social Networking Accounts and User Forecast (M), 2013-2017

(*) Note: Includes both Business and Consumer Social Networking users.

- The Mobile Email market has shown strong growth over the past year, a trend that is expected to continue. Anywhere access has become a common feature for all users, who now access their mail from a number of devices, at any time and from any location. Growth of Mobile email use is driven by affordable and advanced mobile devices, which allow users to easily access their email accounts from their mobile devices. In 2013, worldwide mobile email users, including both Business and Consumer users, total 897 million.

	2013	2014	2015	2016	2017
Worldwide Mobile Email Users* (M)	**897**	**1,152**	**1,422**	**1,632**	**1,779**
% Growth		*28%*	*23%*	*15%*	*9%*

Table 4: Worldwide Mobile Email User Forecast (M), 2013-2017

(*) Note: Includes both Business and Consumer Mobile email users.

To view the complete Table of Contents for this report, visit our website at www.radicati.com.

Exhibit G: Internet 2012 in Numbers

Internet 2012 in numbers

JANUARY 16, 2013
IN TECH BLOG

There is so much happening on the Internet during a year that it's impossible to capture it all in a blog post, but we're going to give it a shot anyway. How many emails were sent during 2012? How many domains are there? What's the most popular web browser? How many Internet users are there? These are some of the questions we'll answer for you.

To bring you these answers, we've gone to the ends of the web – wherever that is – and back again, and compiled a list of truly fascinating facts about the year that was. Some of the numbers are snapshots taken during the year, others cover the entire period. Either way, they all contribute to giving us a better understanding of Internet in 2012. Enjoy!

Email

- **2.2 billion –** Number of email users worldwide.
- **144 billion –** Total email traffic per day worldwide.
- **61% –** Share of emails that were considered non-essential.
- **4.3 billion –** Number of email clients worldwide in 2012.
- **35.6% –** Usage share of the most popular email client, which was Mail for iOS.
- **425 million –** Number of active Gmail users globally, making it the leading email provider worldwide.
- **68.8% –** Percentage of all email traffic that was spam.
- **50.76% –** Percentage of all spam that was about pharmaceuticals, the top category of all spam.
- **0.22% –** Share of worldwide emails that comprised some form of phishing attack.

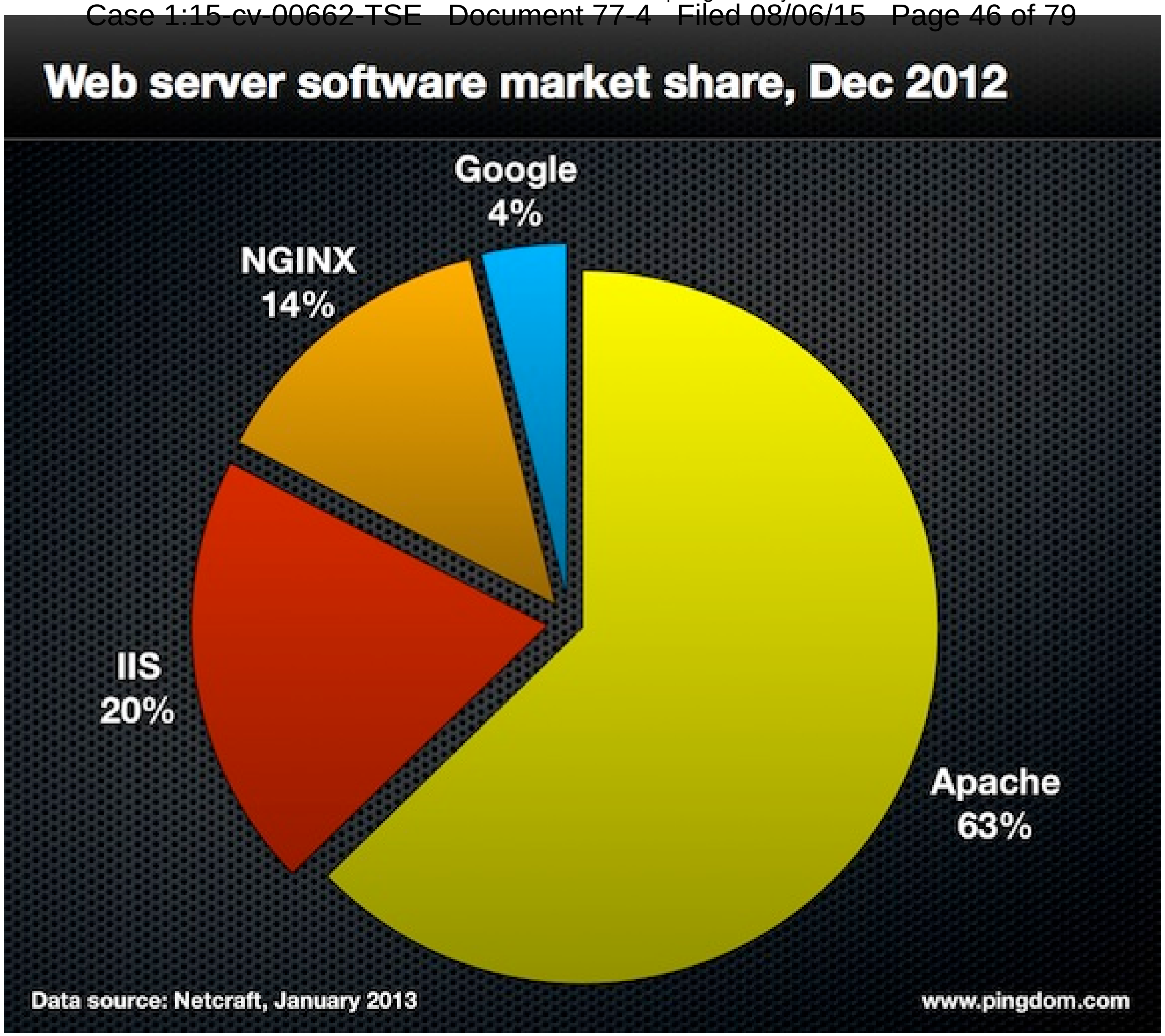
Web pages, websites, and web hosting

- **634 million –** Number of websites (December).
- **51 million –** Number of websites added during the year.
- **43% –** Share of the top 1 million websites that are hosted in the U.S.
- **48% –** Share of the the top 100 blogs that run WordPress.
- **75% –** Share of the top 10,000 websites that are served by open source software.

- **87.8 million –** Number of Tumblr blogs.
- **17.8 billion –** Number of page views for Tumblr.
- **59.4 million –** Number of WordPress sites around the world.
- **3.5 billion –** Number of webpages run by WordPress viewed each month.
- **37 billion –** Number of pageviews for Reddit.com in 2012.
- **35% –** The average web page became this much larger during 2012.
- **4% –** The average web page became this much slower to load during 2012.
- **191 million –** Number of visitors to Google Sites, the number 1 web property in the U.S. in November.

Web servers

- **-6.7%** – Decline in the number of Apache websites in 2012.
- **32.4%** – Growth in the number of IIS websites in 2012.
- **36.4%** – Growth in the number of NGINX websites in 2012.
- **15.9%** – Growth in the number of Google websites in 2012.



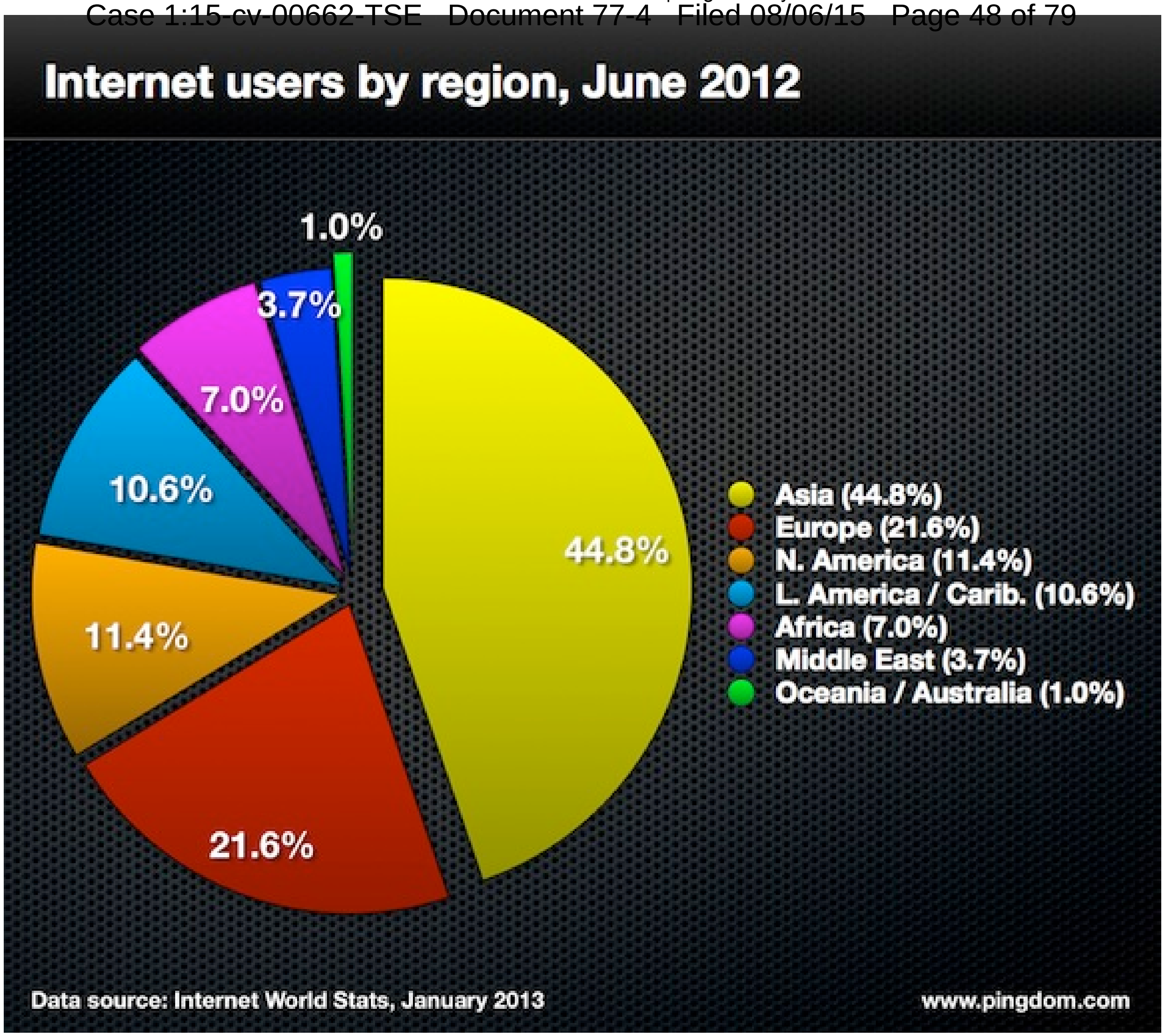
Domain names

- **246 million –** Number of domain name registrations across all top-level domains.
- **104.9 million –** Number of country code top-level domain name registrations.
- **329 –** Number of top level domains.

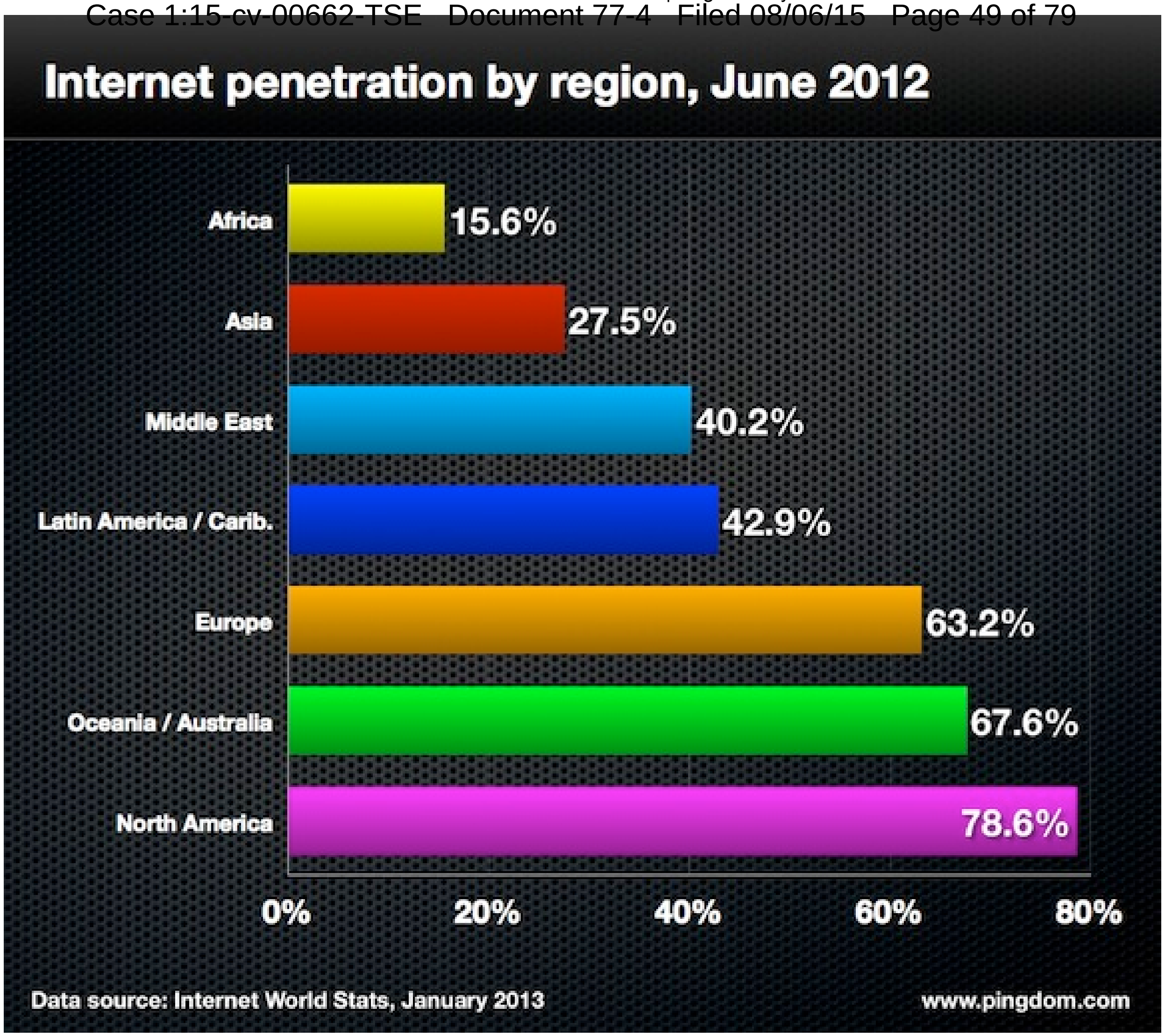
- **100 million –** Number of .com domain names at the end of 2012.
- **14.1 million –** Number of .net domain names at the end of 2012.
- **9.7 million –** Number of .org domain names at the end of 2012.
- **6.7 million –** Number of .info domain names at the end of 2012.
- **2.2 million –** Number of .biz domain names at the end of 2012.
- **32.44% –** Market share for GoDaddy.com, the biggest domain name registrar in the world.
- **$2.45 million –** The price for Investing.com, the most expensive domain name sold in 2012.

Internet users

- **2.4 billion –** Number of Internet users worldwide.
- **1.1 billion –** Number of Internet users in Asia.
- **519 million –** Number of Internet users in Europe.
- **274 million –** Number of Internet users in North America.
- **255 million –** Number of Internet users in Latin America / Caribbean.
- **167 million –** Number of Internet users in Africa.
- **90 million –** Number of Internet users in the Middle East.
- **24.3 million –** Number of Internet users in Oceania / Australia.
- **565 million –** Number of Internet users in China, more than any other country in the world.
- **42.1% –** Internet penetration in China.



Internet users by region, June 2012
1.0%
3.7%
7.0%
10.6%
11.4%
21.6%
44.8%
Asia (44.8%)
Europe (21.6%)
N. America (11.4%)
L. America / Carib. (10.6%)
Africa (7.0%)
Middle East (3.7%)
Oceania / Australia (1.0%)
Data source: Internet World Stats, January 2013
www.pingdom.com

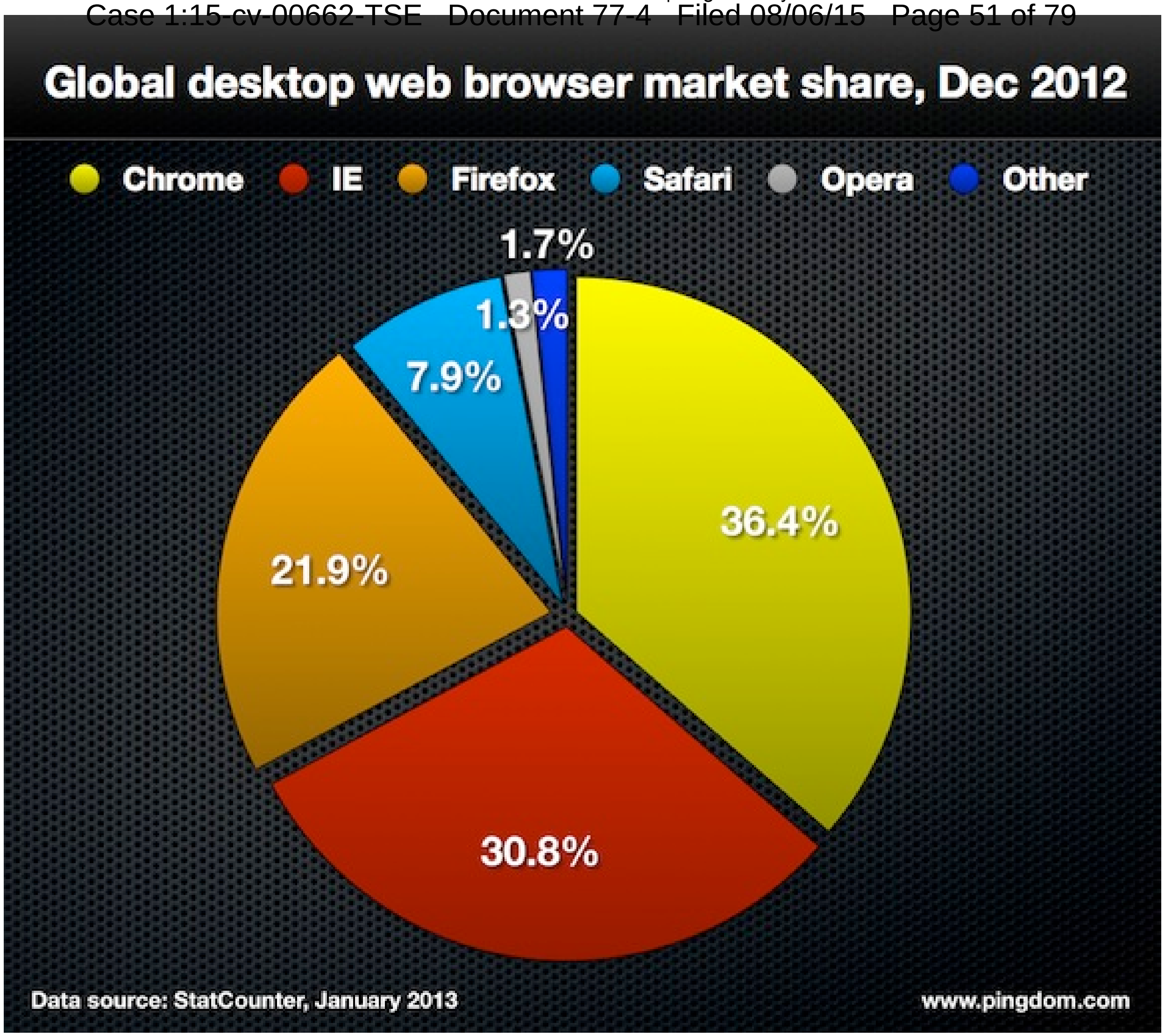


Social media

- **85,962 –** Number of monthly posts by Facebook Pages in Brazil, making it the most active country on Facebook.
- **1 billion –** Number of monthly active users on Facebook, passed in October.

- **47% –** Percentage of Facebook users that are female.
- **40.5 years –** Average age of a Facebook user.
- **2.7 billion –** Number of likes on Facebook every day.
- **24.3% –** Share of the top 10,000 websites that have Facebook integration.
- **200 million –** Monthly active users on Twitter, passed in December.
- **819,000+ –** Number of retweets of Barack Obama's tweet "Four more years", the most retweets ever.
- **327,452 –** Number of tweets per minute when Barack Obama was re-elected, the most ever.
- **729,571 –** Number of messages per minute when the Chinese microblogging service Sina Weibo saw 2012 finish and 2013 start.
- **9.66 million –** Number of tweets during the opening ceremony of the London 2012 olympics.
- **175 million –** Average number of tweets sent every day throughout 2012.
- **37.3 years –** Average age of a Twitter user.
- **307 –** Number of tweets by the average Twitter user.
- **51 –** Average number of followers per Twitter user.
- **163 billion –** the number of tweets since Twitter started, passed in July.
- **123 –** Number of heads of state that have a Twitter account.
- **187 million –** Number of members on LinkedIn (September).
- **44.2 years –** Average age of a Linkedin user.
- **135 million –** Number of monthly active users on Google+.
- **5 billion –** How many times per day the +1 button on Google+ is used.
- **20.8% –** Usage share of HootSuite as a social media management tool among the world's top 100 brands.

Web browsers



Search

- **1.2 trillion –** Number of searches on Google in 2012.
- **67% –** Google's market-leading share of the U.S. search market (December).
- **1 –** The top trending question of the year on Ask.com: "Will Rob and Kristen get back

together?"

Mobile

- **1.1 billion –** Number of global smartphone subscribers.
- **6.7 billion –** Number of mobile subscriptions.
- **5 billion –** Number of mobile phone users.
- **5.3 billion –** Number of mobile handsets.
- **1.3 billion –** Number of smartphones in use worldwide by end of 2012.
- **465 million –** Number of Android smartphones sold in 2012, a 66% market share.
- **31% –** Percentage of the U.S. Internet population that used a tablet or e-reader.
- **13% –** Mobile share of global Internet traffic.
- **5 billion –** Number of mobile broadband subscriptions.
- **1.3 exabytes –** Estimated global mobile data traffic per month in 2012.
- **59% –** Share of global mobile data traffic that was video.
- **500 megabytes –** Amount of monthly data traffic consumed by the average smartphone.
- **504 kbps –** The average mobile network connection speed globally (all handsets).
- **1,820 kbps –** The average mobile network connection speed globally (smartphones).

Video

- **14 million –** Number of Vimeo users.
- **200 petabytes –** Amount of video played on Vimeo during 2012.
- **150,648,303 –** Number of unique visitors for video to Google Sites, the number one video property (September).
- **1 billion –** PSY's Gangnam Style video became the first online video to reach 1 billion views (currently just over 1.1 billion) and it achieved it in just 5 months.

- **2.7 billion –** Number of views of videos uploaded to YouTube tagged Obama or Romney during the 2012 U.S. election cycle
- **2.5 million –** Number of hours of news-related video that was uploaded to YouTube.
- **8 million –** The number of concurrent viewers of the lifestream of Felix Baumgartner's jump from the edge of space, the most ever on YouTube.
- **4 billion –** Number of hours of video we watched on YouTube per month.
- **60 million –** Number of global viewers monthly on Ustream.
- **16.8 million –** Number of total viewers in a 24 hour period for a video on Ustream, the most ever.
- **181.7 million –** Number of total unique viewers of online video in the U.S. during December.

Images

- **7 petabytes –** How much photo content Facebook added every month.
- **300 million –** Number of new photos added every day to Facebook.
- **5 billion –** The total number of photos uploaded to Instagram since its start, reached in September 2012.
- **58 –** Number of photos uploaded every second to Instagram.
- **1 –** Apple iPhone 4S was the most popular camera on Flickr.

What about the Internet in 2013?

Just a couple of weeks into 2013 we don't yet know much about what the year ahead has in store for us. However, we can perhaps make a few predictions: we will be accessing the Internet more with mobile devices, social media will play an increasingly important role in our lives, and we'll rely even more on the Internet both privately as well as professionally.

We will be back again early next year to wrap up 2013. In the meantime, you may also want to check out our annual summaries for 2008, 2009, 2010, and 2011.

SHARE & COMMENT

34 COMMENTS

Mercalyn January 16, 2013 at 4:51 pm

Um, "Gagnam".. style?

Reply

Pingdom January 17, 2013 at 2:25 am

@Mercalyn 🙂 Fixed

Reply

Nargg January 17, 2013 at 4:39 pm

@Pingdom @Mercalyn

I think I preferred the mis-spelling Gag! 🙂

Reply

Aley Hegui January 16, 2013 at 7:02 pm

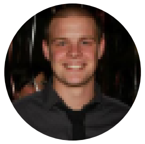
Wow.. Grt job.

Reply

Pradeep Kumar January 16, 2013 at 7:42 pm

Very geart job

Reply



Cam Jackson January 16, 2013 at 7:46 pm

A couple of things:
The web server stats are slightly confusing because you list the % changes as relative ones, which makes it difficult to relate them to the pie graph after it. It'd be nice to see the absolute change listed as well.
The two country graphs are really hard to read because the colours change from one graph to the next! I was trying to look at how that pie will change as penetration grows in e.g. Africa and Asia, but it's annoying having to keep checking the legend.

Very interesting read though!

Reply

Jack Amberkar January 17, 2013 at 4:41 am

Internet users

Reply

Gautam Chowdhary January 17, 2013 at 6:58 am

Used to.. too! 🙂

Reply

Ryan Varghese January 17, 2013 at 9:16 am

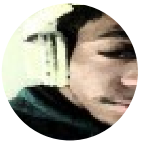
Hmmmm nice one.:)

Reply

Kunal Kumar January 17, 2013 at 10:58 am

great

Reply



Dre_Mane January 17, 2013 at 1:10 pm

lmao Other has more browser usage than Opera.

Reply

Carmen Schlesinger January 17, 2013 at 4:33 pm

good .....

Reply

Nargg January 17, 2013 at 4:39 pm

Sad to see Apache so strong. That web server is so full of security risks it's not funny.

Reply

Andrew Sandhu January 18, 2013 at 9:58 am

EXCELLENT

Reply

Pankaj Kumar January 18, 2013 at 10:54 am intresting figures……

Reply

SaisankarSai January 18, 2013 at 2:46 pm

Great!

Reply

Justin Robertson April 9, 2013 at 8:33 pm

This information is mind boggling. No wonder it is so hard to get noticed. I have some information that can help http://ow.ly/jUHH3

Reply

sarthak123 April 15, 2013 at 5:53 am

Why does people use chrome instead of mozilla firefox,mozilla firefox is far better?
Regards,
Torsion
http://www.tricksblogg.blogspot.in/

Reply

pragyaware May 23, 2013 at 7:14 am

osmiumbin I think you are absolutely right. I also have some doubts with rating that mentioned in this article.

Reply

Anita_1 June 3, 2013 at 7:50 am

Sorry for my English, but I'll try:
What I don't get is the number of the new websites
In 2010 you said there were 255 websites, new 21.4. I've calculated it 2009: 234+ 21.4= 255.
In 2011 you said there were 555 websites. Increased by 300 new ones. 555-300= 255.

In 2012 you says there are now 634 with 51 new websites. BUT 555+ 51= 606. (634-606-28 ???)
So I'm missing 28 new webpages is that correct?

Reply

MizSadie1 June 22, 2013 at 10:44 pm

Do people really have noting better to ask about than whether Rob and Kristen,(whoever they are), stayed together?

Reply

DaveGordon July 26, 2013 at 4:36 am

frankandersson76 Not sure why you think that? The majority of the people using paid for servers – wikll use Windows Servers – with which ever WebServer they feel happy with.

Reply

jnnydeep August 30, 2013 at 6:18 am

070
Mobile numbers are used for forwarding calls on your landline or mobile. 070 number is a virtual number through which you can hide the actual phone number being called.

Reply

gregthain February 24, 2014 at 10:28 pm

very good, but from where do you get the figures

Reply

bizlinkx March 1, 2014 at 9:29 am

I want to know the total number of video searches there where in 2013. I mean the total number of searches for videos on maybe the top 3 video sites. How do I find that out?

hmmm

Reply

Web Eminence March 24, 2014 at 6:02 pm

Good info. What about the % of websites on different types of hosting (shared, VPS, dedicated, etc.). I've been searching for this info and can't find it. Anyone seen this statistic?

Reply

PanosAlexandro March 25, 2014 at 4:43 pm

wow!interesting numbers!

Reply

agen007bet April 29, 2014 at 2:25 pm

slow but for sure video will be number 1 to promote your products, actually now i'm focus on vblog which gave me a high traffic and good at search engine.

Reply

Jonathan May 7, 2015 at 7:38 pm

I wonder what the 2015 numbers are. I can't imagine how the current infrastructure will keep with the growing demand for internet all across the world. I saw a similar article to this on http://www.unlockpwd.com

Reply

osmiumbin January 22, 2013 at 10:52 am

@Pingdom @osmiumbin Then that is very strange considering how many likes a page/article/post has on both networks (this one for example has 2.9k for FB and 0.6k for G+) 🙂

Reply

meinhard February 3, 2013 at 10:47 pm

@Pingdom @osmiumbin

Reply

meinhard February 3, 2013 at 10:52 pm

@Pingdom @osmiumbin The wording "is used" might be a little bit misleading here. Nick Fox, Vice President of Product Management at Google already said on October 3, 2011: "Since introducing the +1 button earlier this year, we now have more than 5 billion impressions on publisher sites a day." (http://googleblog.blogspot.kr/2011/10/ads-are-just-answers.html) – so it's 5B hits, not clicks. A number from end of 2012 and the number of clicks would be interesting.

Reply

damoc February 13, 2013 at 8:37 am

@Objectiveli Hi there,In response to the email question you pose. The actual fact is that there actually is a ‘new’ email about to be released. No SPAM, 100% deliverability of content (video, Image & text) and is permission based meaning you send and receive what you want, from whom you want. I do not want to use this as the forum to post any direct links but please do email me if your are interested in knowing a little more. I believe that if you’re aware of what’s happening, the better the decisions you can make regarding how it can best benefit yourself.My email is ShareToDream@iinet.net.auCheers and I look forward to hearing from you.

Damian Cooke

Reply

damoc February 13, 2013 at 8:39 am

@Objectiveli
Hi there,
In response to the email question you pose. The actual fact is that there actually is a ‘new’ email about to be released. No SPAM, 100% deliverability of content (video, Image & text) and is permission based meaning you send and receive what you want, from whom you want.

I do not want to use this as the forum to post any direct links but please do email me if your are interested in knowing a little more. I believe that if you're aware of what's happening, the better the decisions you can make regarding how it can best benefit yourself.

My email is ShareToDream@iinet.net.au

Cheers and I look forward to hearing from you.

Damian Cooke

Reply

Comments are moderated and not published in real time. All comments that are not related to the post will be removed.

NAME * EMAIL *

COMMENT

POST

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Which stories grow wings on Facebook?

MAY 18, 2015

There's money in the metrics

MAY 13, 2015

GO TO PINGDOM.COM ARCHIVES

Exhibit H: Krikorian, Raffi, New Tweets per Second Record and How

Sign in

Search

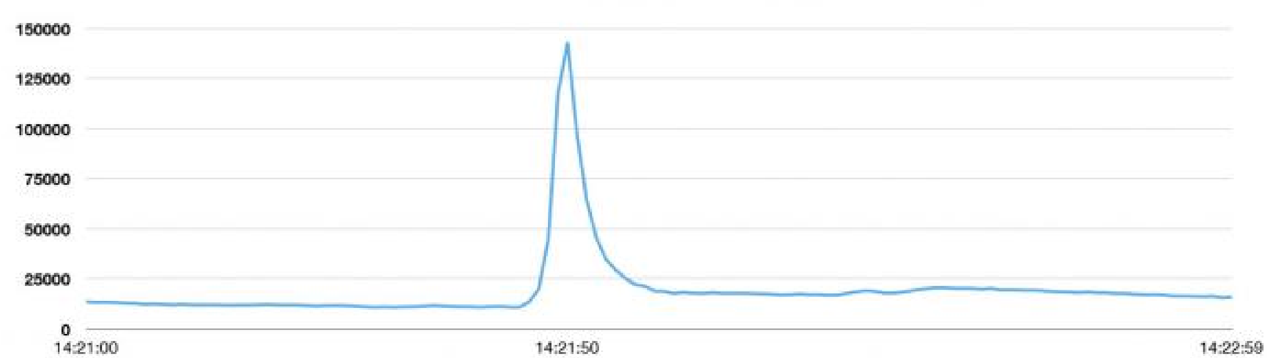
Tweet

New Tweets per second record, and how!

Friday, August 16, 2013 | By uɐıɹoʞıɹʞ ıɟɟɐɹ (@raffi), VP, Platform Engineering [22:33 UTC]

Recently, something remarkable happened on Twitter: On Saturday, August 3 in Japan, people watched an airing of Castle in the Sky, and at one moment they took to Twitter so much that we hit a one-second peak of 143,199 Tweets per second. (August 2 at 7:21:50 PDT; August 3 at 11:21:50 JST)

To give you some context of how that compares to typical numbers, we normally take in more than 500 million Tweets a day which means about 5,700 Tweets a second, on average. This particular spike was around 25 times greater than our steady state.



During this spike, our users didn't experience a blip on Twitter. That's one of our goals: to make sure Twitter is always available no matter what is happening around the world.

New Tweets per second (TPS) record: 143,199 TPS. Typical day: more than 500 million Tweets sent; average 5,700 TPS.

This goal felt unattainable three years ago, when the 2010 World Cup put Twitter squarely in the center of a real-time, global conversation. The influx of Tweets — from every shot on goal, penalty kick and yellow or red card — repeatedly took its toll and made Twitter unavailable for short periods of time. Engineering worked throughout the nights during this time, desperately trying to find and implement order-of-magnitudes of efficiency gains. Unfortunately, those gains were quickly swamped by Twitter's rapid growth, and engineering had started to run out of low-hanging fruit to fix.

After that experience, we determined we needed to step back. We then determined we needed to re-architect the site to support the continued growth of Twitter and to keep it running smoothly. Since then we've worked hard to make sure that the service is resilient to the world's impulses. We're now able to withstand events like Castle in the Sky viewings, the Super Bowl, and the global New Year's Eve celebration. This re-architecture has not only made the service more resilient when traffic spikes to record highs, but also provides a more flexible platform on which to build more features faster, including synchronizing direct messages across devices, Twitter cards that allow Tweets to become richer and contain more content, and a rich search experience that includes stories and users. And more features are coming.

Below, we detail how we did this. We learned a lot. We changed our engineering organization. And, over the next few weeks, we'll be publishing additional posts that go into more detail about some of the topics we cover here.

Starting to re-architect

After the 2010 World Cup dust settled, we surveyed the state of our engineering. Our findings:

- We were running one of the world's largest Ruby on Rails installations, and we had pushed it pretty far — at the time, about 200 engineers were contributing to it and it had gotten Twitter through some explosive growth, both in terms of new users as well as the sheer amount of traffic that it was handling. This system was also monolithic where everything we did, from managing raw database and memcache connections through to rendering the site and presenting the public APIs, was in one codebase. Not only was it increasingly difficult for an engineer to be an expert in how it was put together, but also it was organizationally challenging for us to manage and parallelize our engineering team.

- We had reached the limit of throughput on our storage systems — we were relying on a MySQL storage system that was temporally sharded and had a single master. That system was having trouble ingesting tweets at the rate that they were showing up, and we were operationally having to create new databases at an ever increasing rate. We were experiencing read and write hot spots throughout our databases.
- We were "throwing machines at the problem" instead of engineering thorough solutions — our front-end Ruby machines were not handling the number of transactions per second that we thought was reasonable, given their horsepower. From previous experiences, we knew that those machines could do a lot more.
- Finally, from a software standpoint, we found ourselves pushed into an "optimization corner" where we had started to trade off readability and flexibility of the codebase for performance and efficiency.

We concluded that we needed to start a project to re-envision our system. We set three goals and challenges for ourselves:

- We wanted big infrastructure wins in performance, efficiency, and reliability — we wanted to improve the median latency that users experience on Twitter as well as bring in the outliers to give a uniform experience to Twitter. We wanted to reduce the number of machines needed to run Twitter by 10x. We also wanted to isolate failures across our infrastructure to prevent large outages — this is especially important as the number of machines we use go up, because it means that the chance of any single machine failing is higher. Failures are also inevitable, so we wanted to have them happen in a much more controllable manner.
- We wanted cleaner boundaries with "related" logic being in one place — we felt the downsides of running our particular monolithic codebase, so we wanted to experiment with a loosely coupled services oriented model. Our goal was to encourage the best practices of encapsulation and modularity, but this time at the systems level rather than at the class, module, or package level.
- Most importantly, we wanted to launch features faster. We wanted to be able to run small and empowered engineering teams that could make local decisions and ship user-facing changes, independent of other teams.

We prototyped the building blocks for a proof of concept re-architecture. Not everything we tried worked and not everything we tried, in the end, met the above goals. But we were able to settle on a set of principles, tools, and an infrastructure that has gotten us to a much more desirable and reliable state today.

The JVM vs the Ruby VM

First, we evaluated our front-end serving tier across three dimensions: CPU, RAM, and network. Our Ruby-based machinery was being pushed to the limit on the CPU and RAM dimensions — but we weren't serving that many requests per machine nor were we coming close to saturating our network bandwidth. Our Rails servers, at the time, had to be effectively single threaded and handle only one request at a time. Each Rails host was running a number of Unicorn processes to provide host-level concurrency, but the duplication there translated to wasteful resource utilization. When it came down to it, our Rails servers were only capable of serving 200 - 300 requests / sec / host.

Twitter's usage is always growing rapidly, and doing the math there, it would take a lot of machines to keep up with the growth curve.

At the time, Twitter had experience deploying fairly large scale JVM-based services — our search engine was written in Java, and our Streaming Api infrastructure as well as Flock, our social graph system, was written in Scala. We were enamored by the level of performance that the JVM gave us. It wasn't going to be easy to get our performance, reliability, and efficiency goals out of the Ruby VM, so we embarked on writing code to be run on the JVM instead. We estimated that rewriting our codebase could get us > 10x performance improvement, on the same hardware — and now, today, we push on the order of 10 - 20K requests / sec / host.

There was a level of trust that we all had in the JVM. A lot of us had come from companies where we had experience working with, tuning, and operating large scale JVM installations. We were confident we could pull off a sea change for Twitter in the world of the JVM. Now, we had to decompose our architecture and figure out how these different services would interact.

Programming model

In Twitter's Ruby systems, concurrency is managed at the process level: a single network request is queued up for a process to handle. That process is completely consumed until the network request is fulfilled. Adding to the complexity, architecturally, we were taking Twitter in the direction of having one service compose the responses of other services. Given that the Ruby process is single-threaded, Twitter's "response time" would be additive and extremely sensitive to the variances in the back-end systems' latencies. There were a few Ruby options that gave us concurrency; however, there wasn't one standard way to do it across all the different VM options. The JVM had constructs and primitives that supported concurrency and would let us build a real concurrent programming platform.

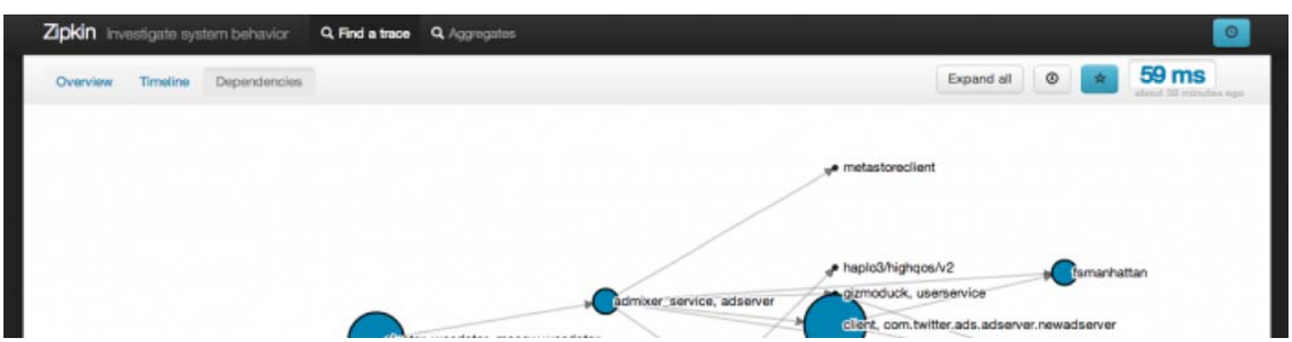
It became evident that we needed a single and uniform way to think about concurrency in our systems and, specifically, in the way we think about networking. As we all know, writing concurrent code (and concurrent networking code) is hard and can take many forms. In fact, we began to experience this. As we started to decompose the system into services, each team took slightly different approaches. For example, the failure semantics from clients to services didn't interact well: we had no consistent backpressure mechanism for servers to signal back to clients and we experienced "thundering herds" from clients aggressively retrying latent services. These failure domains informed us of the importance of having a unified, and complementary, client and server library that would bundle in notions of connection pools, failover strategies, and load balancing. To help us all get in the same mindset, we put together both Futures and Finagle.

Now, not only did we have a uniform way to do things, but we also baked into our core libraries everything that all our systems needed so we could get off the ground faster. And rather than worry too much about how each and every system operated, we could focus on the application and service interfaces.

Independent systems

The largest architectural change we made was to move from our monolithic Ruby application to one that is more services oriented. We focused first on creating Tweet, timeline, and user services — our "core nouns". This move afforded us cleaner abstraction boundaries and team-level ownership and independence. In our monolithic world, we either needed experts who understood the entire codebase or clear owners at the module or class level. Sadly, the codebase was getting too large to have global experts and, in practice, having clear owners at the module or class level wasn't working. Our codebase was becoming harder to maintain, and teams constantly spent time going on "archeology digs" to understand certain functionality. Or we'd organize "whale hunting expeditions" to try to understand large scale failures that occurred. At the end of the day, we'd spend more time on this than on shipping features, which we weren't happy with.

Our theory was, and still is, that a services oriented architecture allows us to develop the system in parallel — we agree on networking RPC interfaces, and then go develop the system internals independently — but, it also meant that the logic for each system was self-contained within itself. If we needed to change something about Tweets, we could make that change in one location, the Tweet service, and then that change would flow throughout our architecture. In practice, however, we find that not all teams plan for change in the same way: for example, a change in the Tweet service may require other services to do an update if the Tweet representation changed. On balance, though, this works out more times than not.



This system architecture also mirrored the way we wanted, and now do, run the Twitter engineering organization. Engineering is set up with (mostly) self-contained teams that can run independently and very quickly. This means that we bias toward teams spinning up and running their own services that can call the back end systems. This has huge implications on operations, however.

Storage

Even if we broke apart our monolithic application into services, a huge bottleneck that remained was storage. Twitter, at the time, was storing tweets in a single master MySQL database. We had taken the strategy of storing data temporally — each row in the database was a single tweet, we stored the tweets in order in the database, and when the database filled up we spun up another one and reconfigured the software to start populating the next database. This strategy had bought us some time, but, we were still having issues ingesting massive tweet spikes because they would all be serialized into a single database master so we were experiencing read load concentration on a small number of database machines. We needed a different partitioning strategy for Tweet storage.

We took Gizzard, our framework to create sharded and fault-tolerant distributed databases, and applied it to tweets. We created T-Bird. In this case, Gizzard was fronting a series of MySQL databases — every time a tweet comes into the system, Gizzard hashes it, and then chooses an appropriate database. Of course, this means we lose the ability to rely on MySQL for unique ID generation. Snowflake was born to solve that problem. Snowflake allows us to create an almost-guaranteed globally unique identifier. We rely on it to create new tweet IDs, at the tradeoff of no longer having "increment by 1" identifiers. Once we have an identifier, we can rely on Gizzard then to store it. Assuming our hashing algorithm works and our tweets are close to uniformly distributed, we increase our throughput by the number of destination databases. Our reads are also then distributed across the entire cluster, rather than being pinned to the "most recent" database, allowing us to increase throughput there too.

Observability and statistics

We've traded our fragile monolithic application for a more robust and encapsulated, but also complex, services oriented application. We had to invest in tools to make managing this beast possible. Given the speed with which we were creating new services, we needed to make it incredibly easy to gather data on how well each service was doing. By default, we wanted to make data-driven decisions, so we needed to make it trivial and frictionless to get that data.

As we were going to be spinning up more and more services in an increasingly large system, we had to make this easier for everybody. Our Runtime Systems team created two tools for engineering: Viz and Zipkin. Both of these tools are exposed and integrated with Finagle, so all services that are built using Finagle get access to them automatically.

```
stats.timeFuture("request_latency_ms") {
// dispatch to do work
}
```

The above code block is all that is needed for a service to report statistics into Viz. From there, anybody using Viz can write a query that will generate a timeseries and graph of interesting data like the 50th and 99th percentile of request_latency_ms.

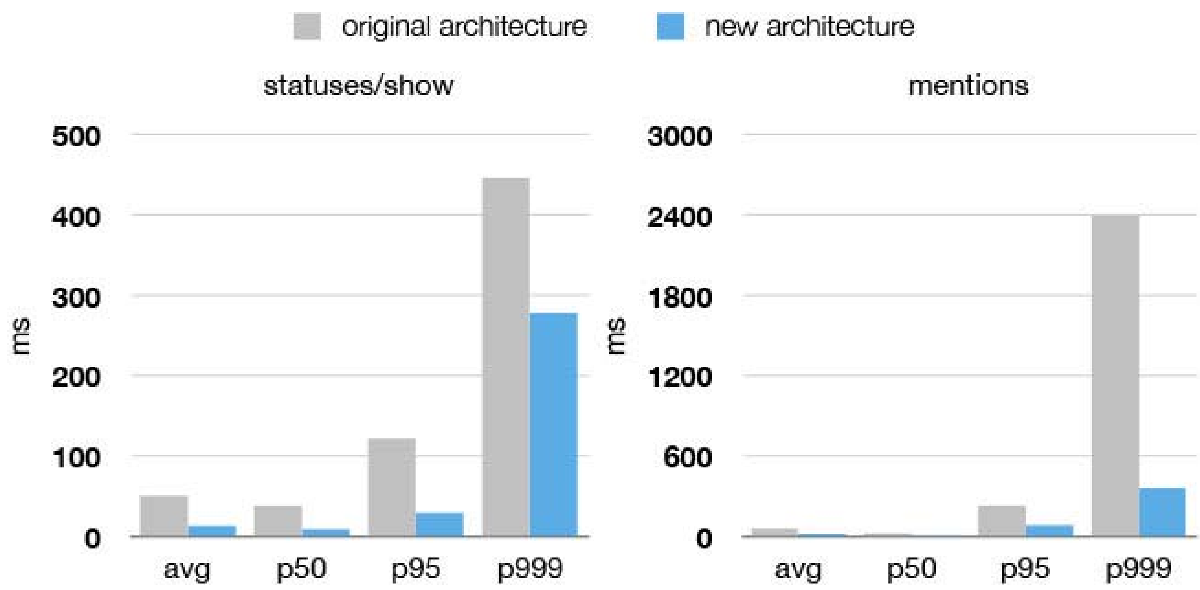
Runtime configuration and testing

Finally, as we were putting this all together, we hit two seemingly unrelated snags: launches had to be coordinated across a series of different services, and we didn't have a place to stage services that ran at "Twitter scale". We could no longer rely on deployment as the vehicle to get new user-facing code out there, and coordination was going to be required across the application. In addition, given the relative size of Twitter, it was becoming difficult for us to run meaningful tests in a fully isolated environment. We had, relatively, no issues testing for correctness in our isolated systems — we needed a way to test for large scale iterations. We embraced runtime configuration.

We integrated a system we call Decider across all our services. It allows us to flip a single switch and have multiple systems across our infrastructure all react to that change in near-real time. This means software and multiple systems can go into production when teams are ready, but a particular feature doesn't need to be "active". Decider also allows us to have the flexibility to do binary and percentage based switching such as having a feature available for x% of traffic or users. We can deploy code in the fully "off" and safe setting, and then gradually turn it up and down until we are confident it's operating correctly and systems can handle the new load. All this alleviates our need to do any coordination at the team level, and instead we can do it at runtime.

Today

Twitter is more performant, efficient and reliable than ever before. We've sped up the site incredibly across the 50th (p50) through 99th (p99) percentile distributions and the number of machines involved in serving the site itself has been decreased anywhere from 5x-12x. Over the last six months, Twitter has flirted with four 9s of availability.



Twitter engineering is now set up to mimic our software stack. We have teams that are ready for long term ownership and to be experts on their part of the Twitter infrastructure. Those teams own their interfaces and their problem domains. Not every team at Twitter needs to worry about scaling Tweets, for example. Only a few teams — those that are involved in the running of the Tweet subsystem (the Tweet service team, the storage team, the caching team, etc.) — have to scale the writes and reads of Tweets, and the rest of Twitter engineering gets APIs to help them use it.

Two goals drive us as we did all this work: Twitter should always be available for our users, and we should spend our time making Twitter more engaging, more useful and simply better for our users. Our systems and our engineering team now enable us to launch new features faster and in parallel. We can dedicate different teams to work on improvements simultaneously and have minimal logjams for when those features collide. Services can be launched and deployed independently from each other (in the last week, for example, we had more than 50 deploys across all Twitter services), and we can defer putting everything together until we're ready to make a new build for iOS or Android.

Keep an eye on this blog and @twittereng for more posts that will dive into details on some of the topics mentioned above.

Thanks goes to Jonathan Reichhold (@jreichhold), David Helder (@dhelder), Arya Asemanfar (@a_a), Marcel Molina (@noradio), and Matt Harris (@themattharris) for helping contribute to this blog post.

Older post Newer post

Under the hood

Tools, projects & community

engineering.twitter.com

Tweets Follow

Apache Mesos @ApacheMesos 28 Jul

Register for @MesosCon by 7/31 and save $100, the conference is less than a month away! mesos.apache.org/blog/register-... #Mesos

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Expand

Finagle @finagle 28 Jul

Join us at @TwitterSF for #FinagleCon on August 13 to hear @marius, @pcalcado, and many others talk about Finagle: finagle.github.io/finaglecon/

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Twitter @twitter 23 Jul

Congratulations @GirlsWhoCode graduates!

Tweet to @TwitterEng

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trends (1)
Fabric (1)
developers (1)
events (1)
Twitter data (1)
visualizations (1)
web scale (3)
distributed database (1)

Show more tags

Tweet 3,869