

Cisco Visual Networking Index – Forecast and Methodology, 2007–2012



This forecast is part of the Cisco Visual Networking Index, an ongoing initiative to track and forecast the impact of visual networking applications. The purpose of this paper is to lay out the details of Cisco's global IP traffic forecast and the methodology behind it. For a more analytical look at the implications of the data presented below, please see the companion article to this paper entitled "Approaching the Zettabyte Era"

June 16, 2008

Executive Summary

In 2012, the total annual volume of IP traffic will reach half a zettabyte. At 44 exabytes per month, the annual run rate of traffic will be 522 exabytes per year. A zettabyte, or 1,000 exabytes, will be the new milestone to look for beyond 2012.

IP traffic will nearly double every two years through 2012. Total IP traffic will increase by a factor of six from 2007 to 2012. Driven by high-definition video and high-speed broadband penetration, consumer IP traffic will bolster the overall IP growth rate so that it sustains a steady growth rate through 2012, growing at a compound annual growth rate (CAGR) of 46 percent.

Last year was a year of phenomenal growth in IP and Internet traffic. Total IP traffic grew 55 percent during 2007, and is estimated to grow by 63 percent in 2008. Internet traffic grew 46 percent in 2007, and is estimated to increase 51 percent in 2008.

Traffic from all applications grew in volume in 2007, but the traffic mix shifted considerably. Peer-to-peer (P2P) file sharing networks are now carrying 600 petabytes per month more than they did this time last year, which means there is the equivalent of an additional 150 million DVDs crossing the network each month, for a total monthly volume of over 500 million DVD equivalents, or two exabytes. Despite this growth, P2P as a percentage of consumer Internet traffic dropped to 51 percent at the end of 2007, down from 60 percent the year before. The decline in traffic-share is due primarily to the increasing share of video traffic. A secondary factor in the decline is a trend toward web-based file sharing in place of P2P file sharing in some regions.

Video is now approximately one-quarter of all consumer Internet traffic, not including the amount of video exchanged through P2P file sharing. Internet video grew from 12 percent in 2006 to 22 percent in 2007, and will reach 32 percent by the end of this year.

Internet video will account for 50 percent of all consumer Internet traffic in 2012. Internet video-to-PC will make up the majority of Internet video at 40 percent of total Internet traffic, but Internet video-to-TV will grow rapidly to 10 percent of the total in 2012.

Non-Internet IP video will increase more rapidly than consumer Internet. The twin trends of on-demand viewing and high-definition video are generating very rapid growth in cable video and IPTV traffic transported over IP in the metro. Consumer IPTV and CATV traffic will grow at a 68 percent compound annual growth rate (CAGR) between 2007 and 2012, compared to a CAGR of 43 percent for consumer Internet traffic.

Mobile data traffic will double each year from now through 2012. Mobile broadband-enabled laptops are creating sharp increases in mobile traffic. In some parts of the world, mobile broadband is becoming a substitute for fixed broadband.

Japan's mobile data and Internet traffic was still twice as high as that of any other region in 2007. However, by 2009, North America will surpass Japan in mobile traffic, as will the rest of Asia-Pacific.

Internet traffic is growing fastest in Latin America, followed by Western Europe and Asia-Pacific. The rapidly increasing Internet penetration and the advent of high-speed connections to a greater number of universities and businesses will result in Latin America having the highest growth rate through 2012.

Business IP traffic will grow at a CAGR of 35 percent from 2007 to 2012. Increased broadband penetration in the small business segment and the increased adoption of advanced video communications in the enterprise segment will result in a CAGR of 35 percent for business IP traffic from 2007 to 2012.

Business Internet traffic will grow fastest in developing markets and Asia-Pacific. North America, Western Europe, and Japan will have slower growth rates. In volume, North America will continue to have the most business IP traffic through 2011, followed by Western Europe and Asia-Pacific.

Global IP Traffic Growth 2006–2011

Table 1 shows the top-line forecast. According to this forecast, global IP traffic in 2008 stands at more than 10 exabytes per month, more than quadrupling to reach 44 exabytes per month in 2012. Consumer IP traffic will exceed 32 exabytes per month, business IP traffic will approach 10 exabytes per month, and mobility traffic will exceed 1.6 exabyte per month.

Table 1. Global IP Traffic 2006–2012

IP Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Type (PB per month)								
Internet	3,339	4,884	7,394	10,666	14,984	20,662	28,339	42%
Non-Internet IP	895	1,693	3,353	5,630	9,244	12,321	15,179	55%
By Segment (PB per month)								
Consumer	2,641	4,359	7,674	12,003	18,261	24,760	32,183	49%
Business	1,586	2,193	3,008	4,140	5,622	7,479	9,839	35%
Mobility	7	26	65	153	345	744	1,496	125%
By Geography (PB per month)								
North America	1,471	2,419	3,997	5,912	8,542	10,694	14,309	43%
Western Europe	886	1,354	2,267	3,591	5,504	7,646	10,882	52%
Asia Pacific	1,307	1,963	3,151	4,740	7,071	10,152	12,319	44%
Japan	267	373	571	843	1,217	1,637	2,021	40%
Latin America	118	189	332	554	891	1,390	2,020	61%
Central Eastern Europe	116	172	264	414	656	983	1,307	50%
Middle East and Africa	69	107	164	243	347	481	659	44%
Total (PB per month)								
Total IP traffic	4,234	6,577	10,747	16,296	24,228	32,983	43,518	46%

Source: Cisco, 2008

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

Mobility: includes mobile data and Internet traffic generated by handsets, notebook cards, WiMAX

Internet: denotes all IP traffic that crosses an Internet backbone

Non-Internet IP: includes corporate IP WAN traffic, IP transport of TV/VoD, and mobile “walled garden” traffic

Generally, this forecast relies on analyst projections for Internet users, broadband connections, video subscribers, mobile connections, and Internet application adoption. Our trusted analyst forecasts come from Kagan, Ovum, Informa, IDC, Gartner, ABI, AMI, Screendigest, and Parks Associates. Additional splits of the forecast and details of the methodology for each segment and type can be found in the sections that follow.

Consumer IP Traffic 2006–2012

As shown in Table 2, global consumer IP traffic is expected to surpass 32 exabytes per month in 2012. The majority of today’s consumer IP traffic is Internet traffic, but consumer IPTV and VoD traffic will grow more rapidly at a CAGR of more than 68 percent.

Table 2. Global Consumer IP Traffic 2006–2012

Consumer IP Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Type (PB per month)								
Internet	2,280	3,397	5,315	7,735	10,884	14,950	20,331	43%
Non-Internet IP	361	962	2,359	4,268	7,378	9,810	11,852	65%
By Geography (PB per month)								
North America	848	1,571	2,862	4,371	6,446	7,866	10,522	46%
Western Europe	589	947	1,704	2,816	4,438	6,191	8,884	56%
Asia Pacific	917	1,406	2,356	3,604	5,472	7,959	9,323	46%
Japan	131	190	321	499	743	989	1,151	43%
Latin America	68	114	217	366	596	899	1,182	60%
Central Eastern Europe	68	98	156	259	437	679	889	55%
Middle East and Africa	20	34	57	89	129	176	233	47%
Total (PB per month)								
Consumer IP traffic	2,641	4,359	7,674	12,003	18,261	24,760	32,183	49%

Source: Cisco, 2008

Consumer Internet Traffic 2006–2012

This category encompasses any IP traffic that crosses the Internet and is not confined to a single service provider's network. Peer-to-peer (P2P) traffic, still the largest share of Internet traffic today, will decrease as a percentage of overall Internet traffic. Internet video streaming and downloads are beginning to take a larger share of bandwidth, and will grow to nearly 50 percent of all consumer Internet traffic in 2012.

Table 3. Global Consumer Internet Traffic 2006–2012

Consumer Internet Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Sub-Segment (PB per month)								
Web, email, data	509	710	999	1,336	1,785	2,337	3,087	34%
P2P	1,358	1,747	2,361	3,075	3,981	5,161	6,740	31%
Gaming	91	131	187	252	324	399	490	30%
Video communications	16	25	37	49	70	103	154	44%
VoIP	23	39	56	72	87	101	114	24%
Internet video to PC	269	647	1,346	2,196	3,215	4,501	6,216	57%
Internet video to TV	14	99	330	756	1,422	2,348	3,529	104%
By Geography (PB per month)								
North America	605	862	1,251	1,705	2,219	2,818	3,452	32%
Western Europe	530	821	1,395	2,203	3,308	4,812	6,791	53%
Asia Pacific	890	1,342	2,113	3,035	4,255	5,818	8,101	43%
Japan	114	158	226	308	406	526	644	32%
Latin America	60	98	163	246	363	516	721	49%
Central Eastern Europe	65	91	127	178	247	341	463	38%
Middle East and Africa	15	26	41	60	86	118	159	43%

Consumer Internet Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
Total (PB per month)								
Consumer Internet traffic	2,280	3,397	5,315	7,735	10,884	14,950	20,331	43%

Source: Cisco, 2008

Definitions

Web, Email, and Data: includes web, email, instant messaging, newsgroups, and file transfer (excluding P2P and commercial file transfer such as iTunes)

P2P: includes peer-to-peer traffic from all recognized P2P systems such as BitTorrent, eDonkey, etc.

Gaming: includes casual online gaming, networked console gaming, and multiplayer virtual world gaming

Video Communications: includes PC-based video calling, webcam viewing, and web-based video monitoring

VoIP: includes traffic from retail VoIP services and PC-based VoIP, but excludes wholesale VoIP transport

Internet Video to PC: free or pay TV or VoD viewed on a PC, excludes P2P video file downloads

Internet Video to TV: free or pay TV or VoD delivered via Internet but viewed on a TV screen using a STB or media gateway

Crosscheck: Japan's Ministry of Internal Affairs and Communications estimates that broadband Internet traffic averaged 636.6 Gbps, or 206 petabytes per month, as of November 2006, and 235 petabytes per month at the end of 2007. Andrew Odlyzko publishes the most recent data on Japan and other countries on [his website at the University of Minnesota](#). The Ministry's traffic figures most likely include business broadband connections in addition to consumer, since service providers often do not distinguish between residences and small offices. Cisco's estimate for total Internet traffic in Japan in 2006 is 200 petabytes per month for 2006, and 270 petabytes per month in 2007. Consumer traffic is estimated by Cisco to have been 114 petabytes per month in 2006 and 150 petabytes per month in 2007.

Web, Email, and Data

This is a general category that encompasses web browsing, email, instant messaging, data (which includes file transfer using HTTP, FTP, etc.) and other Internet applications. Note that "data" may include the download of video files that are not captured by the "Internet video to PC" forecast. It includes traffic generated by all individual Internet users. An Internet user is here defined as someone who accesses the Internet through a desktop or laptop at home, school, Internet café, or other location outside the context of a business.

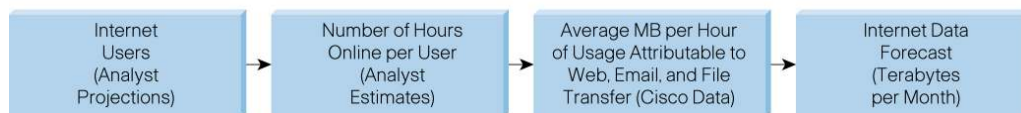
Table 4. Global Consumer Web, Email, and Data Traffic 2006–2012

Consumer Web, Email, and Data Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Geography (PB per month)								
North America	152	209	280	365	478	620	799	31%
Western Europe	113	153	205	274	364	469	604	32%
Asia Pacific	168	244	369	507	692	925	1,266	39%
Japan	34	42	54	67	82	97	116	23%
Latin America	12	19	31	44	65	91	128	46%
Central Eastern Europe	23	31	42	55	70	89	112	29%
Middle East and Africa	7	12	17	24	34	46	62	40%
Total (PB per month)								
Consumer web, data	509	710	999	1,336	1,785	2,337	3,087	34%

Source: Cisco, 2008

Figure 1 shows the methodology behind the web, email, and data traffic forecast.

Figure 1. Methodology for Consumer Web, Email, and Data Traffic Forecast



Analyst projections used in this portion were from IDC, Ovum, and Gartner.

Peer-to-Peer (P2P)

This category includes traffic from P2P applications such as BitTorrent and eDonkey. Note that a large portion of P2P traffic is due to the exchange of video files, so a total view of the impact of video on the network should count P2P video traffic (estimated to be approximately 60 to 70 percent of P2P) in addition to the traffic counted in the “Internet Video to PC” and “Internet Video to TV” categories. Table 5 shows the forecast for consumer P2P traffic from 2006 to 2012.

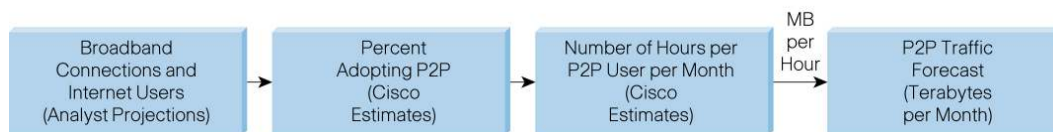
Table 5. Global Consumer Peer-to-Peer Traffic 2006–2012

Consumer Peer-to-Peer 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Geography (PB per month)								
North America	370	416	493	570	632	736	842	15%
Western Europe	304	378	484	620	801	1,014	1,299	28%
Asia Pacific	556	773	1,125	1,534	2,074	2,774	3,754	37%
Japan	49	63	88	112	140	181	220	29%
Latin America	38	61	97	140	203	284	397	45%
Central Eastern Europe	37	47	62	82	107	137	179	30%
Middle East and Africa	5	7	11	17	24	34	49	46%
Total (PB per month)								
Consumer P2P	1,358	1,747	2,361	3,075	3,981	5,161	6,740	31%

Source: Cisco, 2008

Figure 2 shows the methodology behind the P2P forecast.

Figure 2. Methodology for Consumer Peer-to-Peer Traffic Forecast



Internet Gaming

The “Internet Gaming” category includes only the traffic generated from gameplay. The download of the game is included in “Web, Email, and Data.” Table 6 shows the forecast for Internet Gaming from 2006 to 2012.

Table 6. Global Consumer Internet Gaming Traffic 2006–2012

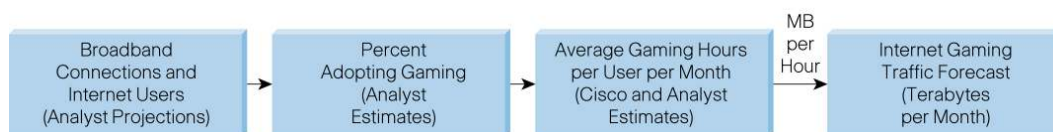
Consumer Gaming 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Geography (PB per month)								
North America	14	17	21	26	32	38	45	22%
Western Europe	16	30	48	67	84	94	105	28%
Asia Pacific	52	71	97	130	170	214	274	31%
Japan	8	11	17	23	31	41	52	36%
Latin America	1	1	1	2	3	4	5	43%
Central Eastern Europe	1	1	2	3	4	5	6	46%
Middle East and Africa	0	0	1	1	2	2	3	48%
Total (PB per month)								
Consumer gaming	91	131	187	252	324	399	490	30%

Source: Cisco, 2008

Crosscheck: World of Warcraft announced in early 2008 that they had reached 10 million active subscribers, up from 8 million in early 2007. Other massive multiplayer online role-playing games (MMORPGs) have a total of approximately 7 million subscribers¹. If the average MMORPG gamer plays 80 hours per month² per game, at 20 MB per hour, the total monthly MMORPG gaming traffic in late 2007 would be 27 PB per month. This would mean our estimate for 2007, which includes casual gaming, first-person shooters, and online console gaming, is approximately five times MMORPG traffic, which is within reason.

Figure 3 shows a simplified illustration of the methodology behind the gaming forecast.

Figure 3. Methodology for Consumer Internet Gaming Traffic Forecast



This methodology was applied separately to casual gaming, MMO gaming, and console gaming.

Voice over IP (VoIP)

This category includes phone-based VoIP services direct from a service provider, phone-based VoIP services offered by a third-party but transported by a service provider, and softphone-based Internet VoIP applications such as Skype. Table 7 shows the global forecast for consumer VoIP to 2012.

¹ Source: Woodcock, Bruce Sterling. “An Analysis of MMOG Subscription Growth” MMOGCHART.COM 23.0. April 2008. <http://www.mmogchart.com>

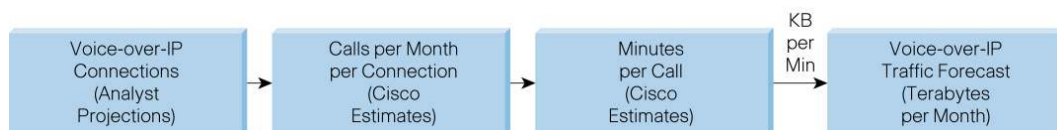
² According to a survey conducted by Nick Yee at Stanford, MMORPG players spent 22 hours per week in gameplay. Yee, N. (2006). The Demographics, Motivations and Derived Experiences of Users of Massively-Multiuser Online Graphical Environments. PRESENCE: Teleoperators and Virtual Environments, 15, 309-329.

Table 7. Global Consumer VoIP Traffic 2006–2012

Consumer Voice-over-IP Traffic, 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Geography (PB per month)								
North America	4	6	8	10	12	13	14	17%
Western Europe	6	10	15	19	23	27	30	24%
Asia Pacific	7	14	20	27	34	41	48	28%
Japan	5	6	8	9	10	11	12	14%
Latin America	0	1	1	2	3	3	4	36%
Central Eastern Europe	1	1	2	2	3	4	4	33%
Middle East and Africa	0	1	1	1	2	2	3	37%
Total (PB per month)								
Consumer VoIP	23	39	56	72	87	101	114	24%

Source: Cisco, 2008

Figure 4 shows a simplified illustration of the methodology behind the VoIP forecast.

Figure 4. Methodology for Consumer Voice-over-IP Traffic Forecast

Video Communications

The “Video Communications” category includes Internet video calling, video instant messaging, video monitoring, and webcam traffic. This segment is relatively small for the forecast period, but is included for tracking purposes, because it is expected to experience substantial long-term growth in the 2012–2017 timeframe.

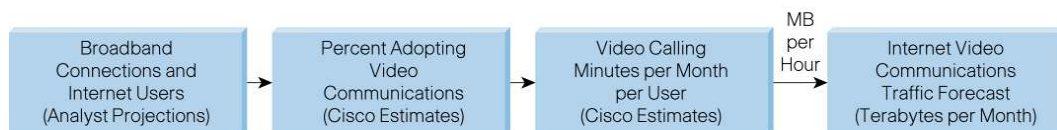
Table 8. Global Consumer Internet Video Communications 2006–2012

Consumer Internet Video Communications 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Geography (PB per month)								
North America	3	4	5	6	8	11	13	29%
Western Europe	5	7	10	13	17	27	53	50%
Asia Pacific	6	12	20	25	40	58	79	46%
Japan	1	1	1	1	1	2	2	28%
Latin America	1	1	1	1	1	2	2	28%
Central Eastern Europe	0	1	1	1	2	2	2	30%
Middle East and Africa	0	0	0	0	1	1	1	35%
Total (PB per month)								
Consumer video communications	16	25	37	49	70	103	154	44%

Source: Cisco, 2008

Figure 5 shows a simplified illustration of the methodology behind the video communications forecast.

Figure 5. Methodology for Consumer Internet Video Communications Traffic Forecast



Internet Video to PC

“Internet Video to PC” refers to online video that is downloaded or streamed for viewing on a PC screen. It excludes peer-to-peer downloads, and is distinct from Internet-delivery of video to a TV screen through a set-top box or equivalent device. Much of the video viewed on PC is short-form content, and the bulk is made up of free clips, episodes, and other content offered by traditional content producers such as movie studios and television networks.

Table 9. Global Consumer Internet Video-to-PC Traffic

Consumer Internet Video to PC 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Geography (PB per month)								
North America	59	156	270	389	505	635	771	38%
Western Europe	83	227	571	975	1,459	2,062	2,852	66%
Asia Pacific	99	210	414	686	1,028	1,469	2,137	59%
Japan	13	25	36	53	73	100	121	37%
Latin America	9	14	29	50	77	115	161	64%
Central Eastern Europe	4	9	16	30	53	91	138	74%
Middle East and Africa	2	6	9	14	20	28	35	42%
Total (PB per month)								
Consumer Internet video to PC	269	647	1,346	2,196	3,215	4,501	6,216	57%

Source: Cisco, 2008

Crosscheck: Global YouTube traffic is estimated to have generated 15–20 petabytes per month at the end of 2006. Our estimate for user-generated content viewing traffic in that year is approximately 27 petabytes per month.

Crosscheck: comScore estimates that in the United States, 10.2 billion online video streams were initiated in December 2007. If each stream generated 10 megabytes of traffic, the total for the United States would be 102 petabytes for the month of September, up from approximately 43 petabytes for the month of March 2007. Compare this to our North American estimate of 163 petabytes per month of Internet video-to-PC traffic by year-end 2007. Cisco’s Internet-video-to-PC category includes a certain amount of traffic that is excluded from the comScore estimates, such as videos from government websites and certain Internet television applications such as Joost.

Figure 6 shows a simplified illustration of the methodology behind the video-to-PC forecast.

Figure 6. Methodology for Consumer Internet Video-to-PC Traffic Forecast



Internet Video to TV

“Internet Video to TV” includes video delivered via Internet to a TV screen, by way of an Internet-enabled set-top box or equivalent device. Examples of devices now available include Apple TV, Tivo Series3, and Microsoft’s Xbox 360, through which users can download film and television content.

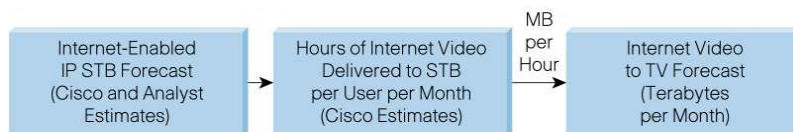
Table 10. Global Consumer Internet Video-to-TV Traffic 2006–2012

Consumer Internet Video to TV 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Geography (PB per month)								
North America	4	54	174	338	553	765	968	78%
Western Europe	3	14	61	236	561	1,118	1,848	167%
Asia Pacific	2	19	67	125	217	336	544	96%
Japan	5	10	22	43	68	95	120	64%
Latin America	0	1	3	7	11	16	22	101%
Central Eastern Europe	0	1	2	5	8	13	20	84%
Middle East and Africa	0	0	1	2	3	5	6	87%
Total (PB per month)								
Consumer video to TV	14	99	330	756	1,422	2,348	3,529	104%

Source: Cisco, 2008

Figure 7 shows a simplified illustration of the methodology behind the video-to-TV. Analyst projections were used for networked consoles, IPTV set-top boxes (STBs), and non-service-provider Internet STBs. For cable Internet-enabled STBs, Cisco’s own forecast was used.

Figure 7. Methodology for Consumer Internet Video-to-TV Traffic Forecast



Crosscheck: At the end of 2007 there were approximately 10 million Xbox consoles in North America capable of downloading video. If 30 percent of those consoles downloaded 5 hours of content per month, that would generate approximately 30 petabytes per month. Our estimate for Internet-to-TV in North America for 2007 is 54 petabytes, the remainder made up by Internet-enabled STBs and other gaming consoles.

Consumer Non-Internet IP Traffic 2006–2011

“Non-Internet IP Video” refers to IP traffic generated by traditional commercial TV services. This traffic remains within the footprint of a single service provider, so it is not considered Internet traffic. (For Internet video delivered to the set-top box, please see “Internet Video to TV” in the previous section.)

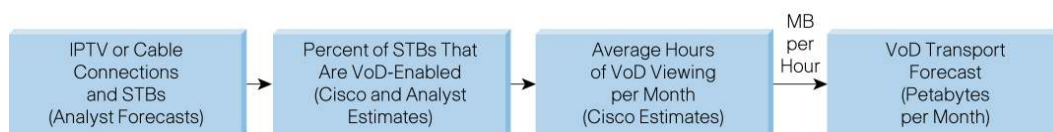
Table 11. Global Consumer Non-Internet IP Traffic 2006–2012

Consumer Non-Internet IP Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Sub-Segment (PB per month)								
Cable VoD	334	883	2,078	3,535	5,655	6,996	7,565	54%
Cable IP VoD	0	3	48	198	635	1,277	2,144	269%
IPTV VoD	25	73	230	531	1,083	1,532	2,138	97%
Broadcast	3	3	3	4	4	5	5	12%
By Geography (PB per month)								
North America	243	709	1,611	2,666	4,226	5,048	7,070	58%
Western Europe	59	126	309	612	1,129	1,378	2,092	75%
Asia Pacific	27	64	244	569	1,218	2,141	1,222	80%
Japan	17	32	95	191	337	463	507	74%
Latin America	7	16	54	120	233	383	461	95%
Central Eastern Europe	2	7	29	81	190	339	426	125%
Middle East and Africa	5	7	17	29	44	58	74	60%
Total (PB per month)								
Non-Internet IP video traffic	361	962	2,359	4,268	7,378	9,810	11,852	65%

Source: Cisco, 2008

Figure 8 shows a simplified illustration of the methodology behind the VoD portion of the non-Internet IP traffic forecast.

Figure 8. Methodology for VoD Transport Traffic Forecast



Given the importance of this forecast to the top-line amount of traffic, more details on the assumptions follow:

- **IPTV or cable connections and STBs:** Trusted analyst sources for this data were Kagan, MRG, and Gartner.
- **Percent of STBs that are VoD-enabled:** The percentage of digital STBs that are VoD-enabled varies by region. In North America, nearly all digital STBs are VoD-enabled. In other regions the percentage is lower. Trusted analyst sources for this were Kagan and ABI.
- **Average hours of VoD viewing per month:** We adopted a conservative estimate of VoD views per STB per month in order to compensate for (1) users who are VoD-enabled but do not use VoD and (2) VoD streams that are terminated before completion (believed to

constitute 25 percent of all VoD views). In 2007, we assumed that 4 percent of total household viewing hours per month were VoD. In North America, where the average household views 8 hours of television per day, this would amount to 342 million hours per month.

Crosscheck: In mid-2008, Comcast's VoD views were approximately 300 million per month, up from 150 million per month in mid-2006. Time Warner's VoD views were 110 million per month, and the other cable operators are estimated to generate another 250 million, for a total of 660 million VoD views per month in North America at the end of 2007. Assuming each view is approximately 30 minutes, this would amount to approximately 330 million hours per month, which is very close to Cisco's estimate. (Source: Comcast, Time Warner, Kagan, 2008.)

Our model assumes that VoD's share of overall household viewing hours will increase gradually, reaching approximately 12 percent of viewing hours in 2012.

- **Percent of VoD that is transported over IP in the metro:** It was assumed that in most regions, once a VoD-enabled STB is deployed, the cable operator is transporting the VoD traffic over IP in the metro. All IPTV VoD traffic is assumed to travel over IP in both the metro and core.
- **MB per hour:** The bandwidth consumed per hour is expected to grow with the availability of high-definition content and the penetration of high-definition STBs. In addition, the model factored in the bandwidth savings that will accompany DOCSIS 3.0 (MPEG-4) and switched digital video. Other means of bandwidth recovery were not considered in this version of the forecast.

Business IP Traffic

The enterprise forecast is based on the number of network-connected computers worldwide. In our experience, this provides the most accurate measure of enterprise data usage. An average business user might generate 4 gigabytes per month of Internet and WAN traffic. A large-enterprise user would generate significantly more traffic, 8–10 GB per month.

Table 12. Business IP Traffic 2006–2012

Business IP Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Sub-Segment (PB per month)								
Business Internet traffic	1,055	1,469	2,031	2,811	3,818	5,076	6,677	35%
Business IP WAN traffic	531	723	977	1,329	1,804	2,404	3,162	34%
By Geography (PB per month)								
North America	620	840	1,115	1,492	1,991	2,624	3,409	32%
Western Europe	295	405	554	747	989	1,284	1,642	32%
Asia Pacific	389	553	784	1,112	1,543	2,076	2,755	38%
Japan	134	175	233	311	412	541	705	32%
Latin America	50	74	112	180	274	395	568	50%
Central Eastern Europe	49	73	105	149	206	280	380	39%
Middle East and Africa	49	73	105	149	206	280	380	39%
Total (PB per month)								
Business IP Traffic	2,279	3,417	5,383	7,806	10,939	14,988	20,341	35%

Source: Cisco, 2008

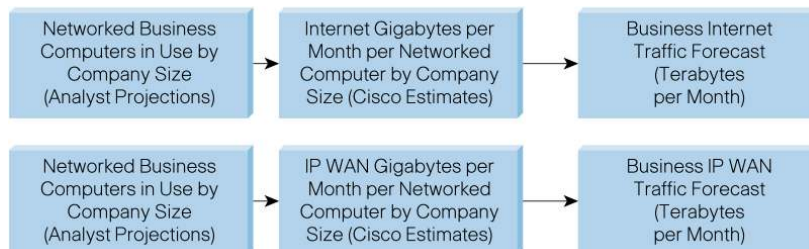
Definitions

Business Internet Traffic: all business traffic that crosses the public Internet

Business IP WAN: all business traffic that is transported over IP but remains within the corporate WAN, excluding storage or backup transfer.

Figure 9 shows a simplified illustration of the methodology behind the business IP traffic forecast.

Figure 9. Methodology for Business IP Traffic Forecast



Mobile Data and Internet Traffic

Mobile data traffic includes handset-based data traffic, such as text messaging, multimedia messaging, and handset video services. Mobile Internet traffic is generated by wireless cards for portable computers, Wi-Fi hotspots, and handset-based mobile Internet usage.

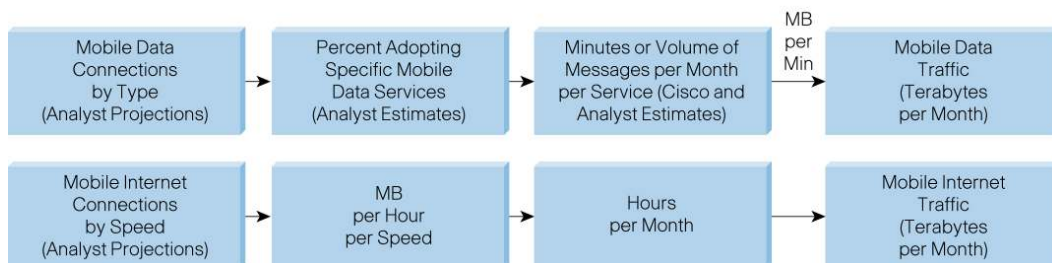
Table 13. Mobile Data and Internet Traffic 2006–2012

Mobile Data and Internet Traffic 2006–2012								
	2006	2007	2008	2009	2010	2011	2012	CAGR 2007–2012
By Sub-Segment (PB per month)								
Mobile Internet	7	26	65	153	345	744	1,496	125%
By Geography (PB per month)								
North America	2	8	21	48	105	203	378	116%
Western Europe	1	2	10	28	77	171	357	171%
Asia Pacific	1	4	10	25	56	118	241	125%
Japan	2	8	17	34	62	107	165	82%
Latin America	0	1	3	8	21	96	271	199%
Central Eastern Europe	0	1	3	6	13	24	38	99%
Middle East and Africa	0	1	2	5	11	25	45	133%
Total (PB per month)								
Mobile data and Internet	7	26	65	153	345	744	1,496	125%

Source: Cisco, 2008

Figure 10 shows a simplified illustration of the methodology behind the mobile data and Internet traffic forecast.

Figure 10. Methodology for Mobile Data and Internet Traffic Forecast



Frequently Asked Questions

Q. Have there been any methodological changes in the latest forecast update?

A. The only methodological change since the January 2008 forecast is that the “Multinationals” category of business traffic was eliminated. Instead of treating multinationals separately, traffic from offices of multinationals is now counted in the respective regions where the offices are located.

Q. The growth rate seems high. I have heard that Internet traffic growth is slowing.

A. The model estimates that Internet traffic grew 46 percent from 2006 to 2007. This growth rate is in line with estimates from [Andrew Odlyzko at the University of Minnesota](#), widely recognized as an authority on Internet traffic. Cisco does project a slight increase in the growth from 2007 to 2008 of 51 percent, followed by 44 percent for 2009 and 40 percent for 2010, and continuing to decline in subsequent years. Cisco’s forecast is considered conservative by most industry analysts.

Q. The growth rate seems low, given the rapid adoption of video.

A. There is no question that video is driving a substantial amount of traffic. However, the volumes are so large that sustaining high growth rates becomes increasingly difficult. For instance, despite a declining growth rate, Cisco is projecting that global Internet traffic in 2012 will be over a thousand times greater than all the traffic traversing the U.S. Internet backbone in 2000.

Q. Why is VoIP traffic so low?

A. While immensely popular, VoIP is very lightweight in terms of bandwidth. However, it is an important consideration for service providers in that quality of service (QoS) is important for voice, and one strategy for improving QoS is to increase capacity so that there is always sufficient bandwidth for the speedy transport of time-sensitive voice and video traffic.

Q. Does this forecast include signaling traffic?

A. No, signaling traffic is not included. However, an estimate can be made using the standard rule that IP signaling traffic is approximately 3 percent of bearer traffic.

Q. Why is broadcast TV traffic so low in comparison to VoD traffic?

A. Broadcast traffic is low because it is a one-to-many service rather than a one-to-one service, like VoD. For each VoD request, a new stream must be served, whereas when hundreds of people tune in to the same television show, only one copy of this show needs to cross most of the network, until close to the edge where it is split and sent over each access line. In this forecast, the access-line traffic for broadcast TV is not included.

Q. What about satellite video traffic?

A. Because satellite is similar to broadcast in that it is one-to-many, the exclusion of satellite from the forecast is not expected to make any significant difference. However, many analysts believe that direct broadcast satellite (DBS) providers will move to establish a broadband connection to the home (possibly through WiMAX), in order to be able to offer on-demand content, Internet content, and interactive content. This scenario has not been included in this forecast, but has been considered by the analyst whose WiMAX connections forecast has been incorporated into our assumptions.

Q. What about digital terrestrial video traffic?

A. Like satellite, digital terrestrial television (DTT) is a one-to-many service, so the exclusion of DTT is not expected to materially impact the accuracy of the forecast. Also similar to satellite,

Pay-OTT providers may move to establish a broadband connection to the home in order to be able to offer on-demand content, Internet content, and interactive content. This scenario has not been included in this forecast, because the penetration of OTT remains low throughout the forecast period. This may be included in future versions of the forecast.

Q. Why isn't Internet gaming traffic more significant in 2012?

A. First-person shooters (FPS) are the most bandwidth-intensive games at over 50 MB per hour of play. However, FPS are played by a minority of gamers. The most popular games, such as casual online games, non-shooter console games, and multiplayer virtual worlds, are surprisingly lightweight in terms of traffic, partly because much of the graphical processing and rendering occurs on the client side, which is downloaded once and then does not cross the network again after download. There is a possibility that multiplayer games will break into the mainstream, whereas we assume that online gamers constitute a maximum of approximately 40 percent of the online population, and that multiplayer gamers are a maximum of approximately 40 percent of the gaming population. Please see the companion paper "Approaching the Zettabyte Era" for consideration of this and other alternative scenarios.

For More Information

For more information, see the companion paper "Approaching the Zettabyte Era." Inquiries can be directed to Arielle Sumits and Jaak Defour at traffic-inquiries@cisco.com.



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.

CCDE, CCENT, Cisco Eos, Cisco Lumin, Cisco Nexus, Cisco StadiumVision, the Cisco logo, DCE, and Welcome to the Human Network are trademarks; Changing the Way We Work, Live, Play, and Learn is a service mark; and Access Registrar, Aironet, AsyncOS, Bringing the Meeting To You, Catalyst, CCDA, CCDP, CCIE, CCIP, CCNA, CCNP, CCSP, CCVP, Cisco, the Cisco Certified Internetwork Expert logo, Cisco IOS, Cisco Press, Cisco Systems, Cisco Systems Capital, the Cisco Systems logo, Cisco Unity, Collaboration Without Limitation, EtherFast, EtherSwitch, Event Center, Fast Step, Follow Me Browsing, FormShare, GigaDrive, HomeLink, Internet Quotient, IOS, iPhone, iQ Expertise, the iQ logo, iQ Net Readiness Scorecard, iQuick Study, IronPort, the IronPort logo, LightStream, Linksys, MediaTone, MeetingPlace, MGX, Networkers, Networking Academy, Network Registrar, PCNow, PIX, PowerPanels, ProConnect, ScriptShare, SenderBase, SMARTnet, Spectrum Expert, StackWise, The Fastest Way to Increase Your Internet Quotient, TransPath, WebEx, and the WebEx logo are registered trademarks of Cisco Systems, Inc. and/or its affiliates in the United States and certain other countries.

All other trademarks mentioned in this document or Website are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (0805R)