OPERATORS' BEHAVIOR IN RELATION TO IPV6 DEPLOYMENT IN LATIN AMERICA AND THE CARIBBEAN

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Operators' Behavior in Relation to IPv6 Deployment in Latin America and the Caribbean

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Summary

Operators' Behavior in Relation to IPv6 Deployment in Latin America and the Caribbean[1] discloses the main aspects of how internet operators in the LAC region behave in relation to IPv6 deployment.[2] To do so, the study explores the incentives and benefits of operators who have opted to deploy IPv6, their opinions about the process, as well as the obstacles and enabling factors they have encountered. It also examines the reasons, barriers, and plans of those operators who have not deployed IPv6 to supply internet addresses in the short and medium term.

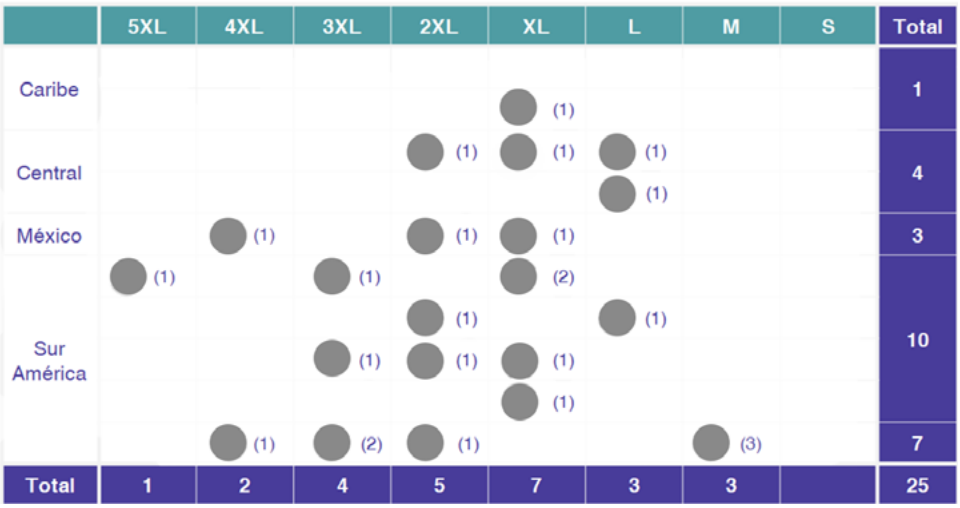
At the methodological level—and specifically when defining our sample— different segmentation options were evaluated that would allow us to perform the intended analysis and attain the goals of the study. The decision was made to analyze the behavior of operators selected based on their size. A total of 25 interviews[3] were conducted with the largest Internet Service Providers (ISPs) (category L or above).

The initial survey considered the technologies they used (mobile networks, fiber, cable, etc.) and the market segments served by the various operators (residential and corporate customers, and the use of the Internet Protocol (IP). The analysis also included smaller operators in Brazil as a specific case of interest. The study also considered information obtained from interviews with multinational companies providing services over the Internet and with Internet service providers. The goal of the latter was to complement the qualitative survey and include the point of view of other key actors.

The figures below show the interviews and their characteristics.

The information of the different figures is presented in the study's original language

Figure 1. Interviews conducted by operator size and region[4]



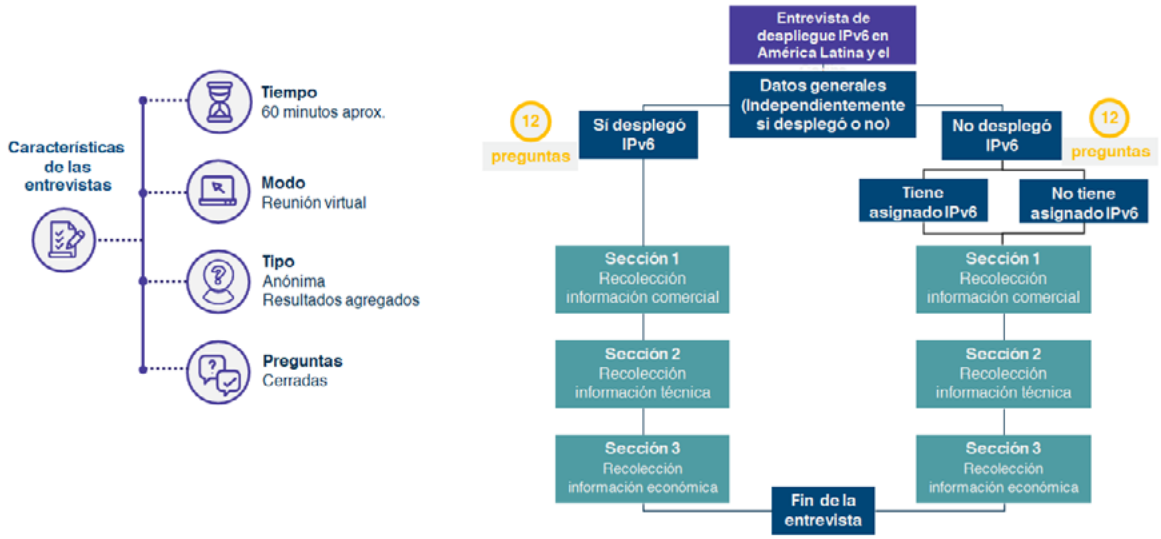
1 Within the context of this study, the term "operators" refers to Internet Service Providers (ISPs) that are members of LACNIC.

2 Out of the total number of operators who were interviewed, only two had not yet deployed IPv6.

3 Once the sample had been defined, LACNIC sent an introduction letter to 60 selected operators. SMC+ was then responsible for following up on these contacts and conducting the interviews. LACNIC management participated in most of the interviews. In general, the interviews were not conducted with the initial contact proposed by LACNIC, but with the network administrator of each company or with person suggested by the initial contact.

4 The selection of the sample was conducted considering the country, region and size of the operators.

Figure 2. Characteristics of the interviews.



Together with market reports and other publicly available information, the information provided by the operators allowed us to conduct additional research to complement the trends that were initially identified. IPv6 deployment was analyzed based on a matrix that considers each operator's potential for business growth and IPv4 address availability.

Thus, the study surveys the most prominent trends in operators' behavior and identifies the influence of technological renewal and support, two of the factors that affect IPv6 deployment. In turn, each organization has specific characteristics related to their internal networks and end-user devices, and there are also considerations related to the support provided by infrastructure providers and other vendors. Among other elements, this section includes considerations on the differences between the deployments of fixed and mobile networks and content generators.

The report also addresses the main catalysts for IPv6 deployment—specifically, the advent of 5G technologies and the Internet of Things (IoT)—as well as the growth of the gaming sector and the role gamers play. Finally, the report concludes with some considerations on IPv6 deployment, operators' business growth potential, and IPv4 address availability. This section also incorporates the aspects surveyed among operators who have not implemented IPv6.

Trends identified in operators' behavior

The trends identified by the study have been divided into two groups: on the one hand, those related to infrastructure and technology upgrades; on the other, those related to support requirements. In fact, a significant portion of IPv6 deployment costs is incurred as part of the technological renewal process and is therefore not assigned to any *ad hoc* IPv6 deployment project. The following is a list of the technological renewal processes we identified, and which would include IPv6 deployment costs:

- Backbone infrastructure
- Customer Premises Equipment (CPE): IPv6 ready
- Operation Support System (OSS): updated in all cases
- Business Support System (BSS): absorbed as part of IT costs or developed in-house
- Training built into infrastructure packages

As IPv6 is deployed organically due to technology upgrades or other reasons, companies do not identify a clear business case *a priori* and the strategic decision to deploy IPv6 does not reach the organization's CEO or CFO. In turn, technical departments generally perceive that a business case associated with IPv6 would not withstand an economic analysis, as technology is upgraded anyway and there are no significant cost differences between the two options.

Technology upgrade

The study identified that the organic **technology upgrade** by ISPs results in IPv6 deployment without any significant incremental costs. As for infrastructure, it should be noted that organic equipment renewal already incorporates IPv6 into the base technology, thus making deployment even more gradual. Also, there are currently no devices (backbone, transport, aggregation) that do not support IPv6. Indeed, a high percentage of operators' CPEs are IPv6-compatible, as they have been replaced organically. However, even when the network supports IPv6 because of the technological changes introduced when equipment/devices were replaced, IPv6 traffic continues to be low. During the technology upgrade process, operators also upgraded their OSS and BSS. Given that the cost of the upgrade is absorbed as part of the natural investment in IT, a large number of operators do not identify or relate the cost assigned to OSS or BSS development or adaptation with IPv6. Included below are some of the elements related to the technology upgrade factor.

Internal network

Initially, systems were detected at the company level that did not support IPv6. Even today, having IPv6-compatible systems is not a priority for a large part of the operators.

End-user devices

This is one of the main limitations to IPv6 adoption, even when IPv6 has already been deployed. Many end-user devices are still not compatible with IPv6 (surveillance cameras, mobile devices, game consoles, smart TVs, computers; typically, any device that is not replaced or does not require frequent software upgrades). As an example, in the case of Mexico, there is a high correlation between socioeconomic sector and low-end devices. Operators have not surveyed—nor do they have detailed knowledge of— end-user devices with the greatest limitations.

Support

Support is an important factor for a successful IPv6 deployment. Findings include the support offered by infrastructure providers and other vendors, as well as the support that ISPs must provide to their own customers.

Infrastructure providers

Initially, support quality appears to have been inadequate or poor. Over time, this has changed, and operators have relied on the technical support of their providers (mostly larger operators, including training for implementation as part of their infrastructure acquisition agreements). Currently, providers have personnel that are trained to solve issues related to deployment, both during the implementation (initial) stages as well as during router and equipment configuration in the various phases.

Applications and device vendors (e.g., CPE or mobile devices)

Among other things, software or hardware changes are required to use IPv6. When IPv6 deployment began, IPv6 connectivity was not promoted by vendors and, even today, some do not offer IPv6 support and instead prefer to support IPv4 only. Based on the interviews we conducted, a major Colombian mobile communications operator mentioned that IPv6 mobile phone adoption is “very elusive,” that it is highly dependent on each vendor, and that many end-user devices do not support IPv6. Specifically in Central America, one of the operators we interviewed mentioned that vendors only offer IPv4 solutions; however, they did not specify whether this referred to them directly or if it was their representatives in each country the ones who were offering IPv4 devices for business reasons.

Customer service

IPv6 deployment does not appear to increase demand for customer support or generate additional calls to operators’ call centers. This appears to relate to the fact that, end customers are generally not aware of the existence or use of one protocol or the other, but instead tend to complain about lower quality of service. A global analysis shows that customers do not acquire IPv6 services directly, but a landline, mobile, or internet service.

Likewise, because users are generally unaware of the difference between IPv4 and IPv6, specific questions on the subject are very limited. When they do occur, they are mostly from niche groups with specific knowledge of technology, for example, from gamers. According to the survey, remote guidance is often not possible, as it is extremely difficult for users to follow the instructions. This, in turn, might lead to customer dissatisfaction with the ISP (even when the problem may be attributable to the content generator or to their own devices). On the other hand, it should be noted that the technical staff of the companies considered in the study acquired specific know-how as part of their general training.

Differences in deployment in fixed and mobile networks

Progress in **fixed networks** has been slower, as they must replace their CPEs with others that are compatible with both protocols and also with end-user devices. This implies other requirements in addition to deployment in the backbone infrastructure. CPEs are replaced once they are obsolescent or when there is a change in technology, such as, for example, when the copper network was replaced by fiber. So much so that every new infrastructure and CPE deployment supports IPv6. For these reasons, restrictions are mostly observed in legacy copper networks and relate to the fixed network.

Mobile networks have been deployed considering the use of NAT (Network Address Translation) and mostly without double stack technology. As for terminals, mobile devices are replaced faster than that CPEs or other devices for home use, as their cost is absorbed by the customer and their replacement frequency is significantly higher.[5]

5 There are several reasons why mobile devices are replaced more frequently than others, including the speed of technological progress, the speed with which new devices with new functionalities are launched, the higher risk and high break rate, technical defects, and robberies.

Main catalysts for IPv6 deployment

The data we collected allowed us to identify potential catalysts for mass IPv6 deployment, including: 1) the advent of technologies such as 5G and IoT; 2) the growing number of gamers and their demands based on technical knowledge.

In the first case, an annual growth of 12% is estimated for IoT devices in Latin America and the Caribbean (LAC) (GSMA, 2020), which could further contribute to accelerating IPv6 deployment. However, in developing markets, IoT adoption is related to affordability and high total cost of ownership. The main challenges for its growth include security risks, data privacy and protection, and integration costs (Zhou, Cao, Dong, Vasilakos, 2017). Transportation and mobility, industry, smart cities and public infrastructure services, as well as agribusiness and mining are the most mature segments (Nižetić, Šolić, López de Ipiña González de Artaza, Patrono, 2020), all of them key potential areas given their economic relevance in LAC.

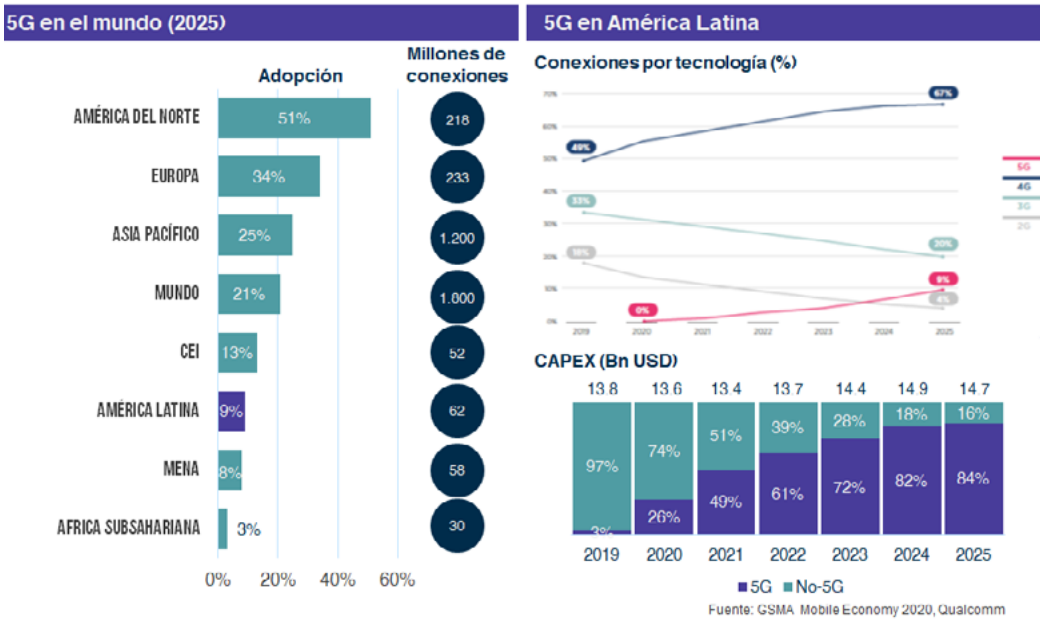
Figure 3. Evolution of IoT devices in LAC

* TACC: tasa anual de crecimiento compuesto
Fuente: elaboración propia en base a estimaciones de GSMA

Use cases that may grow as 5G technology is deployed include telemedicine, smart cities, edge computing connectivity, artificial intelligence, and virtual and augmented reality (GSMA, 2020). Tenders for allocation of spectrum for 5G services would be essential to start the commercial deployment of this technology. Latin America and the Caribbean is somewhat lagging in this area compared to other regions, so it is to be expected that deployments will occur later than in other markets that have already started this process. According to GSMA projections,[6] 5G adoption in Latin America will be 9% in 2025, the equivalent of approximately 62 million connections (GSMA, 2020, 9).

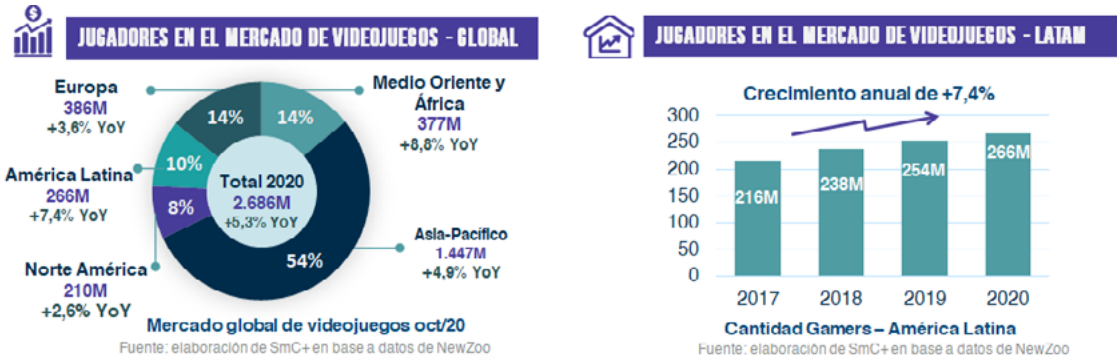
6 The higher replacement frequency of mobile devices compared to others is due to different reasons, including the speed of technological advances, the speed with which new devices with new functionalities are launched, the higher risk and rate with which they suffer damages and technical faults, as well as robberies.

Figure 4. 5G adoption worldwide and in Latin America



Another driver of IPv6 adoption is the growth of the gaming community. After the Middle East and Africa, Latin America is the region with the highest growth in this sector.

Figure 5. Gaming: players in the global and the Latam gaming markets



The rise of online gaming is creating a demand for lower latency network connections so that gamers can enjoy their experience without any lag or interruptions.[7] It should be noted that the most popular game consoles (Xbox One and Series X, PS5, Nintendo) have already incorporated IPv6 compatibility.

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7 Latency is a connection's reaction time and, as such, represents a key metric for video games. For the best possible experience, latency should be less than 59 ms; for a user to remain in the game, it should be between 60 and 129 ms. If latency exceeds 130 ms, online gaming is no longer enjoyable.

Most popular game consoles and IPv6

- **Xbox One and Series X:** These consoles have native IPv6 support. Enabling IPv6 is recommended for a better user experience.
- **App Store:** As from June 2016, any application (including games) sent to the App Store must have been tested on IPv6-only networks.
- **Nintendo:** The console is compatible with IPv6; however, its software or firmware is not.
- **PlayStation:** PS4 does not have native IPv6 support and works only with IPv4. PS5 is compatible with IPv6. However, the new protocol has not yet been enabled in all PlayStation Network (PSN)[8] servers.

8 PSN: PlayStation Network

IPv6 deployment analysis

IPv6 deployment by operators in Latin America and the Caribbean was analyzed based on a matrix that considers their potential for business growth and their IPv4 address availability. According to information provided by the operators themselves during our interviews, the characteristics of each member, such as their availability of IPv4 addresses and their prospects for business growth, affect IPv6 deployment. The size of each operator would seem to have no impact.

Based on the analysis of the two variables, operators were segmented into the following quadrants:

1. **Aggressive deployment:** Operators who expect significant growth and who do not have enough or have already run out of IPv4 addresses.

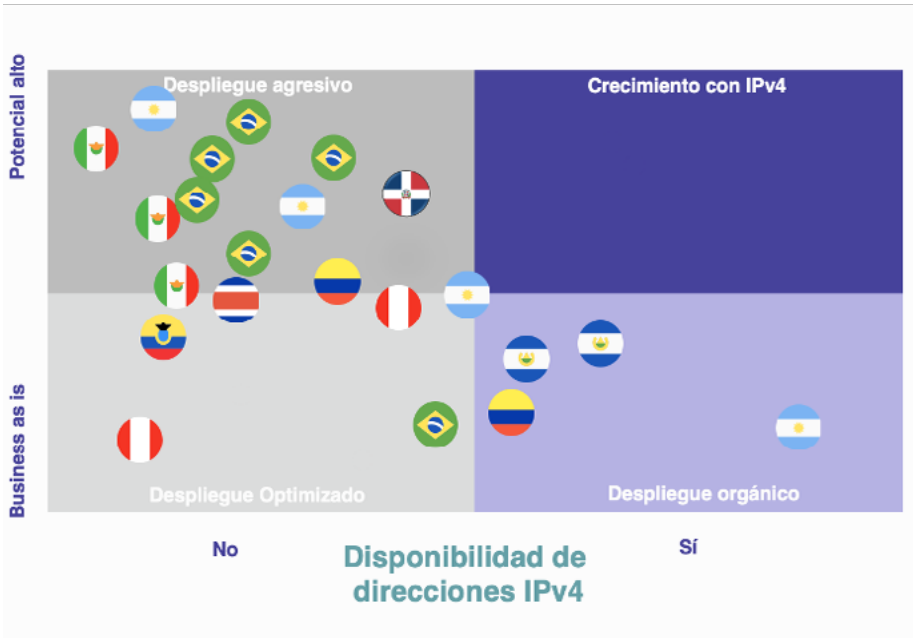
2. **Growth with IPv4:** Operators who expect significant growth of their customer base and who have the IPv4 addresses needed to supply them.

3. **Optimized deployment:** Operators who expect little growth and who will optimize the use of their IPv4 addresses in the event of their potential future exhaustion.

4. **Organic deployment:** Operators who are growing organically and who update their equipment (IPv6 compatible) when a technology becomes obsolete and is replaced by another, even if they do have IPv4 addresses.

The position of each of the operators interviewed for this study is illustrated in the matrix in the figure below.

Figure 6. Analysis of IPv6 deployment based on operators' growth potential and IPv4 address availability



Based on the interviews that were conducted and the situation of each of operator, the enabling factors for each of the quadrants are identified below.

Aggressive deployment

In the case of the operators in the **Aggressive deployment** quadrant, the following factors enable mass IPv6 deployment:

- **Scarcity of IPv4 addresses:** The operators we interviewed were very decisive about the scarcity of IP addresses being an enabling factor: "Because IPv4 was imminent, a solution was needed before reaching that point." One of the operators interviewed mentioned having increased their CGNAT (Carrier Grade NAT) capacity, but, in any case, stated that they need more address blocks of their own to assign.

- **Specific customer requirements:** In some cases, deployment was accelerated because operators received specific requirements for the provision of IPv6 from customers in various sectors, particularly the government sector and, to a lesser extent, corporate customers, and universities.

- **Organic technological renewal:** For those who began their activities working exclusively with IPv6 addresses, the technological renewal has allowed them to complete a gradual deployment process and to continue to operate in a context of significant customer and operator growth. Additionally, in most cases, the renewal allows IPv6 support. According to the survey, CGNAT capacity has increased, but the simultaneity of sessions creates restrictions and switching causes performance to drop. As a result, in some of the cases we analyzed, IPv6 deployment had to be accelerated.

- **Growing need for IP addresses**: Forecasts regarding the growing need for IP addresses are associated not only with business growth, but also with a greater demand for IoT, 5G, and specific applications. However, for this type of operators, the possibility of acquiring IPv4 blocks in the secondary market and the optimization of the use of IPv4 addresses have slowed down IPv6 deployment. Despite this, blocks can only be leased in the case of smaller customers, not for large companies, to which they must assign their own IP addresses.

On the other hand, in practice, adoption by corporate clients who require IPv6 is lower than expected and applications that do not support IPv6 are common (for example, banks that develop their systems and applications in-house). Additionally, the fact that IPv6 traffic still represents a small part of all traffic is delaying adoption, just as network equipment or end-user terminals and devices, which are not fully IPv6-compliant.

In this case, IPv6 is handled through dual stack technology and IPv4 with CGNAT to ensure compatibility. One aspect of the migration process worth noting is that, according to the operators, the coexistence of IPv4 and IPv6 increases operational complexity and automation requirements. As an example, some operators report that customers are not registered as dual stack by default. The latter

requires manual configuration or automating the process. Nevertheless, operators see the benefit of deploying IPv6, as it avoids or reduces the need for NAT devices (routing from Local Area Network [LAN] to Wide Area Network [WAN]). This means that the process requires one less device, thus avoiding additional delays.

Optimized deployment

In the case of the operators in the **Optimized deployment** quadrant, it is possible to identify actions they have taken to advance in their deployment. According to the survey, there are two main reasons why these actions have not been implemented in an accelerated manner: 1) Unlike those in the previous quadrant, these operators do not expect their business to grow. While mass IoT and 5G deployment would accelerate the deployment of IPv6, they believe they are still lagging. 2) They do not have the IPv4 addresses they need.

Operators in this category generally offer IPv6, but customers may not require this protocol, or perhaps their devices do not support the protocol.

Specific actions to optimize the use of available IPv4 addresses

According to the analysis, some operators have optimized the use of available IPv4 addresses by implementing the following actions:

- Recovering addresses by scanning the network to identify any blocks that are not in use.
- Providing their service using a public IP address and maintaining CGNAT for other customers.
- This action is used when CGNAT creates issues for certain applications.

- Organic deployment of IPv6 by purchasing IPv6-ready equipment. This is done when the equipment needs to be replaced after reaching obsolescence and with OSS /BSS support included as part of the infrastructure acquisition agreement.

Organic deployment

In the case of the operators in the **Organic deployment** quadrant, IPv6 is deployed in the backbone due to the need for a technological upgrade of the equipment. However, the high availability of IPv4 addresses means that there is no need for the deployment. The requirements of specific customers, such as oil companies, banks, universities, or the Government, slightly accelerate the IPv6 deployment process. In general, specific requests are received from large companies, not from smaller customers. This is to be expected, to a large extent, as a result of these customers' own technological upgrades.

The availability of IPv4 addresses and the expectation of little or no growth in their customer base mean that the operators in this quadrant do not see a clear business case for accelerating IPv6 deployment. This situation is accentuated by the customers' lack of a specific demand for IPv6. Operators in this quadrant perceive a risk associated with accelerated deployment. In particular, there

is great dispersion in the capacity and the age of the equipment, and the main limitations that are observed have to do with the copper network, which makes the process even slower.

Indeed, incumbents owned a lot of old equipment and have had to work with CPE vendors to find the right version of firmware. Given the existence of multiple CPE providers, the transition has demanded a great deal of coordination. While no specific investments in IPv6-compatible CPE are being made, these are being deployed as part of other projects, thus favoring an organic transition to IPv6.

In addition, the complexity of managing and administering two protocols (IPv4 and IPv6) when using dual stack decelerates mass deployment. Indeed, in dual-stack networks (fixed and mobile) a new customer profile must be defined and configured so that it does not use IPv4 by default. This requires a system that automates client configuration. In terms of access, some limitations have been identified in the deployment, mainly when applying functionalities related to multicast that generated restrictions in IPv6 configuration. In any case, operators have solved these difficulties with new versions or software updates.

Growth with IPv4

In the case of the operators in the **Growth with IPv4** category, their expected increase in the number of IP addresses is considered, not only as a result of business growth, but also due to the deployment of IoT, 5G, and applications. At the same time, when one technology is replaced by another, a gradual upgrade towards IPv6-compatible devices tales place and this favors IPv6 deployment. However, the availability of IPv4 addresses to cover the expected growth, the efficient use of these addresses, or the purchase of addresses in the secondary market are delaying the process. In this sense, a more efficient use of IPv4 is taking place as IPv6 is deployed due to the change in technology. On the other hand, the fact that few customers perceive the need for IPv6 limits the possibility of requiring this protocol. None of the operators interviewed for this study were found to be in this quadrant.

Operators who have not deployed IPv6

Finally, this study covers operators who have not deployed IPv6. The purpose of this is to incorporate qualitative information into the analysis regarding the reasons why they have not attempted to include IPv6 in their business. The main considerations are detailed below.

These operators do not perceive a specific requirement or need for IPv6 from their customers. They even stress the request to have IPv4 on a mandatory basis, to provide access to the internet and infrastructure, without requiring or mentioning IPv6.

Other cases worth noting

Chile

To analyze the case of Chile, certain peculiarities must be considered. On the one hand, the country is at the forefront in the adoption of technologies and the deployment of digital infrastructure (ECLAC, 2021). On the other, IPv6 adoption levels are very low (less than 1.0%). One possible reason for this may be market characteristics such as a high concentration of traffic. This analysis of the operators' behavior did not include interviews with operators in Chile; however, it did include an interview with an Internet Exchange Point (IXP) for the purpose of understanding different perceptions on the behavior of the Chilean market. Results show that the low level of IPv6 adoption is the result of a market with high concentration of traffic (approximately 80% of connections).

The reasons for not deploying IPv6 could be related to the lack of expectation of significant growth in the customer base, as well as the protocol's non-mandatory nature from a regulatory point of view. Combined with the availability of IPv4 addresses for these operators and the lack of market demand, these reasons have led to a practically inexistent IPv6 deployment.

Small-scale operators: The case of Brazil

Small-scale operators in Brazil mostly fit the **aggressive deployment** profile—small organizations with high levels of expected growth and low availability of IPv4 addresses.

These operators usually provide services in a specific region or city and are not national in scope, so they have considered IPv6 deployment as a business opportunity or a long-term economic solution. In addition, in some cases, their position has improved with respect to that of their competitors.

Small-scale operators in Brazil apply a dynamic solution to optimize the availability of IPv4 and IPv6 by analyzing customer requirements. Some have started IoT testing, for example, using Google Home and Amazon/Alexa, to ensure quality and compatibility with end-user devices.

Final Thoughts

The purpose of the study on the behavior of operators in Latin America and the Caribbean was to briefly present the main trends related to IPv6, including organizations that have opted to deploy the protocol, as well as others that have not. The study identified trends in the reasons for IPv6 deployment: some cases have to do with infrastructure and technology upgrades, others are related to support requirements. It should be noted that part of the costs of IPv6 deployment is covered by the technological renewal process and that there are differences between deployment in fixed and mobile networks as well as different implications in each area.

The analysis considers two variables: the potential business growth and the availability of IPv4 addresses of each operator. It classifies operators based on their position in the matrix. Finally, the study highlights the considerations raised by operators regarding emerging technologies such as 5G and IoT, the growth of the gaming sector, and the role of gamers in IPv6 deployment.

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