

# **BEREC Report on the Study Visit to Brazil 2024**

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## 1. Introduction and acknowledgements

Each year, BEREC organises a study visit to a non-member country to gain insights from local electronic communications markets and digital ecosystems. During a typical study trip, the BEREC delegation meets representatives from National Regulatory Authorities, relevant ministries, as well as incumbent operators, smaller operators and other industry stakeholders. Past destinations have included Japan, Canada, India, the United States of America (both West Coast and East Coast), China and South Korea. In 2024, the BEREC Chair, Tonko Obuljen (HAKOM) joined by the Vice-Chairs Konstantinos Masselos (EETT), Robert Mourik (ComReg), Patricia Silva Gonçalves (ANACOM), Laure de La Raudière (ARCEP), László Ignéczi (BEREC Office), Domagoj Maričić (CN Chair 2024), Ioanna Choudalaki (CN Chair 2023) and Patrícia Matos Nogueira (CN representative of ANACOM) undertook a study visit to Brazil. During this visit, the BEREC delegation engaged with senior policymakers, top management of various global industry stakeholders (including telecom operators), the Brazilian Network Information Center as well as representatives of the innovation ecosystem. Meetings were held between 5 to 9 February 2024 in Brasília, Sao Paulo and Campinas with the aim to learn and exchange about regulatory and other developments in the field of electronic communications, end-to-end connectivity and the internet ecosystem. We would like to warmly thank all the people we met in Brazil for their hospitality and for generously sharing their time.

## 2. Key insights and main trends

This is a short overview of the key insights and main trends that were gathered during the BEREC Study Trip to Brazil in February 2024. It is important to note however that this overview should not be viewed as absolute truths, or a complete definite picture but rather as a reflection of the impression that the BEREC delegation got during their visit.

### 2.1. Connectivity

The fixed broadband market in Brazil is characterised by a large heterogeneity among players. There are currently more than 12,000 ISPs in Brazil, ranging from large operators offering bundles of communication services to smaller providers operating in remote areas not yet commercially attractive to larger ISPs. Smaller regional operators continue to be the trailblazers of the fixed broadband sector, having 53% of the fixed broadband market. When it comes to technology used in the fixed broadband market, around 35 million broadband subscribers are on fiber and additional 8.7 million on cable, adding up to over 90% of all broadband subscriptions (~47 mio lines in total).

When it comes to fiber networks, the trend in Brazil includes the following:

- There are multiple networks built entirely separately. Major operators and local internet service providers deploy multiple full-fiber networks.
- The three large operators (Vivo, Oi, TIM) proceeded recently with the voluntary creation of independent wholesale only networks.

Fixed telephony lines continue to decline and represent almost half of the fixed broadband market lines (~25 mio lines in total).

In the mobile communications market in Brazil, three large mobile network operators offer services together with companies licensed to operate as mobile virtual network operators. The total customer base of mobile connections is ~255 mio subscriptions. In contrary to the fixed broadband market, the three large mobile network operators have in total ~97% market share, while smaller operators have in total ~3% market share. The 4G mobile household coverage in Brazil is 92.5% (99.6% in urban areas and 53.5% in rural areas). For 5G, for which the assignment of the bands of 2.3 GHz, 3.5 GHz, and 26 GHz was concluded in 2021, the respective figures are 52.7% household coverage (60.9% in urban areas and 7.8% in rural areas).

Satellite infrastructure encompasses 43 geostationary systems (29 foreign and 15 national) in commercial operation and 7 non-geostationary (all foreign). Around 0.4 mio subscribers in 2023 used satellite broadband communication services, with 33% of these enjoying average download speeds over 34 Mbps.

## 2.2. Digital inclusion

Digital inclusion is a topic that attracts a lot of interest and effort in Brazil. Although there is an expansion of the Internet in small municipalities, resulting in the diversification of activities carried out in the online environment by the population, barriers still exist, especially among residents of rural, remote, and hard-to-reach areas, and vulnerable groups. Public authorities undertake various initiatives with the aim of bridging the digital gap.

One example is the investment obligations introduced by the 2021 5G auction. These obligations set targets for coverage, demand optical fiber backhaul deployment in 530 municipalities and introduce funding of R\$3,1 billion for public school connectivity projects. In addition, mobile operators need to contribute to the deployment of Amazon Region Infoways and the Federal Government Private Network. Apart from these, further potential connectivity projects can be undertaken by mobile operators reducing the auction payment.

When it comes to Public School Connectivity obligation set by the 5G auction, in the context of the first pilot project, 175 schools were selected from municipalities in need, including criteria such as the human development index, percentage of disconnected pupils, density of broadband internet coverage and differentiated location. In addition to last-mile internet

connections and local network facilities, the project will provide mobile computer labs with the necessary equipment and electrical energy.

The national regulatory authority (ANATEL) is also aiming to the digital inclusion of Brazilian citizens. Due to its importance in the digital age, ANATEL's new institutional mission (2023) takes a new look at the connectivity of individuals, encompassing the concept of "meaningful connectivity". The authority is also focusing on digital skills which are considered a critical pillar for end users to protect themselves in the online environment because these skills build trust and confidence, enabling them to efficiently use digital services.

Another example of the importance of the digital inclusion topic for the public authorities is the Connected North Programme which expands the communications infrastructure in the Amazon Region, through the implementation of sub-river fiber optic cables, aiming to enable/support telecommunications, education, research, health and defense. The program ensures digital inclusion in 59 municipalities by offering high quality internet access to 10 million people with the deployment of 12,000 km of subfluvial optical cable networks funded by the revenues of the 5G spectrum auctions.

### **2.3. Digital regulation**

The need of further digital regulation in Brazil has been recognized due to the needs stemming from artificial intelligence, the digital markets/economy, the issue of fake news, etc.

Already in 2019, some bills have been circulated in the Brazilian National Congress to regulate AI systems. However, the pandemic limited public debate on these bills. In May 2023, Bill nº 2338/2023 was proposed by the President of the Federal Senate aiming at the development and use of responsible and trustworthy AI. When the BEREC delegation was in Brazil, the debates on this proposed legislation were still open.

The issue of fake news and the rules that need to be introduced to combat their negative effects are widely discussed among policy makers in Brazil. A proposal was published on 30 June 2020 (Bill nº 2630/2020), with the intention of introducing measures for creating accountability for the spreading of fake news on social networks and digital platforms. The issue of fake news is considered extremely important in light of the upcoming elections at municipality level. The proposed rules were still under debate when the BEREC delegation was in Brazil. The same legislative proposal also includes rules to ensure fair compensation for the use of third-party news content by online platforms.

When it comes to digital markets, a legislative proposal (Bill nº 2768/2022) was presented to the House of Representatives of Brazil on November 10, 2022. The purpose of the law is to govern digital platforms that are currently operating in Brazil, particularly those that have a large amount of market power. The proposed rules that encompass various products and

services, including search engines, social media, video streaming platforms, and cloud storage services, were still under debate when the BEREC delegation was in Brazil.

### 3. Overview and brief summary of meetings held by the BEREC delegation

#### 3.1. National Telecommunications Agency (ANATEL)

The National Telecommunications Agency is a special agency in Brazil created by the general telecommunications act in 1997. The agency is administratively and financially independent, and not hierarchically subordinate to any government agency. Its decisions can only be appealed in court. From the Ministry of Communications, ANATEL has inherited the powers of authorizing, regulating, and supervising telecommunications in Brazil.



During the meeting ANATEL and BEREC exchanged views on current practices, future-looking trends and regulatory developments in the field of telecommunications and digital policy. More specifically, the representatives of ANATEL:

- Explained the connectivity challenges that Brazil faces and the ways ANATEL contributes in bridging the connectivity gap. ANATEL performs every five years (updated on an annual basis) a thorough evaluation of the country's broadband networks (fixed, mobile and satellite), aiming to coordinate the efforts to close the universal service gap. They also illustrated the specifics of the Connected North Program. This program aims to expand the communications infrastructure in the Amazon Region, through the implementation of sub-river fiber optic cables, aiming to meet public policies in telecommunications, education, research, health, defense and the judiciary, among others public policies that will be integrated into the scope of the Program. Furthermore, this programme aims to expand internet access in the region,

with the possibility of integration with neighboring countries that make up the Pan Amazon. The Connected North Program is also aligned with the Sustainable Development Goals.

- Presented the investment obligations introduced in the context of the 5G auction and the hybrid payment system put in place to incentivise further connectivity projects.
- Presented the Brazilian Regulatory Framework regarding the use of spectrum, including the 2-level authorization (on a primary or secondary basis).
- Described ANATEL's work regarding market analysis of fixed, mobile, broadband and pay TV services as well as the ex ante and ex post competition measures imposed.
- Presented ANATEL's work on consumer rights and protection for telecoms services and digital inclusion. ANATEL has always been the protagonist and recognized by consumers as the body capable of resolving problems and bringing broader regulatory solutions. To identify issues and then decide on their relevant actions, they use input they collect from surveys about satisfaction and perceived quality, complaints, Dialogue with Society, research, as well as identifying issues in the press and social networks. ANATEL's presentation also included some examples of their relevant initiatives to protect and empower end-users.
- Furthermore, ANATEL referred to the need to incentivize innovation, while keeping monitoring the new tech developments. Also, it referred to the institutional picture that must fit these new developments, thus addressing the need to create a new or to adapt the current sectorial regulator, by accommodating new powers and attributions.

ANATEL was also very interested in learning from BEREC about the discussion and work in Europe for the formulation of the regulatory framework on Artificial Intelligence. AI regulation is considered a very relevant topic in light of the upcoming municipal elections in Brazil. In this context, ANATEL mentioned that it was preparing a public consultation on what are the undergoing initiatives on AI implementation.

## 3.2. Telcomp

Telcomp is one of the Brazilian industry associations that represents regional operators and in particular small and medium-sized Brazilian fixed and mobile telephony operators, broadband and internet access providers, Pay TV providers, data centers as well as corporate services providers. Founded in January 2000, TelComp represents more than 60 telecommunications companies and works to promote competition as a lever for the development of the sector.



During the meeting, the representatives of Telecomp:

- Presented the fixed telecommunications value chain in Brazil, covering international connectivity, metropolitan networks, services provided to corporate customers and public authorities, as well as access provided to residential customers and SMEs.
- Emphasized the fact that numerous small and medium sized companies (mainly regional) currently hold 53% of the market share of the fixed broadband market in Brazil. Independent value chain, friendly regulatory framework and affordable optical fibers contributed to this significant market share held by this type of operators.
- Explained on how the fixed connectivity value chain in Brazil ensures the provision of different services to all type of end-users but also contributes to employment opportunities.
- Provided some insights regarding the mobile telecommunications value chain in Brazil, covering tower companies, MNOs, MVNOs and resellers. In the mobile market, small and medium sized firms have only 2% market share. According to them, access to spectrum is considered a barrier for entry. Apart from this, they also see prohibitive wholesale prices and difficulties in accessing new technologies.

Apart from the issues mentioned above, Telcomp indicated the following topics as important challenges: access to poles used in energy sector, network fee, cybersecurity and widespread connectivity.

### 3.3. Ministry of Communications (MCOM)

The Ministry of Communications is a federal administration body, which was created in June 2020 after being split from the Ministry of Science, Technology and Innovation. The Ministry was created with the aim of strengthening the areas of national telecommunications and broadcasting policy, as well as the areas of postal services and broadcasting. Furthermore,

the Ministry is charged with operating the Federal Government's communication and publicity policy.



During the meeting, presentations were given and an exchange of views was held about:

- The digital transformation strategy of Brazil which encompasses in total 100 strategic actions from four digital transformation pillars and five enabler pillars. Digital transformation aims to increase productivity, provide digital government services to citizens and facilitate digital inclusion in society.
- Regarding infrastructure, MCOM explained the various public policies that promoted the increase in broadband coverage over the years, reaching more than 90% of households which can be considered an enabler of the digital transformation of the economy.
- MCOM presented in detail the specifics of the 5G auction that took place in November 2021. The auction of four separate bands (700MHz, 2.3 GHz, 3.5 GHz and 26GHz), in either national or regional blocks, introduced a set of commitments emphasizing on coverage requirements, rather than the increase of revenue from the spectrum licenses. In this regard, winning bidders had the option to deduct the estimated investments required for the additional coverage obligations from the value of the bids (approx. US\$ 10 billion).
- MCOM also referred to the Connected North Program which has been also presented by ANATEL. The program ensures digital inclusion in 59 municipalities by offering high quality internet access to 10 million people with the deployment of 12,000 km of subfluvial optical cable networks funded by the revenues of the 5G spectrum auctions.
- A presentation about the project of connected schools followed. The project aiming at connecting every school to the internet, has been funded by the Universal Services Fund and the 5G Spectrum Auction

- BEREC presented the Digital Decade Policy Programme of the European Union, referred to the ongoing 'debate' between telecom operators and CAPs about the 'fair contribution' to network deployments and discussed about the importance of the security of submarine cables.

### 3.4. Ministry of Science, Technology and Innovation (MSTI)

The Brazilian Ministry of Science, Technology and Innovation is responsible for:

- I - national science, technology and innovation policies;
- II - planning, coordination, supervision, monitoring and evaluation of science, technology and innovation activities;
- III - digital transformation and automation development policies;
- IV - national biosafety policy;
- V - space policy;
- VI - nuclear policy;
- VII - control of the export of sensitive goods and services; and
- VIII - articulation with the Governments of the States, the Federal District and Municipalities, with society and with federal Government bodies, with a view to establishing guidelines for national science, technology and innovation policies.

The BEREC delegation met with the Secretariat of Science and Technology for Digital Transformation.



During the meeting BEREC and the Ministry of Science, Technology and Innovation exchanged on the following:

- MSTI highlighted the importance of the Brazilian Strategy for Digital Transformation, which focuses on: (a) Research, Development and Innovation, (b) Human Capital, (c) Infrastructure and (d) Regulation. The areas covered by ICT policy programmes comprise of: (i) Artificial Intelligence, (ii) Semiconductors, (iii) Quantum Technologies, (iv) Advanced Communications, (v) Cybersecurity, (vi) IOT and (vii) Industry 4.0.
- MSTI explained the Brazilian AI Strategy which includes 73 strategic actions and is currently under revision. When it comes to the topics of legislation, regulation, and ethical use, discussions with different groups from civil society and the government are currently held with the aim to reconcile development and improvement of the business and innovation environment with the problems and risks of AI that need to be mitigated.
- MSTI presented information about various Brazilian AI Applied Research Centers. These centers, that focus on the areas of Industry, Agriculture, Smart Cities, Digital Health, Cybersecurity, Education and Renewable Energy, aim to:
  1. Stimulate applied basic research and innovation;
  2. Strengthen product development (hardware/firmware, software, algorithms and mathematical models);
  3. Contribute strongly to the connection between Government, Companies and Research Centers;
  4. Provide necessary infrastructure for the expansion of research networks;
  5. Develop advanced and qualified technological skills and training;
  6. Contribute to the economic growth and social progress of the country.
- As MSTI explained, apart from the Applied Research Centers, various competence centers are active in Brazil with the aim to create an innovative environment in new technologies like 5G/6G, Open Ran, Virtual/Augmented Reality, Hardware platform with smart and connected products, Quantum Computing, Cyber Security and Advanced Genomics.

### 3.5. EU Delegation in Brazil

The Delegation of the European Union to Brazil is one of the 146 European Union diplomatic missions around the world. It represents the European Union in Brazil and works in close coordination with the 25 EU Member States' Diplomatic Missions accredited in the country. The Delegation to Brazil, promotes European Union values and policies, represents the EU and its citizens and builds networks and partnerships. By engaging with political actors, the media, academia, business, and civil society, it raises awareness of EU issues and interests and promotes the importance of the EU-Brazil bilateral relations among the Brazilian public. It also develops cooperation through projects and grants.



The BEREC delegation and the EU Delegation in Brazil exchanged views on:

- The Strategic Partnership between the EU and Brazil which promotes sectoral dialogues in areas such as political relations, human rights, trade, energy, cyber issues, research & innovation, information society and climate change.
- As regards information society, there are ongoing dialogues on digital matters, covering topics such as connectivity, digital inclusion, AI, cybersecurity, 6G development, data protection, etc.
- Establishment of the EU–LAC Digital Alliance during the EU-CELAC summit in July 2023. The EU-LAC Digital Alliance is an informal, values-based framework for cooperation, open to all Latin American and Caribbean (LAC) countries and EU Member States who may participate through their respective governments and agencies related to the digital agenda. It aims at promoting connectivity, inclusion, innovation and the digitalisation of public services and business, by supporting digital projects. Brazil plays a prominent role in EU-LAC Digital Alliance.
- Implementation of Global Gateway flagship initiatives in the context of the EU–LAC Digital Alliance, aiming at boosting links in the digital sector.

### 3.6. Chamber of Deputies

The Chamber of Deputies is a federal legislative body and the lower house of the National Congress of Brazil. The chamber comprises 513 deputies, who are elected by proportional representation to serve four-year terms. BEREC delegation met with Deputy Luisa Canziani who has been chairing the Science, Technology, and Innovation Committee of the Brazilian Chamber of Deputies since 15/3/2023.



BEREC delegation and Deputy Luisa Canziani exchanged on the following:

- The importance of the AI legislation which is under discussion currently in Brazil. Policy makers in Brazil are interested in available international experience about AI and they are especially interested on how EU is dealing with this important topic. The Chamber of Deputies is also supporting a number of AI relevant projects. BEREC delegation explained the status play about the EU AI act.
- The critical issue of misinformation especially in light of the upcoming elections in Brazil at the municipality level and the regulatory framework that can be used to tackle this issue. The BEREC delegation referred to the European Digital Services Act provisions which can contribute to the mitigation of such risks.

### 3.7. Brazilian Telecommunications Policies Seminar

During BEREC's study trip in Brazil, Vice-Chair Ms Patricia Silva Gonçalves (ANACOM) was invited to participate in the Brazilian Telecommunications Policies Seminar, held in Brasilia on February 6th 2024 and organized in partnership with Brasilia University's Communication Policies Studies Centre, gathering regulators, public policy makers and operators. Ms Patricia Silva Gonçalves participated in a panel about "The new regulator and policies for a changing environment" together with Carlos Baigorri, (President of Anatel), Alex Braga (President of Ancine), Mário Girasole (VP of institutional relations and regulation of TIM) and Márcio Iório Aranha (Director of CCOM/UnB).



During her key-note speech, Ms Patricia Silva Gonçalves presented the current context of the sector in the EU, the already available initiatives/actions to meet the challenges of the digital world and BEREC's role in this context. In particular:

- First, she addressed the expectation regarding the upcoming (at that time) publication of the White Paper that would focus on challenges for the future of connectivity. She also mentioned that there would also be a European Commission Recommendation on the resilience and security aspects of submarine cable infrastructures.
- Ms. Patrícia Silva Gonçalves also presented the recent EC's legislative initiatives, namely the two new elements in the regulatory framework for the digital sector: the Digital Markets and Digital Services Acts, which apply directly to all Member States. In this context, she highlighted that the experience of regulators in the telecoms sector is noteworthy, as they have been able to adapt to the different transformations in the sector, which is constantly undergoing technological (r)evolution, also recognizing that there is therefore a clear challenge of coordination between regulators and between competent authorities, not only at the level of each country, but also at international level.
- Furthermore, Ms. Patrícia Silva Gonçalves referred to BEREC's role in the debate on regulation in the new digital context, pointing out that BEREC has already adopted its 2030 action plan, aimed at actively facilitating and promoting open, secure, high-quality, competitive and sustainable digital ecosystems, which will be the key to empowering people and businesses in future societies.
- Finally, she confirmed that BEREC remains attentive and seeks to promote co-operation with partners from other countries and regions of the world, as it is the case of Brazil.

### 3.8. V.tal

V.tal operates the largest neutral fiber optic network in Brazil, serving telecom operators, internet providers and OTTs. V.tal was spun off from Oi (Note: Oi, formerly known as Telemar, is the largest fixed telephone operator and used to be the fourth mobile telephone operator in Brazil). In addition to its ground-based fiber optic infrastructure, which connects several municipalities in Brazil, V.tal also has 26,000 kilometers of subsea cables that connect Brazil to Argentina, Chile, Venezuela, Colombia, Bermuda and the United States, as well as edge data centers distributed between Brazil and Colombia.



During the meeting the following topics were discussed:

- Their business model as a wholesale-only operator and the efficiencies that it has introduced to the market by cutting costs (CAPEX and OPEX) to half. The representatives of V.tal referred to the challenges in replicating infrastructure, mentioning that they are not only cost-specific but are also related to complexities such as Rights of Way (RoW) approvals. Wholesale-only operators can handle these issues more effectively, making leasing a preferred option to building.
- Despite being a spin-off from Oi, V.tal operates independently, with no voting rights held by Oi. Oi is one of V.tal's clients, but V.tal maintains a neutral approach across all its customers.
- Apart from telecommunications providers, V.tal is also serving OTTs (eg Amazon, Meta) with its data centers transforming its business from "only fiber" to "full digital infrastructure" business.

- V.tal offers a variety of solutions to its customers, including end-to-end products, solutions where customers can use their own backbone network, fiber to the pole, backhaul services offered to tower companies, etc., depending on their specific needs.
- BEREC and V.tal also exchanged about the challenges faced by a wholesale-only operator due to the significant increase in traffic, reaching a percentage of 50-60% in annual basis. According to V.tal, vertically integrated companies are more vulnerable than infrastructure companies to such traffic increase. Traffic increase is inserting challenges not only to backbone network but also to access network which requires improvements in the OLT equipment. Metaverse could introduce a big change that will in turn require respective adjustments in the network.

### 3.9. TELEFONICA (Vivo)

Telefonica Brazil, trading as Vivo, is a Brazilian telecommunications group, subsidiary of Spanish Telefonica. It was originally formed as part of Telebras, the state-owned telecom monopoly at the time. In 1998, Telebras was demerged and privatized. Telefonica bought Telesp, the Sao Paulo division, and rebranded it to Telefonica. In 2010, Telefonica acquired the shares of Vivo that belonged to Portugal Telecom, and transferred control of the company to Telefonica-Vivo, its subsidiary in Brazil. In 2012 the company's services (internet access, cable and satellite television, fixed and mobile telecommunications) began to be marketed under the Vivo brand. Vivo has the largest market share in the mobile market in Brazil.



At the meeting the delegations exchanged views on the following topics:

- Telefonica's presentation included insights into Brazil's economic outlook, highlighting the vast opportunities for the telecommunications and digital services industries in such a populous country. In addition, they explained the way the company is evolving into the digital ecosystem, providing services beyond traditional telecommunications for B2C and B2B customers.
- Focus was placed on key regulatory themes in Brazil, including the impending end in 2025 of the STFC (Fixed Switched Telephony Service) concession. Telefonica is currently negotiating an agreement with ANATEL and MCOM. This agreement shall take into account the level of competition in the various areas and shall contribute in having investments aligned with public policies and in avoiding spending of public resources.
- Another regulatory topic discussed was the market review by ANATEL, aimed at promoting competition in the mobile market, with the inclusion of two new relevant wholesale markets while the infrastructure markets for fixed access networks cease to be relevant markets in this review. Telefonica stressed the importance of maintaining incentives for operators to invest and innovate.
- "Fair share" issue was also mentioned, as it is a topic that is currently discussed in Brazil. In particular, there were 2 public inquiries from ANATEL to understand the consumer's perspective. "Fair share" is perceived as part of the solution to ensure sustainability of network investments. A possible new Regulation would classify OTTs as mass users of telecom networks, with co-responsibility for the stability of networks and internet security, introducing an obligation of an agreement between OTTs and operators to define fair remuneration for the use of networks.
- Finally, Telefonica outlined the framework about the general parameters of administration, conditions of use, authorization and control of the spectrum. They also explained the challenges of the secondary use of the spectrum. For example, exclusive secondary use of radio frequencies would have implications for the rights of primary companies and their business plans. According to Telefonica, the current framework is already sufficient to meet the demand for spectrum by different stakeholders.

### **3.10. PADTEC**

PADTEC offers an extensive product portfolio that meets end-to-end demands - in transmission, optical amplification and route protection - of service providers, integrators, carriers, utilities, governments and enterprises. PADTEC offers solutions for backbone networks, metropolitan networks and for SAN Extension and DCI for data centres interconnection. PADTEC's services unit, with more than 40 points of presence in Latin America, provides for the implementation, operation, maintenance and on-going network management of systems. PADTEC (founded in 2001) is a spin-off of CPQD and CPQD owns 54% of PADTEC. CPQD research feeds into PADTEC's product portfolio.



In the first part of the visit, the PADTEC delegation presented:

- An overview of the company, including its vision, values, history, footprint and the key financial indicators. PADTEC's main activity includes development and manufacture of solutions for high-capacity broadband networks, based on DWDM technology.
- Details about PADTEC's customer portfolio, ranging from telecom operators, regional providers, carriers, subsea systems to utilities and integrators, data centers and multimedia, government and research institutions. They highlighted their service to over 150 Internet Service Providers, collectively responsible for more than 60% of FttH in Brazil.
- In-depth information about PADTEC's optical network solutions for backbone transport serving linear topology, ultra long-haul and high capacity transmission. They also explained how their products are used in metro networks in which transmission is characterized by the following: ring or mesh topologies, medium haul, high capacity and dynamic traffic matrix. Apart from backbone and metro usage, PADTEC's products offer solutions for utilities (eg hydroelectrics, electric power stations, oil platforms, etc) because they can minimize the need for repeaters and support very long spans (up to 380 km). Finally, their products can be used for providing connectivity to remote regions only accessible through rivers.
- PADTEC's provision of services and solutions facilitating site monitoring, network operation and maintenance, network management, fiber characterization and supervision etc.

After the presentation and the exchanges, BEREC delegation had the chance to visit the premises of PADTEC's factory and see the production lines.

### 3.11. CPQD

CPQD is one of the largest Latin American R&D centers in Telecommunications and IT. CPQD carries out the largest research and development program in Latin America, generating ICT solutions that are applied in various sectors, such as: telecom, agribusiness, finance, utilities, industries, cities, retail and defense and security services. They operate oriented towards trends with the potential to transform people's lives and the business world, such as Internet of Things (IoT), Artificial intelligence, Blockchain, Electric Mobility, Connectivity Technologies, Smart Cities, Smart Agribusiness and Advanced Manufacturing.



During the meeting, the CPQD and BEREC delegations discussed about the following:

- CPQD performs market driven research and development (and not just academic research), aiming at meeting the ICT needs of players in various sectors. Around 40% of their revenues is sourced from private companies.
- CPQD has very close co-operation with the Ministry of Communications and the Ministry of Science, Technology and Innovation, contributing to public policy objectives and technical standards defined by ANATEL.
- Regarding AI, CPQD has been developing products and creating tailor-made solutions, based on computational techniques that emulate human behavior, using data science and machine learning for more than 10 years.

- CPQD has also worked in developing software products for Operational Support Systems (OSS) in order to meet the needs of telecom operators. It is also considered a national excellence centre for Open Ran.
- CPQD presented their C2n solution used by operators in order to expand the connectivity of 4G/5G private networks and FWA, succeeding coverage of large areas. This software platform offers their customers greater flexibility and cost savings.

Following the meeting, a lab tour provided insights into CPQD's research and development in practice.

### 3.12. NIC.br/IX.br/CEPTRO.br/Cetic.br

The final visit was to the Brazilian Network Information Center (NIC.br) which is a non-profit organization responsible for the administrative and operational functions related to the .br domain. In addition to providing and maintaining the domain names registration activity, NIC.br is also investing in projects that contribute to the improvement of the available Internet infrastructure in Brazil, using the revenue collected exclusively from the .br domain.

IX.br is the Internet exchange point system of Brazil. Another related unit is the Center for Studies and Research in Network and Operations Technology (CEPTRO.br) which is responsible for initiatives and projects that support or improve the Internet infrastructure in Brazil, contributing to its development. Finally, the Regional Center for Studies on the Development of the Information Society (Cetic.br) is the NIC.br department responsible for the production of indicators and statistics on the availability and use of the Internet in Brazil.



The two delegations exchanged views on:

- The Brazilian interconnection system which is based on 36 IXP which are not interconnected. A non-profit model is applied, which used to operate for free until 2017 and since then, very low fees have been introduced. These fees are only applied where

traffic exceeds 2 Tbit/s and aim to cover just the relevant operational costs. The three main IXP are located in Sao Paulo, Rio de Janeiro and Fortaleza where the submarine cables land.

- The Fixed Broadband Market in Brazil is quite fragmented including 5 big Telcos holding approximately 47% of the market share, while over 12.000 small-medium ISPs collectively hold the remaining 53%. These two categories of operators have a different approach when it comes to interconnection. Small and Medium ISPs initially receive 50 – 70% Internet traffic from IX.br São Paulo and when they grow, they start requesting caches. They can also purchase IP transit services offered by telecom companies in IX.br (using a private VLAN).
- Cetic.br explained their work in producing ICT statistics. They operate as a knowledge center on ICT-data production and they apply capacity-building methodologies for the production and use of ICT statistics. In addition, they want to be a laboratory of ideas and methodological innovation and they also aim at measuring the impacts of ICT in society and producing strategic recommendations & policy briefs.
- Producing ICT statistic is quite expensive in Brazil and therefore the revenues from .br domain are used for this purpose. Cetic.br stands as the sole official data source for ICT statistics in Brazil that is also used by OECD and ITU. They also explained their recent work on measuring the impacts of new digital technologies such as robotics, AI, and the Internet of Things (IoT).
- Finally, their delegation presented their work on Quality of Service (QoS) measurement, emphasizing their efforts to customize measurements and address representativeness issues, particularly concerning people living in rural areas with limited connectivity. Their approach involves combining data to enhance the quality of QoS measurements.