3. Market developments

This chapter discusses market developments in the telecommunication and broadcasting sectors in Brazil. It examines telecommunication revenue and investment, as well as the availability and quality of communication access paths. After assessing the availability and quality of communication services, it looks at affordability and usage. The last part of the chapter explores essential inputs to communication infrastructures such as backhaul and backbone connectivity, autonomous systems, Internet exchange points, submarine fibre cable, data centres and spectrum availability. The chapter ends with an overview of competition-related concerns, and recent trends in the broadcasting sector and pay TV.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

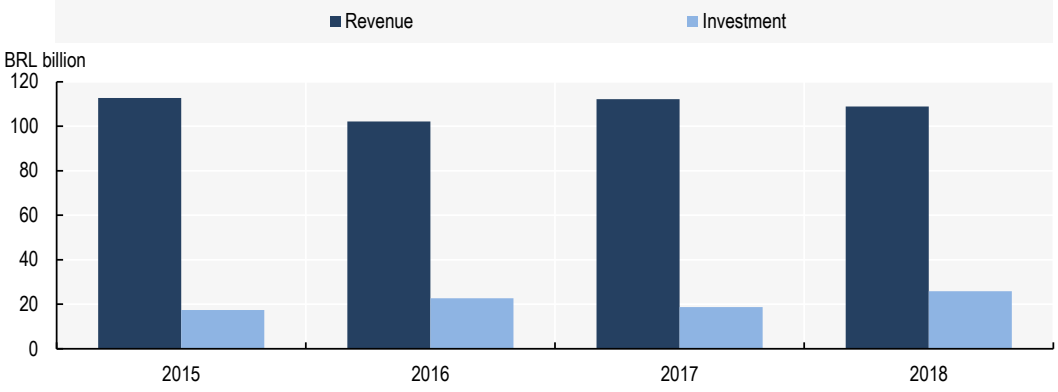
Developments in the communication sector in Brazil

This chapter examines trends and structural features of the communication market in Brazil. The first section provides an overview of investment and revenues in the communication sector, indicators of the evolution of fixed and mobile broadband markets, and developments in machine-to-machine (M2M) subscriptions. The remainder discusses key communication market developments and market structures.

Telecommunication revenue and investment

Revenues and investment in the Brazilian telecommunication market have remained relatively stable since 2015. By 2018, total revenue and investment in the telecommunication sector in Brazil amounted to BRL 108.8 billion (USD 30 billion) and BRL 25.8 billion (USD 7 billion), respectively (Figure 3.1).[1]

Figure 3.1. Total telecommunication revenue and investment in Brazil (2015-18)



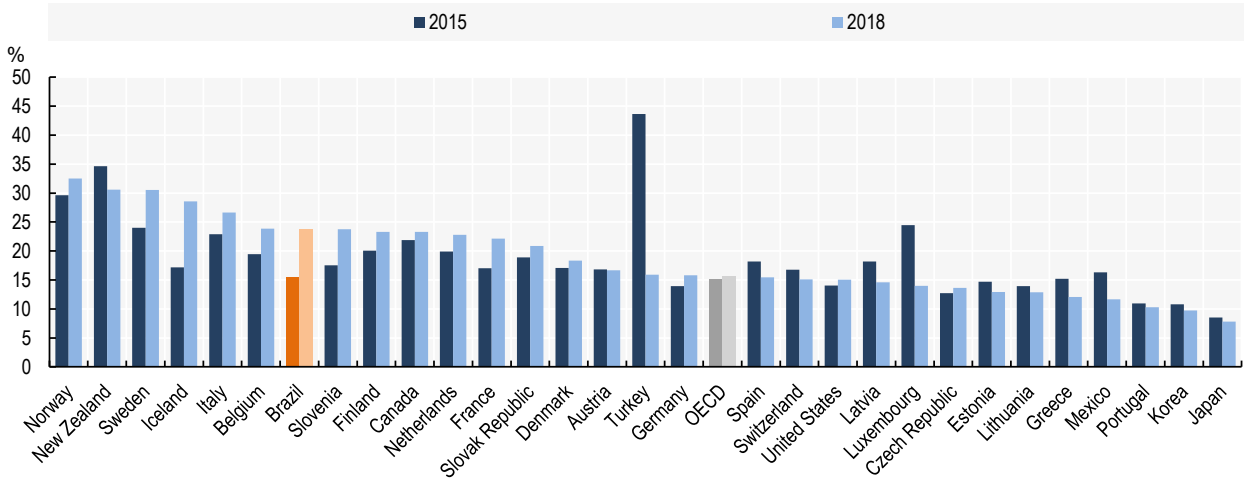
Source: Anatel's response to the questionnaire of the review.

From 2015 to 2018, the growth of telecommunication revenues in Brazil was negative (-3.4%). Conversely, investment grew by 49% (equivalent to an annual compound growth rate of 14%). In the meantime, Brazil's gross domestic product contracted by 1.2% (in constant Brazilian reais) during the same period (The World Bank, 2020[1]). This trend compares to OECD-wide industry growth rates of revenue and investment of 3% and 1.8%, respectively, for 2015-18. The percentage of investment as a proportion of revenues in Brazil in 2018 was around 23.8%. This compares to 15.7% in the OECD area for the same year (Figure 3.2).

Most investment (76%) in the telecommunication sector in Brazil targeted wireless infrastructure in 2017 (i.e. mobile networks and other wireless infrastructure). Only 24% was used for fixed infrastructure deployment. In light of the increased convergence of fixed and mobile networks, and with the advent of 5G, Brazil will need to foster investments in fixed networks to bring fibre closer to customers, irrespective of whether their "last mile" access is fixed or mobile.

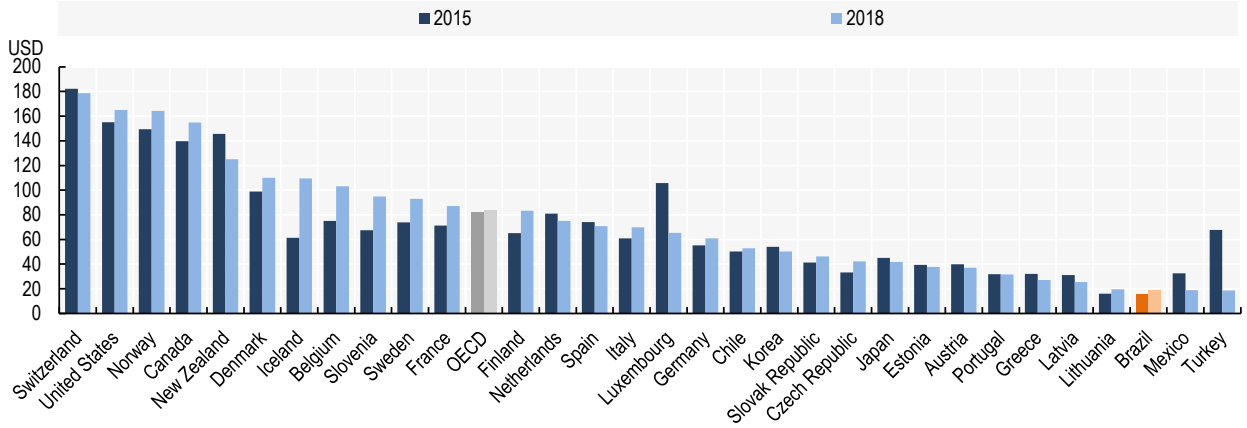
In 2015, telecommunication investment per access path in Brazil was around USD 16, which was lower than the OECD average of around USD 82. This number rose slightly to USD 19.2 by the end of 2018, still below the 2018 OECD average of USD 84. It was well below that of Switzerland, which was the leading OECD country with USD 179 per access path at the end of 2018 (Figure 3.3).

Figure 3.2. Telecommunication investment as a percentage of revenue in OECD countries and in Brazil (2015 and 2018)



Note: Data for Japan are for 2017 instead of 2018.
Sources: OECD (2019[2]), *OECD Telecommunication and Internet Statistics* (database), http://dx.doi.org/10.1787/tel_int-data-en (accessed on 16 March 2020); for data from Brazil, Anatel's response to the questionnaire of the review.

Figure 3.3. Telecommunication investment per access path in OECD countries and in Brazil (2015 and 2018)



Source: OECD (2019[2]), *OECD Telecommunication and Internet Statistics* (database), http://dx.doi.org/10.1787/tel_int-data-en (accessed on 16 March 2020).

These figures may be a lower bound of the actual investment and revenues in the Brazilian telecommunication sector given the surge of regional small Internet service providers (ISPs). There is substantial lack of reporting of small ISPs. As they lack reporting obligations (e.g. on investments and revenues), small ISPs are only partially accounted for in the statistics of the National Telecommunications Agency (Agência Nacional de Telecomunicações, Anatel).

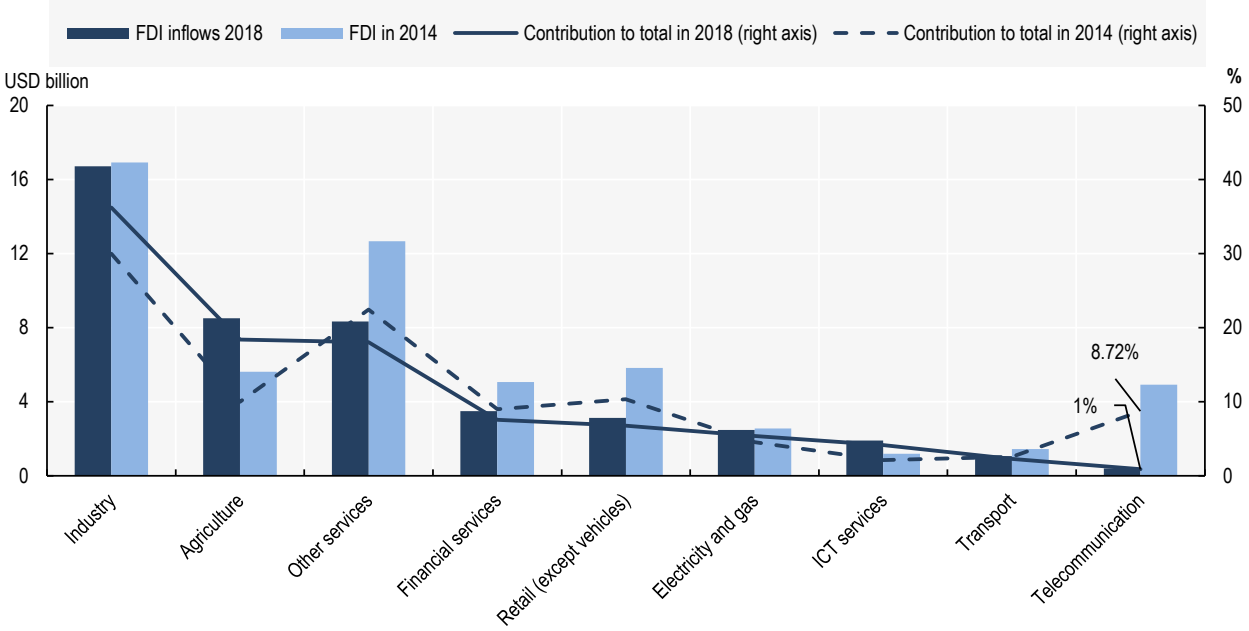
Some estimate that regional ISPs have been responsible for most of the increase in fibre-to-the-home (FTTH) subscriptions in recent years. According to Anatel, small ISPs accounted for 20% of fixed broadband subscriptions in 2019 (Anatel, 2020[3]). In addition, the ICT Providers Survey by CETIC.br/NIC.br provides evidence on the number of small ISPs in Brazil. The survey estimated that Brazil had 6 618 ISPs in 2017, of which 75% were small ISPs with fewer than 1 000 subscriptions (CGI.br, 2019[4]).

In Brazil, total foreign direct investment (FDI) inflows in the telecommunication sector amounted to USD 4.9 billion in 2014 (representing 8.72% of total FDI that year). FDI decreased to USD 404 million in 2018, which was 1% of total FDI that year (Figure 3.4). The two main countries that invested in the Brazilian telecommunication sector in 2018 were the United States (USD 322 million) and the Netherlands (USD 50 million) (Banco Central do Brasil, 2019[5]).

More FDI reflects greater confidence in the governance of the market. As well, it enhances an important channel to foster competition and increase investment in telecommunication networks. FDI also decreased in other sectors of the economy (with the exception of agriculture) from 2014 to 2018, due to the cyclical nature of these investments (Figure 3.5). However, the decrease in the telecommunication sector as a share of total FDI investments seems more pronounced (Figure 3.4). This decrease could reflect movements in mergers and acquisitions. It may also be responding to the nature of FDI, which is sensitive to volatility in the economic cycle of the country. For instance, the period in question contains a peak in investments in the 2014-15 biennium due to preparations related to the World Cup and the Olympic Games. This may partially explain the decrease in FDI.

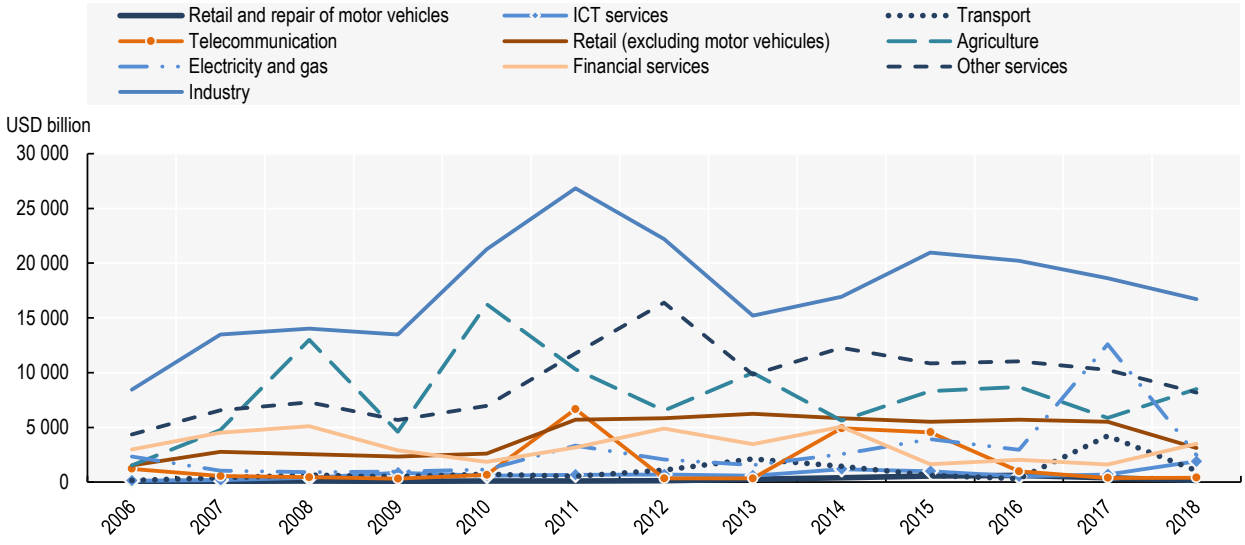
The high level and complexity of taxation in the communication sector in Brazil may influence investment levels, both domestic and foreign. These factors place a higher burden on a sector with many positive spillovers throughout the economy, relative to other sectors without these levies. High taxes in Brazil may be hampering levels of adoption, innovation and investment in the communication sector (Chapter 7).

Figure 3.4. Foreign direct investment in Brazil, by sector (2014 and 2018)



Note: FDI = foreign direct investment; ICT = information and communication technology.
Source: Banco Central do Brasil (2019[6]), *Série histórica dos fluxos de investimento direto – distribuições por país ou por setor* (database), www.bcb.gov.br/acessoinformacao/legado?url=https:%2F%2Fwww.bcb.gov.br%2Fhtms%2Finfecon%2Fserieshistfluxoinvdir.asp (accessed on 22 October 2019).

Figure 3.5. Evolution of foreign direct investment in Brazil, by sector (2006-18)



Note: ICT = information and communication technology.
Source: Banco Central do Brasil (2019[6]), *Série histórica dos fluxos de investimento direto – distribuições por país ou por setor* (database), www.bcb.gov.br/acessoinformacao/legado?url=https:%2F%2Fwww.bcb.gov.br%2Fhtms%2Finfecon%2Fserieshistfluxoinvdir.asp (accessed on 22 October 2019).

Trends in communication access paths

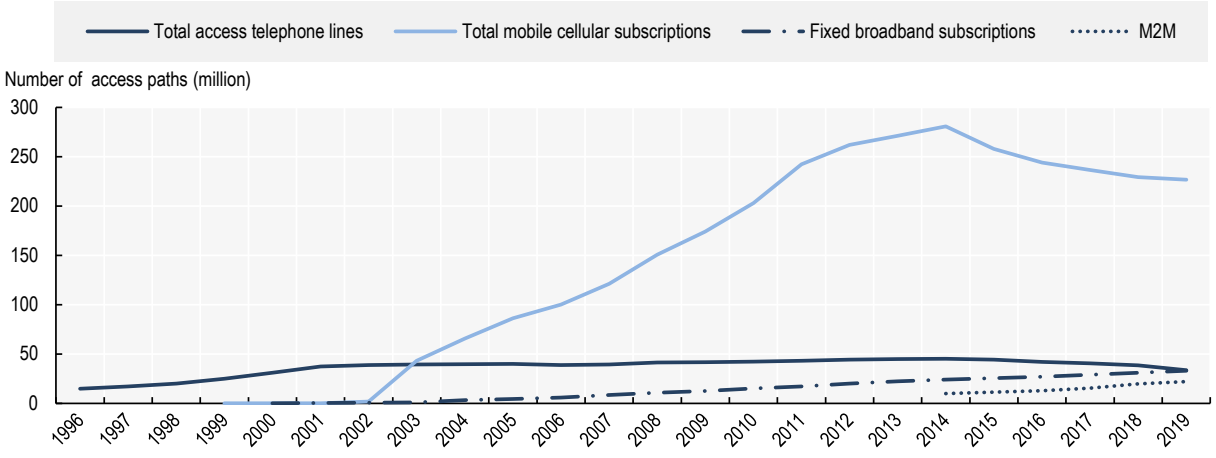
Subscriptions to communication services (i.e. total access paths)[2] have continued to increase. This increase occurred notwithstanding the negative revenue growth (-3.4%) in Brazil during the three-year period between 2015 and 2018; the percentage does not account for the role of small regional ISPs. This follows a similar trend of growth in communication access paths observed in the OECD area, albeit starting from lower penetration rates (Figure 3.6).

In terms of access paths, the most substantial change in the communication market stems from mobile cellular subscriptions, which includes both mobile voice and mobile broadband. In particular, mobile broadband subscriptions more than tripled between the 2012 and 2019 period, passing from 59.2 million to 196.6 million. In contrast, fixed telephony lines have begun to decrease slightly in Brazil since 2014, a trend observed across the OECD as some users replace traditional voice services with mobile telephony.

Still, most of the disconnected Public Switched Telephone Network fixed lines in 2019 were from operators working under the concessions regime (public regime) (Julião, 2019[7]). This may be related to the differential regulatory treatment, recently reformed in October 2019 (Chapters 1, 2, 4 and 5). Fixed broadband subscriptions also grew in Brazil, passing from 19.8 million to 32.9 million access lines between 2012 and 2019 (Figure 3.6). The growth of small regional ISPs in recent years has contributed to the expansion of fixed broadband access in Brazil; their share of subscribers grew from 9.6% to 18.4% between 2015 and 2018 (Anatel, 2020[3]).

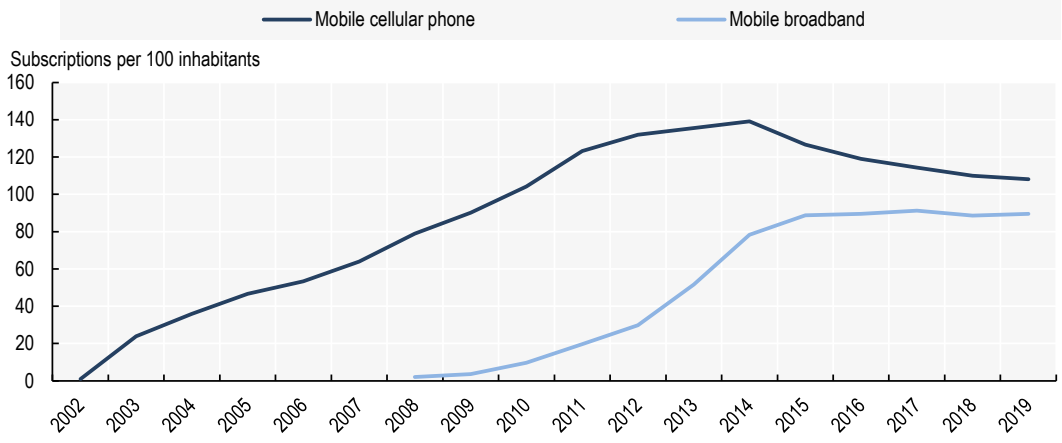
Mobile voice penetration, i.e. the number of subscriptions per 100 inhabitants, has continued to grow over the past 11 years. It passed from 78.8 to 108 subscriptions per 100 inhabitants between 2008 and 2019. Mobile broadband went from 2 to 89.5 subscriptions per 100 inhabitants during the same period (Figure 3.7).

Figure 3.6. Evolution of communication access paths in Brazil (1996-2019)



Note: M2M = machine to machine.
Source: Anatel (2020[8]), *Painéis de Dados: Acessos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

Figure 3.7. Mobile voice and mobile broadband penetration in Brazil (2002-19)

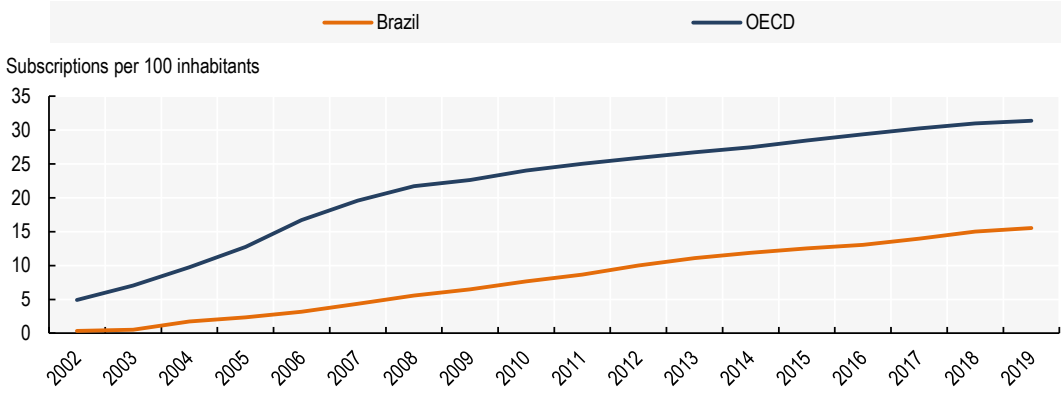


Source: Anatel (2020[8]), *Painéis de Dados Acessos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

In the past nine years, the use of mobile services has been a primary driver for increasing connectivity in Brazil. From 2010 to 2019, mobile broadband subscriptions rose from 9.7 to 89.5 per 100 inhabitants, which represents a compound annual growth rate (CAGR) of 28%. Subscriptions for mobile voice grew slower than for mobile broadband, rising from 104 to 108 per 100 inhabitants over the same period, which represents a CAGR of 0.42%. The share of subscriptions of 4G (long-term evolution networks) in Brazil reached 67.8% at the end of 2019, up from 9.9% in 2015. This reflects a CAGR of around 61.8%.

The evolution of fixed broadband penetration in Brazil follows a similar trend as the OECD average, albeit departing from a lower level. In 2019, fixed broadband penetration in Brazil reached 15.5%, which compares to an OECD average of 31.4% (Figure 3.8).

Figure 3.8. Evolution of fixed broadband penetration in Brazil and in the OECD (2002-19)



Note: Data for 2019 are for Q2 2019.
Sources: OECD (2020[9]), *Broadband Portal* (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm (accessed on 20 May 2020); Anatel (2020[8]), *Painéis de Dados: Acessos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

Communication services can be assessed using a number of key measures. These include the availability of services, their quality and their price levels for businesses and consumers. Regarding broadband availability, indicators include the number of broadband subscriptions per 100 inhabitants (i.e. broadband penetration rates), the number of households or businesses with access to broadband, or geographical coverage of networks (e.g. urban, rural and remote).

A further indicator for broadband assessment is the quality of communication services, such as download connection speeds. Apart from using speed to gauge overall performance, other measures will become increasingly important to measure quality of networks. The need for improved response times (latency)[3] between devices and compute nodes will grow, supporting diverse usage case scenarios for the Internet of Things (IoT). Operators will also increasingly be measured by assurance of delivery (packets loss) across their networks (OECD, 2019[10]).

The affordability of communication services is also key for benefiting from the opportunities created by the digital transformation. The next subsections present indicators of Brazilian broadband markets over these three aspects (i.e. availability, quality and prices).

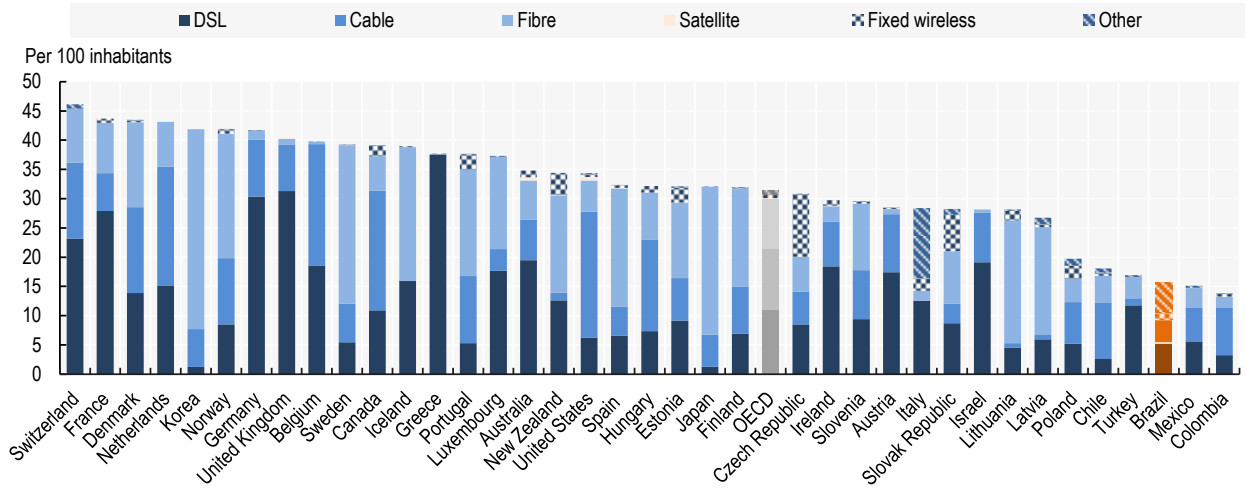
Availability and quality of communication services

Availability of fixed and mobile broadband services

In June 2019, fixed broadband penetration in Brazil (i.e. 15.5%) was similar to countries in the region such as Chile (18%), Mexico (15%) and Colombia (13.8%). However, this level was about half of the OECD average of 31.4%. Indeed, it was well below leading OECD countries in terms of fixed broadband penetration with more than 40 subscriptions per 100 inhabitants (e.g. Switzerland, France, Denmark, the Netherlands, Korea, Norway, Germany and the United Kingdom) (Figure 3.9).

Subscriptions per 100 inhabitants, which is a supply-side indicator, may not entirely reflect use of broadband services by households or individuals (i.e. demand-side indicators). The number of people using the Internet is higher, as Brazilian households tend to be larger than OECD average households. Neighbours also seem to share broadband subscriptions in Brazil. In fact, 20% of Brazilian households declared they shared their Internet connection with one or more neighbours in 2018 (CGI.br, 2019[11]).

Figure 3.9. Number of fixed broadband subscriptions in OECD countries and in Brazil, by technology (June 2019)



Notes: DSL = Digital subscriber line.
Sources: OECD (2020[9]), *Broadband Portal* (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm (accessed on 20 May 2020); Anatel (2020[8]), *Painéis de Dados: Acessos*, https://www.anatel.gov.br/paineis/acessos/ (accessed on 28 May 2020).

In terms of its technology mix, at the end of June 2019, most (34%) of the fixed broadband subscriptions in Brazil were digital subscriber line (DSL) subscriptions (5.3 subscriptions per 100 inhabitants), followed by those using fibre (3.7 subscriptions per 100 inhabitants), which accounted for 24% of total broadband subscriptions compared to 25% in Chile, 22% in Mexico and 14% in Colombia (Figure 3.9).

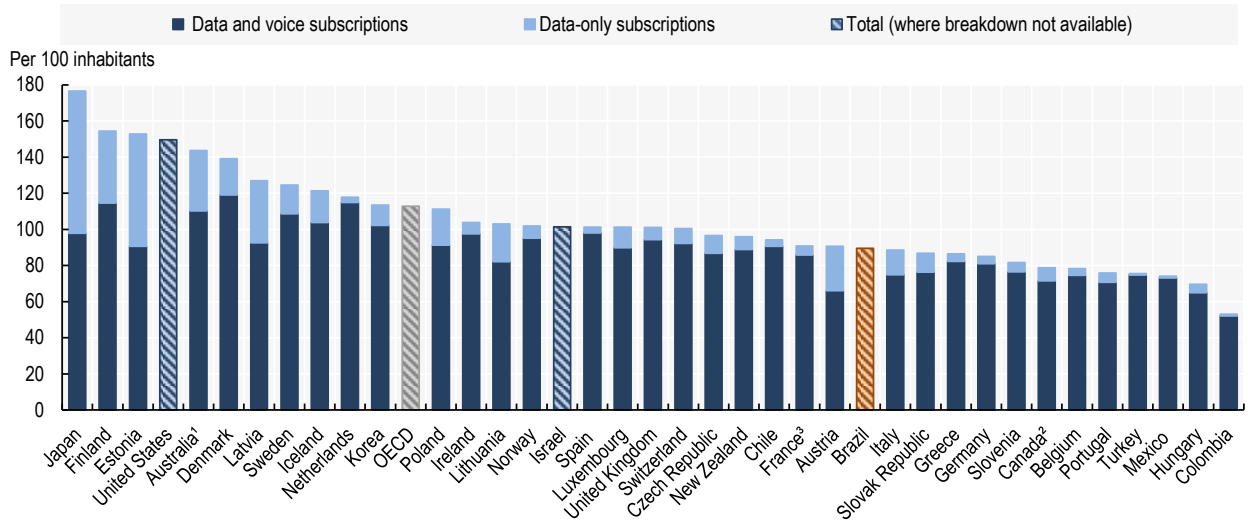
The share of high-speed fibre in fixed broadband connections in OECD countries rose from 12% to 27% between 2010 and June 2019. However, this percentage masks large differences between countries. The share of fibre in total broadband ranges from above 70% in Japan, Korea and Lithuania to below 10% in Austria, Belgium, Germany, Greece, Ireland, Israel, Italy and the United Kingdom (Figure 3.9). As in the OECD, Brazil has experienced an increase in the share of fibre broadband connections over the same period. Its share of fibre over total fixed broadband connections rose from 0.43% to 24%. This is a welcome development as it is one indicator of higher network capabilities stemming from greater fibre deployment. Despite this progress, Brazil lags well behind the OECD average in terms of the percentage of fibre of total fixed broadband subscriptions (although Anatel lacks information from small regional ISPs).

With respect to mobile broadband subscriptions, Brazil had 89.5 per 100 inhabitants in June 2019. This is not far from the OECD average of 112.8 per 100 inhabitants (Figure 3.10). When compared to regional peers, mobile broadband penetration in Brazil is similar to that of Chile (94.2%) and higher than in Mexico (74%) and Colombia (53%).

Mobile broadband networks are more pervasive in Brazil than fixed broadband networks. However, efforts must still be made to ensure that most municipalities have mobile connectivity. In 2018, there was a 4G signal in 4 676 Brazilian municipalities, where 96.7% of the population live, compared to an equivalent "coverage" of 99.8% for 3G networks (Figure 3.11). Some municipalities have a large geographic span with many rural and remote areas. As not all inhabitants of a municipality with 3G or 4G signal necessarily live within the covered area, actual population coverage is likely to be lower. Therefore, this indicator (i.e. existence of a network signal within a municipality) does not provide an estimate of the actual percentage

of the population covered. Nor does it provide a precise measurement of the geographical span of mobile network coverage.

Figure 3.10. Number of mobile broadband subscriptions in OECD countries and in Brazil, by technology (June 2019)

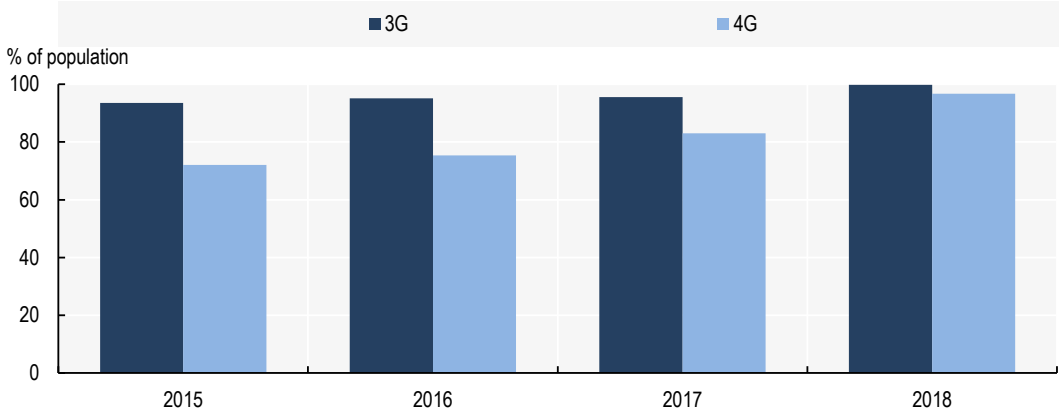


1. A new entity using a different methodology is collecting data reported for December 2018 and onwards.
2. Fixed wireless includes satellite.
3. Cable data includes VDSL2 and fixed 4G solutions.

Notes: Figures reported from December 2018 comprise a series break and are incomparable with previous data for any broadband measures Australia reports to the OECD. Data for Canada, Switzerland and United States are preliminary.

Sources: OECD (2020[9]), *Broadband Portal* (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm (accessed on 20 May 2020); Anatel (2020[8]), *Painéis de Dados: Acessos*, https://www.anatel.gov.br/paineis/acessos/ (accessed on 28 May 2020).

Figure 3.11. Presence of 3G and 4G signals within municipalities, estimated as percentage of the population[1] in Brazil (2015-18)



1. The indicator represents a network signal in a given municipality. Population coverage is then estimated by the number of inhabitants in the municipality that have presence of a mobile network signal. It provides an estimate of the percentage of the population covered by mobile networks rather than a precise measurement of the geographical span of mobile network coverage.

Source: Anatel (2020[12]), *Telefonia Móvel – Municípios atendidos*, https://www.anatel.gov.br/setorregulado/component/content/article/115-universalizacao-e-ampliacao-do-acesso/telefonia-movel/423-telefonia-movel-municipios-atendidos (accessed on 20 February 2020).

While the number of municipalities where there is presence of mobile networks seems high, many have only been covered by a single operator. This may be related to developments that occurred around the privatisation of Telebrás and the issuing of regional licences. Furthermore, the lack of national roaming agreements among mobile operators may accentuate the presence of a single provider in several municipalities. For example, in the first half of 2018, 3 071 municipalities with fewer than 30 000 inhabitants were almost entirely served by a single provider. They also lacked roaming agreements. According to Anatel, 4 747 roaming agreements are needed across all major mobile service providers to ensure full mobile coverage of these municipalities (Tele.Sintese, 2019[13]).

One of the main challenges in Brazil is rural coverage of broadband services. With a geographical size of 8.5 million square kilometres (km^2), the country is approximately eight times the size of France and Spain measured jointly. In addition, 60% of the Amazon forest lies within Brazil's borders. Many other factors are at play such as competition in communication markets, whether pro-competitive regulation is in place policies to reduce infrastructure deployment costs. However, the geographical dimension creates important challenges to fulfil coverage objectives in rural and remote areas of Brazil. In addition, a large percentage of the population is sparsely distributed, which exacerbates the issue.

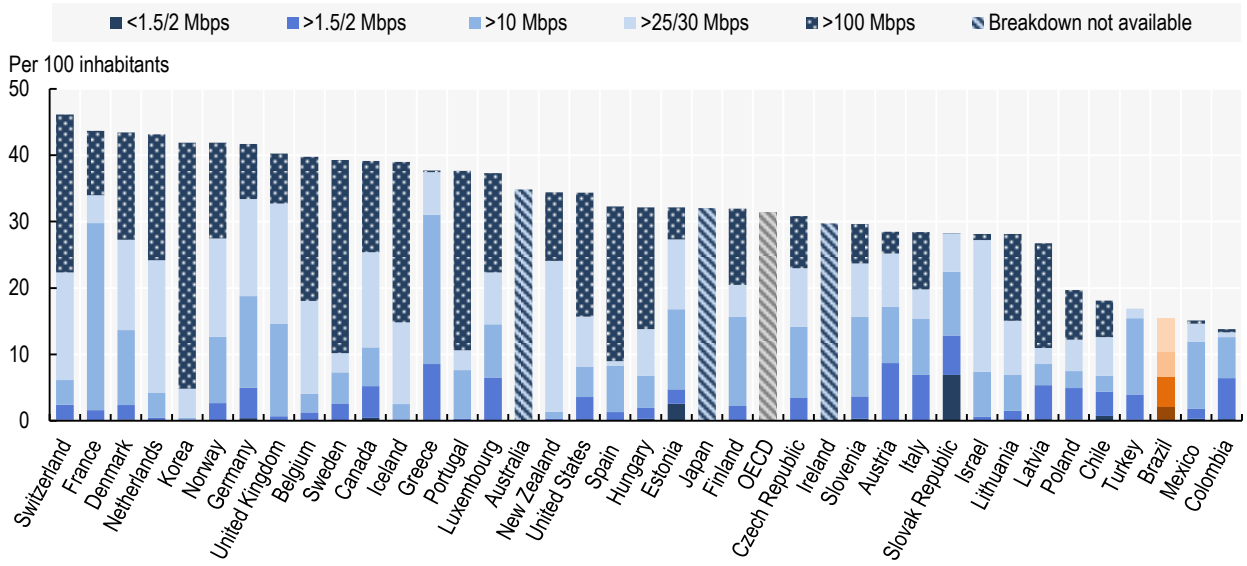
Quality of fixed and mobile broadband networks

A key indicator in relation to fixed and mobile broadband quality is connection speed. A useful measure to complement any assessment of broadband services is to observe penetration rates by speed tiers. In Brazil, more than half of fixed broadband subscriptions (58%) exhibited speeds above 12 Mbps in June 2019. In particular, 25% of fixed broadband subscriptions belonged to the "12-34 Mbps" speed tier; and 33% of subscriptions exhibited speeds above 34 Mbps. Compared to regional peers, 79% and 69% of fixed broadband connections in Mexico and Colombia were in the 3 to 10 Mbps speed tier, respectively. For comparison, in Switzerland – the leading OECD country in terms of fixed broadband penetration – 52% of fixed broadband subscriptions corresponded to subscriptions with speeds above 100 Mbps (Figure 3.12).

Advertised speeds may differ from actual speeds experienced by users. Regulatory authorities across the OECD have increasingly paid attention to the significant gaps between "advertised" and actual speeds experienced. In this sense, it is useful to observe data from different sources measuring actual speeds, such as Ookla, M-Lab and Steam, among others (Figure 3.13, Figure 3.15 and Figure 3.16).

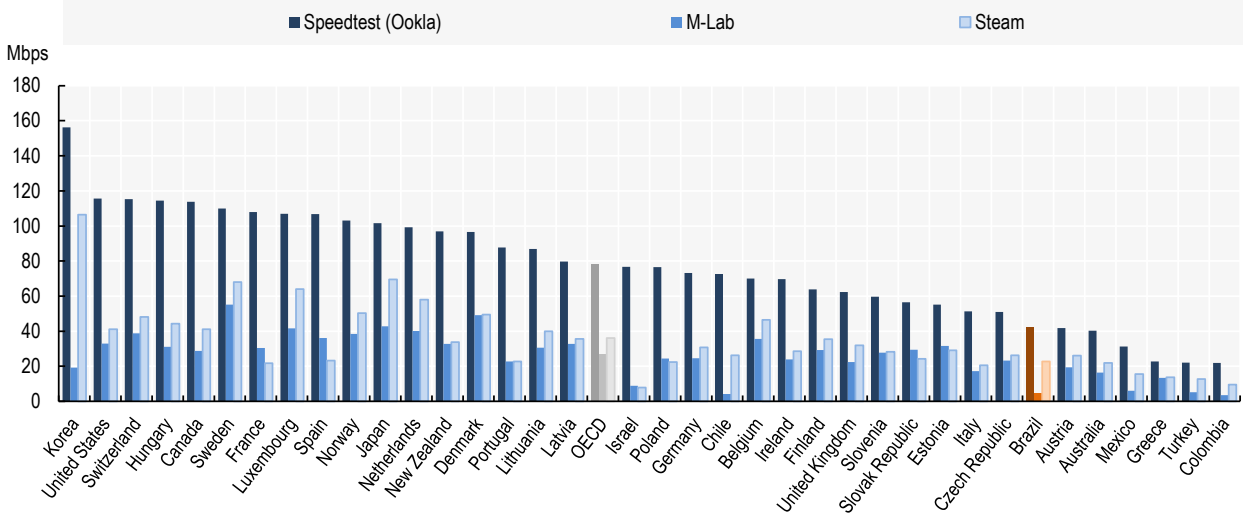
It is worth noting the features of the different tools used for measuring download speeds when drawing conclusions from these data. M-Lab and Ookla compile results from speed tests by users who actively measure their actual speed to access the Internet. Steam data is a further way to consider download speeds across countries, which reflects the speeds of users using one of the most Internet Protocol (IP) intensive applications: online games. According to M-Lab data, the average fixed broadband download speed in Brazil was 4.8 Mbps in May 2019, which compares to an OECD average of 26.8 Mbps. Using Steam data and the population section of gamers as a reference, the average download speed for fixed broadband in Brazil was 22.7 Mbps on the Steam platform in July 2019. Conversely, the OECD average, based on Steam data, was 36.1 Mbps (Figure 3.13).

Figure 3.12. Number of fixed broadband subscriptions in OECD countries and in Brazil, per speed tier (June 2019)



Notes: Mbps = megabits per second. The speed tiers data are for end of 2018, and data on fixed broadband subscriptions per 100 inhabitants are for June 2019. Data for Brazil on speed tiers and fixed broadband subscriptions correspond to June 2019. Brazil uses different speed tiers, which are: <2Mbps, >2 Mbps, >12 Mbps and >34 Mbps.
Sources: OECD (2020[9]), *Broadband Portal* (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm; data on Brazil is from Anatel (2020[8]), *Painéis de Dados: Acessos*, https://www.anatel.gov.br/paineis/acessos/ (accessed on 28 May 2020).

Figure 3.13. Average experienced download speeds of fixed broadband connections in OECD countries and in Brazil (2019)

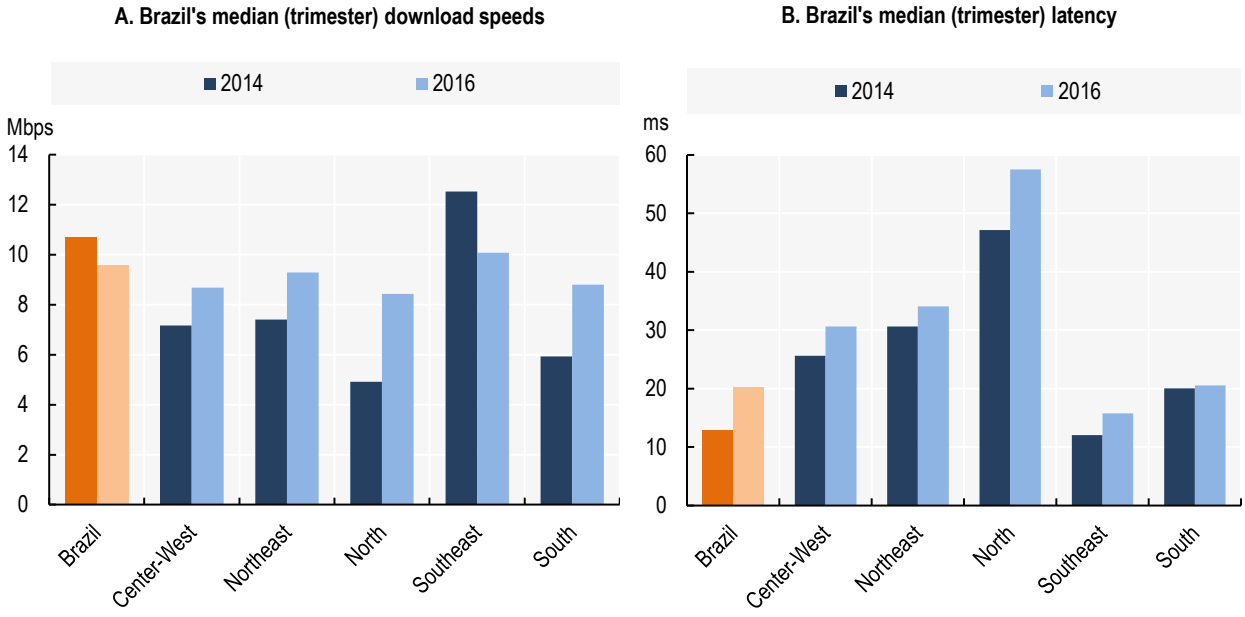


Notes: Mbps = megabits per second. Sorted using Ookla data. Speedtest (Ookla) data are for July 2019; M-Lab (Worldwide broadband speed league) speeds were measured from 9 May 2018 to 8 May 2019; Steam data are for July 2019.
Sources: Ookla (2019[14]), "Speedtest", https://www.speedtest.net/ (accessed on 10 July 2019); M- Lab (2019[15]), "Worldwide broadband speed league", https://www.cable.co.uk/broadband/speed/worldwide-speed-league/ (accessed on 9 May 2019); Steam (2019[16]), *Steam Download Stats*, https://store.steampowered.com/stats/content (accessed on 10 July 2019).

CETIC.br/NIC.br has measured the quality of Brazilian broadband connections through an initiative called SIMET. A 2018 report shows download speeds, latency and jitter upload (stability of the connection) indicators of broadband connections for the different regions in Brazil (NIC.br, 2018[17]). All three quality measures are evaluated at the median calculated by trimester and per region. In 2016, the median of download speeds among regions ranged from 8.4 Mbps (Northern region) to 10.1 Mbps (Southeast region), while the national median was 9.6 Mbps. In terms of latency, there are more accentuated regional differences. The Northern region exhibited latency of 57.5 milliseconds (ms), while the Southeast region was 15.8 ms and the national median was 20 ms (Figure 3.14).

Figure 3.14. Quality of broadband connections in Brazil

Median download speeds and latency per trimester and per region in 2014 and 2016



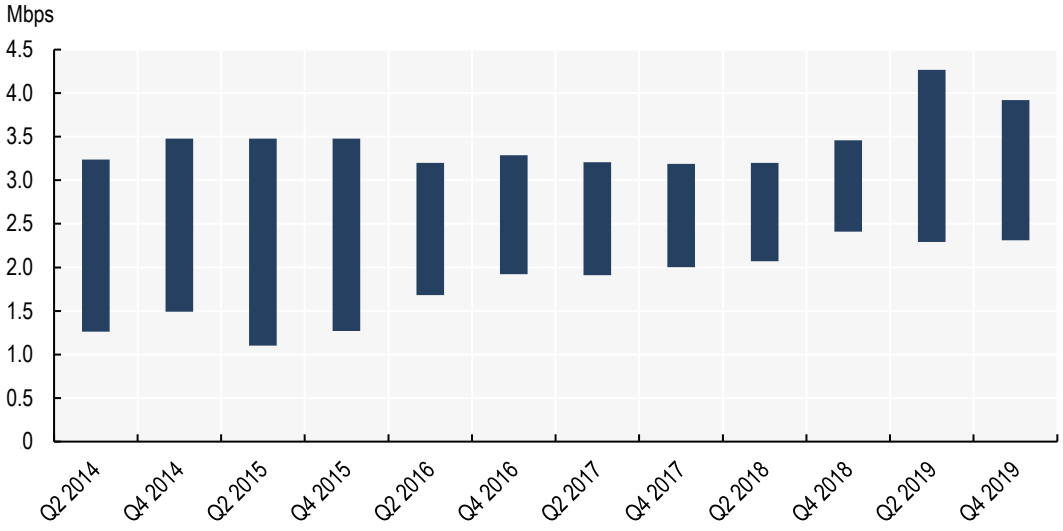
Note: Mbps = megabits per second; ms = millisecond.
Source: NIC.br (2018[17]), "Banda Larga no Brasil: um estudo sobre a evolução do acesso e da qualidade das conexões à Internet", https://cetic.br/media/docs/publicacoes/1/Estudo%20Banda%20Larga%20no%20Brasil.pdf.

Another useful indicator is the "Netflix ISP Speed Index", which measures download speed performance of certain ISPs while users are streaming Netflix content (Netflix, 2019[18]). This provides useful information on speeds experienced by almost 10 million reported Netflix users in Brazil. The speed reported by Netflix of prime-time performance of ISPs in Brazil shows a stable trend of low broadband speeds in 2014-18 (Figure 3.15). For example, lowest speeds ranged from 1.42 Mbps in Q2 2014 to 2.47 Mbps in Q4 2019. Highest reported speeds ranged from 3.08 Mbps in Q2 2014 to 3.76 Mbps in Q4 2019. In September 2019, the three leading ISPs in terms of speeds as reported by Netflix were Vivo Fibra (3.76 Mbps), Algar Fibra (3.62 Mbps) and Oi Fibra (3.61 Mbps).

Data collected by Opensignal, including over different network generations, can provide a perspective on mobile network performance. Opensignal collects real-time data from mobile phone users that have downloaded its application on their smartphone. This is done at different times of the day and from different locations (e.g. indoors, outdoors). For 3G and 4G networks, Opensignal measured average download mobile broadband connection speeds of 13 Mbps for Brazil in May 2019. This was roughly in line with speeds in Chile (12 Mbps) and

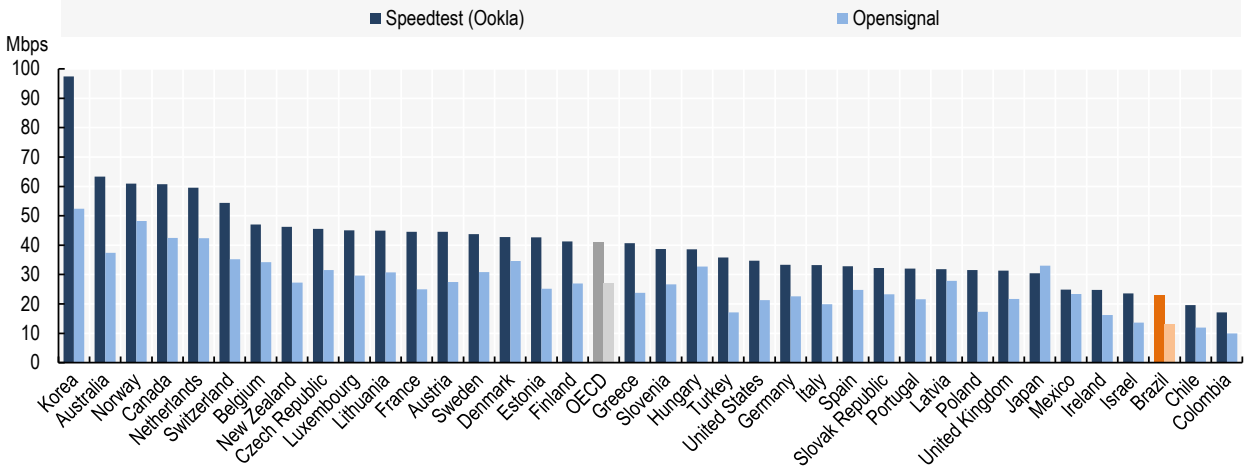
Colombia (10 Mbps) in 2019. When considering the Ookla speed tests for mobile networks of July 2019, Brazil exhibited download speeds for mobile broadband of 23 Mbps. This was similar to regional peers, but below the OECD average of 40.89 Mbps (Figure 3.16).

Figure 3.15. Download speeds experienced by Netflix users in Brazil, peak and lowest speeds (2014-19)



Notes: Mbps = megabits per second. The Netflix ISP Speed Index is a measure of prime-time Netflix performance on particular ISPs around the globe. It does not measure overall performance for other services/data that may travel across the specific ISP network.
Source: Netflix (2019[18]), "ISP Speed Index: Brazil", https://ispspeedindex.netflix.com/country/brazil/ (accessed on 16 September 2019).

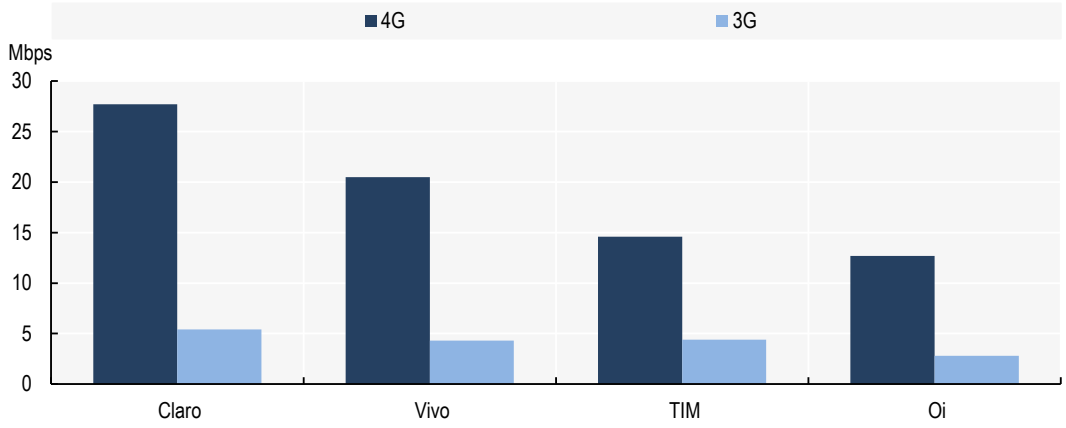
Figure 3.16. Mobile broadband download speeds in OECD countries and in Brazil (2019)



Notes: Mbps = megabits per second. Speedtest (Ookla) data are for July 2019; Opensignal data are for the average download connection speed on long-term evolution networks, May 2019. Opensignal data for Estonia, Latvia, Lithuania, Luxembourg, Mexico and Slovenia are for February 2018 instead of May 2019. The definition of download speeds for Opensignal is "…average download speed experienced by Opensignal users across an operator's 3G and 4G networks".
Sources: Ookla (2019[14]), "Speedtest", www.speedtest.net/global-index; Opensignal (2019[19]), *The State of Mobile Experience, May 2019*, http://dx.doi.org/www.opensignal.com/sites/opensignal-com/files/data/reports/global/data-2019-05/the_state_of_mobile_experience_may_2019_0.pdf.

Opensignal data of the end of 2019 for mobile operators reveal that Claro had the fastest download speeds for 4G (27.7 Mbps). This speed was followed by Vivo (20.5 Mbps), TIM (14.6 Mbps) and Oi (12.7 Mbps) (Figure 3.17). The rollout of networks using the 700 MHz frequency band may be one key factor in the increased quality and coverage of mobile networks in Brazil. By the same token, Oi's lack of lower frequency spectrum may partially explain why it exhibits lower speeds; it did not acquire spectrum in the 700 MHz auction of 2015 (Opensignal, 2019[20]).

Figure 3.17. 4G and 3G download speeds experienced in 2019 in Brazil, by mobile operator



Notes: Mbps = megabits per second. Opensignal data report of January 2020, with data collection spanning over 1 September-29 November 2019, with 5 157 million measurements conducted in around 4 million devices.
Source: Opensignal (2020[21]), *Brazil: Mobile Network Experience Report January 2020*, https://www.opensignal.com/reports/2020/01/brazil/mobile-network-experience.

To improve the performance experienced by users in terms of speed, operators will need to invest in upgrading their networks. To that end, they should extend backbone and backhaul connectivity, as well as pursue other avenues such as enhancing transit and peering relationships. For example, Netflix partners with hundreds of local ISPs in Brazil to localise substantial amounts of traffic. They embed the "Open Connect Appliance" within the ISP servers (at no charge), where they have open peering at these interconnection locations. This improves the experience of Netflix users by minimising delivery of traffic served over a transit provider (Netflix, 2019[22]).

In addition, ISPs across OECD countries that provide the highest speeds to their users often note the prevalence of Internet exchange points (IXPs) as a main attribute to improve broadband quality. The number of IXPs across Brazil is commendable, and still growing. On the other hand, important investments in fixed network infrastructure are still required across the country to improve quality of both fixed and mobile broadband services. These investments can be fostered through market competition.

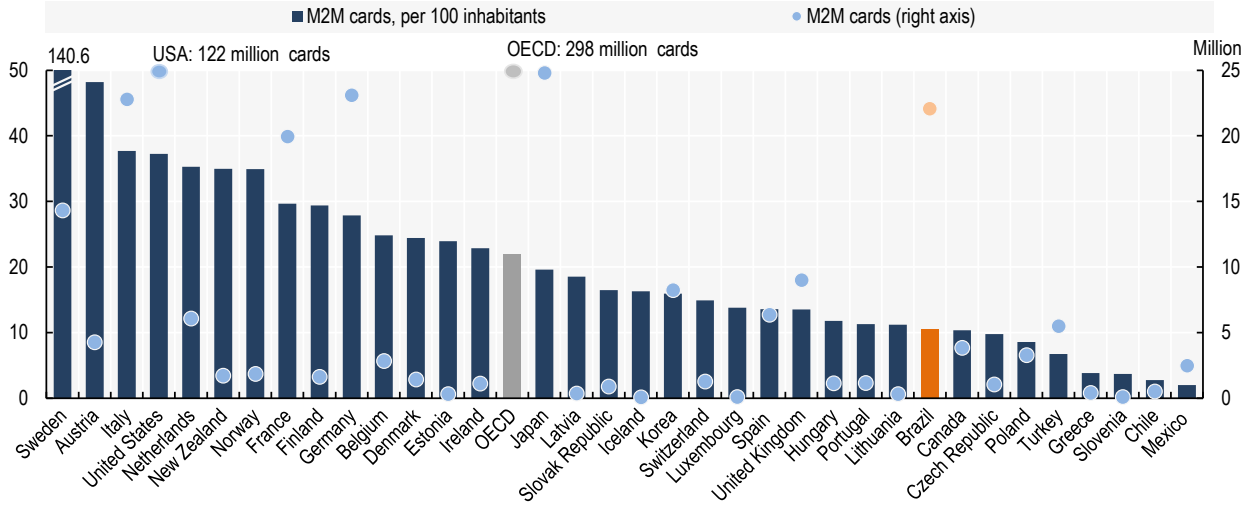
Internet of Things in Brazil

As highlighted in the OECD Cancun Ministerial, following the convergence between fixed and mobile networks and between telecommunication and broadcasting, the IoT represents the next step in convergence between ICTs, economies and societies on an unprecedented scale (OECD, 2016[23]).[4] Given that many connected devices will have different network requirements, the OECD has developed a framework (taxonomy) that breaks down the IoT into categories. For example, critical IoT applications such as remote surgery and automated

vehicles will require high reliability and low latency connectivity. Conversely, massive and disperse M2M sensors (for electrical grids, predictive maintenance, smart agriculture, etc.) may not be that sensitive to latency or network speeds (OECD, 2018[24]).[5]

Since 2012, the OECD has been collecting data on M2M/embedded mobile cellular subscriptions, a subset of the IoT.[6] Between the end of 2014 and June 2019, the number of M2M communication subscriptions in the OECD more than doubled, increasing from 108 million to 298 million. In Brazil, during the same period, the number of M2M connections also more than doubled, passing from 10 million to 22 million. This was likely due to tax breaks on M2M SIM cards (Figure 3.18). In June 2019, the level of M2M SIM cards per 100 inhabitants at the OECD was 22 compared to 10.6 in Brazil (Figure 3.18).

Figure 3.18. Number of M2M/embedded mobile cellular subscriptions in OECD countries and in Brazil (June 2019)



Notes: M2M = machine to machine. Data for Australia reported as of December 2018 are being collected by a new entity using a different methodology. Data for Switzerland are preliminary.
Source: OECD (2020[9]), *Broadband Portal* (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm (accessed on 20 May 2020).

The IoT for precision agriculture or smart farming (e.g. sensors measuring humidity levels to improve water efficiency or predict better crop yield) may reduce costs, while mitigating environmental consequences. The same is true for sensors for industrial applications that allow predictive maintenance of machines. Therefore, this subcategory of the IoT – massive and disperse M2M – can play a key role in the digital transformation of the industrial and agricultural sectors in Brazil.

As its main features, the IoT for smart farming involves millions of sensors spread over wide areas (in terms of km). However, the amount of data transmitted per device may be small and tends to be less sensitive to latency issues (OECD, 2018[24]). These key features of massive M2M sensors – the need for large-scale deployment coupled with low data transmission per device – may translate into negligible revenue and data traffic per device. Therefore, taxes by the Telecommunications Oversight Fund (Fundo de Fiscalização das Telecomunicações, FISTEL) imposed individually on each M2M SIM card could reduce incentives to roll out the IoT at a larger scale. This, in turn, could impair adoption of massive and disperse M2M (Chapter 7).

Prices and usage of communication services

Communication service prices

In many countries, high prices can be an important barrier for the adoption and use of broadband. In a 2018 study, 61% of households identified affordability as the main reason for not adopting the Internet in Brazil (CGI.br, 2019[11]).[7] Identifying the factors influencing prices of communication services is thus key.

Prices of communication services depend greatly on the competitive conditions of the market in each country. In some instances, they also depend on regulation for specific services. In a sector with high fixed costs and barriers to entry, as is the case for telecommunication, the institutional and regulatory framework weighs heavily on the resulting market structure. As such, it has a direct influence on the affordability of communication services and the disciplines applied to prices by competition. In this sense, the prices of communication services and levels of investment provide useful indicators of competition and framework conditions in Brazilian communication markets.

Apart from the level of competition, the high level of taxes in the sector such as that on commerce and services (Imposto sobre Circulação de Mercadorias e Serviços, ICMS) also influences affordability of communication services in Brazil. Several stakeholders claim the pass-through of these taxes can represent up to half of the retail price of communication services in Brazil (Chapter 7).

The OECD's telecommunication baskets provide detailed information on Brazil's prices for fixed and mobile communication services compared to OECD countries and regional peers. The OECD uses a pricing methodology that designs usage baskets (i.e. low, medium and high usage) for different consumption patterns. It collects the data twice a year, using prices on websites that are shown for consumers at a certain date. This assumes that rational consumers can make decisions based on the information available to them.

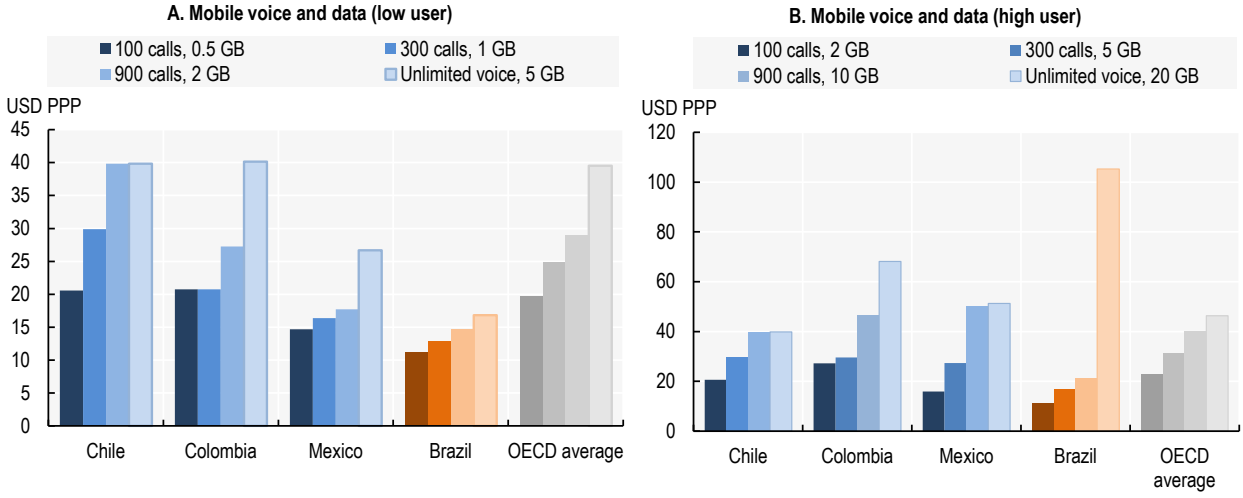
In terms of mobile broadband services (i.e. mobile voice and data plans for smartphones), for a low-usage type of basket (i.e. ranging from 0.5 GB to 5 GB of data volume consumed per month), Teligen data from November 2019 show that Brazil has affordable plans compared to OECD average prices (Figure 3.19). For example, for the basket of 300 calls and 1 GB of data, Brazilian consumers paid USD PPP 12.9, compared to USD PPP 24.9 for the OECD average (purchasing power parities, PPP).

For the high-usage profile of mobile voice and data, Brazil also exhibited low prices except for mobile broadband plans with unlimited voice and 20 GB. These particular plans were twice as expensive in Brazil (USD PPP 105.3) as average plans in the OECD (USD PPP 46.4). Although mobile broadband service plans seem affordable, this indicator should be interpreted along with the actual speeds provided by these plans (Figure 3.16). In other words, both quality and prices of communication services are important dimensions of the competitive dynamics of the market.

The affordability of fixed broadband services is less evident, which may be a result of the lack of transparency in Brazilian advertised offers for fixed broadband services. Operators establish a price cap for fixed services, and register the plan tariffs with Anatel prior to commercialisation. Advertised plans in Brazil appear with time-limited promotional tariffs and with the price cap tariff. The post-promotion tariff is unknown to users, who only observe the price ceiling. This practice generates a lack of transparency in advertised plans for consumers. The regulator is holding a public consultation to eliminate the practice through a revision of the Regulatory Framework for Consumer Rights of Telecommunication Services (Regulamento Geral de

Direitos do Consumidor de Serviços de Telecomunicações). At the moment of writing, plans were advertised with the price cap and promotional prices lasted for a limited time.

Figure 3.19. Mobile broadband prices in Brazil compared to regional peers and the OECD average (November 2019)



Notes: PPP = purchasing power parity; GB = gigabyte. Mobile voice and data baskets range in terms of number of voice calls, SMS included and data allowance (GB per month). For more details on the OECD price basket methodology, refer to OECD (2017[25]), "Revised OECD Telecommunication Price Baskets", http://www.oecd.org/sti/broadband/DSTI-CDEP-CISP(2017)4FINAL.pdf.
Source: OECD calculations based on Strategy Analytics (2019[26]), "Teligen tariff & benchmarking market data using the OECD methodology", https://www.strategyanalytics.com/access-services/service-providers/tariffs---mobile-and-fixed/.

For comparability reasons, the present report applies the OECD price basket methodology for Brazil. It thus relies on the fixed broadband price information available online in December 2019 for Brazilian consumers. This was the price cap tariff and promotional prices, where the promotional price had a clear expiration date. Unlike as in most OECD countries, fixed broadband operators in Brazil do not explicitly state the price that will be in effect after the promotional tariff expires.

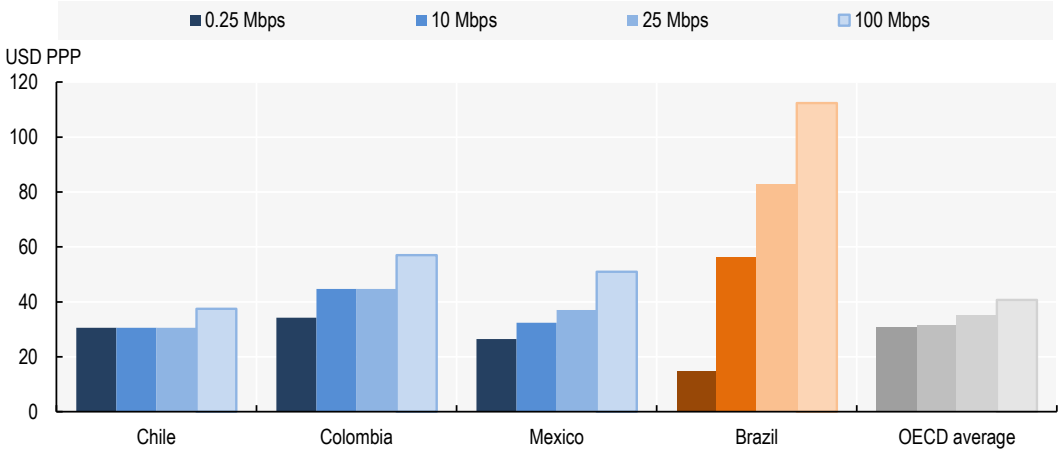
The OECD supposes a 36-month contract to account for potential promotions and to smoothen the installation costs over a sufficiently long period (OECD, 2017[25]). This represents the typical length that consumers usually keep the same contract. This concept differs from the minimum commitment period in some OECD countries after which a consumer may cancel the contract without penalties (e.g. 12 months).

Again, offers in the Brazilian market lack transparency on the "post" promotional price. For comparability reasons, the OECD considered the tariff after the promotional period expired was the price cap. The rationale behind this approach is twofold. On the one hand, these are the only two price elements observable to Brazilian consumers in advertised fixed broadband plans. On the other, a 36-month promotional period would not be comparable with other OECD countries where operators explicitly state the price that will be used when the promotional period ends. While this approach ensures comparability with the OECD methodology, the price basket results presented in this report may be an upper margin of fixed broadband prices in Brazil.

The regulator suspended the use of data caps in commercial offers of the largest players in 2016, making download speeds the leading quality feature of fixed broadband baskets in

the Brazilian market. In December 2019, Brazil had higher prices of fixed broadband compared to the OECD average and its regional peers such as Chile, Colombia and Mexico (Figure 3.20). The exception was for baskets with low download speeds (i.e. 256 kbps) for the rest of the usage profiles (i.e. low, medium and high); these consider data volumes per month (measured in gigabytes) and download speeds (measured in megabits per second). The gap is more pronounced for fixed broadband plans with download speeds up to 10 Mbps. For a medium-usage basket of 30 GB data volume and 10 Mbps, for example, the OECD average price was USD PPP 31.6, while in Brazil it was USD PPP 56.1. This same usage basket was significantly less affordable in Brazil than in Latin American countries such as Chile (USD PPP 30.6), Colombia (USD PPP 44.7) and Mexico (USD PPP 32.4).

Figure 3.20. Fixed broadband prices (medium-usage basket) in Brazil compared to regional peers and the OECD average (December 2019)



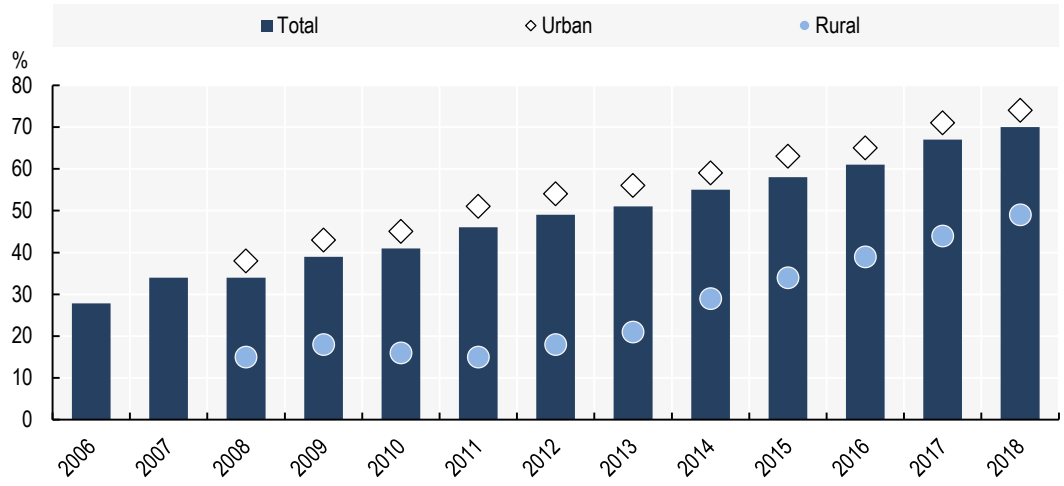
Notes: PPP = purchasing power parity; Mbps = megabits per second. In the low-usage alternative, data allowances of plans range from 5 to 100 GB/month; in the medium data-volume alternative, the data allowance ranges from 15 to 300 GB/month; and in the high-usage alternative, this ranges from 45 to 900 GB/month following the OECD methodology approved by all member countries. For more details on the OECD price basket methodology, see OECD (2017[25]), *Revised OECD Telecommunication Price Baskets*, http://www.oecd.org/sti/broadband/DSTI-CDEP-CISP(2017)4FINAL.pdf. The prices taken into account in Brazil for the OECD baskets consider promotional prices for the valid period of the offers (e.g. 12 months), and revert to the price-cap tariff afterwards.
Source: OECD calculations based on Strategy Analytics (2019[26]), "Teligen tariff & benchmarking market data using the OECD methodology", www.strategyanalytics.com/access-services/networks/tariffs---mobile-and-fixed.

Usage indicators and the digital divide

Broadband subscription (i.e. supply-side) data broken down by rural and urban locations are not readily available. However, usage indicators (i.e. surveys based on demand-side data) provide an idea of the rural digital divide. In this regard, CETIC.br/NIC.br has been collecting ICT household and firm surveys for more than ten years.

Between 2006 and 2018, the percentage of individuals accessing the Internet in Brazil increased from 27.8% to 70% (Figure 3.21). However, this positive trend masks the difference between usage among individuals in rural and urban areas. For example, in 2008, 15% of individuals in rural households had accessed the Internet, compared to 38% of individuals in urban households. Although the number of people using the Internet has increased in absolute terms over the past decade, the rural digital divide has persisted. It was around 20 percentage points up until 2018, where the gap was around 25% in terms of usage between individuals in rural and urban households.

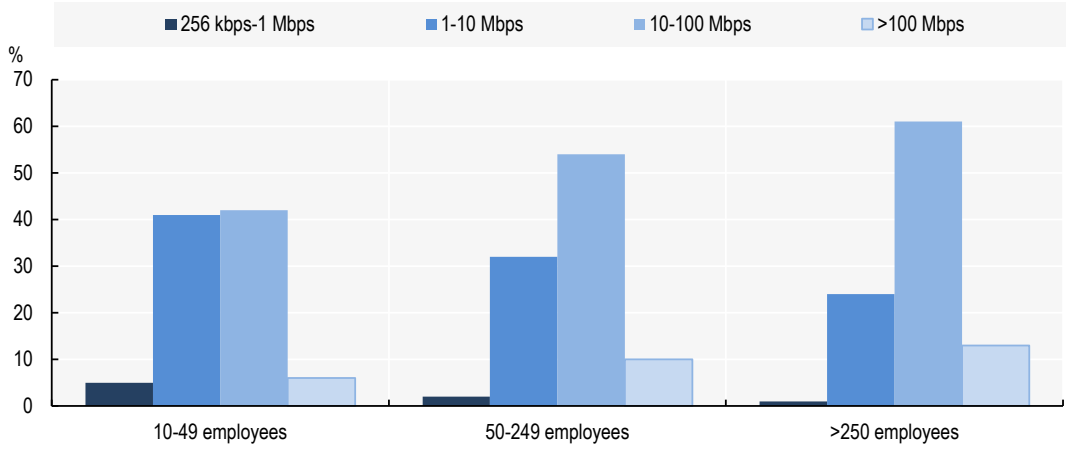
Figure 3.21. Proportion of individuals that have used the Internet in the last three months in Brazil (2006-18)



Source: CGI.br (2019[11]), *Pesquisa sobre o Uso das Tecnologias de Informação e Comunicação nos domicílios brasileiros – TIC Domicílios 2018*, https://cetic.br/arquivos/domicilios/2018/domicilios/ (accessed on 11 September 2019).

Access to broadband can enhance a firm's propensity to engage in trade (Kneller and Timmis, 2016[27]), as well as reduce transaction costs and foster productivity. Therefore, improving access to communication networks and services in Brazil is crucial to foster opportunities for Brazilian firms. Measuring digital divides across firm size helps in understanding whether most people have similar access to opportunities from digital transformation.

Figure 3.22. Firms with higher speed tier broadband access in Brazil, by firm size (2017)



Note: kbps = kilobits per second; Mbps = megabits per second.
Sources: CGI.br (2018[28]), *Pesquisa Sobre o Uso das Tecnologias de Informação e Comunicação nas Empresas Brasileiras*, https://www.cetic.br/media/docs/publicacoes/2/TIC_Empresas_2017_livro_eletronico.pdf; Anatel (2019[29]), *Mapeamento de Redes de Transporte*, https://www.anatel.gov.br/dados/mapeamento-de-redes (accessed on 13 September 2019).

In this sense, CETIC.br/NIC.br has made laudable progress in understanding digital divides across firm size through its ICT Enterprise Survey.[8] In 2017, the digital divide between small and larger firms in Brazil only starts to be evident at higher speed tiers of broadband

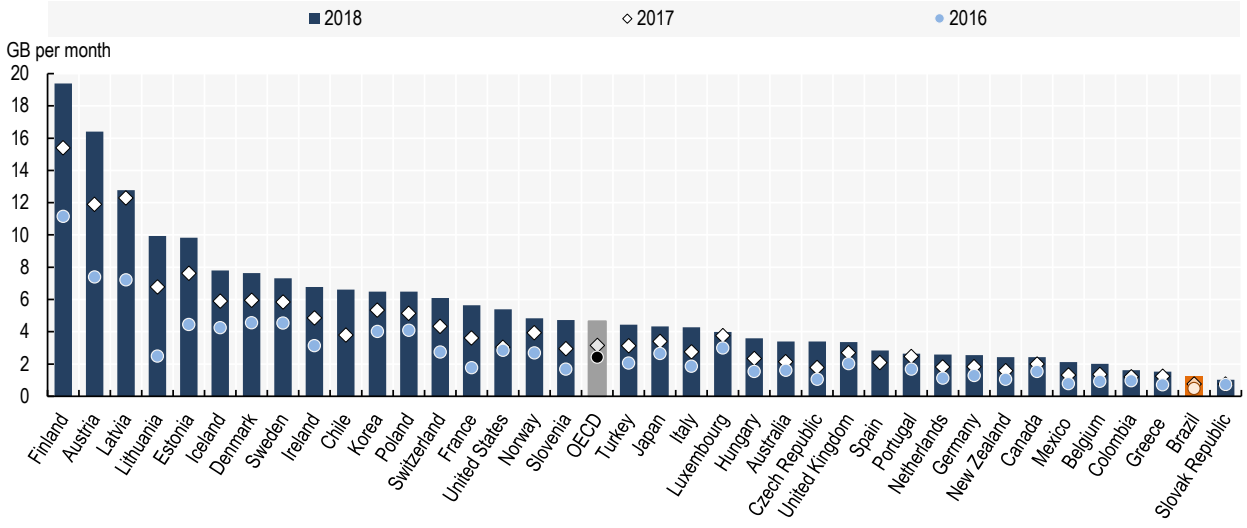
access, i.e. between 10 and 100 Mbps or above 100 Mbps (Figure 3.22). High broadband quality allows taking advantage of data-intensive applications that may deliver the highest returns in terms of productivity (e.g. cloud computing). Closing the access gap to high-speed broadband will play an important role for an inclusive digital transformation.

Complementarity of fixed and wireless networks

Data (Internet Protocol) traffic over mobile broadband networks

The amount of data used by subscribers is an indicator closely linked to affordability of broadband packages. Average mobile data usage per month in the OECD (out of 34 countries for which data were available) was 4.65 GB in 2018, up from 2.42 GB in 2016. The top OECD countries for data usage in 2018 were Finland (19.4 GB), Austria (16.4 GB), Latvia (12.8 GB) and Lithuania (9.9 GB). In comparison, Brazil's average monthly mobile data consumption was 1.25 GB in 2018, up from 0.47 GB in 2016. With respect to regional peers, Mexico and Colombia had higher data consumption per mobile subscription than Brazil in 2018 – around 2.11 GB and 1.62 GB, respectively (Figure 3.23).

Figure 3.23. Mobile data usage per mobile broadband subscription in OECD countries and in Brazil (2016, 2017 and 2018)



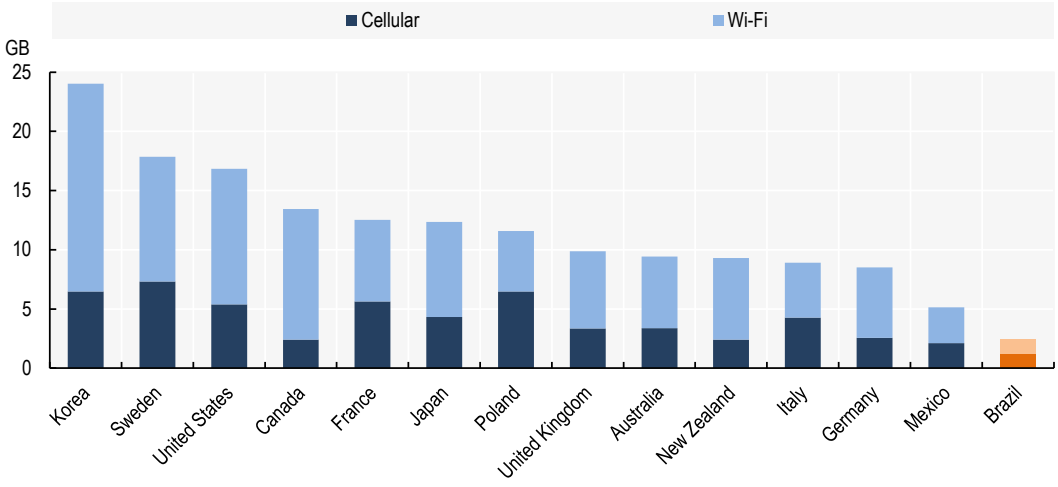
Notes: GB = gigabyte. Methodology – the multiplier 1 024 is used to convert terabytes into gigabytes; the total amount of gigabytes is divided by the yearly average number of mobile broadband subscriptions. Australia: Data reported for December 2018 and onwards are being collected by a new entity using a different methodology. Figures reported from December 2018 comprise a series break and are incomparable with previous data for any broadband measures Australia reports to the OECD.
Sources: OECD (2020[9]), *Broadband Portal* (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm (accessed on 20 May 2020); for data from Brazil, Anatel's response to the questionnaire of the review.

As more people and devices go online, increasing amounts of data of new applications will place additional demands on communication networks. For example, the Cisco Mobile Visual Networking Index (VNI) estimates that mobile data traffic between 2017-22 will grow sevenfold globally and six-fold in Brazil (a CAGR of 45%) (Cisco, 2018[30]). Investments in both fixed and mobile networks will continue to be crucial to take advantage of the digital transformation in Brazil.

Fixed and mobile networks in OECD countries are complementary as most users are connected to Wi-Fi technology for more than half their day and download far more data over Wi-Fi than on cellular networks. Moreover, the offloading of this traffic improves the performance of cellular access for other users because fixed networks are doing the "heavy lifting" (OECD, 2017[31]). In 2017, about 54% of mobile cellular traffic around the world was offloaded to fixed networks through Wi-Fi or small, low-power cellular base stations (i.e. femtocells). In Brazil, 49% of traffic was offloaded to fixed networks through Wi-Fi (Cisco, 2018[30]). However, the substitution between fixed and wireless networks may be greater in emerging economies than in the OECD. This is likely the case because wireless connectivity may be the primary source of access to broadband, as it is in Brazil.

The amount of traffic in terms of GB generated by mobile devices (Figure 3.24) can be estimated by combining two sources. On the one hand, CISCO VNI data provide the percentage of smartphone data traffic offloaded through fixed networks using Wi-Fi. On the other, the amount of mobile traffic generated per mobile broadband subscription can be identified. Using this approach for 13 OECD countries and Brazil,[9] at the end of 2017, Korea had the largest amount of total data usage per smartphone device (24 GB), followed by Sweden (17.9 GB); Brazil exhibited 2.5 GB of total amount of data usage per smartphone (Cisco, 2018[30]).

Figure 3.24. Total data per mobile broadband user (smartphone) per month in selected OECD countries and in Brazil (2018)[1]



1. Mobile data traffic corresponds to 2018, while CISCO VNI data correspond to the end of 2017.
Notes: GB = gigabyte. Offloaded Wi-Fi traffic is calculated using the Cisco VNI percentage of smartphone offloaded traffic.
Source: OECD using data from OECD (2020[9]), *Broadband Portal* (database), www.oecd.org/sti/broadband/oecdbroadbandportal.htm and Cisco VNI Global Fixed and Mobile Internet Forecasts, www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html.

Essential inputs for communication infrastructures

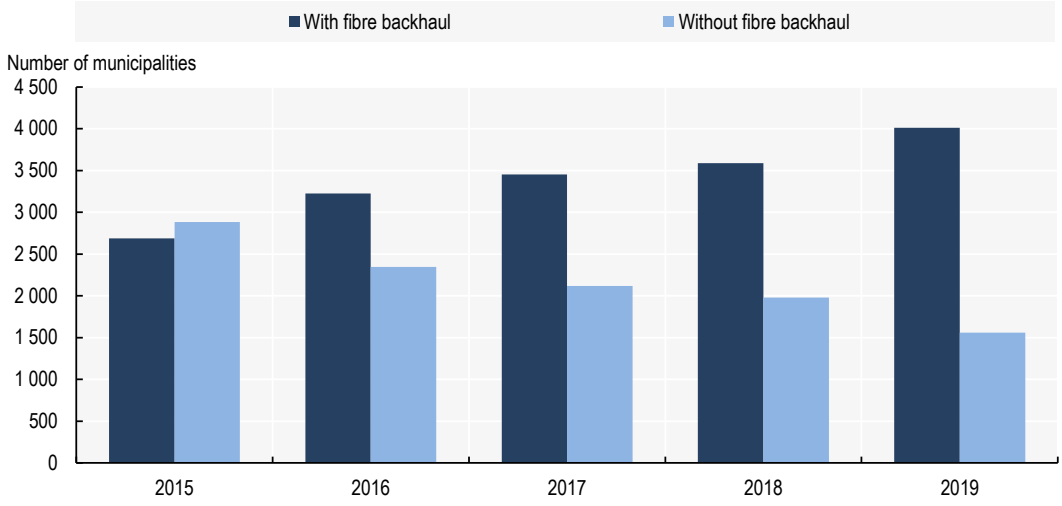
Backhaul and backbone connectivity

As the demand for mobile data traffic surges, wireless networks rely increasingly on fixed broadband infrastructure. In a way, wireless networks become extensions of fixed networks, and this is even more the case when it comes to 5G networks. Thus, it is crucial for Brazil to continue deploying fixed network infrastructure, as there is an increasing need for fibre backhaul and backbone connectivity.

Taking fibre backhaul closer to the end user, whether a business location or residential dwelling, is important for increasing speed across all technologies. This is true for 5G, and also for coaxial cable or copper connections. A growth in fibre backhaul availability should help support projected capacity demands, especially those raised by 5G networks (OECD, 2019[32]).

Anatel has been collecting data that allows a mapping of the transport infrastructure of high capacity networks used to provide telecommunications services, (i.e. backhaul and backbone connectivity). The regulator is working to entice all companies to report availability of backhaul. This aims to prevent the negative competitive effects of subsidising broadband deployment in areas that already have ISPs (Anatel, 2019[29]). An Anatel study showed that only 48.2% of municipalities in Brazil were served by fibre backhaul in 2015. This number reached 70% in 2019, which translates into 3 882 municipalities connected to fibre backhaul (Figure 3.25). However, backhaul connectivity in a municipality does not imply that the wholesale operator has any open access obligations (Anatel, 2019[29]).

Figure 3.25. Number of municipalities with fibre backhaul connectivity in Brazil (2015-19)



Source: Anatel (2019[29]), *Mapeamento de Redes de Transporte*, https://www.anatel.gov.br/dados/mapeamento-de-redes (accessed on 13 September 2019).

Challenges persist in achieving full coverage of backhaul connectivity: 51% of municipalities without fibre are in the North and Northeast regions. The state of Minas Gerais, which has the largest number of municipalities in the country, accounts for 26% of those municipalities without backhaul. However, comparing availability of backhaul connectivity by number of municipalities can be misleading. The largest states are the Amazonas and Pará in the North region, where one municipality in Pará (Altamira), is roughly the size of Portugal with a population of around 110 000. As such, a municipality may have the presence of backhaul in a given area, but given the heterogeneity in the size of municipalities in Brazil, the presence of backhaul is not a measure of geographic coverage of this wholesale input.

Previous OECD research identified a serious obstacle for the development of Internet infrastructure in a given country. If an incumbent dominates the market for backhaul and co-location, it may prevent the emergence of independent co-location facilities (OECD, 2014[33]). In Brazil, 47.7% of municipalities with fibre backhaul have two or more backhaul connectivity providers, whereas 24.2% of them have only one (Table 3.1).

Table 3.1. Number of fibre backhaul providers in municipalities in Brazil (2019)

Backhaul providers (fibre)	Number of municipalities	Share of municipalities (%)
0	1 558	28.0
1	1 350	24.2
2	1 031	18.5
3	593	10.6
4	406	7.3
5 or more	632	11.3

Source: Anatel (2020[3]), *Plano Estrutural de Redes de Telecomunicações (PERT) 2019-2024, Atualizaçao 2020*, https://sei.anatel.gov.br/sei/modulos/pesquisa/md_pesq_documento_consulta_externa.php?eEP-wqk1skrd8hSlk5Z3rN4EVg9uLJqrLYJw_9INcO4m2N1jXIPEu1rXnv7UHJFGKd-jO_xz5ZYqyuXgvKFPZe9U7a4FRauel0Ej_GJ3pzD2sKi_sQQhtHNHQk_javEK.

As reliable connectivity is essential for the digital transformation, ensuring network resilience and capacity becomes increasingly important. Extending fibre deeper into networks is key to ensure these can cope with the increasing demands in IP traffic.

The recent COVID-19 crisis has highlighted the importance of capacity and resilience of the Internet infrastructure. Along the entire Internet value chain, fixed and mobile broadband operators, content and cloud providers, and points where Internet networks connect to each other to exchange traffic, called Internet exchange points (IXPs), are experiencing as much as 60% more Internet traffic than before the outbreak. In this unprecedented situation, the resilience and capability of broadband networks has become even more critical.

In addition to ensuring network resilience and capacity, with the digital transformation of all sectors of the economy through 5G networks and the proliferation of IoT and AI applications, it becomes essential to enhance the digital security of communication networks and ensure "security by design".

Autonomous systems and IPv6

A well-functioning communication infrastructure includes an efficient exchange of Internet traffic. The allocation of autonomous system numbers and IP addresses is the foundation of Internet activities. Autonomous systems are the networks that form the Internet (a network of networks). They range from large ISPs to small local ISPs, academic, military or government networks, or firms with a particular need for network independence (OECD, 2007[34]).

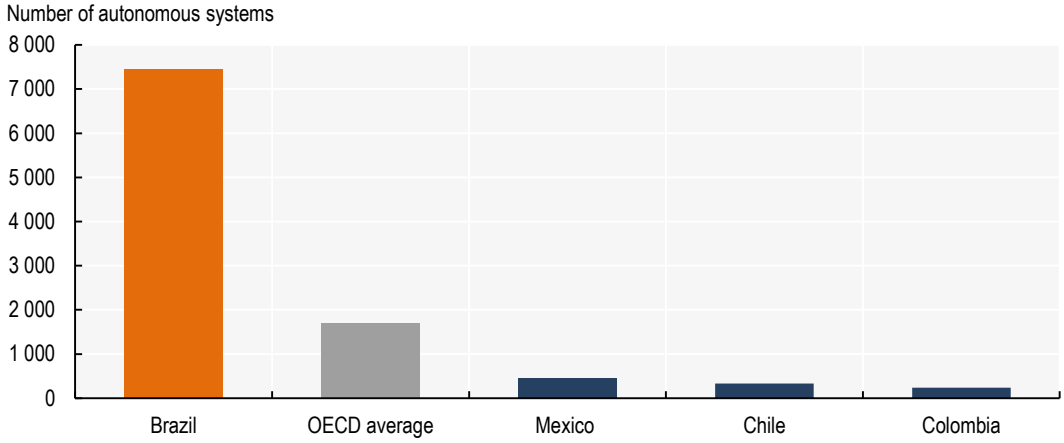
In the last 15 years, Brazil registered a high number of new autonomous systems. As of February 2020, Brazil had 7 451 autonomous systems, 16 times more than Mexico (450) and more than quadruple the OECD average (1 703) (Figure 3.26). The large increase in autonomous systems in Brazil starting in 2008 coincides with measures to deploy the newer version of the Internet Protocol, IPv6.

One potential challenge for the future of the Internet is its ability to scale to connect tens of billions of devices and machines, and a key aspect of that scalability is the use of the Internet Protocol (IP). The IP specifies how communications take place between one device and another through an addressing system. Two versions of the IP are in use. In IPv4, the distribution of unassigned addresses is largely exhausted. While IPv6 is plentiful, adoption has been slower than desired.

Encouraging deployment of IPv6 has been a long-standing goal for OECD countries. With regards to development of the IoT, IPv6 is important for two reasons. In addition to scalability, it could be more conducive to end-to-end encryption. Such encryption could be favourable for the security of industrial IoT applications. In addition, the increase in transaction

costs linked to IPv4 address exhaustion may hinder development of new applications and services (OECD, 2014[35]; OECD, 2018[36]).

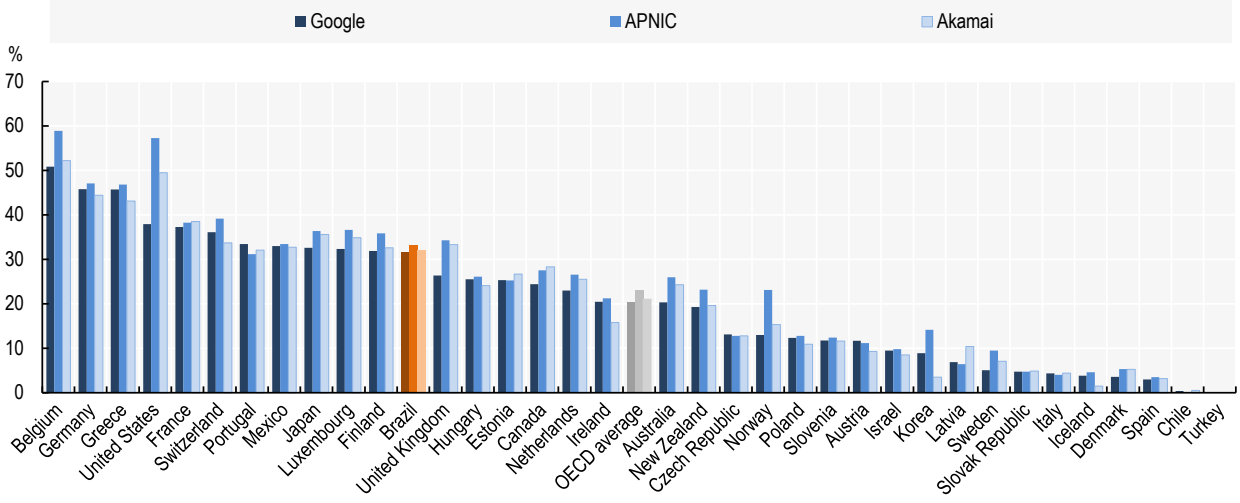
Figure 3.26. Autonomous systems in Brazil compared to regional peers and the OECD average (2019)



Source: Maigron (2020[37]), *Regional Internet Registries Statistics* (database), https://www-public.imtbs-tsp.eu/~maigron/RIR_Stats/ (accessed on 19 February 2020).

As with the number of autonomous systems, Brazil is ranking well compared to OECD countries in terms of IPv6 adoption (Figure 3.27). IPv6 adoption can be measured in different ways. Akamai provides data on the share of traffic transiting its Content Delivery Network that uses IPv6; data from Google indicates the share of users accessing its search engine via IPv6, and data from APNIC presents the share of Internet addresses provided by Regional Internet Address Registries that are IPv6-compliant.

Figure 3.27. Percentage of IPv6 addresses among all registered IP addresses in OECD countries and in Brazil (2020)



Note: Registered IPv6 addresses ranked by Google statistics.
Sources: Google (2020[38]), *Per-country IPv6 adoption*, https://www.google.com/intl/en/ipv6/statistics.html#tab=per-country-ipv6-adoption (accessed on 20 February 2020); APNIC (2020[39]), *IPv6 Measurement Maps*, http://stats.labs.apnic.net/ipv6 (accessed on 20 February 2020); Akamai (2020[40]), *State of the Internet: IPv6 Adoption Visualization*, https://www.akamai.com/us/en/resources/our-thinking/state-of-the-internet-report/state-of-the-internet-ipv6-adoption-visualization.jsp (accessed on 20 February 2020).

The increase in autonomous systems and the adoption of IPv6 addresses have been mainly driven by the Brazilian Network Information Centre (Núcleo de Informação e Coordenação, NIC.br) (Box 3.1). NIC.br decisions and projects are approved by CGI.br, the Brazilian Internet Steering Committee (Comitê Gestor da Internet), the entity that co-ordinates and integrates Internet service in Brazil. In addition, Anatel has an action plan for communication service providers to deploy IPv6 capabilities in all their main network equipment (Anatel, 2014[41]).

Box 3.1. The role of NIC.br in IPv6 deployment

Compared to OECD countries and other Latin American countries, Brazil has a large number of registered IPv6 addresses. NIC.br played a significant role in boosting IPv6 uptake. It worked through the Center for Studies and Research in Network Technology and Operations (Centro de Estudos e Pesquisas em Tecnologia de Redes e Operações). Actions taken to raise awareness and develop capacity among stakeholders, since 2008, in the public and private sectors to promote IPv6 deployment include:

- Co-ordination meetings, involving regional ISPs, communication operators, Anatel and other government agencies, equipment vendors, financial institutions and other actors. These address themes such as IPv4 depletion, problems caused by adoption of Carrier Grade Network Address Translation, strategies to adopt IPv6, etc. These meetings fostered actions towards IPv6 deployment in all participant sectors.
- Events, such as a series of open sessions "Breakfast with IPv6", and technical conferences "Brazilian IPv6 Forum", to reach out to a broad audience.
- Trainings: 200 technical training classes were held between 2008-19, engaging 6 000 professionals from the main regional ISPs, communication operators, universities, government agencies, financial institutions, and other networks and actors. These trainings gave participants enough knowledge about IPv6 to start practical actions to deploy it in their respective networks.
- Other courses, trainings, lectures, etc. For instance, more than 70 lectures were held at universities and academic institutions, and tens of speeches and lectures were given in meetings promoted by ISP associations in Brazil.
- Workshops, such as the 2018 and 2019 Internet Governance Forum.

Source: NIC.br (2020[42]), *NIC.br e CGI.br trabalhando para a melhoria da Internet no Brasil: Activdades*, www.nic.br/atividades/.

Internet exchange points

National fibre backbones, submarine cables and IXPs play a crucial role in IP interconnection. Several national broadband plans in the Latin America and Caribbean (LAC) region, including in Brazil, have focused on extending backbone and backhaul connectivity. Moreover, some analysts have highlighted the importance of regulation to ensure access to backbone and backhaul infrastructure by small and medium-sized network operators (Cavalcanti, 2010[43]). IXPs allow for access providers to interconnect with each other and the national backbone, fostering Internet traffic exchange.

Table 3.2. Internet exchange points in Brazil

City	Name	Participants	Average traffic (Gbps)
São Paulo	PTT Metro São Paulo	1 724	4 870
Rio de Janeiro	PTT Rio de Janeiro	319	967
Porto Alegre	PTT Porto Alegre	202	162
Fortaleza	PTT Fortaleza	181	328
Belo Horizonte	PTT Belo Horizonte	123	9.2
Curitiba	PTT Curitiba	103	103
Recife	PTT Recife	82	8.4
Salvador	PTT Salvador	74	15.4
Campina Grande	PTT Campina Grande	71	12.7
Brasilia	PTT Brasília	62	14.4
Maringá	PTT Maringá	56	3.8
São Paulo	Equinix São Paulo	50	100
Campinas	PTT Campinas	48	14
Florianópolis	PTT Florianópolis	45	3.8
Natal	PTT Natal	36	7.3
Londrina	PTT Londrina	34	17
Belém	PTT Belém	31	6
Manaus	PTT Manaus	30	1
Goiânia	PTT Goiânia	29	3.5
Aracajú	PTT Aracajú	27	0.16
Lajeado	PTT Lajeado	26	17
Vitória	PTT Vitória	23	4.2
Teresina	PTT Teresina	19	2.1
São José do Rio Preto	PTT São José do Rio Preto	18	1.5
Santa Maria	PTT Santa Maria	17	1.9
Cuiabá	PTT Cuiabá	17	0.218
São Luís	PTT São Luís	16	0.5
Foz do Iguaçu	PTT Foz do Iguaçu	15	1.6
Maceió	PTT Maceió	14	1.1
São José dos Campos	PTT São José dos Campos	13	0.227
João Pessoa	PTT João Pessoa	12	7.8
Caxias do Sul	PTT Caxias do Sul	6	0.28
Blumenau	FURB Internet Exchange	3	0.7
Ponta Grossa	UEPG Internet Exchange	3	0.75

Note: PTT = Ponto de Troca de Tráfego (Portuguese for IXP); Gbps = gigabits per second.
Source: Packet Clearing House (2020[44]), *Internet Exchange Directory* (database), https://www.pch.net/ixp/dir (accessed on 18 February 2020).

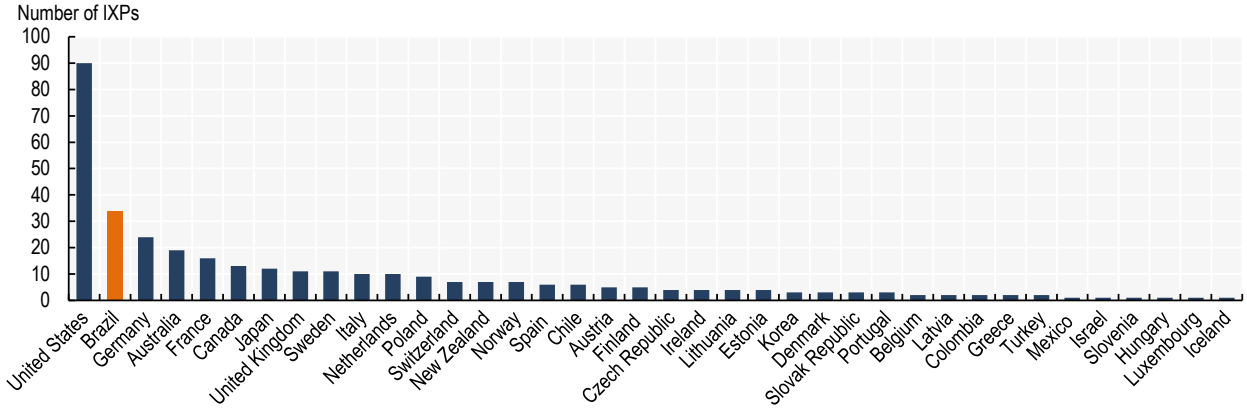
IXPs keep traffic local (Weller and Woodcock, 2013[45]). For an IXP to function well, multiple players would ideally exchange an important amount of traffic in the Internet ecosystem. Websites and content should also be ideally hosted in close proximity. This keeps the exchange of traffic local rather than routing data via other countries, which would increase latency and might be more costly. A significant amount of data routed via other countries often indicates a suboptimal development of the Internet traffic exchange market in a given country.

Brazil has built up a substantial number of IXPs. It is the leading country in the region for the overall number of IXPs, IXP participants and total traffic exchanged. IXPs exist in all major cities throughout the country via the Brazilian IXP System, the PTT (Ponto de Troca de Tráfego) Metro system.

Brazil has 34 active IXPs with more than 3 500 participants that exchange traffic at the national level (Table 3.2). The number of IXPs depends on a range of factors, including the size of the economy and the geography of a country. Brazil has a higher number of IXPs than many OECD countries (Figure 3.28).

The PTT Metro São Paulo is one of the largest IXPs in the world in terms of participants and the third largest IXP in terms of average traffic. It has more than 1 700 participants and an average traffic of around 4.8 Tbps (Packet Clearing House, 2020[44]). For average traffic, it follows only the Deutsche Commercial Exchange Frankfurt, Germany with 5.8 Tbps and the Amsterdam Internet Exchange, Netherlands with 5.6 Tbps (Packet Clearing House, 2020[44]). This enables operators in Brazil to exchange local traffic at the closest IXP with all the attendant benefits. It also helps Brazil avoid shifting traffic to another country and then back again (i.e. IP traffic "tromboning") as many countries still must do. A number of foreign South American providers also rely on the PTT Metro São Paulo, which functions as a continental hub.

Figure 3.28. Number of IXPs in Brazil and in OECD countries (2019)

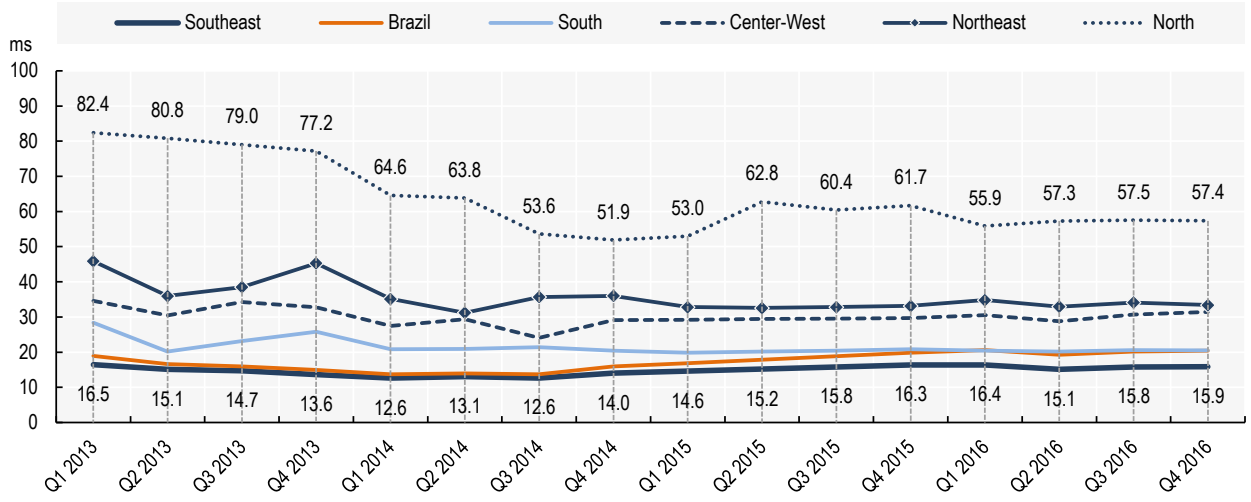


Note: Only IXPs listed with at least three participants are included.
Source: Packet Clearing House (2020[44]), *Internet Exchange Directory* (database), https://www.pch.net/ixp/dir (accessed on 18 February 2020).

As could be expected, latency is lowest in the Southeast Region of Brazil, where most IXPs and the two largest IXPs (São Paulo and Rio de Janeiro) are situated (Figure 3.29). The median latency in the Southeast and the North is 15.9 ms and 57.4 ms, respectively. The elevated latency in the North further demonstrates the low availability of backhaul in the region. Moreover, the low availability of backhaul also results in differences in the amount of traffic interchanged. The Manaus IXP, the largest in the North region with 30 participants, had an average traffic of only 1.3 Gbps. The Aracajú IXP, in the Northeast region, with a comparable number of participants, had a peak traffic of 0.16 Gbps in February 2020 (Packet Clearing House, 2020[44]).

There has to be enough local traffic to exchange significant amounts of traffic at a specific IXP. It is also preferable that websites and content are hosted close (i.e. domestically) to this IXP. To date, around 89% of Brazilian companies use the .br domain and 3% use one of the various Brazilian subdomains (CGI.br, 2018[28]). Nevertheless, high usage of the Brazilian country code top-level domain (ccTLD) ".br", does not necessarily indicate that the respective content is also hosted in Brazil. In fact, data collected in 2013 showed that only 54% of Brazilian websites using the ccTLD ".br" are hosted in the country facilities (OECD, 2014[33]). This may indicate that certain website owners do not perceive it to be cost-effective to store their content locally. There may also be challenges to establish the infrastructure needed to host content locally, as discussed further below.

Figure 3.29. Median latency in Brazil, total and per region (2013-16)



Notes: ms= millisecond. Latency is the time for a message to go to a destination and back.
Source: NIC.br (2018[17]), "Banda Larga no Brasil: um estudo sobre a evolução do acesso e da qualidade das conexões à Internet", https://cetic.br/media/docs/publicacoes/1/Estudo%20Banda%20Larga%20no%20Brasil.pdf.

The PTT Metro system is managed by NIC.br under the mandate of CGI.br, which also manages the ccTLD ".br". An interesting feature of Brazilian Internet infrastructure management is that the revenues from the domain name registration support improvements in Internet management and infrastructure. Among others, this includes programmes to enhance traffic management, measure the quality of broadband connections and support IPv6 adoption. NIC.br also invests its revenues in the implementation and operation of IXPs. The extensive number of active IXPs can therefore be attributed to the establishment of the .br domain, its success and the way its revenues are used (Box 3.2).

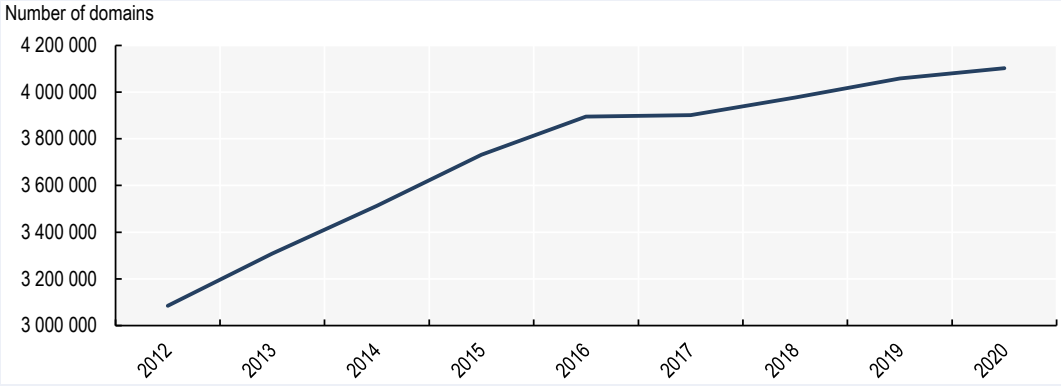
Box 3.2. The .br domain

The year 2019 marked the 30th anniversary of the ccTLD .br, which as of December 2019 had over 4 million registered domains (Figure 3.30). The emergence of Internet exchange points (IXPs) in Brazil is closely tied to the history of the .br ccTLD. Through the revenues generated by the .br domains, NIC.br (under CGI.br) funds activities to deploy IXPs and other projects in Brazil.

Initially, ".br" was used to identify machines in the academic environment, and registrations were few and done manually. In 1989, Jon Postel from the Internet Assigned Numbers Authority, responsible for the assignment of top-level domains, assigned .br to the team that, at the time, operated academic networks at the São Paulo Research Foundation.

In 1991, the subdomains "gov.br", "com.br", "net.br", "org.br" and "mil.br", respectively referring to the government, companies, non-profit organisations and armed forces, were established. Driven by the commercialisation of the Internet at the end of 1994, the ".br" grew rapidly. From 851 domains registered in 1995, it reached more than 7 500 domain names in the month of December 1996. The process started to be automated and the mark of 1 million domains was reached in 2006, only ten years later.

Figure 3.30. Number of .br domains (2012-20)



Note: Estimates as of February 2020.
Source: NIC.br (2020[46]), *Estatísticas: Domínios .br Registrados até o Momento*, https://registro.br/estatisticas.html (accessed on 20 January 2020).

As of April 2019, ".br" is the seventh most popular domain in the world. With the creation of new subdomains, it now provides for more than 120 different options. Among others, there are subdomains to identify specific interests (such as "ong.br", "art.br", "eco.br"), or cities (e.g. "rio.br", "manaus.br", "cuiaba.br", "floripa.br", "foz.br").

Source: Convergência Digital (2019[47]), ".br completa 30 anos com 4 milhões de domínios registrados," https://www.convergenciadigital.com.br/cgi/cgilua.exe/sys/start.htm?UserActiveTemplate=site&infoid=50498&sid=4 (accessed on 20 February 2020).

Submarine fibre cables

Brazil is well-served by multiple submarine fibre cables, which form the backbone of the international communication infrastructure. These cables are deemed less prone to failure than over-land cables and can carry large amounts of data. With around 378 cables in service worldwide as of early 2019 (TeleGeography, 2019[48]), around 99% of all intercontinental Internet data traffic is exchanged via the submarine fibre infrastructure.

Currently, 19 cables land in Brazil, giving the country access to a network of nearly 180 000 km (TeleGeography, 2020[49]). Out of 19 cables, 7 were added between 2017-18, and 5 were planned for service in 2020 or 2021, reflecting the growth of submarine fibre connectivity. The largest cables, South America-1 (SAm-1) and GlobeNet, with 25 000 km and 23 800 km respectively, were deployed in 2000 and 2001 (Table 3.3). Many of the landing stations are in Fortaleza, Santos and Rio de Janeiro, but most land in Fortaleza. This may be for its location, as it represents Brazil's closest point to Africa and Europe.

Table 3.3. Submarine fibre cables in Brazil

Name	Owner	Length (km)	Established/ ready for service	Landing points in Brazil	International landing points
South America-1 (SAm-1)	Telxius	25 000	2001	Fortaleza, Rio de Janeiro, Salvador, Santos	Chile, Colombia, United States, Argentina, Peru, Guatemala, Dominican Republic, Ecuador
GlobeNet	BTG Pactual	23 500	2000	Fortaleza, Rio de Janeiro	Colombia, United States, Venezuela, Bermuda

Name	Owner	Length (km)	Established/ ready for service	Landing points in Brazil	International landing points
South American Crossing (SAC)	Telecom Italia Sparkle, CenturyLink	20 000	2000	Fortaleza, Rio de Janeiro, Santos	Colombia, Panama, Argentina, Peru, Venezuela, United States, Chile
América Móvil Submarine Cable System-1 (AMX-1)	América Móvil	17 800	2014	Fortaleza, Rio de Janeiro, Salvador	Colombia, Mexico, United States, Guatemala, Dominican Republic
BRUSA	Telxius	11 000	2018	Fortaleza, Rio de Janeiro	United States
Seabras-1	Seaborn Group	10 800	2017	Praia Grande	United States
Monet	Angola Cables, Google, Algar Telecom, Antel Uruguay	10 556	2017	Fortaleza, Santos	United States
Atlantis-2	Consortium	8 500	2000	Fortaleza	Portugal, Spain, Senegal, Argentina, Cape Verde
Americas-II	Consortium	8 373	2000	Fortaleza	Venezuela, French Guiana, United States, Martinique, Trinidad and Tobago. Aruba, Bonaire, Curaçao, Saba, Saint Eustatius, Saint Maarten
EllaLink	EllaLink Group	6 200	2020	Fortaleza, Praia Grande	Portugal, French Guiana, Cape Verde
South Atlantic Cable System (SACS)	Angola Cables	6 165	2018	Fortaleza	Angola
South Atlantic Inter Link (SAIL)	Camtel, China Unicom	5 900	2018	Fortaleza	Cameroon
Brazilian Festoon	Embratel	2 543	1996	Aracajú, Atafona, Ilhéus, João Pessoa, Macaé, Maceió, Natal, Porto Seguro, Recife, Rio de Janeiro, Salvador, Sitio, São Mateus, Vitória	x
Malbec	GlobeNet, Facebook	2 500	2020	Praia Grande, Rio de Janeiro	Argentina
Tannat	Google, Antel Uruguay	2 000	2018	Santos	Argentina, Uruguay
Junior	Google	390	2018	Rio de Janeiro, Santos	x

Note: x = not applicable.
Source: TeleGeography (2020[49]), *Submarine Cable Map*, https://www.submarinecablemap.com/#/country/brazil (accessed on 20 February 2020).

Data centres

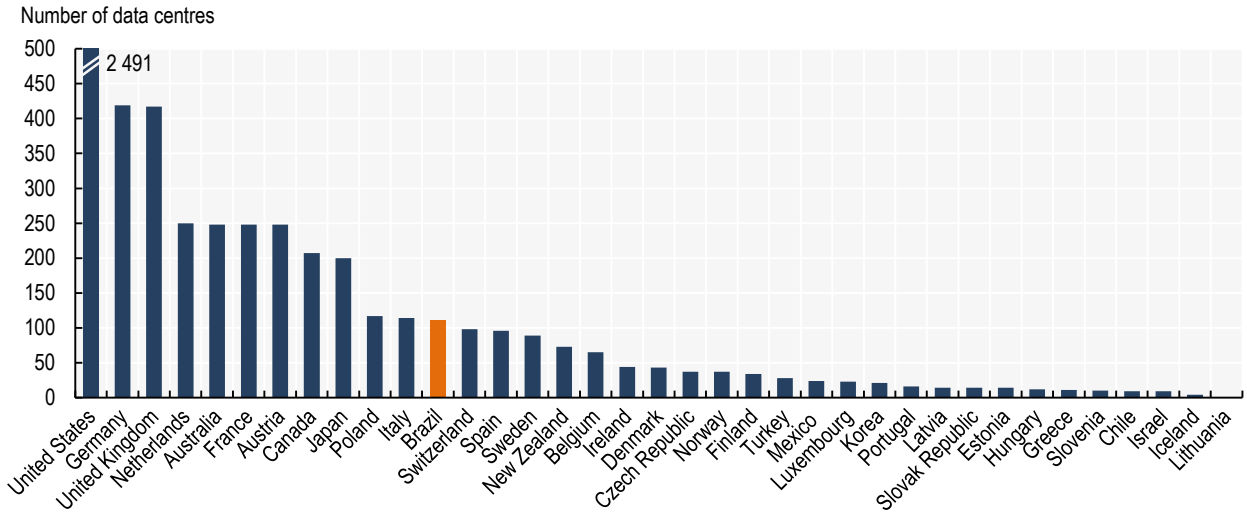
Brazil has a considerable number of data centres (111) (Cloudscene, 2019[50]) compared to OECD countries (Figure 3.31). In addition, Amazon Web Services, the cloud computing arm of Amazon, announced an investment of around USD 230 million over 2020 and 2021 to expand its data centre infrastructure in Brazil (Goodison, 2020[51]).

Data centre deployment can be further improved in Brazil. The low amount of content hosted locally may indicate a non-competitive environment that is not attractive to website owners. In fact, data centre services may be comparatively more expensive in Brazil. Bigger companies may also refrain from deploying in-house data centres in Brazil for a number of reasons.

Energy represents a major input for data centres. Energy prices in Brazil are comparatively high (Figure 3.45) perhaps in part because the energy sector, like the communication sector,

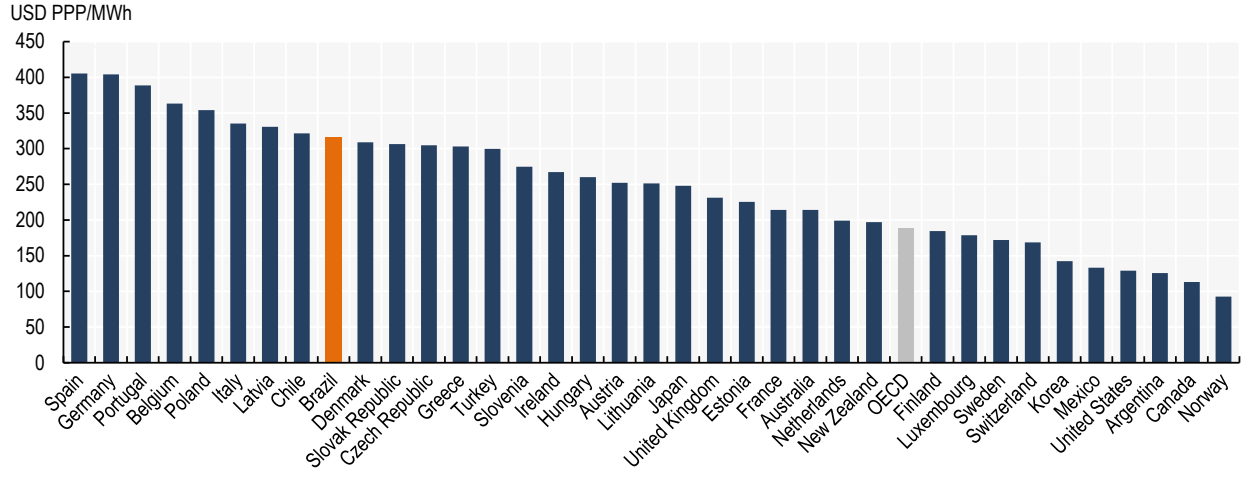
is taxed through the state-level ICMS tax. In 2017, Brazilian companies paid almost twice as much (USD PPP 269) per MWh as the OECD average (USD PPP 143).

Figure 3.31. Number of data centres in OECD countries and in Brazil (2019)



Note: This statistic relies on self-reported data and may therefore only serve as a rough estimate.
Source: Cloudscene (2019[50]), *Markets: Brazil* (database), https://cloudscene.com/market/data-centers-in-brazil/all (accessed on 5 October 2019).

Figure 3.32. Energy end-user prices in OECD countries and in Brazil (2017)



Note: PPP = purchasing power parity; MWh = megawatt-hour.
Source: IEA (2019[52]), "Energy Prices and Taxes for OECD Countries 2019", https://doi.org/10.1787/71612f7e-en (accessed on 18 February 2020).

In addition, communication network quality, capacity and prices may hold investors back from deploying data centres. Prices are especially critical for cloud services, as for its generally high volume/low price business models. Bureaucracy related to land acquisition and permits, as well as municipal approval of construction projects, is also cited as a common hindrance. Furthermore, some experts reported that some Brazilian states may try to classify cloud services as telecommunication services that are subject to ICMS. This, in turn, would make cloud services expensive.

Moreover, capital goods for data centres must often be imported. As discussed, there are high tariffs on imports unless there is no comparable product made in Brazil. Additionally, if a foreign company that aims to establish a data centre in Brazil is designing its own infrastructure and technology, it has to send parts of the infrastructure to Brazil for testing before importing and deploying the data centre (Chapter 7).

Spectrum availability

Availability of spectrum is a key factor and underlying condition of the competitive dynamics of mobile markets in Brazil. Anatel is in charge of spectrum management and licensing. Before the 2019 reform of the General Telecommunications Law (Lei Geral de Telecomunicações, LGT), spectrum licences for mobile services lasted 15 years in Brazil. They were renewable once for the same length of time in line with Anatel Resolution No. 321 of 27 September 2002, which is under review (Anatel, 2002[53]).

For the licensing, Anatel has approved a comprehensive set of regulations and a framework for spectrum valuation. Spectrum caps used in auctions were updated to address demand and, simultaneously, maintain competition in the sector. With the LGT reform in October 2019, Law No. 13 879 allows the successive renewal of spectrum licences indefinitely without an auction (Chapter 5).

The total amount of allocated spectrum for mobile services in Brazil (Serviço Móvel Pessoal) in 2020 amounts to 1 179 MHz in bands below 6 GHz (Anatel, 2020[54]; Anatel, 2018[55]). Namely, 204 MHz have been allocated in frequency bands below 1 GHz; 575 MHz in frequency bands between 1 and 3 GHz; and 400 MHz in the 3.5 GHz band. In addition, Brazil has identified mmWave spectrum to be allocated for international mobile telecommunications (IMT), i.e. 6 400 MHz of spectrum in the 26 GHz frequency band.

Regarding spectrum availability in the market, by 2019, 629 MHz of spectrum had been assigned through auctions. Most of the spectrum assigned is concentrated in the 1.7-2.1 GHz band (also known in some countries as the AWS band), the 2.3 GHz band and the 2.5 GHz band. Regarding the 700 MHz band (i.e. the digital dividend band), 60 MHz was assigned in 2014, with 20 additional MHz planned for the upcoming 5G auction. Furthermore, the government will make an additional 400 MHz available in the 3.5 GHz band, 90 MHz in the 2. 3 GHz band and 3 200 MHz in the 26 GHz band through the upcoming 5G auction expected by the beginning of 2021 (Figure 3.33).

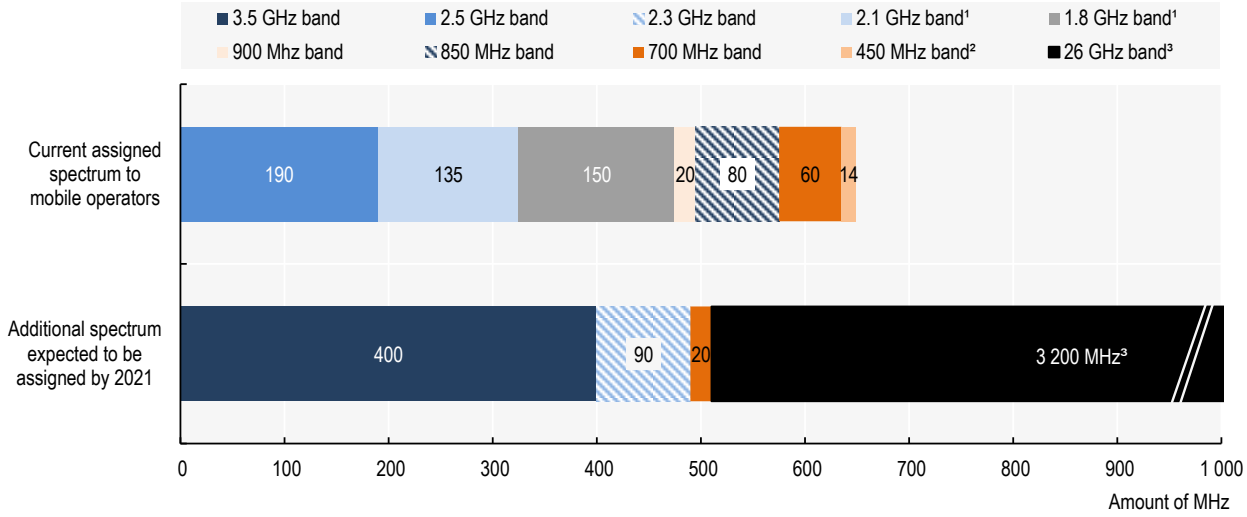
The deployment of 5G commercial networks in Brazil is likely to begin in 2021, after the spectrum auction takes place. The 3.5 GHz and 26 GHz frequency bands were chosen as the pioneer bands for 5G in Brazil.

Spectrum auctions can shape competition dynamics in the telecommunication sector. Specifically, the design of the blocks, along with other factors, can determine how many strong mobile players will prevail in mobile markets in years to come. Thus, the design of spectrum auctions becomes vital for communication markets.

Two key policy objectives should be considered when designing future spectrum auctions in Brazil (e.g. upcoming auction intended for 5G): increasing coverage of communication networks and enhancing competition in mobile markets. The design of spectrum auctions depends on three main elements: reserve prices, coverage obligations and spectrum caps. For example, spectrum caps are widely used in OECD countries for encouraging entry and addressing dominance (OECD, 2014[56]).

Coverage obligations can contribute to a broader coverage of the population in rural and remote areas. However, the extent of coverage obligations should not impede certain actors from bidding in the auction (OECD, 2019[57]). See Chapter 5 for more details.

Figure 3.33. Spectrum availability in Brazil (2019) in MHz assigned through auctions



1. 1.7-2.1 GHz corresponds to the AWS band in other countries.
2. Anatel is revoking the 450 MHz frequency licences, and operators have challenged the decision.
3. The amount of spectrum that will be available in the 26 GHz band corresponds to 3 200 MHz.

Note: GHz = gigahertz; MHz = megahertz.

Sources: Anatel's response to the questionnaire of the review; Amaral (2019[58]), *Com recorde de 3,6 GHz, edital do leilão 5G chega ao conselho na semana que vem*, http://teletime.com.br/22/05/2019/com-recorde-de-36-ghz-edital-do-leilao-5g-chega-ao-conselho-na-semana-que-vem/.

Competition in fixed and mobile markets

Communication market participants

In Brazil, the largest players in the telecommunication market are Telefónica's Brazilian subsidiary, Telefônica Brasil with the brand name Vivo (hereafter "Vivo"); América Móvil's Brazilian subsidiary Claro Brasil with the brand name Claro (hereafter "Claro"); Oi; and Telecom Italia's Brazilian subsidiary, Tim Brasil, with the brand name TIM (hereafter "TIM") (Table 3.4). Leading providers differ depending on the market segment (i.e. fixed voice, mobile voice, broadband, fixed broadband and pay TV).

The main mobile voice and mobile broadband players are Vivo, Claro, TIM and Oi. The main fixed broadband players are Claro, Vivo and Oi. Claro, Vivo and Oi are also present in the pay TV market. A major player in the pay TV market is Sky Brasil, which was acquired by DirectTV in 2010, and has become part of AT&T.

As described in Chapter 2, the telecommunication sector in Brazil liberalised during the 1990s with the support of the LGT. The privatisation of Telebrás, the State-owned company, took place in July 1998. It was split into the long-distance operator (Embratel), three regional fixed-line companies and eight wireless carriers. Telebrás was re-established as a State-owned company in 2010.

Embratel is the historical long-distance fixed incumbent in the private sector. Although created in 1965 as a public company as part of the Telebrás system, Embratel became a

privately owned company in 1998. At first, MCI acquired the controlling stake of the company in the privatisation auction on 29 July 1998. In July 2004, Teléfonos de México S.A. de C.V. ("Telmex") acquired the controlling stake of 98.42%.

Table 3.4. Main players in the Brazilian communication markets

Communication player	Markets where it operates	Ownership structure
Telebrás	Public company to fulfil national broadband policies	Mixed (public ownership re-instated in 2010, where the government owns 89.45% of shares)
América Móvil (Claro)	Fixed voice, fixed broadband, mobile, pay TV	América Móvil (83.72%), others (16.28%)
Embratel	Long-distance fixed incumbent of wholesale access services	América Móvil (98.42%)
Oi	Fixed voice, fixed broadband, mobile, pay TV	Goldentree Asset Management LP (14.95%), York Global Finance Fund LP (11.44), Bratel S.A.R.L. (5.08%), Brookfield Asset Management Inc. (5.92%), Solus Alternative Asset Management LP (3.47%) and others (59.14%)
Telefônica Brasil (Vivo)	Fixed voice, fixed broadband, mobile, pay TV	Telefónica Spain (94.31%), institutional holdings (5.69%)
Telecom Italia (TIM)	Fixed voice, fixed broadband, mobile, pay TV	Telecom Italia (67%), others (33%)
Algar Telecom	Fixed voice, fixed broadband, pay TV	Algar S.A (67.74%), Archy LLC (25.3%), others (6.96%)
Sky Brasil	Pay TV	AT&T (93%), others (7%)
Globo	Media holding (Free-To-Air [FTA] TV and radio broadcasting, pay TV channel and other media)	Grupo Globo
Record	Media holding (FTA TV and radio broadcasting, pay TV channel and other media)	Grupo Record
Band	Media holding (FTA TV and radio broadcasting, pay TV channel)	Grupo Bandeirantes
SBT	Broadcasting (FTA TV)	Grupo Silvio Santos

Dynamics of fixed voice and fixed broadband markets

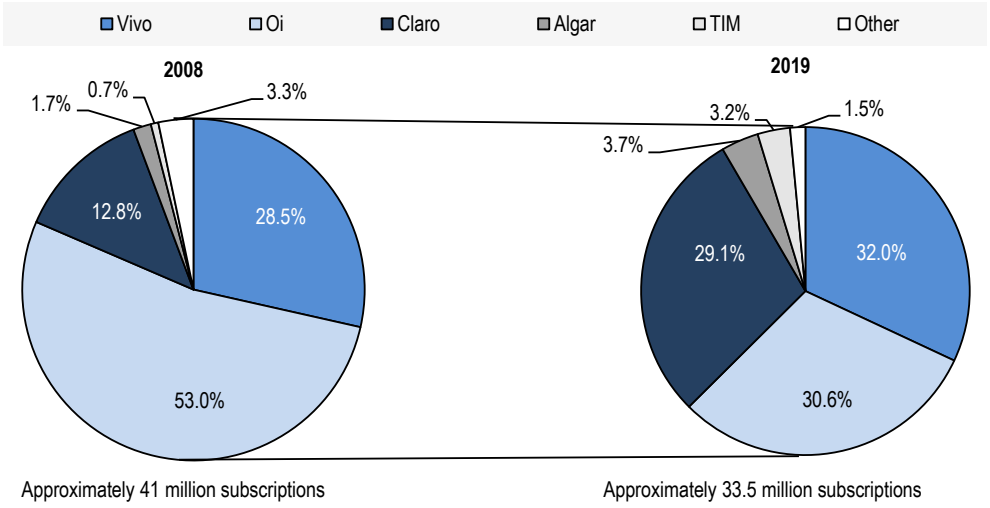
Apart from pricing and investment, the evolution of market shares is a further indicator of the level of competition in the market.

The largest players in the fixed telephony market in 2019 were Vivo, Oi and Claro. Over the past decade, the market share of Oi, measured in terms of subscribers, significantly decreased from 53% to 30.6% between 2008 and 2019. During the same period, Claro more than doubled its market share, rising from 12.8% to 29.1%. The market share of Vivo increased slightly during the period from 28.5% to 32% (Figure 3.34).

The fixed broadband market nearly tripled between 2008 and 2019, with subscriptions moving from some 11 million to 32.9 million. The three largest providers of fixed broadband in 2019 covered 66.4% of the market. They were Claro (29.1% market share), Vivo (21.3%) and Oi (16%) (Figure 3.35). Claro has gained the most market share during the period, passing from 11.2% to 29.1%. Its expansion in fixed networks is related to Claro's ownership of Embratel (the fixed incumbent of wholesale access services in Brazil) and Net (a highly successful cable operator in Brazil).

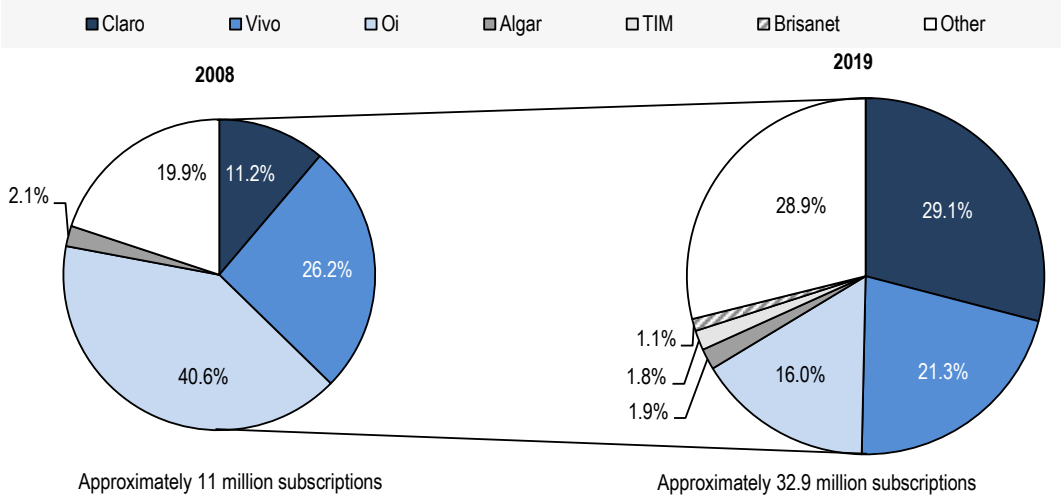
The fixed broadband market in Brazil is largely heterogeneous. There are more than 13 000 ISPs in Brazil, which include both large and small operators. The large ones offer bundles of communication services, while the small ones operate in remote areas not yet commercially attractive to larger ISPs.

Figure 3.34.Fixed telephony market shares as percentage of subscribers in Brazil (2008 and 2019)



Source: Anatel (2020[8]), *Painéis de Dados: Accesos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

Figure 3.35. Fixed broadband market shares as percentage of subscribers in Brazil (2008 and 2019)



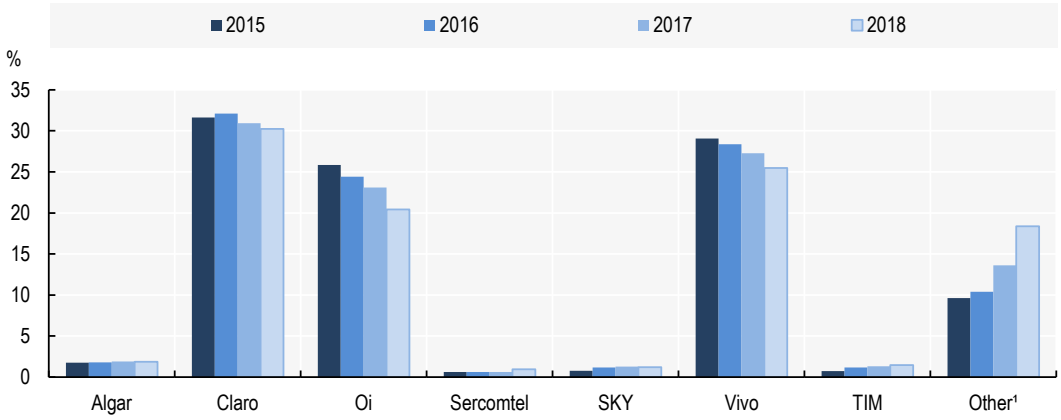
Source: Anatel (2020[8]), *Painéis de Dados: Accesos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

"Small regional" broadband access providers have grown in recent years ("Others", in Figure 3.36). More than one-third (35.4%) of cities have two or more backhaul providers with fibre in Brazil. This may have also been conducive to the growth of regional providers.

"Small providers" (Prestadores de Pequeno Porte) are defined as ISPs with a national market share of less than 5%. According to Anatel, these providers are expanding their fixed broadband networks, and have been using fibre to expand them. These providers are already present with fibre in 2 451 municipalities; 783 rely solely on these small providers for fibre access (Anatel, 2020[3]).

In 2018, small ISPs accounted for 18.4% of Brazil's fixed broadband subscriptions (Figure 3.36). According to Anatel, this figure rose above 20% in 2019. Overall, those small providers drive competition in the Brazilian market and contribute to deploy fibre deeper into the Brazilian networks.

Figure 3.36. Share of fixed broadband subscriptions per ISP in Brazil (2015-18)

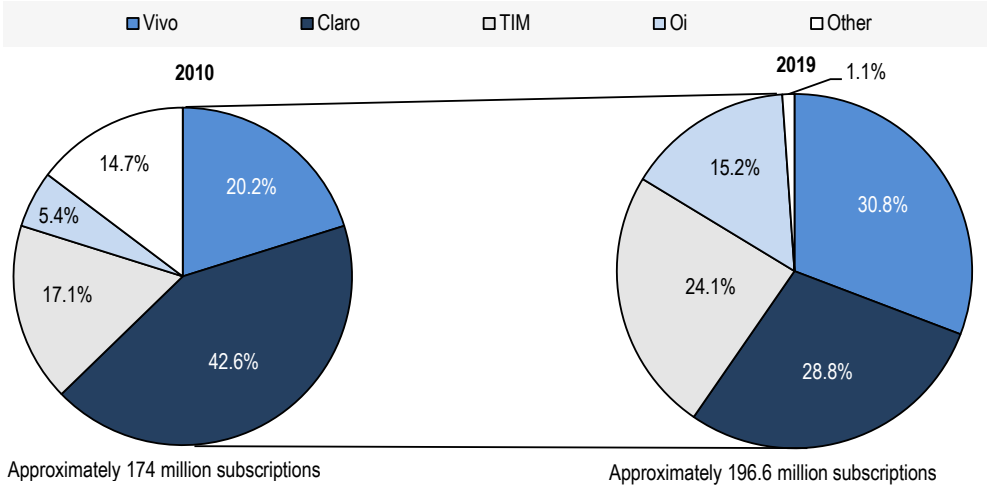


1. Small Internet service providers.
Source: Anatel (2019[59]), *Plano Estrutural de Redes de Telecomunicações (PERT)*, www.anatel.gov.br/dados/pert.

Dynamics of mobile voice and mobile broadband markets

The three largest players in the mobile voice telephony market in 2019 were Telefônica Brasil (Vivo) with around 32.9% market share, Telecom Americas (Claro Brasil) with 25.5% market share and TIM with 24% of total subscribers (Anatel, 2020[8]).

Figure 3.37. Mobile broadband market shares as percentage of subscribers in Brazil (2010 and 2019)



Source: Anatel (2020[8]), *Painéis de Dados: Accesos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

Mobile broadband market shares in the past nine years have evolved. In 2019, Vivo led the market with a share of roughly 30.8%, followed by Claro (28.8%) and TIM (24.1%). In

2008, Claro was the leading mobile network operator (MNO) with a market share of 42.6%, more than twice than Vivo (20.2%) (Figure 3.37). Claro acquired Nextel in March 2019; Anatel approved the transaction in September 2019. Therefore, Claro's market share in 2019 includes Nextel's subscribers.

During the past nine years, the size of the market has grown from approximately 174 million mobile broadband subscriptions to 196.6 million (Figure 3.37). Meanwhile, other smaller MNOs had a combined market share of 1.1% (e.g. Algar and Sercomtel). Finally, several mobile virtual network operators (MVNOs) accounted for less than 0.01% of the market (Teleco, 2019[60]).

There are 22 MVNOs in Brazil: 8 authorised (either service providers, enhanced service providers or full MVNOs) and 14 certified (branded resellers that do not require prior authorisation by Anatel). The main licenced MVNO is Datora Mobile Telecomunicações with 533 000 users in 2019. The market witnessed the exit of an MVNO, Porto Seguro Telecomunicações, in 2019.

Developments in the broadcasting sector and pay TV in Brazil

Trends in broadcasting and pay TV

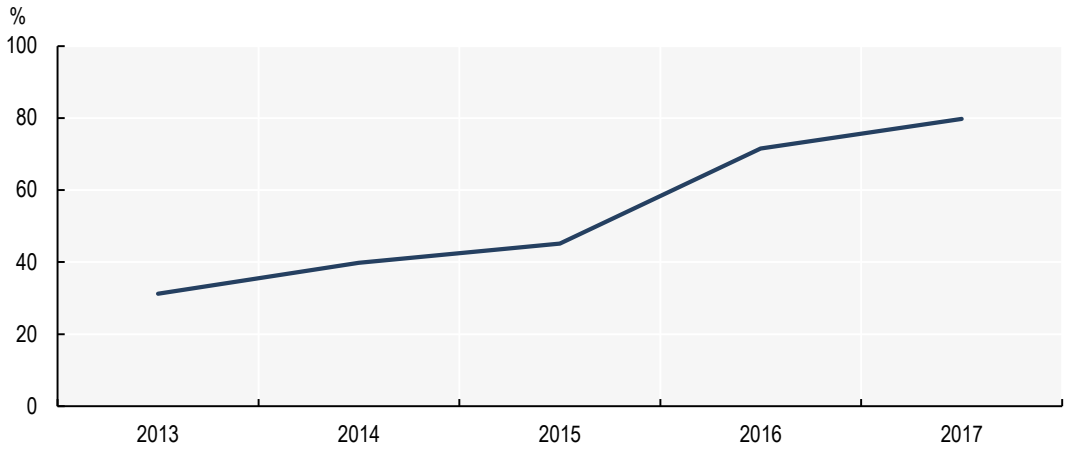
Free-to-air (FTA) broadcasting television remains the audio-visual medium with the most substantial reach in Brazil. Radio and TV signals, together, reach practically 100% of all Brazilian municipalities. In 2017, 96.7% of households in Brazil owned a television, a penetration consistently maintained in the past decades (IBGE, 2018[61]). That corresponds to 68 million of 70 million households of Brazil. This figure is higher than the regional average in Latin America (94% of households with television) and 93% in Mexico in 2016. It is only lower than the television ownership rate of North America, which stands at 98%, but has higher rates of cable television (OECD, 2017[62]).

According to the Brazilian Association for Radio and TV Broadcasting (Associação Brasileira de Emissoras de Rádio e Televisão, ABERT) estimates that FTA television alone stands for 200 000 direct and indirect jobs. It also reports that broadcasting production (not including newscasts) consists of about 70 000 hours per year. The volume of news reports amounts to 180 000 hours per year. Brazil also exports its broadcasting content widely, licensing TV productions to more than 130 countries.

Since Brazil decided to implement digital terrestrial television (DTT) in 2006, many developments have taken place. From 2013 to 2016, the number of households with digital TV jumped from 19 million to 54 million, i.e. from 31% from 79% of households with TV (Figure 3.38). The analogue switch-off, according to ABERT, did not seem to have a significant negative impact on FTA terrestrial TV audiences. This was a particularly important goal, given the vast majority of the population relies on FTA in Brazil.

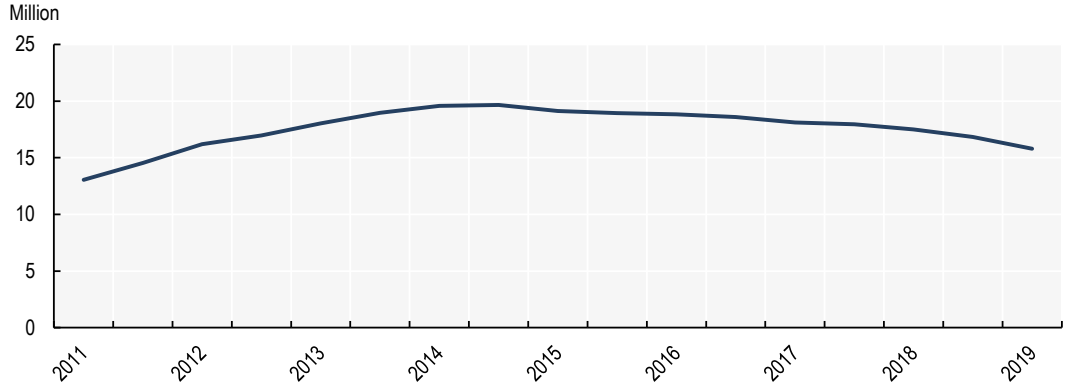
In contrast to the near-universal access to FTA, pay TV services are less common in Brazil. According to a 2017 survey, 32% of households with television subscribed to pay TV services, a decline from 33.7% the year before (IBGE, 2018[61]). Households without pay TV gave several reasons for not having the service: too expensive (55.3%), no interest (39%) and lack of availability (1.6%) (IBGE, 2018[61]). Data reported by pay TV service providers to Anatel show slightly lower subscription numbers. However, they also point to a decline in penetration of total households in the past five years – from a peak of around 30.3% to 22.7% between 2014 and 2019. In this same period, the Brazilian pay TV market contracted from 19.6 million to 15.8 million subscribers (Figure 3.39).

Figure 3.38. Penetration of digital TV in households with a TV set in Brazil (2013-17)



Source: IBGE (2018[61]), "Acesso à Internet e à televisão e Posse de Telefone Móvel celular para Uso Pessoal 2017", https://biblioteca.ibge.gov.br/visualizacao/livros/liv101631_informativo.pdf.

Figure 3.39. Number of total pay TV subscriptions in Brazil, 2011-19



Source: Anatel (2020[8]), *Painéis de Dados: Accesos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

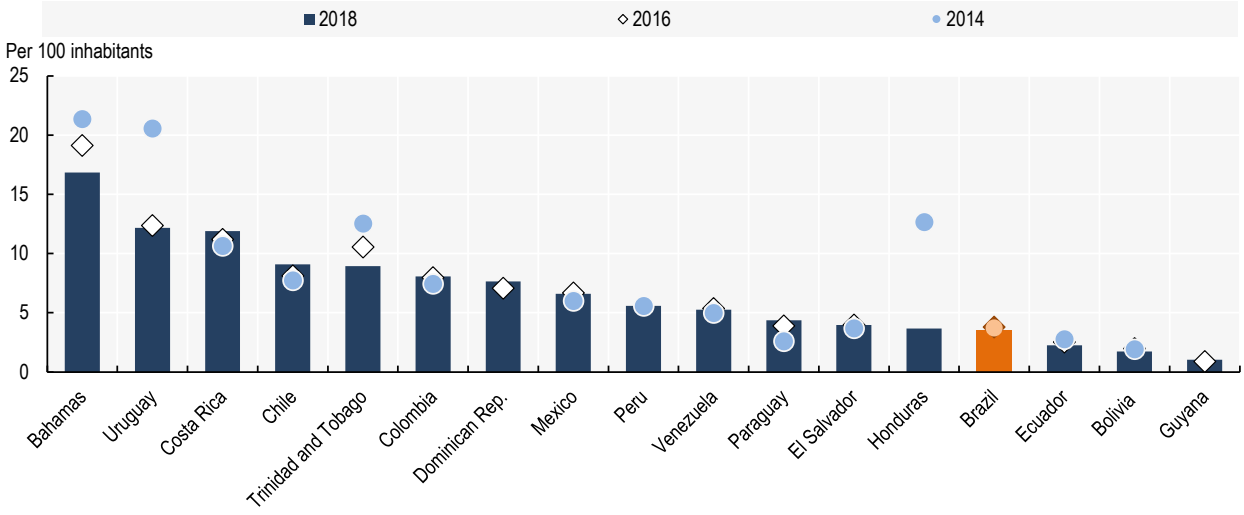
The penetration of pay TV services varies considerably across regions in Brazil. The region with the highest number of pay TV subscriptions per 100 households is the Southeast (31.9%), followed by the South (22.8%) and Centre-West (20.1). The North and Northeast lag considerably behind, with 13.6% and 10.6%, respectively. The percentages are calculated from the number of subscriptions reported to Anatel and the number of households by IBGE.

Pay TV subscriptions per 100 inhabitants in Brazil are lower than for other countries in the region, particularly for cable TV (Figure 3.40 and Figure 3.41).

In terms of preference for type of pay TV services, subscriptions of satellite services have grown, surpassing terrestrial pay TV (cable and FTTH) in 2011. Satellite services continued to dominate until 2018. In 2019, however, the pay TV market was equally shared among subscriptions between satellite and terrestrial pay TV (cable and FTTH) (Figure 3.42).

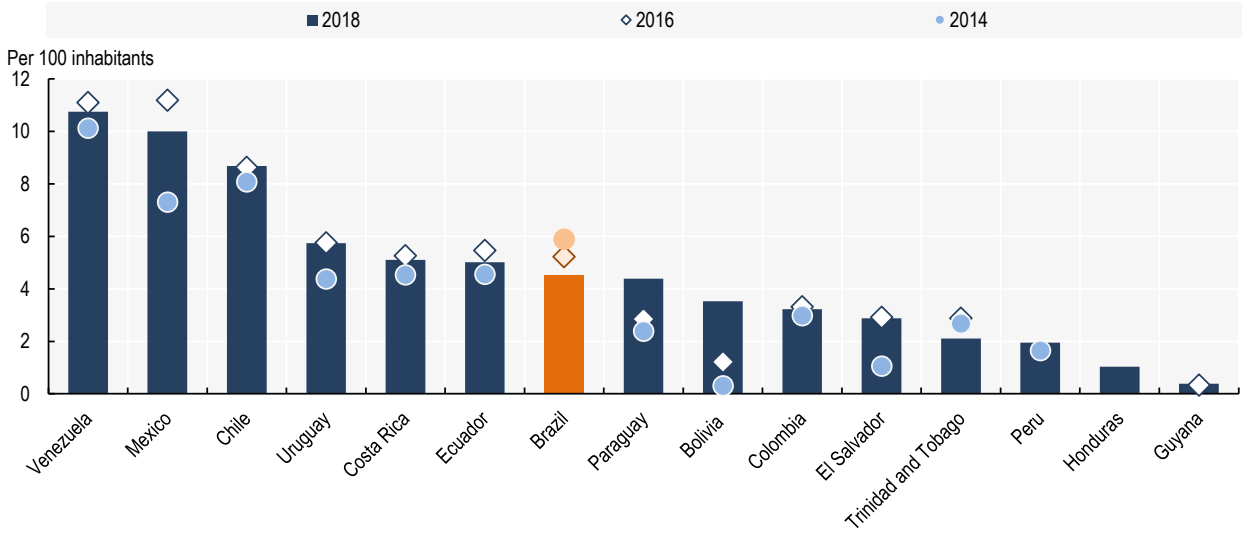
The markets of FTA broadcasting, pay TV and over-the-top (OTT) audio-visual content providers had combined revenues of around USD 12 billion in 2017 (Katz, 2019[63]). The audio-visual sector as a whole, including the movie and video games industries, corresponded to an estimated 335 000 direct and indirect jobs (Katz, 2019[63]).

Figure 3.40. Number of cable TV subscriptions in Latin America (2014, 2016 and 2018)



Source: ITU (2019[64]), *World Telecommunication/ICT Indicators*, https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx (accessed on 10 October 2019).

Figure 3.41. Number of satellite TV subscriptions in Latin America (2014, 2016, 2018)



Source: ITU (2019[64]), *World Telecommunication/ICT Indicators*, https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx (accessed on 10 October 2019).

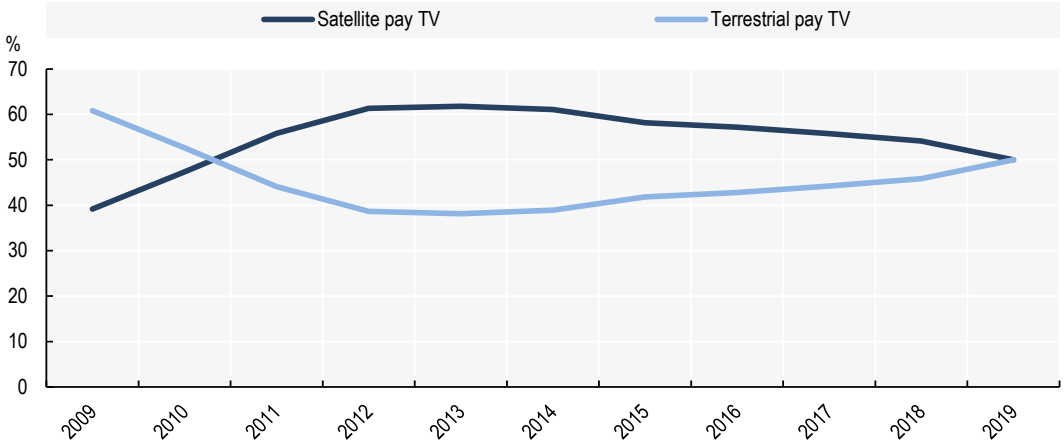
Market participants

This section analyses market structure for both broadcasting and pay TV segments, including an overview of market shares and competition dynamics. It also includes available data on OTT audio-visual content providers.

FTA broadcasting

Brazil has a high number of TV channels. In December 2018, the country had 862 commercial FTA TV nationwide channels, 131 public nationwide ones (generating own content), 20 874 commercial regional channels and 75 public regional ones (as relay stations).

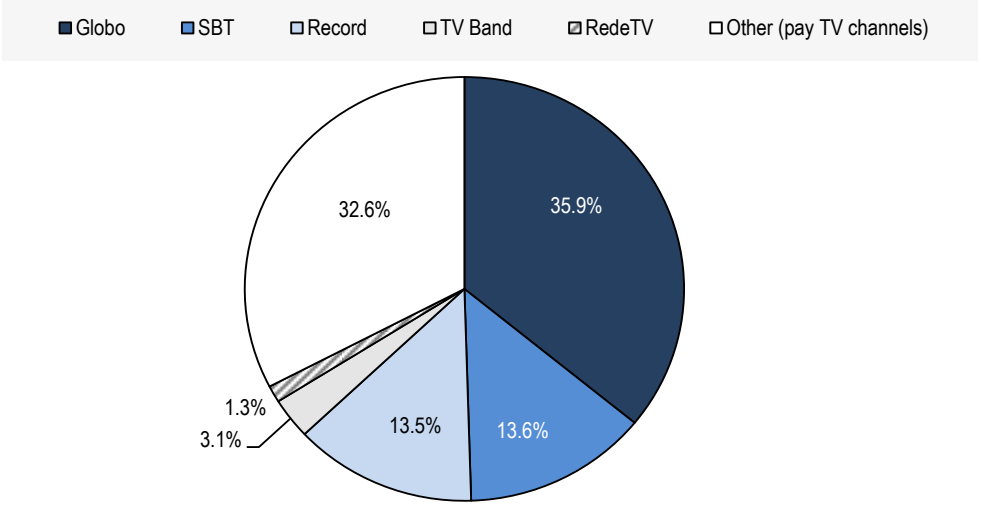
Figure 3.42. Share of terrestrial and satellite pay TV in total pay TV subscriptions in Brazil (2009-19)



Note: Terrestrial pay TV corresponds to both cable and FTTH and satellite pay TV to DTH.
Source: Anatel (2020[8]), *Painéis de Dados: Accesos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

According to audience ratings from Kantar Ibope Media, Globo is the most-watched channel. It is part of the Globo Group, which is owned by the Marinho family. Among all TV channels, the three most-watched have been Globo, SBT (owned by Silvio Santos Group) and Record (Record Group), which are all FTA channels. These FTA channels surpass by far the most-watched pay TV channels, which do not achieve one point of audience rating each. In November 2019, Globo had 16 audience rating points (an audience share of 35.9%),[10] SBT had 6 points (13.6% audience share) and Record also had 6 points (13.5% audience share). The audience shares of these three main channels correspond to 63% of overall ratings. When all other smaller FTA channels are considered, FTA channels had over 70% of audience shares, while pay TV channels had 29% in 2019 (Figure 3.43 and Table 3.5).

Figure 3.43. Audience shares of FTA and pay TV channels in Brazil (November 2019)



Note: The channels (or group of channels) with the largest market share are highlighted in bold. Data include both paid and FTA channels (VHF and UHF). Each share point stands for 1 of every 100 TV sets tuned to a certain TV channel in comparison to other channels being watched at the same time.
Source: Kantar Ibope Media cited by Feltrin (2019[65]), *Ibope outubro: 70% das TVs no país sintonizaram só canais abertos*, https://www.bol.uol.com.br/entretenimento/2019/11/15/ibope-outubro-70-das-tvs-no-pais-sintonizaram-so-canais-abertos.

Table 3.5. Top ten most-watched TV channels in Brazil (November 2019)

Channel	Audience ratings (points)	Share (%)	Type	Ownership
Globo	16.05	35.89	Commercial	Globo Group
SBT	6.09	13.62	Commercial	Silvio Santos Group
Record	6.02	13.47	Commercial	Record Group
TV Band	1.39	3.12	Commercial	Grupo Bandeirantes Group
RedeTV	0.57	1.28	Commercial	Amilcare Dallevo Group and Marcelo de Carvalho Group
TV Cultura	0.34	0.77	Public	São Paulo State Government
TV Brasil	0.31	0.69	Public	Federal Government
TV Aparecida	0.21	0.47	Commercial	Rede Aparecida de Comunicação
Rede Vida	0.16	0.37	Commercial	Brazilian Institute of Christian Communication
RecordNews	0.13	0.30	Commercial	Record Group
TV Gazeta	0.11	0.24	Commercial	Cásper Líbero Foundation
TV Novo Tempo	0.06	0.13	Commercial	Seventh-day Adventist Church
CNT	0.05	0.11	Commercial	Organizações Martinez
RIT	0.03	0.06	Commercial	International Grace of God Church
TV Escola	0.04	0.04	Public	Federal Government (Ministry of Education)
TV Senado	0.02	0.03	Public	Senate
TV Câmara	0.01	0.03	Public	Chamber of Deputies
Futura	0.01	0.02	Commercial	Globo Group
TV Justiça	0.00	0.01	Public	Federal Supreme Court
Other non-FTA channels (pay TV)	68.4	29.35	Commercial pay TV	x
Total FTA channels	31.6	70.65	x	x

Notes: x = not applicable. Data include both paid and FTA channels (VHF and UHF). Each audience rating point stands for 254 000 households watching a particular TV channel. Each share point stands for 1 of every 100 TV sets tuned to a certain TV channel in comparison to other channels being watched at the same time.
Source: Kantar Ibope Media cited by Feltrin (2019[65]), *Ibope outubro: 70% das TVs no país sintonizaram só canais abertos*, https://www.bol.uol.com.br/entretenimento/2019/11/15/ibope-outubro-70-das-tvs-no-pais-sintonizaram-so-canais-abertos.

The Globo Group, in addition to holding 51% of all FTA audience shares, owns several pay TV channels (e.g. Globo News, Telecine, GNT, Multishow, Canal Viva, SporTV, Megapix, Gloob, etc.). In March 2019, the Globo Group owned 11 of the top 40 most-watched channels, including both FTA and pay TV, i.e. one out of every three channels (Feltrin, 2019[66]).

Pay TV

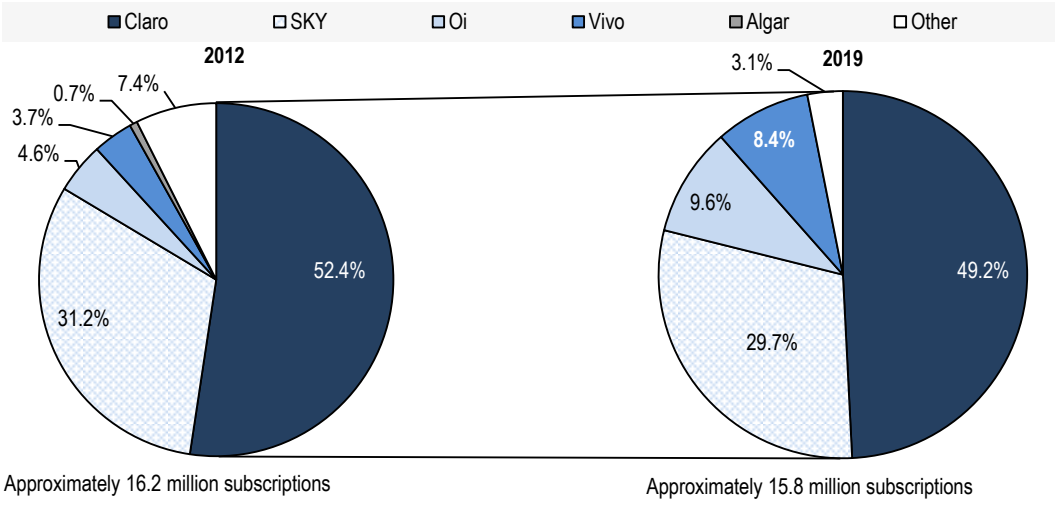
The pay TV value chain can be divided into content production, programming, packaging and distribution. The National Film Agency (Agência Nacional do Cinema, Ancine) regulates the markets of content programming and packaging, while Anatel regulates content distribution markets.

Brazilian regulation characterises the content distribution market as a telecommunication service. Two main groups dominated the Brazilian pay TV market in 2019 with a combined market share of 78.9%. Claro (also owning Embratel and Net) had 49.2% of the market followed by Sky/DirecTV at 29.7%. Two other large groups – Oi, Vivo (also owning GVT) – together shared 18.1% of the market. Algar, which in December 2018 had 0.5% of the pay TV market, exited the market in February 2020 (Figure 3.44). These four main groups also operate in other telecommunication segments.

More than 80 pay TV operators held the remaining 3.1% of market share in 2019, which declined from 7.4% in 2012. According to Ancine, in addition to the asymmetry of market share between companies, there is significant variation among municipalities in which

these operators offer services and in which the technology is adopted. Moreover, the market lost almost 3.5 million pay TV subscriptions from 2014 to 2019.

Figure 3.44. Pay TV market shares as percentage of subscribers in Brazil (2012 and 2019)



Notes: Data are for December 2019. Algar exited the pay TV market in February 2020 and its client base was incorporated to Sky.
Source: Anatel (2020[8]), *Painéis de Dados: Accesos*, https://www.anatel.gov.br/paineis/acessos (accessed on 28 May 2020).

In terms of content production and packaging, the market dynamic is different, but also concentrated. Of total subscriptions of individual pay TV channels in December 2018, 50.4% were divided between only two economic groups, Globo and Warner Media (Ancine, 2019[67]). The same two groups represented 52.5% of the content programmed in all the pay TV channels. They also owned almost all premium channels[11] in the categories "movies and series" and "sports" (e.g. Telecine, Premiere FC and Combate). These are considered to be of high value to subscribers (Ancine, 2019[67]), which may indicate market concentration of content programming. In 2018, Globo had the largest number of individual channels (63), followed by Warner Media (54), Discovery (22), Disney (14), Bandeirantes (6) and AMC networks (6) (Table 3.6).

According to Ancine (2019[67]), concentration in the pay TV market when measured by the number of subscribers by pay TV programmer is not a concern; it has a Herfindahl-Hirschman Index (HHI) of 630, which would indicate lack of market concentration. However, the measurement of pay TV subscribers by economic group shows evidence of moderate concentration (HHI of 1 627). Regulatory measures and policy initiatives to foster competition and media pluralism are discussed in Chapter 6.

Table 3.6. Pay TV programmers by number of channels in Brazil (2018)

Economic Group	Programmer	Channels	
		Number	%
Globo	Globosat Programadora	21	9.4
	Horizonte Conteúdos	18	8.1
	Telecine Programação de Filmes	14	6.3
	NBC Universal Networks International Brasil Programadora	6	2.7
	Canal Brazil	2	0.9
	Globo Comunicação e Participações	2	0.9
Total Globo		63	28.3

Economic Group	Programmer	Channels	
		Number	%
Warner Media	Turner International Latin America	18	8.1
	Brasil Programming	11	4.9
	Brasil Productions	7	3.1
	Set Brazil	4	1.8
	History Channel Brazil Distribution	4	1.8
	A&E Brazil Distribution	2	0.9
	Brasil Advertising	2	0.9
	E! Brazil Distribution	2	0.9
	Lifetime Brazil Distribution	2	0.9
	Warner Channel Brazil	2	0.9
Total Warner Media		54	24.2
Discovery	Discovery Latin America	20	9.0
	FNLA	2	0.9
Total Discovery		22	9.9
Fox	Fox Latin American Channel	19	8.5
The Walt Disney	Espn Do Brasil Eventos Esportivos	9	4.0
	Buena Vista International	5	2.2
Total Disney		14	6.3
Viacom	MTV Networks Latin America	10	4.5
PBI	PBI - Programadora Brasileira Independente	8	3.6
Bandeirantes	Newco Programadora e Produtora de Comunicação	4	1.8
	Companhia Rio Bonito - Comunicações	2	0.9
Total Bandeirantes		6	2.7
AMC Networks	AMC Networks Latin America	2	0.9
	Pramer SCA	2	0.9
	Sundance Channel Latin America	2	0.9
Total AMC		6	2.7
Total Others[1]		21	9.1
TOTAL		223	100

1. Others correspond to 13 distinct economic groups and programmers.
Source: Ancine (2019[67]), "Assinantes no Mercado de Programação na TV por Assinatura 2019", https://oca.ancine.gov.br/sites/default/files/repositorio/pdf/informe_assinantes_no_mercado_de_programacao_-_versao_diagramada.pdf.

OTT audio-visual content providers

The growth of OTT providers has been an important change in many communication markets around the world, including Brazil. Under its legislation, Brazil classifies most OTT applications as value-added services (serviços de valor adicionado, SVAs). They are considered neither a telecommunication nor a broadcasting service.

Several commercial video-on-demand (VoD) services (i.e. OTTs) are available in Brazil. These range from VoD subscription (S-VoD), such as Netflix and Globoplay, to transactional (T-VoD), such as Telecine On and Sky Play App, among others (Table 3.7). Estimates for 2018 indicate the number of unique OTT subscriptions in Brazil was around 21.3 million users, a subscription base growing since 2011 (Katz, 2019[63]). By comparison, total pay TV subscriptions were approximately 17.6 million in 2018.

The multitude of OTT audio-visual content providers in Brazil reflects the diversity of this market in the country. Adding to the presence of pure OTT providers (e.g. Netflix), players from other markets have invested in audio-visual content platforms servicing users directly

over IP-based networks. These other players include broadcasting (e.g. Globo), telecommunication (e.g. Vivo, AT&T, Claro and Oi) and device manufacturers (e.g. Microsoft, Sony and Apple).

In 2018, the Business Consultant Bureau survey indicated that Netflix was the most popular platform among Brazilians for consuming VoD (18%). The other leading on-demand content service providers are Globo Group (Globoplay) with 4% of market share, and Telecine Play and Sky Online, both with 3% of the market.

Audio-visual content is the category most consumed online in Brazil. In a 2017 survey, 71% of respondents reported that watching videos, TV programmes, films or series and listening to music were cultural activities they carried out online, an increase from 58% in 2014 (CGI.br, 2018[68]). In contrast, 55% mentioned reading newspapers, magazines or news online, 34% mentioned gaming and only 11% mentioned viewing exhibitions or museums online.

Table 3.7. OTT audio-visual content providers in Brazil (December 2018)

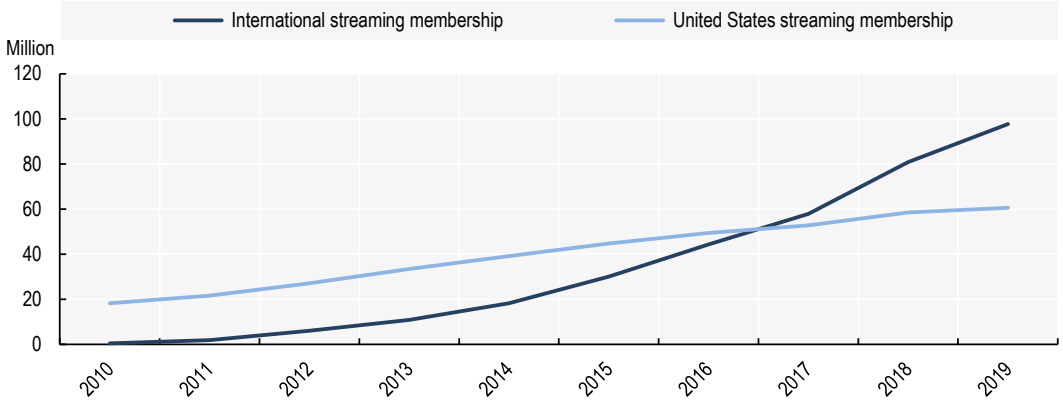
VoD type	Platform	Ownership	Core business	Country based
S-VoD	Netflix	Netflix	Video production/distribution	United States
	Globo Play	Globo	Broadcasting	Brazil
	YouTube Premium	Google	Digital advertising	United States
	Twitch	Amazon	Content production/distribution	United States
	Cartoon Network Ja!	Warner Media	Content Production/pay TV	United States
	Esporte Interativo	Warner Media	Content Production/pay TV	United States
	Claro Video	América Móvil	Telecommunications/Distribution	Mexico
	Amazon Prime Video	Amazon	Content production/distribution	United States
	Playkids.TV	Movile	Apps production/distribution	Brazil
	Sony Crackle[1]	Sony	Content distribution	United States
	Planet Kids (Youyn)[1]	Google	Digital advertising	United States
	Vivo play.net	TVE	Telecommunications/Distribution	Venezuela
	Crunchyroll	Warner	Media Content Production/pay TV	United States
	Serie A Pass	Disney	Content production/distribution	United States
	NetMovies	NetMovies	Content distribution	Brazil
	Filmotech[1]	EGEDA	Content distribution	Spain
	PlayPlUnited States Grupo	Record	Content distribution	Brazil
	Viki	Rakuten Inc.	Content distribution	Japan
	Looke	Looke	Content distribution	Brazil
	Philos TV	Globo	Broadcasting	Brazil
	GuideDoc	Guide Doc	Content distribution	Spain
	Baby TV	Fox Latin America	Broadcasting	United States
	Selecta TV	Selecta Media Ltd.	Content distribution	Mexico
	Noggin	Viacom Int.	Broadcasting	United States
	Caracol Play	Caracol Television	Content production/distribution	Colombia
	EnterPlay	Enter Play	Content distribution	Brazil
	GoldFlix[1]	GoldFlix RCT	Content distribution	Brazil
	GC Flix	Golden Ceiba Prod.	Content Distribution	Mexico
	ClickVeo	ClickVeo	Content distribution	Uruguay
	Mubi	Bazaar Inc.	Content distribution	United States
	TVN Play	TVN de Chile	Content production /distribution	Chile
	Fanatiz	Fanatiz SPA	Content distribution	Chile
	HBO Go	Warner Media	Telecommunications/pay TV	United States
	FOX APP	Fox Latin America	Broadcasting	United States

VoD type	Platform	Ownership	Core business	Country based
T-VoD	Telecine On	Globo	Broadcasting	Brazil
	PlayStation	Video Sony Pictures	Equipment	United States
	SKY Play APP	ATT	Telecommunications/pay TV	United States
	Now VOD	América Móvil	Telecommunications/Distribution	Mexico
	Oi Play	Oi	Telecommunications/Distribution	Brazil
	Google Play Movies	Google	Digital advertising	United States
	Vivo VOD	Telefónica	Telecommunications/Distribution	Spain
	Microsoft Movies & TV	Microsoft Corp.	Equipment	United States
	SmartVOD	Vonetize	Content distribution	Brazil
	iTunes Movies	Apple	Equipment	United States
	Fanatiz	Fanatiz SPA	Content distribution	Chile
	HBO Go	Warner Media	Telecommunications/pay TV	United States
	FOX APP	Fox Latin America	Broadcasting	United States
	Telecine On	Globo	Broadcasting	Brazil
	PlayStation Video	Sony Pictures	Equipment	United States
	SKY Play APP	AT&T	Telecommunications/Pay TV	United States
	Now VOD	América Móvil	Telecommunications/Distribution	Mexico
	Oi Play	Oi	Telecommunications/Distribution	Brazil
	Google Play Movies	Google	Digital advertising	United States
	Microsoft Movies & TV	Microsoft Corp.	Equipment	United States
	SmartVOD	Vonetize	Content distribution	Brazil
	iTunes Movies	Apple	Equipment	United States

1. These platforms have interrupted their services in 2019.
Note: S-VoD = subscription-based video-on-demand (pay per subscription to watch content with no limits); T-VoD = transactional-based video-on-demand (pay per content watched).
Source: Katz (2019[63]), "Alterações nos mercados de audiovisual global e brasileiro: Dinâmica competitiva, impacto no bem estar do consumidor e implicações em políticas públicas e no modelo de concorrência", http://www.teleadvs.com/wp-content/uploads/191014-Katz-Report_FINAL.pdf (accessed 14 February 2020).

The survey pointed to the role of the Internet in providing cultural activities. However, it also noted inequalities in urban vs. rural areas, as well as related to social classes and education levels (e.g. lack of foreign language skills). These reflect broader barriers to Internet access and broader cultural habits (e.g. lack of reading habits and preference for audio-visual content).

Figure 3.45. Number of Netflix subscribers in the United States and globally (2010-19)



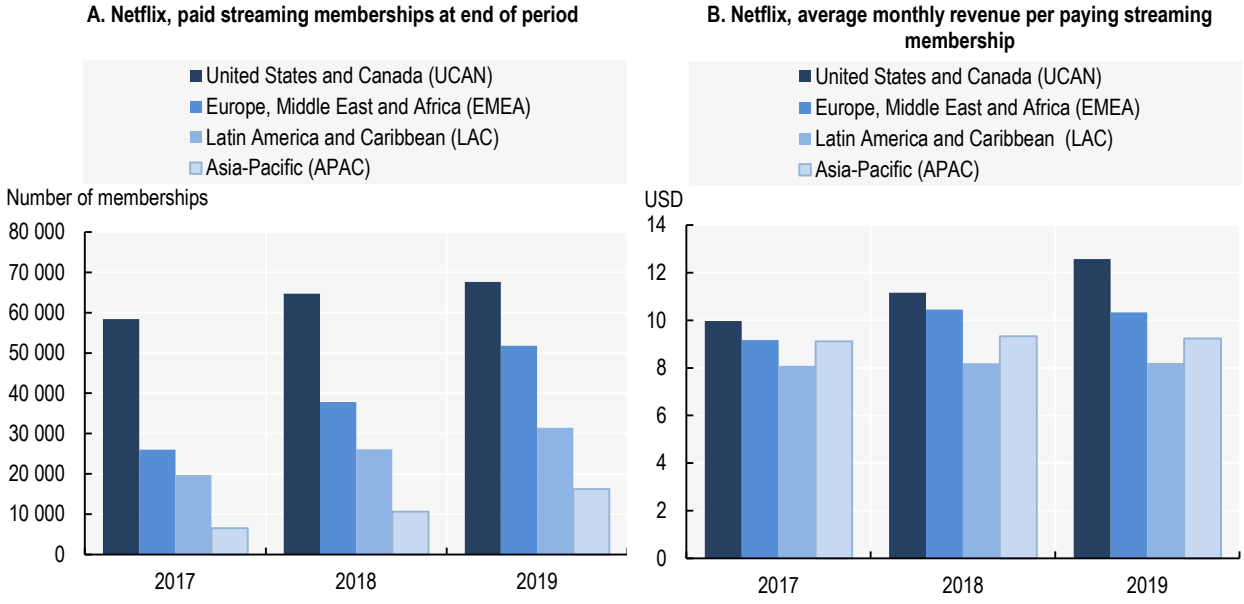
Source: Netflix (2020[69]), *Investors: Quarterly Earnings data*, www.netflixinvestor.com/financials/quarterly-earnings/default.aspx (accessed on 20 May 2020).

Netflix first entered the Brazilian market in 2011, as part of a wider rollout in LAC, and has become the leading streaming platform in the country. In September 2019, out of 158 million global subscribers, the company reported reaching 10 million subscribers in Brazil. This is equivalent to one-tenth of Netflix's international customer base (Cardin, 2019[70]).

The global figures on Netflix point to an increased internationalisation strategy of this OTT provider. For the first time in 2017, the amount of international Netflix subscribers surpassed those within the United States' market. In 2019, it reached 98 million international subscribers compared to around 61 million within the United States (Figure 3.45).

The number of Netflix subscribers in LAC has also been steadily growing. From 2017 to 2019, subscriptions in the region grew from 19.7 million to 31.4 million (Figure 3.46 A). In terms of revenues, the region registered, at the end of 2019, a lower average monthly revenue per subscriber (USD 8.21) than in the United States and Canada (USD 12.57) and in Europe, Middle East and Africa (USD 10.33) (Figure 3.46 B).

Figure 3.46. Number of Netflix subscribers and monthly revenue per subscription, by world region (2017-19)



Source: Netflix (2020[69]), *Investors: Quarterly Earnings data*, www.netflixinvestor.com/financials/quarterly-earnings/default.aspx (accessed on 20 May 2020).

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Notes

[1] Using the exchange rate of 3.8742 BRL/USD for the year 2018 from OECD.stat (https://stats.oecd.org/).

[2] Total communication access paths = Total access telephone lines + total fixed broadband subscriptions + cellular mobile subscriptions.

[3] Latency is the round trip time for information between two devices across the network.

[4] The OECD has adopted the following definition for the IoT: "The Internet of Things includes all devices and objects whose state can be altered via the Internet, with or without the active involvement of individuals. While connected objects may require the involvement of devices considered part of the 'traditional Internet', this definition excludes laptops, tablets and smartphones already accounted for in current OECD broadband metrics." (OECD, 2018[24])

[5] The definition of "massive M2M communications" is analogous to the definition set forth by the ITU in their vision of the fifth generation of wireless networks, or the IMT 2020 standard, yet to be finalised in 2019 in the ITU's World Radio Communications Conference. This standard is being conceived with IoT in mind with three main usage scenarios (i.e. enhanced mobile broadband, massive machine type communications, and critical communications/applications).

[6] To calculate the number of M2M/embedded mobile cellular subscriptions, the OECD defines M2M on mobile networks as "the number of SIM-cards that are assigned for use in machines and devices (cars, smart meters, and consumer electronics) and are not part of a consumer subscription".

[7] As highlighted in *Going Digital in Brazil* (OECD, forthcoming[71]), which takes a closer look at adoption and use of the Internet by firms and individuals.

[8] Chapter 4 of *Going Digital in Brazil* (OECD, forthcoming[71]) provides more detail of how firms are using information communication technologies.

[9] The countries for which CISCO VNI Mobile Highlights 2017-2018 includes information for are: the United States, Canada, Chile, Mexico, Poland, France, Germany, Italy, Spain Sweden, United Kingdom, Japan Korea, Australia, and New Zealand (Cisco, 2018[30]).

[10] Each audience rating point stands for 254 000 households watching a particular TV channel. Each share point stands for one out of every 100 TV sets tuned to a certain TV channel in comparison to other channels tuned in at the same period of time.

[11] Other premium channels not owner by the economic groups of Globo and Warner Media are Fox Premium 1 and Fox Premium 2 from Fox Latin American Channel.