

Cisco Visual Networking Index: Forecast and Methodology, 2016–2021

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This forecast is part of the Cisco® Visual Networking Index™ (Cisco VNI™), an ongoing initiative to track and forecast the impact of visual networking applications. This document presents the details of the Cisco VNI global IP traffic forecast and the methodology behind it. For a more analytical look at the implications of the data presented in this paper, refer to the companion document, [The Zettabyte Era—Trends and Analysis](#), or the [VNI Forecast Highlights tool](#).

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Executive summary

Annual global IP traffic will reach 3.3 ZB (ZB; 1000 Exabytes [EB])

by 2021. In 2016, global IP traffic was 1.2 ZB per year or 96 EB (one billion Gigabytes [GB]) per month. By 2021, global IP traffic will reach 3.3 ZB per year, or 278 EB per month.

Global IP traffic will increase nearly threefold over the next 5 years, and will have increased 127-fold from 2005 to 2021. Overall, IP traffic will grow at a Compound Annual Growth Rate (CAGR) of 24 percent from 2016 to 2021.

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 51 percent in 2016, compared with 32-percent growth in average traffic. Busy-hour Internet traffic will increase by a factor of 4.6 between 2016 and 2021, while average Internet traffic will increase by a factor of 3.2.

Smartphone traffic will exceed PC traffic by 2021. In 2016, PCs accounted for 46 percent of total IP traffic, but by 2021 PCs will account for only 25 percent of traffic. Smartphones will account for 33 percent of total IP traffic in 2021, up from 13 percent in 2016. PC-originated traffic will grow at a CAGR of 10 percent, while TVs, tablets, smartphones, and Machine-to-Machine (M2M) modules will have traffic growth rates of 21 percent, 29 percent, 49 percent, and 49 percent, respectively.

Traffic from wireless and mobile devices will account for more than 63 percent of total IP traffic by 2021. By 2021, wired devices will account for 37 percent of IP traffic, while Wi-Fi and mobile devices will account for 63 percent of IP traffic. In 2016, wired devices accounted for the majority of IP traffic at 51 percent.

Global Internet traffic in 2021 will be equivalent to 127 times the volume of the entire global Internet in 2005. Globally, Internet traffic will reach 30 GB per capita by 2021, up from 10 GB per capita in 2016.

The number of devices connected to IP networks will be three times as high as the global population in 2021. There will be 3.5 networked devices per capita by 2021, up from 2.3 networked devices per capita in 2016. Accelerated in part by the increase in devices and the capabilities of those devices, IP traffic per capita will reach 35 GB per capita by 2021, up from 13 GB per capita in 2016.

Broadband speeds will nearly double by 2021. By 2021, global fixed broadband speeds will reach 53.0 Mbps, up from 27.5 Mbps in 2016.

Video highlights

It would take an individual more than 5 million years to watch the amount of video that will cross global IP networks each month in 2021. Every second, a million minutes of video content will cross the network by 2021.

Globally, IP video traffic will be 82 percent of all consumer Internet traffic by 2021, up from 73 percent in 2016. Global IP video traffic will grow threefold from 2016 to 2021, a CAGR of 26 percent. Internet video traffic will grow fourfold from 2016 to 2021, a CAGR of 31 percent.

Live Internet video will account for 13 percent of Internet video traffic by 2021. Live video will grow 15-fold from 2016 to 2021.

Internet video surveillance traffic increased 72 percent in 2016, from 516 Petabytes (PB) per month at the end of 2015 to 883 PB per month in 2016. Internet video surveillance traffic will increase sevenfold between 2016 and 2021. Globally, 3.4 percent of all Internet video traffic will be due to video surveillance in 2021, up from 1.8 percent in 2016.

Virtual reality and augmented reality traffic will increase 20-fold between 2016 and 2021, at a **CAGR of 82 percent.**

Internet video to TV grew 50 percent in 2016. Internet video to TV will continue to grow at a rapid pace, increasing 3.6-fold by 2021. Internet video-to-TV traffic will be 26 percent of consumer Internet video traffic by 2021, up from 24 percent in 2016.

Consumer Video-on-Demand (VoD) traffic will nearly double by 2021. The amount of VoD traffic in 2021 will be equivalent to 7.2 billion DVDs per month.

Content Delivery Network (CDN) traffic will carry 71 percent of all Internet traffic by 2021. Seventy-one percent of all Internet traffic will cross CDNs by 2021 globally, up from 52 percent in 2016.

Mobile highlights

Globally, mobile data traffic will increase sevenfold between 2016 and 2021. Mobile data traffic will grow at a CAGR of 46 percent between 2016 and 2021, reaching 48.3 EB per month by 2021. Fixed IP traffic will

grow at a CAGR of 21 percent between 2016 and 2021, while mobile traffic grows at a CAGR of 46 percent.

Global mobile data traffic will grow twice as fast as fixed IP traffic from 2016 to 2021. Global mobile data traffic was 7 percent of total IP traffic in 2016, and will be 17 percent of total IP traffic by 2021.

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 42 percent between 2016 and 2021.

IP traffic in North America will reach 85 EB per month by 2021, at a CAGR of 20 percent. Monthly Internet traffic in North America will generate 11 billion DVDs' worth of traffic, or 44.7 EB per month.

IP traffic in Western Europe will reach 37 EB per month by 2021, at a CAGR of 22 percent. Monthly Internet traffic in Western Europe will generate 6 billion DVDs' worth of traffic, or 24.1 EB per month.

IP traffic in Asia Pacific will reach 108 EB per month by 2021, at a CAGR of 26 percent. Monthly Internet traffic in Asia Pacific will generate 14 billion DVDs' worth of traffic, or 56.4 EB per month.

IP traffic in Latin America will reach 16 EB per month by 2021, at a CAGR of 42 percent. Monthly Internet traffic in Latin America will generate 2 billion DVDs' worth of traffic, or 9.9 EB per month.

IP traffic in Central and Eastern Europe will reach 17.0 EB per month by 2021, at a CAGR of 22 percent. Monthly Internet traffic in Central and Eastern Europe will generate 4 billion DVDs' worth of traffic, or 15.9 EB per month.

IP traffic in the Middle East and Africa will reach 16 EB per month by 2021, at a CAGR of 42 percent. Monthly Internet traffic in the Middle East and Africa will generate 3 billion DVDs' worth of traffic, or 10.3 EB per month.

Note: Interactive tools are available for custom highlights and forecast charts by region, by country, by application, and by end-user segment (refer to the [Cisco VNI Forecast Highlights tool](#) and the [Cisco VNI Forecast Widget tool](#)).

Global business highlights

Business IP traffic will grow at a CAGR of 21 percent from 2016 to 2021. Increased adoption of advanced video communications in the enterprise segment will cause business IP traffic to grow by a factor of 3 between 2016 and 2021.

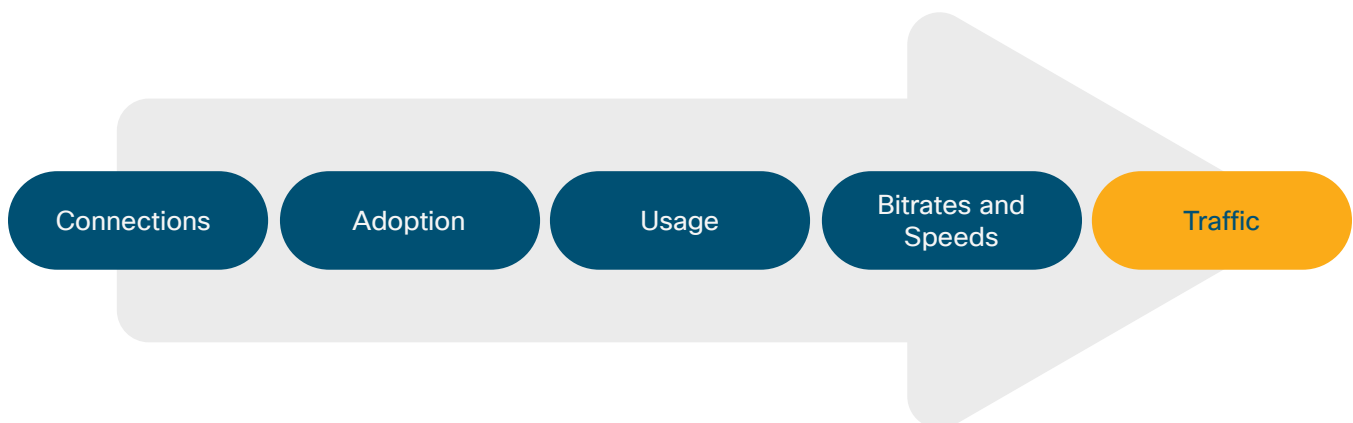
Business Internet traffic will grow at a faster pace than IP WAN. IP WAN will grow at a CAGR of 10 percent, compared with a CAGR of 20 percent for fixed business Internet and 41 percent for mobile business Internet.

Business IP traffic will grow fastest in North America. Business IP traffic in North America will grow at a CAGR of 23 percent, a faster pace than the global average of 21 percent. In volume, Asia Pacific will have the largest amount of business IP traffic in 2021, at 17 EB per month. North America will be the second at 14 EB per month.

Overview of VNI methodology

The Cisco Visual Networking Index Forecast methodology has been developed based on a combination of analyst projections, in-house estimates and forecasts, and direct data collection. The analyst projections for broadband connections, video subscribers, mobile connections, and Internet application adoption come from SNL Kagan, Ovum, Informa Telecoms & Media, Infonetics, IDC, Gartner, AMI, Verto Analytics, Ookla Speedtest.net, Strategy Analytics, Screen Digest, Dell'Oro Group, Synergy, comScore, Nielsen, Maravedis, Machina Research, ACG Research, ABI Research, Media Partners Asia, IHS, International Telecommunications Union (ITU), CTIA, UN, telecommunications regulators, and others. Upon this foundation are layered Cisco's own estimates for application adoption, minutes of use, and kilobytes per minute. The adoption, usage, and bit-rate assumptions are tied to fundamental enablers such as broadband speed and computing speed. All usage and traffic results are then validated using data shared with Cisco from service providers. Figure 1 shows the forecast methodology.

Figure 1. Cisco VNI forecast methodology incorporates fundamental enablers of adoption and usage



Following is the methodology through each step for a single application category (in this case, Internet video) where the estimation process is illustrated.

Step 1: Number of users

The forecast for Internet video begins with estimations of the number of consumer fixed Internet users. Even such a basic measure as consumer fixed Internet users can be difficult to assess, because few analyst firms segment the number of users by both segment (consumer versus business) and network (mobile versus fixed). The number of consumer fixed Internet users was not taken directly from an analyst source but was estimated from analyst forecasts for consumer broadband connections, data on hotspot users from a variety of government sources, and population forecasts by age segment. The number of Internet video users was collected and estimated from a variety of sources, and the numbers were then reconciled with the estimate of overall Internet users.

Step 2: Application adoption

After the number of Internet video users has been established, the number of users for each video subsegment must be estimated. It was assumed that all Internet video users view short-form video in addition to other forms of video they may watch. The number of Internet video users who watch long-form video (based partially on comScore Video Metrix figures for video sites whose average viewing time is longer than 5 minutes), live video, ambient video, and Internet Personal Video Recorder (PVR) is estimated.

Step 3. Minutes of use

For each application subsegment, Minutes of Use (MOU) are estimated. Multiple sources are used to determine MOU. Special care is taken to help ensure that the total number of Internet video minutes is well within the total number of video minutes (including television broadcast) for each user. For example, if the average individual watches a total of 4 hours of video content per day, the sum of Internet, managed IP, and mobile video hours should be a relatively small portion of the total 4 hours.

Step 4. Bit rates

After MOU have been estimated for each sub segment of video, the next step is to apply kilobytes (KB) per minute. To calculate KB per minute, first the regional and country average broadband speeds are estimated for the years 2016 through 2021. For each application category, a representative bit rate is established, and this representative bit rate grows at approximately the same pace as the broadband speed. For video categories, a 7 percent annual compression gain is applied to the bit rate. Local bit rates are then calculated based on how much the average broadband speed in the country differs from the global average, the digital screen size in the country, and the computing power of the average device in the country. Combining these factors yields bit rates that are then applied to the MOU.

Step 5: Rollup

The next step in the methodology is to multiply the bit rates, MOU, and users together to get average PB per month.

Step 6: Traffic migration assessment

The next step is to reconcile the Internet, managed IP, and mobile segments of the forecast. The portion of mobile data traffic that has migrated from the fixed network is subtracted from the fixed forecast, and the amount of mobile data traffic offloaded onto the fixed network through dual-mode devices and femtocells is added back to the fixed forecast.

The sections that follow present quantitative results of the forecast and details of the methodology for each segment and type. Due to rounding, numbers presented in this document may not add up precisely to the totals.

Global IP traffic growth, 2016–2021

Table 1 shows the top-line forecast. According to this forecast, global IP traffic in 2016 stands at 96 EB per month and will nearly triple by 2021, to reach 278 EB per month. Consumer IP traffic will reach 232.7 EB per month and business IP traffic will be 45.5 EB per month by 2021.

Table 1. Global IP traffic, 2016–2021

IP Traffic, 2016–2021							
	2016	2017	2018	2019	2020	2021	CAGR 2016–2021
By Type (Petabytes [PB] per Month)							
Fixed Internet	65,942	83,371	102,960	127,008	155,121	187,386	23%
Managed IP	22,911	27,140	31,304	35,226	38,908	42,452	13%
Mobile data	7,201	11,183	16,646	24,220	34,382	48,270	46%
By Segment (PB per Month)							
Consumer	78,250	99,777	124,689	154,935	190,474	232,655	24%
Business	17,804	21,917	26,220	31,518	37,937	45,452	21%
By Geography (PB per Month)							
Asia Pacific	33,505	43,169	54,402	68,764	86,068	107,655	26%
North America	33,648	42,267	51,722	62,330	73,741	85,047	20%
Western Europe	14,014	17,396	21,167	25,710	30,971	37,393	22%
Central and Eastern Europe	6,210	7,451	8,940	11,016	13,781	17,059	22%
Middle East and Africa	2,679	3,910	5,538	7,773	10,941	15,490	42%
Latin America	5,999	7,502	9,141	10,861	12,909	15,464	21%
Total (PB per Month)							
Total IP traffic	96,054	126,994	150,910	186,453	228,411	278,108	24%

Source: Cisco VNI, 2017

Definitions

- **Consumer:** Includes fixed IP traffic generated by households, university populations, and Internet cafés
- **Business:** Includes fixed IP WAN or Internet traffic generated by businesses and governments
- **Mobile:** Includes mobile data and Internet traffic generated by handsets, notebook cards, and mobile broadband gateways
- **Internet:** Denotes all IP traffic that crosses an Internet backbone
- **Managed IP:** Includes corporate IP WAN traffic and IP transport of TV and VoD

The following tables show cross-tabulations of end-user segment and network type for the final year of the forecast period (2021). Consumer Internet remains the primary generator of IP traffic, but mobile data has the highest growth rate and begins to generate significant traffic by 2021 (Table 2).

Table 2. Exabytes per month as of year end 2021

	Consumer	Business	Total
Internet	154	33	187
Managed IP	37	5	42
Mobile data	41	7	48
Total	233	45	278

Source: Cisco VNI, 2017

Table 3 shows the same data as Table 2, but in terms of annual traffic run rates. These run rates are based on the monthly traffic at the end of 2021.

Table 3. Exabytes per year as of year end 2021

	Consumer	Business	Total
Internet	1,848	400	2,249
Managed IP	447	63	509
Mobile data	497	82	579
Total	2,792	545	3,337

Source: Cisco VNI, 2017

Consumer and business traffic are both dominated by Internet traffic, although business traffic is more evenly distributed across public Internet and managed IP (Table 4).

Table 4. Traffic share by end-user segment as of year end 2021

	Consumer	Business
Internet	66%	73%
Managed IP	16%	12%
Mobile Internet	18%	15%
Total	100%	100%

Source: Cisco VNI, 2017

Consumer traffic accounts for the majority of IP traffic in every network type segment. Consumer traffic will be 82 percent of all fixed Internet traffic, 88 percent of all of managed IP traffic, and 86 percent of all mobile data traffic (Table 5).

Table 5. Traffic share by network type as of year end 2021

	Consumer	Business	Total
Internet	82%	18%	100%
Managed IP	88%	12%	100%
Mobile Internet	86%	14%	100%
Total	84%	16%	100%

Source: Cisco VNI, 2017

Consumer Internet traffic will represent more than half of all IP traffic, followed by consumer-managed IP (VoD), which represents 13 percent of traffic (Table 6).

Table 6. Overall traffic share as of year end 2021

	Consumer	Business	Total
Internet	55%	12%	67%
Managed IP	13%	2%	15%
Mobile data	15%	2%	17%
Total	84%	16%	100%

Source: Cisco VNI, 2017

Consumer IP traffic, 2016–2021

As shown in Table 7, global consumer IP traffic is expected to reach 233 EB per month in 2021. Most of today's consumer IP traffic is Internet traffic.

Table 7. Global consumer IP traffic, 2016–2021

Consumer IP Traffic, 2016–2021							CAGR 2016–2021
	2016	2017	2018	2019	2020	2021	
By Type (PB per Month)							
Internet	52,678	67,081	83,518	103,696	127,152	154,023	24%
Managed IP	19,619	23,351	27,142	30,683	33,978	37,215	14%
Mobile data	5,953	9,345	14,029	20,556	29,343	41,417	47%
By Geography (PB per Month)							
Asia Pacific	27,039	35,160	44,736	56,994	71,703	90,185	27%
North America	28,776	35,823	43,787	52,665	62,147	71,327	20%
Western Europe	11,206	14,084	17,282	21,131	25,539	30,924	23%
Central and Eastern Europe	4,521	5,596	6,892	8,664	10,992	13,776	25%
Middle East and Africa	1,864	2,926	4,379	6,408	9,297	13,505	49%
Latin America	4,844	6,188	7,614	9,073	10,795	12,938	22%
Total (PB per Month)							
Total IP traffic	78,250	99,777	124,689	154,935	190,474	232,655	24%

Source: Cisco VNI, 2017

Consumer internet traffic, 2016–2021

This category encompasses any IP traffic that crosses the Internet and is not confined to a single service provider’s network. Internet video streaming and downloads are beginning to take a larger share of bandwidth and will grow to more than 81 percent of all consumer Internet traffic by 2021 (Table 8).

Table 8. Global consumer internet traffic, 2016–2021

Consumer Internet Traffic, 2016–2021							CAGR 2016–2021
	2016	2017	2018	2019	2020	2021	
By Network (PB per Month)							
Fixed	52,678	67,081	83,518	103,696	127,152	154,023	24%
Mobile	5,953	9,345	14,029	20,556	29,343	41,417	47%
By Subsegment (PB per Month)							
Internet video	42,029	57,116	75,109	98,182	125,853	159,161	31%
Web, email, and data	9,059	10,681	12,864	15,120	17,502	19,538	17%
Online gaming	915	1,818	2,857	4,396	6,753	10,147	62%
File sharing	6,628	6,810	6,717	6,554	6,388	6,595	0%
By Geography (PB per Month)							
Asia Pacific	20,049	26,401	34,179	44,669	57,659	74,419	30%
North America	19,365	25,132	31,802	39,647	48,224	56,470	24%
Western Europe	8,929	11,475	14,344	17,857	22,011	27,211	25%
Central and Eastern Europe	4,206	5,152	6,321	7,960	10,155	12,822	25%
Middle East and Africa	1,771	2,801	4,218	6,209	9,059	13,229	50%
Latin America	4,311	5,466	6,683	7,909	9,387	11,288	21%
Total (PB per Month)							
Consumer Internet traffic	58,630	76,426	97,547	124,252	156,496	195,440	27%

Source: Cisco VNI, 2017

Definitions

- **Web, email, and data:** Includes web, email, instant messaging, and other data traffic (excludes file sharing)
- **File sharing:** Includes peer-to-peer traffic from all recognized peer-to-peer (P2P) systems such as BitTorrent and eDonkey, as well as traffic from web-based file-sharing systems
- **Gaming:** Includes casual online gaming, networked console gaming, and multiplayer virtual-world gaming
- **Internet video:** Includes short-form Internet video (for example, YouTube), long-form Internet video (for example, Hulu), live Internet video, Internet video to TV (for example, Netflix through Roku), online video purchases and rentals, webcam viewing, and web-based video monitoring (excludes P2P video file downloads)

Web, email, and data

This general category encompasses web browsing, email, instant messaging, data (which includes file transfer using HTTP and FTP), and other Internet applications (Table 9). Note that data may include the download of video files that are not captured by the Internet video-to-PC forecast. This category 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 computer at home, school, Internet café, or other location outside the context of a business.

Table 9. Global consumer web, email, and data traffic, 2016–2021

Consumer Web, Email, and Data Traffic, 2016–2021							CAGR 2016–2021
	2016	2017	2018	2019	2020	2021	
By Network (PB per Month)							
Fixed web and data	6,795	7,467	8,569	9,610	10,706	11,337	11%
Mobile web and data	2,263	3,214	4,295	5,509	6,796	8,201	29%
By Geography (PB per Month)							
Asia Pacific	3,393	4,102	5,072	6,160	7,398	8,453	20%
North America	2,578	2,863	3,149	3,410	3,631	3,792	8%
Central and Eastern Europe	1,302	1,404	1,598	1,790	1,994	2,095	10%
Western Europe	693	901	1,177	1,450	1,692	1,882	22%
Middle East and Africa	469	732	1,038	1,358	1,728	2,189	36%
Latin America	624	680	831	953	1,059	1,128	13%
Total (PB per Month)							
Consumer web, email, and data	9,059	10,681	12,864	15,120	17,502	19,538	17%

Source: Cisco VNI, 2017

File sharing

This category includes traffic from P2P applications such as BitTorrent and eDonkey, as well as web-based file sharing. 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 in addition to the traffic counted in the Internet video-to-PC and Internet video-to-TV categories. Table 10 shows the forecast for consumer P2P traffic from 2016 to 2021. Note that the P2P category is limited to traditional file exchange and does not include commercial video-streaming applications that are delivered through P2P, such as PPStream or PPLive.

Table 10. Global consumer file-sharing traffic, 2016–2021

Consumer File Sharing, 2016–2021							CAGR 2016–2021
	2016	2017	2018	2019	2020	2021	
By Network (PB per Month)							
Fixed	6,599	6,773	6,679	6,517	6,353	6,552	0%
Mobile	29	37	38	36	35	43	8%
By Subsegment (PB per Month)							
P2P file transfer	5,376	5,249	4,845	4,334	3,807	3,858	-6%
Other file transfer	1,252	1,561	1,873	2,220	2,581	2,737	17%
By Geography (PB per Month)							
Asia Pacific	2,534	2,571	2,519	2,434	2,290	2,335	-2%
North America	1,204	1,416	1,616	1,824	2,006	2,196	13%
Western Europe	1,178	1,222	1,212	1,190	1,130	1,195	0%
Central and Eastern Europe	927	809	656	532	494	467	-13%
Latin America	671	698	645	536	436	366	-11%
Middle East and Africa	114	94	69	39	33	36	-21%
Total (PB per Month)							
Consumer file sharing	6,628	6,810	6,717	6,554	6,388	6,595	0%

Source: Cisco VNI, 2017

Internet video

With the exception of the Internet video-to-TV subcategory, all of the Internet video subcategories consist of online video that is downloaded or streamed for viewing on a PC screen (Table 11). Internet video to TV is Internet delivery of video to a TV screen through a Set-Top Box (STB) or equivalent device. Much of the video streamed or downloaded through the Internet consists of free clips, episodes, and other content offered by traditional content producers such as movie studios and television networks.

Table 11. Global consumer internet video, 2016–2021

Consumer Internet Video 2016–2021							
	2016	2017	2018	2019	2020	2021	CAGR 2016–2021
By Network (PB per Month)							
Fixed	38,369	51,022	65,413	83,172	103,341	125,988	27%
Mobile	3,660	6,094	9,696	15,010	22,512	33,173	55%
By Category (PB per Month)							
Video	29,325	39,518	51,722	68,279	89,181	116,905	32%
Internet video to TV	12,704	17,598	23,387	29,903	36,672	42,255	27%
By Geography (PB per Month)							
Asia Pacific	13,845	19,228	25,854	35,024	46,423	61,352	35%
North America	15,254	20,114	25,778	32,329	39,275	45,485	24%
Western Europe	6,290	8,520	11,005	14,035	17,533	21,760	28%
Middle East and Africa	1,170	1,944	3,068	4,754	7,218	10,895	56%
Central and Eastern Europe	2,527	3,350	4,369	5,824	7,754	10,170	32%
Latin America	2,943	3,960	5,035	6,215	7,650	9,500	26%
Total (PB per Month)							
Consumer Internet video	42,029	57,116	75,109	98,182	125,853	159,161	31%

Source: Cisco VNI, 2017

Definitions

- **Internet video to TV:** Video delivered through the Internet to a TV screen by way of an Internet-enabled set-top box (for example, Roku) or equivalent device (for example, Microsoft Xbox 360), Internet-enabled TV, or PC-to-TV connection
- **Video:** Includes the following underlying categories:
 - **Short form:** User-generated video and other video clips generally less than 7 minutes in length
 - **Video calling:** Video messages or calling delivered on fixed Internet initiated by smartphones, non-smartphones, and tablets
 - **Long form:** Video content generally greater than 7 minutes in length
 - **Live Internet TV:** Peer-to-peer TV (excluding P2P video downloads) and live television streaming over the Internet
 - **Internet PVR:** Recording of live TV content for later viewing
 - **Ambient video:** Nannycams, petcams, home security cams, and other persistent video streams
 - **Mobile video:** All video that travels over a second-, third-, or fourth-generation (2G, 3G, or 4G, respectively) network

Content delivery network traffic, 2016–2021

With the emergence of popular video-streaming services that deliver Internet video to the TV and other device endpoints, CDNs have prevailed as a dominant method to deliver such content. Globally, 70 percent of all Internet traffic will cross CDNs by 2021, up from 52 percent in 2016. Globally, 77 percent of all Internet video traffic will cross CDNs by 2021, up from 67 percent in 2016 (Table 12).

Table 12. Global content delivery network internet traffic, 2016–2021

CDN Traffic, 2016–2021							CAGR 2016–2021
	2016	2017	2018	2019	2020	2021	
By Geography (PB per Month)							
North America	17,696	24,545	32,795	42,976	53,141	63,519	38%
Asia Pacific	10,259	14,715	20,416	28,415	38,831	55,306	53%
Western Europe	7,155	9,869	13,035	17,049	21,750	27,760	40%
Central and Eastern Europe	1,589	2,257	3,025	4,093	5,565	7,650	50%
Latin America	1,245	1,799	2,453	3,226	4,414	6,569	52%
Middle East and Africa	396	702	1,168	1,877	3,092	4,848	84%
Total (PB per Month)							
CDN Internet traffic	38,340	53,888	72,893	97,636	126,793	165,651	44%

Source: Cisco VNI, 2017

Consumer-managed IP traffic, 2016–2021

Managed IP video is IP traffic generated by traditional commercial TV services (Table 13). 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, refer to Internet video to TV in the section “Internet Video”.)

Table 13. Global consumer-managed IP traffic, 2016–2021

Consumer-Managed IP Traffic, 2016–2021							CAGR 2016–2021
	2016	2017	2018	2019	2020	2021	
By Network (PB per Month)							
Fixed	19,619	23,351	27,142	30,683	33,978	37,215	14%
By Geography (PB per Month)							
North America	6990	8759	10556	12325	14044	15767	18%
Asia Pacific	9411	10691	11985	13018	13923	14856	10%
Western Europe	2277	2609	2937	3274	3528	3713	10%
Latin America	532	722	931	1164	1408	1650	25%
Central and Eastern Europe	315	444	572	703	837	953	25%
Middle East and Africa	94	125	161	198	239	276	24%
Total (PB per Month)							
Managed IP video traffic	19,619	23,351	27,142	30,683	33,978	37,215	14%

Source: Cisco VNI, 2017

Business IP traffic

The enterprise forecast is based on the number of network-connected computers worldwide. In our experience, this basis provides the most accurate measure of enterprise data usage. An average business user might generate 4 GB per month of Internet and WAN traffic. A large-enterprise user would generate significantly more traffic, 8–10 GB per month (Table 14).

Table 14. Business IP traffic, 2016–2021

Business IP Traffic, 2016–2021							
	2016	2017	2018	2019	2020	2021	CAGR 2016–2021
By Network Type (PB per Month)							
Business Internet traffic	13,264	16,291	19,442	23,312	27,969	33,363	20%
Business managed IP traffic	3,292	3,789	4,161	4,543	4,930	5,236	10%
Business mobile data	1,248	1,838	2,617	3,664	5,039	6,853	41%
By Geography (PB per Month)							
Asia Pacific	6,466	8,009	9,667	11,770	14,365	17,469	22%
North America	4,872	6,444	7,935	9,665	11,594	13,720	23%
Western Europe	2,808	3,312	3,885	4,578	5,432	6,469	18%
Central and Eastern Europe	1,689	1,855	2,047	2,352	2,789	3,283	14%
Latin America	1,155	1,313	1,527	1,787	2,114	2,526	17%
Middle East and Africa	814	983	1,159	1,365	1,643	1,985	20%
Total (PB per Month)							
Business IP traffic	17,804	21,917	26,220	31,518	37,937	45,452	21%

Source: Cisco VNI, 2017

Definitions

- **Business Internet traffic:** All business traffic that crosses the public Internet
- **Business IP traffic:** All business traffic that is transported over IP but remains within the corporate WAN
- **Business mobile data traffic:** All business traffic that crosses a mobile access point

Mobile data traffic

Mobile data traffic includes handset-based data traffic, such as text messaging, multimedia messaging, and handset video services (Table 15). Mobile Internet traffic is generated by wireless cards for portable computers and handset-based mobile Internet usage.

Table 15. Mobile data and internet traffic, 2016–2021

Mobile Data and Internet Traffic, 2016–2021							CAGR 2016–2021
	2016	2017	2018	2019	2020	2021	
By Geography (PB per Month)							
Asia Pacific	3,135	4,943	7,470	11,105	15,991	22,715	49%
Middle East and Africa	612	1,200	2,020	3,194	4,893	7,428	65%
North America	1,369	1,887	2,571	3,438	4,525	5,883	34%
Central and Eastern Europe	901	1,355	1,956	2,755	3,772	5,071	41%
Western Europe	724	1,073	1,530	2,135	2,947	4,036	41%
Latin America	459	724	1,098	1,593	2,254	3,137	47%
Total (PB per Month)							
Mobile data and Internet	7,201	11,183	16,646	24,220	34,382	48,270	46%

Source: Cisco VNI, 2017

For more information

For more information, refer to the companion document [The Zettabyte Era—Trends and Analysis](#). Several interactive tools are available to help you create custom highlights and forecast charts by region, by country, by application, and by end-user segment (refer to the [Cisco VNI Forecast Highlights tool](#) and the [Cisco VNI Forecast Widget tool](#)). Inquiries can be directed to traffic_inquiries@cisco.com.