Chapter 2 : Continuing to accelerate the transition to IPv6

THE BOTTOM LINE

- The transition to IPv6 has become a pressing issue, to prevent the internet from being split into two with IPv4 on one side and IPv6 on the other.
- At the end of 2025, 94% of residential fixed access customers (FttH, cable, ADSL) in France were IPv6-enabled, (+7 point YoY), compared to 82% on mobile networks(+12 points YoY). There continue to be disparities between operators, however, particularly in terms of enabling IPv6 on enterprise plans.
- Looking at content providers and web hosting companies, 38% of websites are IPv6-ready (+3 points YoY). The pace of this evolution makes it possible to expect to see a complete transition within the next few years.
- Of the 100 countries with the most internet users, France now ranks first in IPv6 adoption as of November 2025, with a combined residential and business adoption rate estimated at 75.6% in March 2026, ahead of India (75.1% IPv6) and Germany (65.4% IPv6).

1| The transition to IPv6, vital to the future of the internet

Every device connected to the internet has an IP address. Public IP addresses are registered and routable on the internet and are therefore unique.

1.1. A shortage of IPv4 addresses since 2019

Internet Protocol version 4, or IPv4, which has been used on the internet since the 1980s, is limited to around 4.3 billion (2^{32}) IP addresses. Although, at the time, this appeared to be more than enough for the fledgling network, the overwhelming success of the internet and proliferation of consumer applications since the 1990s and 2000s, have led directly to the exhaustion of available IPv4 addresses. As a result, since 25 November 2019, RIPE NCC (the regional internet registry that allocates IPv4 addresses in Europe and the Middle East) has been experiencing a shortage of IPv4 addresses [11]. This has forced operators to **share IPv4 addresses between multiple users,** including on FttH networks. This sharing can lead to service malfunctions, identification issues, and possible security issues. Because of the scarcity, since 2022 [12] some web hosting companies and cloud service providers have been **charging their customers for the use of IPv4 addresses.** The exhaustion of IPv4 addresses, and the resulting increase in their value, constitutes a barrier to entry for new entrants, operators and content and application providers. **Continuing to maintain an IPv4 internet will not prevent it from functioning, but it will prevent it from growing.**

1.2. IPv6 is the only structural and future-proof solution

To tackle this situation, IPv6 specifications were **finalised in 1998.** They incorporate functions for increasing security by default and optimising routing. Above all, **IPv6 delivers an almost infinite number of IP addresses: 667 million IPv6 addresses** for each square millimetre of the Earth's surface.

IPv6 makes it possible not only to overcome the exhaustion of addresses, but also to simplify the technical management of the internet: Stateless Address Autoconfiguration (SLAAC) enables devices to generate their own unique IP addresses without conflict, and to assign very large address blocks to countries or enterprises, makes data routing more efficient.

In this context, **the transition to IPv6 is a crucial to safeguarding innovation, competitiveness and an open internet.**

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(11) The five Regional Internet Registries (RIR) all have an IPv4 shortage. The IPv4 address exhaustion curve can be viewed RIR by RIR at: https://ipv4.potaroo.net/.

(12) In September 2022 OVH announced that it would be charging for previously free IPv4 addresses. In 2026, the price of an IPv4 address rose to €2.39, incl. VAT/month per IPv4 address. Billing for IPv4 addresses is now a common practice will all of the leading hosting companies and cloud service providers.

IPv6 is not, however, backwards compatible with IPv4. Technically, an IPv6-only computer cannot talk to an IPv4-only computer. As a result, when a website or application is hosted in "IPv6-only", it will **not be accessible** to users with an "IPv4-only" device, which creates the **risk of splitting the internet in two, with IPv4 on the one side and IPv6 on the other,** as illustrated in the following diagram.

Because of how complex the internet is today, with billions of connected objects, **the migration from IPv4 to IPv6 cannot happen overnight.** It can only occur gradually, by deploying IPv6 alongside IPv4 (cohabitation phase). Once every actor has added IPv6 compatibility to their servers, network equipment and devices, IPv4 can be definitively phased out, to be fully replaced by (IPv4 shut-down phase).

Although the transition to IPv6 began in 2003, today, in 2026, the internet is still in the cohabitation phase. The IPv4 and IPv6 protocols will continue to coexist for as long as IPv6 is not ubiquitous on every link of the internet chain. Some countries have nonetheless announced **that they will begin to shut down IPv4 in 2032** [13].

OVERVIEW OF TECHNOLOGIES SUPPORTING IPV6 TRANSITION

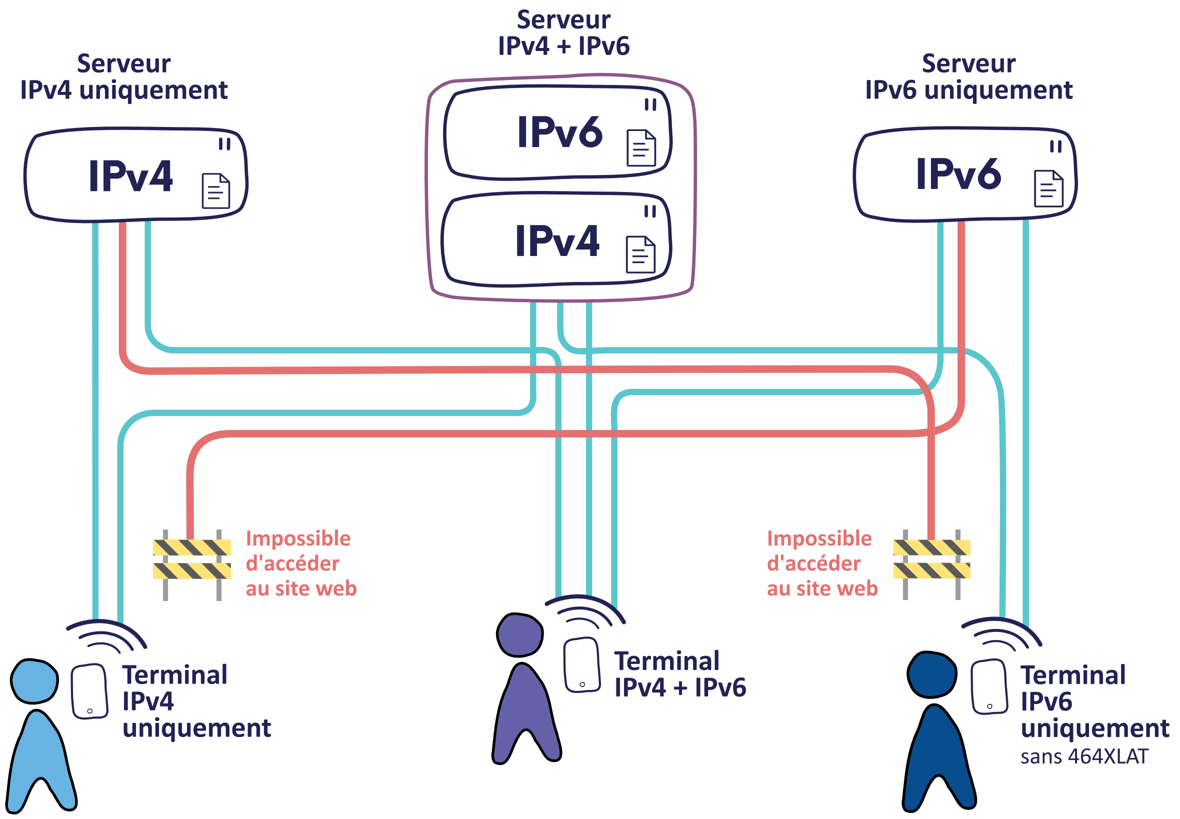
From an operational standpoint, the transition to IPv6 is being achieved using one of three cohabitation methods:

Dual stack: this is the most common solution. Devices (computer, smartphone, router) have two addresses at once: one IPv4 and one IPv6. If they connect to an IPv6-ready site, they will use their IPv6 address. When connecting to an IPv4 site, they will use their IPv4 address.

Tunnelling: an IPv4 packet is encapsulated inside an IPv6 packet. Like putting a letter written in IPv4 inside an envelope addressed in IPv6 to relay an IPv4 stream over a network that no longer manages IPv4. The reverse is also possible to relay an IPv6 stream over a network that does not yet manage IPv6.

Translation (NAT64 / DNS64): a piece of network equipment (typically belonging to one's ISP) acts as a real time translator. It converts IPv6 packets to IPv4, and vice-versa to enable non-compatible devices and servers to "talk" to each other.

IPv6 IS NOT NATIVELY RETROCOMPATIBLE WITH IPv4



Source: Arcep

(13) The Czech government has demanded that government departments no longer provide e-government services using IPv4 as of 6 June 2032. The countdown is available at: https://konecipv4.cz/en/.

2 | Status of the transition to IPv6 in 2026

To assess IPv6 deployment in France, Arcep uses data collected in accordance with its Decision No. 2024-0589 along with data from Afnic to produce an annual Barometer of the Transition to IPv6 in France, providing an overview of IPv6 adoption in France. This Chapter covers the main findings of the 2026 edition.

2.1. A host of actors, at different stages in their transition

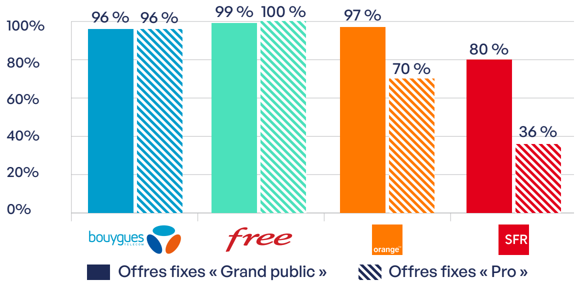
Operators are making the transition to IPv6 more rapidly than web hosting companies and other content providers. At the end of 2025, 94% of customers of residential internet service providers were IPv6-enabled (+7 points YoY), compared to 83% of mobile customers (+13 points YoY). This increase in IPv6 activation can be attributed in particular to the progress made by operator SFR on fixed access (+26 points) and by Free on mobile access (+48 points). With regards to content providers and hosting companies, 38% of websites (+3 points YoY), and 25% of e-mail servers (+2 points YoY) were IPv6-ready.

Virtually all consumer market customers should be IPv6 ready by the end of 2028 [14]. **The rate of progress amongst content providers and hosting companies suggests that is highly unlikely their transition will be completed within the next few years.**

2.2. Fixed ISPs

According to forecasts provided by operators, **the transition to IPv6 amongst residential customers should be virtually complete by the end of 2028** and could end in 2030 with the switch off of the copper network. Some operators have chosen not to migrate infrastructures that are coming to the end of their life to the IPv6 protocol. For internet plans designed for businesses and professionals, the transition could take a few years longer.

FIXED NETWORKS: PERCENTAGE OF IPv6-ENABLED CUSTOMERS

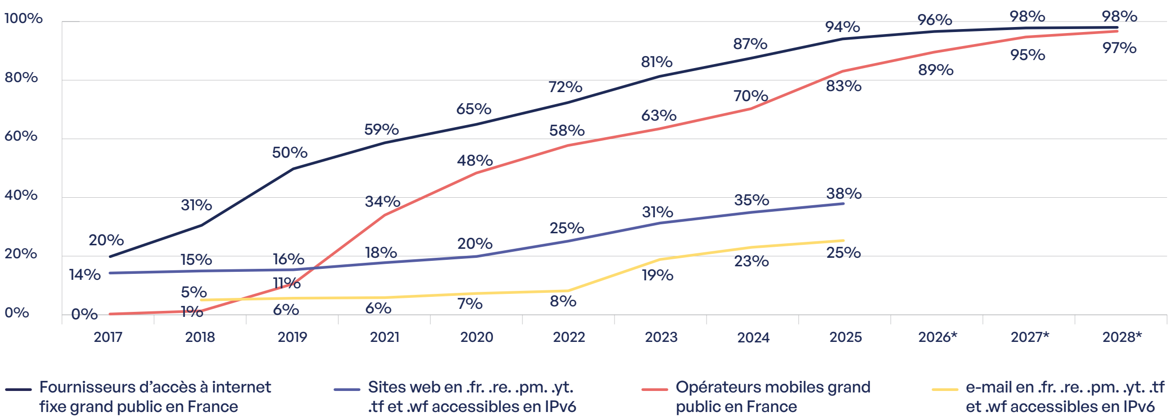


Source: Data as of end of December 2025, collected by Arcep from operators

On **residential fixed networks,** regarding the top electronic communications operators in France, Arcep notes that:

- **Bouygues Telecom** enables IPv6 for all of its residential FttH, ADSL and VDSL customers connected to its own network. IPv6 is enabled for most Bouygues customers with a fixed 4G or 5G router. IPv6 is not offered for ADSL or VDSL on a third-party backhaul network (these are Bouygues Telecom customers who are connected to an Orange DSLAM).

STATUS OF THE TRANSITION TO IPv6 IN FRANCE



** Figures subject to change (operator forecasts, except for Free mobile: Arcep forecasts)*

Operator source: data from end of December 2025, collected by Arcep from the main operators and aggregated according to market share as of Q3 2025. For the sake of the analysis, the assumption is that Android has a 61% market share and iOS 39%.
Website and email source: Afnic data from January 2026

(14) On fixed networks, by 2028, customers who do not have access to IPv6 will be on networks at the end of their life (ADSL/VDSL/cable), and the legacy copper network is due to be switched off by 2030. On mobile networks, the only devices that are not IPv6-enabled are old devices that will gradually be removed from circulation with the shut-down of 3G in 2029.

- **Free** enables IPv6 for all of its residential FttH, ADSL, and VDSL customers connected to its own network. IPv6 is not available for ADSL or VDSL on a third-party backhaul network (aka non "unbundled" customers) nor on 4G+/5G Free modem.

- **Orange** enables IPv6 for all of its residential FttH customers. IPv6 is enabled for most customers equipped with a 4G Home, and 5G Home routers. For ADSL and VDSL customers IPv6 is enabled on a network that assigns its DHCP addresses to most Orange xDSL customers. IPv6 is not available for a small number of residential ADSL customers (addresses assigned via PPP). In addition, all new ADSL customers are assigned by DHCP scope.

- **SFR** is phasing out the replacement of network equipment that was not IPv6-compatible on the FttH network. At the end of 2025, virtually all SFR FttH customers are IPv6 enabled. It is enabled for most customers equipped with a fixed 4G or 5G router. As the copper access network is gradually being switched off, in 2023 SFR elected to eliminate IPv6 support on ADSL/VDSL plans. IPv6 (encapsulated in IPv4) had previously been available with ADSL and VDSL plans but was not enabled by default (as of end of June 2022, 1% of ADSL and VDSL customers had enabled this option). IPv6 is also not available on the cable network.

For **"pro" plans designed for small businesses,** Bouygues Telecom and Free emulate residential market strategies. Orange and SFR "Pro" customers have the lowest rate of IPv6 readiness:

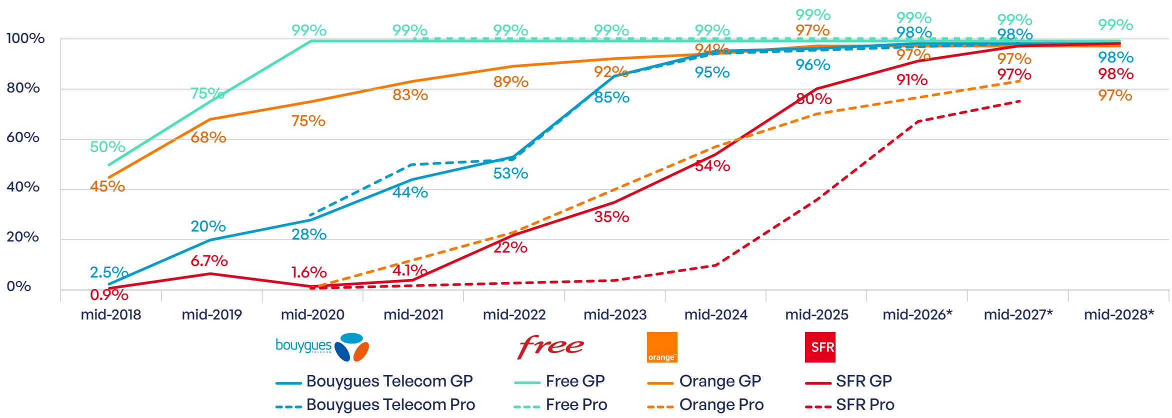
- **Orange:** IPv6 has been enabled IPv6 or most FttH "Pro" customers. It is also enabled for a minority of customers with a 4G or 5G router. It is not offered to Orange ADSL or VDSL "Pro" small business customers.

- **SFR** began enabling IPv6 on FttH lines in 2025. As with residential market customers, SFR does not yet enable IPv6 for its ADSL, VDSL or cable "Pro" plans. The forecast up to the end of 2027 suggests a strong increase in IPv6 readiness for FTTH Pro plans.

The transition to IPv6 for retail market operators with fewer than three million customers (in metropolitan and overseas France) is detailed in the annual Arcep Barometer of the Transition to IPv6 in France.

Arcep has observed the adoption of IPv6 by new operators every year, although a certain number of those with fewer than three million customers still do not offer IPv6.

RESIDENTIAL FIXED NETWORK: PROGRESSION OF IPv6-ENABLED CUSTOMERS



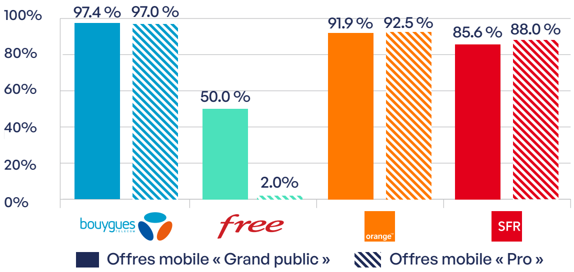
** Figures subject to change.*

Source: Data as of end of December 2025, collected by Arcep from operators

2.3. Mobile ISPs

According to the forecasts provided by France's four largest ISPs, **the transition of mobile access lines to IPv6 should be virtually complete by the end of 2029[15],** for both consumer and enterprise customers. The transition could take longer for "data only" plans (4G/5G portable routers, tablets, computers, etc.). While the progress made in 2025 by operators Orange, Bouygues and SFR continued at the same pace as previous years, the rate of IPv6 readiness for Free consumer customers surged from just over 1% at the end of 2024 to 50% at the end of 2025. The operator has announced even more significant progress for Free Pro customers in 2026, going from 2% IPv6-enabled at the end of 2025 to 77% at the end of 2026.

MOBILE NETWORK: PERCENTAGE OF IPv6-ENABLED CUSTOMERS



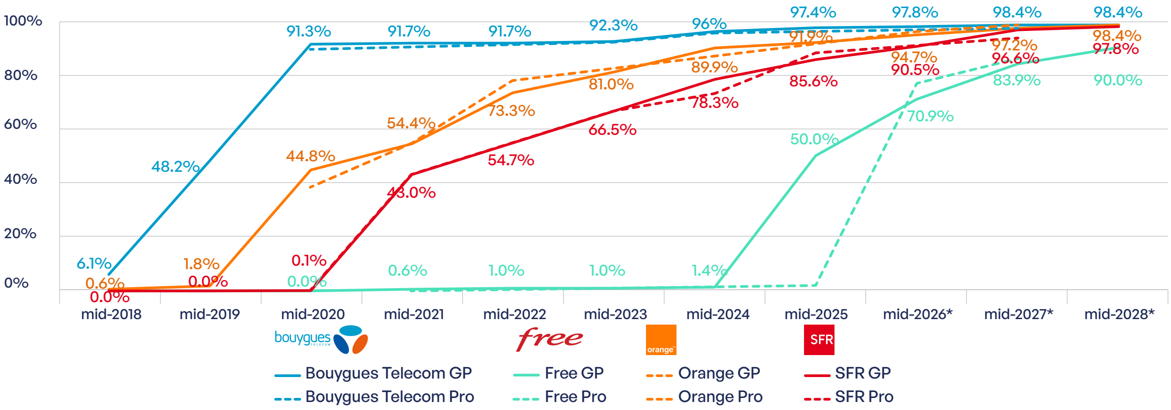
Source: Data as of end of 2025, collected by Arcep from operators and aggregated, with an assumed 61% market share for Android and 39% for iOS.

Arcep has observed sizeable disparities in the transition of **consumer mobile** plans to IPv6. Although all the main operators offer IPv6, there are real differences in their approach to enabling the protocol:

- **Android:** Bouygues Telecom, Orange, and SFR all enable IPv6 by default on Android phones released after 2018 (Bouygues), 2020 (Orange), and 2021 (SFR). At the end of 2024, Free had enabled IPv6 on smartphones with VoLTE Free enabled.
- **iPhone:** Bouygues Telecom, Orange, and SFR all enable IPv6 by default on iPhones with at least iOS 12.2 (Bouygues), iOS 13.0 (Orange for iPhone 7 and more recent), iOS 14.3 (SFR), and iOS 15.4 (Orange for iPhone 6S and SE). Free enabled IPv6 by default in 2025 for iPhones compatible with VoLTE Free (iPhone 7 and later) running on iOS 15.4 and later. This widespread compatibility with IPv6 means that more iPhones than Android smartphones are IPv6 compatible.

For "Pro" **small business plans,** Bouygues Telecom, Orange, SFR, and Free offer IPv6 under the same terms as consumer plans. Free is expected to enable all Free Pro mobile phones 2026.

CONSUMER MOBILE NETWORK: PERCENTAGE OF IPv6-ENABLED CUSTOMERS



** Figures subject to change.*
Source: Data as of end of 2025, collected by Arcep from operators and aggregated, with an assumed 61% market share for Android and 39% for iOS.

(15) The shut-down of the 3G network in 2029 is expected to trigger the replacement of old non-VoLTE compatible devices, which overlap to a degree with non-IPv6 compatible devices.

2.4. Web hosting

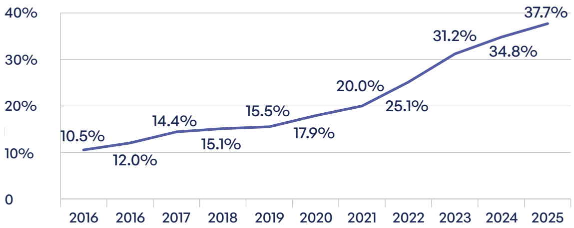
A website is considered accessible in IPv6 when it has a DNS IPv6 registration. To exclude a portion of the unused domain names, the rate is calculated using only domain names with a valid HTTPS certificate, which amounts to 2.4 million domain names ending in .fr, .re, .pm, .yt, .tf and .wf, which are analysed below.

As of early 2026, web hosting companies were one of the weakest links in the migration to IPv6. **Only 37.7% of websites are in fact IPv6-ready,** marking a 20-point increase over the past five years, but an only three-point increase last year

The percentage of IPv6-ready websites is growing, **but the pace of the evolution suggests that the transition is unlikely to be completed over the next few years.**

PROGRESSION OF IPv6-ENABLED WEBSITES

for .fr, .re, .pm, .yt, .tf and .wf domain names



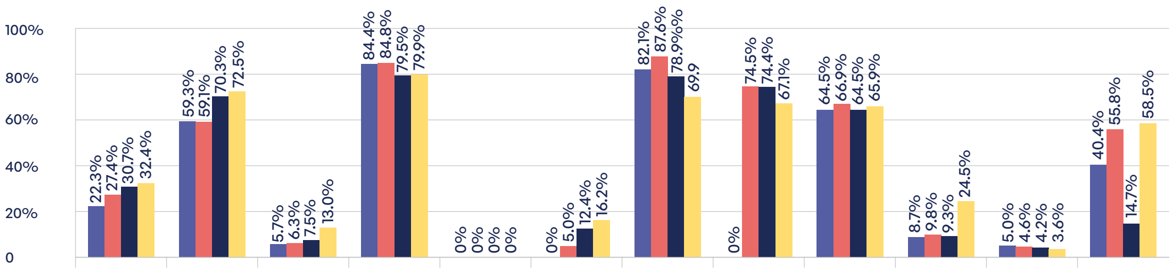
Source: Afnic data as of January 2026. Only domain names with a valid TLS certificate are included.

Of the top 12 web hosting companies in France, only Cloudflare, IONOS, LWS, Hostinger, LWS, Infomaniak and Hetzner Online have more than half the websites they host IPv6-enabled, setting an example to be followed.

Data on all .fr, .re, .pm, .yt, .tf, and .wf web hosting companies are available in four formats: PDF, OpenDocument spreadsheet (which can be read with LibreOffice Calc or Excel), Office Open XML spreadsheet (which can be read with Microsoft Excel and other spreadsheet software), and CSV raw data.

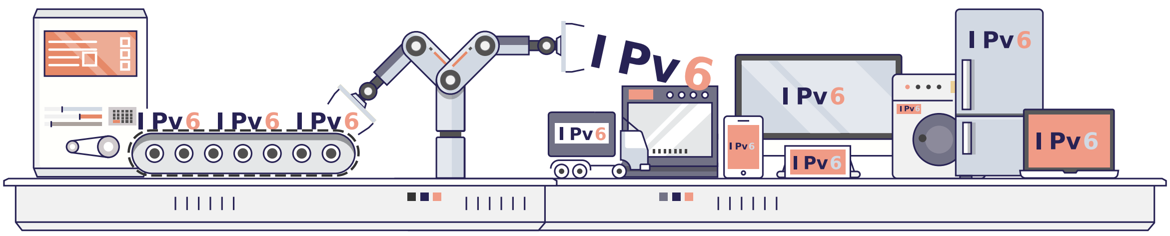
PERCENTAGE OF IPv6-ENABLED WEBSITES

for .fr, .re, .pm, .yt, .tf, and .wf domain names



Number of domain names	OVHcloud AS16276	Cloudflare AS13335	Amazon AWS AS16509	IONOS AS8560	o2switch AS50474	Google Cloud AS396982	Hostinger AS47583	LWS AS210403	Infomaniak AS29222	Scaleway AS12876	Gandi AS29169	Hetzner Online AS24940
2022	914,545	123,076	162,338	165,455	97,415	25,694	11,919	63,803	42,355	46,697	49,808	12,534
2023	928,130	160,590	185,553	181,318	119,967	92,612	35,600	63,000	48,585	43,791	49,455	19,841
2024	847,140	181,849	209,733	177,582	138,309	110,472	61,794	62,014	54,243	36,889	41,891	13,527
2025	881,977	240,929	188,399	183,138	167,358	127,169	104,146	68,110	63,965	42,792	40,861	40,058

Source: Afnic data as of January 2026. Only domain names with a valid TLS certificate are included.



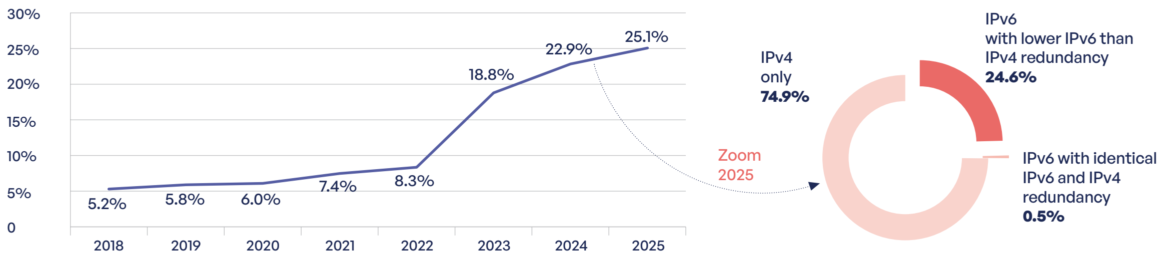
2.5. Mail hosting

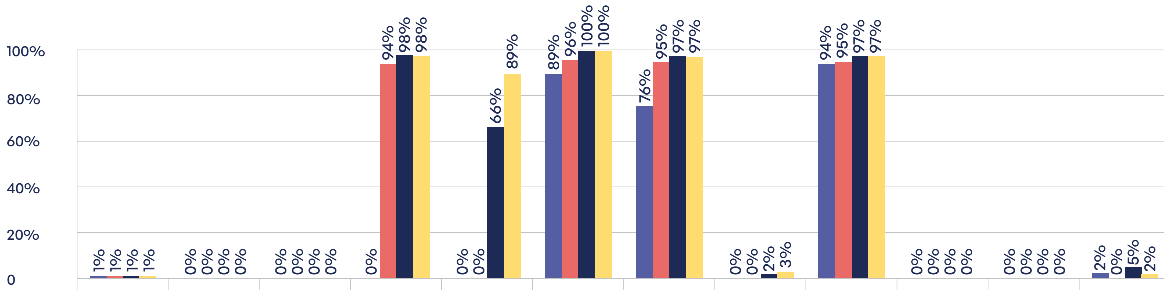
Mail hosting servers also lag a long way behind in the transition: in early 2026, only 25.1% of mail servers currently use IPv6 addresses. [16] There has nevertheless been a considerable increase over the past three years, during which the number of IPv6-enabled mail servers has increased by 17 points, compared to a three-point increase in the four previous years. The increase in 2025 stood at only two points, however. **If this link in the internet chain does not catch up over the next few years, it could delay the shut-down of IPv4,** and prolong the inherent complexities of sustaining the IPv4/IPv6 cohabitation on the networks.

Looking at the top 12 e-mail hosting actors in terms of domain names, the strongest performances comes from Gandi, Microsoft, Google, Cloudflare and Infomaniak, each with more than 89% IPv6-enabled domain names for mail. Also noteworthy are the significant strides made by Microsoft over the past two years, going from 0.1% to 89% IPv6-enabled addresses for its mail hosting. While Google virtually systematically hosts mails with the domain names it manages in IPv6, such is not the case with Google Cloud where IPv6 is not used at all.

PERCENTAGE OF WEB MAIL ACCESSIBLE IN IPv6

for .fr, .re, .pm, .yt, .tf, and .wf domain names





Number of domain names	OVHcloud AS16276	IONOS AS8560	o2switch AS50474	Gandi AS29169	Microsoft AS8075	Google AS15169	Cloudflare AS13335	LWS AS210403	Infomaniak AS29222	Google Cloud AS396982	PlanetHoster AS53589	DigitalOcean AS14061
2022	840,850	187,152	87,794	186,925	83,504	90,841	1,639	67,162	25,223	26,472	24,208	6,239
2023	865,177	205,282	107,546	182,500	100,460	76,558	40,551	66,991	28,050	9,785	25,620	20,684
2024	802,806	208,451	122,210	145,649	109,130	81,727	57,938	66,863	35,230	20,368	25,199	23,542
2025	851,930	217,187	147,036	135,314	125,050	98,984	82,437	73,509	44,555	31,286	27,030	24,854

Source: Afnic data as of January 2026. Only domain names with a valid TLS certificate are included.

(16) Afnic data for the end of 2024, for all websites with domain names ending in .fr, .re, .pm, .yt, .tf, and .wf, excluding those that do not offer valid HTTPS hosting and an MX (Mail eXchanger).

3| The transition to IPv6 around the world

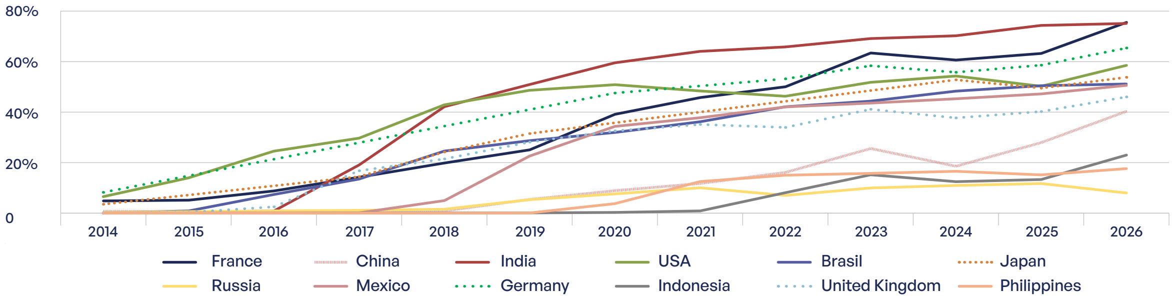
Arcep's interactive map is a key tool for monitoring the transition to IPv6. The IPv6 take-up rate displayed on the map corresponds to the percentage of users who have been IPv6-enabled by their ISP. This percentage, measured by hosting companies that already offer IPv6[17], provides a clear picture of the status of transition on the end-user side: consumers and businesses, using fixed and mobile networks.

In October 2025, Arcep released a new version of its interactive IPv6 map, that introduces several significant improvements designed to increase data reliability, granularity and transparency:

- **Extended history:** available data now goes back to October 2013, providing an expanded historical perspective.
- **Geographical coverage expanded from 100 to 229 countries:** the map now incorporates data from every country, providing a comprehensive global snapshot of the transition to IPv6.
- **More frequent updates:** data are now updated monthly, instead of every two months.
- **More reliable data:** measurements are now based on the average of daily data over the course of the month, and no longer on a single point of measurement.
- **IPv6 ranking of the 100 countries with the most internet users:** the methodology and reliability of this ranking were reviewed and strengthened.

Since November 2025, **France has risen to the top of 100 countries,** with a rate of IPv6 use amongst consumers and businesses estimated at 75.6% in March 2026, ahead of India (75.1% IPv6) and Germany (65.4% IPv6). This percentage includes ISPs' consumer plans, as well as internet access plans for small businesses and for large companies.

RATE OF IPv6 USE IN THE 12 COUNTRIES WITH THE MOST INTERNET USERS, IN MARCH OF EACH YEAR



Source: median of Google, Akamai, Facebook and Apnic data for the month of March of the year in question. 12 countries with the most internet users according to the Wikipedia page: "List of countries by number of internet users".

(17) The map presents the median of the four sources, corresponding the arithmetical average of the two central values, to ensure balanced and robust representation of the data. The main sources of the aggregated data are Google, Akamai, Facebook and APNIC.

4 | Work being done by the Task-Force on IPv6 in France

On 27 January 2026, IDATE, Arcep and the IPv6 Forum hosted a workshop at Arcep headquarters, dedicated to the development and progress of IPv6 in France. **The exhaustion of IPv4 addresses has made it imperative to accelerate the migration of all internet actors to IPv6 , and to prepare for an internet without IPv4.** Continuing to maintain IPv4 creates problems for the smooth running of the internet, particularly in terms of access to services and IP address identification. The transition to IPv6 is therefore the only future-proof solution to ensure the internet remains a space of innovation and competitiveness, for the benefit of users.

IPv6 Task-Force workshop, 27 January 2026, at the Arcep offices

The workshop brought together more than 80 people with a range of backgrounds: experts, internet professionals and afficionados, to discuss the progress made, and the trends and challenges surrounding the adoption of IPv6. IDATE, Arcep and IPv6 Forum would like to thank all those who participated in this event. All of the talks given at the workshop are available in video, audio podcast and PDF on the IPv6 Task-Force pages.

This event provided an opportunity to get a progress report on the work done by the "IPv6 2030: requirements for a future IPv6 internet" working group, created in 2025 to establish the conditions required to guarantee an accelerated transition to IPv6 between now and 2030.

The aim of this working group is to:

- Examine the new issues and challenges for IPv6 take-up and network evolution created by the internet's evolution
- Investigate the conditions needed to enable the development of innovative services and end-to-end IPv6-only ultrafast, high quality network architectures.

IPv6 arcep

— GIVING STAKEHOLDERS THE FLOOR

GONZAGUE DAMBRICOURT
Founder & Manager of BoucheCousue

IPv6 deployment with BoucheCousue customers

A company that specialises in networks, videoconferencing and managed services for very small, small and medium businesses, BoucheCousue is assisting its customers in their gradual IPv6 deployment.

Incremental dual stack deployment on customer systems

The company has opted for a dual stack approach, which consists of having IPv4 and IPv6 coexist on the same network. This method creates the ability to maintain current uses while adding IPv6 connectivity.

This means that IPv6 can be introduced incrementally, while maintaining current applications and limiting the risk of an interruption of service. It also facilitates the testing and adjustment phase, and remains suited to the various environments that BoucheCousue encounters.

This strategy thus makes it possible to accompany customers in their transition to IPv6 in a gradual fashion, without forcing a sudden change on users or technical teams.

Concrete improvements in traffic optimisation

Other positive effects are also being seen with some customers that require a lot of bandwidth. Integrating IPv6 can help optimise network equipment's performance, especially during peak traffic times. One concrete example: a customer in the hotel sector with a great deal of equipment that is connected simultaneously, especially at night. A large number of devices perform automatic backups to the cloud overnight. This generates huge spikes in traffic on the network.

After having activated IPv6 on their infrastructure, there was a noticeable improvement in UDM Pro router performance. CPU use in particular was reduced during these spikes.

These gains can be attributed to improved network traffic management with IPv6, to a reduction in the processing associated with IPv4 (notably the NATs) and, finally, to more efficient traffic distribution.

Ongoing issues

Despite the clear benefits, the prospect of widespread IPv6 adoption is still coming up against several technical, operational and organisational obstacles:

- Not all operators offer **IPv6 connectivity in all of their plans,** which can limit the ability of some customers to make the transition.
- There also continue to be restrictions in terms of **equipment and network administration tools.** In multisite environments, the centralised management solutions used to maintain a homogeneous configuration do not always enable complete IPv6 integration. For the sake of consistency and ease of operations, its deployment may therefore be postponed.
- Lastly, **VPN architectures** are another sticking point. A great many inter-site or remote access VPNs are still largely based on IPv4, and require supplementary checks to guarantee the continuity and security of communications.

These various elements show that, despite a willingness to adopt it, the widespread take-up of IPv6 still depends heavily on the ecosystem, operators, hardware, management tools and existing uses. Which is why the transition is taking place only gradually, apace with the evolution of these different actors.

LEXICON

3GPP: The 3rd Generation Partnership Project is an umbrella organisation for cooperation between standard development organisations to establish technical specifications for mobile networks.

4G: The fourth generation of mobile telephony standards. It is defined by 3GPP Release 8 standards.

5G: The fifth generation of mobile telephony standards. It is defined by 3GPP Release 15 standards.

Agent Communication Protocol (ACP): Protocol developed by IBM that enables AI agents to communicate. The project merged with the A2A protocol in August 2025.

Conversational agent: Computer system designed to interact with a human user in natural language. It uses artificial intelligence technologies, such as natural language processing and machine learning, to understand requests, generate relevant responses and simulate a smooth conversation. Conversational agents can be deployed as chatbots, virtual assistants or voice interfaces.

AI agent: Software system that employs artificial intelligence techniques (including LLMs) to perceive its environment, make decisions and perform tasks autonomously on behalf of human users or organisations.

Peering: The process of exchanging internet traffic between two peers. A peering link can be either free or paid (for the peer that sends more traffic than the other peer). Peering can be public, when performed at an IXP (Internet Exchange Point), or private when over a PNI (Private Network Interconnect), in other words a direct interconnection between two operators.

Algorithmic bias: An error, or sub-optimal result, of a machine learning or artificial intelligence system caused by assumptions inherent in the model or by an imbalance in the training data.

CDN (Content Delivery Network): Internet content delivery network.

On-net CDN: Content delivery network (CDN) located directly in an ISP's network.

Cloud: Article 2(8) of the Data Act defines a cloud service as "a digital service [...] that enables ubiquitous and on-demand network access to a shared pool of configurable, scalable and elastic computing resources of a centralised, distributed or highly distributed nature that can be rapidly provisioned and released with minimal management effort or service provider interaction".

Codec: A device or computer program that encodes or decodes a digital data stream, for transmission or storage purposes.

Gatekeeper: A digital company regulated under the European Digital Markets Act (DMA). A gatekeeper provides core platform services (such as search engines, operating systems, virtual assistants, instant messaging services, etc.) and constitutes a major point of access between business users and end users. Because of its position, it represents a bottleneck in the digital economy. It is designated on the basis of quantitative thresholds, or qualitative criteria following a market investigation. Examples include Alphabet, Amazon, Apple, Booking, ByteDance, Meta and Microsoft.

Speed: Also referred to as throughput. Quantity of digital data transmitted within a set period of time. Connection speeds or bitrates, are often expressed in bits per second (bit/s) and its multiples: Mb/s, Gb/s, Tb/s, etc. It is useful to draw a distinction between the speed at which data can be:

- received by a piece of terminal equipment connected to the internet, such as when watching a video online or loading a web page. This is referred to as download or downlink speed
- sent from a computer, phone or any other piece of terminal equipment connected to the internet, such as when sending photos to an online printing site. This is referred to as upload or uplink speed.

Discoverability: The Ministry of Culture defines the discoverability of content in the digital environment as "its online availability and its ability to be found among a vast set of other content, especially by a person who was not specifically searching for it."

DNS (Domain Name System): Mechanism for translating internet domain names into IP addresses.

Dual stack: Assigning both an IPv4 address and an IPv6 address to a device on the network.

Training/Learning: Refers to the process by which a system uses data and algorithmic models to perform calculations in order to provide features, improve its performance or acquire the ability to perform certain tasks autonomously.

ISP: Internet Service Provider.

CAP: Content (web pages, blogs, videos) and/or application (search engine, VoIP applications) providers.

FttH (Fibre-to-the-Home) network: Ultrafast electronic communications network, where fibre is pulled right into the customer's residential or business premises.

Large language model or LLM (Large Language Model): Natural language processing AI model comprising a large number of parameters.

HTTP (Hypertext Transfer Protocol): Client-server communication protocol developed for the World Wide Web.

HTTPS: HTTP Secured through the use of SSL (secure socket layer) or TLS (transport layer security) protocols.

Agentic AI: Field of techniques related to AI agents (see above).

Generative AI: Field of techniques that use artificial intelligence models to generate new content such as text, computer code, images, music, etc.

Indexing (crawling): Activity of automated indexing robots (called crawlers) that browse web pages. Most often, their purpose is to index content on behalf of a search engine, although these robots are increasingly being used to collect content directly for uses related to artificial intelligence (referred to as scraping).

Inference (phase): Phase during which an artificial intelligence model is used to make predictions, as opposed to the training phase. A GenAI service relies on one or more LLMs in the inference phase.

Prompt: Text request sent to a model by a user.

Artificial intelligence: Field of research that aims to enable artificial systems, most often computer-based, to perform tasks associated with human or natural intelligence. Machine learning is its main approach today.

Internet: Network of networks, formed by the interconnection of different AS (see above) with one another. Infrastructure enabling the provision of and access to online content or services.

iOS: Mobile operating system developed by Apple for its mobile devices.

IP (Internet Protocol): Communication protocol that enables a single addressing service for any device used on the internet. IPv4 (IP version 4) is the protocol that has been used since 1983. IPv6 (IP version 6) is its successor.

IPv6-enabled: Device or connection that actually transmits and receives traffic using IPv6 routing, either through activation by the customer or activation performed by the operator.

IPv6-ready: Device or connection that is compatible with IPv6, but on which IPv6 is not necessarily activated by default.

IXP (Internet Exchange Point) or GIX (Global Internet Exchange): Physical infrastructure enabling the ISPs and CAPs connected to it to exchange internet traffic between their networks through public peering agreements.

AI model: An artificial intelligence model is a computer system based on algorithms and learned or defined parameters, trained on data in order to represent relationships or regularities, and capable of producing outputs such as predictions, classifications, inferences or generated content, within the scope of specific tasks.

NAT: Network Address Translation: mechanism for remapping one IP address space to another, used in particular to limit the number of public IPv4 addresses being used.

OS (Operating System): Software that runs a peripheral device, such as Windows, macOS, Linux, Android, or iOS.

Digital platform: The term digital platform is generally used to refer to a varied set of online services and actors offering intermediation services, such as marketplaces, community platforms or app stores. These actors can have highly variable characteristics (in size, revenue, etc.) and operate in many sectors. Certain large platforms alone concentrate a number of digital services used daily by citizens and businesses.

Network termination point: The physical location at which a user gains access to public electronic communications networks.

Software port: Every internet connection originating from an application is associated with a UDP or TCP session, itself identified by a “port number”, i.e. a 16-bit encoded address.

Internet gateway: Service or platform through which a very large number of users access online content, services or information (search engines, social networks, browsers, mobile operating systems, conversational agents, etc.). Because of their central position, these actors can have a significant influence on the visibility, access to or ranking of content.

Protocol: Set of standardised rules that enable computer systems to format, transmit and process data in order to communicate with one another.

Robots exclusion protocol, known as robots.txt: Protocol proposed in 1996 by the IETF, aiming to establish a standardised format (in the robots.txt file, located at the root of the website) of rules enabling indexing robots to know which pages they are or are not allowed to access.

Data Act: European regulation that aims to strengthen the data economy by increasing the accessibility and availability of data. It provides for a right of access to data from connected products, and lays down common rules on data sharing between businesses. It also lays down obligations for cloud service providers, in particular to enable customers to switch providers or to use several providers simultaneously (multi-cloud), and for participants in data spaces.

Digital Markets Act (DMA): European regulation defining ex ante a series of obligations and prohibitions with which companies qualified as “gatekeepers” must comply, since March 2024 and for each of their designated core platform services. Among the obligations established by the DMA, gatekeepers must, for example, enable easy uninstallation of preinstalled applications on devices such as phones, computers or tablets, and the use of their operating system with third-party app stores; and they must not treat their own services and products more favourably in ranking than similar offers from third parties on the platform.

Digital Services Act (DSA): European regulation governing the activities of providers of digital intermediary services, including online platforms. It aims to strengthen content moderation, algorithm transparency, online safety and the accountability of large platforms. It applies to all providers of intermediary services, with a specific regime for very large online platforms (VLOPs) and very large online search engines (VLOSEs).

Core platform service: Digital services regulated under the European Digital Markets Act (DMA). These include online intermediation services (e.g. marketplaces, app stores), online search engines, social networks, video-sharing platform services, instant messaging services, operating systems, web browsers, virtual assistants, cloud services and advertising services. Only core platform services provided by gatekeepers are regulated (cf. infra).

Specialised service: Electronic communication service(s) that is distinct from internet access services, and which requires specific quality of service levels.

Autonomous Systems (AS): A collection of networks managed by the same administrative entity, with relatively homogeneous routing protocols.

Tier 1: Network capable of reaching every other internet network through peering without requiring a transit provider. Wikipedia lists 14 Tier 1 networks in 2025 :

- Arelion (formerly Telia Carrier)
- AT&T
- Deutsche Telekom AG
- Global Telecom & Technology (GTT Communications)
- Liberty Global
- Lumen (formerly CenturyLink then Level 3);
- NTT Communications
- Orange
- PCCW Global
- Tata Communications
- Telecom Italia Sparkle
- Telxius/Telefónica
- Verizon Enterprise Solutions
- Zayo Group.

Depending on the criteria, some operators, such as Cogent, may not be considered to be Tier 1.

Transit: Bandwidth that one operator sells to a client operator, providing access to the entire internet as part of paid, contractual service.

Transit provider: Company that provides transit services.

UDP (User Datagram Protocol): Simple, connectionless (i.e. no prior communication required) transmission protocol, which makes it possible to transmit small quantities of data rapidly. The UDP protocol is used on top of IPv4 or IPv6.

End users: Individuals who use their own equipment and contract a subscription with an ISP to access content on the internet.

Wehe: Android and iOS application, developed by Northeastern University in partnership with Arcep, to detect traffic management practices that are in violation of net neutrality rules.

xDSL (Digital Subscriber Line): Electronic communications technologies used on copper networks that enable ISPs to provide broadband or superfast broadband internet access. ADSL2+ and VDSL2 are the most commonly used xDSL standards in France for providing consumer access.

Zero-rating: A pricing practice that allows subscribers to use one or more particular online application without the traffic being counted against their data allowance.

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Arcep's **manifesto**

The internet, fixed and mobile electronic communication networks, data centres, as well as postal and press distribution networks constitute "infrastructures of freedom". Freedom of expression, freedom to communicate, freedom to access knowledge and to share it, but also freedom of enterprise and innovation, all of which are key to the country's economic development and cohesion within Europe.

Because it is essential to be able to enjoy these freedoms fully, national and European institutions work to ensure that these networks develop as a **"common good"** regardless of their ownership structure, in other words that they meet the highest standards in terms of accessibility, universality, performance, neutrality, trustworthiness and sustainability.

The genesis of the Regulatory Authority for Electronic Communications, Postal Affairs and Press Distribution (Arcep) was the acknowledgement that independent state oversight was needed to ensure that no power, be it economic or political, is in a position to control or hinder citizens', businesses', associations', publishers' or innovators' ability to communicate or trade. A neutral and expert arbitrator with the status of independent administrative authority, Arcep is **the architect and guardian** of communication networks' status as common goods in France.

As network **architect,** Arcep creates the conditions for an open and decentralised network organisation. It works to safeguard the competitiveness of the sectors it is responsible for regulating, by promoting pro-investment competition. It provides the framework for the networks' interoperability so that, despite their diversity, they remain easy to access and seamlessly interconnected. It coordinates effective interaction between public and private sector stakeholders, particularly when local authorities are involved. It provides the trustworthiness needed for data intermediation between different enterprises. It also creates the conditions for open and competitive access to cloud computing solutions for businesses.

As network **guardian,** Arcep enforces the principles that are essential to safeguarding all users' current and future ability to communicate and trade. It oversees the provision of the Universal Service and assists public authorities in guaranteeing the most extensive access possible to high-quality and resilient networks nationwide. It ensures users' access to clear and accurate information, their freedom of choice, and protects against possible neutrality violations on both the internet and in the press. More generally, Arcep combats any type of impediment that could threaten the freedom to communicate and trade on the networks or the free movement of data and, to this end, pays close attention to the intermediaries that are devices and the internet's gatekeeper platforms. For the sake of generations to come, the Authority is dedicated to future-proofing digital technology and its uses, measuring the progression of its environmental footprint, and making sustainabilitya core tenet of its regulatory actions.

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