



# **2022 Global IPv6 Support White Paper**

IPv6 Forum

Support: BII Group

Thank: APNIC, Cisco, CAICT, Hurricane Electric, Internet Society

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## Explanation of nouns

**AAAA record:** An AAAA record type is a foundational DNS record when IPv6 addresses are used.

**Active prefix:** When an entity plans to enable IPv6 on its network, the first step is to ask the RIRs for IPv6 prefixes. The second step is to make this prefix reachable on the network. The activity of this prefix was then measured against APNIC lab-based data and seed-based Eric Vyncke data. If you can see traffic from one of these two sources, then you can assume the prefix is active.

**APNIC:** APNIC (the Asia Pacific Network Information Centre) is the regional Internet address registry (RIR) for the Asia-Pacific region. It is one of the world's five RIRs and is part of the Number Resource Organization (NRO).

**BGP:** BGP is a routing protocol among autonomous systems. The network reachability information exchanged by BGP provides enough information to detect routing loops and make routing decisions based on performance priorities and policy constraints.

**CDN:** A content delivery network, or content distribution network (CDN), is a geographically distributed network of proxy servers and their data centers.◦

**IPv6:** IPv6 is the abbreviation of "Internet Protocol Version 6" (Internet Protocol Version 6), which is the next-generation IP protocol designed by the Internet Engineering Task Force (IETF) to replace IPv4.

**IPv6 Enabled CDN Logo:** An IPv6 support certification program for CDN initiated by the IPv6 Forum. The certification tests the IPv6 support of CDN products in terms of domain name CNAME binding resolution, network connectivity, page and file acceleration, and audio and video stream acceleration.

**IPv6 Ready Logo:** The IPv6 Forum IPv6 Ready Logo Program is a conformance and interoperability testing program intended to increase user confidence by demonstrating that IPv6 is available now and is ready to be used.

**Transit AS:** Transit AS is the AS through which data packets pass, it is neither origin

nor destination. From a more practical point of view: all ASs that appear on the AS path in the BGP table (and are not source AS or destination) are considered to be Transit ASs.

## **Foreword**

IPv6 is the core and underlying foundation of the global digital upgrade. Promoting IPv6 deployment is of great significance in enhancing the global internet's carrying capacity and service level, helping the digital transformation of the economy and society, and promoting global economic prosperity and development. In recent years, countries around the world have been promoting the deployment of IPv6. countries such as China, the United States, Vietnam, India and Kenya have introduced initiatives to accelerate IPv6 deployment, IPv6 capacity on all continents has increased significantly in the past year, and the proportion of IPv6 users on Google and Facebook has exceeded 41% and 36% respectively.

This white paper illustrates the latest progress of global IPv6 technology, the number of global users, network and domain name system, international operators, websites, cloud services, network equipment, etc., the all-around elaboration of statistics are comprehensive, objective and will accurately reflect the global IPv6 development status.

# **Chapter 1 The Latest Development of Global IPv6**

## **1.1 Global Initiatives to Promote IPv6 Deployment**

We list the policies and measures introduced by various countries to accelerate IPv6 deployment from the beginning of 2020 to November 2022.

In March 2020, the U.S. Office of Management and Budget (OMB) issued guidelines on IPv6 deployment and use, requiring federal agencies to accelerate the transition to IPv6. In November, the OMB released the final draft of the guidance, requiring agencies to develop plans to have at least 20 percent of IP assets on federal networks running pure IPv6 by the end of FY 2023, at least 50 percent by 2024, and at least 80 percent by 2025.

In March 2020, the Ministry of Industry and Information Technology of the People's Republic of China issued the "Notice on Carrying out the 2020 IPv6 End-to-End Interconnection Capability Improvement Special Action", from strengthening network application infrastructure, improving terminal equipment IPv6 support capabilities, and improving industry websites and Internet application IPv6 support capabilities , Strengthening IPv6 network security capabilities and other aspects put forward work requirements and tasks.

In July 2020, Malaysia began to implement mandatory IPv6 certification for terminal equipment, network equipment and network security equipment in accordance with the regulations of "MCMC MTSFB TC T013:2019".

In November 2020, France Arcep released the data report "French IPv6 Transition Indicators 2020", which requires operators with 5G licenses to make their mobile networks compatible with IPv6 by the end of 2020.

In January 2021, Vietnam announced the IPv6 For Gov plan for the period 2021-2025, requiring that between 2021-2025, 100% of ministries, commissions, industries and localities will release IPv6 scale deployment plans and complete their portals, public service portals, IPv6 deployment of network and services working and ready to

run pure IPv6.

In April 2021, the Nigerian IPv6 Committee and ATCON jointly held an IPv6 deployment webinar, clearly stating that through the deployment of IPv6, Digital Nigeria and the Nigerian National Broadband Plan (NNBP 2020-2025) will be realized.

In April 2021, the National Internet Exchange of India (NIXI) announced that it will work with the Indian Department of Telecommunications (DoT) and the Indian Ministry of Electronics and Information Technology (MeitY) to form an IPv6 expert group (IP Guru), establish the NIXI Academy and develop An IPv6 indexing portal way to increase IPv6 awareness and adoption in India.

In July 2021, China's Ministry of Industry and Information Technology and the Office of the Central Cybersecurity and Informatization Commission issued a notice on the "Three-Year Special Action Plan for IPv6 Traffic Improvement (2021-2023)", with the goal of forming an application-driven, Collaborative and innovative IPv6 benign development pattern.

In July 2021, China's Central Internet Information Office, the National Development and Reform Commission and the Ministry of Industry and Information Technology issued the "Work Arrangement for Deepening the Deployment and Application of IPv6 in 2021", which clearly defines the main objectives, key tasks and timetable for deepening the deployment and application of IPv6 in the 14th Five-Year Plan period.

In July 2021, China's Office of the Central Cybersecurity and Informatization Commission, the National Development and Reform Commission, and the Ministry of Industry and Information Technology issued the "Notice on Accelerating the Scale Deployment and Application of Internet Protocol Version 6 (IPv6)" to clarify IPv6 Development Goals for 2023 and 2025.

In April 2022, China's the Central Cyberspace Administration, the National Development and Reform Commission, and the Ministry of Industry and Information Technology jointly issued the "2022 Work Arrangement for Further Promoting Large-scale IPv6 Deployment and Application", which clarified the work goals for 2022.

In July 2022, Kenya released the IPv4 to IPv6 Migration Action Plan. From September to December 2022, improve public awareness of IPv6. From January to December 2023, implement the IPv6 training plan. From October 2022 to June 2023, service providers submit IPv6 readiness reports. In July 2023 and thereafter, there are type certification requirements for IPv6 equipment, inclusion of IPv6 adoption requirements in telecom resource allocation, and inspection and certification of new and existing service providers to ensure adoption of IPv6.

From the measures taken by various countries for IPv6 deployment, it can be seen that countries in Europe, America and Asia have entered the implementation stage of accelerating IPv6 deployment. By issuing policy documents to clarify the phased indicators of IPv6 deployment, some countries in Africa have also realized that the importance of IPv6, and plans to start the transition to IPv6.

## **1.2 The Latest Technical Standard of IPv6**

Since March 2022, the IETF (The Internet Engineering Task Force) international standards organization has generated a total of 8 IPv6-related standards. As can be seen from the table below, the standards are mainly concentrated in two areas. One is to improve and optimize the current IPv6 network and IPv4/v6 transition network, for example, RFC9243 proposes a YANG data model for DHCP configuration to solve the management and configuration of the three types of DHCPv6 settings; the second is to explore and optimize the application of SRv6 in IPv6 networks. Taking RFC 9259 as an example, it proposes Use an existing method and a new way of thinking to handle the operation, management and maintenance in the SRv6 network. There are many draft documents about IPv6. The R&D and creation of IPv6 standards are closely related to the development and deployment of IPv6. While accelerating the transition of IPv6, it also improves the value and intelligence of IPv6 networks.

Table 1-1 Recent IETF IPv6 related standards

Number	Title	Date	Status
RFC 9224 part of STD 95	Finding the Authoritative Registration Data Access Protocol (RDAP) Service	Mar-22	Internet Standard
RFC 9229	IPv4 Routes with an IPv6 Next Hop in the Babel Routing Protocol	May-22	Experimental
RFC 9243	A YANG Data Model for DHCPv6 Configuration	Jun-22	Proposed Standard
RFC 9252	BGP Overlay Services Based on Segment Routing over IPv6 (SRv6)	Jul-22	Proposed Standard
RFC 9259	Operations, Administration, and Maintenance (OAM) in Segment Routing over IPv6 (SRv6)	Jun-22	Proposed Standard
RFC 9268	IPv6 Minimum Path MTU Hop-by-Hop Option	Aug-22	Experimental
RFC 9288	Recommendations on the Filtering of IPv6 Packets Containing IPv6 Extension Headers at Transit Routers	Aug-22	Informational
RFC 9313	Pros and Cons of IPv6 Transition Technologies for IPv4-as-a-Service (IPv4aaS)	Oct-22	Informational

### 1.3 Global IPv6 Deployment Status

According to the global IPv6 deployment statistics provided by Cisco (Figure 1-1), as of November 2022, countries or regions with a comprehensive IPv6 deployment rate of around 30% or above accounted for more than half of the map area. The global IPv6 deployment rate is the comprehensive situation of IPv6 deployment calculated according to certain weights based on the network (IPv6 Prefix/Transit IPv6 AS), IPv6 website and IPv6 users in each country and region. The darker the area in the figure, the higher the degree of IPv6 deployment, and the higher the corresponding IPv6 deployment rate.

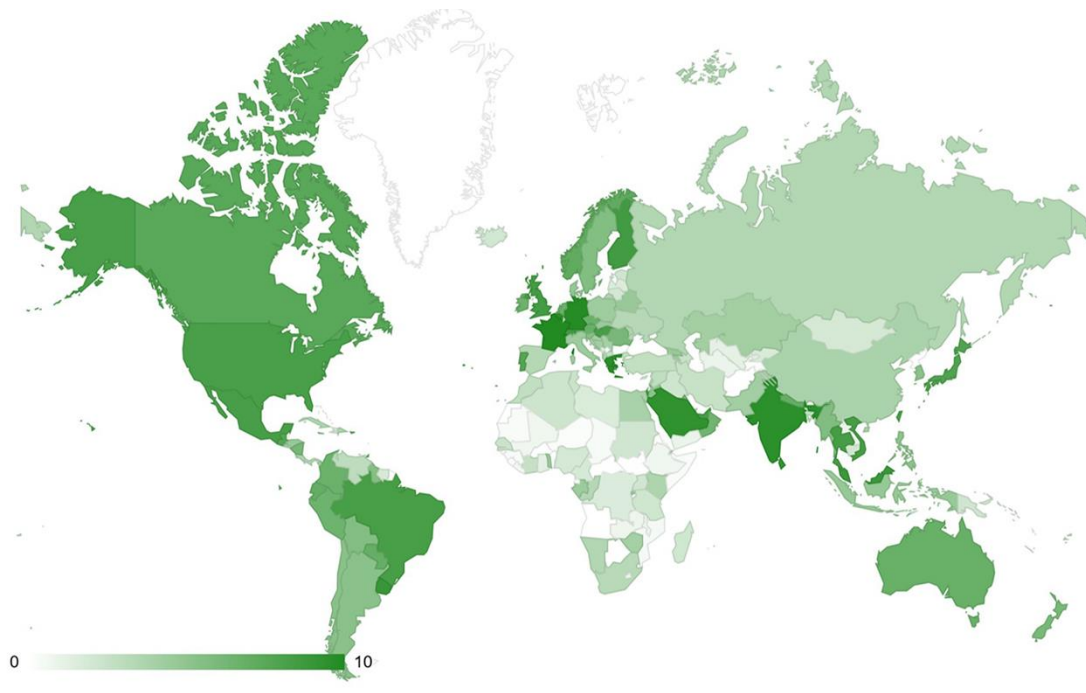


Figure 1-1 Global IPv6 deployment status

Table 1-2 lists the statistics of IPv6 deployment in some representative countries or regions in each continent. Some representative countries and regions in Europe, the Americas, Asia, Oceania and other regions have overall IPv6 deployments exceeding 40%, while the overall IPv6 deployment rate in African countries is still relatively low.

Table 1-2 IPv6 deployment in some countries

Continent	Country / Region	Active prefix(%)	Transit AS(%)	Content(%)	Users(%)	overall(%)	Rate of Change
North America	America	30.71%	69.02%	63.59%	48.10%	<b>58.73%</b>	<b>2.24%</b>
	Canada	36.25%	73.77%	66.89%	34.30%	<b>54.37%</b>	<b>-0.46%</b>
	Mexico	25.33%	71.59%	68.68%	44.10%	<b>59.17%</b>	<b>1.30%</b>
South America	Brazil	61.58%	81.24%	65.20%	43.80%	<b>60.39%</b>	<b>3.24%</b>
Europe	The United kingdom	34.17%	78.44%	70.69%	43.00%	<b>60.96%</b>	<b>6.92%</b>
	France	38.87%	76.43%	66.27%	72.50%	<b>71.09%</b>	<b>11.52%</b>
	Germany	47.83%	85.19%	65.94%	65.50%	<b>70.59%</b>	<b>11.98%</b>
	Belgium	34.28%	77.87%	71.56%	61.50%	<b>69.22%</b>	<b>14.40%</b>
	Russia	20.84%	52.38%	36.95%	8.72%	<b>26.56%</b>	<b>-1.43%</b>
Asia	China	7.16%	88.25%	27.73%	5.93%	<b>31.68%</b>	<b>3.82%</b>
	Japan	45.69%	84.71%	48.92%	46.90%	<b>57.47%</b>	<b>1.98%</b>
	Korea	10.92%	64.61%	48.32%	18.80%	<b>38.76%</b>	<b>3.74%</b>
	India	26.84%	65.48%	68.41%	67.80%	<b>67.45%</b>	<b>4.78%</b>
	Saudi Arabia	18.52%	89.30%	62.43%	59.00%	<b>67.84%</b>	<b>5.96%</b>
Oceania	Australia	21.83%	67.88%	65.43%	28.80%	<b>49.53%</b>	<b>1.84%</b>
	New Zealand	25.22%	77.27%	66.78%	18.00%	<b>45.32%</b>	<b>1.48%</b>
Africa	Sudan	36.36%	67.79%	60.17%	0.14%	<b>19.12%</b>	<b>-0.67%</b>
	South Africa	46.87%	66.26%	64.53%	2.41%	<b>25.92%</b>	<b>2.49%</b>
	Egypt	50.00%	74.52%	66.01%	4.00%	<b>30.82%</b>	<b>0.45%</b>

According to APNIC Labs, as of November 2022, the IPv6 deployment rate in 26 regions has exceeded 40%, an increase of 9 compared with last year; the IPv6 deployment rate in 37 regions has exceeded 30%, an increase of 7 compared with last year; The regional IPv6 deployment rate exceeded 20%, an increase of 8 compared with last year.

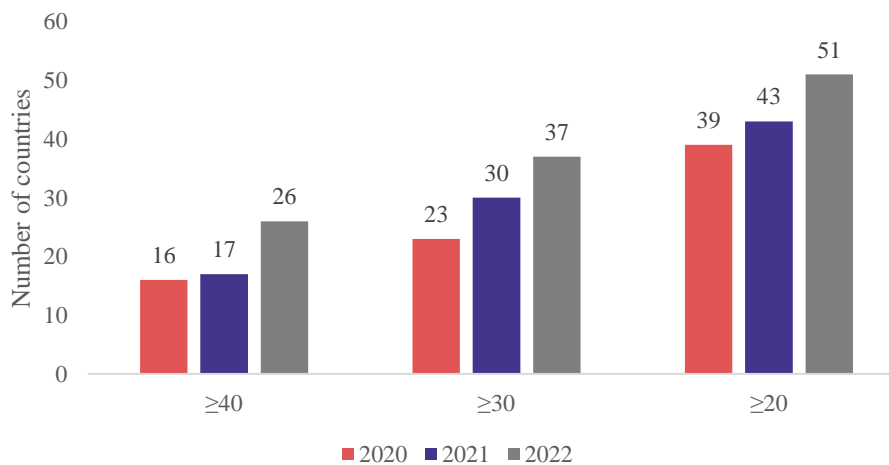


Figure 1-2 2020-2022 country/region IPv6 capability

Table 1-3 lists the IPv6 support capabilities of each region. In Asia, South Asia has the highest IPv6 support capability, with an overall level close to 60%, East Asia and Southeast Asia have also reached 21% and 20%, West Asia has 10%, and Central Asia has only 0.1%. In terms of the Americas, North America has dropped from 51% in 2020 to 44%, but it still ranks second among all regions. Central America has the largest improvement in IPv6 capabilities, rising from 22% to 29%, and South America also reached 26%. Only 5% in the Caribbean. In Europe, the IPv6 support capacity in Western Europe reached 39%, 30% in Northern Europe, 11% and 9% in Eastern Europe and Southern Europe. IPv6 support in Africa is poor, with no region exceeding 5%.

Table 1-3 IPv6 capabilities by continent

Region	IPv6 Capable	Rate of Change	IPv6 Capable	Rate of Change
South Asia	65.26%	5.74%	64.89%	8.82%
Western Europe	54.51%	14.53%	53.98%	15.13%
North America	51.05%	6.76%	49.48%	6.04%
Central America	40.91%	11.47%	39.80%	10.58%
Australia and New Zealand	38.53%	10.57%	37.36%	11.36%
Nordic	36.34%	7.37%	35.88%	7.67%
South America	29.21%	2.86%	28.94%	3.07%
Southeast Asia	29.15%	9.08%	28.67%	9.47%
East Asia	23.27%	1.31%	20.92%	1.60%
West Asia	15.30%	5.02%	14.91%	4.79%
Eastern Europe	11.46%	0.69%	10.92%	0.35%
Southern Europe	10.83%	1.23%	10.67%	1.21%
Caribbean	6.79%	1.46%	6.55%	1.27%
Polynesia	4.16%	4.12%	4.10%	4.06%
South Africa	3.55%	2.63%	3.43%	2.58%
Melanesia	2.25%	2.14%	2.15%	2.04%
North Africa	1.84%	0.25%	1.80%	0.22%
Central Africa	1.64%	0.40%	1.60%	0.37%
Central Asia	1.64%	1.53%	1.60%	1.50%
East Africa	1.55%	-0.48%	1.52%	-0.49%
West Africa	0.78%	0.41%	0.73%	0.42%
Micronesia	0.03%	0.01%	0.03%	0.01%

## Chapter 2 Development of Global IPv6 Users

According to the data of APNIC Labs and China's "National IPv6 Development Monitoring Platform", we listed the number of IPv6 users in some countries around the world. As of December 2022, the top five countries/regions with the number of IPv6 users in the world are China (718 million), India (495 million), the United States (155 million), Brazil (69 million), Japan (59 million) ( Table 2-2). The number of IPv6 users in China and India will still be in a stage of rapid growth in 2022, increasing by 110 million and 50 million respectively in one year; the number of IPv6 users in the United States has increased by 24% year-on-year; the number of IPv6 users in Brazil and Japan is also growing steadily stage.

Table 2-1 Number of IPv6 users in some countries

Continent	Country / Region	Number of IPv6 users(est.)
North America	America	155 million
	Canada	13 million
	Mexico	44 million
South America	Brazil	69 million
Europe	The United kingdom	31 million
	France	29 million
	Germany	47 million
	Belgium	7.2 million
	Russia	26 million
Asia	China	718 million
	Japan	59 million
	Korea	8.7 million
	India	495 million
	Saudi Arabia	21 million
Oceania	Australia	12 million
	New Zealand	1.4 million
Africa	Sudan	0.2 million
	South Africa	1.67 million
	Egypt	8 million

Table 2-2 Global IPv6 user number ranking

Rank	Country	2021 IPv6 users	2022 IPv6 users	Change	Rate of Change
1	China	607 million	718 million	↑111 million	18%

2	India	455 million	495 million	↑50 million	11%
3	America	125 million	155 million	↑30 million	24%
4	Brazil	61 million	69 million	↑7 million	11%
5	Japan	48 million	59 million	↑11 million	23%

According to Google statistics, as of October 29, 2022, the number of users accessing Google using IPv6 accounted for 41.31% of the total users, as shown in Figure 2-6, an increase of 4.56% compared to the same period in 2021. The proportion of IPv6 users accessing Facebook to the total users has also reached 36.1%, an increase of 3% compared with the same period in 2021.

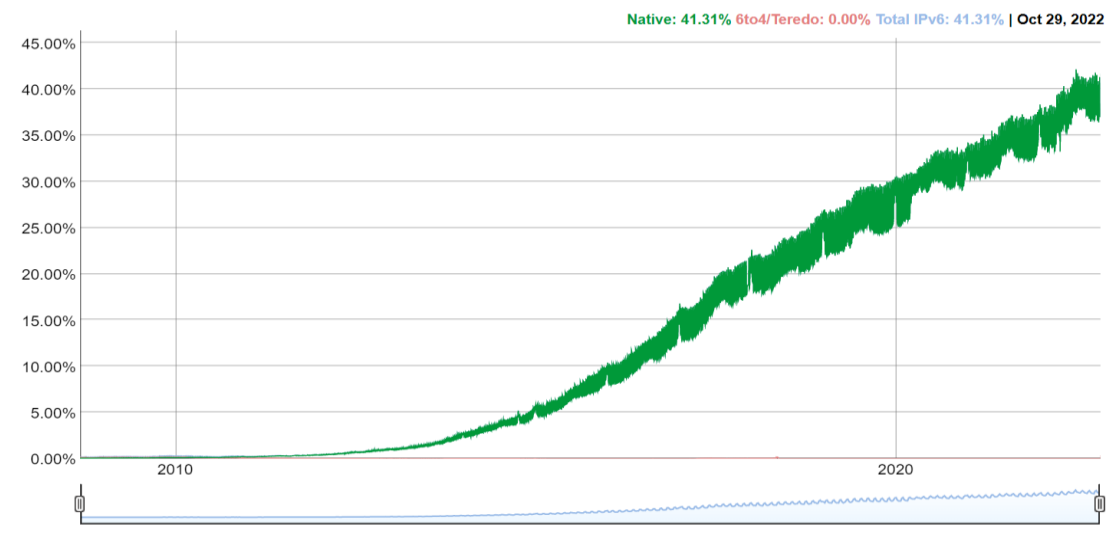


Figure 2-6 Google IPv6 user growth trend

#### IPv6 Adoption

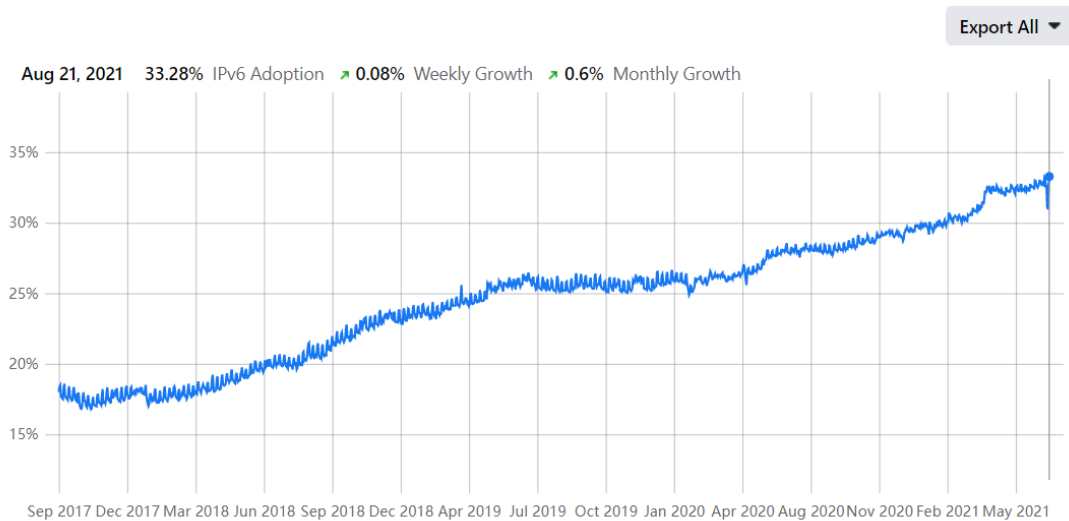


Figure 2-7 Facebook IPv6 user growth trend

## Chapter 3 Global Network and Domain Name System IPv6

### Deployment Status

#### 3.1 Domain Name System IPv6 Deployment Status

In terms of domain name system, according to the data provided by Hurricane Electric, as of November 2022, among the 1,485 top-level domains in the world, 1,464 support IPv6, accounting for 98.6% of the total. Among the 1,485 top-level domains, 1,461 Authoritative servers support IPv6, accounting for 98.4% of the total top-level domains. There are at least 23,012,168 domain names with AAAA records in the world, accounting for 8.5% of the total domain names, an increase of 0.3% compared to last year, an increase of 1,456,826. A total of 234,205 (23.4%) URLs in the Alexa top 1 million websites offer IPv6 addresses in their AAAA records, an increase of 1.5% compared to last year.

#### 3.2 Network IPv6 Deployment Status

In terms of network, the number of active BGP routing entries reached 173,450, a year-on-year increase of about 28% (Figure 3-1).

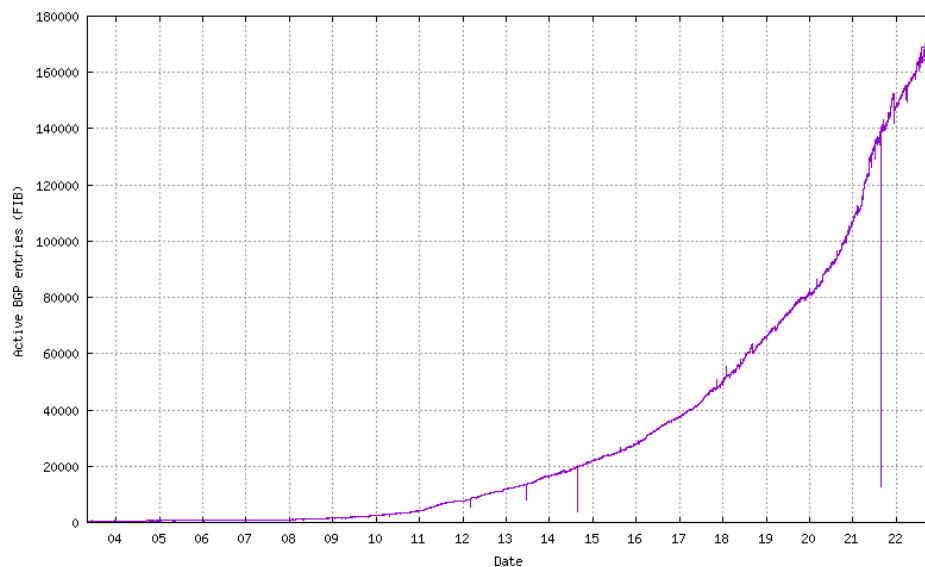


Figure 3-1 Active BGP entries growth trend

Among the globally allocated prefixes, there are 14,378 prefixes with traffic, accounting for 6.8% of the allocated prefixes; 91,483 announced prefixes, accounting for 43.3% of the allocated prefixes; 49,038 announced and aggregated prefixes, Accounting for 23.2% of the allocated prefixes; there are 70,800 not announced ones, accounting for 33.5% of the allocated prefixes (Table 3-1).

Table 3-1 IPv6 prefixes

Category	2021	2022	Rate of Change
Traffic from this prefix has been seen	14997	15959	6.41%
Announced on BGP	137161	168231	22.65%
Announced on BGP but under an aggregated prefix	67428	89053	32.07%
Not announced on BGP	82399	109752	33.20%
Assigned/allocated	286988	367036	27.89%

### 3.3 Mobile Operators IPv6 Deployment

In 2009, the 3rd Generation Partnership Project (3GPP) standards body began requiring wireless service providers to enable IPv6 on their 4G wireless infrastructure, and mobile operators also began focusing on integrating IPv6 into their networks. One advantage mobile operators have over cable service providers in driving IPv6 adoption is that they have greater influence and control over the software and hardware used by mobile subscribers. In addition, rapid updates of mobile devices will speed up the deployment of IPv6 handsets. Apple's iOS system and Android system. The availability of IPv6-capable and large numbers of mobile phones running these systems paves the way for future maximization of IPv6 users and traffic. We list the IPv6 deployment of well-known operators in some countries.

In the United States, Verizon Wireless has nearly 150 million subscribers and is the largest mobile operator in the United States. Verizon has been actively working on backbone and 4G network IPv6 deployments for more than a decade. Figure 3-2 below shows what Verizon has achieved in increasing IPv6 subscribers over the past eight years. T-Mobile is one of the world's largest mobile operators, with about 230 million subscribers. T-Mobile is one of the first mobile providers to fully embrace

IPv6 and has conducted early tests using NAT64/DNS64. T-Mobile's significant progress in IPv6 has made it the world's number one in IPv6 deployment, with a deployment rate of over 91%. Figure 3-3 below shows T-Mobile's achievements in IPv6 deployment. AT&T is the second largest mobile operator in the United States. Figure 3-4 shows that AT&T Wireless started to enable IPv6 in 2015, and the IPv6 deployment rate will reach 83% by 2021.

In Brazil, Vivo, the largest local operator, started to implement IPv6 in October 2015, and the IPv6 deployment rate increased from zero to nearly 70% within six years (Figure 3-5).

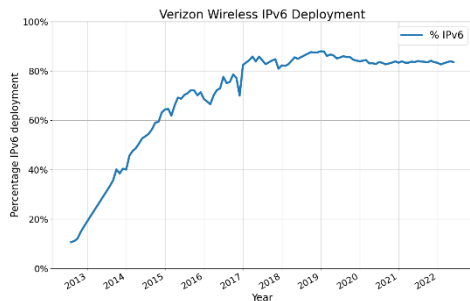


Figure 3-2 Verizon Wireless

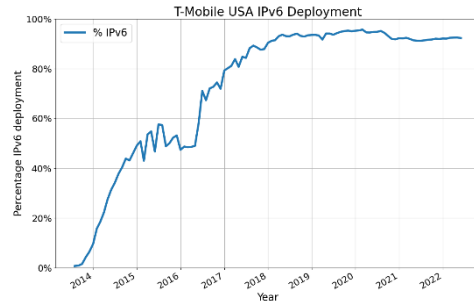


Figure 3-3 T-Mobile USA

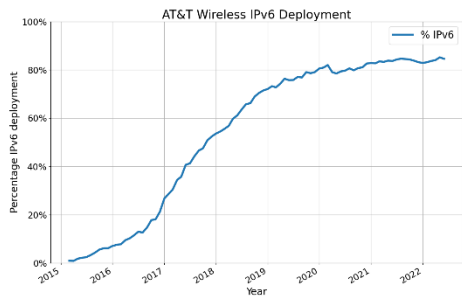


Figure 3-4 AT&T Wireless

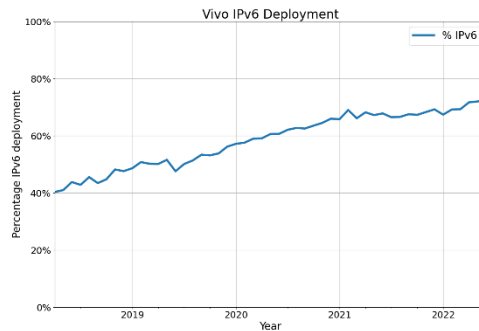


Figure 3-5 Vivo

In Europe, Cosmote is the largest mobile operator in Greece with 7.9 million subscribers and Figure 3-6 shows that it started IPv6 in 2016, increasing its IPv6 deployment rate to 85% in 5 years, but this figure is declining from 2021, with the current deployment rate at 76%. Deutsche Telekom AG, the German telecoms

operator, has increased its IPv6 deployment rate to 70% in seven years (Figure 3-7).

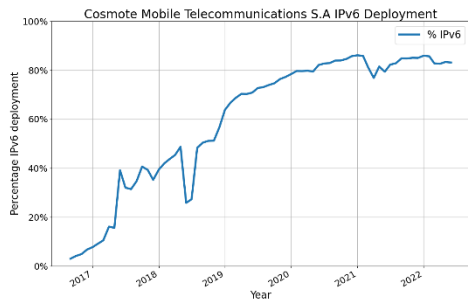


Figure 3-6 Cosmote Mobile

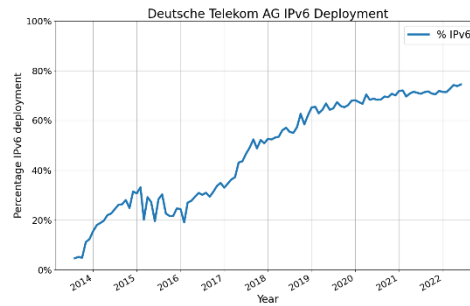


Figure 3-7 Deutsche Telekom AG

In Asia, Japanese operator SoftBank increased the IPv6 deployment rate from 4% to 53% within six years (Figure 3-8). India's telecom operator Reliance Jio has grown to 90% in just a few years (Figure 3-9).

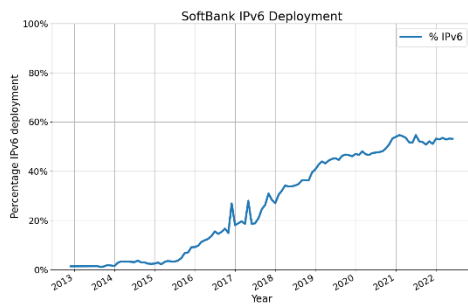


Figure 3-8 Soft Bank

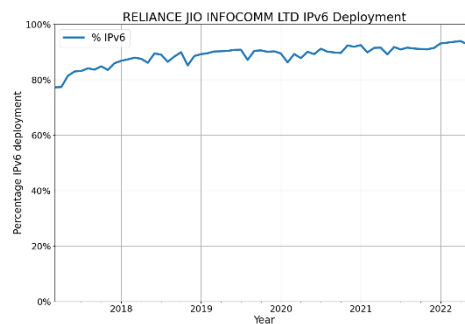


Figure 3-9 Reliance Jio

### 3.4 Broadband Operators IPv6 Deployment

In North America, Comcast is one of the largest multiple system operators (MSOs), with more than 30 million subscribers. Comcast started to deploy IPv6 before 2000. They have put a lot of effort into upgrading their core backbone, upgrading cable modem termination systems (CMTSs), and helping customers upgrade to DOCSIS 3.0 and 3.1 modems and other newer CPE equipment that supports IPv6. As a result, their IPv6 traffic increased significantly, with more than 73% of users using IPv6 (Figure 3-10). The IPv6 deployment rate of US operator AT&T has reached 80% (Figure 3-11). Rogers Communications is Canada's largest cable MSO with nearly 11 million subscribers. Figure 3-12 shows that in just a few months

in 2016, they shifted significantly more customer traffic to IPv6 by turning on IPv6 for more users.

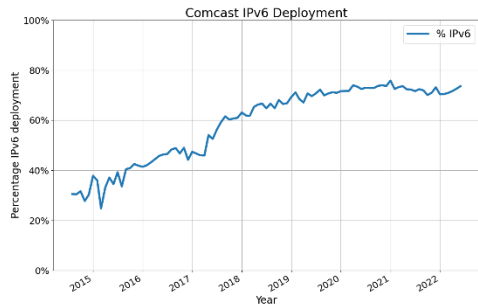


Figure 3-10 ComCast

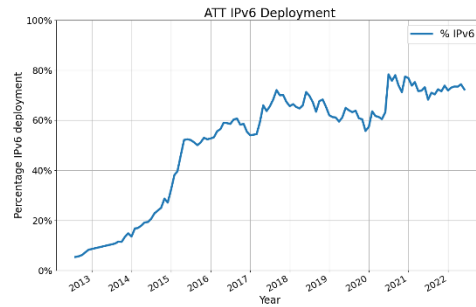


Figure 3-11 AT&T

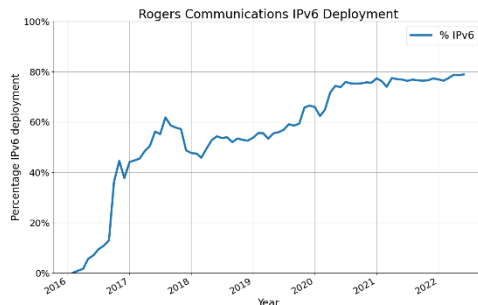


Figure 3-12 Rogers Communication

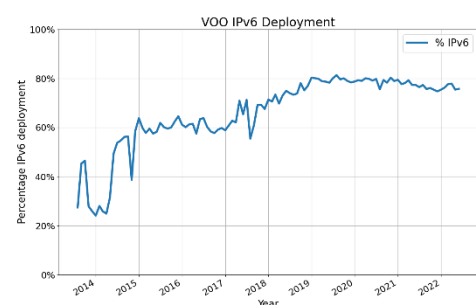


Figure 3-13 VOO

In Europe, Nethys (VOO) is a local cable TV operator in Belgium. Figure 3-13 shows that VOO has supported IPv6 since 2013, and increased the deployment rate of IPv6 to 80% in 2020. BT-British Telecom is the largest telecommunications operator in the UK, and all telephone lines in the UK are opened through them. Figure 3-14 shows that BT started to support IPv6 in 2018, and the IPv6 deployment rate rose from 40% to 80% within two years. The British Sky Broadcasting Corporation launched IPv6 end-to-end (from the Internet to users) services in just five months at the beginning of 2016, and the IPv6 deployment rate soared from 10% to 70% (Figure 3-15).

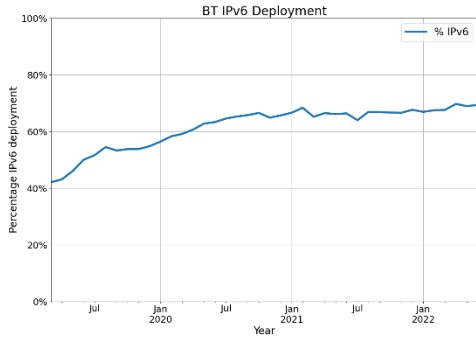


Figure 3-14 BT

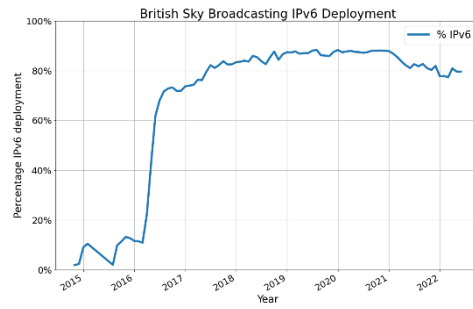


Figure 3-15 British Sky Broadcasting

In Asia, VNPT is the operator with the largest fixed network market share in Vietnam. From the graph in Figure 3-16, it can be seen that the company started to support IPv6 in 2017, and the IPv6 deployment rate has increased from 0 increased to 40%. Telekom Malaysia is the only telecom company in Malaysia, and the current IPv6 deployment rate is close to 45% (Figure 3-17).

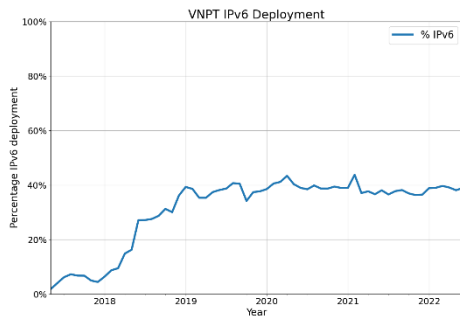


Figure 3-16 VNPT

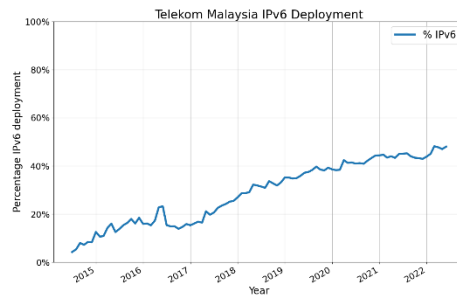


Figure 3-17 Telekom Malaysia

## Chapter 4 Internet Service IPv6 Support status

### 4.1 Website IPv6 Support status

#### 4.1.1 Global Website IPv6 Support status

According to W3Techs data, as of November 8, 2022, 21.5% of all websites in the world support IPv6 access, an increase of 2.1% over last year. 29.1% of the top 1 million websites support IPv6 access, an increase of 3.7% over last year. The IPv6 support rate of the top 10,000 websites is 41.4%, an increase of 5.4% over last year (Figure 4-2).

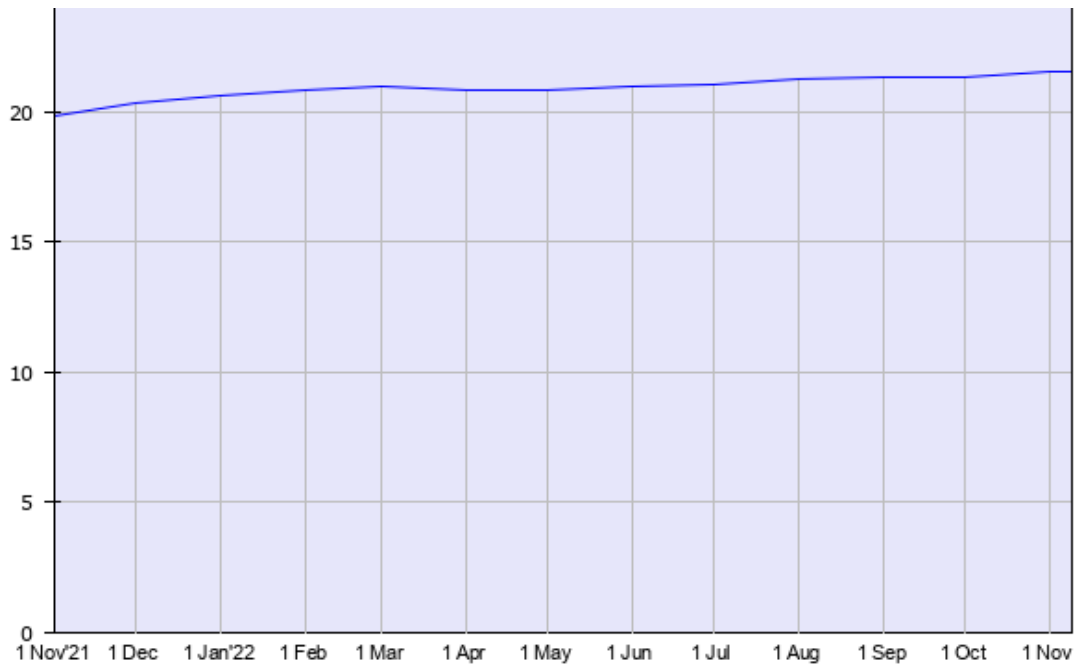


Figure 4-1 Website IPv6 support trend

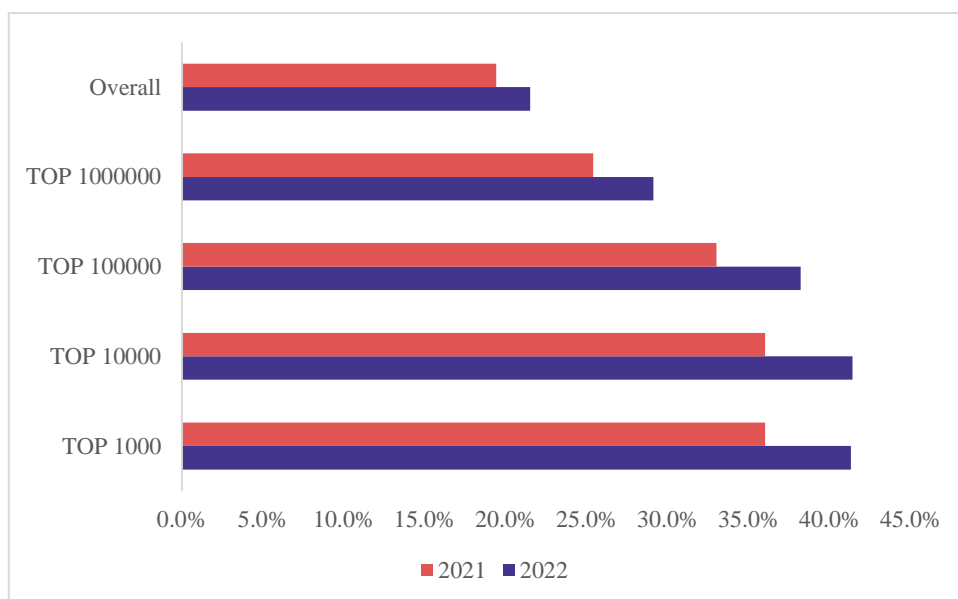


Figure 4-2 Percentage of website IPv6 support in 2021 and 2022

Table 4-1 IPv6 support of world-renowned websites

NO.	Website	IPv6 Support	No.	Website	IPv6 Support
1	360.cn	Not Support	69	Medium	Support
2	500px	Not Support	70	Meetup	Not Support
3	9GAG	Not Support	71	Microsoft	Not Support
4	Adobe	Some Support	72	Mixer	Support
5	Aftonbladet	Some Support	73	Mozilla Observatory	Not Support
6	AliExpress	Not Support	74	N26	Not Support
7	Alipay	Some Support	75	Naver	Not Support
8	Amazon	Some Support	76	Netcologne	Support
9	Aparat	Not Support	77	Netflix	Support
10	Apple	Support	78	Netlify	Not Support
11	Arch Linux	Support	79	NixOS	Support
12	Ars Technica	Not Support	80	O2	Not Support
13	Arxes Tolina	Not Support	81	Okezone	Support
14	Baidu	Not Support	82	Origin	Not Support
15	Bandcamp	Not Support	83	panda.tv	Not Support
16	BBC	Some Support	84	Pastebin	Support
17	BigPulse	Not Support	85	PayPal	Not Support
18	Bing	Support	86	Pinboard	Not Support
19	Bitbucket	Support	87	Pinterest	Not Support
20	bongacams.com	Not Support	88	Playstation	Some Support
21	CenturyLink	Support	89	Reddit	Some Support
22	Chaturbate	Support	90	Rubygems	Support
23	CodePen	Support	91	Scribd	Not Support
24	Codeship	Not Support	92	Shopify	Not Support
25	CoreOS	Not Support	93	Sina	Not Support

26	Coveralls	Not Support	94	Skype	Support
27	CSDN	Not Support	95	Slack	Not Support
28	Debian	Support	96	Snapchat	Support
29	Delicious	Not Support	97	Sohu	Not Support
30	Deutsche Welle	Support	98	SoundCloud	Not Support
31	DeviantArt	Not Support	99	Spotify	Some Support
32	Digg	Not Support	100	Stack Exchange	Not Support
33	DigitalOcean	Support	101	StackPath	Some Support
34	Discord	Not Support	102	Steam	Not Support
35	Docker	Some Support	103	Strava	Not Support
36	Dribbble	Not Support	104	Taobao	Not Support
37	Dropbox	Support	105	TechChruch	Support
38	Duckduckgo	Not Support	106	Telegram Messenger	Support
39	Ebay	Not Support	107	Tencent	Some Support
40	Facebook	Support	108	The Register	Not Support
41	Fedora	Support	109	tianya.cn	Not Support
42	Fiducia	Not Support	110	TIDAL	Not Support
43	Flickr	Support	111	Tmall	Not Support
44	Foursquare	Not Support	112	Travis-CI	Not Support
45	Geizhals	Not Support	113	Trello	Not Support
46	Gentoo	Support	114	Tumblr	Not Support
47	GitHub	Not Support	115	Twitch	Not Support
48	GitLab	Support	116	Twitter	Some Support
49	Glovo	Not Support	117	Uber	Not Support
50	Google	Support	118	Ubuntu	Support
51	Gravatar	Some Support	119	Vapiano	Not Support
52	Hacker News	Not Support	120	Vimeo	Not Support
53	Hastebin	Support	121	VK	Not Support
54	Hound CI	Not Support	122	Weibo	Not Support
55	Huanqiu	Not Support	123	WhatsApp	Support
56	IFTTT	Support	124	Wikipedia	Support
57	IMDb	Not Support	125	WIRED	Not Support
58	Imgur	Not Support	126	Wordpress	Not Support
59	Instagram	Support	127	Xbox	Some Support
60	IPv6.com	Not Support	128	Xing	Not Support
61	JD	Not Support	129	xinuanet	Not Support
62	JetBrains	Not Support	130	Yahoo	Some Support
63	JSFiddle	Not Support	131	Yandex	Support
64	Last.fm	Support	132	YouTube	Support
65	LinkedIn	Support	133	YY	Some Support
66	Lobsters	Support	134	Zhanqi	Not Support
67	mailbox.org	Some Support	135	Zoom	Not Support
68	Matrix.org	Support	136	Zwift	Not Support

### 4.1.2 IPv6 Support status for Websites in Countries

The Vyncke website counted the support for IPv6 on each of the global and individual country Alexa Top 50 websites. Currently, approximately 34 of the top 50 websites worldwide support IPv6 (Figure 4-3). We listed the ranking of IPv6 support on the Top 50 websites in different countries/regions/organizations and the data shows that only 14 of the Top 50 countries have more than 50% support for IPv6, with Guernsey ranking highest with 33 websites supporting IPv6; the USA with 23 websites supporting IPv6; Germany with 21 websites supporting IPv6 and India and Brazil have 19.

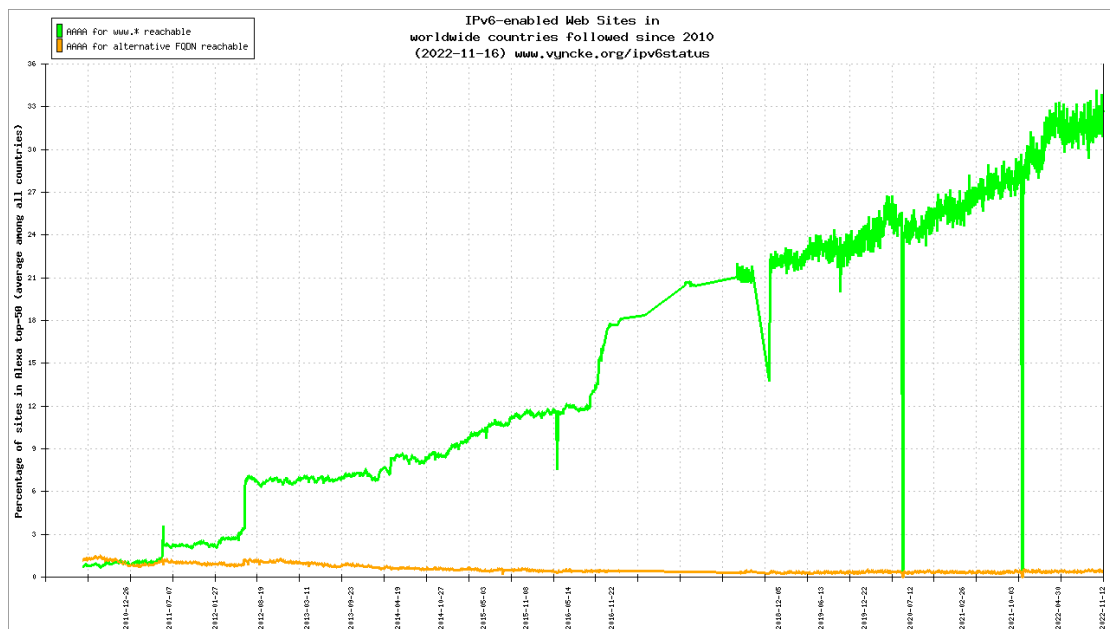


Figure 4-3 Alexa TOP 50 websites support IPv6

Table 4-2 IPv6 support ranking of top 50 websites in some countries/regions

Country/Region	Number of IPv6 websites supported	Proportion	Country/Region	Number of IPv6 websites supported	Proportion
Guernsey	34	68%	Palestinian Territory	19	38%
Albania	30	60%	Croatia	19	38%
Armenia	29	58%	India	19	38%
Samoa	29	58%	Cyprus	19	38%
Greece	28	56%	Brazil	19	38%
Tonga	27	54%	South Africa	18	36%
Belize	27	54%	Slovakia	18	36%
Azerbaijan	27	54%	United-Kingdom	18	36%
Norway	26	52%	Finland	17	34%
Sweden	26	52%	Iraq	17	34%
Antigua and Barbuda	26	52%	Estonia	17	34%
Switzerland	26	52%	Anguilla	17	34%
Saint Helena	25	50%	Turkey	17	34%
Netherlands	25	50%	Italy	17	34%
United States of America	23	46%	Romania	16	32%
Somalia	23	46%	France	16	32%
New Zealand	23	46%	Libya	16	32%
Australia	22	44%	Malaysia	16	32%
Panama	22	44%	Morocco	16	32%
Czech Republic	22	44%	Bosnia and Herzegovina	16	32%
Dominican Republic	22	44%	Austria	16	32%
Nigeria	22	44%	Costa Rica	16	32%
Ukraine	21	42%	Portugal	16	32%
Peru	21	42%	Taiwan	15	30%
Germany	21	42%	Egypt	15	30%
Slovenia	21	42%	Kenya	15	30%
Philippines	20	40%	Ireland	15	30%
Laos	20	40%	Uganda	15	30%
Sri Lanka	20	40%	Argentina	15	30%

## 4.2 Application IPv6 support status

Eight of the top ten mobile apps by downloads globally support IPv6, while Zoom and TikTok do not currently support.

Table 4-3 Global top App IPv6 support status

App	IPv6 Support
TikTok	Not Support
WhatsApp	Support
Facebook	Support
Instagram	Support
Zoom	Not Support
Messenger	Support
Snapchat	Support
Telegram	Support
Google	Support
Skype	Support
LinkedIn	Support
Kik	Support
Dropbox	Support
YouTube	Support
Wikipedia	Support
Netflix	Support

iOS and Android together account for more than 90% of the world's mobile operating systems. On June 1, 2016, the Apple App Store announced that all apps submitted for listing must support IPv6-only networks, that is, all App Store apps support IPv6 from that moment on.

The Android application store Google Play does not seem to impose mandatory requirements on IPv6. And there are no mandatory requirements for IPv6 in China's major application stores as well, but according to the data of its National IPv6 Development Detection Platform, 99% of the top 100 applications in China already support IPv6.

### 4.3 Software IPv6 Support status

Software is generally divided into two categories: system software and application software. System software generally refers to basic underlying software such as the operating system, and application software is the part of software provided to meet the needs of users in different fields and applications.

### 4.3.1 OS IPv6 support status

The Operating System (OS) is the computer program that manages the hardware and software resources of a computer, and is the kernel and cornerstone of a computer system. The OS deals with such basic matters as managing and configuring memory, prioritizing system resources, controlling input and output devices, operating the network and managing the file system. The operating system also provides an interface for the user to interact with the system. Operating systems come in a wide variety of forms and can be installed on different machines, from simple to complex, from embedded systems for mobile phones to large operating systems for supercomputers. Many operating system developers define its scope inconsistently, for example some operating systems integrate a graphical user interface (GUI), while others use only a command line interface (CLI), Treating the GUI as a non-essential application.

As the basis of various applications, the operating system can basically support IPv6 at present, but there are still big differences between different operating systems in terms of specific usage and support, mainly reflected in whether the IPv6 protocol stack is installed by default and whether DHCPv6/ND is supported RDNSS, whether to support the DNS automatic discovery mechanism and other aspects. Table 4-4 shows the IPv6 support of common operating systems. Among the 34 common operating systems, 31 systems claim to support IPv6.

Table 4-4 Comparison of IPv6 support in operating systems

OS	Version	Claimed IPv6-ready	Installed by default	DHCPv6	ND RDNSS
AIX	4.3	Yes	Yes	Yes	No
AlliedWare Plus	5.4.4	Yes	Yes	Yes	No
Android	4.2 (Ice Cream Sandwich)	Yes	Yes	No	Yes
ChromeOS	67.0.3396.99	Yes	Yes	No	Yes
Cisco IOS	15.3	Yes	Yes	Yes	Yes
Cisco Meraki	MX + MR + MX series	No	No	No	No
Debian	3.0 (woody)	Yes	Yes	Yes	Yes
Fedora	13	Yes	Yes	Yes	Yes
FreeBSD	9	Yes	Yes	Addon	Yes

HP-UX	11i	Yes	Yes	Yes	Yes
IBM i	7.1	Yes	Yes	Yes	No
iOS	4.1	Yes	Yes	Yes	Yes
Juniper JUNOS	14.1	Yes	Yes	Yes	Yes
LibreELEC	9.2.1	Yes	Yes	Yes	Yes
macOS	Mac OS X 10.7 (Lion)	Yes	Yes	Yes	Yes
MeeGo	1.2	No	Yes	No	Yes
NetBSD	7	Yes	Yes	Yes	Yes
OpenBSD	6.6	Yes	Yes	Addon	Yes
openSUSE	42.1 (Leap)	Yes	Yes	Yes	Yes
OpenVMS	8.3	Yes	Yes	No	No
ReactOS	0.4.11	No	No	No	No
Red Hat Enterprise Linux	6	Yes	Yes	Yes	Yes
Solaris	11	Yes	Yes	Yes	Yes
SUSE Linux Enterprise Server	11	Yes	Yes	Yes	Yes
Symbian	7	Yes	Yes	No	No
Ubuntu	All supported versions	Yes	Yes	Yes	Yes
webOS	2.1.0	No	No	No	No
Windows NT [includes Windows 10 Mobile]	5.1 (XP)	Yes	No	Addon	No
	6.X (Vista, 7, 8, 8.1), 10 RTM-Anniversary Update	Yes	Yes	Yes	No
	10 Creators Update and later	Yes	Yes	Yes	Yes
	11		Yes		
Windows Mobile	6.5	Yes	Yes	Lite	No
Windows Phone	7.5	No	No	No	No
Windows Phone	8(.1)[30]	Yes	Yes	Yes	No
z/OS	V1R4.0	Yes	Yes	No	
z/VM	V5R1.0	Yes	Yes	No	No
z/VSE	V4R2	Addon	No		

Whether the IPv6 protocol stack is installed by default in each operating system, and the statistics on the support for DHCPv6 and RDNSS are as follows:

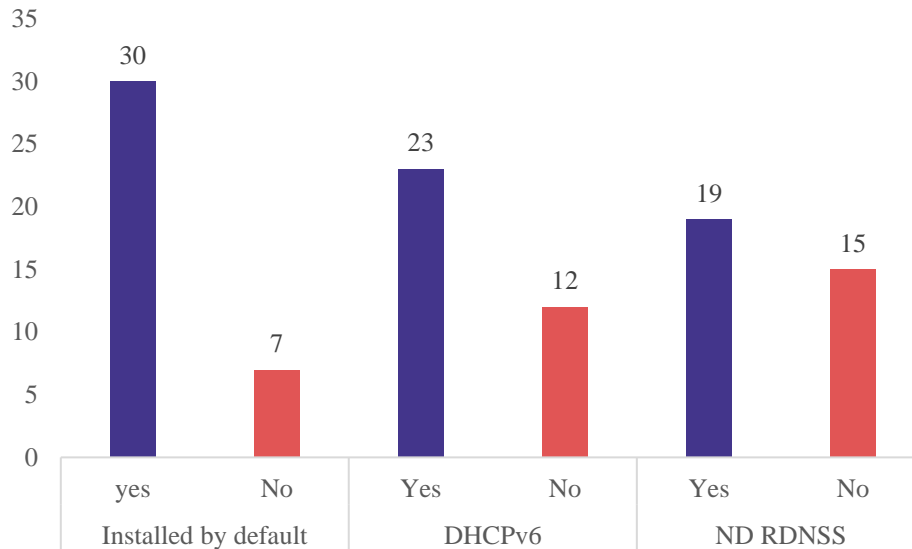


Figure 4-4 Comparison of operating systems supporting IPv6

As shown in Figure 4-4, about 81% of the current operating systems install the IPv6 protocol stack by default, about 65% support DHCPv6, and about 55% support ND RDNSS.

### 4.3.2 Application Software IPv6 Support Status

With the operating system that supports IPv6 as the basis, various application software also gradually begin to support IPv6 to meet the needs of the majority of users. A small part of basic application software can already support IPv6, among which browser software, such as IE series, Chrome, Firefox and Opera, etc. all support IPv6; download software and mail client software, such as FileZilla3, SmartFTP4 and Outlook, etc. all support IPv6.

#### 4.3.2.1 E-mail

The email system mainly consists of two parts:

MUA: Mail User Agent, mail user agent, can be understood as a mail client.

MTA: Mail Transfer Agent, mail transfer agent, can be understood as a mail server.

Mail clients come in many forms, including text-based, Web-based, and GUI applications. Microsoft Outlook falls into the last category. E-mail transmission

protocols mainly include: SMTP, POP, and the emerging IMAP.

Generally, the most commonly used mail client in the Windows operating system is Outlook. This software has supported IPv6 since the 2007 version, and Apple's Apple Mail also supports IPv6, but Foxmail 7, which occupies a large market share in China, does not yet support IPv6. See Table 4-5 for the mail transfer agent and mail client IPv6 support,

Table 4-5 Common mail transfer agent/client IPv6 support status

Name	Version	IPv6 Support	Note
Mail Transfer Agents			
exim	4.2	Yes	
zmailer	2.99.55	Yes	
sendmail	8.12.9	Yes	
postfix	native since 2.2.0	Yes	
courier	0.42.2	Yes	
Mail User Agents			
Outlook	2007	Yes	
mutt	1.4.1	Yes	Text-based mail client for UNIX systems
sylpheed	0.9.6	Yes	
sylpheed-claws	0.9.5	Yes	
Kmail	3.1.2	Yes	KDE mail client
mozilla-mail	since 1.4	Yes	
thunderbird	since 1.0	Yes	Mozilla-based open source mail client software
ximian-evolution	1.4.5	Yes	
alpine	2.0	Yes	
pine	4.62	Yes	
Apple Mail	4.0 (OS 10.6)	Yes	
imap-uw	imap-2007f	Yes	
Postfix	2.9.5	Yes	
Lotus Notes	8.5.3	Yes	

### 4.3.2.2 FTP

Common file transfer server/client IPv6 supports are shown in Table 4-6.

Tabled 4-6 File transfer server/client IPv6 support status

Name	Version	IPv6 Support	Note
FTP server			
ftpd	0.17	Yes	no longer maintained
fftpd	N/A	Yes	
pure-ftpd	1.0.14	Yes	
wu-ftpd	2.6.2	No	
ftpd-bsd	0.3.3	Yes	no longer maintained
ProFTPD	1.2.9rc2	Yes	
troll-ftpd	1.2.8	No	
ginseng-ftpd	1.6	Yes	
libra-ftpd	1.3.4	Yes	
oftpd	0.3.7	Yes	no longer maintained
vsftpd	2.0.0	Yes	
tnftpd	2.0 beta3	Yes	
publicfile	0.52	Yes	
moftpd	1.1.4	Yes	
wzdftpd	0.3.3	Yes	
FTP client			
ftp	0.17-35.e15 / 0.17-51.fc12	Yes	
lftp	2.6.5	Yes	
tnftp	2.0 beta1	Yes	
cftp	0.12	Yes	
ncftp	3.1.9	Yes	
fget	0.4.1	Yes	
konqueror	3.1.2	Yes	
ftpcopy	0.6.4	Yes	
ftpmirror	1.96	Yes	
FileZilla	3.3.5.1	Yes	
FileZilla Client	3.28.0	Yes	
SmartFtp	8	Yes	
SecureFX	7.0.3	Yes	
AbsoluteTelnet	6.28	Yes	
UploadFTP	2.0.1	Yes	

### 4.3.2.3 TTP

The TTP protocol (HyperText Transfer Protocol, Hypertext Transfer Protocol) is a transmission protocol used to transmit hypertext from a WWW server to a local

browser. It can make browsers more efficient and reduce network transfers. It not only ensures that the computer transmits hypertext documents correctly and quickly, but also determines which part of the document to transmit, and which part of the content is displayed first (such as text before graphics), etc.

HTTP is an application layer protocol consisting of requests and responses. It is a standard client-server model. The HTTP server and client IPv6 support are shown in Table 4-7,

Table 4-7 HTTP server and client IPv6 support status

Name	Version	IPv6 Support	Note
HTTP server			
Apache HTTP Server	2.0.43	Yes	
tiny/turbo/throttling HTTP Server	2.20c	Yes	
Boa Webserver	0.94.13	Yes	
webfs	1.19	Yes	
publicfile	0.52	Yes	
bozohtpd	20030622	Yes	
leahhtpd	0.04	Yes	
screws	0.51	Yes	
HTTP client			
mozilla	since 1.4	Yes	
firefox	since 1.0	Yes	
konqueror	3.1.2	Yes	
lynx	2.8.4	Yes	
netscape navigator	7.1	Yes	
opera	7.20b	Yes	
w3m	0.4	Yes	
links	0.98	No	Currently there is only one patch to support IPv6 for the very old 0.92 version of links
elinks	0.9.2rc2	Yes	
httrack	3.23	Yes	
wget	1.9.1	Yes	
curl	7.10.7	Yes	

mGet	1.4.1	Yes	
mMosaic	3.7.2	Yes	
midori	0.2.9	Yes	

#### 4.3.2.4 Application Development

Most of the application software is implemented through various programming languages. In order to develop application software, various corresponding development environments or tools are required. These languages and tools themselves are also a kind of software, and these software are gradually adapting to market needs, began to support IPv6. The following will list some common program development software that supports IPv6.

Apache is the world's number one Web server software. It can run on almost all widely used computer platforms, and is widely used due to its cross-platform and security, and is one of the most popular web server-side software. Apache2 supports IPv6, which provides a basis for deploying IPv6 on websites.

Both Ruby and Python are object-oriented programming languages. Ruby version 1.9.2 adds a Socket API that supports IPv6, and Python supports IPv6 from version 2.4,

Table 4-8 Application Development IPv6 support status

Name	Version	IPv6 Support	Note
Apache	2.4.29	Yes	
Tomcat	8.5.23	Yes	
WebLogic Server	12.2.1	Yes	
python	3.6.3	Yes	
ruby	2.4.2	Yes	
Adobe Dreamweaver	17.5.0	Yes	
Java Development Kit	1.8.0_131	Yes	
Java Runtime Environment	1.8.0_131	Yes	
Microsoft SharePoint	2010	Yes	
Microsoft Internet Information Services (IIS)	10	Yes	
IBM WebSphere® Application Server (WAS)	8.5	Yes	

Hiawatha	9.14	Yes	
PHP	7.1.11	Yes	
Perl	5.26.1	Yes	

#### 4.3.2.5 Database

Database software refers to a software system used for data management, which has the functions of information storage, retrieval, modification, sharing and protection. Currently popular database software includes Access, Sybase, SQL Server, Oracle, FoxPro, etc.

All kinds of websites and applications need the support of the database. The support of the database for IPv6 operation is gradually mature. The mainstream database software can already support IPv6. The main database software supporting IPv6 is shown in Table 4-9.

Table4-9 Database IPv6 support status

Name	Version	IPv6 Support	Note
DB2	2.4.29	Yes	
FileMaker Pro	8.5.23	Yes	
FileMaker Server	12.2.1	Yes	
Microsoft SQL Server	3.6.3	Yes	
MySQL	2.4.2	Yes	Versions before 5.6.6 disable IPv6 function by default
MariaDB	17.5.0	Yes	A fork of MySQL
Oracle Database	1.8.0_131	Yes	
PostgreSQL	1.8.0_131	Yes	
IBM Informix® Dynamic Server (IDS)	2010	Yes	
Sybase OpenSwitch	10	Yes	

#### 4.3.2.6 Multimedia player software

Multimedia player software supporting IPv6 mainly means that the player can connect to the server through IPv6 to realize online playback. After testing, the software in Table 4-10 currently supports IPv6:

Table 4-10 Multimedia player software IPv6 support status

名称	版本	是否支持 IPv6	说明
RealPlayer	16.0.6.4	支持	
Windows Media Player	11.0.5721.5262	支持	
VLC media player	3.0.5	支持	
XMMS	2.0.9	支持	Linux 下的音频播放器
Quicktime	7.7.9	支持	
Adobe Flash Player	27.0.0.170	支持	
Winamp	5.8.0.3660	支持	
freeamp	2.1.1	支持	
mpg123	0.59r	支持	

#### 4.4 CDN IPv6 Support status

According to "The Best CDN Providers Of 2022" released by Digital, the top ten CDNs are: Akamai, Alibaba Cloud Content Delivery Service, Amazon CloudFront, Aryaka Global SD, CacheFly, CDNetworks, Cloudflare, G-Core Labs Content Delivery Network, Imperva, Keycdn.

We summarized the IPv6 support of the top ten CDN providers.

1) Akamai. Akamai, one of the world's largest CDN providers, has turned on support for IPv6 and made the dual-stack protocol the default for new configurations. Akamai's IPv6 traffic peaked at 21Tpbs. Currently, Akamai has provided services related to the visualization of IPv6 adoption based on its CDN's support for IPv6.

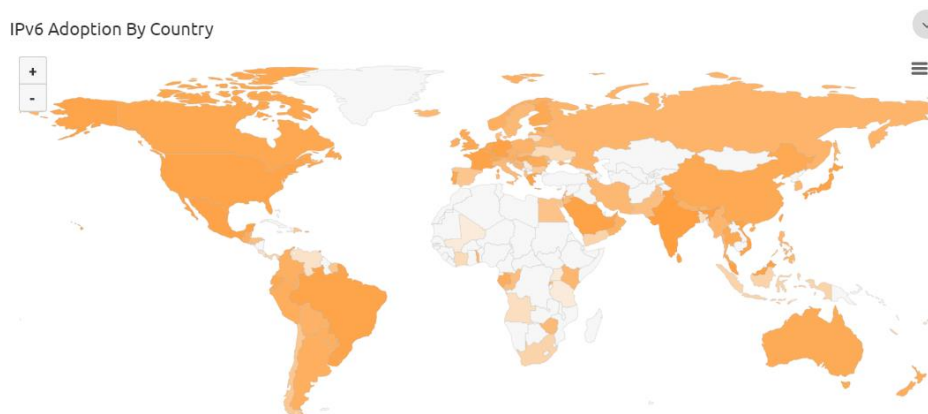


Figure 4-5 Akamai offers service to visualize IPv6 adoption

2) Alibaba Cloud Content Delivery Service. It already supports IPv6 and can be

enabled manually. At the same time, Alibaba Cloud CDN is also the only provider among the ten that has passed the IPv6 Enabled CDN Logo certification.

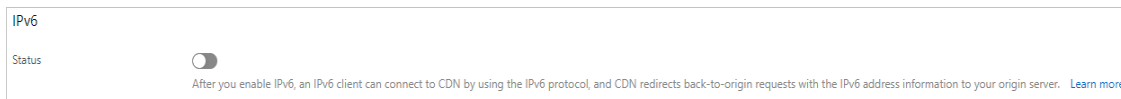


Figure 4-6 Alibaba Cloud CDN supports manually enabling IPv6

3) Amazon CloudFront. CloudFront is a CDN product for the world. Amazon AWS has announced its support for IPv6 connections, all newly created CloudFront will have IPv6 enabled by default, and all existing features of CloudFront will continue to work on IPv6. Currently CloudFront is still supported.

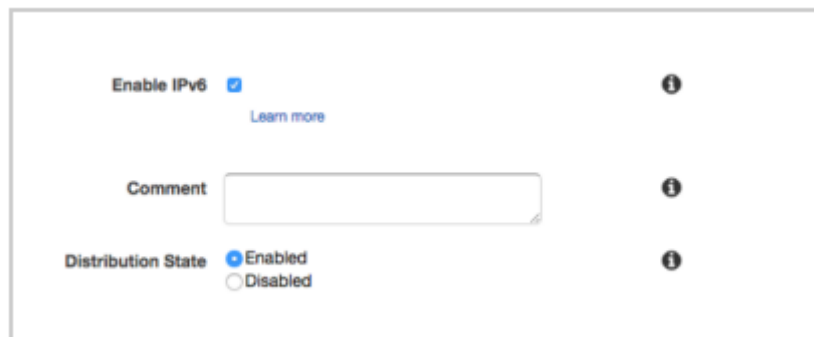


Figure 4-7 AWS CloudFront enables IPv6 option by default

4) Aryaka Global SD. Aryaka also supports IPv6, which can be enabled through tool settings.

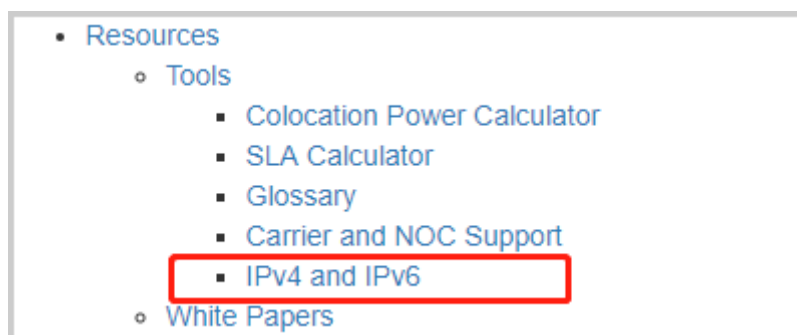


Figure 4-8 Aryaka supports IPv6

5) CacheFly. CacheFly used to be a US-centric CDN, but has recently become a global CDN provider and one of the fastest CDN service providers in the world. CacheFly has announced that its CDN service supports IPv6.

6) CD Networks. CDNetworks has stated on its official website that it supports

IPv6: CDNetwork supports dual protocol stack technology, CDN PoPs will have IPv6 and IPv4 addresses to achieve communication between IPv6 and IPv4.

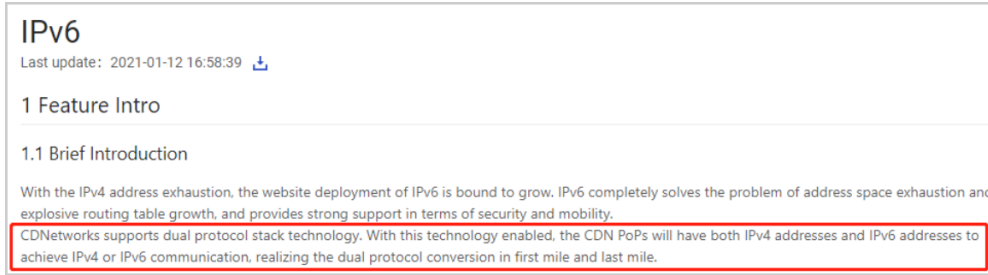


Figure 4-9 CDNetworks supports IPv6

7) Cloudflare. Cloudflare is a world-renowned CDN provider that already supports IPv6.



Figure 4-10 Cloudflare's IPv6 configuration has been changed to enable by default

8) G-Core Labs Content Delivery Network. G-Core Labs CDN already supports IPv6.

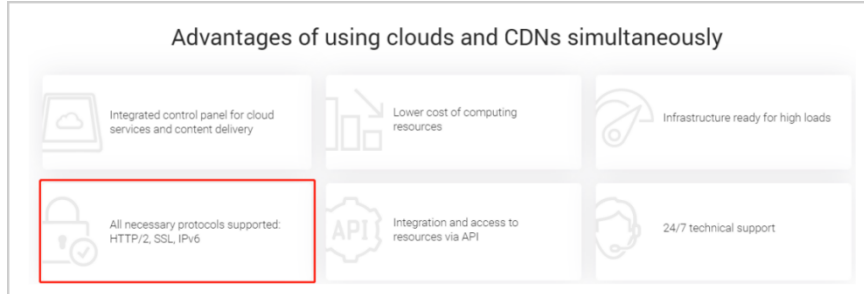


图 4-11 G-Core Labs CDN supports IPv6

9) Imperva。 Imperva already support IPv6。

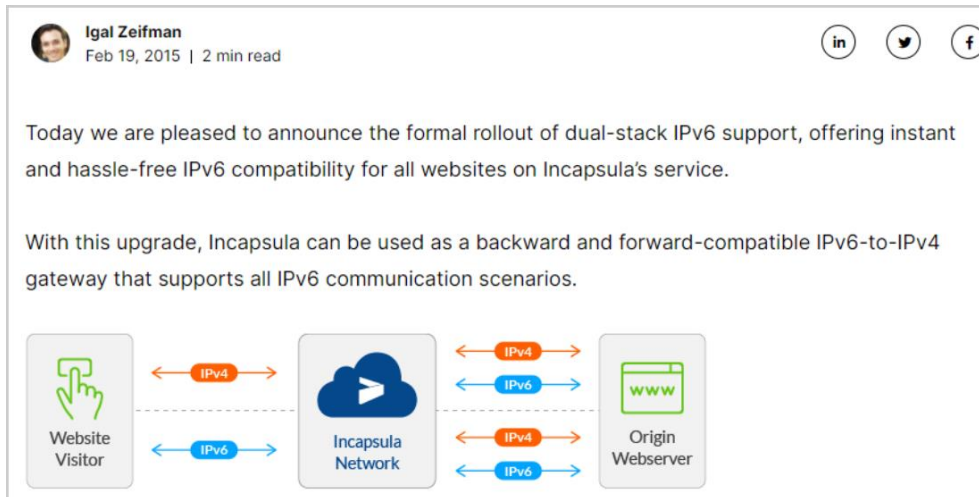


Figure 4-12 Imperva announced support for IPv6 in 2015

10) Keycdn. Keycdn has 34 data centers around the world, deploying more than 82,000 servers. IPv6 is also currently supported.

To sum up, in the CDN list released by Digital, the top ten CDNs have all supported IPv6, with a support rate of 100%.

#### 4.5 Cloud Service IPv6 Support status

According to "The World's Top Cloud Vendors" released by CLOUD WARS, the current top ten cloud vendors are: Microsoft, Amazon, Google Cloud, Salesforce, Oracle, SAP, ServiceNow, Workday, Snowflake, IBM.

We compiled a summary of the IPv6 support of the top 10 cloud providers.

1) Microsoft. Microsoft Azure already implemented "native IPv6 support" this year. Its earlier services that support IPv6 are load balancers and virtual machines. The Internet-facing Basic SKU Load Balancer can be deployed with an IPv6 address. In addition to IPv4 connectivity, the following features are also possible: Native end-to-end IPv6 connectivity between public Internet clients and Azure virtual machines (VMs) through a load balancer; IPv6-enabled clients between VMs and the public Internet Establish a local end-to-end IPv6 output connection between them.

实例详细信息	
名称 *	NET-IPv4IPv6 ✓
区域 *	(Asia Pacific) 东亚 ▼
虚拟网络 ①	TEST-vnet ▼ <a href="#">管理所选的虚拟网络</a>
子网 * ①	default (10.0.0.0/24, ace:ceb:deca:deed::/64) ▼
专用 IP 地址分配	<input checked="" type="radio"/> 动态 <input type="radio"/> 静态
网络安全组 ①	无 ▼
专用 IP 地址(IPv6)	<input checked="" type="checkbox"/>
IPv6 名称 *	ipconfig2 ✓

Figure 4-13 Azure supports IPv6 related settings page

2) Amazon. The cloud service of Amazon AWS is a service provider that started to support native IPv6 earlier. Services that support IPv6 include AWS WAF, S3 Transfer Acceleration, and EC2. Among them, EC2 is a new service that supports IPv6 compared with the previous survey.

3) Google Cloud. The only thing Google Cloud Platform currently supports IPv6 is still the load balancer. Technicians can configure IPv4 and IPv6 external addresses for load balancers that support HTTP(S), SSL, and TCP. A load balancer can accept IPv6 connections from users and proxy those connections over IPv4 to virtual machines (instances), making those instances appear to IPv6 clients as IPv6 services.

4) Salesforce. Salesforce is a SaaS platform provider. Provide customers with cloud CRM software services, and its services have provided IPv6 access to support IPv6.

5) Oracle. The services provided by Oracle include: servers and tools, cloud databases, and enterprise application software. According to the information published on Oracle's official website, its main products already support IPv6: servers can provide IPv6 access addresses, cloud databases can establish IPv6 connections, and cloud enterprise application software supports IPv6 access.

6) SAP. SAP is a global enterprise software provider, currently mainly serving enterprises through cloud solutions. SAP has announced support for IPv6: With the release of SAP NetWeaver 7.0 Enhancement Pack 2, SAP has supported IPv6.



Figure 4-14 SAP supports IPv6

7) Service Now. ServiceNow is a SaaS platform provider similar to Salesforce. Help enterprises realize the automation, standardization and standard business process of IT services and operation and maintenance. ServiceNow also supports IPv6.

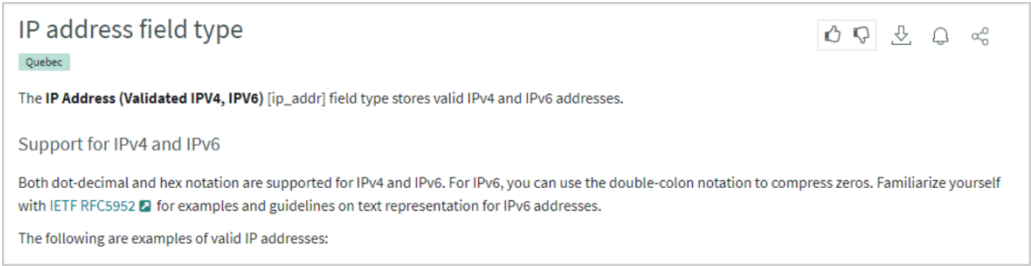


Figure 4-15 ServiceNow supports IPv6

8) Workday. Workday is also a SaaS platform provider. Currently Workday still does not support IPv6, and there is no IPv6 address among its accessible IP addresses.

9) Snowflake. Snowflake, a data warehouse provider, also currently supports IPv6.

10) IBM. IBM Cloud has a high degree of support for IPv6 and provides a set of detailed and comprehensive IPv6 solutions. There are detailed descriptions of IPv6 solutions on its official website.



Figure 4-16 IBM cloud provides IPv6 solutions

To sum up, in the cloud provider list released by CLOUD WARS in 2022, nine of the top ten providers already support IPv6. Except for the eighth-ranked workday, all others have supported IPv6, with a support rate of 90%.

## Chapter 5 Network product IPv6 support status

With the global development of IPv6, manufacturers of network equipment, network security equipment and terminal equipment have developed a large number of IPv6 products, which are rich in types and basically cover all network products (including routers, switches, servers, network security products, VPN gateways, home terminal, office terminal, etc.), which can meet the needs of commercial deployment.

IPv6 Ready Logo certification is a test certification program initiated by the IPv6 Forum, which provides conformance testing and interoperability testing for IPv6 products. The main purpose of the certification is to ensure the interconnection and interoperability of IPv6 equipment and application software, and build confidence for global IPv6 commercial deployment.

According to IPv6 Ready Logo data, as of November 2022, 3,014 IPv6 Ready Logo certifications have been issued worldwide, and the number of certified devices has reached 6,228, and the growth trend is accelerating, as shown in Figure 5-1.

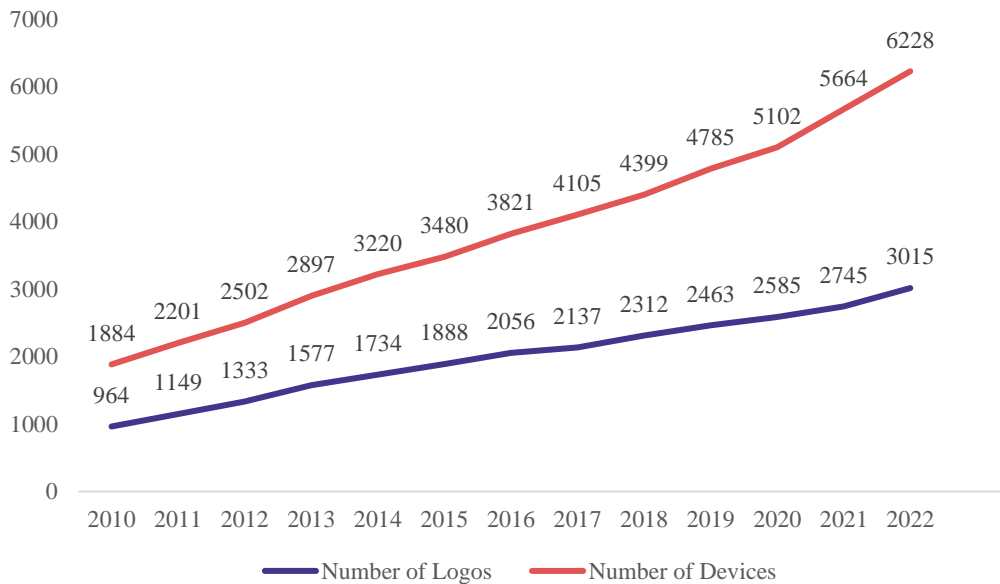


Figure 5-1 Growth trend of IPv6 Ready Logo

As of November 1, 2022, among the countries that have obtained IPv6 Ready Logo in the world, the number of China's IPv6 Ready Logo has reached 1,273, and the number of certified devices has reached 2,453, which is the largest in the world. In

the United States, 932 IPv6 Ready logos were obtained, and 2,083 devices were certified. The number of IPv6 Ready Logos in Japan was 468, and the number of certified devices was 990. The number of IPv6 Ready logos in Korea was 178, and the number of certified devices was 383. India, New Zealand, Germany, France, Brazil and other countries have a total of 164 IPv6 Ready Logos and 319 certified devices, as shown in Figure 5-2 below.

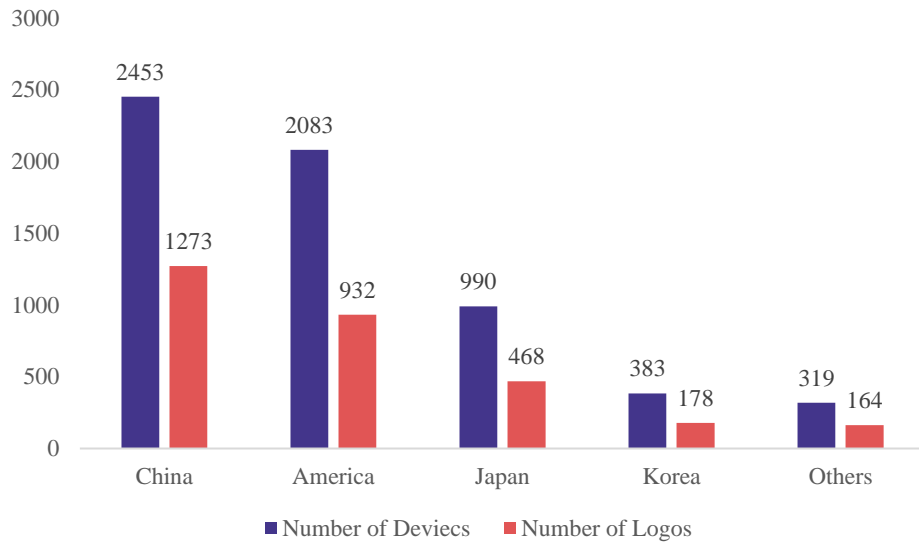


Figure 5-2 IPv6 Ready Logo Certification Data (Country/Region)

There have been more than 100 applications for routers, switches, office terminal equipment, protocol stacks, operating systems, security devices, and home gateways, among which the number of switch Logo has exceeded 500, and the number of devices has exceeded 1900, ranking the largest; the number of switch Logo Nearly 300, the number of devices exceeds 700; the number of Logo applied for network security products is close to 600, and the number of certified devices exceeds 700, as shown in Figure 5-3 and Figure 5-4,

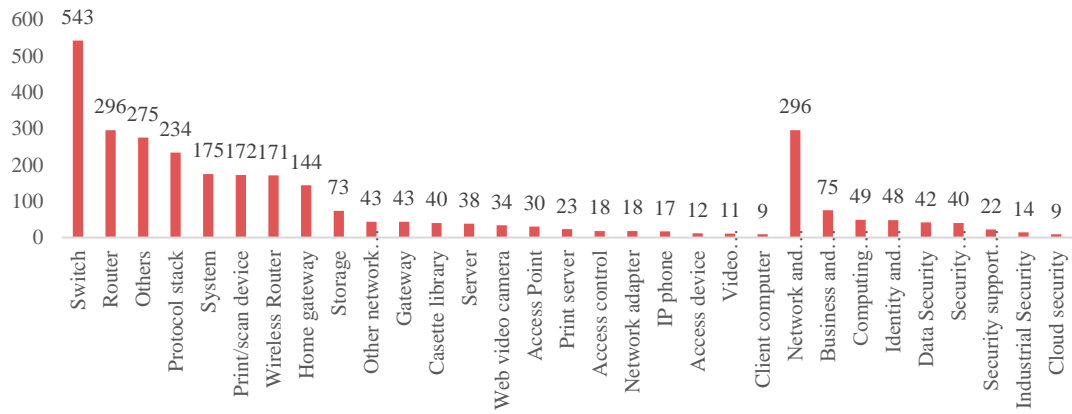


Figure 5-3 Number of IPv6 Ready Logo certifications

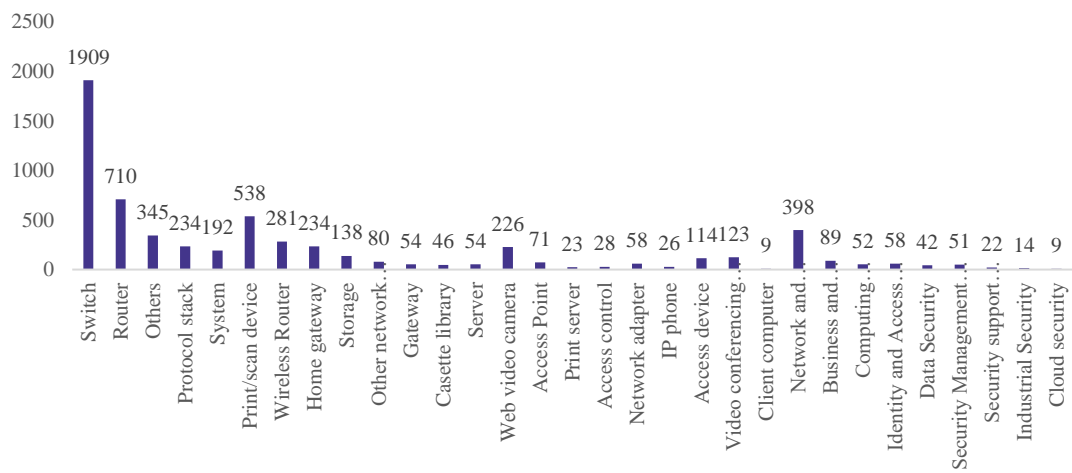


Figure 5-4 Number of certified devices

Figure 5-5 to Figure 5-8 are the certification statistics of China, the United States, Japan, and South Kor

## China

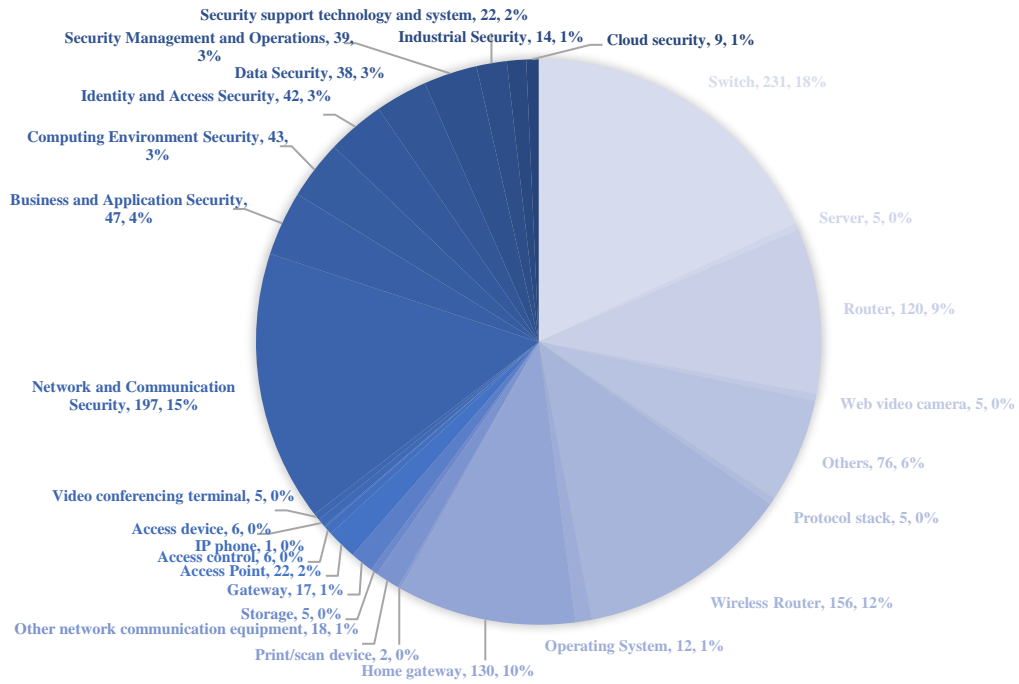


Figure 5-4 Classification of IPv6 Ready certified devices in China

## America

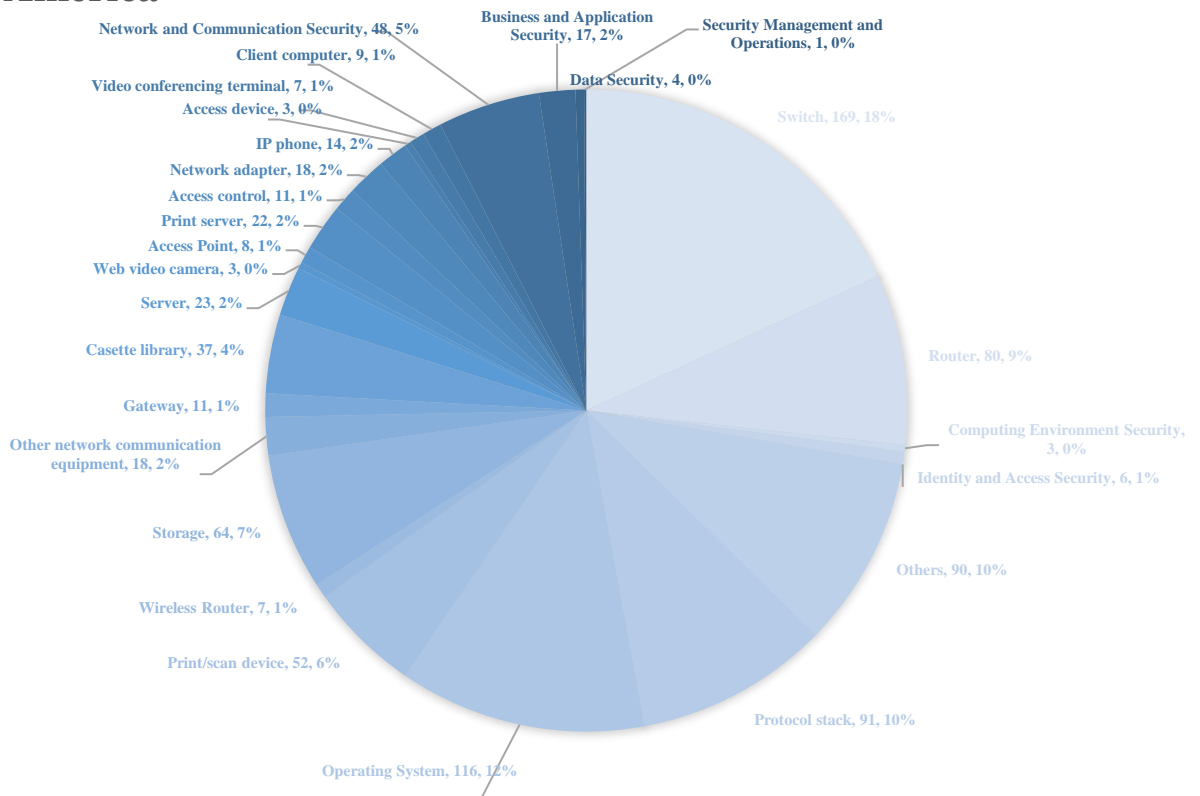


Figure 5-6 Classification of IPv6 Ready certified devices in America

## Japan

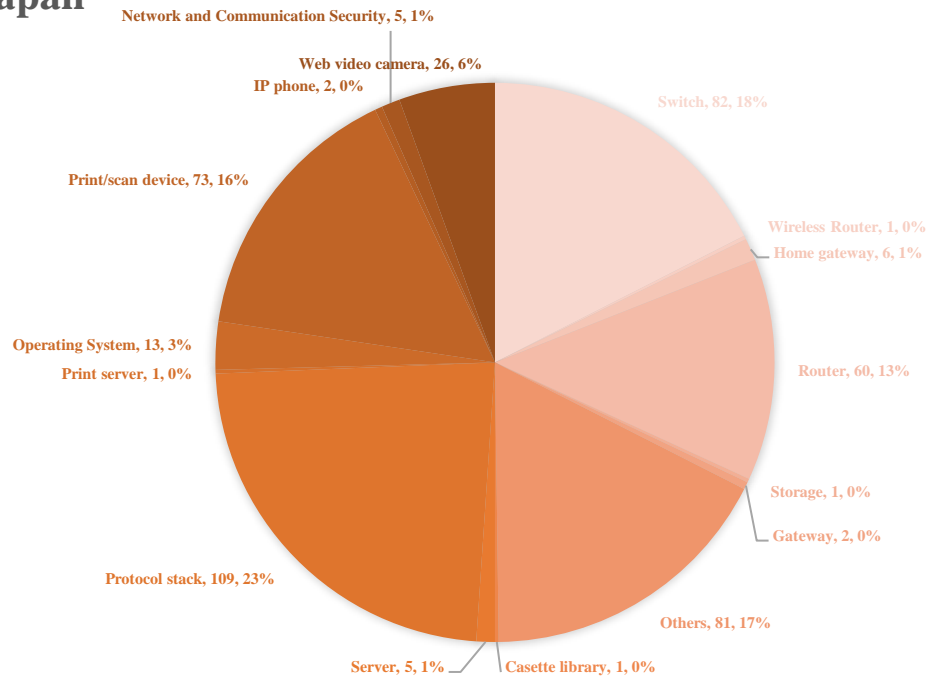


Figure 5-7 Classification of IPv6 Ready certified devices in Japan

## KOREA

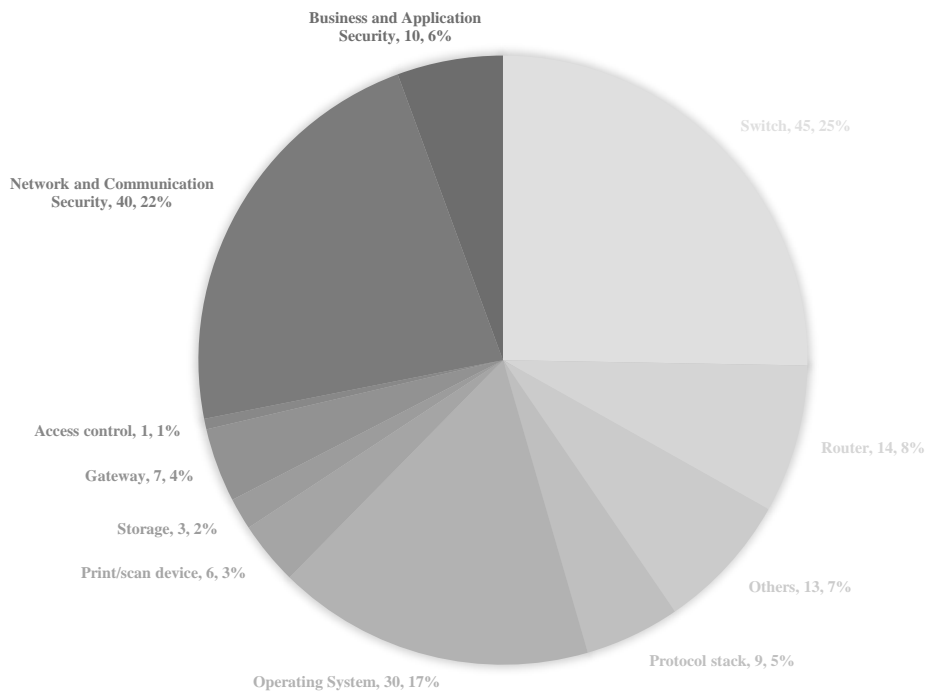


Figure 5-8 Classification of IPv6 Ready certified devices in Korea

The number of applications for routers, switches, wireless routers, home gateways, network security and other equipment in China accounted for more than 85%, and there were fewer applications for other equipment types; switches, routers, protocol stacks, operating systems, storage, printing/scanning in the United States Equipment accounts for a large proportion of its total; applications in Japan are mainly concentrated in switches, routers, protocol stacks, and printing/scanning equipment, accounting for 70% of its total applications; switches, operating systems, network and communication security equipment in South Korea There are many applications, and there are also certain applications for protocol stacks and routers, as shown in Table 5-1.

Table 5-1 Domestic proportion of certified devices

Classification	China	America	Japan	Korea
Switch	18.15%	18.13%	17.52%	25.28%
Router	9.43%	8.58%	12.82%	7.87%
Others	5.97%	9.66%	17.31%	7.30%
Protocol stack	0.39%	9.76%	23.29%	5.06%
Operating System	0.94%	12.45%	2.78%	16.85%
Print/scan device	0.16%	5.58%	15.60%	3.37%
Wireless Router	12.25%	0.75%	0.21%	0.00%
Home gateway	10.21%	0.00%	1.28%	0.00%
Storage	0.39%	6.87%	0.21%	1.69%
Other network communication equipment	1.41%	1.93%	0.00%	0.00%
Gateway	1.34%	1.18%	0.43%	3.93%
Cassette library	0.00%	3.97%	0.21%	0.00%
Server	0.39%	2.47%	1.07%	0.00%
Web video camera	0.39%	0.32%	5.56%	0.00%
Access Point	1.73%	0.86%	0.00%	0.00%
Print server	0.00%	2.36%	0.21%	0.00%
Access control	0.47%	1.18%	0.00%	0.56%
Network adapter	0.00%	1.93%	0.00%	0.00%
IP phone	0.08%	1.50%	0.43%	0.00%
Access device	0.47%	0.32%	0.00%	0.00%
Video conferencing terminal	0.39%	0.75%	0.00%	0.00%
Client computer	0.00%	0.97%	0.00%	0.00%
Network and Communication Security	15.48%	5.15%	1.07%	22.47%
Business and Application Security	3.69%	1.82%	0.00%	5.62%
Computing Environment Security	3.38%	0.32%	0.00%	0.00%
Identity and Access Security	3.30%	0.64%	0.00%	0.00%
Data Security	2.99%	0.43%	0.00%	0.00%
Security Management and	3.06%	0.11%	0.00%	0.00%

Operations				
Security support technology and system	1.73%	0.00%	0.00%	0.00%
Industrial Security	1.10%	0.00%	0.00%	0.00%
Cloud security	0.71%	0.00%	0.00%	0.00%

As shown in Table 5-2, China's wireless routers, home gateways, network security products, access points accounted for more than 70% of the total global applications, including data security, security management and operations, industrial control security, cloud computing security and other categories of products more than 90%, access devices, video conferencing terminals, routers, switches applications accounted for more than 40% of the total global applications; the United States IP phones, tape libraries, tape libraries, storage, print servers In the United States, IP phones, tape libraries, network adapters, storage, print servers accounted for more than 80%, operating systems, servers, video conferencing terminals accounted for more than 60%, routers, switches, protocol stacks also accounted for a certain proportion; Japan's network cameras accounted for more than 70%, protocol stacks, printing/scanning equipment accounted for more than 40%, routers and switches also accounted for a certain proportion; South Korea's operating systems, gateways and network and communications security products accounted for a certain proportion.

Table 5-2 Global percentage of certified devices

Classification	China	America	Japan	Korea
Switch	42.54%	31.12%	15.10%	8.29%
Router	40.54%	27.03%	20.27%	4.73%
Others	27.64%	32.73%	29.45%	4.73%
Protocol stack	2.14%	38.89%	46.58%	3.85%
Operating System	6.86%	66.29%	7.43%	17.14%
Print/scan device	1.16%	30.23%	42.44%	3.49%
Wireless Router	91.23%	4.09%	0.58%	0.00%
Home gateway	90.28%	0.00%	4.17%	0.00%
Storage	6.85%	87.67%	1.37%	4.11%
Other network communication equipment	41.86%	41.86%	0.00%	0.00%
Gateway	39.53%	25.58%	4.65%	16.28%
Cassette library	0.00%	92.50%	2.50%	0.00%
Server	13.16%	60.53%	13.16%	0.00%
Web video camera	14.71%	8.82%	76.47%	0.00%
Access Point	73.33%	26.67%	0.00%	0.00%
Print server	0.00%	95.65%	4.35%	0.00%

Access control	33.33%	61.11%	0.00%	5.56%
Network adapter	0.00%	100.00%	0.00%	0.00%
IP phone	5.88%	82.35%	11.76%	0.00%
Access device	50.00%	25.00%	0.00%	0.00%
Video conferencing terminal	45.45%	63.64%	0.00%	0.00%
Client computer	0.00%	100.00%	0.00%	0.00%
Network and Communication Security	66.55%	16.22%	1.69%	13.51%
Business and Application Security	62.67%	22.67%	0.00%	13.33%
Computing Environment Security	87.76%	6.12%	0.00%	0.00%
Identity and Access Security	87.50%	12.50%	0.00%	0.00%
Data Security	90.48%	9.52%	0.00%	0.00%
Security Management and Operations	97.50%	2.50%	0.00%	0.00%
Security support technology and system	100.00%	0.00%	0.00%	0.00%
Industrial Security	100.00%	0.00%	0.00%	0.00%
Cloud security	100.00%	0.00%	0.00%	0.00%

Among all the manufacturers that have obtained IPv6 Ready Logo certification, D-Link, Cisco, HP, H3C, Dell, and Panasonic have more than 60 logos. Table 5-3 lists the top ten manufacturers. Cisco ranks first with 232 logos, with 854 certified devices, D-link ranks second with 182 logos, with 229 certified devices, HP ranks third with 120 logos, with 291 certified devices.

Table 5-3 Top 10 Vendors by number of logos

No.	Vendor	Country/Region	Number of Logos	Number of certified devices
1	Cisco	US	232	854
2	D-Link	CN	182	229
3	HP	US	120	291
4	H3C	CN	88	387
5	Dell	US	77	84
6	Huawei	CN	71	249
7	Panasonic	JP	60	224
8	Allied Telesis	JP	42	167
9	Fujitsu	JP	41	74
10	IBM	US	38	39

The following is the number of logo and the number of devices obtained by the top manufacturers according to the type of equipment.

1. In terms of security equipment, it includes all categories of security equipment including network and communication security, business and application security, identity and access security, etc. Among the top 10 manufacturers in the number of logos, Chinese manufacturers occupy eight, among which Topsec ranks first with 37 logos, Qi Anxin ranks second with 35 logos, and Venustech ranks third with 26 logos. Among the above-mentioned manufacturers, Topsec, Qi Anxin, Venustech, Bluedon, NSFOCUS, Dbappsecurity and Sangfor have more certified products and cover a wider range of security fields. Cisco, Huawei, New H3C, SonicWALL and Future system are more concentrated in the field of network communication security such as FW, IPS and IDS, the details are shown in Table 5-4:

Table 5-4 Top 10 security vendors by number of logos

No.	Vender	Country/Region	Number of Logos	Number of certified devices
1	Topsec	CN	37	45
2	Qi Anxin	CN	35	35
3	Venustech	CN	26	36
4	H3C	CN	24	25
5	Cisco	US	18	46
6	Huawei	CN	17	17
7	SonicWALL	US	17	17
8	Bluedon	CN	17	17
9	NSFOCUS	CN	16	16
10	Dbappsecurity	CN	13	13
11	Sangfor	CN	13	13
12	Future system	KR	13	13

2. In terms of switches, among the top ten manufacturers, there are five Chinese manufacturers, four American manufacturers, and one Korean manufacturer. Cisco has 80 logos with 394 certified devices, ranking first, D-Link has 66 logos with 95 certified devices, ranks second, H3C has 35 logos with 259 certified devices, ranks third, as shown in Table 5-5:

Table 5-5 Top 10 Switch vendors by number of logos

No.	Vender	Country/Region	Number of Logos	Number of certified devices
1	Cisco	US	80	394
2	D-Link	CN	66	95
3	H3C	CN	37	259
4	Allied Telesis	US	31	48

5	Huawei	CN	27	129
6	Ruijie	CN	26	77
7	HP	US	24	75
8	PIOLINK	KR	16	75
9	AVAYA	US	12	12
10	ZTE	CN	9	56

3. In terms of router equipment, they are mainly enterprise routers. Among the top ten manufacturers with the most logos, there are five Chinese manufacturers, four Japanese manufacturers, and one American manufacturer. Cisco has 66 logos with 176 certified devices, ranking first, Allied Telesis has 66 logos with 41 certified devices, ranking second, H3C has 26 logos with 77 certified devices, ranking third. The number of Huawei and ZTE logos is not high, but the number of certified devices has reached 68 and 58, as shown in Table 5-6:

Table 5-6 Top 10 Router vendors by number of logos

No.	Vender	Country/Region	Number of Logos	Number of certified devices
1	Cisco	US	66	176
2	Allied Telesis	JP	27	41
3	H3C	CN	26	77
4	NEC	JP	20	77
5	D-Link	CN	14	14
6	Huawei	CN	11	68
7	ZTE	CN	10	58
8	YAMAHA	JP	10	9
9	Fujitsu	JP	9	29
10	Fiberhome	CN	8	11

4. In terms of home wireless routers, among the top three manufacturers, there are two Chinese manufacturers and one American manufacturer. D-Link has 81 logos with 97 certified devices, ranking first, TP-Link has 27 logos with 109 certified devices, ranking second, Netgear has 22 logos with 22 certified devices, ranking third. As shown in Table 5-7:

Table 5-7 Top 5 Home wireless router vendors by number of logos

No.	Vender	Country/Region	Number of Logos	Number of certified devices
1	D-Link	CN	81	97
2	TP-Link	CN	27	109

3	NETGEAR	US	22	22
4	Cisco	US	12	12
5	Zyxel	CN	6	11

5. In terms of home gateways, the top five manufacturers are all Chinese manufacturers. China Mobile has 25 logos with 32 certified devices, ranking first, ZTE has 22 logos with 65 certified devices, ranking second, FiberHome has 14 logos with 18 certified devices, ranking third, as shown in Table 5 -8 :

Table 5-8 Top 5 Home gateway vendors by number of Logos

No.	Vender	Country/Region	Number of Logos	Number of certified devices
1	China Mobile	CN	25	32
2	ZTE	CN	22	65
3	Fiberhome	CN	14	18
4	SuperElectron	CN	13	13
5	Huawei	CN	12	23

6. Server equipment, including storage equipment, tape library equipment and server equipment. Among the top five manufacturers in terms of quantity, there are four in the United States and one in Japan. Dell ranks first with 28 logos, IBM ranks second with 21, and Japanese manufacturer Hitachi ranks third with 16. The details are shown in Table 5-9:

Table 5-9 Top 5 IT vendors by number of logos

No.	Vender	Country/Region	Number of Logos	Number of certified devices
1	Dell	US	28	33
2	IBM	US	21	22
3	Hitachi	JP	16	27
4	HP	US	17	26
5	EMC	US	12	24

7. Software system, including software such as embedded system and application system. The software systems of eight manufacturers around the world have obtained IPv6 Ready Logo certification, six of which are from the United States, and one from Japan and one from South Korea. Dell ranked first with 18 logos, IBM ranked second

with 15 logos, and Microsoft ranked third with 10 logos, as shown in Table 5-10:

Table 5-10 Top 8 Operating system vendors by number of logos

No.	Vender	Country/Region	Number of Logos	Number of certified devices
1	Dell	US	18	18
2	IBM	US	15	15
3	Microsoft	US	13	13
4	Fujitsu	JP	11	11
5	Red Hat	US	11	11
6	Samsung	KR	10	10
7	Apple	US	9	9
8	HP	US	9	9

## Conclusion

In 2022, the overall global IPv6 deployment is still in the process of accelerating deployment. According to the statistics in the white paper, the number of global IPv6 users and the deployment rate have been steadily increasing year by year, and the support of networks, domain name systems, and websites for IPv6 has increased. Specifically, the number of Internet and IPv6 users is increasing rapidly, and the absolute value is relatively high; the website content supports IPv6 relatively low, and many large enterprises and commercial websites support IPv6 poorly. More websites are needed at this stage Support IPv6 to solve the situation of lack of IPv6 content; relatively good infrastructure such as cloud services and CDN and other top-ranked service providers such as Amazon, Microsoft and Alibaba Cloud are the first to support IPv6, laying the foundation for websites and applications to support IPv6 foundation and provide strong protection. In terms of network products, as of November 2022, the total number of issued IPv6 Ready Logos worldwide exceeds 3,000, and the number of devices exceeds 6,000. China ranks first in the world in total, followed by the United States, Japan, and South Korea. Among the types of certified equipment, routers, switches, protocol stack equipment, and network security equipment are more certified, and the number of IPv6 certification of home gateway terminal products has ushered in a relatively large increase in the past two years.

The global Internet IPv6 upgrade transition is a huge project, and any link has a decisive impact on the development of IPv6. We call on the upstream and downstream of the Internet industry chain to strengthen cooperation, actively communicate and exchange, collaborate and innovate, and jointly contribute to the deployment and development of IPv6.

## Resources

<http://labs.apnic.net/dists/v6dcc.html>

<https://www.vyncke.org/ipv6status/prefixes.php>

<http://www.alexa.com/topsites/countries>

<https://www.google.com/ipv6/statistics.html#tab=per-country-ipv6-adoption>

<https://6lab.cisco.com/stats/index.php?option=prefixes>

[http://www.delong.com/ipv6\\_alexa500.html](http://www.delong.com/ipv6_alexa500.html)

<https://www.ipv6ready.org/db/index.php/public/search/> <https://www.ipv6ready.org.cn/>