arcep
autorité de régulation
des communications électroniques,
des postes et de la distribution de la presse

FRENCH REPUBLIC

ANNUAL BAROMETER OF THE TRANSITION TO IPv6 IN FRANCE

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1. Accelerating the transition to IPv6: a major issue for competitiveness and innovation[1]

IPv4, which stands for Internet Protocol version 4, has been used since 1983 to allow the Internet to function: each device or machine that is connected to the Internet (computer, phone, server, etc.) has an IPv4 address. The protocol is technically limited to 4.3 billion addresses. However, the Internet's success, coupled with the diversity of uses and the growing number of connected objects has resulted in a **steady decrease in the number of available IPv4 addresses,** with some parts of the world being more heavily affected than others. The top operators in France (Bouygues Telecom, Orange and SFR)[2] had already **assigned between roughly 92% and 95% of** their IPv4 addresses, as of end of June 2020[3].

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

But the complexity of today's Internet makes it impossible to achieve the transition from IPv4 to IPv6 in one fell swoop, overnight (i.e. flag-day). It must therefore take place gradually, starting with a period of cohabitation with IPv4. Once every player has migrated to the new protocol, IPv6 will fully replace IPv4 (switch-off phase).

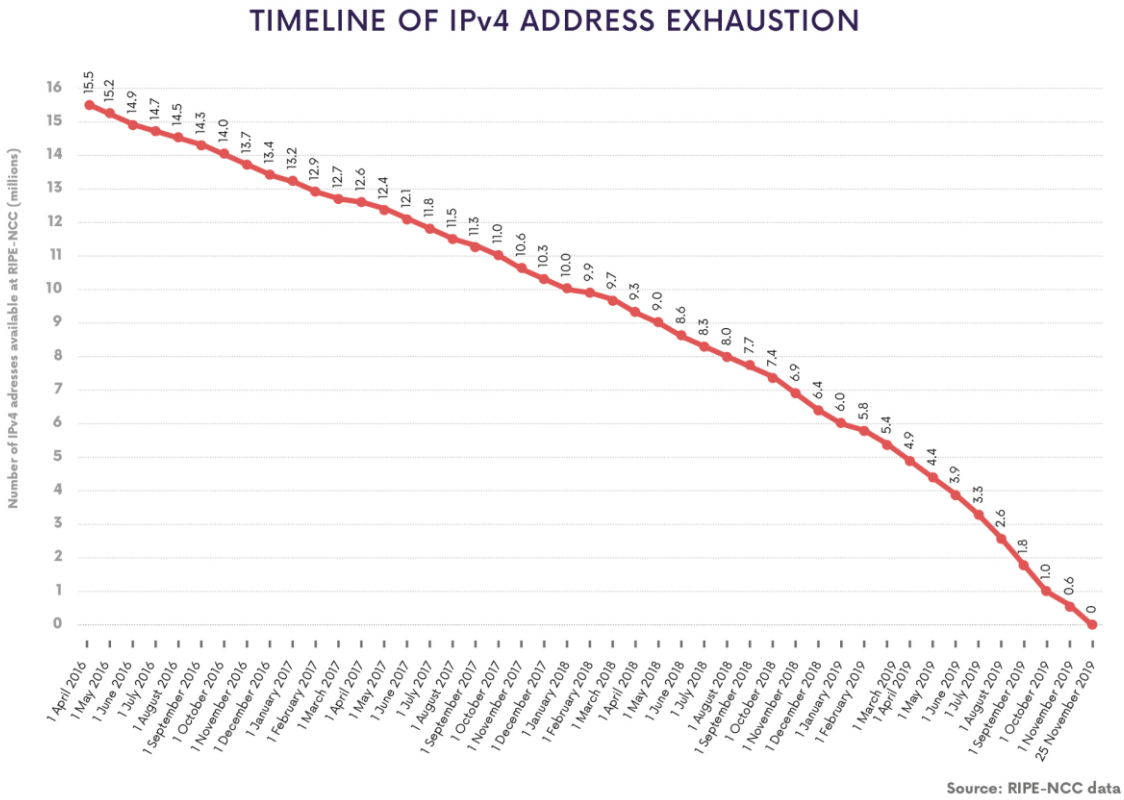
The transition to the IPv6 protocol began in 2003. Despite which, in 2019, **the Internet is still only at the beginning of the cohabitation stage. IPv4 and IPv6 protocols will coexist as long as IPv6 is not widespread in all parts of the Internet value chain.**
On 25 November 2019, RIPE NCC (the regional Internet registry which is tasked with allocating IP addresses in Europe and the Middle East) announced that it had run out of IPv4 addresses, after having made the final /22 IPv4 allocation (i.e. 1024 addresses) from the last remaining addresses in their pool[4].

[1] ARCEP specifies that the observations and work mentioned in this document concern only the Internet and do not apply to the private interconnection between two actors, in particular the interconnection of the networks of two operators for the termination for voice calls in IP mode.
[2] Free did not provide the number of IPv4 addresses already assigned.
[3] Data collected from ISPs by Arcep, in accordance with Decision No. 2019-0287.
[4] There is a waiting list for IPv4 addresses that come back to the RIPE NCC, even though few of them do. RIPE NCC explains that these necessarily rare allocations will not be able to meet networks' current IPv4 address needs.

If continuing to have the Internet operate in IPv4 will not prevent it from functioning, it will prevent it from growing, because of the risks inherent in solutions that enable the Internet to continue to function in IPv4 despite the lack of addresses:

- Having several customers share IPv4 addresses could cause malfunctions on certain categories of Internet services (smart home control systems, network gaming, etc.). Added to which, these sharing mechanisms increase the risk to users of being denied access to a service, e.g. when an IP address they share has been put on a blacklist due to fraudulent behaviour by another user of that same IPv4 address. Another collateral effect of IPv4 sharing is the increased difficulty in identifying a suspect in a criminal investigation based on their IP address, in some instances requiring law enforcement agencies to investigate people whose only "crime" is sharing an IP address with the suspect.
- It is possible to buy IPv4 addresses on a secondary market, but the prices charged are likely to create a sizeable barrier to entry for newcomers to the market. Added to which, IPv4 address bought on the secondary market can block access to certain banking and video on demand services if the address's geolocation has not been updated.

Because of this expected shortage and the risks it entails, **making the transition to this new Internet protocol has become a key to ensuring competitiveness and innovation.**



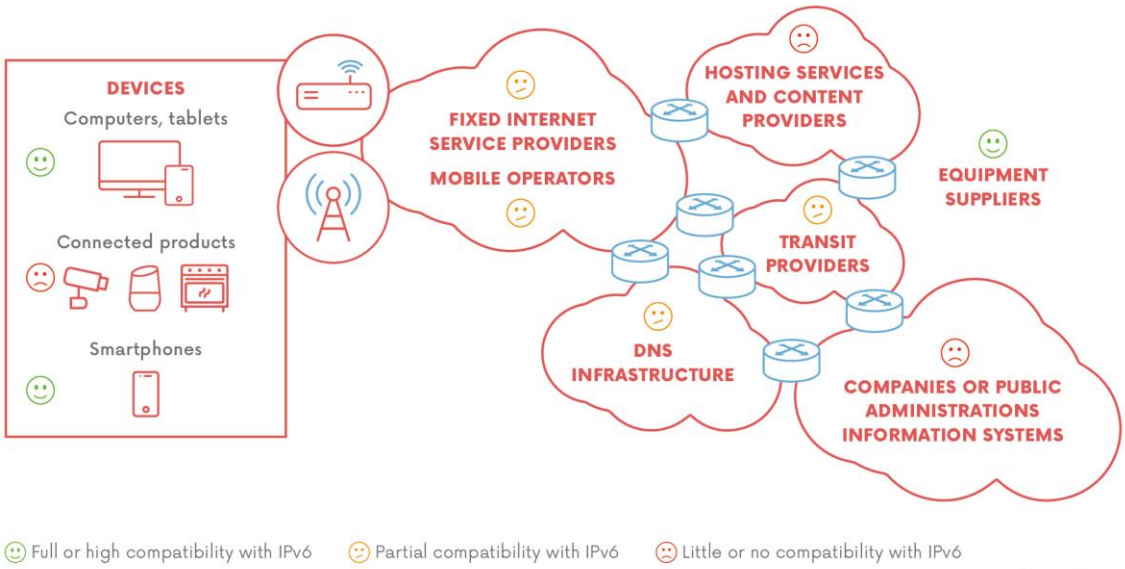
2. Different players at different stages in the transition

To ensure IPv6 protocol functions from end to end, migration needs to cover all of the links along the Internet value chain simultaneously.

Arcep has employed several indicators in order to evaluate the status of IPv6 deployment in France for the various stakeholders involved in the transition. These indicators are calculated using data collected by Arcep in accordance with Decision No 2020-0305, as well as third-party data[5], for the Internet ecosystem's different stakeholders.

These indicators make it possible to have an overview of the status of IPv6 deployment. Which, today, is as follows:

STATUS OF THE TRANSITION TO IPv6
FOR THE DIFFERENT ECOSYSTEM ACTORS



Source: Arcep

[5] Cf. exact source in the sections devoted to each type of player.

3. Fixed Internet service providers

Four conditions need to be met for a fixed line to be able to transmit and receive traffic in IPv6:

- the **fixed network** used must be IPv6-compatible;
- the hardware of the **box** being used must be IPv6-compatible, and its firmware must be capable of managing the protocol. If most of operators' boxes in 2019 are IPv6-compatible, some have not yet upgraded their firmware to be able to handle IPv6.

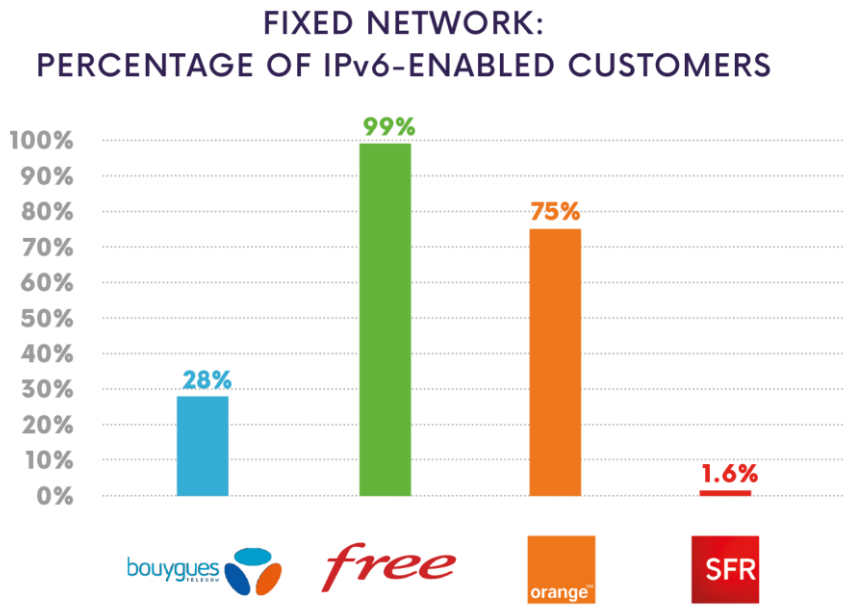
When both the network and the box are IPv6-compatible, a customer is said to be IPv6-ready (cf. table below).

- The operator needs to **remotely configure the customer's box** for it to be IPv6-enabled (cf. table below). If the customer is IPv6-ready but the operator has not enabled IPv6, the customer can configure his/her own box manually for it to be IPv6-enabled. Nevertheless, because the vast majority of users don't take the initiative to do so, it is the action taken by ISPs that will drive the transition.
- The **device's operating system** must be IPv6-compatible and enabled (cf. section on Devices below).

Thus:

- **a customer is said to be "IPv6-ready"** if they are able to activate IPv6 themselves on their own box (both the network and the box are IPv6-compatible);
- **A customer is said to be "IPv6-enabled" if their box** actually sends and receives IPv6 traffic, either through manual activation performed by the customer themselves, or through activation performed by the operator.

3.1. Operators with over 3 million customers on fixed networks



Source: data as of the end of June 2020, collected by Arcep from operators.

FIXED NETWORK: PERCENTAGE OF IPv6-READY AND IPv6-ENABLED CUSTOMERS

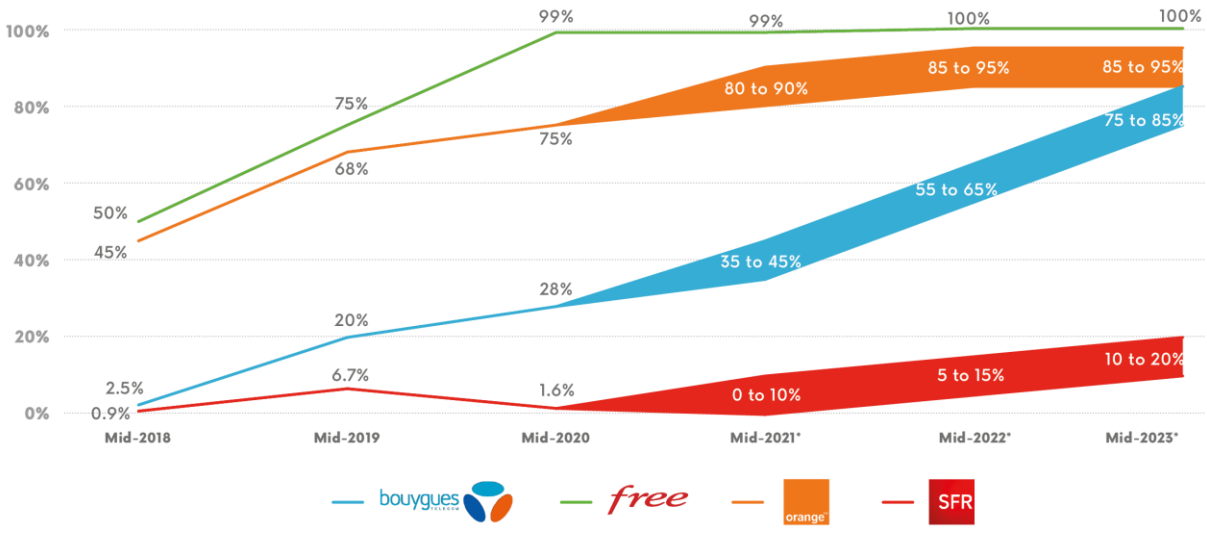
		bouygues IPv6-ready	bouygues IPv6-enabled	free IPv6-ready	free IPv6-enabled	orange IPv6-ready	orange IPv6-enabled	SFR IPv6-ready	SFR IPv6-enabled
xDSL	Own network	44%	44%	100%	100%	67%	66%	100%	1.8%
	Backhaul Network	0%	0%	0%	0%	N/A		100%	1.8%
	Whole network	32%	32%	99%	99%	67%	66%	100%	1.8%
Cable	Own network	N/A		N/A		N/A		0%	0%
	Backhaul Network	0%	0%	N/A		N/A		N/A	
	Whole network	0%	0%	N/A		N/A		0%	0%
FttH	Own network	25%	25%	100%	100%	100%	97%	10%	3.5%
	Backhaul Network	N/A		N/A		N/A		10%	3.5%
	Whole network	25%	25%	100%	100%	100%	97%	10%	3.5%
4G fixed wireless	Own network	0%	0%	0%	0%	100%	1%	0%	0%
Whole network	Own network	33%	33%	100%	100%	77%	75%	50%	1.6%
	Backhaul Network	0%	0%	0%	0%	N/A		50%	1.6%
	Whole network	28%	28%	99%	99%	77%	75%	50%	1.6%

Source: data as of the end of June 2020, collected by Arcep from operators.

The disparities between the percentage of customers who are IPv6-ready and the percentage of customers who are actually IPv6-enabled (transmitting and receiving IPv6 traffic) can be explained by the main operators' different IPv6 activation policies.

The four main operators have also provided forecasts for the percentage of customers that will be IPv6-ready and IPv6-enabled one year and three years from now (cf. annex for more details).

FIXED NETWORK: PERCENTAGE OF IPv6-ENABLED CUSTOMERS EVOLUTION



* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

Operators have provided details on their IPv4 sharing and IPv6 activation practices (cf. annex).

The four operators all have different IPv4 address sharing practices depending on their fixed network technologies:

- Some Free fixed network customers (40% of xDSL and 75% of FttH customers) as well as a tiny percentage of Bouygues Telecom customers (0.1% xDSL) have a shared IPv4 address. However, both operators provide a dedicated IPv4 address for free upon request. This system of IPv4 address sharing could become increasingly common over the coming years as a way to handle the exhaustion of IPv4 addresses.
- Regarding fixed 4G access, if Bouygues Telecom and SFR customers have a dedicated IPv4 address by default, all Free customers and half of Orange customers have a shared IPv4 address. Neither of these operators offer a dedicated IPv4 address for fixed 4G.

Bouygues Telecom, Free and Orange activate IPv6 by default if the customer is IPv6-ready. It is in fact impossible to deactivate IPv6 on all Free boxes, and on more and more Bouygues Telecom ones, which constitutes a best practice. For SFR, activation by default is only performed for IPv6-ready customers. Remaining customers must activate IPv6 themselves by configuring their box.

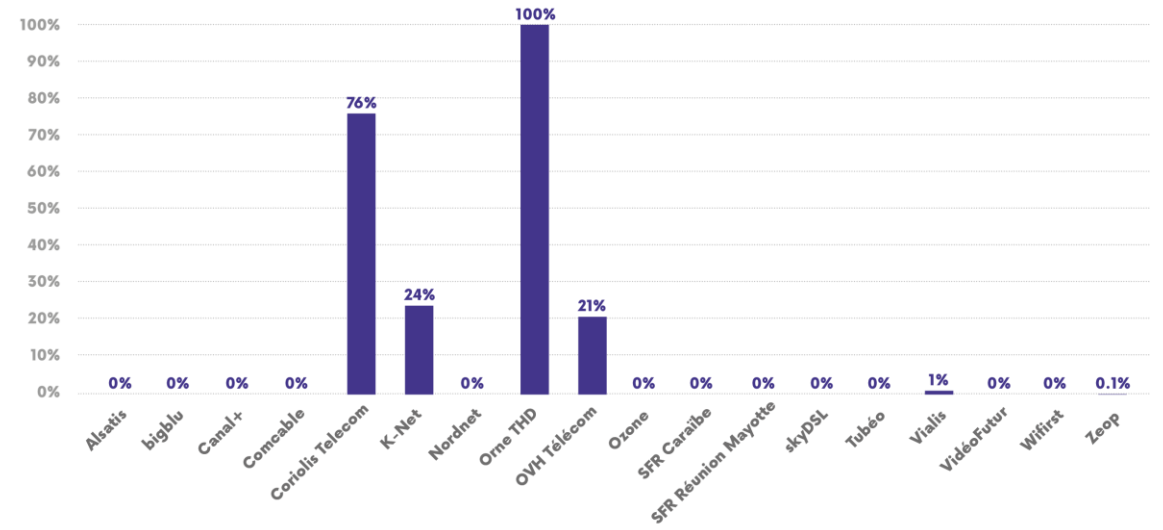
Bouygues Telecom, Orange and SFR have adopted the best practice of installing an IPv6 firewall by default for their customers, which can be configured. Free only offers a firewall as a non-configurable option.

Arcep has observed progress on fixed networks from the main telecom operators in France, but is calling on them to maintain and step up their efforts:

- The percentage of IPv6-enabled SFR customers, all technologies combined, has decreased from 6.7% in mid-2019 to 1.5% in mid-2020. This decrease, which is due chiefly to the decline in the number of IPv6-ready FttH customers, is a source of concern, given the exhaustion of IPv4 addresses. Upcoming activations also remain inadequate: between 5% and 15% by mid-2022 and between 10% and 20% by mid-2023. Arcep is thus urging SFR to accelerate the transition to IPv6 on its fixed network, especially on FttH, and to begin this transition on cable. Because the vast majority of users will not take the initiative to enable IPv6 manually, Arcep is encouraging SFR to systematically perform this configuration by default.
- Despite an increase in the number of activated IPv6 customers and the encouraging forecasts (between 75% and 85% by mid-2023) the pace of Bouygues Telecom's IPv6 deployment is still too slow to deal with the shortage. Bouygues Telecom is once again being urged to increase the number of IPv6-ready customers, and to step up deployment efforts on its fixed network.
- The percentage of Free and Orange customers who are IPv6-ready is relatively high (around 99% and 75%, respectively) in addition to having increased. Projections for mid-2023 are encouraging (100% for Free and between 85% and 95% for Orange).
- Bouygues Telecom, Free and SFR are being urged to begin the transition on 4G fixed wireless as soon as possible. Orange in particular, whose 4G fixed wireless customers are all IPv6-ready, is being encouraged to perform IPv6 activation by default on this technology.

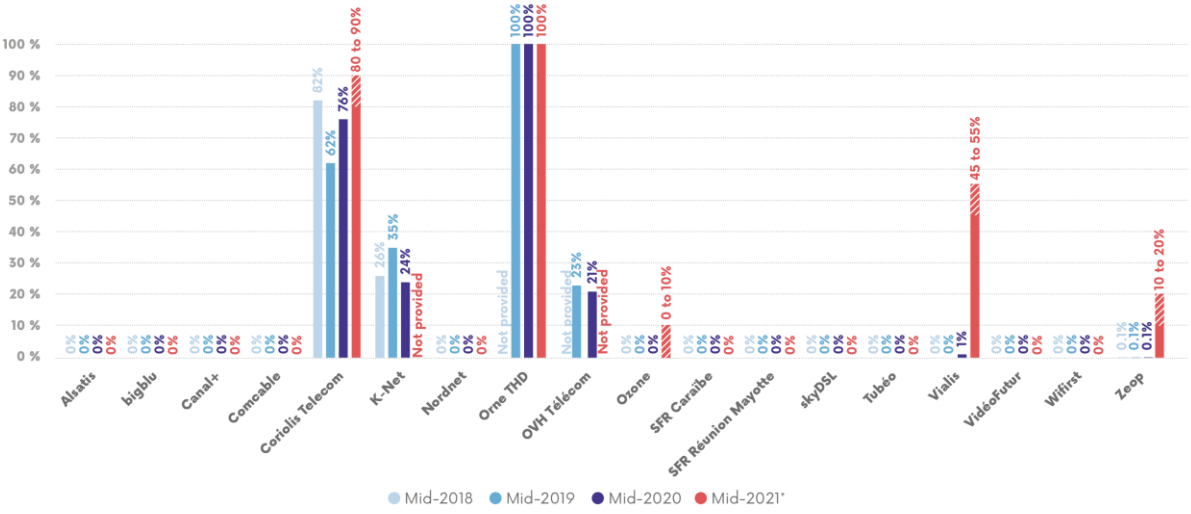
3.2. Operators with between 5,000 and 3 million customers on fixed networks

FIXED NETWORK: PERCENTAGE OF IPv6-ENABLED CUSTOMERS



Source: data as of the end of June 2020, collected by Arcep from operators.

FIXED NETWORK: PERCENTAGE OF IPv6-ENABLED CUSTOMERS EVOLUTION



* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

The operators that had already begun their transition are moving ahead with their IPv6 deployment, with notable initiatives from Coriolis, K-Net and OVH Telecom which continue the transition to IPv6 they began several years ago. Noteworthy too are Orne THD, which completed the migration of its customers to the new protocol in 2019, and Vialis which began its transition this year. Even though several other operators plan to accelerate their transition in 2021 (Coriolis Telecom, Vialis and Zeop) and one (Ozone) is set to begin its transition next year, the pace of deployment still seems insufficient in light of the IPv4 addresses shortage.

The operators have also supplied details on their IPv4 sharing and IPv6 activation practices (cf. annex).

Canal+, Comcable, Coriolis Telecom, K-Net, Nordnet, Orne THD, OVH Télécom, Ozone and Zeop, for instance, provide a dedicated IPv4 address to every customer, whereas Alsatis, Tubéo, Vialis, VidéoFutur and Wifirst use IPv4 address sharing for either a small percentage or all of their customers.

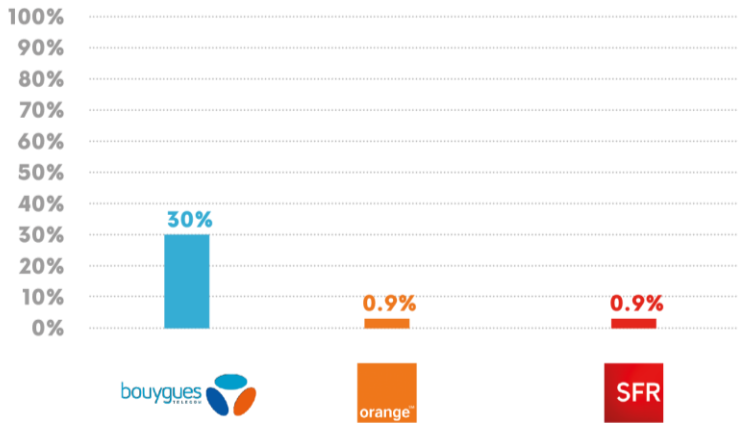
It should be noted that Coriolis Telecom and Orne THD have adopted the best practice of activating IPv6 by default, and making it impossible to deactivate it.

Forecasts for most operators that have between 5,000 and 3 million customers are either non-existent or entirely insufficient in terms of both targets and pace of deployment, even if some have made tremendous strides.

3.3. Operators providing "Pro" plans on their fixed networks

Following reports received on its "J'alerte l'Arcep" platform regarding the difficulties that some businesses were experiencing in obtaining IPv6 solutions from their operators, Arcep expanded its information gathering to include operators that market solutions designed for business customers – aka "Pro" plans – on their fixed network.

FIXED NETWORK "PRO" PLANS:
PERCENTAGE OF IPv6-ENABLED CUSTOMERS



Source: data as of the end of June 2020, collected by Arcep from operators.

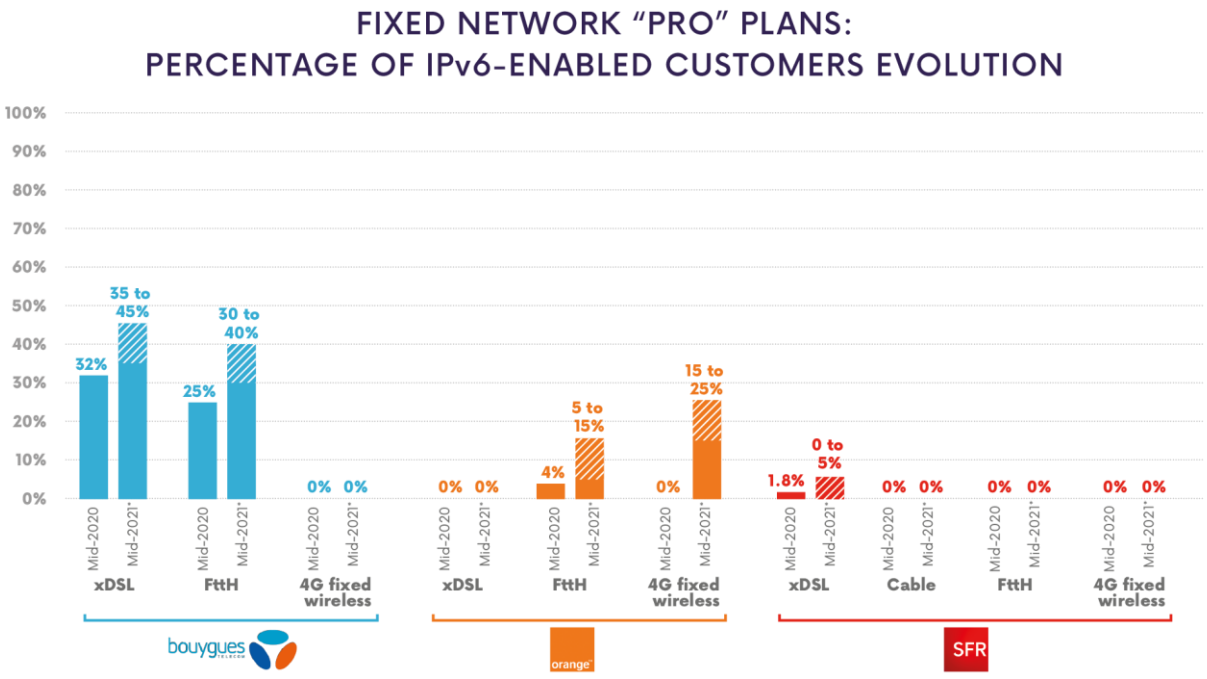
FIXED NETWORK "PRO" PLANS:
PERCENTAGE OF IPv6-READY AND IPv6-ENABLED CUSTOMERS EVOLUTION

		bouygues		orange		SFR	
		IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled
xDSL	Mid-2020	32%	32%	0%	0%	100%	1.8%
	Mid-2021*	35-45%	35-45%	0%	0%	100%	0-5%
Cable	Mid-2020	0%	0%	N/A		0%	0%
	Mid-2021*	N/A		N/A		0%	0%
FttH	Mid-2020	25%	25%	4%	4%	0%	0%
	Mid-2021*	30-40%	30-40%	5-15%	5-15%	0%	0%
4G fixed wireless	Mid-2020	0%	0%	100%	0%	0%	0%
	Mid-2021*	0%	0%	100%	15-25%	not provided	
Whole network	Mid-2020	30%	30%	0.9%	0.9%	51%	0.9%

* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

The three operators have also provided their one-year forecasts for IPv6-ready and IPv6-enabled fixed network customers (cf. annex for details).



* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

Arcep's central conclusion regarding fixed network "Pro" plans is that deployment is falling short, and urges operators to include IPv6 solutions in their plans for businesses:

- Arcep notes Bouygues Telecom's efforts to deploy IPv6 for its "Pro" customers (30% enabled in mid-2020). The operator already activates IPv6 by default, but is encouraged to continue its efforts to increase the number of IPv6-ready customers.
- 100% of business customers on the SFR fixed network are IPv6-ready, but only 1.8% are IPv6 enabled. SFR is invited to perform IPv6 activation by default, and to begin making all of its FttH and cable business customers IPv6 compatible.
- Orange has begun the transition to IPv6 for its FttH business customers (4% of customers activated as of mid-2020, forecast of 12% for mid-2021), but is also being urged to accelerate the pace on FttH and to begin the transition to IPv6 on xDSL.
- Bouygues Telecom and SFR are urged to begin the transition as quickly as possibleon 4G fixed wireless for business plans. Although 100% of Orange 4G fixed wireless customers are IPv6-ready, none are IPv6 enabled. Orange is thus being invited to perform this activation by default.

4. Mobile operators

Four conditions need to be met for a mobile line to be able to transmit and receive traffic in IPv6:

- The **mobile network** used must be IPv6-compatible, in other words the Access Point Name (APN) must be capable of managing the IPv6 protocol (cf. table below). When the APN is IPv6-compatible, the customer is said to be "IPv6-ready". It should be noted that some operators have an APN for tethering which is different from the APN used for the terminal's internet access. In which case, it is possible that only one of the two APN is IPv6-ready;
- The **device's operating system** must be IPv6-compatible (cf. section on Devices below). If this is already the case for almost all recent smartphones (Android 5 and more recent, iOS 12 and more recent), a substantial number of 4G routers being sold in 2019 are still not IPv6-compatible. Among those routers that are IPv6-compatible, the lack of support for some IPv6 standards could cause some applications to malfunction with an "IPv6-only" APN[6];
- The operator must **remotely enable the mobile device** before it can use IPv6. With Android, the APN can be configured manually to be made IPv6-compatible. However, because the vast majority of users will not take the initiative of activating IPv6 themselves, it is actions taken by ISPs that will drive the transition. This could require an upgrade by the mobile device's manufacturer. iPhone users cannot enable IPv6 manually.

Thus:

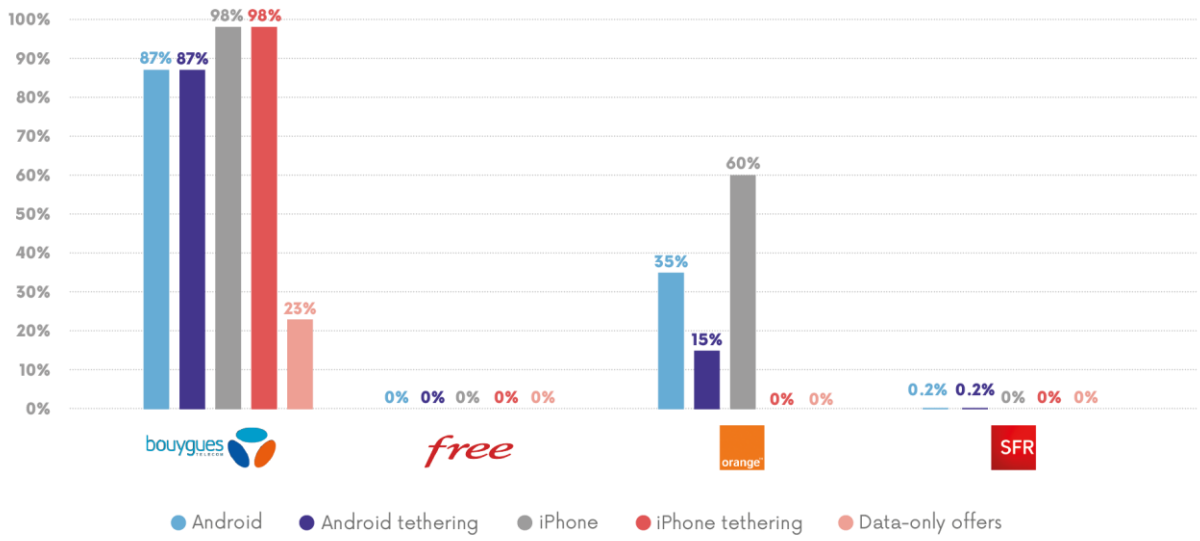
- **a customer is said to be "IPv6-ready"** if they are able to activate IPv6 themselves on their own device (the network is IPv6-compatible);
- **A customer is said to be "IPv6-enabled" if their device** actually sends and receives IPv6 traffic, either through manual activation performed by the customer themselves, or through activation performed by the operator.

[6] Three types of connection are possible on a mobile device:

- *IPv4-only*: The device is connected to the network only by an IPv4 address. Such is the case with IPv4-only plans;
- IPv4/IPv6: The device is both IPv4 and IPv6-enabled. This is the most common by type of connection on fixed networks with IPv6;
- *IPv6-only*: The device is connected to the network only by an IPv6 address. This is the most common type of connection for smartphones. Mechanisms such as NAT64, DNS64 and 464XLAT are put into place to ensure that the handset can the IPv4-only, internet using an IPv6 device.

4.1. Operators with over 3 million customers on mobile networks

MOBILE NETWORK: PERCENTAGE OF IPv6-ENABLED CUSTOMERS



Source: data as of the end of June 2020, collected by Arcep from operators.

The disparity between the percentage of customers who are IPv6-ready and the percentage of customers who are actually IPv6-enabled (transmitting and receiving IPv6 traffic) can be explained by the main operators' different IPv6 activation policies.

Operators are changing the APN configuration, to make their "IPv6-ready" customers "IPv6-enabled" ones, which typically takes the form of an update by the mobile device's manufacturer. These are the devices to have undergone IPv6 activation in their latest software update:

MOBILE NETWORK: IPv6 ACTIVATION POLICY

	bouygues	free	orange	SFR
IPv6 enabled by default on Android	Android 4.4 or higher, via device manufacturer update	N/A	Samsung: Android 9 newer. Other brands: new products from May 2020 onwards	No (customer performs activation on their device)
IPv6 enabled by default on Android, with a shared connection	Android 4.4 or higher, via device manufacturer update	N/A	Samsung: Android 10 newer. Other brands: new products from January 2021 onwards	No (customer performs activation on their device)
IPv6 enabled by default on iPhone	iPhone 5S and newer, running iOS 12.2 or higher	N/A	iPhone 7 and newer, running iOS 13 or higher	iPhone 6S and newer, running iOS 14.3 or higher
IPv6 enabled by default on iPhone, with a shared connection	iPhone 5S and newer, running iOS 12.2 or higher	N/A	iPhone 7 and newer, running iOS 14 or higher	iPhone 6S and newer, running iOS 14.3 or higher
IPv6 enabled by default on data plans only	Progressive update of compatible devices	N/A	New products from January 2021 onwards	No (customer performs activation on their device)

Source: data as of the end of June 2020, collected by Arcep from operators.

Arcep offers a tutorial (in French) on **its site** explaining how to activate IPv6 on Android smartphones, operator by operator. iPhones do not currently allow users to change the APN protocol themselves.

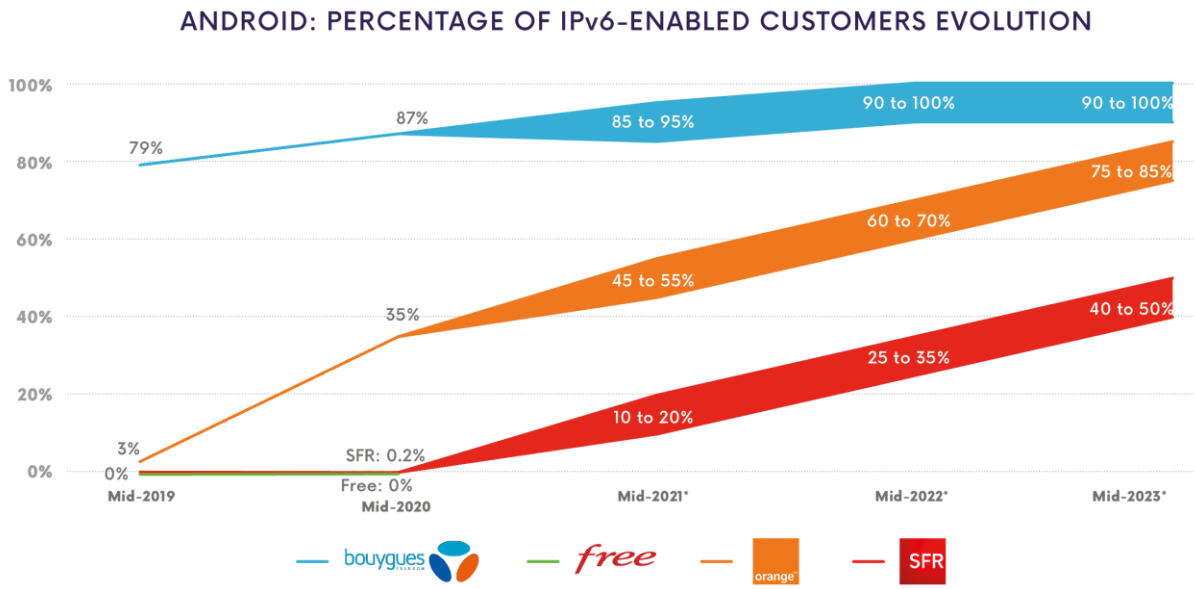
MOBILE NETWORK:
PERCENTAGE OF IPv6-READY AND IPv6-ENABLED CUSTOMERS EVOLUTION

		bouygues		free		orange		SFR	
		IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled
Android	Mid-2019	100%	79%	0%	0%	100%	3%	0%	0%
	Mid-2020	100%	87%	0%	0%	100%	35%	2%	0.2%
	Mid-2021*	100%	85-95%	not provided	not provided	100%	45-55%	100%	10-20%
	Mid-2022*	100%	90-100%	not provided	not provided	100%	60-70%	100%	25-35%
	Mid-2023*	100%	90-100%	not provided	not provided	100%	75-85%	100%	40-50%
Android tethering	Mid-2019	100%	79%	0%	0%	0%	0%	0%	0%
	Mid-2020	100%	87%	0%	0%	100%	15%	2%	0.2%
	Mid-2021*	100%	85-95%	not provided	not provided	100%	35-45%	100%	10-20%
	Mid-2022*	100%	90-100%	not provided	not provided	100%	50-55%	100%	25-35%
	Mid-2023*	100%	90-100%	not provided	not provided	100%	65-75%	100%	40-50%
iPhone	Mid-2019	100%	0%	0%	0%	100%	0%	0%	0%
	Mid-2020	100%	98%	0%	0%	100%	60%	2%	0%
	Mid-2021*	100%	99%	not provided	not provided	100%	65-75%	100%	85-95%
	Mid-2022*	100%	99%	not provided	not provided	100%	75-85%	100%	90-100%
	Mid-2023*	100%	99%	not provided	not provided	100%	85-95%	100%	95-100%
iPhone tethering	Mid-2019	100%	0%	0%	0%	0%	0%	0%	0%
	Mid-2020	100%	98%	0%	0%	100%	0%	2%	0%
	Mid-2021*	100%	99%	not provided	not provided	100%	55-65%	100%	85-95%
	Mid-2022*	100%	99%	not provided	not provided	100%	65-75%	100%	90-100%
	Mid-2023*	100%	99%	not provided	not provided	100%	75-85%	100%	95-100%
Data-only offers (4G dongles, tablets, computers, etc.)	Mid-2019	0%	0%	0%	0%	0%	0%	0%	0%
	Mid-2020	100%	23%	0%	0%	100%	0%	2%	0%
	Mid-2021*	100%	35-45%	not provided	not provided	100%	5-15%	100%	45-55%
	Mid-2022*	100%	40-50%	not provided	not provided	100%	15-25%	100%	55-65%
	Mid-2023*	100%	50-60%	not provided	not provided	100%	45-55%	100%	70-80%

* Figures subject to change

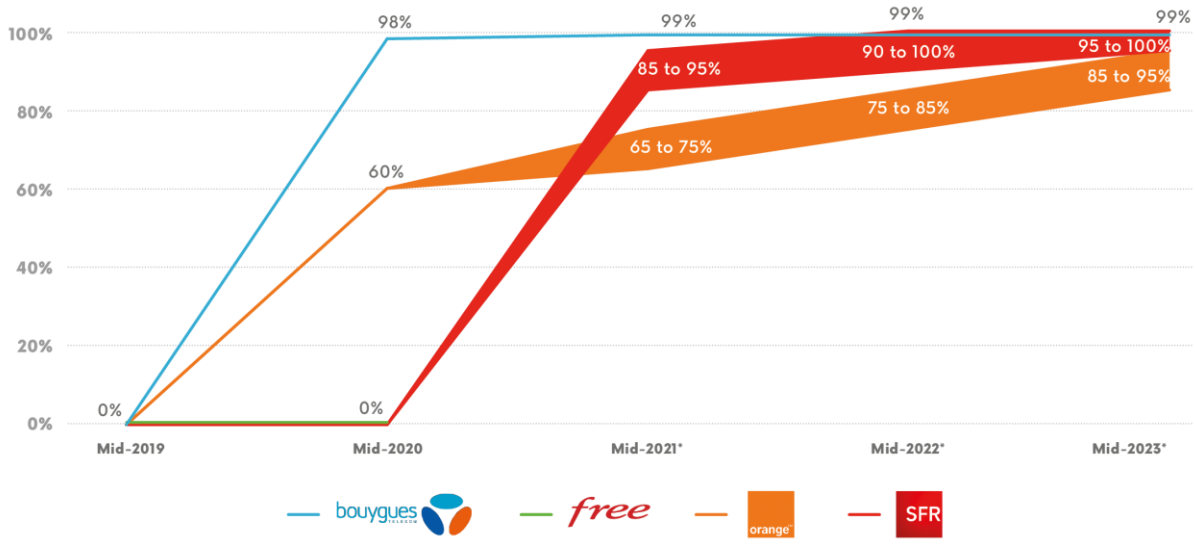
Source: data as of the end of June 2020, collected by Arcep from operators.

Regarding the different operators' plans for upgrading their mobile network to IPv6 one year and three years from now[7]:



* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.



* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

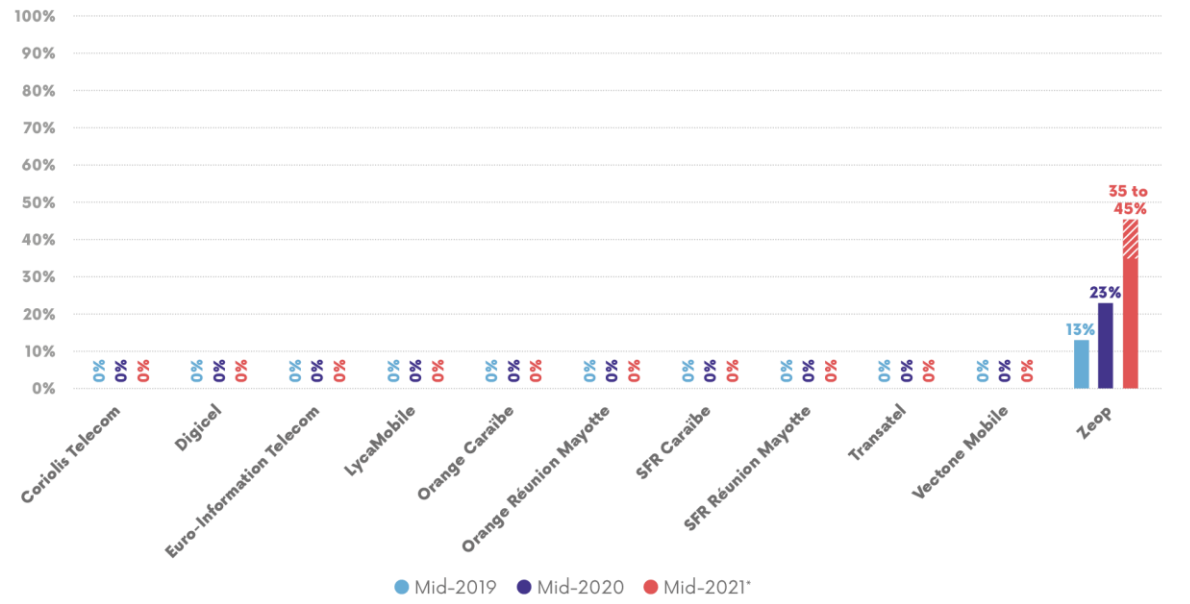
[7] Data collected in 2018 were aggregated and can therefore not be compared by 2019 data by individual device category.

Despite the delay in IPv6 deployment on mobile networks, Arcep notes the encouraging forecasts and invites operators to continue working to accelerate the pace of the transition:

- Bouygues Telecom has achieved a noteworthy deployment on mobile networks, with 87% of Android customers and 98% of iPhone customers IPv6 enabled in mid-2020.
- IPv6 on the Orange mobile network is also worth noting (35% of Android customers and 60% of iPhone customers IPv6 enabled). Orange is invited to continue its IPv6 activation of mobile devices.
- Despite having only a tiny fraction of IPv6-enabled customers (0.2% in mid-2020), SFR has increased its forecasts and is now targeting 100% IPv6-ready customers in mid-2021. iPhone forecasts are very encouraging (90% in mid-2021 and 97% in mid-2023). Deployment forecasts for Android, on the other hand, seem too low in light of the shortage of IPv4 addresses. SFR is thus being urged to step up the pace of Android device IPv6 activation.
- It is particularly regrettable that that Free Mobile has not yet begun the transition on its mobile network, and was unable to supply its forecasts.
- Operators are all being called on to accelerate the pace of IPv6 deployment on all of their products, notably their "data only" plans.

4.2. Operators with between 5,000 and 3 million customers on mobile networks

MOBILE NETWORK: PERCENTAGE OF IPv6-ENABLED CUSTOMERS EVOLUTION



* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

Zeop is the only mobile operator with between 5,000 and 3 million customers that has begun to enable IPv6 on its network (23% in mid-2020) and has a target of 40% of customers IPv6 enabled by mid-2021. The remaining operators do not plan to have deployed IPv6 by mid-2021.

Mobile networks' IPv6 deployment is even more behind than it is on fixed networks, and operators with between 5,000 and 3 million mobile customers are urged to begin the transition to IPv6 very soon.

4.3. Operators marketing "Pro" plans on their mobile network

To improve its monitoring of the transition to IPv6, Arcep expanded its information gathering to include operators that market solutions designed for business customers – aka "Pro" plans – on their fixed network.

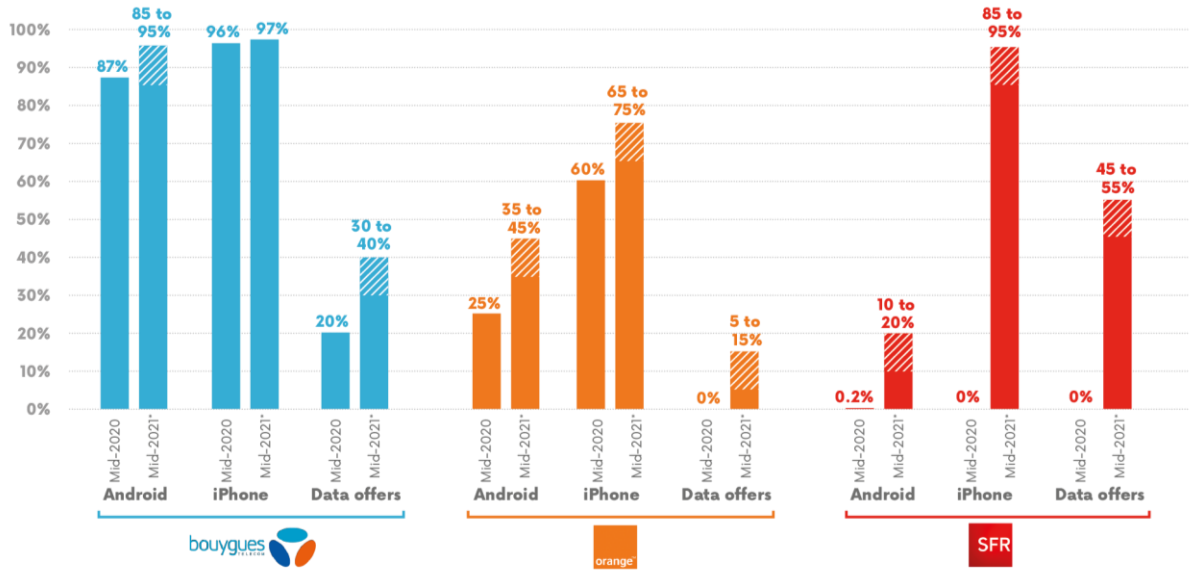
MOBILE NETWORK "PRO" PLANS:
PERCENTAGE OF IPv6-READY AND IPv6-ENABLED CUSTOMERS EVOLUTION

		bouygues		orange		SFR	
		IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled
Android	Mid-2020	100%	87%	100%	25%	2%	0.2%
	Mid-2021*	100%	85-95%	100%	35-40%	100%	10-20%
Android tethering	Mid-2020	100%	87%	100%	12%	2%	0.2%
	Mid-2021*	100%	85-95%	100%	20-30%	100%	10-20%
iPhone	Mid-2020	100%	96%	100%	60%	2%	0%
	Mid-2021*	100%	97%	100%	65-75%	100%	85-95%
iPhone tethering	Mid-2020	100%	96%	100%	0%	2%	0%
	Mid-2021*	100%	97%	100%	55-65%	100%	85-95%
Data-only offers (4G dongles, tablets, computers, etc.)	Mid-2020	100%	20%	30%	0%	2%	0%
	Mid-2021*	100%	30-40%	100%	5-15%	100%	45-55%

* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

MOBILE NETWORK "PRO" PLANS:
PERCENTAGE OF IPv6-ENABLED CUSTOMERS EVOLUTION



* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

The main operators' IPv6 activation policies explain the difference between the percentage of customers that are IPv6-ready and the percentage that are actually IPv6-enabled (i.e. who transmit and receive IPv6 traffic).

There are sizeable disparities between operators when it comes to IPv6 deployment on their mobile network "Pro" plans:

- As it has with mobile plans for consumers, Bouygues Telecom has achieved a remarkable deployment, activating most business plans' Android (87%) and iOS (96%) devices.
- Only a small percentage of Orange and SFR "Pro" mobile plans on Android devices are IPv6 enabled (25% for Orange and 0.2% for SFR) and projections for mid-2021 remain far too low (40% for Orange and 13% for SFR). Future deployments on iPhones are encouraging, however, with a target of 90% of iPhones IPv6 enabled by mid-2021 for SFR and 70% for Orange. Orange and SFR are invited to increase the number of Android devices used by "Pro" plans that are IPv6-enabled, and to activate IPv6 on all iOS devices.
- Operators are invited to initiate and accelerate IPv6 deployment on all of their "Pro" plans.

4.4. An obligation of IPv6 compatibility in mobile networks

Arcep introduced an obligation for operators who are awarded a licence to use 5G frequencies in the 3.4 – 3.8GHz band in Metropolitan France to be IPv6 compatible[8]: "The licence-holder is required to make its mobile network compatible with the IPv6 protocol as of 31 December 2020". As stipulated in its reasons, the goal is to ensure that services are interoperable and to remove obstacles to using services that are only available in IPv6, as the number of devices in use continues to soar, and because the RIPE NCC has run out of IPv4 addresses.

[8] Arcep Decision on the terms and conditions for awarding licences to use frequencies in the 3.4 – 3.8 GHz band: https://www.arcep.fr/uploads/tx_gsavis/19-1386.pdf

5. Hosting services, content providers and DNS infrastructure

Five conditions need to be met for a hosting service to be able to transmit and receive in IPv6:

- The **hosting service network** must be IPv6-compatible;
- The **server's operating system** must be IPv6-compatible and its IPv6 stack enabled. It is the case for all currently used servers' operating systems;
- The hosting service must **preconfigure the server**, to use IPv6 addressing.

Once these three conditions have been met, the hosting service can then enable IPv6 at the server level (cf. see diagram in Part 1).

- The content provider must use **server applications** (web, mail, etc.) that can manage the IPv6 protocol. It is almost already the case by default.
- The content provider must **configure the DNS** by adding an IPv6 record, so that the domain name points towards an IPv6 address.

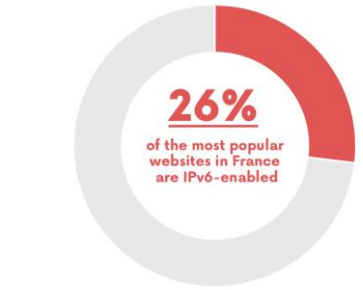
Once all of these conditions are met, the hosted service can be IPv6-enabled.

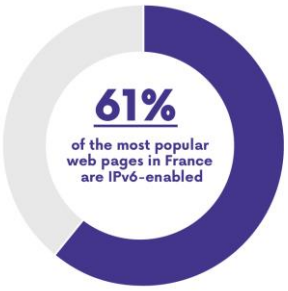
Thus, unlike an ISP that can enable IPv6 remotely, without requiring any action from its customers (i.e. end users), a hosting service's customer (i.e. content provider) must take several steps before IPv6 can be used end-to-end.

In the next part of this section, we take a look at three types of applications: web, mail and DNS infrastructure.

5.1. Web hosting

Web hosting services continue to constitute **one of the main bottlenecks** in the migration to IPv6: of the most popular websites in France according to Alexa rankings, only 26% are IPv6-enabled[9]. A site is considered IPv6-enabled if its domain name is mapped as being IPv6 (AAAA) in the DNS server record.





Source: 6lab Cisco as of 11/02/2020 (6lab.cisco.com). Data of the top 730 websites in France as ranked by Alexa (www.alexa.com/topsites/countries).

Note that the percentage of web pages that are IPv6-enabled (IPv6 content) is significantly higher than that (61%[10]). The reason is that many of the smaller content providers operate websites (generally small number of pages viewed) that are not IPv6-compatible.

The percentage of IPv6-enabled sites stands at a mere 17.9% when looking at the 3.62 million .fr, .re, .pm, .yt, .tf, and .wf[11] websites. This percentage has been increasing since 2015, but

[9] Cisco 6lab as of 02/11/2020 (https://6lab.cisco.com); Data on the top 731 websites in France, Alexa rankings: http://www.alexa.com/topsites/countries

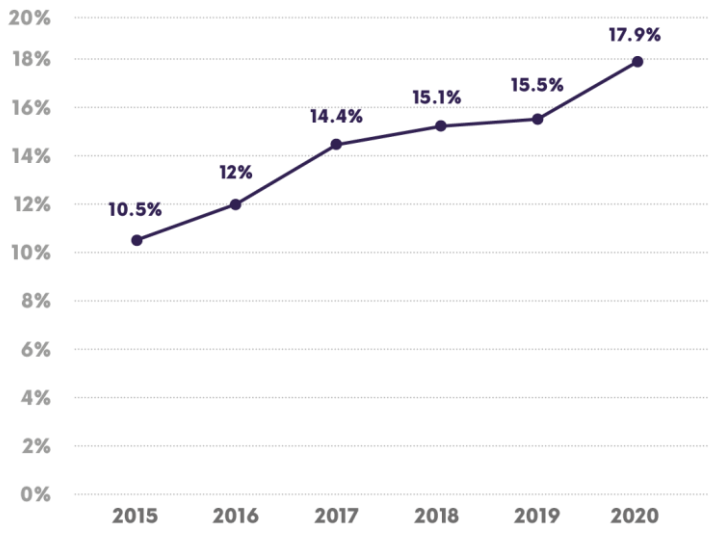
[10] *Ibidem.*

[11] Afnic data, August 2020. For these data, the Top 10 and Top 100 are defined in terms of the number of domain names hosted.

the pace of this increase appears far from fast enough to enable a complete transition in the next few years.

EVOLUTION OF IPV6-ENABLED WEBSITES

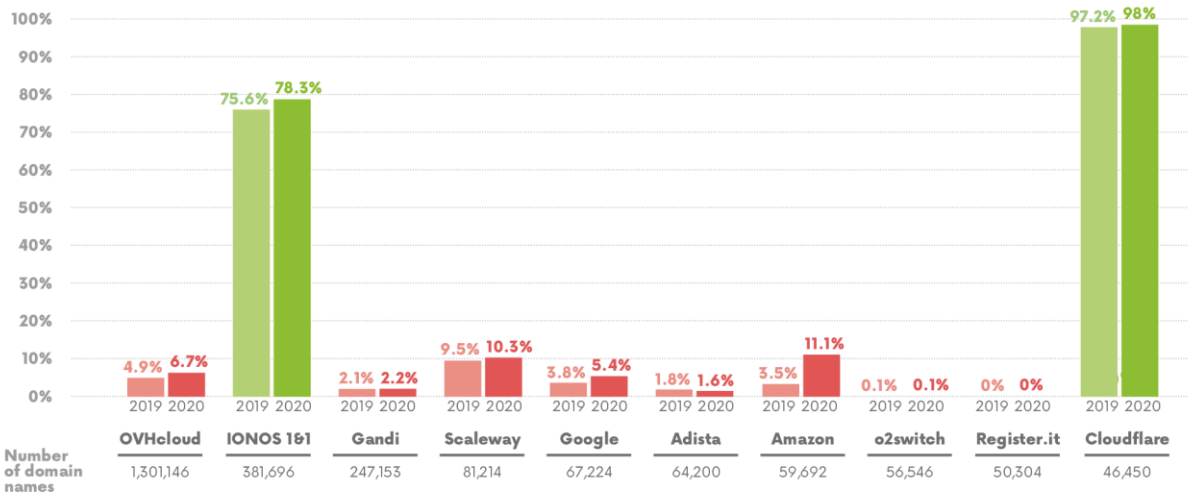
on .fr, .re, .pm, .yt, .tf and .wf domain names



Source: Afnic data, August 2020.

PERCENTAGE OF IPV6-ENABLED WEBSITES

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



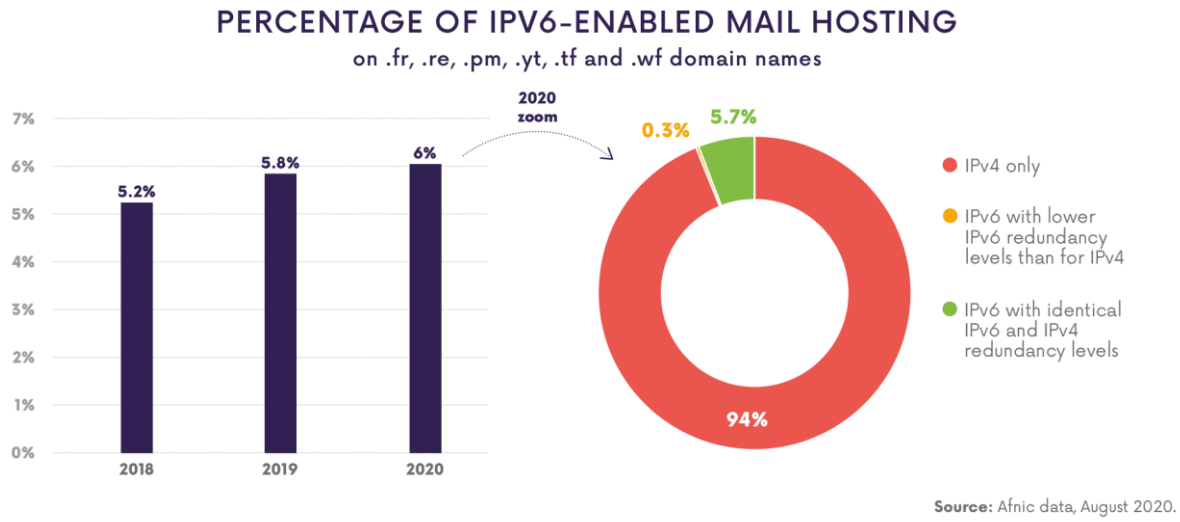
Source: Afnic data, August 2020.

Even if several hosting services include IPv6 in their solutions, **the percentage of websites accessible in IPv6 is very low** for all of the Top 10 web hosting services (in number of domain names) as it is **not activated by default.** Among that Top 10, only IONOS 1&1 and Cloudflare have more than three quarters of their sites IPv6 enabled, which make them examples to follow.

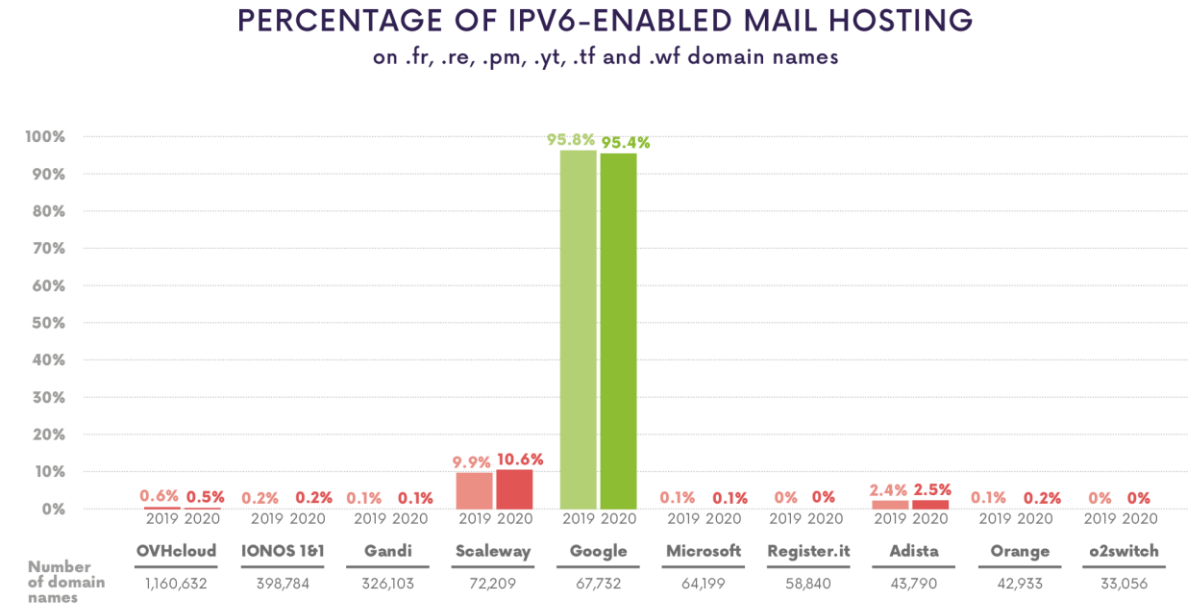
Further details on the Top 100 hosting services are available in annex.

5.2. Mail hosting

The transition of the main mail hosting services is also proving **very slow**: only 6% of mail servers on .fr, .re, .pm, .yt, .tf and .wf domain names are currently IPv6-enabled (compared to 5.8% at mid-2020). It should also be noted that on a number of them, there is an IPv6 redundancy level that is below the one provided for IPv4, which is likely to create resilience issues[12].



Source: Afnic data, August 2020.



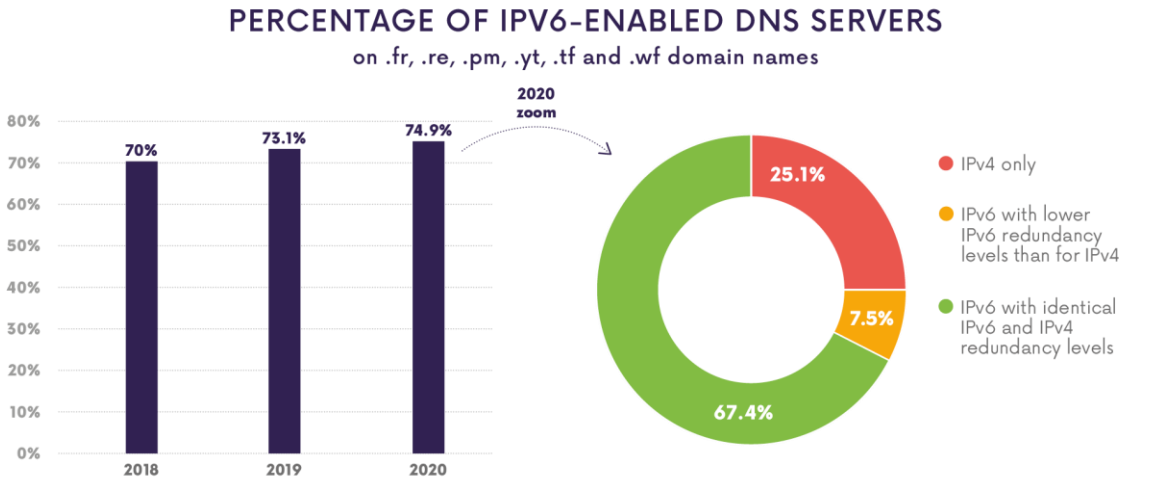
Source: Afnic data, August 2020.

Once again this year, the lack of IPv6-readiness amongst mail hosting services is alarming. If it is not remedied in the next few years, the protracted lag on this link in the internet value chain could force IPv4 to be kept for longer than planned, with all the resulting costs. Only Google stands out here, with more than 95% of domain names for mail using IPv6 (cf. annex for more details on the Top 100).

[12] Afnic data, August 2020.

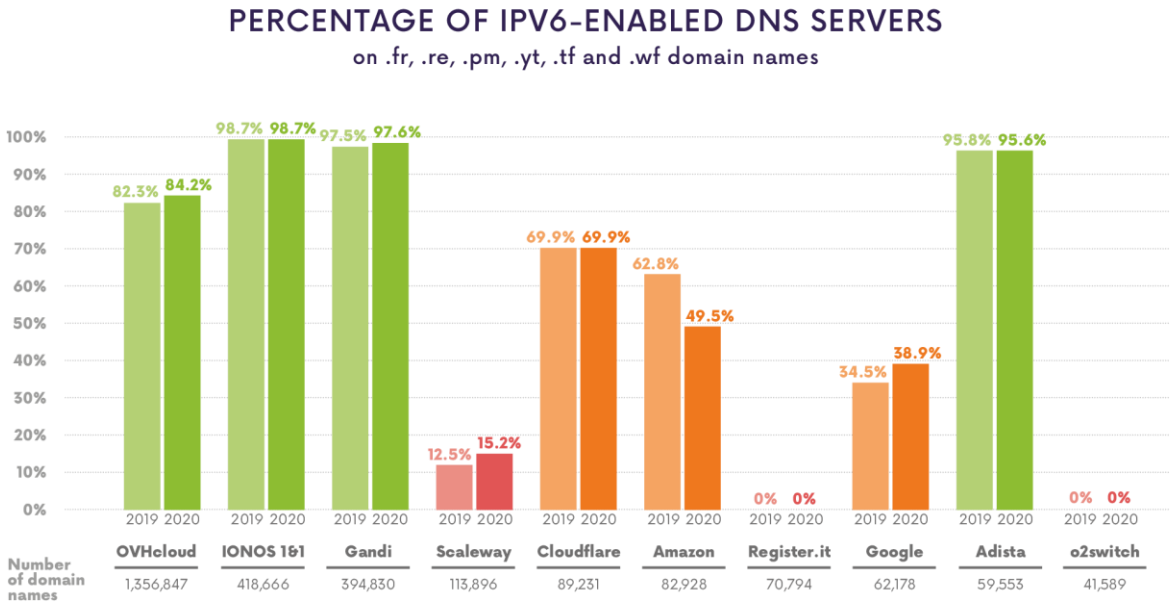
5.3. DNS infrastructure

DNS infrastructure makes it possible to translate a domain name, e.g. www.arcep.fr, into an IP address. This is currently **the sector that is the most advanced in the transition to IPv6**, with around 73% of authoritative name servers[13] supporting IPv6. Around 67%[14] of DNS servers guarantee an IPv6 resilience equivalent to IPv4 (identical redundancy levels).



Source: Afnic data, August 2020.

It is worth noting the ongoing tremendous disparity in the Top 10 hosting company rankings, with four players (OVHcloud, 1&1 IONOS, Gandi and Adista) virtually systematically activating IPv6, contrary to the other six (cf. annex for details on the Top 100).



Source: Afnic data, August 2020.

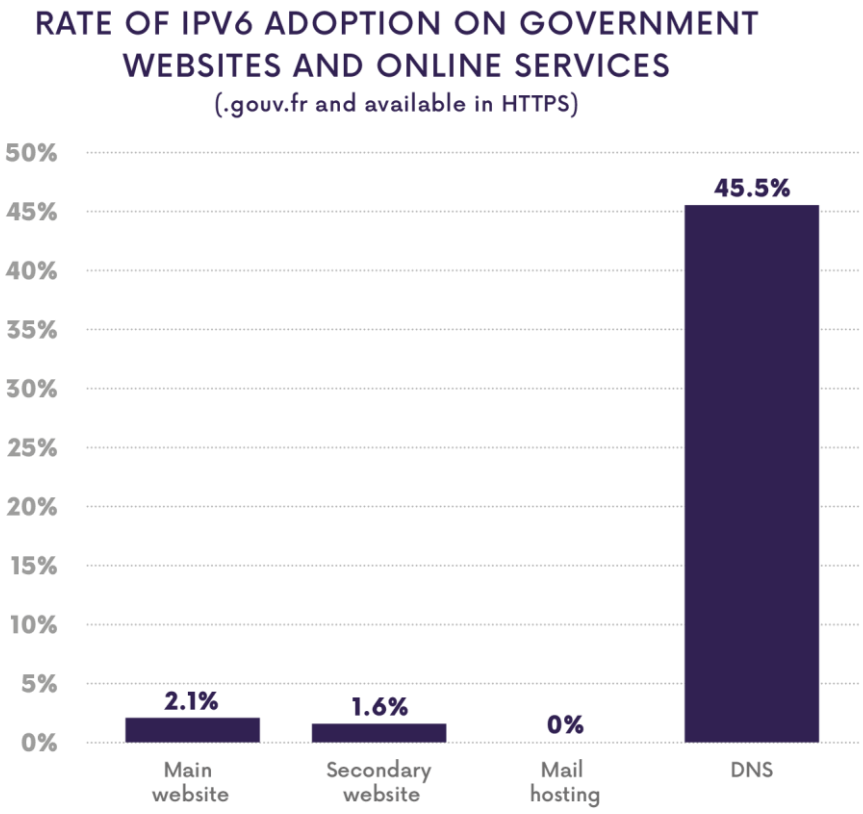
[13] An authoritative DNS (domain name server) is the primary DNS server for a domain, in other words the one that holds the domain name resolution information.
[14] Afnic data, August 2020.

5.4. Government websites and online services (.gouv.fr)

Since having the government lead by example is one of the most important paths to an accelerated transition, this year the barometer has been enhanced with indicators on the progression of this transition to IPv6 by French government websites and online services. The current study pertains to the 243 sites with the .gouv.fr suffix and available in HTTPS[15].

DNS servers' transition to IPv6 is relatively well advanced, with 45.5% of them being IPv6-enabled. Mail hosting, on the other hand, is still entirely in IPv4 and the percentage of government websites using IPv6 stands at only 2.1% for the main websites[16] and 1.6% for secondary ones[17] (cf. annex for details on the websites and online services in question).

Even if some sites are available in IPv6, it is regrettable that the vast majority are still using only IPv4. The level of IPv6 deployment on government websites and online services thus remains very inadequate, particularly given the goal of leading the transition to IPv6 by example. More attention could be paid to IPv6 compatibility when upgrading existing websites and when drafting specs for calls to tender to create new online services.



Source: tests performed by Arcep in November 2020, based on Afnic data.

[15] Of the 1,009 existing domain names ending with .gouv.fr in August 2020, only the 243 whose HTTPS response has a valid TLS certificate were taken into account, and so excluding from the analysis domain names that are not being maintained or that are not attached to a website.

[16] Main site: the site suggested/linked to by default by a search engine.

[17] Secondary site: site that redirects to the main site (if the main site has the "www" prefix, the secondary site does not, and vice-versa).

6. Equipment suppliers, transit providers and devices

6.1. Equipment suppliers

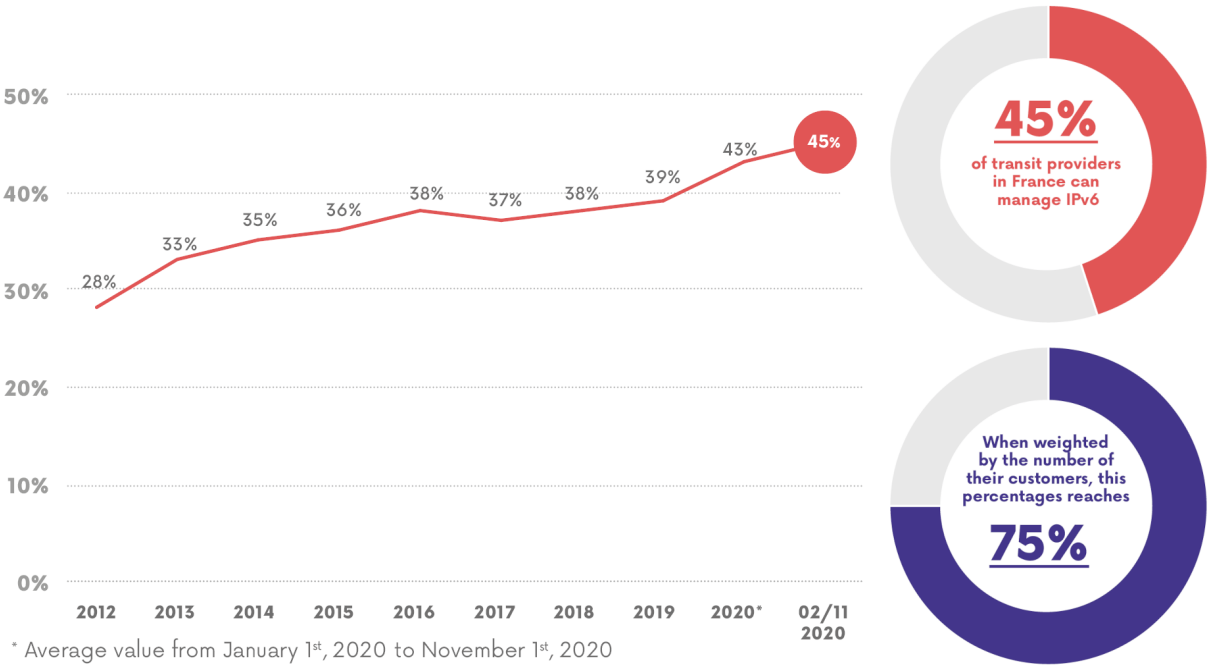
All of the major equipment suppliers (Cisco, Juniper and Nokia) have indicated that all the network solutions they sell (routers, etc.) are **systematically made IPv6-compatible**[18].

This compatibility does not necessarily guarantee that traffic will be routed in IPv6, as this would require each player (ISPs, hosting services, transit providers, etc.) to have configured IPv6 routes at the router level.

6.2. Transit providers[19]

The percentage of transit providers that manage IPv6 in France has increased by more than 15 points over the past eight years.

EVOLUTION OF IPv6 TRANSIT AS IN FRANCE



* Average value from January 1st, 2020 to November 1st, 2020

Source: 6lab Cisco as of 11/02/2020 (6lab.cisco.com).

Today, 45% of the transit providers operating in France (88 of the 196 transit providers) can manage IPv6 traffic, compared to 38% at the end of October 2019[20].
When weighted by the number of transit providers' customers, this percentage climbs to around 75%, versus 72% at the end of October 2019. This means that several of the larger transit providers are better equipped to manage IPv6[21].

[18] Arcep 2016 questionnaire.
[19] The methodology employed by Cisco's 6lab stipulates that "all AS that appear on an AS path of BGP table (and that are not the origin AS or the destination) are considered Transit AS.
[20] Figures as of October 2019 were updated from those contained in the 2019 barometer, following additional information provided by Cisco.
[21] 6lab Cisco as of 02/11/2020: **https://6lab.cisco.com/**.

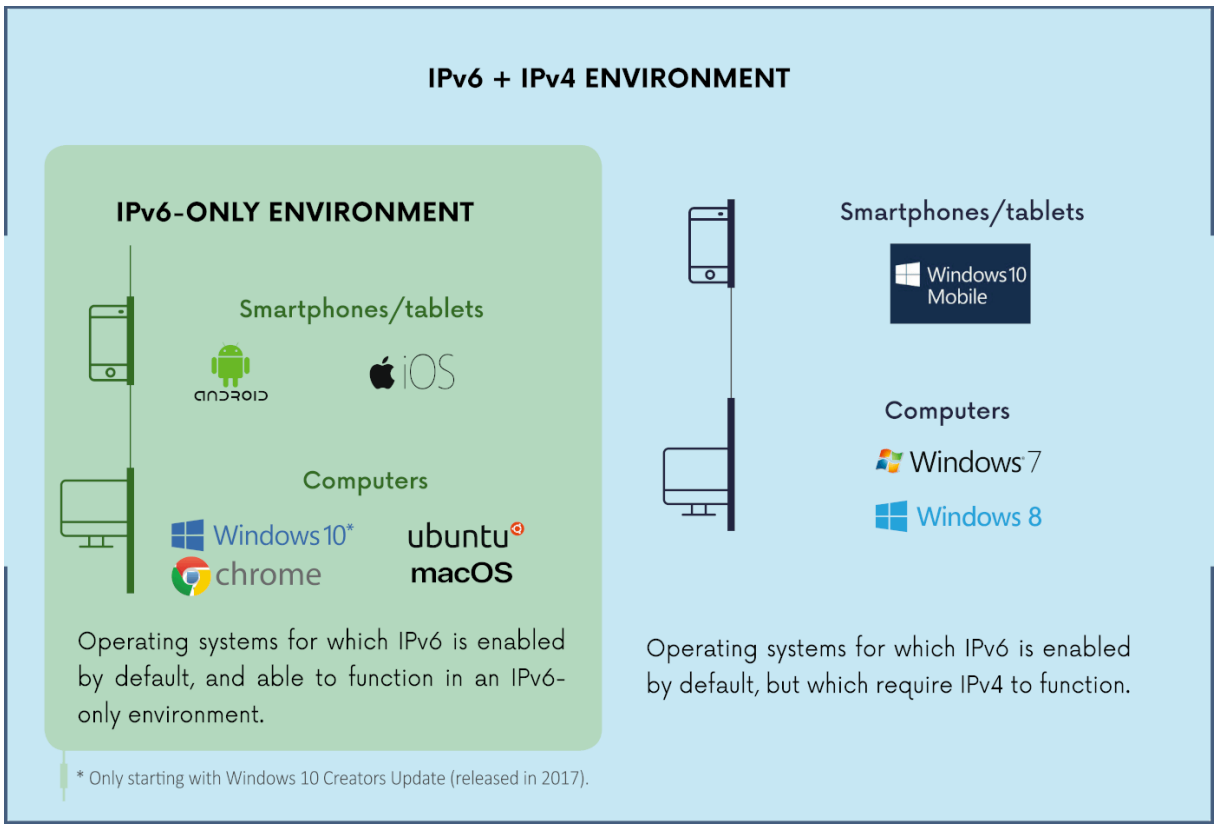
6.3. Devices

For a device to be able to transmit and receive IPv6 traffic, the operating system (OS) must be IPv6-compatible, and IPv6 must be enabled by default.

In the many connected objects (alarm systems, televisions, etc.), **IPv6 is integrated into the OS but has not been enabled by the connected object's manufacturer.**

Only the versions of operating systems that are preinstalled on retail market computers, tablets and smartphones, and still maintained (i.e. for which security updates, etc. are still provided) are examined below.

All of these operating systems are compatible with IPv6, which has been enabled by default for several years now (for instance, IPv6 has been enabled by default in Windows since Windows Vista in 2007). However, some OS cannot work properly in IPv6 without an IPv4 address (i.e. when IPv6 is the only protocol available) as they do not include support for the RFC 8106 Neighbor Discovery Protocol RDNSS.



7. Where does France stand?

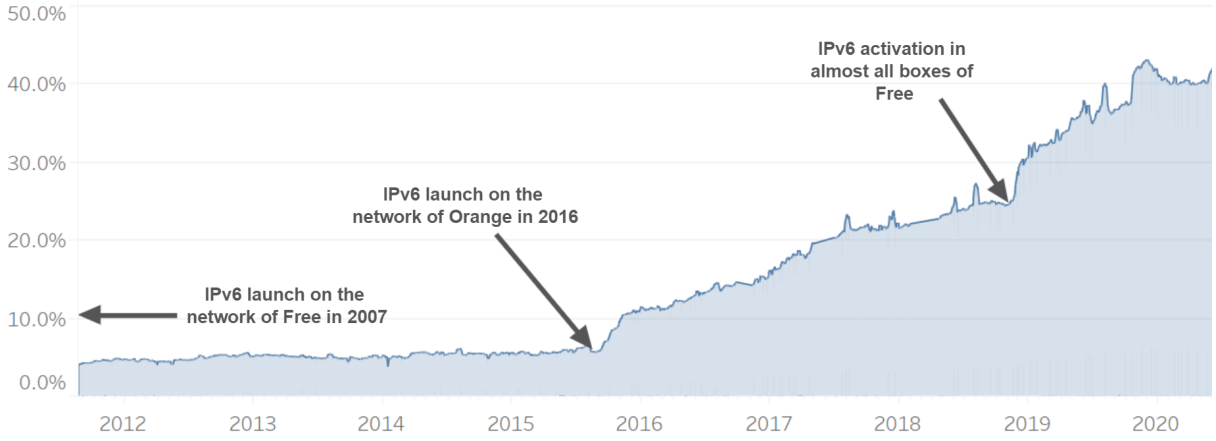
The **IPv6 adoption rate** represents the percentage of users measured at a hosting service level (service proposing already IPv6). This therefore gives an idea of the status of the transition amongst devices, ISPs and mobile operators, and by other technical intermediaries when the hosting service in question makes use of transit providers.

As measured by Google, this rate currently stands at more than 42% in France.

It is worth noting that, during the first lockdown in France due to the Covid-19 pandemic, the rate of IPv6 use rose from around 37% to 43% between mid-March and the end of April 2020. This rate dropped slightly after the lockdown, which can be attributed in particular to the surge in residential internet traffic during the lockdown, which is more widely IPv6-enabled than business internet access.

Evolution of IPv6 adoption in France, as measured by Google

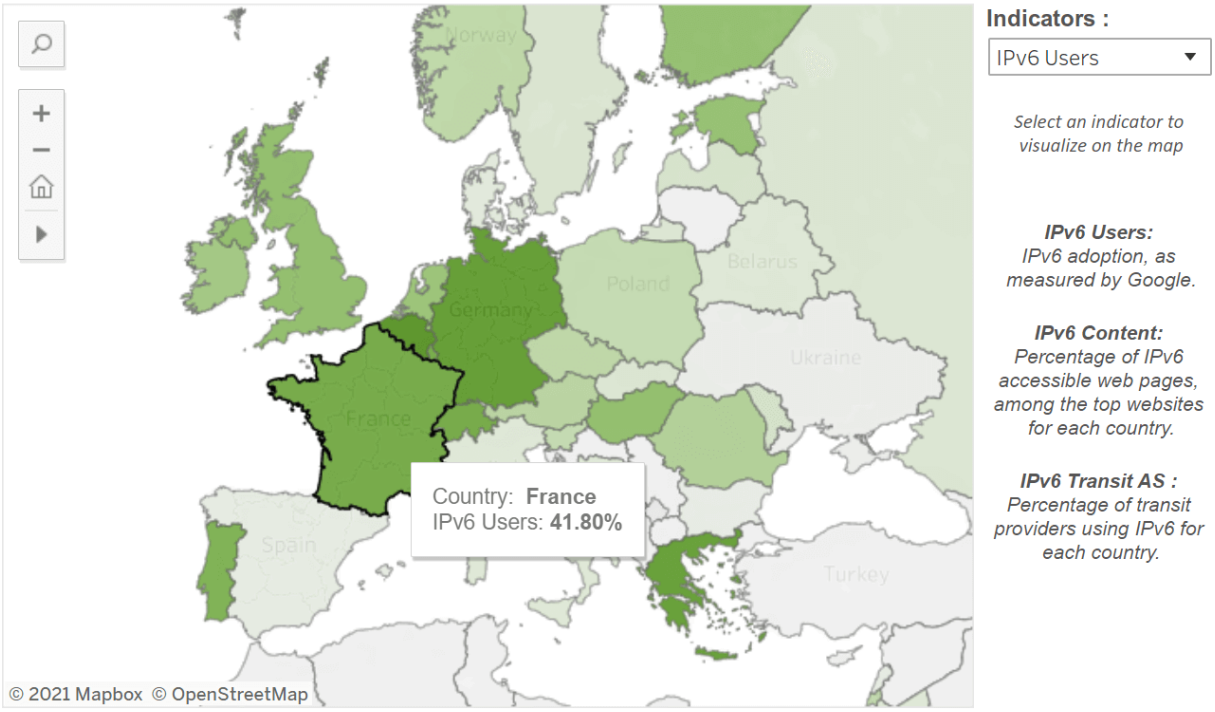
Source : Cisco - 6Lab



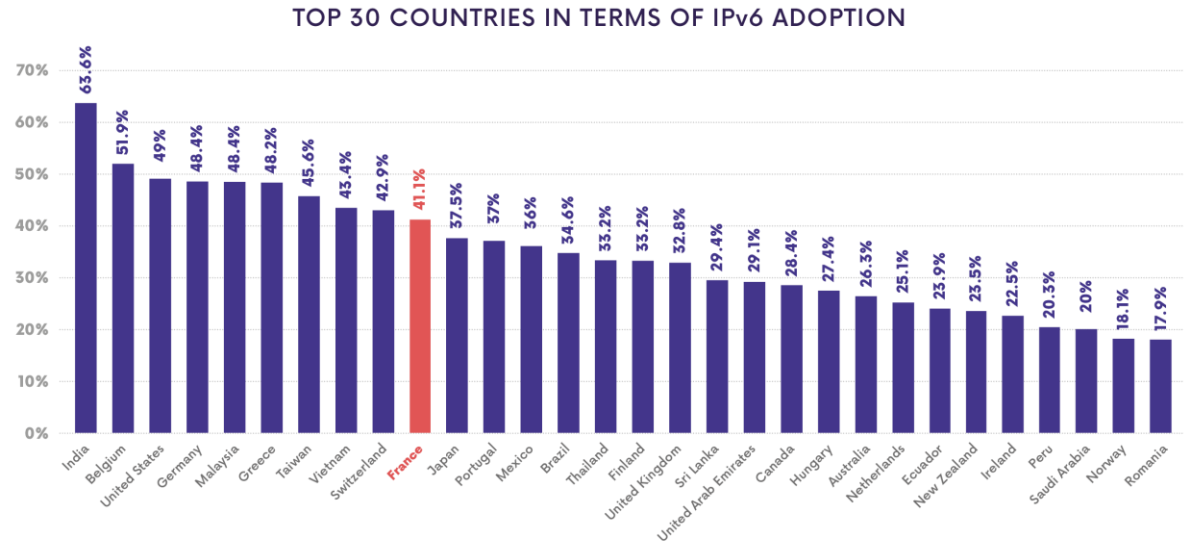
Because Google servers are typically located close to end users, this indicator gives an only partial view of the actual situation (the **percentage of transit providers that have adopted IPv6** has a direct influence on the number of IPv6-initated Internet connections in France, but is marginally taken into account by this indicator). It is also important to know how many web hosts are actually able to provide IPv6, by measuring the **percentage of web pages that are accessible through IPv6 (or content).** The following map provides a comparison of the different countries around the world for the three indicators listed above.

State of the transition to IPv6 in the world as of 02/11/2020

Source: Cisco - 6Lab



France is among the **Top 10 worldwide** in terms of IPv6 use, according to the four main sources of publicly available data employed to assess IPv6 adoption (Google, Akamai, Facebook and Apnic)[22]. France ranks **fifth in Europe**, behind Belgium, Germany, Greece and Switzerland.

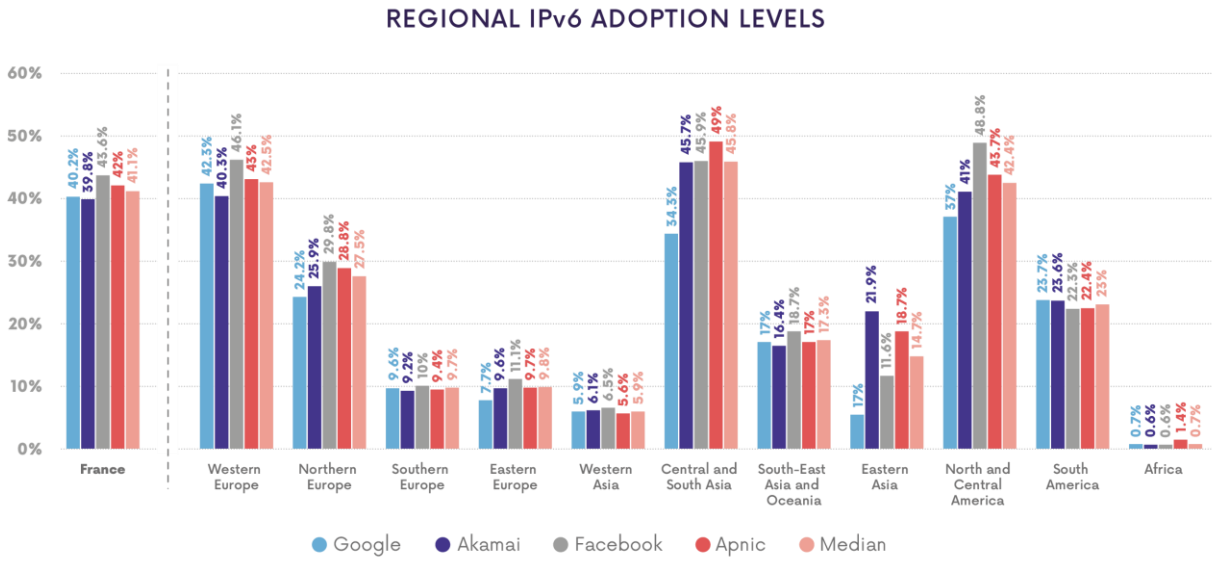


Source: median of "Google IPv6 adoption", "Akamai IPv6 adoption", "Facebook IPv6 adoption", "Apnic IPv6 adoption" data from October 2020. Pertains only to the 100 countries with the most internet users.

IPv6 deployment levels vary considerably from region to region. The three regions with the most advanced transition to IPv6 are Central and South Asia (46% IPv6 use), Western Europe (43%),

[22] Based on the median of Google IPv6 adoption", "Akamai IPv6 adoption", "Facebook IPv6 adoption", "Apnic IPv6 preferred" data from October 2020. Aggregation of national data is prorated based on the number of internet users (source: Wikipedia, data as of 20/10/2020). The median of the four sources is calculated country by country, before being aggregated on a pro-rated basis, according to the number of internet users in each region.

North and Central America (42%). The regions that lag the furthest behind in IPv6 deployment are Western Asia (5.9%) and Africa (0.7%).



Source: "Google IPv6 adoption", "Akamai IPv6 adoption", "Facebook IPv6 adoption", "Apnic IPv6 preferred" data from October 2020. Pertains only to the 100 countries with the most internet users. Aggregation of national data is prorated based on the number of internet users. The median of the four sources is calculated country by country, before being aggregated on a pro-rated basis, according to the number of internet users in each region.

Annex: more information on the transition to IPv6

3. Fixed Internet service providers

3.1. Operators with over 3 million customers on fixed networks

FIXED NETWORK:
PERCENTAGE OF IPv6-READY AND IPv6-ENABLED CUSTOMERS EVOLUTION

		bouygues		free		orange		SFR	
		IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled
xDSL	Mid-2018	2.5%	2.5%	99%	Not provided	40%	39%	100%	1.3%
	Mid-2019	25%	25%	99%	69%	60%	59%	100%	1.5%
	Mid-2020	32%	32%	99%	99%	67%	66%	100%	1.8%
	Mid-2021*	35-45%	35-45%	99%	99%	70-80%	65-75%	100%	0-5%
	Mid-2022*	55-65%	55-65%	100%	99%	75-85%	70-80%	100%	0-5%
	Mid-2023*	85-95%	85-95%	100%	99%	75-85%	75-85%	100%	0-5%
Cable	Mid-2018	0%	0%	N/A		N/A		0%	0%
	Mid-2019	0%	0%	N/A		N/A		0%	0%
	Mid-2020	0%	0%	N/A		N/A		0%	0%
	Mid-2021*	N/A		N/A		N/A		0%	0%
	Mid-2022*	N/A		N/A		N/A		5-15%	5-15%
	Mid-2023*	N/A		N/A		N/A		5-15%	5-15%
FttH	Mid-2018	1%	1%	100%	99%	90%	87%	60%	1.5%
	Mid-2019	2%	2%	100%	99%	100%	97%	60%	38%
	Mid-2020	25%	25%	100%	100%	100%	97%	10%	3.5%
	Mid-2021*	30-40%	30-40%	100%	100%	100%	98%	15-25%	10-20%
	Mid-2022*	45-55%	45-55%	100%	100%	100%	98%	25-35%	20-30%
	Mid-2023*	80-90%	80-90%	100%	100%	100%	98%	45-55%	45-55%
4G fixed wireless	Mid-2018	0%	0%	N/A		0%	0%	0%	0%
	Mid-2019	0%	0%	N/A		0%	0%	0%	0%
	Mid-2020	0%	0%	0%	0%	100%	1%	0%	0%
	Mid-2021*	0%	0%	not provided		100%	0-10%	100%	45-55%
	Mid-2022*	45-55%	45-55%	not provided		100%	15-25%	100%	55-65%
	Mid-2023*	75-85%	75-85%	not provided		100%	45-55%	100%	70-80%
Whole network	Mid-2018	2.5%	2.5%	99%	50%	46%	45%	64%	0.9%
	Mid-2019	20%	20%	99%	75%	70%	68%	64%	6.7%
	Mid-2020	28%	28%	99%	99%	77%	75%	50%	1.6%
	Mid-2021*	30-40%	30-40%	99%	99%	80-90%	80-90%	54%	0-10%
	Mid-2022*	50-60%	50-60%	100%	100%	85-95%	80-90%	59%	5-15%
	Mid-2023*	75-85%	75-85%	100%	100%	85-95%	85-95%	63%	10-20%

* Figures subject to change

Source: data as of the end of June 2020, collected by Arcep from operators.

FIXED NETWORK: IPv4 SHARING PRACTICES AND IPv6 PREFIX

		Technologies	bouygues	free	orange	SFR
IPv4	Percentage of customers with a shared IPv4 address	xDSL	0.1%	40%	0%	0%
		cable	0%	N/A	N/A	0%
		FttH	0%	75%	0%	0%
		4G fixed wireless	0%	100%	50%	0%
	If shared, cost of a dedicated IPv4 address	xDSL, cable, FttH	free option	free option	Dedicated IPv4 by default	Dedicated IPv4 by default
		4G fixed wireless	Dedicated IPv4 by default	Dedicated IPv4 not offered	Dedicated IPv4 not offered	Dedicated IPv4 by default
IPv6	Size of IPv6 prefix assigned by default to IPv6 customers	xDSL, FttH	60 bits	61 bits	56 bits	56 bits
	Frequency of IPv6 prefix update *(subject to change on the access or backhaul network)*	xDSL, FttH	Fixed	Fixed	Dynamic	xDSL: Dynamic FttH: Fixed
	IPv6 enabled by default *(subject to eligibility)*		Yes	Yes	Yes	xDSL: no FttH: yes
	Possibility for the customer to disable IPv6 in the box	xDSL, FttH	Depending on firmware	No	Yes	Yes
	IPv6 firewall enabled by default (unsolicited inbound IPv6 flows blocked by default)	xDSL, FttH	Yes	No	Yes	Yes
	IPv6 firewall: possibility to open the unsolicited inbound IPv6 flows	xDSL, FttH	Manually or via uPnP	The optional firewall cannot be configured	Manually or via uPnP	Manually or via uPnP

Source: data as of the end of June 2020, collected by Arcep from operators.

3.2. Operators with between 5,000 and 3 million customers on fixed networks

FIXED NETWORK: PERCENTAGE OF IPv6-READY AND IPv6 ENABLED CUSTOMERS

		Mid-2018		Mid-2019		Mid-2020		Mid-2021*	
		IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled
Alsatis	FttH	0%	0%	0%	0%	0%	0%	0%	0%
	Radio**	0%	0%	0%	0%	0%	0%	0%	0%
	Whole network	0%	0%	0%	0%	0%	0%	0%	0%
bigblu	Satellite	0%	0%	0%	0%	0%	0%	0%	0%
Canal+	FttH	0%	0%	0%	0%	0%	0%	100%	0%
	xDSL	0%	0%	0%	0%	0%	0%	75-85%	0%
	Whole network	0%	0%	0%	0%	0%	0%	90-100%	0%
Comcable	FttH	0%	0%	0%	0%	0%	0%	0%	0%
	Cable	0%	0%	0%	0%	0%	0%	0%	0%
	Whole network	0%	0%	0%	0%	0%	0%	0%	0%
Coriolis Telecom	FttH	82%	82%	62%	62%	76%	76%	80-90%	80-90%
K-Net	FttH	73%	26%	82%	35%	84%	24%	90-100%	not provided
Nordnet	FttH	0%	0%	0%	0%	0%	0%	0%	0%
	xDSL	0%	0%	0%	0%	0%	0%	0%	0%
	Satellite	0%	0%	0%	0%	0%	0%	0%	0%
	Radio**	0%	0%	0%	0%	0%	0%	0%	0%
	Whole network	0%	0%	0%	0%	0%	0%	0%	0%
Orne THD	Cable	0%	0%	100%	100%	100%	100%	100%	100%
OVH Télécom	FttH	100%	not provided	100%	3.5%	100%	3.9%	100%	not provided
	xDSL	100%	not provided	100%	23%	100%	21%	100%	not provided
	Whole network	100%	not provided	100%	23%	100%	21%	100%	not provided
Ozone	FttH	0%	0%	0%	0%	0%	0%	0-15%	0-15%
	xDSL	0%	0%	0%	0%	0%	0%	0%	0%
	Radio**	0%	0%	0%	0%	0%	0%	0-10%	0-10%
	Whole network	0%	0%	0%	0%	0%	0%	0-10%	0-10%
SFR Caraïbe	FttH	0%	0%	0%	0%	0%	0%	0%	0%
	Cable	0%	0%	0%	0%	0%	0%	0%	0%
	xDSL	0%	0%	0%	0%	0%	0%	0%	0%
	Radio**	0%	0%	0%	0%	0%	0%	0%	0%
	Whole network	0%	0%	0%	0%	0%	0%	0%	0%
SFR Réunion Mayotte	FttH	0%	0%	0%	0%	0%	0%	0%	0%
	xDSL	0%	0%	0%	0%	0%	0%	0%	0%
	Radio**	0%	0%	0%	0%	0%	0%	0%	0%
	Whole network	0%	0%	0%	0%	0%	0%	0%	0%
skyDSL	Satellite	0%	0%	0%	0%	0%	0%	0%	0%
Tubéo	FttH	0%	0%	0%	0%	0%	0%	0%	0%
Vialis	FttH	0%	0%	0%	0%	1%	1%	45-55%	45-55%
	Cable	0%	0%	0%	0%	1%	1%	45-55%	45-55%
	Whole network	0%	0%	0%	0%	1%	1%	45-55%	45-55%
VidéoFutur	FttH	0%	0%	0%	0%	0%	0%	0%	0%
	Cable	0%	0%	0%	0%	0%	0%	0%	0%
	Whole network	0%	0%	0%	0%	0%	0%	0%	0%
Wifirst	Radio**	0%	0%	0%	0%	0%	0%	0%	0%
Zeop	FttH	0%	0%	0%	0%	0%	0%	10-20%	10-20%
	Cable	not provided	0.3%	75%	0.3%	90%	0.3%	85-95%	10-20%
	Whole network	not provided	0.1%	18%	0.1%	22%	0.1%	15-25%	10-20%

* Figures subject to change
** Radio technologies: 4G fixed wireless / Wi-Fi / WiMAX

Source: data as of the end of June 2020, collected by Arcep from operators.

FIXED NETWORK: IPv4 SHARING PRACTICES AND IPv6 PREFIX

		IPv4		IPv6					
	Techno-logies	Percentages of customers with a shared IPv4 address	If shared, cost of a dedicated IPv4 address	Size of IPv6 prefix assigned by default to IPv6 customers	Frequency of IPv6 prefix update *	IPv6 enabled by default (subject to eligibility)	Possibility for the customer to disable IPv6 in the box	IPv6 firewall enabled by default (unsolicited inbound IPv6 flows blocked by default)	IPv6 firewall: possibility to open the unsolicited inbound IPv6 flows
Alsatis	FttH	100%	Dedicated IPv4 not offered	N/A	N/A	N/A	N/A	N/A	N/A
	Radio**	50%	Free option	N/A	N/A	N/A	N/A	N/A	N/A
bigblu	Satellite	100%	Dedicated IPv4 not offered	N/A	N/A	N/A	N/A	N/A	N/A
Canal+	FttH	0%	Dedicated IPv4 by default	/56	Fixed	New client	Yes	Yes	Yes
	xDSL	0%	Dedicated IPv4 by default	/56	Fixed	New client	Yes	Yes	Yes
Comcable	FttH	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	Cable	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
Coriolis Telecom	FttH	0%	Dedicated IPv4 by default	/56	Fixed	Yes	No	Yes	Yes
K-Net	FttH	0%	Dedicated IPv4 by default	/56	Fixed	New client	Yes	Yes	Yes
Nordnet	FttH	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	xDSL	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	Satellite	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	Radio**	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
Orne THD	Cable	0%	Dedicated IPv4 by default	/56	Fixed	Yes	No	Yes	Yes
OVH Télécom	FttH	0%	Dedicated IPv4 by default	/56	Fixed	No	Yes	Yes	Yes
	xDSL	0%	Dedicated IPv4 by default	/56	Fixed	No	Yes	Yes	Yes
Ozone	FttH	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	xDSL	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	Radio**	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
SFR Caraïbe	FttH	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	Cable	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	xDSL	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	Radio**	100%	Dedicated IPv4 not offered	N/A	N/A	N/A	N/A	N/A	N/A
SFR Réunion Mayotte	FttH	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	xDSL	0%	Dedicated IPv4 by default	N/A	N/A	N/A	N/A	N/A	N/A
	Radio**	99%	Dedicated IPv4 not offered	N/A	N/A	N/A	N/A	N/A	N/A
skyDSL	Satellite	94%	23.88 € when commissioning and 3.48 € / month	N/A	N/A	N/A	N/A	N/A	N/A
Tubéo	FttH	100%	Dedicated IPv4 not offered	N/A	N/A	N/A	N/A	N/A	N/A
Vialis	FttH	90%	Free option	/56	Fixed	Yes	Yes	Yes	Yes
	Cable	50%	Free option	/56	Fixed	Yes	Yes	Yes	Yes
VidéoFutur	FttH	100%	20 € when commissioning	N/A	N/A	N/A	N/A	N/A	N/A
Wifirst	Radio**	100%	Dedicated IPv4 not offered	N/A	N/A	N/A	N/A	N/A	N/A
Zeop	FttH	0%	Dedicated IPv4 by default	/56	Dynamic (30 days)	No	Yes	Yes	uPnP disabled by default
	Cable	0%	Dedicated IPv4 by default	/56 or /60	Dynamic (30 days)	No	Yes	Yes	

* Subject to change on the access or backhaul network
** Radio technologies: 4G fixed wireless / Wi-Fi / WiMAX

Source: data as of the end of June 2020, collected by Arcep from operators.

4. Mobile operators

4.1. Operators with over 3 million customers on mobile networks

MOBILE NETWORK:
IPV6 TYPE AND THE POSSIBILITY TO CONFIGURE IPv6 FIREWALL

	bouygues	free	orange	SFR
Size of default IPv6 prefix	64 bits	Not provided	64 bits	64 bits
Frequency of IPv6 prefix update	Dynamic	Not provided	Dynamic	Dynamic
IPv6 type for smartphones	IPv6 only + DNS64/NAT64	Not provided	IPv6 only + DNS64/NAT64	Dual-stack (private IPv4 + IPv6)
IPv6 type for data-only offers	IPv6 only + DNS64/NAT64	Not provided	IPv6 only + DNS64/NAT64	Dual-stack (private IPv4 + IPv6)
IPv6 firewall enabled per default	Yes	Not provided	Yes	Yes
IPv6 firewall: possibility to open the unsolicited inbound IPv6 flows via uPnP	No	Not provided	No	No
IPv6 firewall: possibility to open the unsolicited inbound IPv6 flows in the customer area	No	Not provided	No	No

Source: data as of the end of June 2020, collected by Arcep from operators.

4.2. Operators with between 5,000 and 3 million customers on mobile networks

MOBILE NETWORK:
PERCENTAGE OF IPv4-READY AND IPv4-ENABLED CUSTOMERS EVOLUTION

	Mid-2018		Mid-2019		Mid-2020		Mid-2021*	
	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled	IPv6-ready	IPv6-enabled
Coriolis Telecom	0%	0%	0%	0%	0%	0%	0%	0%
Digicel	0%	0%	0%	0%	0%	0%	0%	0%
Euro-Information Telecom**	0%	0%	0%	0%	0%	0%	0%	0%
LycaMobile	0%	0%	0%	0%	0%	0%	0%	0%
Orange Caraïbe	0%	0%	0%	0%	0%	0%	0%	0%
Orange Réunion Mayotte	0%	0%	0%	0%	0%	0%	0%	0%
SFR Caraïbe	0%	0%	0%	0%	0%	0%	0%	0%
SFR Réunion Mayotte	0%	0%	0%	0%	0%	0%	0%	0%
Transatel	0%	0%	0%	0%	0%	0%	0%	0%
Vectone Mobile	0%	0%	0%	0%	0%	0%	0%	0%
Zeop	N/A		100%	13%	100%	23%	100%	35-45%

* Figures subject to change
** Auchan Télécom, Cdiscount Mobile, CIC Mobile, Crédit Mutuel Mobile, NRJ Mobile

Source: data as of the end of June 2020, collected by Arcep from operators.

5. Hosting services, content providers and DNS infrastructure

PERCENTAGE OF IPv6-ENABLED WEBSITES, MAIL HOSTING AND DNS SERVERS

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

Hosting service		Websites				Mail hosting				DNS servers			
		2019		2020		2019		2020		2019		2020	
Name	AS number	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6
Entire .fr .re .pm .yt .tf .wf		3,085,312	15.5%	3,270,376	17.9%	2,682,380	5.8%	2,798,293	6%	3,229,309	73.1%	3,451,693	74.9%
OVHcloud	AS 16276	1,273,753	4.9%	1,301,146	6.7%	1,133,905	0.6%	1,160,632	0.5%	1,320,843	82.3%	1,356,847	84.2%
IONOS 1&1	AS 8560	384,922	75.6%	381,696	78.3%	400,827	0.2%	398,784	0.2%	419,960	98.7%	418,666	98.7%
Gandi	AS 29169	227,365	2.1%	247,153	2.2%	311,470	0.1%	326,103	0.1%	391,990	97.5%	394,830	97.6%
Scaleway	AS 12876	81,361	9.5%	81,214	10.3%	70,881	9.9%	72,209	10.6%	129,016	12.5%	113,896	15.2%
Google	AS 15169	45,420	3.8%	67,224	5.4%	62,743	95.8%	67,732	95.4%	44,079	34.5%	62,178	38.9%
Adista	AS 16347	53,755	1.8%	64,200	1.6%	47,512	2.4%	43,790	2.5%	55,600	95.8%	59,553	95.6%
Amazon AWS	AS 16509	66,710	3.5%	59,692	11.1%	14,776	0.1%	14,278	0.2%	63,469	62.8%	82,928	49.5%
o2switch	AS 50474	35,451	0.1%	56,546	0.1%	27,502	0%	33,056	0%	32,015	0%	41,589	0%
Register.it	AS 39729	51,449	0%	50,304	0%	60,159	0%	58,840	0%	72,283	0%	70,794	0%
Cloudflare	AS 13335	34,265	97.2%	46,450	98%	373	96.2%	1,021	5.3%	87,943	69.6%	89,231	69.9%
Shopify	AS 62679	25,163	1%	37,428	1.1%	90	0%	113	0%	16	0%	62	0%
NordNet	AS 8362	35,851	0%	36,745	0%	36,168	0%	20,705	0%	43,646	0%	40,950	0%
CSC Global	AS 19574	27,938	0%	27,671	0%	390	0%	384	0%	7	0%	7	0%
Infomaniak	AS 29222	19,627	24.1%	25,198	23.6%	12,705	98.5%	14,538	99%	24,266	99.6%	27,516	99.7%
Magic OnLine	AS 35393	25,585	0.1%	22,819	0.1%	31,682	0%	28,441	0%	24,170	27.6%	35,559	0.1%
PlanetHoster	AS 53589	17,879	0.1%	22,710	0.1%	13,513	0%	14,187	0%	19,427	0%	21,266	0%
Solocal PagesJaunes	AS 13034	39,714	0%	22,290	0%	21	0%	1	0%	19,873	0%	1,109	0%
Sedo GmbH	AS 47846	20,447	0%	21,684	0%	88	0%	203	0%	19,425	0%	19,622	0%
Free	AS 12322	20,156	64.3%	20,461	63.3%	8,450	61.1%	7,745	61.9%	29,307	95.8%	28,176	95.6%
WordPress.com	AS 2635	8,846	0.1%	15,537	0.1%	415	0.7%	500	1%	8,868	100%	9,752	100%
TransIP	AS 20857	13,028	57.3%	15,001	63.1%	636	28.1%	828	43.6%	19,299	96.7%	20,512	96.8%
Nameshield	AS 20756	12,759	0.7%	14,372	1%	14,776	0.2%	15,054	0.2%	33,075	52.8%	35,729	53.9%
Orange	AS 3215	11,266	1.8%	11,334	1.9%	43,511	0.1%	42,933	0.2%	29,551	73.9%	27,321	75.1%
One.com	AS 51468	11,845	86.4%	11,134	81%	12,222	0.1%	11,773	0.1%	12,710	100%	12,296	100%
Microsoft	AS 8075	7,115	0.7%	9,988	0.6%	55,187	0.1%	64,199	0.1%	6,207	90.1%	7,093	90.2%
SafeBrands	AS 34173	9,680	0%	9,416	0%	16,446	0%	16,862	0%	13,965	99.6%	13,800	99.6%
Ikoula	AS 21409	8,864	8.9%	9,037	12.8%	4,822	12.4%	4,609	16.2%	9,316	8.4%	9,674	7.7%
GoDaddy	AS 26496	26,484	0.1%	8,273	0.2%	11,818	0%	10,627	0%	29,969	5.6%	32,804	5.1%
alwaysdata	AS 60362	6,274	41.9%	7,837	35.8%	5,602	99.9%	6,359	99.8%	2	100%	1	100%
Jaguar Network	AS 30781	7,674	0.4%	7,722	0.4%	4,722	0.3%	4,498	0.2%	19,083	74.9%	17,873	79.5%
Strato	AS 6724	7,880	93.8%	7,644	93.4%	7,985	96.9%	7,692	97.2%	9,778	92.3%	9,079	95.8%
q.beyond	AS 15598	7,325	0%	7,591	0.1%	7,393	0%	7,739	0%	198	66.7%	195	68.7%
Team Internet AG	AS 61,969	8,760	0%	7,462	0%	48	0%	27	0 %	22	0%	19	0%
Hetzner Online	AS 24940	6,855	15.3%	7,260	15.9%	5,409	31.9%	5,656	18.3%	21,810	79.3%	23,177	82.5%
Eurafibre	AS 35625	6,281	0.1%	6,799	0.9%	14,694	29.9%	15,219	10%	3,478	0%	3,731	0%
Celeonet	AS 31178	6,038	0.1%	6,452	0%	3,448	0%	3,199	0%	4,436	0%	4,242	0%
Combell	AS 34762	4,957	0.4%	5,190	0.4%	5,213	1.2%	5,243	0.9%	6,797	47.4%	6,902	49%
Register.it UK	AS 203461	5,842	0.1%	5,068	0%	12	0%	12	0%	N/A	N/A	N/A	N/A
SFR	AS 15557	4,792	1.5%	4,849	1.3%	11,267	0.1%	10,706	0.1%	13,548	0.1%	13,239	0.1%
ASP Serveur	AS 34235	1,814	0.2%	4,796	0.1%	952	0%	2,609	0%	1,133	0%	2,826	0%
Datacenter.eu	AS 24611	4,868	0.1%	4,771	0.1%	3,975	0.5%	3,710	0.5%	159	0%	150	0%
Cogent	AS 174	4,328	2.7%	4,751	2.5%	4,832	8.4%	21,938	5.4%	6,227	24.6%	6,839	22.7%
Aptum Technologies	AS 13768	7,811	0.1%	4,657	0.5%	9,582	0%	5,730	0%	4,532	0%	3,803	0%
AlpineDC	AS 198385	4,380	0.2%	4,509	0.2%	4,076	0.1%	3,803	0.1%	6,168	0.1%	5,958	0.1%
PHPNET France	AS 42363	4,582	0.1%	4,340	0.1%	212	0%	174	0%	14,662	0%	2,017	0%
Weebly	AS 27647	4,964	0.6%	4,285	0.4%	26	0%	29	0%	3	0%	2	0%
Amazon AS14618	AS 14618	10,308	0.8%	4,188	1.8%	867	0.1%	863	0.1%	16,453	1.8%	13,574	1.9%
Ecritel	AS 8304	4,147	0.3%	4,144	0.1%	3,844	0%	3,247	0%	5,723	0%	5,125	0%
Google Cloud	AS 19527	32	0%	3,934	0.2%	2,391	0%	3,016	0%	N/A	N/A	388	0%
Host Europe	AS 20773	4,111	14.1%	3,553	16.9%	2,642	1.6%	2,498	1.5%	8,527	83.2%	7,144	95.5%
Squarespace	AS 53831	2,777	1.2%	3,469	1.2%	18	0%	20	0%	6	0%	8	0%

Hosting service		Websites				Mail hosting				DNS servers			
		2019		2020		2019		2020		2019		2020	
Name	AS number	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6	Number of domain names	Percentage of IPv6
Entire .fr .re .pm .yt .tf .wf		3,085,312	15.5%	3,270,376	17.9%	2,682,380	5.8%	2,798,293	6%	3,229,309	73.1%	3,451,693	74.9%
Aqua Ray	AS 41653	3,471	1.5%	3,383	2.2%	1,026	0%	1,030	0%	1,185	89.2%	1,128	89.1%
Hostnet	AS 197902	3,449	69.2%	3,358	67.6%	576	0.2%	545	0%	4,337	97.3%	4,126	97.9%
Planet Service	AS 61168	2,803	0.3%	3,351	0.2%	2,653	0%	2,884	0%	3,257	0%	3,491	0%
Gandi AS203476	AS 203476	2,851	45.5%	3,331	54.5%	527	4.2%	524	4.2%	1,005	9.2%	1,040	8.3%
XSALTO	AS 35667	2,930	0%	3,265	0%	1,022	0%	3,238	0%	3,440	0%	3,471	0%
Zayo France	AS 8218	3,710	0.4%	3,243	0.3%	3,303	0.1%	2,832	0.1%	6,177	0%	5,810	0.1%
Namecheap	AS 22612	3,144	0.1%	3,068	0.2%	3,818	0%	4,167	0%	282	0%	185	0%
Nfrance	AS 15826	3,713	0.2%	3,054	0.2%	3,536	5.1%	3,031	5.4%	3,530	98%	3,169	97.9%
Unyc opérateur télécom	AS 50702	3,028	67.6%	2,922	67%	3,384	95%	3,300	94.9%	3,896	99.8%	3,972	99.7%
Colt	AS 8220	3,396	0.1%	2,915	0.1%	2,994	0%	2,774	0%	3,366	0%	3,298	0%
Octopuce	AS 28855	2,478	5.2%	2,766	6.8%	1,785	82.7%	1,962	85.2%	2,107	91.6%	2,306	91.2%
Groupe Ozitem	AS 39444	2,599	0.1%	2,599	0%	3,202	0%	3,070	0%	2,999	0%	3,013	0%
Akamai DDoS Mitigation	AS 32787	2,294	0%	2,489	0%	11	0%	18	0 %	30	0%	23	0%
BDL SYSTEMES	AS 38926	2,619	0.1%	2,480	0.1%	2,014	0%	1,954	0%	3,391	0%	3,296	0%
DigitalOcean	AS 14061	2,385	6%	2,466	5.9%	356	0.8%	422	3.6%	10,577	21%	11,080	22.2%
Simply Transit	AS 29550	2,445	2.4%	2,443	2.1%	653	3.5%	556	4.3%	220	10%	807	3.7%
Webedia group	AS 35717	563	0%	2,430	0.1%	1	0%	5	0%	75	0%	82	0%
Fastly	AS 54113	1,513	4.6%	2,426	4%	14	7.1%	24	4.2%	5	0%	4	0%
Nexylan	AS 199758	2,066	0.4%	2,351	0.5%	603	0.2%	934	0%	2,087	0%	2,016	0%
NFOrce Internet Services	AS 43350	2,129	9.7%	2,220	17.4%	1,858	0.9%	1,658	1.9%	16,522	9.4%	17,396	9.1%
Oceanet Technology	AS 20926	2,390	0.4%	2,215	0.1%	1,121	0%	1,073	0%	19,468	0%	20,196	0%
Domeneshop	AS 12996	2,133	99.9%	2,099	99.7%	103	100%	99	100%	2,223	99.7%	2,324	99.7%
Mono Solutions	AS 201595	1,151	0.1%	2,066	0.2%	N/A	N/A	2	0%	874	0%	1,280	0%
Netrix	AS 62000	1,848	11.6%	2,060	20.4%	1,280	13.1%	952	17.6%	1,235	0.2%	1,069	0.3%
SFR Business	AS 12670	2,259	0.3%	2,037	0.3%	18,607	0%	17,283	0%	4,757	0%	2,407	0%
Hostpoint	AS 29097	1,474	71.2%	2,022	81.8%	1,310	0.3%	1,658	0.3%	1,343	99.9%	1,683	99.9%
Nerim	AS 13193	2,253	0.8%	2,020	0.6%	1,908	0.7%	1,591	0.7%	1,847	3.5%	1,697	3.5%
Linode	AS 63949	1,958	8.4%	1,970	11.5%	17,469	0.4%	19,513	0.4%	7,866	41.5%	7,923	37%
Master Internet	AS 24971	1,015	2.1%	1,932	1.5%	82	13.4%	69	17.4%	168	48.2%	2,190	5%
CSC Domains Provider	AS 34922	2,104	0%	1,905	0%	9,744	0%	9,106	0%	N/A	N/A	N/A	N/A
Domaine-Achat	AS 49328	3,321	0.4%	1,843	0.5%	1,403	0%	1,283	0%	2,086	0%	1,892	0%
Renater	AS 2200	1,813	2.9%	1,834	3%	1,733	30.9%	1,728	34%	3,144	42.7%	3,182	42.9%
BODIS Smart Domain	AS 395082	1,444	1.5%	1,820	1%	23	0%	29	0%	1,047	0%	1,165	0%
C'PRO	AS 197033	1,750	0%	1,810	0%	1,022	0%	909	0%	1,895	0%	1,838	0%
CYSO	AS 25151	1,718	5.6%	1,740	7.2%	1,749	0%	1,676	1.7%	2,212	5.9%	2,170	5.6%
Bouygues Telecom	AS 5410	1,583	2.1%	1,717	1.7%	2,147	0.1%	2,080	0.4%	3,772	0.5%	3,713	0.5%
SdV	AS 8839	1,546	11.6%	1,715	14.5%	1,480	0.5%	1,549	0.5%	1,423	99.9%	1,638	93.3%
Eolas	AS 15401	1,700	0.8%	1,713	0.5%	1,508	0%	1,504	0%	1,672	0%	1,702	0%
LeaseWeb	AS 60781	2,199	7.6%	1,701	11.8%	1,844	48.3%	1,055	13.6%	12,034	70.8%	11,629	68.7%
Claranet	AS 8426	1,898	1.4%	1,577	0.8%	1,014	0.8%	605	1.3%	1,993	14.9%	1,371	20.9%
:yulPa	AS 199712	1,593	0%	1,557	0%	1,706	0%	1,705	0%	1,685	0%	1,673	0%
Mijndomein Hosting	AS 59980	1,484	99.5%	1,537	99.5%	2	100%	3	100%	1,776	99.9%	1,804	100%
Safenames	AS 60819	1,449	2.3%	1,537	0.9%	1,103	0%	1,042	0%	2,587	5.6%	1,582	98.3%
eHealth Ontario	AS 61236	1,773	0%	1,521	0%	1,835	0%	1,667	0%	2,219	0%	1,984	0%
Hostinger	AS 47583	1,994	0.6%	1,493	0.5%	2,166	94.6%	2,227	97.7%	3,219	14%	3,148	11.6%
Imperva	AS 19551	1,292	0.4%	1,426	0.2%	3	0%	4	0%	N/A	N/A	1	0%
CyrusOne	AS 20013	1,205	2%	1,384	0.5%	868	0%	849	0%	1,007	0%	1,005	0%
Groupe ACESI	AS 61136	1,490	0.3%	1,376	0.4%	607	0%	623	0%	555	0%	602	0%
Sewan	AS 8399	1,289	0.1%	1,366	0.2%	9,969	0%	10,236	0%	807	0%	823	2.3%

Source: Afnic data, August 2020.