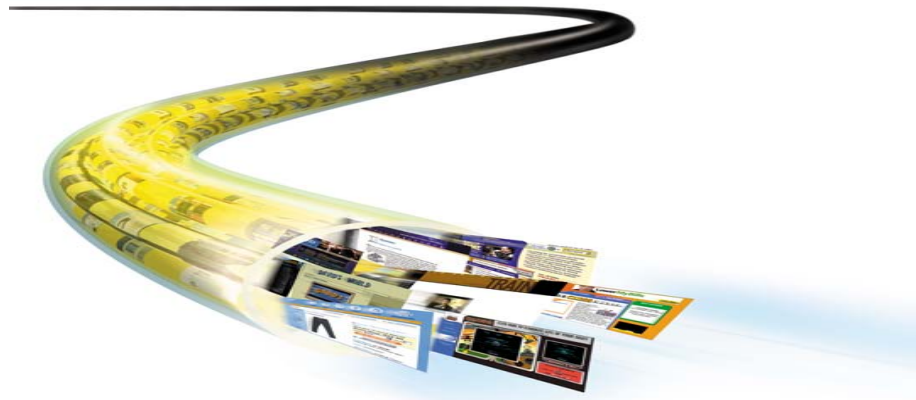


Global IP Traffic Forecast and Methodology, 2006–2011



Cisco® has developed a model for the estimation of future global IP traffic growth. The purpose of this white 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 “The Exabyte Era.”

Updated January 14, 2008

EXECUTIVE SUMMARY

After a brief mid-decade slowdown, IP traffic will nearly double every two years through 2011. Total IP traffic will nearly quadruple in the four-year period from 2007 to 2011. 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 fairly steady growth rate through 2011, growing at a compound annual growth rate (CAGR) of 46 percent and nearly quadrupling the monthly traffic run rate from 2007 to 2011.

Consumer IP traffic will grow faster than business IP traffic. Consumer IP traffic will grow at a CAGR of 52 percent from 2006 to 2011, compared to 29 percent for business IP traffic. Mobility traffic will grow at a CAGR of 116 percent from 2006 to 2011.

Consumer IP traffic generated by the transport of cable and IPTV video-on-demand (VoD) content will grow faster than consumer Internet traffic. Consumer IPTV and IP VoD traffic will grow at a CAGR of 81 percent, while consumer Internet will grow at a rate of 42 percent.

There will be higher growth in metro networks than backbone networks over the next five years. Likewise, there will be higher growth in non-Internet traffic than Internet. In 2011, only 57 percent of consumer IP traffic will be Internet traffic, while 43 percent will be traffic generated by the delivery of traditional commercial video services over IP within a single operator’s network. This is a dramatic shift from the composition of 2006 consumer IP traffic, over 82 percent of which is Internet traffic. While Internet video also experiences high growth, the bulk of the traffic growth will

occur in single-operator metro networks to support the delivery of video over IP.

Peer-to-peer traffic still dominates Internet traffic and growth is not slowing. Peer-to-peer traffic is not expected to decrease over the forecast period. Instead, it will nearly quadruple from 1,330 petabytes per month in 2006 to 5,270 petabytes per month in 2011, driven by the global increase in high-speed broadband penetration, the increasing use of peer-to-peer for standard-definition video file exchange, and the advent of high-definition video file exchange and television content via peer-to-peer.

Despite its continued growth, peer-to-peer (P2P) traffic 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 from 9 percent of all consumer Internet traffic in 2006 to 30 percent in 2011. P2P makes up 62 percent of all consumer Internet traffic in 2006, but despite quadrupling in size, will only make up 43 percent of consumer Internet traffic in 2011.

Internet video will account for 30 percent of all consumer Internet traffic in 2011. Internet video-to-PC will make up the majority of Internet video at 19 percent of total Internet traffic, but Internet-video-to-TV will grow rapidly to 10 percent of the total in 2011.

Internet video-to-TV will increase by more than a factor of 12 from 2007 to 2011. Internet video-to-PC will nearly quintuple over the same four-year period. Internet-enabled set-top boxes are currently available for purchase by consumers, and will be increasingly deployed by IPTV and (later) cable providers. While Internet video-to-PC is dominated by short-form and lower-quality content, video-to-TV traffic will be composed by longer-form and higher-definition content, which means that the far smaller number of video-to-TV streamers and downloads will generate a larger amount of traffic than the greater number of video-to-PC viewers.

Internet traffic is growing fastest in developing markets, followed closely by Asia-Pacific. Even though Internet video is not yet a large factor in developing markets, the rapidly increasing Internet penetration and the advent of high-speed connections to a greater number of universities will result in developing markets having the highest growth rate through 2011.

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.

Business IP traffic will grow at a CAGR of 29 percent from 2006 to 2011. Increased broadband penetration in the small business segment will result in a CAGR of 30 percent for business Internet from 2006 to 2011. Business IP WAN traffic will grow at a slightly slower 27 percent during the same period, driven by the adoption of video applications.

Japan's mobile data and Internet traffic was over sixty percent higher than any other region in 2006. However, by 2008, North America will surpass Japan, as will the rest of Asia-Pacific in 2009.

Together, traffic from 3.5G and WiMAX will make up over half of all mobile data traffic by 2011. Starting in 2008, laptops equipped with 3.5G and WiMAX cards will drive traffic growth.

GLOBAL IP TRAFFIC GROWTH 2005–2011

Table 1 shows the top-line forecast. According to this forecast, global IP traffic in 2007 stands at more than 6 exabytes per month, more than quadrupling to reach 29 exabytes per month in 2011.

Consumer IP traffic will surpass 21 exabytes per month, business IP traffic will surpass 5 exabytes per month, and mobility traffic will exceed 1 exabyte per month.

Table 1. Global IP Traffic 2005–2011

IP Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Type (TB per month)							
Internet	2,342,040	3,199,476	4,675,176	6,734,408	9,221,807	12,440,474	17,338,055
Non-Internet IP	619,814	1,032,438	1,965,863	3,619,219	5,565,951	8,160,182	11,170,878
By Segment (TB per month)							
Consumer	1,753,835	2,634,266	4,517,377	7,518,085	10,982,792	15,465,157	21,598,484
Business	1,200,039	1,569,541	2,043,607	2,656,143	3,445,987	4,423,645	5,585,983
Mobility	7,980	28,108	80,055	179,399	358,980	711,855	1,324,466
By Geography (TB per month)							
North America	917,055	1,268,229	2,304,148	3,729,587	5,277,613	7,026,136	9,247,759
Western Europe	577,826	873,241	1,366,014	2,285,228	3,460,202	5,150,920	7,254,806
Asia-Pacific	783,145	1,142,999	1,666,813	2,473,818	3,417,631	4,735,557	7,068,908
Japan	115,221	190,295	289,000	469,772	720,026	1,060,265	1,409,521
Latin America	69,475	100,701	148,817	231,130	341,888	510,870	734,983
Central Eastern Europe	57,314	82,290	121,292	191,718	304,276	487,817	737,943
Middle East and Africa	27,840	44,970	69,369	110,216	165,872	242,005	337,659
Multinationals (Business)	413,979	529,189	675,586	862,157	1,100,250	1,387,087	1,717,354
Total (TB per month)							
Total IP Traffic	2,961,854	4,231,915	6,641,039	10,353,626	14,787,759	20,600,657	28,508,933

Cisco, 2008

Definitions:

Consumer – includes fixed IP traffic generated by households, university populations, and Internet cafés

Business – includes all fixed IP WAN or Internet traffic generated by organizations (including government)

Mobility – includes mobile data and Internet traffic generated by handsets, notebook cards, Wi-Fi hotspots, 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

Multinationals – includes business traffic that could not be determined to fall within a particular geographical boundary

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, Parks Associates, and Pyramid. 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 2005–2011

As shown in Table 2, global consumer IP traffic is expected to surpass 21 exabytes per month in 2011. 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 80 percent.

Table 2. Global Consumer IP Traffic 2005–2011

Consumer IP Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Type (TB per month)							
Internet	1,564,822	2,153,473	3,257,572	4,801,670	6,571,044	8,783,838	12,289,906

Non-Internet IP	189,014	480,793	1,259,806	2,716,414	4,411,748	6,681,318	9,308,579
By Geography (TB per month)							
North America	668,726	933,975	1,852,607	3,116,600	4,440,485	5,851,336	7,609,884
Western Europe	357,545	579,262	974,453	1,757,338	2,739,745	4,158,731	5,880,001
Asia Pacific	589,170	879,474	1,306,090	1,969,218	2,711,981	3,746,362	5,676,794
Japan	63,076	115,847	179,095	317,493	508,745	770,685	1,019,772
Latin America	21,979	39,755	68,510	126,214	204,604	330,405	496,548
Central Eastern Europe	41,400	61,624	94,250	156,328	257,762	426,624	657,693
Middle East and Africa	11,938	24,329	42,372	74,894	119,469	181,014	257,793
Total (TB per month)							
Total Consumer IP Traffic	1,753,835	2,634,266	4,517,377	7,518,085	10,982,792	15,465,157	21,598,484

Cisco, 2008

CONSUMER INTERNET TRAFFIC 2005–2011

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 from 9 percent of all consumer Internet traffic in 2006 to 30 percent in 2011. P2P makes up 62 percent of all consumer Internet traffic in 2006, but despite quadrupling in size, will only make up 43 percent of consumer Internet traffic in 2011.

Internet video-to-TV will increase by more than a factor of twelve from 2007 to 2011. Internet video-to-PC will increase by a factor of five. Internet video-to-TV begins to catch up with Internet video-to-PC towards the end of the forecast period.

Table 3. Global Consumer Internet Traffic 2005–2011

Consumer Internet Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Sub-Segment (terabytes per month)							
Web, e-mail, file transfer	362,084	505,996	692,812	948,425	1,233,172	1,603,615	2,756,415
P2P	1,060,226	1,329,770	1,772,403	2,379,025	3,111,891	4,040,403	5,269,360
Gaming	66,844	91,943	133,367	188,680	250,574	318,212	386,832
Video Communications	11,629	15,575	24,932	36,638	47,173	66,101	92,453
VoIP	10,965	23,035	39,339	57,653	75,575	92,815	110,456
Internet Video to PC	53,074	174,427	484,027	838,154	1,232,461	1,726,114	2,331,908
Internet Video to TV	0	12,727	110,692	353,095	620,197	936,580	1,342,482
By Geography (TB per month)							
North America	534,236	618,765	917,365	1,287,026	1,698,700	2,242,841	2,861,772
Western Europe	334,600	505,329	814,015	1,281,041	1,856,310	2,515,070	3,458,721
Asia Pacific	565,782	819,072	1,201,277	1,742,834	2,315,755	3,049,294	4,663,774
Japan	60,080	98,747	147,733	223,120	319,788	436,057	556,631
Latin America	19,917	33,755	57,083	90,765	130,466	189,992	268,559
Central Eastern Europe	40,773	59,097	86,196	122,272	165,387	222,895	294,901
Middle East and Africa	9,435	18,708	33,904	54,613	84,637	127,689	185,549
Total (TB per month)							
Consumer Internet Traffic	1,564,822	2,153,473	3,257,572	4,801,670	6,571,044	8,783,838	12,289,906

Cisco, 2008

Definitions:

Web, E-mail, and File Transfer – includes Web, e-mail, 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 consumer broadband Internet traffic averaged 636.6 Gbps, or 206 petabytes per month, as of November 2006. Cisco's estimate for consumer Internet traffic in Japan in 2006 is 150 petabytes per month.

Web, E-mail, and File Transfer

This is a general category that encompasses Web browsing, e-mail, instant messaging, file transfer (using HTTP, FTP, etc.) and other Internet applications. Note that “file transfer” may include the download of video files that are not captured by the “Internet video to PC” forecast. 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. Note: Internet café traffic excludes hotspot and Wi-Fi mesh traffic, which are included under mobility. While fixed WiMAX connections are included in the broadband population, mobile and portable WiMAX connections are included under Mobility.

Table 4. Global Consumer Web, E-mail, and File Transfer Traffic 2005–2011

Consumer Web, E-mail, File Transfer Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Geography (TB per month)							
North America	117,296	156,652	208,935	271,981	342,190	429,152	537,527
Western Europe	78,851	114,199	157,777	214,498	283,394	374,524	479,487
Asia Pacific	116,875	165,501	227,935	321,704	418,615	541,760	1,389,036
Japan	17,593	23,692	30,258	40,276	51,311	64,540	83,472
Latin America	9,786	14,165	21,632	33,266	45,711	65,857	92,403
Central Eastern Europe	17,495	24,145	33,345	45,995	60,253	79,615	103,450
Middle East and Africa	4,187	7,641	12,929	20,705	31,699	48,167	71,039
Total (TB per month)							
Web, E-mail, File Traffic	362,084	505,996	692,812	948,425	1,233,172	1,603,615	2,756,415

Cisco, 2008

Figure 1 shows the methodology behind the Web, e-mail, and file transfer traffic forecast.

Figure 1. Methodology for Consumer Web, E-mail, and File Transfer Traffic Forecast



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

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 2005 to 2011.

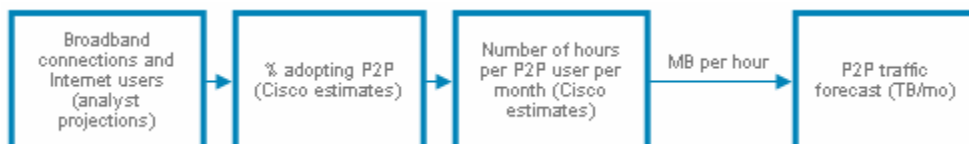
Table 5. Global Consumer Peer-to-Peer Traffic 2005–2011

Consumer Peer-to-Peer Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Geography (TB per month)							
North America	381,746	378,538	462,356	560,817	673,083	852,483	1,080,979
Western Europe	223,519	304,988	411,057	540,032	757,818	991,817	1,330,885
Asia Pacific	391,235	550,664	762,276	1,074,759	1,401,028	1,811,094	2,327,648
Japan	28,621	42,883	58,463	87,446	117,967	154,868	206,803
Latin America	8,732	14,358	23,247	37,284	53,587	80,043	117,731
Central Eastern Europe	22,075	31,009	43,117	59,928	79,589	106,543	141,282
Middle East and Africa	4,297	7,329	11,886	18,759	28,819	43,553	64,033
Total (TB per month)							
Peer-to-Peer Traffic	1,060,226	1,329,770	1,772,403	2,379,025	3,111,891	4,040,403	5,269,360

Cisco, 2007

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, E-mail, and File Transfer.” Table 6 shows the forecast for Internet Gaming from 2005 to 2011.

Table 6. Global Consumer Internet Gaming Traffic 2005–2011

Consumer Internet Gaming Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Geography (TB per month)							
North America	12,289	14,278	17,508	21,711	26,830	33,088	40,213
Western Europe	9,256	16,144	30,635	48,859	67,323	84,320	95,246
Asia Pacific	39,221	51,721	69,657	93,160	119,447	149,297	181,675
Japan	5,274	8,306	12,974	20,691	30,550	42,435	57,339
Latin America	318	570	983	1,610	2,350	3,284	4,438
Central Eastern Europe	332	607	1,036	1,685	2,546	3,576	4,854
Middle East and Africa	154	316	574	964	1,528	2,211	3,066
Total (TB per month)							
Internet Gaming Traffic	66,844	91,943	133,367	188,680	250,574	318,212	386,832

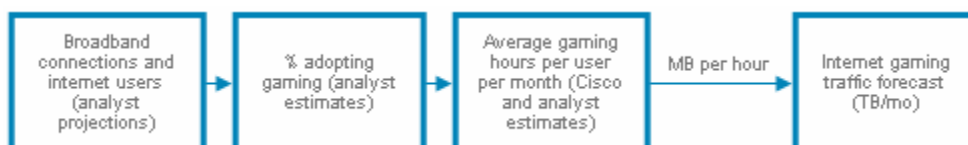
Cisco, 2008

Crosscheck: World of Warcraft announced in early 2007 that they had reached 8 million active subscribers, globally. Other massive multiplayer online role-playing games (MMORPGs) have a

total of approximately 10 million subscribers¹. If the average MMORPG gamer plays 60 hours per month² per game, at 12 MB per hour, the total monthly MMORPG gaming traffic in early 2007 would be 13 PB per month. This would mean our estimate for 2006, which includes casual gaming, first-person shooters, and online console gaming, is approximately seven 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 2011.

Table 7. Global Consumer Voice-over-IP Traffic 2005–2011

Consumer Voice-over-IP Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Geography (TB per month)							
North America	1,976	4,455	6,974	10,247	13,305	15,923	18,835
Western Europe	1,835	4,827	8,912	13,687	18,014	21,655	25,753
Asia Pacific	3,315	7,251	13,653	20,310	27,263	34,019	40,775
Japan	3,473	5,231	7,275	9,447	11,444	13,557	15,671
Latin America	93	458	883	1,308	1,853	2,733	3,390
Central Eastern Europe	177	532	1,056	1,671	2,296	3,025	3,684
Middle East and Africa	96	281	587	983	1,401	1,902	2,348
Total (TB per month)							
Consumer VoIP Traffic	10,965	23,035	39,339	57,653	75,575	92,815	110,456

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



¹ Source: Woodcock, Bruce Sterling. "An Analysis of MMOG Subscription Growth" MMOGCHART.COM 21.0. June 2006. <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.

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 2011–2016 time frame.

Table 8. Global Consumer Internet Video Communications 2005–2011

Consumer Internet Video Communications 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Geography (TB per month)							
North America	2,668	2,970	3,889	4,951	6,459	8,695	11,496
Western Europe	3,526	4,893	7,118	9,927	13,736	17,204	25,677
Asia Pacific	4,358	6,225	11,668	18,620	22,881	34,930	48,561
Japan	486	543	701	879	1,184	1,521	2,004
Latin America	235	366	600	871	1,077	1,369	1,703
Central Eastern Europe	245	393	640	921	1,191	1,521	1,900
Middle East and Africa	111	186	317	469	645	861	1,111
Total (TB per month)							
Internet Video Communications Traffic	11,629	15,575	24,932	36,638	47,173	66,101	92,453

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 Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Sub-Segment (TB per month)							
Free Video Traffic	50,349	131,989	385,492	682,502	988,128	1,364,592	1,840,278
Pay TV Traffic	1,757	7,762	15,526	23,351	31,461	40,789	49,575
Pay Movies Traffic	442	908	3,599	9,489	25,312	51,066	74,528

User-Generated Content Traffic	73	31,595	71,986	108,346	155,646	200,991	261,097
Place-Shifting Traffic	453	2,172	7,425	14,465	31,914	68,676	106,430
By Geography (TB per month)							
North America	18,262	58,560	170,319	272,449	387,207	518,203	668,881
Western Europe	17,613	57,289	165,082	333,587	501,301	715,365	992,168
Asia Pacific	10,777	36,258	98,154	154,186	226,318	325,211	469,264
Japan	4,633	13,289	27,891	42,395	64,427	90,867	96,673
Latin America	752	3,775	9,096	13,884	20,084	27,896	37,066
Central Eastern Europe	448	2,326	6,158	9,940	15,200	22,037	30,278
Middle East and Africa	588	2,929	7,328	11,712	17,924	26,537	37,579
Total (TB per month)							
Internet Video to PC	53,074	174,427	484,027	838,154	1,232,461	1,726,114	2,331,908

Cisco, 2008

Definitions:

Free Video Traffic – traffic generated by the viewing of free or ad-supported content offered by content providers

Pay TV Traffic – traffic generated by the purchase and viewing of full-length television content

Pay Movies Traffic – traffic generated by the purchase and viewing of full-length film content

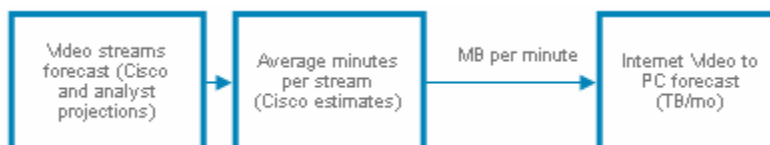
User-Generated Content Traffic – content that has been posted by an individual to a video-sharing site. The content itself is either generated or edited and compiled by the individual

Place-Shifting Traffic – the streaming or download of commercial video content from a person's home to a remote PC or TV

Crosscheck: Global YouTube traffic is estimated to be approximately 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, 9.2 billion online video streams were initiated in September 2007. If each stream generated 10 megabytes of traffic, the total for the United States would be 92 petabytes for the month of September, up from approximately 43 petabytes for the month of March. Compare this to our North American estimate of 170 petabytes per month of Internet video-to-PC traffic by year-end 2007.

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 2005–2011

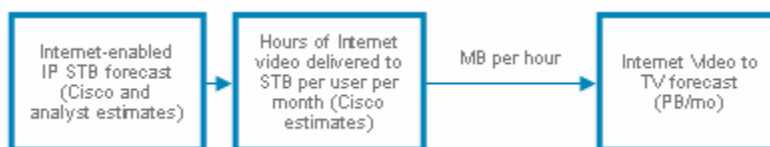
Consumer Internet Video-to-TV Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Geography (TB per month)							
North America	0	3,313	47,384	144,870	249,626	385,297	503,842
Western Europe	0	2,989	33,434	120,451	214,724	310,184	509,503

Asia Pacific	0	1,450	17,935	60,095	100,203	152,984	206,815
Japan	0	4,802	10,171	21,986	42,907	68,268	94,669
Latin America	0	62	642	2,542	5,805	8,811	11,829
Central Eastern Europe	0	85	843	2,130	4,312	6,578	9,453
Middle East and Africa	0	25	283	1,020	2,620	4,458	6,372
Total (TB per month)							
Internet Video to TV	0	12,727	110,692	353,095	620,197	936,580	1,342,482

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 2006 there were approximately 6 million Xbox consoles capable of downloading video. If 20 percent of those consoles downloaded 3 hours of content per month, that would generate 4.5 petabytes per month. Our global estimate for Internet-to-TV for 2006 is approximately three times that amount, the remainder made up by Internet-enabled STBs.

CONSUMER NON-INTERNET IP TRAFFIC 2005–2011

“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 2005–2011

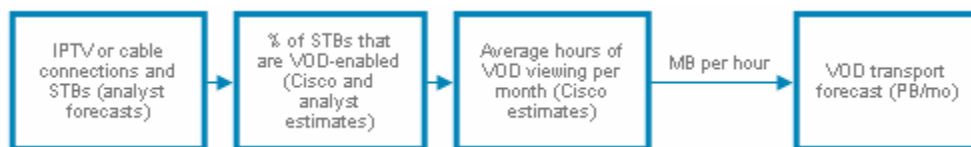
Consumer Non-Internet IP Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Sub-Segment (TB per month)							
Cable VoD	184,105	450,702	1,168,526	2,382,711	3,575,655	4,800,393	5,957,395
Cable IP VoD	0	0	3,346	53,853	223,036	676,742	1,492,947
IPTV VoD	2,500	27,493	85,068	276,611	609,188	1,199,743	1,853,344
By Geography (TB per month)							
North America	134,490	315,210	935,243	1,829,574	2,741,785	3,608,495	4,748,112
Western Europe	22,945	73,933	160,438	476,297	883,434	1,643,660	2,421,280
Asia Pacific	23,388	60,402	104,813	226,383	396,227	697,068	1,013,020
Japan	2,996	17,100	31,362	94,373	188,957	334,629	463,141
Latin America	2,063	6,001	11,427	35,449	74,138	140,412	227,988
Central Eastern Europe	627	2,527	8,054	34,056	92,375	203,729	362,792
Middle East and Africa	2,504	5,621	8,469	20,281	34,833	53,325	72,245
Total (TB per month)							

Non-Internet IP Video Traffic	189,014	480,793	1,259,806	2,716,414	4,411,748	6,681,318	9,308,579
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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 Asia, approximately 25 percent of digital cable STBs will be VoD-enabled by 2011. 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 2006, we assumed that 2 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 166 million hours per month.

Crosscheck: In mid-2006, Comcast's VoD views were approximately 150 million per month, and Time Warner's were 500 million views per month. Assuming each view is approximately 22 minutes, and that 25 percent are terminated after only a few minutes, this would amount to approximately 188 million hours per month, making our estimate conservative. (Source: Comcast, Time Warner, Kagan, 2006.)

Crosscheck: Comcast's cable plants serve 1.5 petabytes per day, or 45 petabytes per month³. At 150 million views per month, this would equate to 300 megabytes per view, which is 20 minutes of standard-definition MPEG-4 video. Reversing the calculation, we can estimate that Comcast serves approximately 50 million hours of content per month. If Time Warner's traffic is three times that of Comcast, there would be a minimum of 200 million hours per month of VoD in early 2007.

Our model assumes that VoD's share of overall household viewing hours will increase gradually, reaching approximately 11 percent of viewing hours in 2011.

³ Source: OneTRAK, 2007

- *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 enterprise user might generate 10 MB per hour of traffic from e-mail, document transfer, and general Internet/intranet use. Video pushes the hourly average up significantly, and a large enterprise user viewing video generates significantly more traffic, 25–50 MB per hour.

Table 12. Business IP Traffic 2005–2011

Business IP Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Sub-Segment (TB per month)							
Business Internet Traffic	770,125	1,019,614	1,340,862	1,758,353	2,300,047	2,957,462	3,741,244
Business IP WAN Traffic	429,913	549,927	702,745	897,790	1,145,940	1,466,183	1,844,739
By Geography (TB per month)							
North America	246,586	327,041	427,715	556,536	721,403	922,976	1,159,318
Western Europe	218,225	288,434	378,009	493,937	642,772	826,786	1,043,898
Asia Pacific	192,944	260,253	349,256	467,607	623,993	823,026	1,063,745
Japan	49,105	62,747	80,978	104,681	135,494	175,669	228,652
Latin America	47,456	60,784	78,525	101,357	130,645	168,537	217,103
Central Eastern Europe and Middle East and Africa	31,744	41,092	53,538	69,868	91,429	119,564	155,914
Multinationals	413,979	529,189	675,586	862,157	1,100,250	1,387,087	1,717,354
Total (TB per month)							
Business IP Traffic	1,200,039	1,569,541	2,043,607	2,656,143	3,445,987	4,423,645	5,585,983

Cisco, 2008

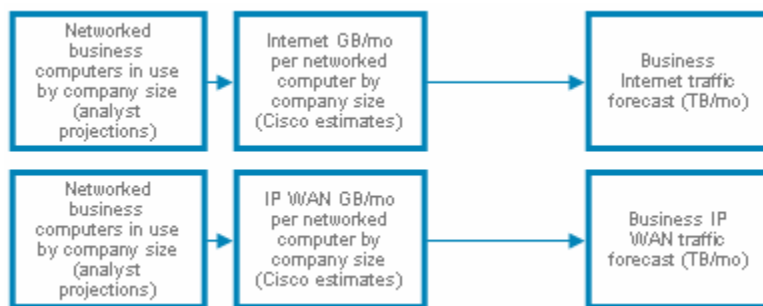
Definitions:

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 back-up 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.

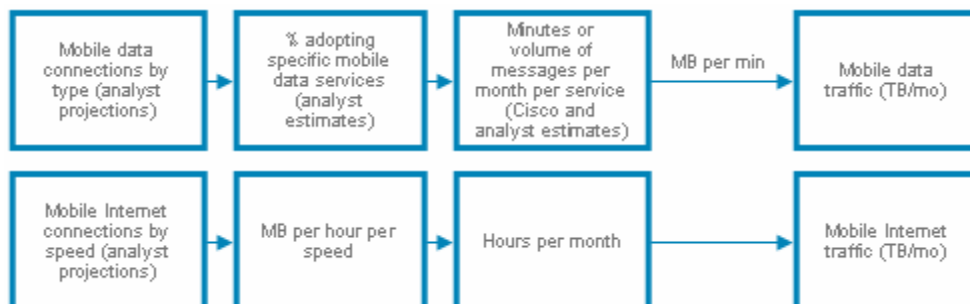
Table 13. Mobile Data and Internet Traffic 2005–2011

Mobile Data and Internet Traffic 2005–2011							
	2005	2006	2007	2008	2009	2010	2011
By Type (TB per month)							
Mobile Data	887	1,718	3,312	5,015	8,263	12,681	17,560
Mobile Internet	7,093	26,390	76,743	174,384	350,716	699,174	1,306,905
By Geography (TB per month)							
North America	1,743	7,212	23,826	56,451	115,726	251,823	478,557
Western Europe	2,055	5,545	13,552	33,952	77,685	165,404	330,907
Asia Pacific	1,032	3,272	11,467	36,993	81,656	166,169	328,370
Japan	3,041	11,701	28,927	47,599	75,787	113,910	161,098
Latin America	39	162	1,782	3,560	6,638	11,929	21,333
Central Eastern Europe	42	120	274	456	799	1,412	2,293
Middle East and Africa	30	96	228	388	688	1,209	1,908
Total (TB per month)							
Mobile Data and Internet	7,980	28,108	80,055	179,399	358,980	711,855	1,324,466

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. 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-DTT 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 DTT 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 2011?

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 "The Exabyte Era" for consideration of this and other alternative scenarios.

FOR MORE INFORMATION

For more information, see the companion paper “The Exabyte Era.” Inquiries can be directed to Arielle Sumits and Jaak Defour at traffic-inquiries@cisco.com.



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