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ICT Households

SURVEY ON THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN BRAZILIAN HOUSEHOLDS

2024

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Brazilian Network Information Center

ICT Households

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2024

Brazilian Internet Steering Committee
www.cgi.br

São Paulo
2025

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Foreword

A successor to Arpanet, the Internet was maintained in its first decades by research funds, such as the National Science Foundation (NSF) in the United States, and by the institutions connected to it. Throughout this period—which lasted until the mid-1990s—the Internet was used mainly for the communication of supercomputing centers and universities, without aiming for self-sustainability. With its widespread dissemination more than three decades later, we can say that the Internet has become mature, and is made up of a very complex ecosystem structured on layers of physical infrastructure, connection protocols, and a wide range of applications.

This maturation process, in addition to the search for Internet sustainability, has involved technical challenges of scalability and security, in addition to interaction with political and regulatory bodies. It has gone through many stages and an extensive multisectoral and international effort to define Internet governance arrangements that are capable of balancing diverse interests and guaranteeing stability, interoperability, and expansion. In the Brazilian case, the establishment of multisectoral, democratic, and collaborative governance was solidified with the creation of the Brazilian Internet Steering Committee (CGI.br) and the institutionalization of the Brazilian Network Information Center (NIC.br), which includes Registro.br, responsible since 1989 for registering domain names with the "last name" .br. In this way, it was possible to guarantee not only the Internet governance framework, already defined by Standard 4 of 1995, but also self-sufficiency in the technical management of names and numbers, making it possible to reinvest in the expansion and improvement of the Internet infrastructure in Brazil.

In addition to managing the registration and publication of .br domain names, and allocating autonomous system numbers (ASN) and Internet protocol (IP) addresses in versions 4 and 6, it carries out a number of other actions, all linked to the promotion of fundamental values for the Internet, such as integrity, interoperability, and accessibility.[1] These actions include supporting research centers with funds from Registro.br, holding national and international events, and promoting actions aimed at expanding the infrastructure and protecting users on the Internet, always with the goal of making the Internet increasingly accessible and safe. Another fundamental aspect is CGI.br's role in fostering constant and careful dialogue about the use of the Internet by individuals, enterprises, and the government.

[1] More information at https://principios.cgi.br/sobre

While technological advances bring countless possibilities, it is also true that new challenges need to be faced collectively if the Internet's guiding principles are to be preserved. In recent years, for example, the growing adoption of mobile devices and Artificial Intelligence (AI) technologies by individuals and organizations has brought to the fore issues such as privacy and data protection, the proliferation of false or misleading content, and the potentially harmful excessive use of digital devices by children. Several events promoted by NIC.br in 2024 addressed these issues, enabling multisectoral reflections anchored in data. Some examples are the 15th edition of the Seminar on Privacy and Personal Data Protection,[2] the 9th Symposium on Children and Adolescents on the Internet,[3] and the seminar launching the Brazilian Artificial Intelligence Observatory (OBIA),[4] which operates under NIC.br.[5]

It is also worth highlighting the participation of CGI.br and the collaboration of NIC.br in various G20 initiatives during Brazil's presidency in 2024. To contribute to the debate on the digital economy, the Regional Center for Studies on the Development of the Information Society (Cetic.br)—a department of NIC.br dedicated to the production of indicators and analyses—has been active in the production of three reports on topics considered to be priorities by the G20 that are fundamental to the dialogue on technology and society. These publications had important international organizations as partners: the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Telecommunication Union (ITU), and the Ministries of Science, Technology and Innovation (MCTI) and Communication (MCom). The first summarizes indicators on the state of AI development in the G20 countries,[6] while the second focuses on the adoption of AI in public services.[7] The third proposes a framework for the international measurement of meaningful connectivity.[8]

Cetic.br|NIC.br is also responsible for a series of other publications that provide a detailed overview of the use of information and communication technologies (ICT) by individuals and organizations in Brazil. In addition to publishing research on ICT adoption in different segments, such as households, enterprises, governments, education, and health, the Center conducts sectoral and cross-cutting studies with a national scope on topics such as meaningful connectivity, AI in health, privacy and data protection, and electronic waste.

In 2025, Cetic.br|NIC.br celebrates two decades of work dedicated to producing reliable indicators and analysis on the use of ICT in Brazil. Over these 20 years, it has established itself as a national and international benchmark in the generation of comparable data, which provides important input for policymaking, the development of academic research,

[2] More information at https://seminarioprivacidade.cgi.br/

[3] More information at https://criancaseadolescentesnainternet.nic.br/

[4] More information at https://seminarioobia.nic.br/

[5] More information at https://obia.nic.br/

[6] More information at https://cetic.br/pt/publicacao/toolkit-for-artificial-intelligence-readiness-and-capacity-assessment/

[7] More information at https://cetic.br/pt/publicacao/mapping-the-development-deployment-and-adoption-of-ai-for-enhanced-public-services-in-the-g20-members/

[8] More information at https://cetic.br/pt/publicacao/universal-and-meaningful-connectivity-a-framework-for-indicators-and-metrics/

and strengthening the multisector debate on digital transformation. Its commitment to methodological rigor and excellence in the production of knowledge has strengthened its position with international organizations, governments, and civil society, making it an important pillar in building a more inclusive and sustainable digital environment.

The publication you have before you is part of this trajectory and reflects the conceptual and methodological knowledge of Cetic.br|NIC.br. In it, you will find essential data and evidence to understand how Brazilian society has been appropriating these technologies over the last two decades, a period marked by significant advances and complex challenges emerging from the digital age. This celebration is not only an institutional milestone, but also an invitation to reflect together on the future of ICT research and the role of data in building policies and strategies for a connected and informed society.

Enjoy your reading!

Demi Getschko
Brazilian Network Information Center - NIC.br

Presentation

Throughout 2024, the Brazilian Internet Steering Committee (CGI.br), in conjunction with the Brazilian Network Information Center (NIC.br), actively participated in national and international debates on the challenges for the governance of the digital environment, reaffirming its commitment to an inclusive and sustainable future for Brazil and the world. In particular, it is worth highlighting the NetMundial+10 Conference,[1] held in April 2024 by CGI.br. The Conference has established itself as a multisectoral platform for dialog on the challenges of Internet governance in a scenario in which digital technologies profoundly transform social, economic, cultural, informational, and political relations. The meeting culminated in the document *NetMundial+10 Multistakeholder Statement: Strengthening Internet governance and digital policy processes*,[2] which has become a reference on global agendas.

Also in 2024, during its presidency of the G20, Brazil took on a leading role in promoting sustainable development, social inclusion, and the reform of global governance. With a focus on reducing inequalities and fighting hunger and poverty, the country promoted debates on the energy transition, climate change, and key issues related to the digital economy. Brazil's chosen priorities in the G20 Digital Economy Working Group (DEWG) also reflect its commitment to a more inclusive and sustainable digital economy, including topics such as meaningful universal connectivity, advancing digital government and digital public infrastructures, promoting information integrity and a more secure digital environment, and Artificial Intelligence (AI) for sustainable development and reducing inequalities.

With the prominent and collaborative work of the Ministries of Science, Technology and Innovation (MCTI), Communications (MCom), Management and Innovation in Public Services (MGI), and the Secretariat for Social Communication (Secom), these priorities were considered strategically, in line with the challenges of the digital economy. NIC.br and CGI.br played an important role in several of these activities, contributing their technical expertise and commitment to multisectoral Internet governance, such as the leadership of the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of NIC.br, in three publications related to the priority themes.[3]

[1] More information at https://netmundial.br/

[2] The Statement can be accessed at https://netmundial.br/pdf/NETmundial10-MultistakeholderStatement-2024.pdf

[3] Toolkit for Artificial Intelligence Readiness and Capacity Assessment; AI for enhanced public services in the G20 members: Artificial Intelligence for inclusive sustainable development and inequalities reduction; and Universal and meaningful connectivity: A framework for indicators and metrics.

At the same time as the international meetings, the 5th National Conference on Science, Technology and Innovation (CNCTI) was held in Brasilia. The meeting, which was open and participatory, was attended by more than 2,500 representatives from civil society, academia, the technical community, international organizations, and the Brazilian government, representing a space for social dialogue and proposing public policies. On that occasion, the Brazilian Artificial Intelligence Plan (PBIA) was launched,[4] which, under the coordination of the MCTI, aims to realize the Brazilian project of technological autonomy, increasing the competitiveness of the national economy, and stimulating the responsible use of AI. As one of their contributions to the issue, NIC.br and CGI.br organized the 1st Seminar of the Brazilian Artificial Intelligence Observatory (OBIA),[5] an integral part of the PBIA, which plays an essential role in producing and disseminating data and studies on the adoption and use of AI-based systems in the country.

To support these debates and monitor the achievement of the commitments made, the availability of data and indicators is essential to map the socioeconomic implications of the adoption of digital technologies by different sectors of society. With two decades of regular production of reliable and internationally comparable statistical data, as well as dissemination of studies and analyses on the impacts of digital technologies on society, Cetic.br|NIC.br has many reasons to celebrate. Its commitment to excellence and methodological rigor in the production of quality data has ensured recognition and influence among public policymakers and international organizations linked to the ecosystem of indicators and statistics. In addition, Cetic.br|NIC.br maintains ongoing cooperation with civil society, the academic community, national statistical offices, and important international organizations such as the Organisation for Economic Co-operation and Development (OECD), the International Telecommunication Union (ITU), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Conference on Trade and Development (UNCTAD), the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and the United Nations Statistics Division (UNSD).

In this context, and in celebration of the 20th anniversary of Cetic.br|NIC.br, this publication offers valuable inputs for building accessible, relevant, and qualified knowledge, which is essential for informing debates and decisions on the country's digital transformation. Through the production of data and evidence as fundamental pillars, we seek not only to understand the challenges of the present, but also to pave the way for a more equitable and secure future for the next generations.

Renata Vicentini Mielli
Brazilian Internet Steering Committee – CGI.br

[4] More information about PBIA is available at https://www.gov.br/lncc/pt-br/assuntos/noticias/ultimas-noticias-1/plano-brasileiro-de-inteligencia-artificial-pbia-2024-2028

[5] OBIA can be accessed at https://obia.nic.br/

Executive Summary

ICT HOUSEHOLDS SURVEY 2024

Executive Summary ICT Households 2024

The 2024 edition of ICT Households features new data on meaningful connectivity for the Brazilian population.

In 2024, the Regional Center for Studies on the Development of the Information Society (Cetic.br|NIC.br) launched the study *Meaningful Connectivity: Measurement proposals and the portrait of the population in Brazil*, which presented the connectivity conditions for the Brazilian population based on the most recent literature on digital inclusion. In this study, nine indicators from ICT Households were analyzed to create a scale for meaningful connectivity (MC). This framework was followed in the current edition of the ICT Households survey.

According to the survey results, 34% of the Brazilian population had the lowest level of meaningful connectivity (0 to 2 points), while 22% had the highest (7 to 9 points). The highest level of MC was more prevalent in urban areas (24%) than in rural areas (5%), as well as in the South and Southeast (33% and 28%, respectively) compared to the Northeast (44%) and North (41%). It was also more prevalent among men (28%), White individuals (28%), those in classes A (73%) and B (58%), and those with a Tertiary Education (58%).

In 2024, only 22% of Internet users had a household Internet connection cost of less than 2% of their declared household income. This proportion was 58% for class A and 6% for classes DE. Among those who owned mobile phones, 57% had prepaid plans—which are more limited in terms of the data package—with higher proportions in rural areas (71%), in the Northeast (66%), and in the classes DE (69%).

In 2024, Internet users represented 84% of the population 10 years old or older, or 159 million individuals, 96% of whom used the Internet every day or almost every day. According to the survey, 60% of users accessed the Internet only via mobile phones, while 40% used both their computers and mobile phones. Internet use via televisions also stood out, maintaining an upward trend since 2014 (7%) and reaching 60% by 2024. Among households, 83% had Internet access, a proportion that remained stable compared to 2023 (84%).

EIGHT OUT OF TEN BRAZILIANS (84%) USED PIX IN 2024, REPRESENTING AN INCREASE OF 18 PERCENTAGE POINTS COMPARED TO 2022

The survey showed that 71% of Brazilian households with Internet access connected via fixed broadband, 65% of which used cable or fiber optics, and 14% used a mobile connection. Among households with Internet access, 30% reported a connection speed of 51 megabits per second or more.

According to the 2024 edition, the home was the main place where users accessed the Internet (98%). Around two-thirds accessed the Internet at someone else's house (64%) and 59% said they used the Internet while on the move. 61% accessed the Internet at home and in at least one other place, a proportion that was 76% in class A and 44% in classes DE.

Digital skills

The 2024 edition of ICT Households showed that the digital skills most used by Internet

users continued to be verifying the reliability of information found online (52%), adopting security measures, such as strong passwords or two-factor authentication, to protect devices and online accounts (48%), and using copy-and-paste tools to duplicate or move content, for example, in documents or messages (45%). Skills that require more technical knowledge continued to be reported less frequently, such as using formulas in a spreadsheet (19%) and creating slide presentations (17%).

The digital skills investigated were strongly associated with factors such as the devices used to access the Internet. They were more present in users who accessed the Internet from both mobile phones and computers than among those who only used mobile phones. There was also a strong relationship between the presence of skills and the MC of individuals. Creating slide presentations, for example, was performed by 38% of users with the highest level of MC, and only 4% of those with the lowest level.

IN 2024, 34% OF THE BRAZILIAN POPULATION HAD THE LOWEST LEVEL OF MEANINGFUL CONNECTIVITY, WHILE 22% HAD THE HIGHEST

Activities carried out on the Internet

In 2024, 92% of Internet users sent instant messages, 82% made voice or video calls, and 81% used social networks.

Approximately six out of ten Internet users 10 years old or older looked up information about goods or services (56%) or searched for financial information, made payments, and other financial transactions (56%), and about half searched for information on health or healthcare services (51%). These were the most common topics searched for by users.

Nearly three-quarters of Internet users 10 years old or older watched videos, programs, movies, or series online (77%) and listened to music online (76%), a result that kept these activities among those most performed by Brazilian Internet users. Approximately nine out of ten users between 10 and 15 years old watched videos, programs, movies, or series (93%) or listened to music (89%), and 85% played games online.

Among Internet users 10 to 15 years old, 88% completed school activities or research, and 65% studied on the Internet on their own, while 34% of users 16 to 24 years old looked up information on undergraduate, graduate, or extension courses, and 27% took distance learning courses.

ELECTRONIC GOVERNMENT

ICT Households 2024 revealed that 61% of Internet users 16 years old or older had used some kind of e-government service, a percentage that remained stable compared to 2023. The most common services carried out by these users were those related to public health (32%), personal documents (31%), and taxes and fees (29%), all stable compared to 2023. On the other hand, services related to labor rights and social security showed a significant reduction, from 33% in 2023 to 25% in 2024.

Regarding whether services were completed entirely online, those related to taxes and fees continued to be more frequently completed entirely online (16%), which proved to be more common among class A users (52%) and those with a Tertiary Education (36%). Among users in classes DE, on the other hand, only 1% carried out these services entirely over the Internet. Furthermore, services associated with public health (12%) had the highest proportion of users who only looked up information on the Internet and carried out the service in person compared to other services.

ELECTRONIC COMMERCE

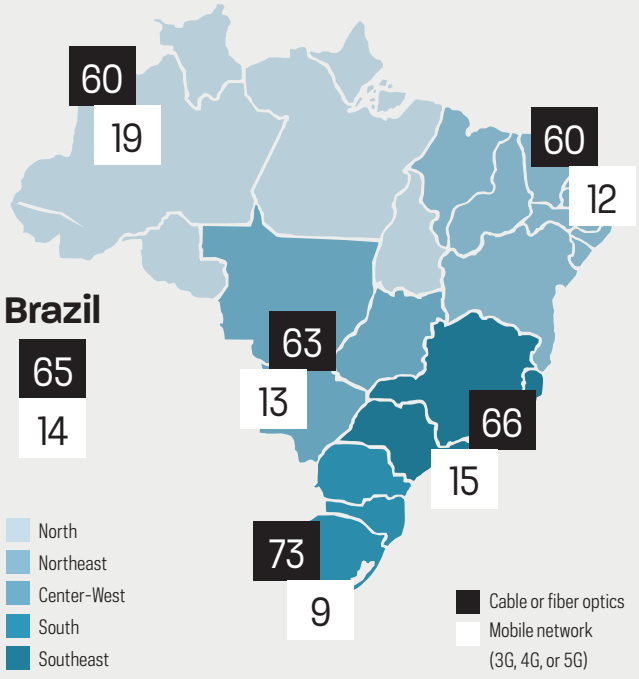
The ICT Households 2024 survey showed that 46% of Internet users purchased goods or services over the Internet in the 12 months

FIGURE 1

–

Households with Internet access, by type and region (2024)

Total number of households (%)



39.8
million households with Internet only

259,000
households with computers only

26.6
million households with computers and Internet

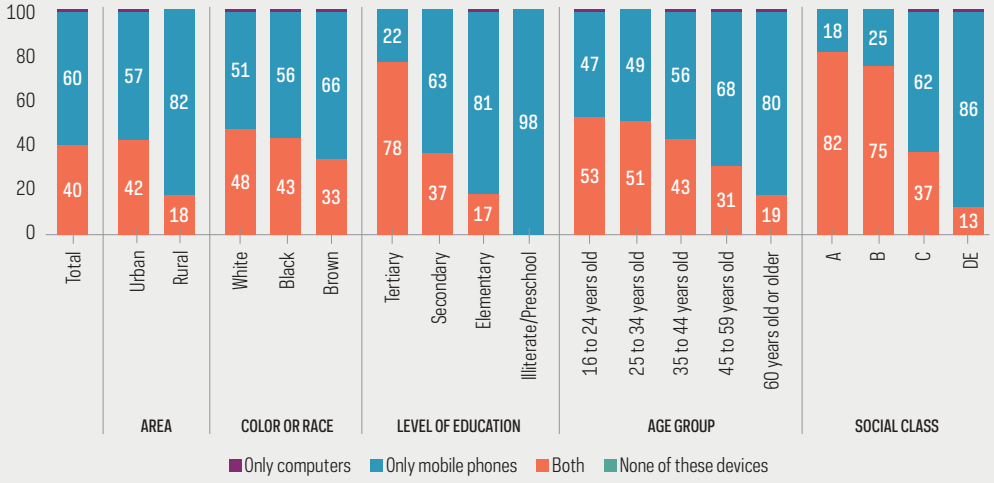
12.9
million households with neither computers nor Internet

CHART 1

–

Internet users by exclusive or simultaneous access via mobile phones and computers (2024)

Total number of Internet users (%)



prior to the study, which represents 73 million people. The most purchased or ordered types of goods were clothes, shoes, and sports materials (71%), representing an increase compared to 2022 (64%). Other products that stood out were home appliances (53%), food and foodstuff (45%), and cosmetics or personal care products (41%). In terms of services, the ones most used were transport apps to order cab rides or private drivers (44%), streaming services for series or movies (40%), and ordering meals on sites or applications (35%).

Regarding the means of payment used by Internet users, the 2024 edition of ICT Households indicated an increase of 18 percentage points in the use of Pix compared to 2022, consolidating it as the means most used by this population (84%). On the other hand, the use of bank payment slips fell from 43% in 2022 to 24% in 2024.

As for selling goods or services online, the survey showed that 16% of Internet users had done so in the 12 months prior to the survey, a percentage that remained stable compared to 2022 (19%). Social networks (73%) remained the most used platforms to sell or advertise these products.

Survey methodology and access to data

The ICT Households survey has been carried out since 2005 and investigates access to and use of information and communication technologies (ICT) in households by individuals 10 years old or older. For this edition, interviews were carried out in 23,856 households and with 21,170 individuals throughout the country. Data collection was conducted by face-to-face interviews between March and August 2024. The survey results, including tables of survey proportions, totals, and margins of error, are available at https://cetic.br. The "Methodological Report" can be consulted in both the publication and on the website.

BOX 1

—

PIX AND THE DEMOCRATIZATION OF DIGITAL PAYMENT

In recent years, the ICT Households survey has been observing a decrease in the differences between various social strata in carrying out financial activities over the Internet, such as consultations, payments or other types of transactions. The growth of Pix as a payment method for online purchases compared to 2022, highlighted in this edition, reinforces this trend.

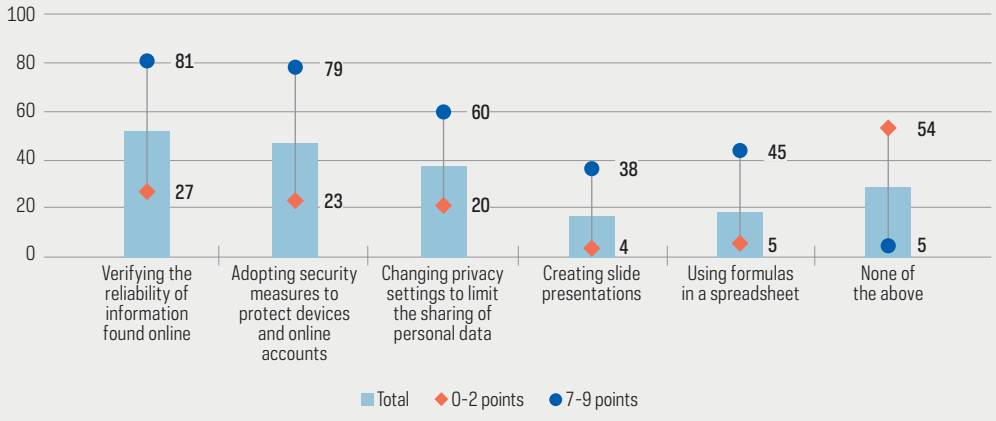
The ICT Households 2024 data indicated that Pix grew compared to 2022, especially among groups with a family income of between one and two minimum wages (25 pp), among Black (28 pp) and Brown individuals (21 pp), and among individuals with a meaningful connectivity level of 3 or 4 points (29 pp). In addition, Pix transfer is related to lower technical, logistical and financial barriers compared, for example, with the use of credit cards, so its dissemination facilitates access to ecommerce for individuals with fewer economic and connectivity resources.

CHART 2

—

Internet users by selected digital skills and level of meaningful connectivity (2024)

Total number of Internet users (%)



Of the 159 million Internet users...

92% sent instant messages

77% watched videos, programs, films, or series online

56% carried out consultations, payments, or other financial transactions

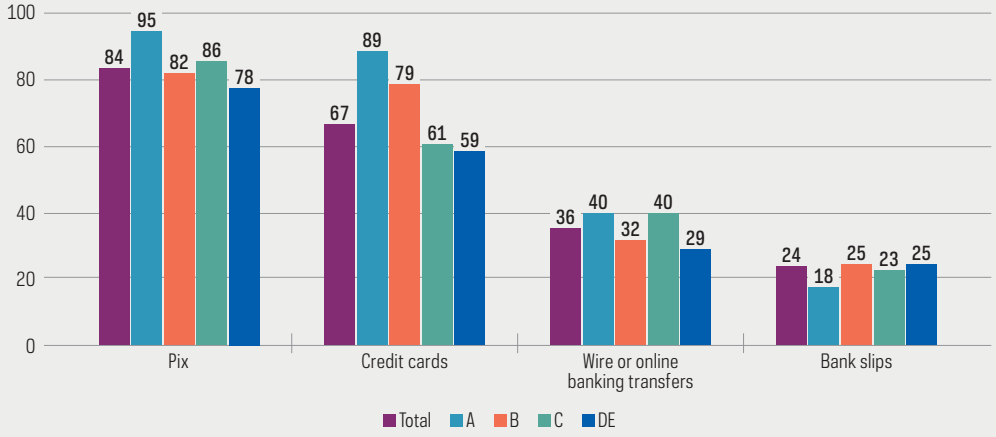
46% purchased goods and services over the Internet

CHART 3

—

Internet users who purchased goods and services online, by payment method and social class (2024)

Total number of Internet users who purchased goods or services online in the last 12 months (%)



Access the full survey data!

In addition to the results presented in this publication, tables of indicators, questionnaires, information on how to access the microdata, and the presentation of the results of the launch event are available on the Cetic.br|NIC.br website, as well as other publications on the topic of the survey. The tables of results (https://cetic.br/en/pesquisa/domicilios/indicadores/), available for download in Portuguese, English, and Spanish, present the statistics produced, including information on the data collected and cross-referencing for the variables investigated in the study. The information available in the tables follows the example below:

Code and indicator name

Population to which the results refer

C5 - INTERNET USERS BY ACTIVITIES CARRIED OUT ON THE INTERNET - COMMUNICATION

Total number of Internet users

PERCENTAGE (%)		SENDING OR RECEIVING E-MAILS	SENDING INSTANT MESSAGES	MAKING VOICE OR VIDEO CALLS	USING SOCIAL NETWORKS	PARTICIPATING IN NEWSGROUPS OR ONLINE FORUMS
TOTAL		62	92	82	81	12
AREA	Urban	64	93	83	82	12
	Rural	45	89	73	70	5
REGION	Southeast	68	92	85	81	13
	Northeast	51	90	78	77	9
	South	67	96	83	85	13
	North	56	90	79	82	11
	Center-West	56	96	85	81	12
SOCIAL CLASS	A	86	98	96	71	31
	B	84	98	92	92	20
	C	62	93	81	80	11
	DE	42	86	75	74	5

Indicator responses

Results tabulation cut-outs: total (population as a whole) and characteristics of analysis (region, age group, etc.), different in each survey

Results: can be in % or totals

Source: Brazilian Network Information Center. (2024). *Survey on the use of information and communication technologies in Brazilian households: ICT Households 2024* [Tables].

How to reference the tables of indicators

This publication is also available in Portuguese on the Cetic.br|NIC.br website.

Methodological Report

ICT HOUSEHOLDS
SURVEY 2024

Methodological Report
ICT Households 2024

The Brazilian Internet Steering Committee (CGI.br), through the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Center (NIC.br), presents the methodology of the ICT Households survey.

The ICT Households survey includes in its data collection process the target population of the ICT Kids Online Brazil survey, encompassing children 9 to 17 years old. Thus, the two surveys share the method for selecting respondents, which is described in detail in the "Sampling plan" section. Even though the data was collected jointly, the results of the two surveys are disclosed in specific reports for each audience.

Survey objective

The main goal of the ICT Households survey is to measure the ownership and use of information and communication technologies (ICT) by residents in Brazil 10 years old or older.

Concepts and definitions

CENSUS ENUMERATION AREA

According to the Brazilian Institute of Geography and Statistics (IBGE) definition for the Population Census, a census enumeration area covers the smallest territorial unit consisting of a contiguous area with known physical boundaries, located in an urban or rural area, of a scale suitable for data collection. The combination of census enumeration areas in a country represents the entire national territory.

AREA

A household may be urban or rural, according to where it is located, based on the legislation in force for the Population Census. Urban status applies to cities (municipal centers), villages (district centers), and isolated urban areas. Rural status applies to all areas outside those limits.

LEVEL OF EDUCATION

This concept refers to the level of education that the individual was attending or had attended, even if they had not completed the entire cycle. For data collection purposes, level of education was divided into 20 subcategories, ranging from "did not attend school" up to "PhD."

MONTHLY FAMILY INCOME

Monthly family income is defined as the sum of the income of all members of the household, including the respondent. For purposes of data publication, six income levels were established, starting at the monthly minimum wage (MW) as defined by the Brazilian Federal Government. The first level refers to households with a total income of up to one MW, while the sixth level refers to households with income of over ten MW:

- up to one MW;
- more than one MW up to two MW;
- more than two MW up to three MW;
- more than three MW up to five MW;
- more than five MW up to ten MW;
- more than ten MW.

SOCIAL CLASS

The most precise term to designate this concept would be "economic class." However, this survey has referred to it as "social class" in the tables and analyses. The economic classification was based on the Brazilian Economic Classification Criteria (Brazilian Criteria), as defined by the Brazilian Association of Research Companies (Abep, 2015). This classification is based on ownership of durable goods for household consumption and level of education of the head of the household. Ownership of durable goods is based on a scoring system that divides households into the following economic classes: A1, A2, B1, B2, C, D, and E. The Brazilian Criteria was updated in 2015, resulting in classifications that are not comparable with the previous edition (Brazilian Criteria 2008). For results published in 2016 and onward, the Brazilian Criteria 2015 were adopted.

ECONOMIC ACTIVITY STATUS

This refers to the economic activity status of respondents 10 years old or older. From a set of four questions, seven classifications were obtained related to respondents' activity status. These alternatives were classified into two categories for analysis, as shown in Table 1.

TABLE 1
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CLASSIFICATION OF ECONOMIC ACTIVITY STATUS

Response options in questionnaire		Status classification
Code	Description	Description
1	Works with pay	In the workforce
2	Works with no pay, i.e., apprentice, assistant, etc.	
3	Works, but is on a leave of absence	
4	Attempted to work in the last 30 days	
5	Unemployed and has not looked for a job in the last 30 days	Not in the workforce

PERMANENT PRIVATE HOUSEHOLDS

This refers to a private household located in a unit that serves as a residence (house, apartment, or room). A private household is the residence of a person or a group of people, where the relationship is based on family ties, domestic dependence, or shared living arrangements.

INTERNET USERS

Internet users are considered to be individuals who have used the Internet at least once in the three months prior to the interview, as defined by the International Telecommunication Union (ITU, 2020).

Target population

The survey target population was made up of permanent private Brazilian households, and also all individuals 10 years old or older residing in permanent private Brazilian households.

Reference and analysis unit

The survey was divided into two units of analysis and reference: permanent private households and residents 10 years old or older.

Domains of interest for analysis and dissemination

For the reference and analysis units, the results are reported for domains defined based on the variables and levels described below.

For the variables related to households:

- **area:** corresponds to the definition of census enumeration areas, according to IBGE criteria, considered rural or urban;
- **region:** corresponds to the regional division of Brazil, according to IBGE criteria, into the macro-regions Center-West, Northeast, North, Southeast, and South;
- **family income:** corresponds to the division of the total income of the households or residents into ranges of MW. These ranges are the following: up to one MW, more than one MW up to two MW, more than two MW up to three MW, more than three MW up to five MW, more than five MW up to ten MW, or more than ten MW;
- **social class:** corresponds to the division into A, B, C, and DE, in accordance with the Brazilian Criteria.

Regarding variables concerning individuals, the following characteristics were added to the domains mentioned above:

- **sex:** corresponds to the division into male or female;
- **color or race:** corresponds to the divisions of White, Black, Brown, Asian, or Indigenous;
- **level of education:** corresponds to the divisions of illiterate/preschool, Elementary Education, Secondary Education, and Tertiary Education;
- **age group:** corresponds to the divisions of 10 to 15 years old; 16 to 24 years old; 25 to 34 years old; 35 to 44 years old; 45 to 59 years old; and 60 years old or older;
- **economic activity status:** corresponds to the division between "in the workforce" and "not in the workforce."

Data collection instrument

INFORMATION ON THE DATA COLLECTION INSTRUMENTS

Data was collected through structured questionnaires with closed questions and predefined answers (single or multiple-choice answers). For more information about the questionnaire, see the section "Data collection instruments" in the "Data Collection Report."

Sampling plan

SURVEY FRAME AND SOURCES OF INFORMATION

Data from the IBGE 2010 Population Census was used for the sample design of the ICT Households and the ICT Kids Online Brazil surveys. In order to increase sample effectiveness, the reference survey frame was modified to create intramunicipal geographic units (also considering urban/rural status) that were made up of pairs of census enumeration areas, which are called primary sampling units (PSU). Thus, the selection of a PSU is equivalent to selecting about one pair of census enumeration areas.

The census enumeration areas were paired to make up the new PSU considering variables of status (urban/rural) and average monthly nominal income of people 10 years old or older, within each municipality.[1]

This process results in aggregates of one, two, or three census enumeration areas, dividing the basis of census enumeration areas approximately in half.

SAMPLE SIZE DETERMINATION

Sample size considered the optimization of resources and quality required for presenting the results of the ICT Households and ICT Kids Online Brazil surveys, according to the proposed objectives. The following sections concern the sample designed for collecting data for both surveys.

SAMPLE DESIGN CRITERIA

The sample plan used to obtain the sample of census enumeration areas can be described as stratified three-stage cluster sampling. The probabilistic sample consisted of three stages: selection of PSU, selection of households, and selection of residents.

SAMPLE STRATIFICATION

The stratification of the probabilistic sample was based on the following steps:

- Twenty-six geographic strata were defined, matching the federative units.
- The Federal District was considered a separate stratum (a federative unit with distinct characteristics from the others).

[1] The detailed algorithm was given by: 1) ordering the census enumeration areas by municipality, status (urban/rural), and average monthly nominal income of people 10 years old or older (either with or without income); 2) numbering the records within the municipality and status in ascending order, thus creating the variable RBA_009; 3) counting census enumeration areas within each MUNICIPALITY-STATUS set, thus creating the variable NUMSC; 4) dividing the total obtained in item 3 by two, thus creating the variable DIV; 5) creating a new PARMUN with one of the following values: a) RBA_009 ≤ DIV; b) DIV if (RBA_009 - DIV) > DIV; or c) RBA_009 - DIV if RBA_009 > DIV.

- Within each of the 26 geographic strata, strata of municipality groups were defined:
  - The capital cities of all the federative units were included in the sample (26 strata)—self-representative municipalities.
  - For nine states, metropolitan region strata were defined: Pará, Ceará, Pernambuco, Bahia, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, and Rio Grande do Sul.
  - All other census enumeration areas, belonging to the other municipalities of the federative units (26), were separated into two strata: rural and urban area.

The primary sampling units, altogether, were divided into 88 strata: 27 capital cities, nine metropolitan regions and 52 PSU strata according to federative unit and household area or status (urban/rural).

SAMPLE ALLOCATION

The sample allocation adhered to parameters related to costs and the quality expected from indicators. In total, approximately 1,080 PSU, or 2,160 census enumeration areas, were selected throughout the entire national territory, and within each, data was to be collected from 15 households, corresponding to a sample of 32,400 households. The PSU sample allocation, considering the 88 strata, was defined as follows:

- 40 PSU per federative unit (26) and 40 PSU in the Federal District;
- 10 PSU in capital cities;
- if the federative unit has a metropolitan region stratum, 10 PSU among the other municipalities in the metropolitan region and 20 PSU among the remaining municipalities in the federative unit, being 14 urban and 6 rural;
- if the federative unit does not have a metropolitan region stratum, 30 PSU among the other municipalities, being 24 urban and 6 rural.

SAMPLE SELECTION

SELECTION OF PSU

The PSU were selected with probabilities proportional to the square root of the number of permanent private households in each PSU, according to the 2010 Population Census, using Pareto's method of probability proportional to size (Freitas & Antonaci, 2014; Rosén, 2000). The size was modified within each stratum of the selection to reduce the variability of the probability of selection in each PSU:

- If the number of permanent private households in the PSU is lower than the 5% percentile, a size equivalent to the 5% percentile is adopted.

- If the number of permanent private households in the PSU is equal to or greater than the 5% percentile and lower than or equal to the 95% percentile, the size observed is adopted.
- If the number of permanent private households in the PSU is greater than the 95% percentile, a size equivalent to the 95% percentile is adopted.

SELECTION OF HOUSEHOLDS AND RESPONDENTS

Permanent private households within each PSU were selected using simple random sampling. In the first stage, the interviewers listed all the households in the PSU (approximately two census enumeration areas) to obtain a complete and updated record. After updating the number of households per PSU selected, 30 households per PSU were randomly chosen to be visited for interviews.

All the households in the sample needed to answer the ICT Households questionnaire—Module A: Access to information and communication technologies in the household.

To determine which survey should be administered in the household (ICT Households—Individuals or ICT Kids Online Brazil), all the residents in each household were listed and the survey was selected as follows:

1. When there were no residents in the 9 to 17 age group, the ICT Households interview was conducted with a resident 18 years old or older randomly selected from among the household's residents.
2. When there were residents in the 9 to 17 age group, a random number was generated between 0 and 1, and:
    a. If the number generated was smaller than or equal to 0.54, the interview for the ICT Kids Online Brazil survey was conducted with a resident 9 to 17 years old, randomly selected among the household's residents in this age group, and with the person responsible for this selected resident.
    b. If the number generated was greater than 0.54 and equal to or less than 0.89, the ICT Households survey interview was conducted with a resident 10 to 17 years old, randomly selected among the household's residents in this age group.
        - In households selected for the ICT Households survey (with a resident 10 to 17 years old) that only had 9-year-old residents, in addition to members 18 years old or older, the ICT Households survey was conducted with a randomly selected resident 18 years old or older.
    c. If the number generated was greater than 0.89, the interview for the ICT Households survey was conducted with a resident 18 years old or older randomly selected from the residents of the household in this age group.

The selection of respondents in each household selected to answer the questionnaire was done after listing the residents.

Data collection procedures

DATA COLLECTION METHOD

Data collection was conducted using computer-assisted personal interviewing (CAPI), which consists of having a questionnaire programmed in a software system for tablets and administered by interviewers in face-to-face interaction.

Data processing

WEIGHTING PROCEDURES

The selection process for each household and resident, as described above, established an initial selection probability for each PSU. Based on the data collection results, nonresponse corrections were made for each step of the selection process. These steps are described below.

WEIGHTING OF PSU

Each PSU has a selection probability, as described in the "Selection of PSU" section. The inverse of this selection probability corresponds to the basic weight of each selected PSU. During data collection, no answers may be collected from households for a PSU. In this case, nonresponse is adjusted considering that the nonresponse is random within the stratum. The correction of the weights of the responding PSU by stratum is given by Formula 1.

FORMULA 1

$$w_{ih}^{r} = w_{ih} \times \frac{\sum_{h=1}^{H} w_{ih}}{\sum_{h=1}^{H} w_{ih} \times I_{h}^{r}}$$

w_{ih}^{r} is the weight of PSU i in stratum h adjusted for nonresponse

w_{ih} is the base weight of the sampling design of PSU i in stratum h

I_{h}^{r} is an indicating variable that is assigned value 1 if PSU i in stratum h had at least one responding household and 0, otherwise

WEIGHTING OF HOUSEHOLDS IN THE PSU

Similar to the weighting of PSU, each household also has an initial selection probability. This probability is defined as the ratio between 15 (number of households that are selected per census enumeration area) and the number of eligible households in each census enumeration area making up the PSU.

The first factor for calculating the weight of households corresponded to the estimated total of eligible households in the census enumeration area. Permanent private households with residents qualified to answer the surveys were considered eligible (households only with individuals unable to communicate in Portuguese, or where there were other conditions that prevented the survey from being conducted, were excluded), according to Formula 2.

FORMULA 2

$$E_{jih} = d_{jih} \times \frac{d^{E}_{jih}}{d^{A}_{jih}}$$

E_{jih} is the estimated total number of eligible households in census enumeration area j in PSU i in stratum h

d^{E}_{jih} is the total number of eligible households approached in census enumeration area j in PSU i in stratum h

d^{A}_{jih} is the total number of households contacted in census enumeration area j in PSU i in stratum h

d_{jih} is the total number of households listed in census enumeration area j in PSU i in stratum h

The second factor corresponded to the total number of eligible households in which the survey was conducted in the census enumeration area. The weight of each household in a census enumeration area is given by Formula 3.

FORMULA 3

$$w_{jih} = \frac{E_{jih}}{\sum_{k=1}^{15} I^{r}_{kjih}}$$

w_{jih} is the weight of the households in census enumeration area j in PSU i in stratum h adjusted for nonresponse in the census enumeration area

E_{jih} is the estimated total number of eligible households in census enumeration area j in PSU i in stratum h

I^{r}_{kjih} is an indicating variable that is assigned value 1 if household k in census enumeration area j in PSU i in stratum h answered the interview and 0, otherwise

As with the PSU, some of the households selected refuse to participate in the survey. In some cases, a census enumeration area of a PSU may have no responding households. Thus, the nonresponse of the census enumeration area within the PSU must be adjusted.

Nonresponse for the households within the PSU is adjusted after calculating the weights of the households in the census enumeration area, as presented above. This adjustment is carried out with Formula 4.

FORMULA 4

$$w^{r}_{jih} = w_{jih} \times \frac{SC_{ih}}{\sum_{j=1}^{SC_{ih}} I^{r}_{ih}}$$

w^{r}_{jih} is the weight of the households in census enumeration area j in PSU i in stratum h adjusted for nonresponse in the PSU

w_{jih} is the weight of the households in census enumeration area j in PSU i in stratum h adjusted for nonresponse in the census enumeration area

SC_{ih} is the total number of census enumeration areas making up PSU i in stratum h

I^{r}_{ih} is an indicating variable that is assigned value 1 if census enumeration area j in PSU i in stratum h had at least one responding household and 0, otherwise

The final weight of each household, adjusted for nonresponse, is given by:

$$w^{d}_{jih} = w^{r}_{ih} \times w^{r}_{jih}$$

CALIBRATION OF HOUSEHOLDS

Based on the household weight adjusted for nonresponse (w^{d}_{jih}) these weights are calibrated to known totals for households and the general population, obtained from estimates in the most recent Continuous National Household Sample Survey (Pnad Contínua) available (IBGE, 2023).

The calibration method considers the characteristics of households and population totals separately. The method used is the iterative proportional updating (IPU) (Ye et al., 2009). This algorithm makes it possible to establish equal weights for the people living in the same household, respecting marginal household and population totals. The methodology is applied to the set of residents who make up the sample and are listed in the household roster, with all residents initially receiving the same calculated household weight w^{d}_{jih}.

The characteristics used in the calibration are listed below.

For households:

- federative unit (2021 to 2024);
- area (rural or urban);
- household size (1, 2, 3, 4, 5, and 6 or more people).

For individuals:

- macro-region;
- area (rural or urban);
- sex;
- age group (0 to 2 years old, 3 to 5 years old, 6 to 8 years old, 9 years old, 10 to 15 years old, 16 to 24 years old, 25 to 34 years old, 35 to 44 years old, 45 to 59 years old, 60 years old or older).

As a result, a final weight is obtained for each household, given by w^{c}_{jih}, which is the weight of households in census enumeration area j in PSU in stratum h adjusted for nonresponse and calibrated for household population and individual population totals.

The weights are calibrated using the *mlfit*[2] package of the free statistical software R.

WEIGHTING OF RESPONDENTS IN EACH HOUSEHOLD

In each selected household, the ICT Households survey was applied according to the composition of the household and a random survey and respondent selection process.

[2] See https://cran.r-project.org/web/packages/mlfit/

The basic weight of each respondent in the survey is calculated with Formulas 5 and 6.

Residents 10 to 17 years old

FORMULA 5

$$w^{T}_{l/kjih} = \frac{1}{0.35 \times (1 - p^{*})} \times P^{T}_{kjih}$$

$w^{T}_{l/kjih}$ is the weight of the respondent 10 to 17 years old in household k in census enumeration area j in PSU i in stratum h

P^{T}_{kjih} is the number of people in the 10 to 17 age group in household k in census enumeration area j in PSU i in stratum h

p^{*} is the estimated proportion of households with only 9-year-olds in relation to the total number of households with a population of 9 to 17 years old[3]

Residents 18 years old or older

FORMULA 6

$$w^{A}_{l/kjih} = \frac{1}{0.11 \times (p^{*} \times 0.35)} \times P^{A}_{kjih}$$

$w^{A}_{l/kjih}$ is the weight of the respondent 18 years old or older in household k in census enumeration area j in PSU i in stratum h

P^{A}_{kjih} is the number of people 18 years old or older in household k in census enumeration area j in PSU i in stratum h

p^{*} is the estimated proportion of households with only 9-year-olds in relation to the total number of households with a population of 9 to 17 years old[3]

FINAL WEIGHT OF EACH RESPONDENT

The final weight of each individual interviewed in the survey was obtained by multiplying the weights obtained in each step of the weighting process.

a. Weight of the respondent to the ICT Households survey (with residents 10 to 17 years old):

$$w_{lkjih} = w^{c}_{jih} \times w^{T}_{l/kjih}$$

b. Weight of the respondent to the ICT Households survey (with residents 18 years old or older):

$$w_{lkjih} = w^{c}_{jih} \times w^{A}_{l/kjih}$$

[3] Obtained from microdata in the most recent Continuous Pnad survey available. In households selected to participate in the ICT Households survey—Individuals (with residents 10 to 17 years old) with only 9-year-olds, in addition to members 18 years old or older, the ICT Households survey—Individuals was conducted with a randomly selected resident 18 years old or older.

CALIBRATION OF THE WEIGHT OF EACH RESPONDENT

The weights of the interviews were calibrated to reflect certain known and accurately estimated population counts, obtained from the most recent Continuous Pnad survey, as it is also done for households. This procedure, in addition to correction for nonresponse, sought to correct biases associated with nonresponse of specific groups in the population, for all the respondents selected in the households to answer the survey.

The variables considered for calibration of the weights of individuals in the ICT Households survey were: sex, age group (six categories: 10 to 15 years, 16 to 24 years, 25 to 34 years, 35 to 44 years, 45 to 59 years, and 60 years old or older), household area (urban or rural), ICT strata, economic activity status (two categories: in the workforce or not in the workforce), and level of education (four categories: illiterate/Preschool, Elementary Education, Secondary Education, or Tertiary Education).

The calibration of the weights was implemented using the calibration function of the survey library (Lumley, 2010), available in the free statistical software R.

SAMPLING ERRORS

Estimates of margins of error took into account the sampling plan set for the survey. The replication method was used for the individuals who responded to the survey, using the as.svrepdesign function in the R survey package. In this method, 200 weights are generated, which correspond to 200 samples with replacement of the original sample, following the same design (stratified and conglomerate).

The replication method was also used to estimate margins of error for the households responding to the survey. In this case, as the calibration process is not available in the R survey package, replicas were generated based on the population using the following algorithm:

1. 200 replicas were generated with weights only adjusted for nonresponse, leaving the base with 201 weights.
2. For the weight adjusted for non-response with all respondents (original weight), the calibration was made for total households and people (IPU).
3. For the 200 replicate weights generated, calibrations were made for the 200 replicate weights available in the Continuous Pnad.

The result is a household database with 201 weights: the weight that provides precise estimates and 200 replicate weights used to calculate the errors of the precise estimates. This adjustment methodology is described in Opsomer and Erciulescu (2021).

From the estimated variances, we opted to disclose errors expressed as the margin of error of the sample. For publication, margins of error were calculated at a 95% confidence level. Thus, if the survey were repeated several times, 19 times out of 20, the range would include the true population value.

Other values derived from this variability are usually presented, such as standard deviation, coefficient of variation, and confidence interval.

The margin of error is calculated by multiplying the standard error (square root of the variance) by 1.96 (sample distribution value, which corresponds to the chosen significance level of 95%). These calculations were made for each variable in all tables. Therefore, all indicator tables have margins of error related to each estimate presented in each cell of the table.

Data dissemination

The results of this survey are presented according to the variables described in the item "Domains of interest for analysis and dissemination."

In some results, rounding caused the sum of partial categories to be different from 100% for single-answer questions. The sum of frequencies in multiple-answer questions usually exceeds 100%. It is worth mentioning that, in the tables of results, hyphens (-) are used to represent nonresponse. Furthermore, since the results are presented without decimal places, cells with zero value mean that there was an answer to the item, but it was explicitly greater than zero and lower than one.

The results of this survey are published online and made available on the website (https://www.cetic.br/) and on the data visualization portal of Cetic.br|NIC.br (https://data.cetic.br/). The tables of proportions, totals, and margins of error for each indicator are available for download in Portuguese, English, and Spanish. More information on the documentation, metadata, and microdata databases of the survey are available on the microdata webpage (https://www.cetic.br/microdados/).

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Data Collection Report

ICT HOUSEHOLDS SURVEY 2024

Data Collection Report
ICT Households 2024

The Brazilian Internet Steering Committee (CGI.br), through the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Center (NIC.br), presents the "Data Collection Report" of the ICT Households 2024 survey. The objective of this report is to provide information about specific characteristics of this edition of the survey, including changes made to the data collection instruments, sample allocation, and response rates.

The complete survey methodology, including the objectives, main concepts, definitions, and characteristics of the sampling plan, is described in the "Methodological Report" in this publication.

Sample allocation

Sample allocation, as described in the "Methodological Report," is based on the selection of 40 primary sampling units per federative unit. For the 2024 collection, the response rates for the 2023 survey were analyzed, and to mitigate a fall in these rates for some locations, complementary census enumeration areas were incorporated into the original sample.[1] Table 1 presents the number of census enumeration areas and households planned for selection per federative unit for the sample selected for the ICT Households 2024 survey.

[1] Complementary census enumeration areas were added for the following states: Ceará, Minas Gerais, Rio de Janeiro, Paraná, and Rio Grande do Sul.

TABLE 1
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Sample allocation by federative unit

Federative unit	Census enumeration areas	Households
Acre	83	1 245
Alagoas	85	1 275
Amapá	83	1 245
Amazonas	89	1 335
Bahia	81	1 215
Ceará	100	1 500
Federal District	80	1 200
Espírito Santo	83	1 245
Goiás	83	1 245
Maranhão	84	1 260
Mato Grosso	82	1 230
Mato Grosso do Sul	85	1 275
Minas Gerais	92	1 380
Pará	83	1 245
Paraíba	81	1 215
Paraná	90	1 350
Pernambuco	82	1 230
Piauí	87	1 305
Rio de Janeiro	112	1 680
Rio Grande do Norte	85	1 275
Rio Grande do Sul	104	1 560
Rondônia	87	1 305
Roraima	95	1 425
Santa Catarina	83	1 245
São Paulo	96	1 440
Sergipe	86	1 290
Tocantins	88	1 320
Total	**2 369**	**35 535**

Data collection instruments

THEMES

For surveys conducted in 2017 and on, the ICT Households survey has adopted a rotation system for its thematic modules, considering both the demand for specific and more in-depth thematic indicators, and also the time constraints in administering questionnaires to respondents.

The thematic rotation of the modules involves collecting in-depth information about a given topic in alternate editions of the survey, to generate broad estimates at greater time intervals without impacting the time needed to administer the questionnaire.

In the 2024 edition of the survey, giving continuity to this system, in addition to contextual and sociodemographic variables, indicators were collected through the following thematic modules:

- M**odule A:** Access to ICT in the household;
- **Module B:** Computer use;
- **Module C:** Internet use;
- **Module G:** Electronic government;
- **Module H:** Electronic commerce;
- **Module I:** Digital skills;
- **Module J:** Mobile phone use;
- **Module L:** Use of selected publications.[2]

PRETESTS

Pretests were conducted to identify potential problems in the stages of the fieldwork, such as approaching households, selecting the questionnaire on the tablet, and administering the interview. This also helped to evaluate how well the questionnaires flowed and the time needed to administer them.

A total of ten interviews was conducted in households located in municipalities in the state of São Paulo, including São Paulo, Guarulhos, Itaquaquecetuba, and Ilhabela.

In the 2024 edition, households were approached intentionally for pretests, without prior listing or random selection of households. On approaching the households, the interviewers first certified whether there were any residents 10 years old or older in the different profiles desired for the pretest.

[2] The indicators in Module L are part of an experimental methodology to investigate Internet use by individuals who do not identify this use through the traditional questions, but who carry out activities on mobile phones that presuppose Internet access. The results of this module are available in the microdata database.

Furthermore, not all visits were conducted as foreseen in the procedure for approaching households on different days and at different times. Interviewers only listed the residents who were present at the time of the approach.

During pretests, the complete interviews took an average of 30 minutes.

CHANGES TO DATA COLLECTION INSTRUMENTS

Due to the coincidence of module rotation, the ICT Households 2024 survey was based on the questionnaire applied in 2022. The cultural activities module (TC) was not applied in 2024, and the reduced version of the electronic government module (G) was applied. In the latter, however, the question on the need to go to in-person citizen service locations to complete public services was kept, in order to investigate variations observed between odd and even years in the use of electronic government services, isolating the possible effect of the collection instrument.

Also considering the rotation of the survey modules, the module addressing electronic commerce (H) was applied in its entirety, with some changes compared to 2022. The categories of the question on the platform used to purchase goods or services online were updated, with the inclusion of "store applications on mobile phones", the updating of the examples of "websites of stores" and "buying and selling websites" (to better differentiate them, reflecting the current reality), and the exclusion of "discount websites" and "e-mail". Finally, questions relating to the use of the Internet to quote prices, the type of event (remote or broadcast) for which tickets were bought online, money spent on purchases online, and problems encountered with online purchases were excluded.

In the module on computer use (B), the question on location of use is now applied to all individuals who used computers in the reference period. Until 2023, it was only applied to individuals who used computers but not the Internet.

In the module on activities carried out on the Internet (C), some answer alternatives were changed in the question on reasons for not using the Internet. The alternatives "lack of interest" and "lack of need" were grouped together ("lack of interest or need"), the alternative "not knowing how to use" was included, and the alternative "lack of computer skills" was excluded.

In the module on mobile phone use (J), in the question on the type of connection used on the mobile phone, 5G was included as an example of a "mobile network" and, to avoid confusion with the name of Wi-Fi networks, the "mobile network" option was placed after the "Wi-Fi" option. In the question about the type of plan contracted, the "control" plan type was included, which, despite not existing in regulatory terms, has become a common commercial expression.

At the beginning of the individual block, gender was asked instead of being observed and, at the end of the block, a question on gender identity was included, the results of which are still being statistically validated. Questions on whether the individual attends school or university and whether they are retired or pensioners were included. Questions were also included to classify the individual's type of occupation (formal or informal). The categories of the question on schooling were updated.

In the household section, the option "other social program, public or private" was excluded from the question about whether any person in the household receives income from social programs. Questions were also included to determine whether any resident of the household is a person with a disability. These questions are part of the reduced set suggested by the Washington Group on Disability Statistics (WG). Difficulties related to vision, hearing, mobility, cognition/memory, personal care, and communication were investigated, and an additional question was included, present in the expanded set of the WG, referring to the hands. This addition is relevant in the context of Internet use on mobile phones, and was also applied by the Brazilian Institute of Geography and Statistics (IBGE) in the 2022 census.

INTERVIEWER TRAINING

A team of trained and supervised interviewers conducted the interviews. They underwent basic research training, organizational training, ongoing improvement training, and refresher training. They also underwent specific training for the ICT Households 2024 survey, which addressed the process of manually or electronically listing census enumeration areas, household selection, selecting the survey to be conducted, approaching the selected households, and properly filling out the data collection instruments. The training also addressed all field procedures and situations, as well as the rules regarding return visits to households.

Interviewers were given three field handbooks, which were available for reference during data collection to ensure the standardization and quality of the work. Two of them provided all the information needed to conduct household listing and selection. The other contained all the information necessary to approach the selected households and administer questionnaires.

In total, 258 interviewers and 16 field supervisors collected the data.

Field data collection

DATA COLLECTION METHOD

Data collection was conducted using computer-assisted personal interviewing (CAPI), which consists of having a questionnaire programmed in a software system for tablets and administered by interviewers in face-to-face interaction.

DATA COLLECTION PERIOD

Data collection for the ICT Households 2024 took place between March and August 2024 throughout Brazil.

FIELD PROCEDURES AND CONTROLS

Various measures were taken to ensure the greatest possible standardization of data collection.

The selection of households to be approached for interviews was based on the number of private households found at the time of listing. Up to four visits were made on different days and at different times in an effort to conduct interviews in households, in case of the following situations:

- no member of the household was found;
- no resident was able to receive the interviewer;
- the selected resident was not able to receive the interviewer;
- the selected resident was not at home;
- denial of access by the gatekeeper or administrator (to a gated community or building);
- denial of access to the household.

It was not possible to complete the interviews in some households even after four visits, as in the situations described in Table 2. In some cases, no interviews were conducted in entire census enumeration areas because of issues relative to violence, blocked access, weather conditions, and absence of households in the area, among other issues.

TABLE 2
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Final field occurrences by number of cases recorded

Situation	Number of cases	Rate (%)
Interview completed	23 856	67
Residents were not found or were unable to receive the interviewer	2 616	7
The selected respondent or their legal guardian was not at home or was not available	267	1
Refusal by the person selected or the person responsible	1 329	4
The selected respondent was traveling and would be away for longer than the survey period (prolonged absence)	278	1
Household up for rent or sale, or abandoned	1 407	4
Household used for a different purpose (store, school, summer house, etc.)	648	2
Refusal	1 838	5
Denial of access by gatekeeper or another person	1 011	3
Household not approached because of violence	423	1

CONTINUES ►

Situation	Number of cases	Rate (%)
Household not approached because of access difficulties, such as blocked access, unfavorable weather, etc.	341	1
Household with people who are unqualified (e.g., under 16 years old) or unable to answer the survey (e.g., due to disability or language)	6	0
Other situations	664	2
Non-existent household	851	2

Throughout the data collection period, weekly and biweekly control procedures were carried out. Every week, the number of municipalities visited, the listed census enumeration areas, and the number of interviews completed were recorded, by type of survey in each ICT stratum and census enumeration area. Every two weeks, information about the profile of the households interviewed was verified, such as income and social class; information about the profile of residents, such as sex and age; use of ICT by the selected respondents; the record of situations for households in which interviews were not conducted; and the number of modules answered in each interview.

In general, it was difficult to achieve the desired response rate in some census enumeration areas with specific features, such as areas with a high incidence of violence and those with a large number of gated communities or buildings, where access to the households was more difficult. In these cases, to motivate residents to participate in the survey, letters were sent via the postal service to 528 selected households.

VERIFICATION OF INTERVIEWS

To ensure the quality of the data collected, 9,877 interviews from the ICT Households and ICT Kids Online Brazil surveys—which have shared the same field operation since 2015—were verified. This corresponds to 28% of the total initial sample and 41% of the total effective sample. The verification procedure was carried out by means of on-site visit, listening to audio recordings of the interviews or, in some cases, through phone calls.

Whenever corrections were needed to the interviews in part or in their entirety, return calls or visits were carried out, depending on the result of the verification.

DATA COLLECTION RESULTS

A total of 23,856 households in 634 municipalities was approached, reaching 67% of the planned sample of 35,535 households. However, during the fieldwork and after counting households by sector, it was observed that the sample represented 33,859 households. The response rate was calculated based on the result of the total number of households counted in the selected sectors (Table 3). In 21,170 households, interviews were conducted with individuals who were the target population of the ICT Households survey (individuals 10 years old or older). In the other 2,686 households, interviews were conducted relative to the ICT Kids Online Brazil survey.

TABLE 3

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Response rate by federative unit

Federative unit	Response rate (%)
Acre	74
Alagoas	66
Amapá	73
Amazonas	73
Bahia	87
Ceará	56
Federal District	68
Espírito Santo	65
Goiás	68
Maranhão	70
Mato Grosso	68
Mato Grosso do Sul	76
Minas Gerais	54
Pará	62
Paraíba	68
Paraná	59
Pernambuco	73
Piauí	69
Rio de Janeiro	46
Rio Grande do Norte	78
Rio Grande do Sul	53
Rondônia	79
Roraima	69
Santa Catarina	66
São Paulo	53
Sergipe	86
Tocantins	70
Total	**67**

Analysis of Results

ICT HOUSEHOLDS SURVEY 2024

Analysis of Results
ICT Households 2024

In 2024, the ICT Households survey reaches its 20th edition. Carried out annually since 2005, the survey provides an overview of access to and use of information and communication technologies (ICT) and, in particular, the Internet by the Brazilian population 10 years old and older. Throughout its history, ICT Households has provided a portrait of the access and use of the Internet in Brazil, informing the development of public policies aimed at ensuring that all people have access to a meaningful connectivity, which allows them to take advantage of the opportunities present in the online environment and mitigate the risks present in it.

The topic of meaningful connectivity was highlighted in 2024 during the Brazilian presidency of the G20, with the publication of the report *Universal and meaningful connectivity: A framework for indicators and metrics* (Digital Economy Working Group [DEWG], 2024), a contribution by Cetic.br|NIC.br in collaboration with the International Telecommunication Union (ITU) and the Ministry of Communications of Brazil (MCom) for the DEWG. A summary of this framework has been incorporated into the G20 Digital Economy Declaration, highlighting not only the key dimensions for measuring meaningful connectivity, but also the importance of data that reveals social and economic disparities.

The year 2024 also saw an important international milestone in the promotion of an inclusive digital future and the fight against digital inequalities. Approved during the Summit of the Future in New York on September 22, 2024, as part of the Pact for the Future, the Global Digital Compact (GDC) is an initiative proposed by the Secretary-General of the United Nations (UN) that aims, among other things, to promote digital inclusion and ensure that everyone has access to ICT.

In international forums, there has been an increasing debate on the importance of promoting meaningful connectivity (MC), which is not just limited to Internet access, but also includes its quality and the digital skills needed to use the Internet effectively, creating a more equitable online environment for all. Thus, the concept of meaningful connectivity has attracted the attention of governments, non-governmental organizations, the technical community, and the private sector, with the potential to produce concrete results in tackling digital inequalities.

In this context, the ICT Households survey provides important information that can contribute to measuring many of the international commitments, especially in the axes of digital inclusion, including the universalization of access and the elements that help make it truly meaningful. As Brazil moves closer to universal access, the survey's "Analysis of Results" was restructured to highlight the qualitative aspects of this connectivity, using the framework on meaningful connectivity developed by the Regional Center for Studies on the Development of the Information Society — Cetic.br (Brazilian Network Information Center [NIC.br], 2024).

Each year, the ICT Households survey adopts a module rotation strategy, enabling in-depth analysis of specific topics that are relevant for the policies of several sectors. In the 2024 edition, the full versions of the electronic government (e-government) and electronic commerce (e-commerce) modules, which had last entered the field in 2022, were administered. Regarding the use of e-government, the results of the survey highlighted the demand for digital public services and measured the extent to which people are taking ownership of the digital transformation of public administration in all its spheres, stimulated by the National Digital Government Strategy, formalized on June 21, 2024 (Decree No. 12.069/2024). The same is true of e-commerce, which was boosted during the COVID-19 pandemic and facilitated by the adoption of Pix as a payment method.

In 2024, some questions were also modified, including the investigation of new ways of accessing the Internet. In the mobile phone use module, for example, "control plan" was included. In the e-commerce module, the category of purchase via store apps was included among the channels for buying products or services online, reflecting changes in the pattern of Internet use and the number of users who access it exclusively via mobile phones.

This analysis is divided into the following sections:

- Meaningful connectivity;
- Profile of Internet users;
- Digital skills;
- Activities carried out on the Internet;
- Electronic commerce;
- Final considerations and agenda for public policies.

Meaningful connectivity

In recent years, the literature on digital inclusion has incorporated the debate on the importance of meaningful connectivity for reducing digital inequalities. Meaningful connectivity is a multifaceted concept that presupposes a combined analysis of distinct dimensions capable of delivering a satisfactory, safe, and productive online experience to Internet users (Alliance for Affordable Internet [A4AI], 2020; Katz & Gonzalez, 2016).

Recently, there has been an intensification of public debate, both in Brazil and abroad, on the subject of meaningful connectivity. In 2024, Cetic.br made an important contribution to this debate by launching a proposal to operationalize the measurement of meaningful connectivity based on the data already collected by the ICT Households survey with the study *Meaningful connectivity: Measurement proposals and the portrait of the population in Brazil* (NIC.br, 2024). The proposal is based on a set of nine indicators that are dichotomized (presence or absence) and added together to create a scale from zero to nine, which is assigned to each individual in the survey's microdata base.

These indicators are divided into four pillars:

- **Affordability:** (1) cost of Internet connection in the household of less than 2% of household income; (2) "post-paid" or "control" type mobile phone plan.
- **Access to devices:** (3) more than one individual access device (mobile phone or computer) per resident 10 years old or older; (4) presence of a computer in the household; (5) access by mobile phone and computer.
- **Quality of connection:** (6) household connection via fiber optics or cable; (7) speed of the main Internet connection in the household is greater than 10 megabits per second (Mbps).
- **Use environment:** (8) Internet use every day or almost every day; (9) Internet use at home and in at least one other institutional location (school, work, and/or free and paid Internet access centers).

In this section, we present the results of the ICT Households 2024 survey regarding these pillars of meaningful connectivity, including both the indicators used to calculate the level of MC (NIC.br, 2024) and other related indicators.

GENERAL RESULTS

According to the ICT Households 2024 survey, 34% of the Brazilian population had the lowest level of meaningful connectivity (0 to 2 points), while 22% presented the highest (7 to 9 points) (Chart 1).

Regarding to the territorial attributes, there was a higher proportion in the upper range of meaningful connectivity among individuals in urban areas (24%) than in rural areas (5%)—in the latter, 58% of the population was in the lower range of MC. Higher proportions at the highest level of MC were observed in the South and Southeast of the country (33% and 28% of the population, respectively) and lower proportions in the Northeast and North (11% and 12%, respectively). While in the average for Brazil 34% of the population was in the group with the lowest level of MC (0 to 2 points), this group represented 44% of the population in the Northeast and 41% in the North. These results show the persistent lack of connectivity infrastructure in remote and less populated areas and in areas less attractive to Internet service providers. In addition, those are also the locations in which we observe other strategies for ensuring connectivity, such as sharing the connection with a neighboring household, as we will see below.

In terms of sociodemographic aspects, the difference by sex stands out. While among the male population 10 years old or older, 28% had higher levels of meaningful connectivity, the proportion was 16% among women, a difference of 12 percentage points (pp). The aggregated analysis of the nine variables reveal prominent differences by sex, revealing the cumulative effect of the numerous layers of inequality. If considered individually, many of these indicators show differences by sex that are within the survey's margin of error.

With regard to age group, the data showed that the levels of meaningful connectivity are higher among the age groups with the greatest participation in the labor market (32% of those 25 to 34 years old and 31% of those 35 to 44 years old were in the highest MC level) and not among the youngest (21% of those 16 to 24 years old and 12% of those 10 to 15 years old were in the highest level). Among the population 60 years old or older, 8% were in the highest MC band, while 62% were in the lowest. This is partly a reflection of the higher proportion of non-Internet users in this group, although being an Internet user does not necessarily translate into good levels of meaningful connectivity. With regard to self-reported color or race, 28% of the White population were in the highest range of meaningful connectivity, proportions that were 23% among the Black and 18% among the Brown population.

Finally, from the socioeconomic point of view, the data reinforced the well-known differences in connectivity among classes: 73% of the population in class A was in the highest MC level, against 3% in classes DE. The association between socioeconomic vulnerability and conditions of meaningful connectivity was reinforced by the data for households in which there were beneficiaries of social programs, who were more vulnerable in socioeconomic terms (43% were in the lowest range of meaningful connectivity and only 9% in the highest). By level of education, 58% of those with a Tertiary Education were in the highest MC level, against 20% for those with a Secondary Education, 4% among those with an Elementary Education, and 1% for those in the category Illiterate/Preschool.

CHART 1

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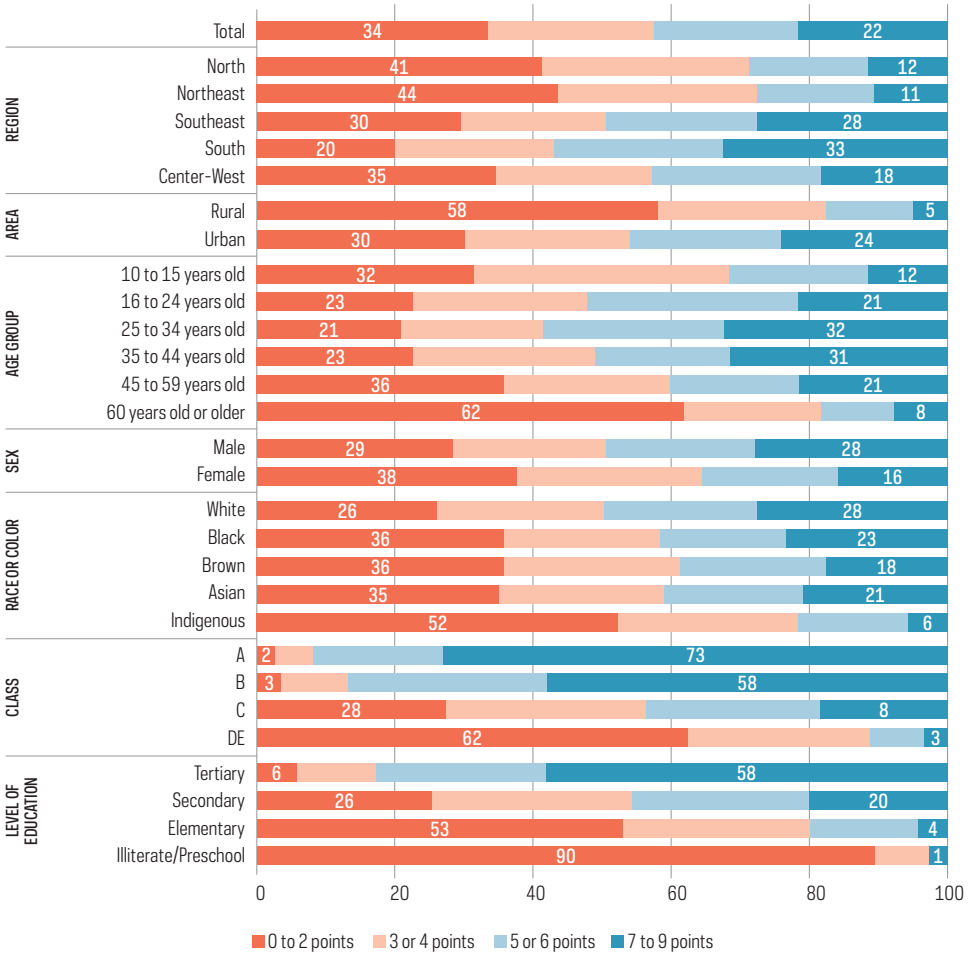
Individuals by level of meaningful connectivity (2024)

Total population (%)



Below we will detail the indicators associated with each of the pillars of the meaningful connectivity concept, including some that are not part of it but which help us to better understand the Brazilian connectivity scenario.

AFFORDABILITY

COST OF HOUSEHOLD CONNECTIONS

The cost of household connections is an important indicator of the affordability of Internet access. For the lower-income section of the population, it is a determining factor

in the absence of such connections, while for another part of the population, this factor influences the quality of the plans contracted.

In terms of cost, 23% of households with Internet access paid between BRL 101 and BRL 150 for access and only 4% spent more than BRL 150, a range that stood out among class A households (10%).

In 2018, the Broadband Commission for Sustainable Development, a public-private partnership established in 2010 by the ITU and the United Nations Educational, Scientific and Cultural Organization (UNESCO) to promote Internet access, set a target that by 2025, basic broadband services should be affordable in developing countries, costing up to 2% of gross national income (GNI) per capita.

The ICT Household data measures affordability for each individual, based on self-reported family income range. In 2024, only 22% of Internet users had a household Internet connection cost of less than 2% of their household income. This proportion was 58% among those in class A, 40% in class B, 22% in class C, and 6% in classes DE (Chart 2).

CHART 2

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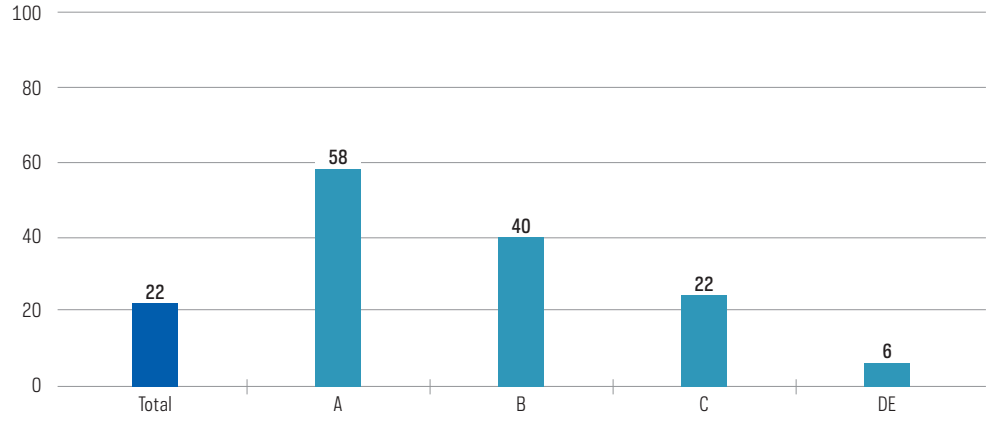
Internet users by cost of household Internet connection below 2% of household income and class (2024)

Total number of Internet users (%)



MOBILE PHONE PLANS

The type of mobile phone plan is another factor that impacts the quality of Internet access. In Brazil, plans are classified by Anatel as prepaid or postpaid. The first type, which is more affordable, is generally associated with a more restricted data package (Institute of Consumer Protection [Idec] & Instituto Locomotiva, 2021; Simão et al., 2020). Commercially, some plans are also presented as "control" plans, with hybrid characteristics between prepaid and postpaid. This category has been investigated separately in ICT Households since 2024.

More than half of mobile phone owners opted for prepaid plans (57%), especially in rural areas (71%), in the Northeast (66%), and in classes DE (69%). It should also be noted that 20% of people with mobile phones used postpaid plans and 18% had control plans.[1]

Postpaid plans, on the other hand, were mentioned more among those with better socioeconomic conditions and higher levels of education: just over a third of those with a Tertiary Education (36%), 47% of those with a family income higher than 10 minimum wages, 37% of those in class B, and 33% of those in class A. In addition, the highest proportions of people using postpaid plans were among residents of urban areas (22%) and regions with better infrastructure, such as the South (29%), the Center-West (26%), and the Southeast (24%).

ACCESS TO ICT

For 20 years, ICT Households has been exploring data on access to ICT in Brazilian households. The recurring analysis of data on household access to ICT and the households' specific attributes makes it possible to draw up a comparative historical overview of the quality of the Brazilian population's Internet access. It also identifies the inequalities that are still present throughout the country, which helps guide public policies aimed at reducing them.

INTERNET IN HOUSEHOLDS

The ICT Households 2024 survey showed that 83% of Brazilian households had Internet access in 2024, a proportion that remained stable compared to 2023 (84%). The presence of Internet in households by class also remained stable, at 100% of households in class A, 99% in class B, 91% in class C, and 68% in classes DE. This shows that there is still socioeconomic inequality in Internet access among Brazilian households.

Taking a broader historical perspective, in 2008, when the survey began to include rural areas, 18% of households had Internet connections, rising to 54% in 2016 and reaching 83% by 2024. But while class A started from a level of 91% of connected households in 2008, in classes DE this proportion was 1% in that year. Over the years, the survey has shown a narrowing of the gap in Internet access between households of classes A and DE, from 90 percentage points (pp) in 2008 to 75 pp in 2016 and, finally, 31 pp in 2024. The survey has also pointed to a scenario of greater stability in this indicator in all classes from 2020 onwards, with the differences between classes remaining the same as a result.

[1] In 2023, when the "control" category was not investigated, the proportion of individuals who had a mobile phone with a postpaid plan was 36%, 16 percentage points higher than in 2024. This suggests that individuals who classified their plan as "control" in 2024 would categorize it as post-paid up to 2023. The greater prevalence of postpaid plans among individuals in class A reinforces this assumption.

CHART 3

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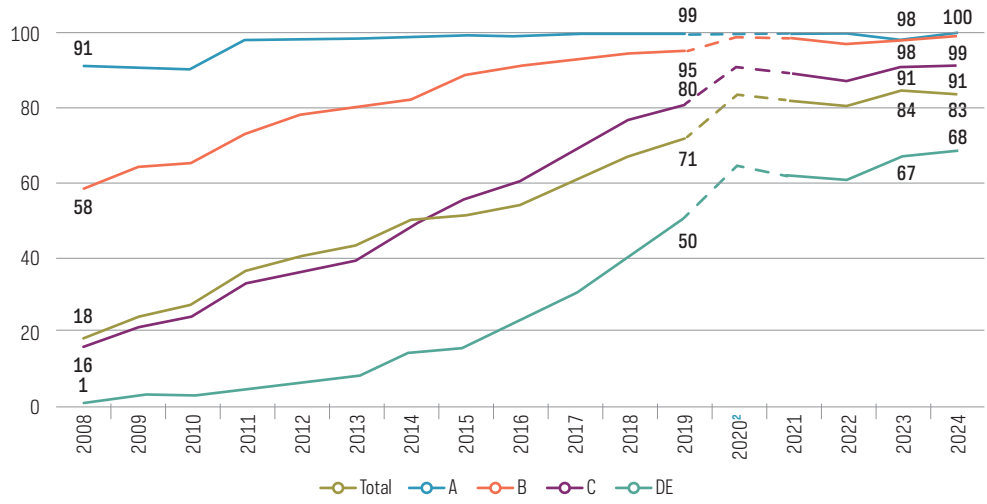
Households with Internet access (2008-2024)

Total number of households (%)



The ICT Households 2024 survey continued to investigate the reasons why a portion of Brazilian households remain without Internet access. As in the previous edition, the most cited reasons were residents not knowing how to use the Internet (51%), cost (49%), and lack of interest (45%), all with stable percentages compared to 2023.

On the other hand, there was a reduction in the proportion of households that did not have access to the Internet because they did not have computers in their homes, from 34% in 2023 to 27% in 2024. With regard to the main reason for not having the Internet, not knowing how to use it was the most cited (28%), followed by cost (22%) and lack of interest (13%).

In the North, 32% of households without Internet access said the main reason was cost, a stable proportion compared to 2023 (35%), but a significant decrease compared to 2022 (48%). This is a region with well-known challenges in terms of service provision. According to the Brazilian Internet Association (Abranet), in 2023, 20% of the area in the North had no Internet coverage at all (Convergência Digital, 2023), and this region also had the highest proportion of households that reported paying connection fees of more than BRL 100 (46%).

[2] In 2020, the methodology for data collection was adapted due to the COVID-19 pandemic, including data collection via telephone interviews. Comparisons with 2020 results should be made with caution.

COMPUTERS IN HOUSEHOLDS

Regarding the availability of computers in households, 34% had these devices, representing 27 million households, a proportion that has been in decline since 2015, when the device was in 50% of the households. This proportion remains very unequal among population profiles. In urban areas, for example, 36% of households had computers, while in rural areas this percentage was less than half, 14%. Socioeconomic inequalities also remained: the percentage of households with computers in class A reached 97%, while in classes DE, only 11% had the devices.

Among the households that had computers, most had laptops (72%), while a smaller proportion had desktop computers (34%) and tablets (28%). In addition, 44% had only laptops, 14% had only desktop computers, and 11% had only tablets. On the other hand, 30% of households with computers had more than one of these three types of devices. This happened predominantly among class A households, of which 74% had more than one type of device, while the percentage was only 5% in class DE households. Despite this difference, in all classes, the predominant type of computer was laptops, with ownership of this type of device alone reaching 51% in households in class C and 25% in households in class A.

The results also showed that 50% of households had Internet access but no computers, while 33% had both and 16% had neither. In other words, half of Brazilian households accessed the Internet using devices other than computers.

DEVICES PER CAPITA

The ICT Households survey investigates the number of mobile phones and computers by type (desktop computers, laptops, or tablets) in households. To assess meaningful connectivity, it is important to know the number of devices in relation to the number of people living in a household. The assumption is that a restricted number of devices per resident results in a major barrier to Internet use—a factor that, in combination with the absence of Internet access at home, for example, prevented students from carrying out school activities and professionals from carrying out their work activities during the pandemic (Benítez-Larghi et al., 2023).

Thus, the ratio of the number of devices (computers and mobile phones) to the number of residents 10 years old or older (the survey's target audience) was calculated. Then, a dichotomized indicator was created, with a value of 1 when the ratio of the sum of all devices present in the household to the number of residents 10 years old or older was greater than 1 (without rounding).

In 2024, of the total population 10 years old or older, 41% lived in households with more than one device per resident. There were significant differences by social class: The proportion was 97% among those in class A, 84% among those in class B, 40% among those in class C, and only 14% among those in classes DE.

COMPUTER USE

Concerning computer use, approximately six out of ten Brazilians 10 years old or older had used these devices at least once in their lives (59%), and 39% were users, i.e., they used the devices at least once in the three months prior to the survey. The frequency of computer use shows marked differences according to age group, level of education, class, region, and area. In general, use was more frequent among those with better socioeconomic conditions, those with higher education levels, and those who lived in urban areas, as has been observed in other survey indicators (Chart 4).

CHART 4

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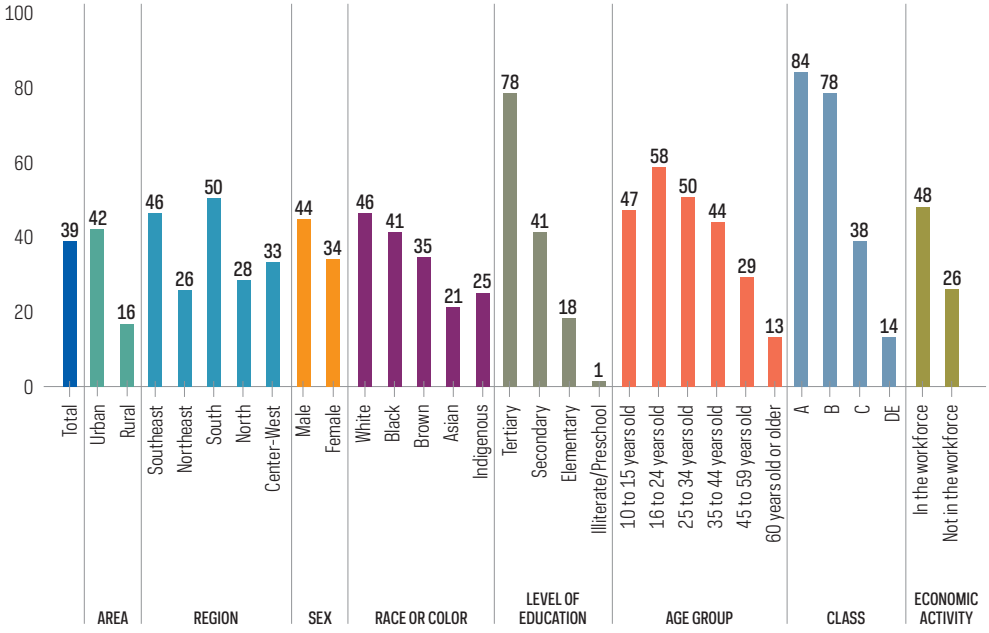
Computer users (2024)

Total population (%)



In order to deepen the analysis of computer use, ICT Households 2024 provided, for the first time, data on the locations where the devices were used. The results showed that, among computer users, the most frequently mentioned place was at home, mentioned by 75% of those interviewed, especially those with a Tertiary Education (89%), those with a family income of more than 10 minimum wages (90%), and those belonging to class A (89%), compared to those who studied up to Elementary School (60%) or those who had a family income of up to 1 minimum wage (64%).

The second most cited location was the workplace (43%), which showed higher percentages among users in the middle age groups, such as 45 to 54 years old (59%), 25 to 34 years old (57%), and 35 to 44 years old (54%), or those who had a higher level of

education, such as those with a Tertiary Education (72%), which reflects the demand for these devices in office work, which is more digitalized. In addition, just over a quarter of computer users said they had used the devices at someone else's house (28%) and 25% in a school or educational facility, a place of use that showed higher proportions among younger computer users, such as those 10 to 15 years old (42%), and those with a Tertiary Education (33%).

DIVERSITY OF ACCESS DEVICES

ICT Households 2024 also examined the different devices used by users 10 years old or older to access the Internet. The results of the survey revealed that 100% used their mobile phones to access the Internet, a proportion that has remained stable since 2019 (99%), confirming the predominance of mobile phones as Internet access devices in Brazil. Also noteworthy is the use of the Internet via televisions, which has been on an upward trend since 2014 (7%), reaching 60% by 2024. This use tended to be more frequent among individuals with better socioeconomic conditions and higher levels of education: those in class A (84%), those with a family income above 10 minimum wages (84%), and seven out of ten people with a Tertiary Education (70%). On the other hand, lower percentages were observed among users in classes DE (46%), those with an income of up to 1 minimum wage (45%), and those with an Elementary Education (52%). In addition, the use of televisions to access the Internet was higher in urban areas (62%) than in rural areas (50%). In regional terms, with the exception of the Center-West (53%), the other regions had proportions equal to or greater than 60% in this indicator. In general, all the devices investigated in the survey maintained stable levels of use compared to 2023 (Chart 5).

CHART 5

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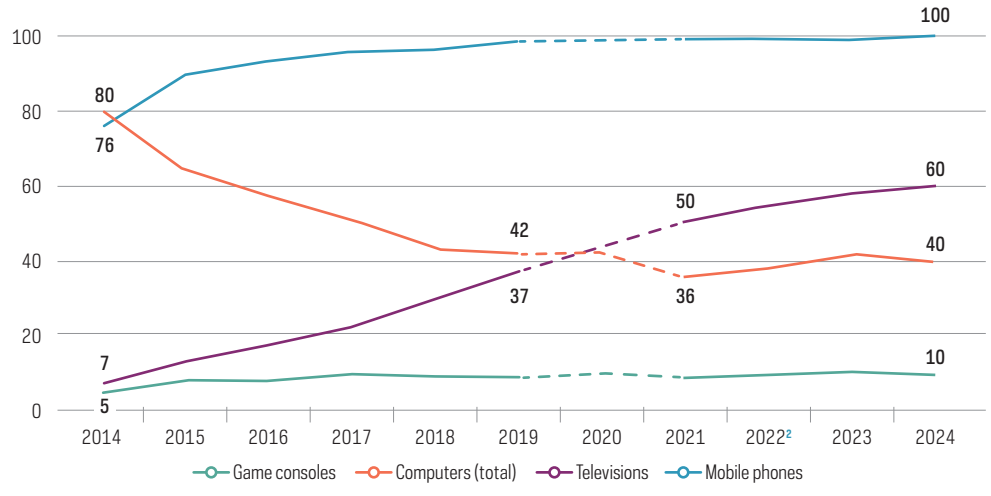
Internet users by access devices (2014-2024)

Total number of Internet users (%)



In order to investigate the dynamics of Internet use and access in more detail, the ICT Households 2024 survey also analyzed access through mobile phones and computers exclusively or from both devices. The results indicated that 60% of users accessed the Internet only on their mobile phones, while 40% used it on both devices. The access through these devices varied markedly among socioeconomic profiles: People with better socioeconomic conditions and higher levels of education tended to access the Internet using both devices, while those with lower levels of education, those with lower incomes, and those belonging to the lower classes tended to do so exclusively using mobile phones. Differences were also observed by age group (Chart 6).

CHART 6

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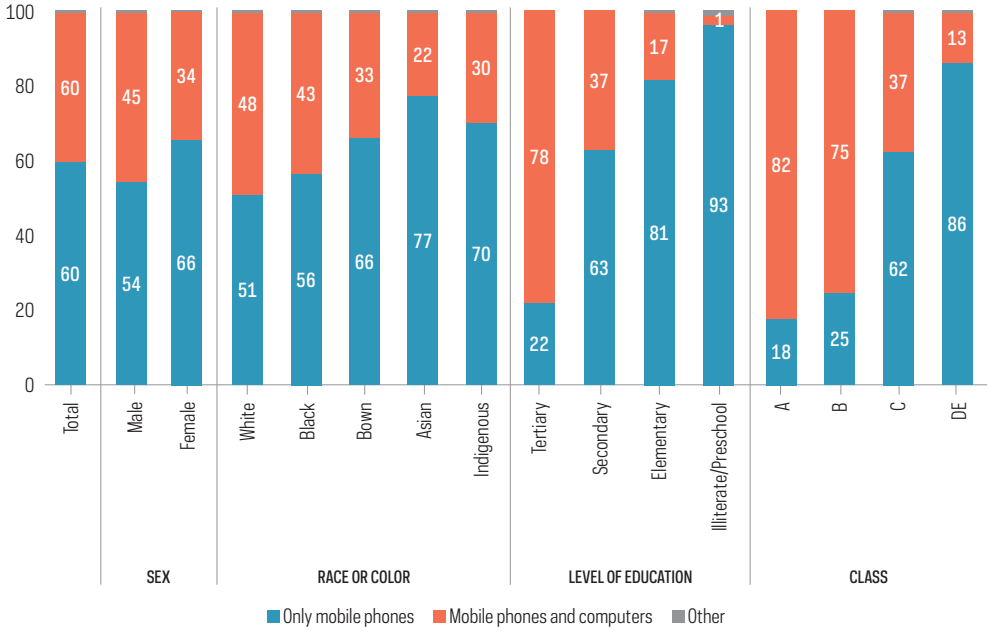
Internet users by access devices used exclusively or simultaneously (2024)

Total number of Internet users (%)



QUALITY OF CONNECTION

TYPES OF HOUSEHOLD CONNECTIONS

The widespread ownership of devices and the availability of Internet connections are fundamental requirements for the digitalization of society, but they must be accompanied by other conditions that guarantee the quality of access. The types of household connections are related to Internet access quality factors such as signal stability and availability, speed, and data packages.

The ICT Households 2024 survey showed that 71% of Brazilian households that accessed the Internet did so via fixed broadband, of which 65% used cable or fiber optics, 4% satellite connections, 2% radio connections, and only 1% connections via telephone lines.[3] In addition, 14% of connected households accessed the Internet via mobile network connections (3G, 4G, or 5G modems or chips). It is important to note the regional differences in this indicator. In the South, while Internet access via fiber optics reached almost three out of every four connected households (73%), access via mobile networks was less common (9%). On the other hand, the North had one of the lowest proportions of access via fiber optics (60%), while there was a significant presence of access via mobile networks (19%). All the proportions remained stable compared to the last edition of the survey, carried out in 2023.

SPEED OF HOUSEHOLD CONNECTIONS

Connection speed is also an important factor in the quality of Internet access. Among households with Internet access,[4] 30% had household connection speeds of 51 Mbps or more, a range that will be consolidated as the most used by Brazilian households in 2024, following the pattern that has already been observed in ICT Households since 2021. Other speed ranges did not exceed 4% of households each.

According to the conceptual model used by Cetic.br|NIC.br to measure meaningful connectivity (NIC.br, 2024), a connection greater than 10 Mbps was considered the minimum speed criterion. In 2024, 39% of Internet users met this threshold.The proportion was 66% among Internet users in class A, compared to 24% of those in classes DE. It should be noted that the base here is the total number of Internet users, not the total number of households with Internet access.

WI-FI PRESENCE

Given the possibility that some Brazilian households connect to the Internet via mobile phone plans, the presence of Wi-Fi in these households is an indicator that helps identify those whose Internet access is linked to home Internet plans.[5] In 2024, 91% of households with Internet had Wi-Fi, a proportion that remained stable compared to the previous edition of the survey.

[3] The difference from 100% in the sum is due to the rounding of proportions.

[4] This question was administered only to households with fixed broadband, whose plans are contractually tied to speed. In cognitive interviews carried out in December 2024, those interviewed were generally able to identify the contracted speed. It is also worth noting the methodological challenges of collecting data on mobile network access speed, which can vary in different access locations, depending on factors such as network type coverage (e.g. 4G, 5G) and antenna distance, for example.

[5] This indicator can also include, subject to the interpretation of the respondents, shared Wi-Fi with neighboring households, public Wi-Fi that reached the households, and Wi-Fi routing of mobile network signals from mobile phones to other devices in the households.

Despite WiFi being predominant in all household profiles, the same inequalities in Internet presence can still be observed between households from different socioeconomic strata. The ICT Households 2024 survey showed that in classes DE and in households whose family income was up to one minimum wage, there was a lower proportion of households with Wi-Fi access (85% in both), in addition to rural areas (86%) and in the North region (87%). On the other hand, all connected households in class A (100%) and those with a family income of more than 10 minimum wages (99%) had Wi-Fi access.

INTERNET SHARING

Another indicator that has been collected by the survey is connection sharing with neighboring households. Considering the total number of households with Internet access, 17% used shared networks, a proportion that was higher in rural areas (26%), among households in classes DE (25%), and in the North (22%) and Northeast (21%), precisely the strata in which other markers indicate more precarious connectivity.

ENVIRONMENT OF USE

INTERNET USE FREQUENCY

The survey also explored the frequency of Internet use among Internet users. Predominantly, Internet use was frequent and daily. Daily use (every day or almost every day) was reported by 96% of Internet users. Virtually all the profiles analyzed had levels close to or above 90% in this indicator, while among users 60 years old or older, the proportion of daily use was 88%. It should also be noted that the proportion of users with a low frequency of Internet use was very small: only 3% accessed the Internet at least once a week, while 1% used the service once a month.

DIVERSITY OF LOCATIONS OF USE

In addition to investigating the devices used to access the Internet, the survey also analyzed the locations where this connection took place. The data pointed to the diversity of contexts in which Brazilians connected to the Internet, with a predominance of use in domestic environments—the respondents' own household stood out as the most mentioned location, with almost all Internet users (98%). Nearly two-thirds of those interviewed also accessed the Internet at someone else's house (64%), while 59% said they used the Internet while on the move, such as on the street, on public transport, or in the car. Only 7% of users said that they accessed the Internet in paid public access centers, such as LAN houses and Internet cafes. In 2008, these centers were used by 48% of users, which represents a decrease of 41 percentage points over the period. It can be observed that 6% of users in classes DE reported accessing the Internet through paid public access centers, while in 2008 the proportion was 79%.

Almost half of users used the Internet at work (47%). Among those in the workforce, 69% accessed the Internet in this location. In addition, approximately one-fifth of users accessed the Internet at school (22%), with a higher proportion among those 10 to 15 years old (53%). Considering the main location of access, the home was the most common (83%), while around 12% of users used the Internet more at work.

Profile of Internet users

Since 2008, the ICT Households survey has monitored Internet access among the Brazilian population 10 years old or older in urban and rural areas—between 2005 and 2007, the survey was applied only in urban areas. The results of the 2024 edition of the survey indicated that nine out of ten urban residents had accessed the Internet at some point in their lives (90%), a proportion that remained stable compared to 2023 (89%). Internet users, i.e., those who had used the Internet in the three months prior to the survey, represented 84% of the population 10 years old or older (Chart 7), equivalent to approximately 159 million people. There was no significant difference compared to 2023 in this indicator.

As observed in previous editions of the survey, the proportion of Internet users varied according to the socioeconomic class and education level of the population 10 years old or older, being higher among individuals in classes A (96%) and B (97%) and among those with a Tertiary Education (95%) or Secondary Education (92%), compared to those in classes DE (73%) and those with Elementary Education (74%). Differences were also observed by area and region: In urban areas, 86% were Internet users, a proportion that reached 90% among residents in the South, with lower percentages in rural areas (76%) and in the North (81%). When comparing the results by age group, with the exception of people 45 to 59 years old (84%) and 60 years old or older (59%), the other age profiles showed proportions above 90%.

Since 2016, the ICT Households survey has presented an expanded indicator for Internet users, using a methodology that more accurately reflects the proportion of people who have carried out activities that depend on the Internet (such as accessing social networks, accessing websites, sending instant messages or downloading applications, among others). As this is not the standard question in the ITU handbook (2020), this indicator is not internationally comparable.

Based on this extended indicator, approximately 166 million people 10 years old or older were Internet users in 2024 in Brazil, which represents 89% of the population (Chart 7). Although inequalities in Internet use remain, the percentage of users in the most vulnerable sections of the population, such as those with only an Elementary Education (79%) and those in classes DE (79%), has increased.

CHART 7

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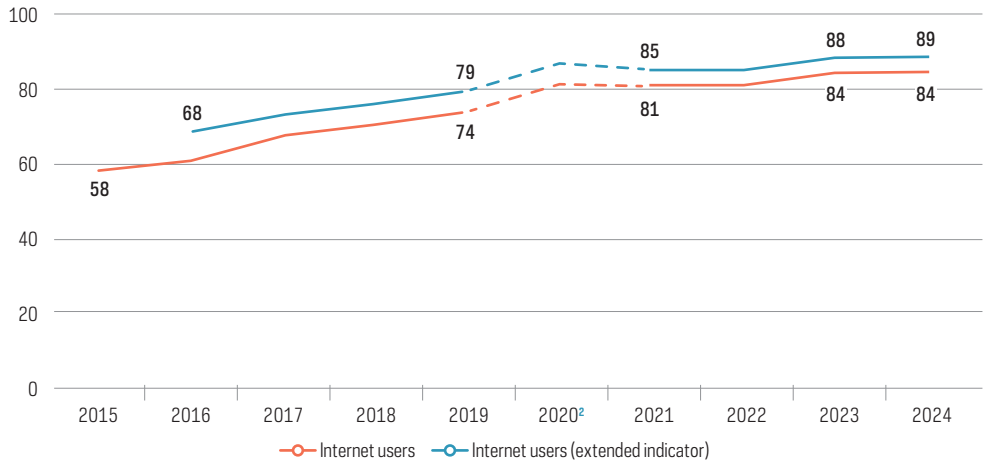
Internet users, standard and extended indicator (2015-2024)

Total population (%)



The results of the ICT Households 2024 survey indicated that around 29 million Brazilians 10 years old or older were not Internet users, i.e., had not accessed the Internet in the three months prior to the survey. These were mainly urban residents (24 million), those with up to an Elementary Education (22 million), and those of Black or Brown color or race (17 million). The number of non-users also stood out in classes DE (16 million), among women (16 million), and among people 60 years old or older (14 million), in addition to residents of the Southeast (12 million) and Northeast (8 million).

The survey also revealed that in 2024, 10% of the population 10 years old or older had never accessed the Internet, which represents approximately 18 million people. Among the most common reasons for not using the Internet was lack of skills (79% said they did not know how to use it) and lack of interest or need (57%). Issues related to security, privacy, and cost were also relevant, since 39% expressed concerns about security and privacy, 37% said they wanted to avoid contact with dangerous content, and around a third considered the service too expensive (33%). When asked about the main reason for never having accessed the Internet, half mentioned lack of skills (50%), while around a fifth indicated lack of interest or need (21%).

INTERNET USE ON MOBILE PHONES

ICT Households also investigated Internet use via mobile phones. The results indicated that around nine out of ten people 10 years old or older (88%) had used the Internet on their mobile phones in the three months prior to the survey, a proportion that remained stable compared to 2023. It is worth noting that, among the investigated profiles, almost all showed proportions close to or above 80% in their use of the Internet via mobile phones, except for those with up to a Preschool Education (39%) and individuals 60 years old or older (62%).

Wi-Fi was the type of connection most used by mobile phone Internet users (96%), an increase of three percentage points compared to 2023. Connection via mobile networks remained stable at 77%. In addition, the survey results indicated that the majority of mobile phone Internet users connected to the Internet via both Wi-Fi and mobile networks (73%). Exclusive Wi-Fi use was a reality for 22% of mobile phone network users, while exclusive use of mobile networks was mentioned by only 4%, a decrease of 2 percentage points compared to 2023.

There were significant differences by class in terms of the types of connection. Among mobile phone Internet users in class A, 95% accessed the Internet via both types of connection, which was true for only 57% of those in classes DE, with another 37% reporting that they connected to the Internet on mobile phones only via Wi-Fi (Chart 8).

CHART 8

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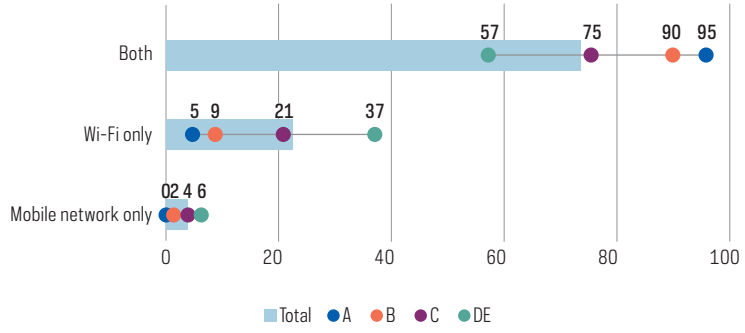
Internet users via mobile phone, by type of connection used exclusively or simultaneously and class (2024)

Total number of Internet users via mobile phone (%)



Among mobile phone users, around nine out of ten people made or received calls (91%) and sent messages (88%), while around eight out of ten watched videos (82%) and took photos (78%). Among the activities investigated, only "watching videos" showed a significant increase compared to 2023 (78%).

Digital skills

The 2024 edition of the ICT Households survey continued to assess the digital skills of Internet users. Until 2021, the survey focused on skills related to computer use. In 2022, the indicator was reformulated to cover digital skills regardless of the devices used, with the question being administered to all users.

Digital skills are strongly associated with how individuals take advantage of the opportunities (informational, relational, work, etc.) created by the Internet, as well as resilience in relation to the risks involved in using the Internet (Livingstone et al., 2021). They are, therefore, a fundamental element in understanding the challenges of increasing the quality of Internet use by users. Based on the ITU framework (2020), ICT Households investigates the performance of activities that express different types of digital skills—information and data literacy, communication and collaboration, creation of digital content, security, and problem-solving—in the three months prior to the survey.

The results of the 2024 edition showed stability compared to the 2023 edition in this set of indicators. Around one in two Internet users carried out the most frequently reported activities: Verifying the reliability of information found online (52%); adopting security measures, such as strong passwords or two-factor authentication, to protect devices and online accounts (48%); and using copy and paste tools to duplicate or move content, for example, within a document or message (45%).

On the other hand, skills that require greater technical knowledge—often linked to features of the labor market—continued to be among the least performed by Internet users in 2024, which revealed inequalities in relation to the ability to obtain tangible benefits in the digital environment. Using formulas in a spreadsheet, for example, a practice valued in many occupations, especially office work, was reported by only 19% of users. Connecting or installing new wired or wireless devices, such as modems, printers, cameras, or microphones (19%), and creating slide presentations (17%), were reported in a similar proportion. In addition, creating computer software or mobile phone applications using programming language was still the least reported activity, carried out by approximately one in ten Internet users. It is also noteworthy that 30% of users declared that they had not carried out any activities related to any of the digital skills.

As shown in Chart 9, there was a strong relationship between the different types of Internet access devices and the development of digital skills. For example, 68% of those who accessed the Internet from both computers and mobile phones used copy-and-paste tools. Among those who used the Internet only on mobile phones, the proportion was 30%. Considering the adoption of security measures, these figures were 71% and 33%, respectively.

CHART 9

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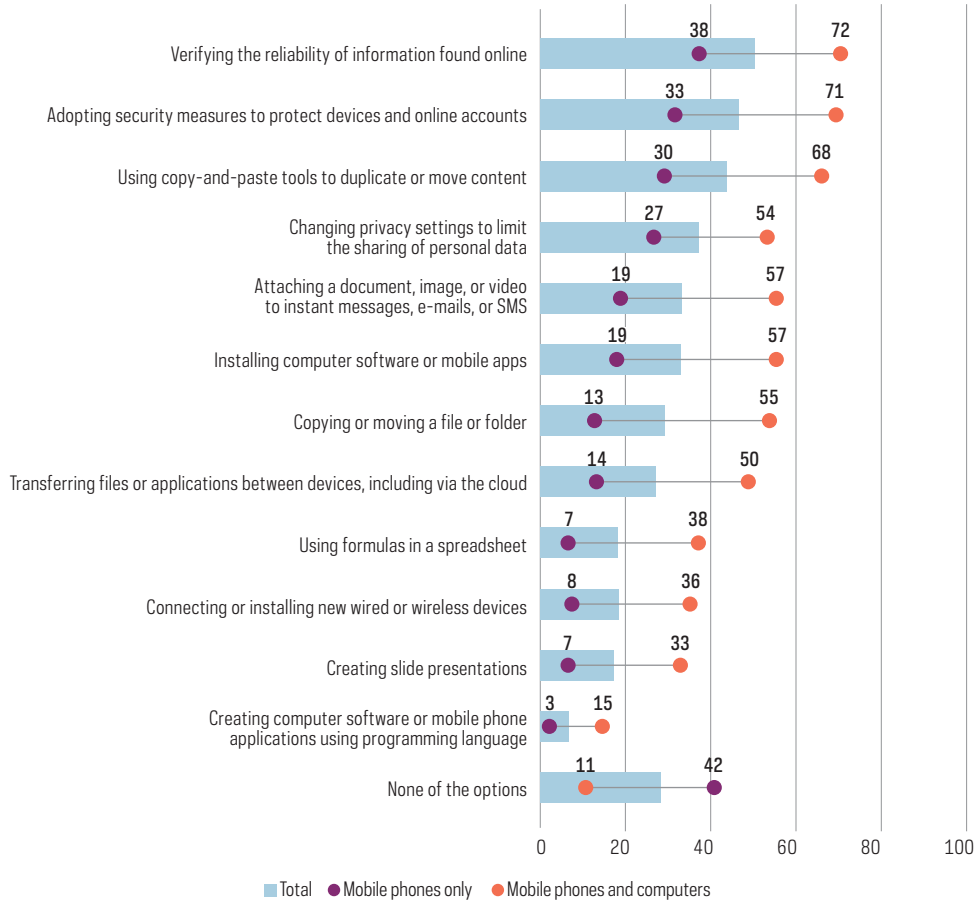
Internet users by types of digital skills and devices used to access the Internet (2024)

Total number of Internet users (%)



Significant differences according to the Internet access device were observed in practically all the skills analyzed. These results suggested that inequalities in access to different devices may be associated with asymmetries in the opportunities created by access to the digital world, as well as greater vulnerability to the risks arising from it. However, the association between these inequalities and other variables—factors such as region, level of education, and class influence both access to different devices and the development of skills—bring even more complexities to the analysis, requiring in-depth studies into the mechanisms behind these inequalities.

The development of digital skills may also be associated with the meaningful connectivity levels of Internet users (NIC.br, 2024). Based on the results of the ICT Households 2024 survey, there was a strong association between the quality of individuals'

connection and the presence of digital skills, providing support for another angle from which to analyze the topic (Chart 10). While 81% of users with the highest level of MC (7 to 9 points) checked whether information found on the Internet is accurate, this proportion was 54% for the second highest level (5 and 6 points), 43% for the third (3 and 4 points) and 27% for the lowest level of significant connectivity (0 to 2 points), a proportion three times lower than of those with the highest level of meaningful connectivity. This relationship was similar for all the skills observed. Creating slide presentations was done by 38% of users with the highest level of MC and only 4% of those with the lowest level; for adopting security measures, the proportions were 79% and 23%, respectively.

CHART 10

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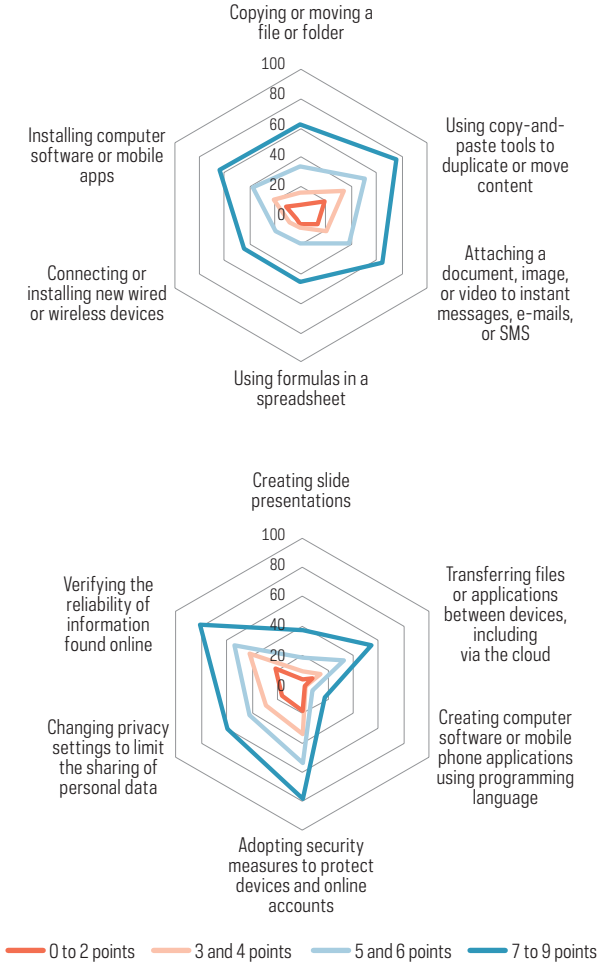
Internet users by types of digital skills and level of meaningful connectivity (2024)

Total number of Internet users (%)



These results suggest that inequalities, both inside and outside the digital world, have an impact on the acquisition of these skills, creating barriers to the safe and productive use of the Internet. In addition to factors already commonly analyzed, such as class, age, education, and types of devices, the quality of connectivity is also relevant. These elements need to be explored in greater depth in order to support policies that reduce digital inequalities and promote digital inclusion in its different dimensions.

Activities carried out on the Internet

Another aspect related to Internet use is the types of activities carried out online. In this regard, the survey investigates activities related to communication practices, searching for information, multimedia, education and work, and e-government. In 2024, we noted stability in most of these activities, with many remaining stable since 2021.

COMMUNICATION ACTIVITIES

In recent years, online communication activities have remained the most popular among Internet users. The survey pointed to stability for the six activities investigated, especially since 2021. Before that, in the 2010s, greater variations were recorded for the activities analyzed, especially due to the rise of smartphones, social networks, and messaging apps.

It was noted that in 2024, 92% of Internet users 10 years old or older used messaging apps, 82% made voice or video calls, and 81% used social networks (Chart 11). Sending and receiving e-mails was carried out by 60% of users. At a lower level, participating in newsgroups or online forums and using microblogs were practices reported by 12% and 8% of Internet users, respectively. In general, the activities investigated by the survey tended to be carried out in greater proportion by Internet users who lived in urban areas, those who had higher levels of education, those in the middle age groups, and those in the upper classes.

CHART 11

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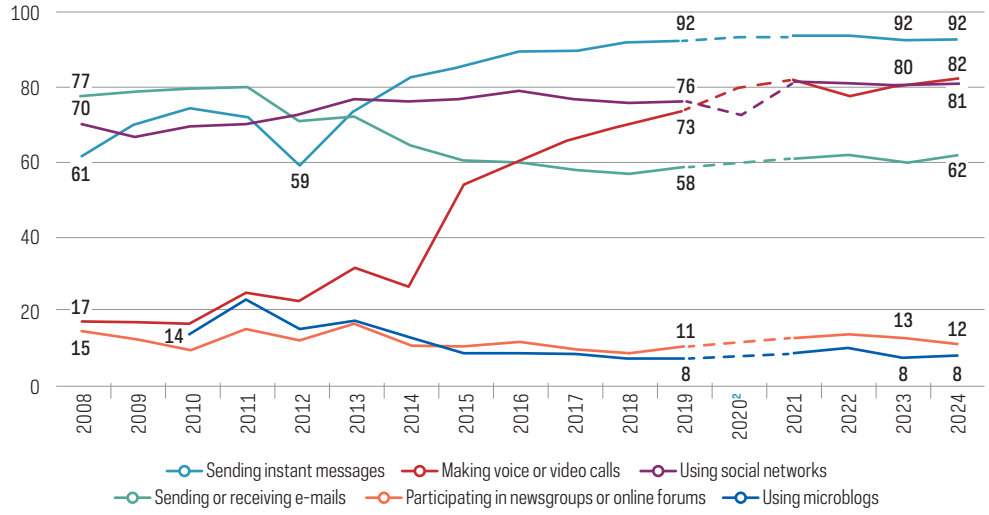
Internet users by activities carried out on the Internet - Communication (2008-2024)

Total number of Internet users (%)



Access to meaningful connectivity is a determining factor in carrying out communication activities. While 87% of those with the highest level of meaningful connectivity (7 to 9 points) sent or received emails, this figure was 37% for those at the lowest level of MC (0 to 2 points). Relevant differences were also reported between the lowest and the highest level of MC in the communication activities of making voice or video calls (95% and 71%, respectively) and using social networks (92% and 64%). Sending instant messages, the most widespread communication practice among respondents, also varied according to the level of meaningful connectivity, albeit to a lesser extent (99% and 85%, for the two extreme levels of MC).

LOOKING UP INFORMATION

Another fundamental aspect of taking advantage of the benefits of the Internet is searching for information. The data from the ICT Households survey showed that looking up information on products and services (56%) and searching for financial information, making payments, and other financial transactions (56%) were the most common information-seeking practices. These were both related to individuals' economic activities, closely followed by searching for information on health or healthcare services (51%). Looking up information on travel and accommodations (28%), looking for information on virtual encyclopedia websites (26%), and job searches or sending resumes (18%) were activities reported less frequently.

Throughout the different editions of the ICT Households survey, level of education has always been a highly relevant variable for understanding the different types of activities related to looking up information. With the new data on meaningful connectivity, the indicator gains another highly relevant variable to research on the topic. With the exception of job searches or sending resumes, for the other activities, there was a difference of at least 30 percentage points between the highest and lowest levels of connectivity. Looking up information on products and services, for example, was carried out by 82% of those with the highest level of meaningful connectivity and 31% of those with the lowest. These figures were, respectively, 87% and 29% for searching for financial information, making payments, and other financial transactions, and 52% and 8% for looking for information on virtual encyclopedia websites.

In 2024, the survey included a new category for disaggregating the results, considering individuals by type of occupation (formal or informal). Five of the six activities were carried out to a greater extent by those in formal employment, with differences of around 10 percentage points between the categories. The exception was job searches or sending resumes, which was done by 16% of those in formal employment and 23% of those in informal employment.

MULTIMEDIA

The carrying out of multimedia activities was also stable compared to the previous edition of the survey. In 2024, around threequarters of users 10 years old or older watched videos, shows, movies or series online (77%) and listened to music online (76%), meaning that these activities remained among the most performed by Brazilian Internet users. In addition, 55% read newspapers, magazines, or news online, and 46% listened to or watched audio or video live streaming, a proportion that remained stable compared to 2023.

Watching videos, listening to music, and playing games on the Internet are multimedia activities that tended to be more common among younger users. Approximately nine out of ten users between 10 and 15 years old watched videos, shows, movies or series online (93%), 89% listened to music, and 85% played games online. For these same activities, among users 60 years old or older, the proportions were significantly lower (49%, 45%, and 12%, respectively).

The quality of individuals' connectivity is an especially important variable for the analysis of multimedia activities, particularly because of the greater connection requirements of some of the analyzed items. Thus, according to the survey, playing games online was an activity carried out by 46% of the Internet users with the highest level of connectivity and by 27% of those with the lowest. Other activities showed greater differences in percentage points, such as listening to music (92% and 58%), listening to podcasts (55% and 13%), watching videos, shows, movies or series online (94% and 58%), reading newspapers, magazines, or news online (78% and 32%), and listening to or watching audio or video live streaming (67% and 26%).

EDUCATION AND WORK

As for activities related to education and work, the percentages remain stable for all the items investigated compared to 2023. However, the historical series of this indicator shows significant changes. Completing school activities or research (42% in 2024), for example, has decreased by 24 percentage points since 2008 (Chart 12), when 66% of users carried out this activity. On the other hand, taking distance learning courses (18%) has increased by six percentage points compared to when it was first measured in 2013 (12%). This is also true of the use of online storage services (32% in 2024 and 19% in 2013) and completing work activities (37% in 2024 and 30% in 2014). Studying on the Internet on one's own (40%) and looking up information on undergraduate, graduate, or extension courses (24%) remained stable in the historical series.

CHART 12

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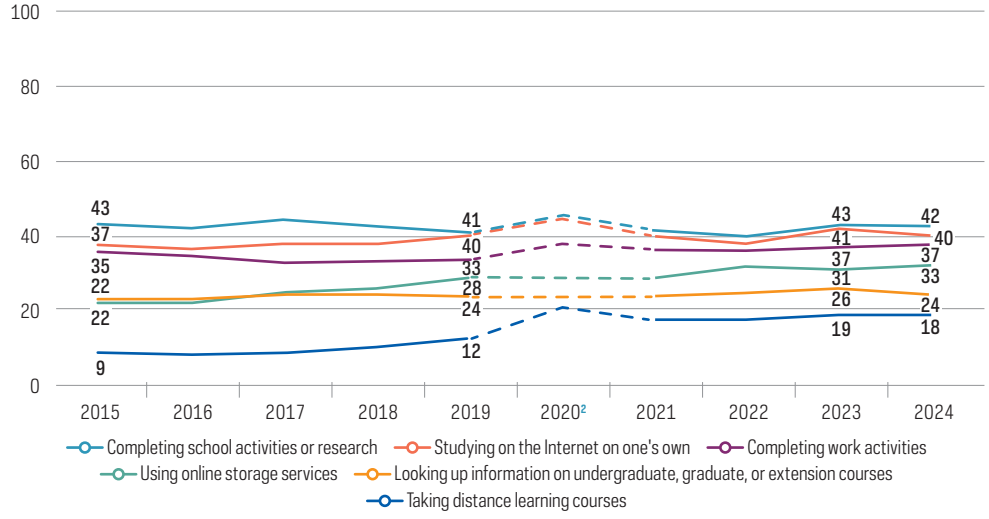
Internet users by activities carried out on the Internet - Education and work (2015-2024)

Total number of Internet users (%)



Activities related to education and studying on the Internet stood out among younger users, especially those 10 to 15 years old, 88% of whom completed school activities or research, and 65% studied on the Internet on their own. On the other hand, activities related to work and looking up information on undergraduate, graduate, or extension courses, as well as taking distance learning courses, were more common among the intermediate age groups: 51% of users 25 to 34 years old carried out work-related activities, while 34% of users 16 to 24 years old looked up information on undergraduate, graduate, or extension courses, and 27% took distance learning courses. Work activities were also more frequent among Internet users with formal jobs (59%) compared to those with informal jobs (43%).

Education and work activities can also be analyzed from the point of view of meaningful connectivity. Distance learning courses were mentioned by 39% of those with the highest level of connectivity, while this figure was 3% for those with the lowest level of connectivity. Significant differences can also be seen in the other areas, especially in carrying out work activities (74% and 11%), the use of online storage services (63% and 9%), and studying on one's own (62% and 21%).

ELECTRONIC GOVERNMENT

The ICT Households 2024 survey provided new data on the use of e-government by Internet users 16 years old or older. In recent years, activities related to e-government have been centralized around the Gov.br system and the increasing digitization of services provided by government organizations: By March 2024, more than 150 million people had Gov.br logins, with the possibility of accessing more than 4,000 digital services.[6] Data from ICT Electronic Government 2023 (Brazilian Internet Steering Committee [CGI.br], 2024) revealed that 41% of Brazilian federal and state public organizations made public services available to citizens entirely via the Internet in 2023, an increase of 14 percentage points compared to 2017.

Considering the 12-month period prior to the survey, the ICT Households shows that around six out of ten Internet users 16 years old or older used e-government in 2024 (61%),[7] a percentage that was lower than in 2023 (73%). The type of online public service with the greatest variation compared to the previous year was that regarding labor rights or social security, with a decrease of 8 percentage points compared to 2023 (Chart 13).[8]

Of the total number of e-government users, 30% used the Internet for only one type of public service, 25% used two types, 17%, three types, and 28%, four or more. Among those with an Elementary Education, 54% used only one type of service and 10% used four or more, while for those with a Tertiary Education, these proportions were 17% and 44%, respectively. E-government users 60 years old or older (46%), those in rural areas (41%), and those in classes DE (40%) also used only one type of online public service to a greater extent.

The survey data suggested that the use of e-government among Internet users 16 years old or older is significantly associated with the individual's level of education: 83% of those with a Tertiary Education and 39% of those with an Elementary Education. The use of e-government was also higher due to meaningful connectivity: while 88% of Internet users with the highest level of MC used this type of service, the proportion was 38% for the group with the lowest MC. Individuals in classes DE (43%), those 60 years old or older (38%), and those earning up to one minimum wage (42%) were among those who used online public services the least.

[6] For more information, visit: https://www.serpro.gov.br/menu/noticias/noticias-2024/gov-br-acesso

[7] E-government users are Internet users 16 years old or older who said "yes" to using at least one of the types of public service investigated by the survey.

[8] Analyzing the survey's historical series, it was observed that between 2019 and 2024, the indicator's variation was inverse to that of the population in the workforce, which is consistent with the nature of this type of service. Furthermore, in 2024, a significant proportion of users performed only one of the types of public service investigated (see below), which makes this indicator sensitive to variations in each of them.

In 2024, the most commonly used online public services were those related to public health (32%), personal documents (31%), and government taxes and fees (29%), all stable compared to 2023 (Chart 13). Services related to labor rights and social security were the only ones to show a significant reduction, from 33% in 2023 to 25% in 2024. At a similar level, public education services, such as those related to the Enem (National High School Exam), Prouni (University for all Policy), and enrolling in public schools or universities, were carried out by 22% of users. Public transportation or other urban services, such as road conservation and cleaning, and public lighting (14%), and police and safety services, such as police reports, police records, or complaints (9%), were the least used.

CHART 13

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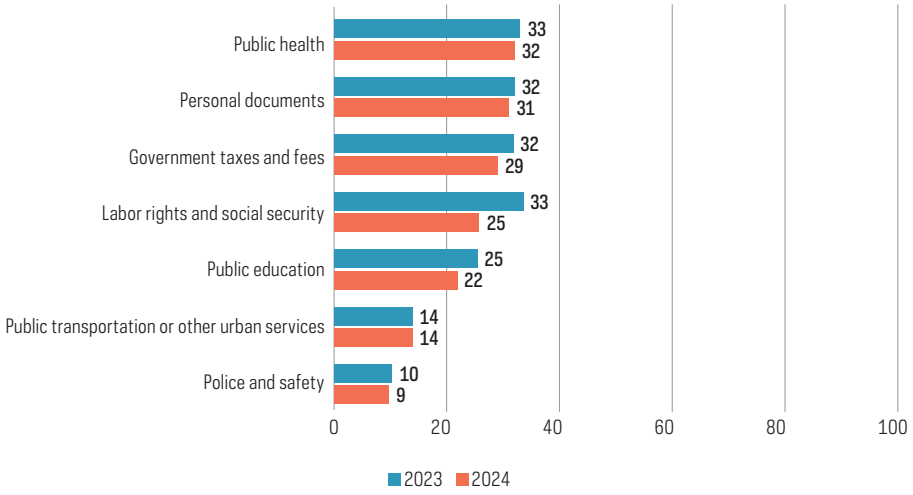
Internet users by type of information regarding public services sought or public service used in the last 12 months (2023-2024)

Total number of Internet users 16 years old or older (%)



The ICT Households 2024 survey also investigated the need to go to in-person citizen service locations to complete public services carried out online. Among the services analyzed, those related to personal documents (10%) and public health (12%) stood out as those that most required individuals to go to in-person citizen service locations to complete public services (Chart 14), followed by services related to labor rights and social security (4%). On the other hand, government taxes and fees services were carried out almost exclusively over the Internet (16%), compared to 3% of those who had to go to in-person citizen service locations to complete the services).

CHART 14

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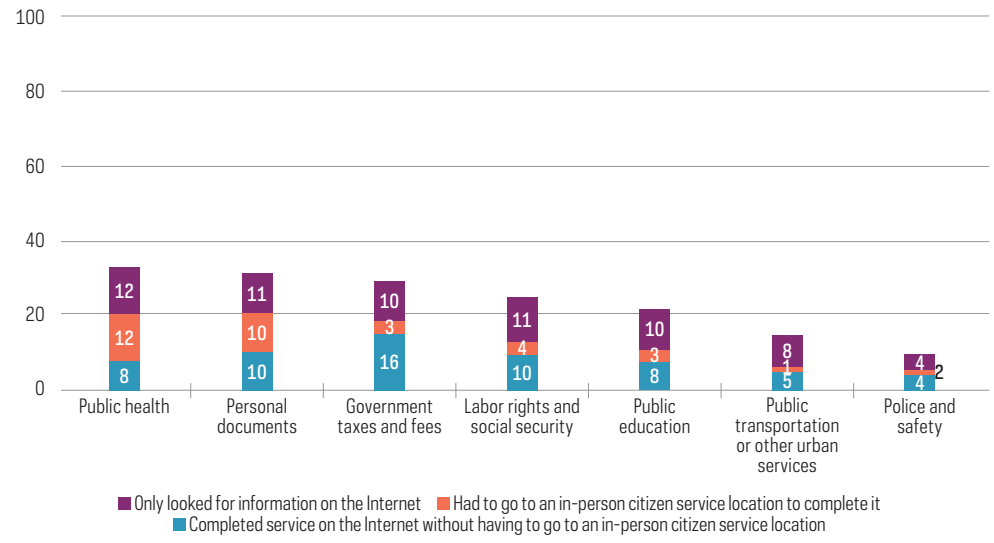
Internet users by need to go to in-person citizen service locations to complete public services (2024)

Total number of Internet users 16 years old or older (%)



Electronic commerce

In 2024, the survey brought back indicators from the e-commerce rotating module, last applied in 2022. That year, the survey recorded a robust expansion of the segment in Brazil in the post-COVID-19 pandemic context, linked to factors such as the spread of commerce and services platforms, the rapid migration of enterprises to the online environment, and the expansion of forms of transaction via the Internet.

In this edition, there was a consolidation of this new level of e-commerce, detailing platforms used for buying and selling online, types of products purchased, payment methods, services provided, and other dimensions. Among the main results was a substantial increase in the use of Pix, which has become the main means of payment for online purchases of products and services, and a decrease in bank payment slips.

One of the module's central indicators is the purchase and sale of goods and services online by Internet users 12 months prior to the survey. The results indicated that 46% of Internet users purchased or ordered products and services online, which represents 73 million people. This figure has remained stable in recent years, pointing to a consolidation of a higher level of e-commerce in the country after the COVID-19 pandemic.

In 2024, the proportion of users who made online purchases was significantly higher among those from the South (55%) and Southeast (54%), compared to those from the Northeast (34%), North (36%), and Center-West (36%). There were also significant differences, especially according to level of education, class, and family income. Internet users with a Tertiary Education, for example, bought products online in a much higher proportion (76%) than those with an Elementary Education (19%), as did users in classes A (72%) and B (76%) compared to those in classes C (45%) and DE (23%) (Chart 15).

CHART 15

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Purchase of goods or services online in the last 12 months, by region, class, and level of education (2024)

Total number of Internet users (%)

The ICT Households 2024 survey also investigated the frequency with which these purchases were made 12 months prior to the survey. The results showed that 46% of Internet users who purchased goods online did so less than once a month, 40% at least once a month, 10% at least once a week, and only 3% every day. It should be noted that all proportions were stable compared to 2022. The way in which the purchases were delivered to the users also remained stable, with the vast majority (94%) receiving them at home, 34% picking up the purchases at the stores or at locations indicated by the sellers, and 32% downloading or accessing the goods or services online through sites, applications, or computer programs.

The types of products purchased or ordered in the greatest proportions by these Internet users were clothing, shoes, and sports materials (71%), showing an increase compared to 2022 (64%) (Chart 16). The other items showed no significant variation and followed the same pattern as in 2022. Other types that stood out were home appliances (53%), food and foodstuff (45%), and cosmetics and personal care products (41%). The categories mentioned least among the items investigated continued to be airfare (11%), computer games or video games (14%), and stationery items (19%). Furthermore, 16% of Internet users reported having bought some other type of product.

CHART 16

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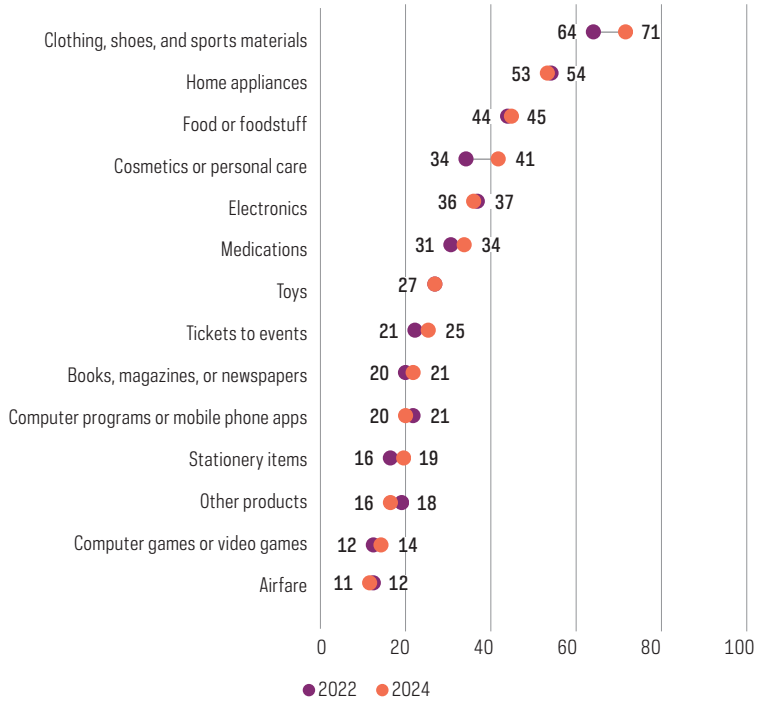
Online shopping by types of goods purchased (2022-2024)

Total number of Internet users who purchased goods or services online in the last 12 months (%)



The main changes observed in the data from this module were in relation to the payment methods used to purchase goods and services on the Internet. The ICT Households 2024 survey identified a substantial expansion of Pix, whose use rose from 66% of Internet users who bought online in 2022 to 84% in 2024, making it the main payment method for online purchases (Chart 17). On the other hand, bank slips, which in 2022 were among the three most used forms of payment (43%), were 24% in 2024, ahead only of reward points of loyalty programs and gift cards or online vouchers.

These variations possibly indicate a process of substitution between these payment methods in online purchases and sales, either because of the ease of payment or because of discounts offered by sellers compared to other methods. As Internet access becomes more universal, Pix becomes a more practical payment option for both sides involved. On the other hand, the lack of such a connection is a barrier to using Pix,[9] whether shopping online or in physical stores.

CHART 17

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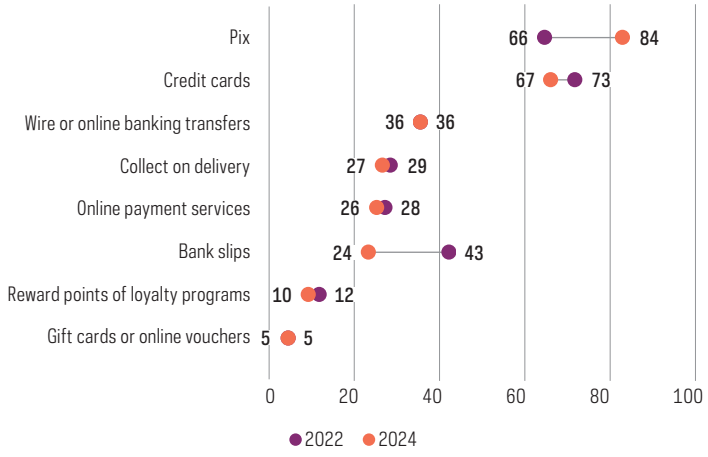
Online shopping by payment method (2022-2024)

Total number of Internet users who purchased goods or services online in the last 12 months (%)



Credit cards were the second most used payment method (67%), with a stable proportion compared to 2022, followed by wire or online banking transfers (36%), collect on delivery (27%), and online payment services, such as PagSeguro, PayPal, or Google Checkout (26%). It is also worth noting that while most payment methods were reported in a similar way between different classes and levels of education, credit cards were used more prominently in classes A (89%) and B (59%) than in classes C (61%) and DE (59%), and online payment services were used more by those with a Tertiary Education (36%) than by those with a Secondary Education (23%) or Elementary education (13%).

The e-commerce module also investigates the channels through which Internet users make their purchases. In the 2024 edition, a new category of analysis was included, "via store applications on mobile phones", which obtained the second highest proportion (65%) among the channels used by those who made purchases online. The new category was second only to marketplaces, which rose from 72% in 2022 to 90% in 2024.

[9] In cognitive interviews carried out in December 2024, Internet users also mentioned the importance of the Internet to confirm that a Pix payment was received, i.e., this is a payment method that depends on the connectivity of both buyers and sellers.

The third most used channel was the website of retail stores, although its representation decreased significantly from 2022 (59%) to 2024 (35%). This movement, in comparison with the frequent use of apps, suggests an ongoing migration of store websites to both specific apps, in an attempt to keep up with the scenario of Internet access mostly via mobile phones, and to marketplaces. It is also worth noting that sales via messaging apps (31%) and social networks (22%) remained practically stable.

In terms of advertisement viewing platforms, there was stability in the mention of advertisements on websites or applications among those who made purchases online (51% in 2022 to 49% in 2024), while online videos about goods and services grew from 40% to 49%. According to the ICT Households 2024 survey, posts on social networks (39%) remains one of the most mentioned viewing platforms. The viewing of ads in messaging apps (25%) and e-mails with sale offers (21%) was less frequent.

With regard to the types of services purchased online, 44% of users used transport apps to order cab rides or private drivers, 40% paid for series or movie streaming services, and 35% ordered meals on sites or applications, all remaining stable compared to 2022 (Chart 18). On the other hand, paying for music streaming services increased compared to the previous edition, going from 13% in 2022 to 19% in 2024. The other services remained stable, with renting a car online remaining the lowest proportion among the services investigated, carried out by only 2% of Internet users.

CHART 18

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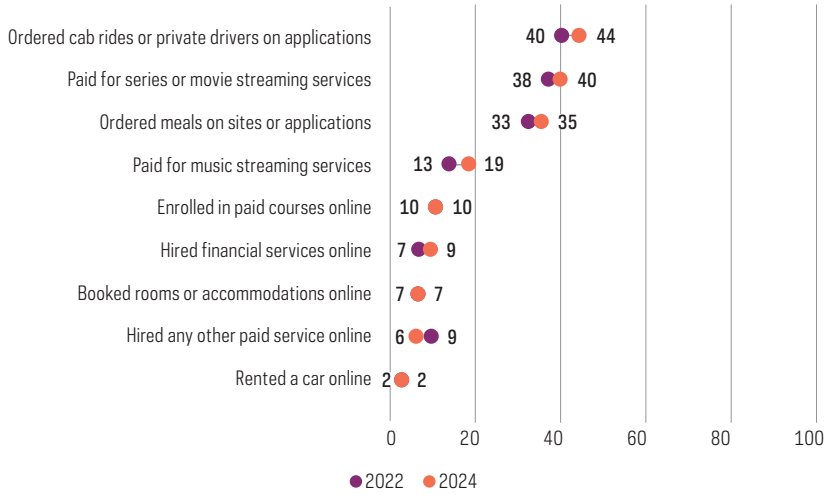
Services delivered online in the last 12 months (2022-2024)

Total number of Internet users (%)



Another important point is to analyze the reasons why users did not purchase goods or services on the Internet, given that in 2024, 54% reported not having made any online purchases. The main reasons reported for this were a preference to shop in person and see the product (80%), a lack of interest in online shopping (53%), concerns about privacy and security (48%), and a lack of trust in the product that will be received (48%). In addition, 40% stated that they did not make purchases online due to lack of need, 37% due to lack of Internet skills, 36% due to problems with the delivery of products, 35% due to the impossibility to make complaints or return the product, and 29% to the impossibility to make online payments. It is interesting to note that not being able to make complaints or returns, lack of Internet skills, and not being able to make online payments were reported in significantly higher proportions among users in classes C and DE compared to those in classes A and B.

Another relevant aspect of e-commerce is the promotion and sale of products and services online by Internet users. The 2024 results indicated that 16% had advertised or sold goods or services online, a percentage that varied within the margin of error compared to 2022 (19%). This activity was more frequent among users with a higher level of education, standing at 6% among those with Elementary Education, 17% for those with Secondary Education, and 28% among those with Tertiary Education (Chart 19). Socioeconomic class was also related to the sale of products on the Internet, since only 8% of Internet users in classes DE carried out this activity, a proportion that was 26% among those in class B and 33% for those in class A.

CHART 19

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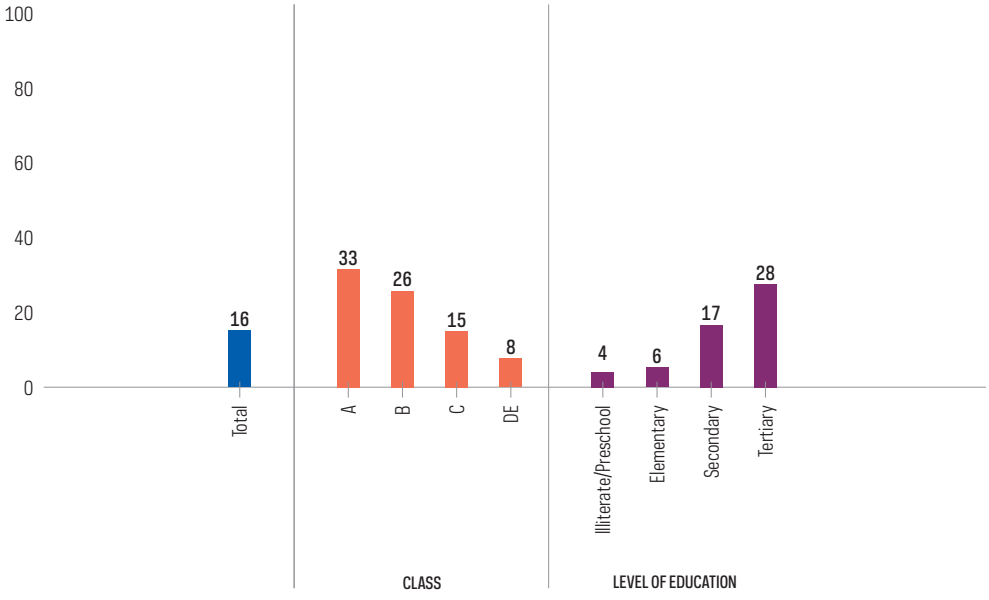
Advertising and sale of goods or services online in the last 12 months, by class and level of education (2024)

Total number of Internet users (%)



The platforms most used to sell or advertise these products were social networks (73%). Just over half of the users who sold goods and services online (55%) sold or advertised through messaging apps such as WhatsApp or Telegram, while around 42% used online marketplaces, such as Amazon and Mercado Livre, and 13% sold via e-mail. These percentages remained stable compared to 2022. The use of social networks as a sales or advertising channel was more frequent among Internet users in the South (89%) and those 16 to 24 years old (87%). On the other hand, sales or advertising via messaging apps was mainly carried out among users with a family income of more than 10 minimum wages (83%) and those in the North (79%).

Final considerations and agenda for public policies

The ICT Households 2024 survey presents an updated overview of Internet access and ICT use and ownership in Brazilian households and among the population 10 years old and older. The results of this edition indicate that inequalities in access to ICT in households persist, with a lower presence of Internet and computers among lower-class households and in rural areas. In addition, the lack of skills to use the Internet and the high cost, also a reflection of socioeconomic and regional inequalities, were the reasons most reported by most households that did not have an Internet connection.

In 2024, the survey pointed to stability in the proportion of Internet users and revealed that individuals in classes DE, those living in rural areas, and those in the North continued to have lower levels of meaningful connectivity. For these groups, access to the Internet was predominantly via mobile phones, which in many cases were the only devices used, limiting the development of digital skills and the appropriation of the opportunities offered by the digital environment.

The results of the survey once again demonstrate the importance of discussions around meaningful connectivity, which adds an important dimension of quality of access in addition to the fundamental—and as yet unachieved—goal of universal access. A meaningful connectivity is essential if Internet users are to gain more tangible benefits from their presence in the digital world. The activities carried out online also add another element to this investigation and show that educational inequalities also have an impact on the activities carried out by different segments on the Internet: Individuals with a higher level of education tend to carry out the activities investigated by the survey in greater proportions than those with a lower level.

It is important to note that the use of e-government services was also more common among those with higher levels of education and also tended to increase with income. The results of the ICT Households 2024 survey indicate that there is still a significant portion of the population, especially those in situations of greater economic and social vulnerability, who do not search for information or demand public services online. This reveals the importance of actions that, on the one hand, facilitate Internet access for those who need to carry out these services but do not have access to it and, on the other, promote their use by Internet users who are unaware of or have difficulties in carrying out these activities. Simplifying services could be one of the ways to increase the use of government services. An example of this is Pix, which has changed the standard of online payments for goods and services purchased.

In general, the results of the survey indicate that there is a long way to go for connectivity in Brazil to be meaningful for all individuals, given that the conditions of Internet access and use still reflect the social inequalities that exist in society. There is still a significant portion of the population that does not use the Internet, as well as people who use it in a more limited way, carrying out a narrower range of activities. This limits access to the opportunities offered by the digital environment by the most vulnerable segments of the population, which in turn tends to reinforce social and economic inequalities.

In its 20 years of existence, the ICT Households survey has sought to contribute to the construction of evidence-based public policies that can reduce digital inequalities and contribute to mitigating social inequalities.

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Articles

Meaningful connectivity and disinformation: Which competencies and knowledge are needed in the age of generative AI?

Danielle Sanches[1] *and Paula Menezes*[2]

The use of technologies based on Artificial Intelligence (AI) models is expanding rapidly in our daily lives. Since the announcement of the launch of ChatGPT in 2022, disruptive AI-based innovations have emerged at every turn. According to a report published by the European Network of Law Enforcement Technology Services (Den Donen, 2021), in the next three years, approximately 90% of the digital content produced will be synthetic in nature, i.e., generated by generative AI models. However, the increased use of applications that operate on the basis of algorithmic modulation created by AI models draws attention to the users' algorithmic literacy, since people do not always understand that they are interacting with AI models or, if they do, they cannot easily distinguish the correct answers from machine hallucinations (Lemos, 2024). A report published by the Organisation for Economic Co-operation and Development (OECD, 2024) pointed out that Brazil ranks last among the 21 countries surveyed when it comes to adults' ability to identify the veracity of online news. Another survey, led by Kaspersky (2021), found that 71% of Brazilians interviewed said they were unable to recognize content generated by a generative AI model that simulates a situation or reality, also known as deepfake.

This advance in the circulation of synthetic content means that there is an imminent risk of an increase in misleading content and revisionist narratives based on "evidence" in the form of texts, images, videos, and audios created by AI. It should be noted that the circulation and consumption of fake news[3] in Brazil is enhanced by the type of connection

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[3] Recognizing the difference between fake news/disinformation (intentional) and misinformation (unintentional) is important to distinguish where distortions and amplification of rumors are located in the information production chain. However, for the purposes of this article, misinformation, disinformation and fake news will be seen as part of the same dispute over information and will be related to the issue of connectivity.

and communication media used by individuals (D'Almonte et al., 2023). Therefore, the levels and types of connectivity constitute the new basis of the information culture in Brazil, which leads to the spread of disinformation combined with little ability to verify and identify fake news.

It is well known that the fake news factory in Brazil is aggravated by the types of connection and devices used by Brazilians. The idea of meaningful connectivity has been gaining ground in Latin America, where the debate has been highlighted in recent years, bringing this international discussion to the Brazilian context and taking into account the features of its diverse reality. This concept has emerged as a necessary element in debates on digital inclusion. Its development indicates that digital inclusion involves not only access to the Internet, but also quality of connection and associated opportunities, such as quality of devices, speed of access, volume of data available, and frequency of use (Brazilian Network Information Center [NIC.br], 2024a).

The Alliance for Affordable Internet (A4AI) developed the perspective that half the world's population is not connected to the Internet due to costs, since for most of the developed world fast and reliable Internet connections cost less than 1% of average monthly income, while in the world's least developed countries the cost of just 500 MB of data per month is around 15% of the average monthly income of the population (A4AI, 2020). A4AI underwent changes, and the leaders founded another organization, but the reference remained as a historical memory of the concept of meaningful connectivity developed by it. A4AI's proposals for meaningful connectivity involve four parameters: (a) having an appropriate device; (b) getting the right speed; (c) connecting with enough data; and (d) using the Internet regularly.

Based on this idea, the International Telecommunication Union (ITU, 2022) launched a framework for universal and meaningful digital connectivity, which expands and deepens the work carried out by A4AI. In Brazil, NIC.br, through the Regional Center for Studies on the Development of the Information Society (Cetic.br), has launched a study that provides a model for measuring meaningful connectivity and applies it to the Brazilian context, with expert opinions on the challenges of connectivity in Brazil (NIC.br, 2024a).

Analyses of meaningful connectivity take the digital divide debate a step further (van Djik, 2020), as they identify opportunities according to the type of Internet an individual has access to. As stated in the NIC.br document (2024a, p. 32), "the digital divide is now a question of what possibilities in education, employment, and public participation are available to an individual, based on the kind of Internet access they have." Relating this to the new context of AI, as these new tools require the use of great connectivity power, the Brazilian population could become a consumer of AI-made content, without access to its concrete use and without being able to discern the reality produced by AI (such as the aforementioned deepfakes).

Therefore, this article proposes an analysis of the relationship between connectivity and disinformation, with the aim of building a framework of specific digital skills for dealing with this phenomenon, such as AI literacy. To do this, we will use data from the Cetic.br|NIC.br ICT Households survey, as well as studies of online disinformation chains. In the end, we will reflect on how education can contribute to critical digital citizenship through literacy, and on the knowledge and skills that can be used to understand the information production chain, even in scenarios in which connectivity is considered to be of poor quality. We will reflect on existing paradigms related to this phenomenon (Ançanello & Casarin, 2023), adapting them to realities in which meaningful connectivity may still be fragile.

Analysis

An analysis of data from the ICT Households 2023 survey (CGI.br, 2024) showed that the main reason given by respondents for the lack of Internet in their households was its cost (25.2%, "residents find it too expensive") and the lack of knowledge about how it works (23.1%, "residents do not know how to use the Internet"). When looking at this data based on income and geographical distribution, these figures are even more significant: 35.3% of households in the North region of Brazil[4] and 26.6% of those in the Northeast said they found the Internet expensive, and 26.6% of households in the Northeast said their residents did not know how to use the Internet. In addition to illustrating how digital inequality is marked by the region of the country, this data also reveals a relationship between quality Internet access and digital skills.

The following chart provides an overview of individuals' digital skills vs. their access devices. The proportion of respondents who checked whether the information they found on the Internet was true was 71% among those who accessed the Internet both by computers and by mobile phones, compared to 37% among those who only accessed by mobile phones. It is worth noting that 39% of respondents who only accessed the Internet by mobile phone said they had not carried out any of the digital skills-related activities investigated by the survey. This data suggests that the use of mobile phones as a central source of information makes individuals less likely to check information and sources.

[4] Brazil's northern region occupies more than 45% of the country's territory. This region and the Northeast have the worst Internet usage indicators in Brazil. See Brazilian Institute of Consumer Protection (Idec) & Derechos Digitales (2022).

CHART 1

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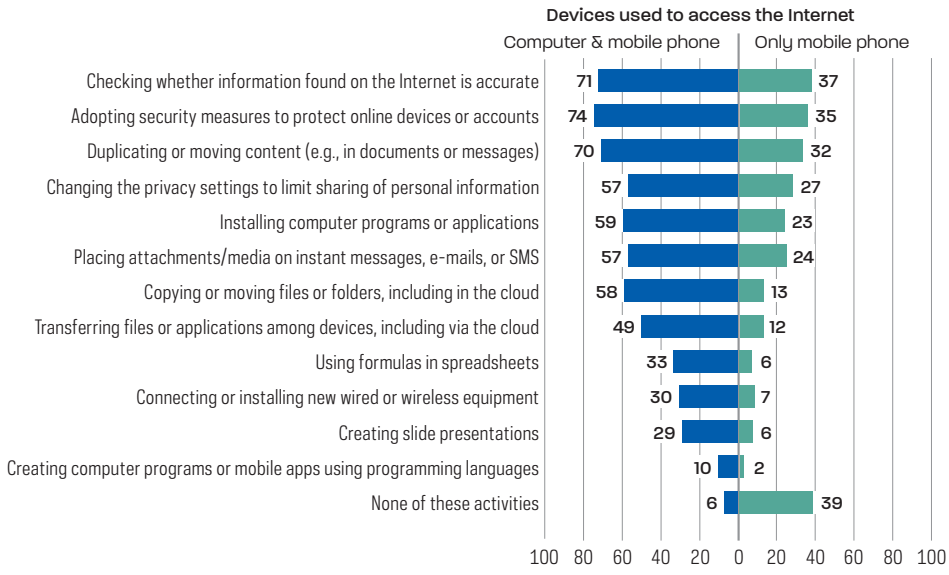
Digital skills by access device (2023)

Total number of Internet users (%)



Source: NIC.br (2024b).

The ICT Households 2023 survey (CGI.br, 2024) also provides important data in relation to: (a) Internet users, by most frequent place of individual access, and (b) individuals who own mobile phones, by type of payment plan. These indicators show how much the Internet has become home-based and individual over the last ten years, with increasingly more people accessing it from home, with connected devices, and primarily on mobile phones. The data on payment plans, however, shows that although they have fallen by ten percentage points since 2016, prepaid plans are still the majority (60% of users). These plans often allow the use of some social networks for free, which encourages users to use them as sources of information, especially those that use the zero-rating system (Garcia e Silva & Marques, 2019).[5]

As already noted, A4AI's (2020) Meaningful Connectivity report (2020) indicated four essential parameters for meaningful connectivity: having an appropriate device; getting the right speed; connecting with enough data; and using the Internet regularly. Faced with the scenario observed in Brazil, digital inequality affects and is affected by the types of use that are made of the Internet; in other words, among the 156 million Brazilians who claim to be Internet users, how many actually have quality access? How many are able to understand what they are consuming in these environments? These are questions that should guide our perception of information production and consumption in digital environments.

[5] Zero-rating is a practice carried out by telephone operators and some technology enterprises, where access to some online services is allowed "free of charge," or without charging for mobile data traffic.

Inserted in an algorithmosphere (Leporace, 2024), we live in a society that has to deal with the actions of algorithms that impose systems of visibility on us (Bentes, 2021; Bruno, 2013), in which we can or cannot access information that is segmented and parameterized according to our preferences and profiles. This customization, which is so present in the digital environment as a way of targeting specific content to interested parties, with a focus on advertising, ends up depersonalizing individuals, who are now part of a cluster and fragmented regarding their access to information outside of their "bubble." With the advent of generative AI and the shifting knowledge that underlies this type of technology, the digital inequalities that exist in Brazil become even more concerning. In reflecting on the performance of AI models, Internet users' awareness of the impact of this synthetic media may be even lower, as there is a profusion of misleading information circulating in the world, which makes the average recipient with low or no meaningful connectivity feel that any file produced (image, audio, video, or text) and circulating in digital environments is riskily convincing (Santaella & Kaufman, 2024).

According to a survey carried out by Opinion Box (2024) on the use and understanding of AI in Brazil, 18% of respondents said that they trust the information they receive from ChatGPT, Open AI's AI model, while 75% said that they usually trust but occasionally have doubts, and only 7% of people said that they do not trust the information provided. When asked about the existence of biases in these interfaces, 36% of respondents said they believe the answers are unbiased, and 24% that they are not sure if there are biases; only 40% said they perceive biases in the answers provided by AI models. These statistics show us the challenges present in the use and consumption of information in Brazil since this belief in the answers given by machines and the non-perception of tendencies or biases by users places them in a condition of informational vulnerability.

As described earlier, the data produced by NIC.br helps us to build a hypothesis that can be further explored in future studies on the subject: The relationship between disinformation and connectivity is conditioned by types of use, types of connectivity, and types of devices used to access the Internet. Although this relationship is complex and largely mediated by the digital infrastructure available, in areas where connectivity is limited or poor-quality, users often turn to platforms that consume less data, such as WhatsApp and Facebook, for information. These platforms are popular among the most vulnerable sections of the population due to the low cost of mobile data (D'Almonte et al., 2023). However, these same platforms are also favorable environments for the spread of fake news, as their architectures make it difficult to moderate and control content, in addition to making it difficult to verify sources. WhatsApp, in particular, plays a crucial role in this process. As it is an end-to-end encrypted messaging platform, it escapes the algorithmic filters that help moderate content on other social networks (Pereira & Coutinho, 2022).

One of the main ways to combat disinformation is by promoting digital and media education. This means showing people how algorithms work and addressing the logic of digital platforms. In the case of AI, presenting how generative AI models can be used to create content and verify the authenticity of information is key. Including knowledge and learning about AI in school curricula and adult training programs can be an effective strategy for dealing with the growing challenge of disinformation.

Important frameworks and reflections have guided how to think about AI in education. Wayne Holmes, one of the leading theorists on the subject, points out that the idea of customization of intelligent systems in education actually depersonalizes teaching, leading to the same results. This is because most of what is offered is based on a "primitive behaviorist" or "instructionist" approach that ends up undermining the creativity of students and teachers (Holmes, 2021). Therefore, he brings up an important issue about how AI systems have been used in education without the necessary reflection on them.

Schools and universities should open up the agenda on this subject, taking into account the connectivity landscape and information culture in Brazil. Although international agencies and documents have released guidelines and ideas for frameworks, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2024), it is necessary to consider the Brazilian context. Drawing up internal institutional policies on the ethical use of AI in educational institutions could be a way to engage communities in this collective reflection, deciding how, where, and when to use AI systems in education, with the necessary regulation.

Digital citizenship seems to be an axis of approach that is coherent with our institutional culture, including knowledge from media education, digital education, and AI literacy. In the face of the growing complexity of the digital environment, digital citizenship also requires various competencies. AI literacy in the Brazilian context must, therefore, take into account Brazil's potential educational inequalities and aim for informed consumption of web platforms and environments that are mediated and/or have their content generated by AI. Furthermore, it must promote reflections on the thinking models behind the manufacture of this content. The main competencies that need to be promoted include:

- **AI literacy:** basic understanding of how AI technologies work and how they impact information consumption. Citizens should be able to identify AI-generated content, such as deepfakes, and understand the implications of these technologies for disinformation.
- **AI production and operation:** a general understanding of how AI models are developed and what knowledge is required for that, as well as the production chain of these models, which includes an understanding of training data. This item also includes reflection on North/South and enterprises/governments power relations, as well as understanding the tendency to generate results based on foreign languages and knowledge.
- **Source verification:** the ability to verify the authenticity of information. This includes using fact-checking tools and identifying warning signs in manipulated content.
- **Media education:** the competency to recognize misleading narratives. This involves critically analyzing sources of information and developing a skeptical attitude toward viral content.
- **Algorithmic competencies:** the ability to interact with algorithms productively. This includes the ability to customize news feeds and social platforms to reduce exposure to biased or uninformative content.

- **Ethics:** ethical reflection on the use of data and the potential limits and risks of AI systems and models in different sectors, such as health, education, justice, financial institutions, governments, etc. Ethical reflection should also consider intersectional elements such as race and gender and the biases they generate.

These digital and media competencies are essential for empowering citizens to deal with the challenges of disinformation in the age of generative AI. However, for these competencies to be disseminated effectively, continuous investment is needed in digital education, both in the formal education system and in training programs for adults. In addition, public policies must ensure that all citizens have access to meaningful connectivity that allows them to make full use of the digital tools and technologies needed to verify information and actively participate in the digital environment.

Conclusion

The rapid expansion of generative AI and the growing production of synthetic content have created an increasingly complex and challenging digital environment, especially as regards disinformation. In Brazil, where meaningful connectivity is still a critical issue, disinformation has proliferated more easily, exacerbated by a lack of digital literacy and the widespread use of platforms such as WhatsApp, Telegram, and Facebook. The ability to deal with these new dynamics depends largely on the development of critical digital citizenship so that people are able to navigate the digital environment in a safe and informed manner.

Promoting specific digital competencies is key to mitigating the impacts of disinformation and ensuring that citizens can be truly inserted into the information society. Meaningful connectivity plays a crucial role in this process, as without a quality connection many of the tools and skills needed to deal with disinformation remain inaccessible to a large part of the population.

Therefore, the future of digital citizenship in Brazil depends on a combination of public policies aimed at expanding meaningful connectivity and educational programs that promote critical digital literacy. Only with these coordinated efforts will it be possible to tackle the challenges of disinformation and ensure that citizens are prepared to navigate safely and responsibly in the age of generative AI.

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Digital public infrastructure: New challenges for democratic governance[1]

José Carlos Vaz[2] and Fernanda Campagnucci[3]

When accessing online resources to interact with the government, citizens quietly connect to digital infrastructure, which integrates technical and social elements. This infrastructure becomes increasingly complex by incorporating emerging technologies such as Internet of Things (IoT) devices, Artificial Intelligence (AI), and Big Data processing. Based on this context, this article analyzes the challenges to democratic governance of public policies and the Internet posed by the increasing expansion of the use, scope, and complexity of the so-called Digital Public Infrastructure (DPI).

First, it defines DPI in technical, political, and institutional terms, highlighting the aspects in dispute in this definition—such as the very notion of "public." In addition, its main constituent elements are identified, which can be the object of democratic governance.

Different theoretical lenses are combined in this analysis. The perspective of the social construction of technology (Pinch & Bijker, 1984) allows us to understand DPI as an artifact built through social disputes for the appropriation of technology. This approach highlights the role of social actors and their networks and strategies. It allows analysis of the chains of use of the technologies that make up DPI, helping to identify relevant elements.

Another lens used is that of state capacities, which allows analyzing DPI from an institutional and systemic point of view (Wu et al., 2015), focusing on the interactions between various organizations and individuals in the construction, operation, and use of DPI, as well as their relationship to Internet governance. Thus, DPI is also a resource that can be mobilized to ensure state capacities, while its governance and operation may require specific capacities.

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After characterizing DPI, the article identifies demands, conflicts, and disputes regarding each of the elements. It then reflects on governance instruments that can expand state capacity for the creation, expansion, and use of DPI within the framework of strengthening democracy and fighting inequalities.

The open government paradigm is used as a reference to explore more democratic possibilities of DPI governance (Campagnucci, 2023). This paradigm is based on four pillars—transparency, social participation, integrity, and open technologies—which are treated as cross-sectional elements to the proposed governance instruments.

After this introduction, which outlines the objectives and methodological approach of this work, we present a brief contextualization on DPI and its definition, followed by a section on its democratic governance. The article ends by considering the challenges to the development and implementation of democratic governance practices of DPI.

A concept in dispute

Like any digital infrastructure, DPI has social, political, economic, and institutional aspects. It contains several components: hardware, software, cables, data, rules, and relationships among actors with varying interests (Mongili & Pellegrino, 2014), among other elements, that are usually "invisible" to users.

As digital infrastructure becomes more central to public services and processes critical to democracy, its conceptualization in the public context is in dispute. The term "public" takes on different meanings, depending on the author and their perspective—therefore, it is not neutral (Eaves et al., 2024). Some of those involved in the discussion argue that DPI is that which serves the public interest—encompassing infrastructure also maintained by private actors (Digital Public Goods Alliance [DPGA], 2022). Other approaches emphasize the economic dimension, as this infrastructure has been used for payment services and inclusion in the financial system (World Bank Group, 2023).

Another notion, inspired by the theoretical lens of the "common good" (Mazzucato, 2023) or digital commons (Avila et al., 2024; Barandiaran et al., 2024), emphasizes governance arrangements that consider infrastructure from the point of view of public interest and openness of technologies. For some, this function should not only be regulated but also organized and funded by the state. Without qualifying aspects of openness of technologies, Brazilian legislation defines DPI as solutions

> that adopt networked technology standards built for the public interest, follow the principles of universality and interoperability, enable use by diverse public and private sector entities, and integrate services across physical and digital channels. (Decree No. 12,069/2024)

All these definitions understand DPI as a structuring and shared digital component that enables the creation of public value and benefits for society as a whole.

The DPGA, a multisectoral initiative whose governance includes bodies of the United Nations (UN) such as the United Nations Development Programme (UNDP) and the United Nations Children's Fund (UNICEF), maintains a register of digital public goods, such as content, software, and modules, including digital infrastructure.[4] To be included, these goods are evaluated according to a set of indicators—such as open licenses, relevance to the Sustainable Development Goals (SDG), independence of proprietary solutions, and data protection.[5] Among the examples of DPI available in the register, systems for secure data transmission stand out, such as *X-Road*,[6] developed in Estonia and used in more than 15 countries, including Brazil, specific public policy information systems such as *SanteSuite*, used for vaccination policy management in Tanzania,[7] and *DIGIT*, for municipal public services in India.[8]

Dataprev, a Brazilian public company responsible for managing the National Register of Social Information (CNIS), which allows the grant of rights such as pensions or the Bolsa Família (Family Allowance) program, is testing[9] one such DPI, *OpenIMIS*. Already registered by the DPGA, this infrastructure was created to manage social protection information and is used in 12 other countries.[10] The register of digital infrastructures of public interest also includes examples built and maintained by civil society, such as *Querido Diário* (Dear Diary), open-source technology that processes and makes more accessible in open data format the content published in official journals of more than 450 Brazilian municipalities.[11]

Democratic governance of DPI

As critical and structuring resources, DPI require investment, governance arrangements, and institutional capacities. These elements must dialogue with demands, disputes, and conflicts around DPI and with the governance objects related to it. Depending on the definition of conflicts and objects, principles, and governance instruments must be applied, as shown in Figure 1.

[4] More information available at https://digitalpublicgoods.net/registry/

[5] Available at https://digitalpublicgoods.net/standard

[6] More information available at https://app.digitalpublicgoods.net/a/11833

[7] More information available at https://app.digitalpublicgoods.net/a/11275

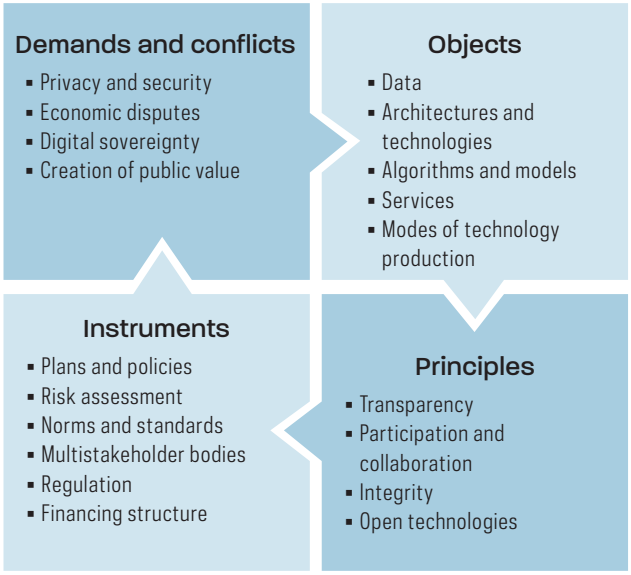
[8] More information available at https://app.digitalpublicgoods.net/a/10024

[9] The information was shared during a public event with the presentation of the case by a representative of Dataprev. More information available at https://digital-dialogues.net/en/news-details/webinar-on-openimis-open-source-solution-for-complex-healthcare-and-social-protection-systems

[10] More information available at https://app.digitalpublicgoods.net/a/11252

[11] More information available at https://app.digitalpublicgoods.net/a/10675

FIGURE 1
—
Elements for structuring the democratic governance of DPI



Source: prepared by the authors.

Based on this approach, we analyze the elements of DPI that can be objects of democratic governance, presenting related conflicts and disputes. Next, we propose instruments to deal with these challenges.

OBJECTS OF DEMOCRATIC GOVERNANCE

Examining DPI and unfolding it into relevant components for building democratic governance yields the following elements:

1. *Data.* DPI collects, stores, uses, and shares personal data and other types of information, whether restricted or in the public interest. Depending on the technology, institutional arrangements, and policies and standards associated with the infrastructure, this data may be more or less accessible, used for different purposes, and more or less exposed to special interests and security flaws (Campagnucci, 2023).
2. *Services offered.* DPI is shared for the provision of services such as Gov.br infrastructure, created by the federal government to manage the identity of Brazilians and used by state and local governments to authenticate users in their own services (Brazilian Internet Steering Committee [CGI.br], 2024; Mitkiewicz, 2024). Thus, services function as a "layer" above DPI (Eaves et al., 2024). The decision about which services can connect to the infrastructure and the data authorized for use can be the subject of the democratic governance of the DPI.

3. *Technological architectures.* A DPI is constructed based on multiple decisions about hardware, software, and connection to networks and communication infrastructures (Mongili & Pellegrino, 2014). The choice of architecture influences how data is stored and accessed, affecting fundamental issues for DPI governance, such as interoperability, privacy, inclusion, and access to the infrastructure and the services it allows to be offered.

4. *AI algorithms and models.* In addition to digital infrastructures, there are also computational processes that analyze data and automate decision-making of various kinds. These processes can be governed by algorithms programmed to perform predefined tasks or rely on more complex technologies, such as deep learning. In 2021, 24% of Brazilian federal and state public agencies used some AI application (CGI.br, 2022). In 2023, this percentage was 30%, reaching 49% only among federal organizations (CGI.br, 2024). This data, however, does not fully capture the momentum of tool adoption from the popularization of large language models (LLMs) with the launch of ChatGPT by OpenAI in 2022. Decisions about adopting different models, the scope of their tasks, and their degree of transparency may be subject to governance in DPI.

5. *Mode of technology production.* There are different possibilities for developing and maintaining DPI: through in-house teams, partnerships with organizations, community involvement of volunteers, reuse of open-source licenses (Mergel, 2015), and the acquisition of licenses. Decisions about the modes of production of technologies and underlying business models are simultaneously political and technological. They involve adopted architectures and standards, openness to external actors, and transparency of decisions or source code (Vaz, 2017). They also impact services offered and data access.

DEMANDS, CONFLICTS, AND DISPUTES

Each element of DPI listed in the previous section is subject to demands, conflicts, and disputes around the impacts generated by its availability and use. We present the main aspects below.

1. *Data privacy and security.* Digital identity verification is at the heart of many DPI initiatives and definitions (Cioffi et al., 2023). To this end, infrastructure collects and stores citizens' data with varying degrees of protection and sharing. This increasing centralization of data demands the creation of protocols for their protection and security.

2. *Economic disputes.* Economic interests impact informational and institutional decisions (Hoeyer, 2020). Stored data can be evaluated for its monetary value and potential generation of public value, especially when connected to other databases (Campagnucci, 2023). Although there is no specific data on the topic, it is plausible to assume that AI solutions in the Brazilian public sector, for example, are largely dominated by proprietary technologies, mostly provided by Big Techs, while open models remain underfunded.

3. *Digital sovereignty*. Disputes around the technological autonomy of the State and digital sovereignty relate to the ability of States to maintain control over technology, preventing the interference of large corporations and other States in the economic, political, and cultural dimension of society (Vaz, 2016). Technological dependence, especially in Latin American countries, weakens this sovereignty, exposing public administration to vulnerabilities and external influences. The implementation of DPI impacts digital sovereignty, which requires its governance to create conditions for this aspect to be considered in decision-making processes, through instruments such as multisectoral instances, regulation, and plans that consider digital sovereignty as a public value to be produced by DPI.

4. *Creation of public value*. Despite contributing to enabling and facilitating access to social benefits and essential services, DPI may face problems in its design or operation that can deepen inequalities. For example, citizens may have their registration in a social program impaired due to errors in the validation of their digital identity (Cioffi et al., 2023; Seth et al., 2023), access barriers (Gonzalez & Araujo, 2021), or failure to integrate government databases (Rosa, 2020). Including civil society organizations, affected communities, and other stakeholders in design and governance (Cioffi et al., 2023) can avoid deviations from purpose and maximize the public value created (Eaves et al., 2024).

INSTRUMENTS OF DEMOCRATIC GOVERNANCE

Considering the constituent elements of DPI, it is possible to propose instruments to guide its functioning to meet demands, resolve conflicts and disputes, and maximize public value. Below we present some instruments to be developed within a broader DPI governance framework in future work.

1. *Plans and policies*. DPI planning can be guided by policies and action plans involving all stakeholders. In Brazil, the Federal Digital Government Strategy for 2024-2027 encourages the development, implementation, and use of DPI (Decree No. 12,198/2024). To this end, it establishes instruments such as Digital Transformation Plans, Open Data Plans, and the Information and Communication Technology Master Plan. These documents lend transparency to the objectives and production processes of the technology involved in DPI. In order to reflect the demands of society and maximize public value, its construction requires the development of state capacities of a political-relational nature in order to enable collaboration with society.

2. *Human rights risk and impact assessments*. These instruments can be designed to create safeguards and mechanisms to mitigate the possible harm that DPI can cause, such as discrimination and exclusion (Cioffi et al., 2023) and the violation of digital rights—such as data protection (Gomes, 2019). In addition to being publicized, these instruments can be developed via multisectoral participatory processes.

3. *Technical standards and norms.* Interoperability in DPI can be promoted by adopting open technical standards with publicly accessible content (Avila et al., 2024). Open data and technologies are principles associated with open government (Campagnucci, 2020), contributing to strengthening democratic practices in DPI governance. The adoption of norms and open standards in DPI contributes to preventing dependence on specific suppliers (vendor lock-in) (Eaves et al., 2024).
4. *Multisectoral governance bodies.* Multisectoral bodies are widely used in Internet governance (Hill, 2014). They allow actors from different sectors and different interested parties to interact more horizontally in the definitions of governance of technological resources. The creation of these bodies offers public management greater political-relational capacity. It allows them to interact with different actors, which contributes to the democratic management of DPI. Brazil already has relevant experience in multisectoral governance, in cases such as the CGI.br (Glaser & Canabarro, 2016) and committees of specific infrastructures, such as the National Open Data Infrastructure (INDA), National Spatial Data Infrastructure (INDE), and the Citizen Base Register (CBC), with different degrees of maturity and involvement of societal sectors.
5. *Regulation.* Regulatory instruments have been mobilized to mitigate the risk impacts generated by the expansion of the use of innovative technologies. Aspects such as information asymmetry, concentration of market power, and the violation of digital rights are considered issues that justify the adoption of regulatory measures (Eaves & Kedia, 2024). Regulatory instruments can have different natures, focusing on economic and technical aspects and consumer relations. They must be able to regulate access to and use of technologies, setting limits for producers, users, and intermediaries. In the case of DPI, the main objective of regulation is to ensure that its construction, management, and use remain public-oriented.
6. *Financing structure.* The forecast of financing structures of DPI is fundamental for its implementation and to ensure sustainability and alignment with the public interest (Eaves & Kedia, 2024). However, there is little public information on how DPI is funded or on its costs (Eaves & Kedia, 2024). This makes it difficult for society to get involved in the discussion of possible models. Researchers and civil society members at the G20 Summit advocated that the alliance countries invest in experimenting with governance models of DPI they are developing or financing, collecting data that allows for the analysis of their effectiveness and the social benefits they generate (Avila et al., 2024).

Final considerations

As critical infrastructure for public policies, the Internet, and democracy itself, DPI requires governance arrangements to deal with demands, conflicts, and disputes. This article presented the general lines of a model that considers these various components and provides instruments aligned with open government principles, aiming to promote the public interest. This is a starting point that can support the creation of more specific instruments.

The democratic governance of DPI faces persistent and new challenges. These include barriers to digital inclusion, meaningful access, and digital and data literacy. Without equal access, online political participation and the use of digital government services become unfeasible. Digital and data literacy is essential for citizens to interpret government information, participate in public consultations, and make informed decisions.

The democratization of DPI brings new challenges, such as infrastructure literacy (Gray et al., 2018). This means that citizens must be able to use technologies, interpret data, and understand how digital infrastructures work. This is crucial for them to participate meaningfully in the debate.

The incorporation of open government principles strengthens DPI governance arrangements. The transparency of these infrastructures' standards, plans, policies, and financing enables society to be involved in decisions about architectures and services. Adopting integrity practices when hiring suppliers can prevent and mitigate conflicts of interest.

Open software, technologies, and standards allow any actor to inspect, modify, and improve government systems, both for producing public services and for social participation and transparency. Recognizing that technology cannot be decoupled from how it is produced (Vaz, 2017), this proposal considers that the development of DPI can promote collaborative coproduction initiatives involving governments, companies, civil society, and universities.

Adopting democratic governance practices is also a strategy for increasing state capacities in creating, expanding, and using DPI at a time when technologies, demands, and conflicts are becoming more complex and exclusive. Governing DPI in a more transparent and participatory manner is therefore not only a technical necessity, but also a way to strengthen democracy, generate public value, and reduce inequality.

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How to ensure the online safety and digital care of community network users

Bruna Zanolli[1]

The current article presents the profiles of those who connect to the Internet through community networks in Brazil and the specifics of their territories. This allows reflections on how these users are generally more susceptible to a lack of meaningful connectivity and more exposed to vulnerabilities related to information security and digital security.

Looking at their territory configuration, we explored the fact that in Brazil most community networks are considered common goods because of the land they occupy and their traditional origins, following collective governance and ownership. Therefore, that also reinforces their nature as commons. Based on both those facts, we explore the vulnerabilities to which they are subject and their particular strengths to mitigate them.

We close by recommending a holistic perspective on the security needs of community networks. To promote information security and digital care, one must consider the entire territory and cultural activities, understanding their profiles, lifestyles, and potential risks and meeting their specific needs.

Community network user profiles

According to the Community Internet Networks in Brazil survey (Brazilian Internet Steering Committee [CGI.br], 2022), 70% of Brazilian community networks are located in municipalities with a per capita GDP below the national level (of these, a third are among the 25% of the country's poorest municipalities). Additionally, almost half of the

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networks are located in the municipalities with the worst school performance among children and young people in the public school system for basic, primary, and secondary education. Thus, users of community networks tend to live in areas of greater social vulnerability, with a significant presence of poor families and poor economic and school performance (CGI.br, 2022).

Considering the territories where the networks operate, 82.5% are in areas with traditional communities, of which 40% are in *quilombos* or *quilombola* territories, 32.5% in indigenous villages or territories, 22.5% in riverside areas, and 32.5% in other areas with traditional populations such as settlements, extractive communities, and *caiçara* communities. Community networks in Brazil are therefore found in traditionally excluded and historically vulnerable regions and localities. The majority of their managers are self-declared Black and Brown (55%) and 20% are Indigenous (CGI.br, 2022).

Also, in relation to broadband access, the networks are located in areas with low access density: 66% are in municipalities with only up to 10 accesses per 100 inhabitants, and 15% are in municipalities with between 11 and 20 accesses. Although we do not have data comparing the availability of mobile data signals and the number of base transceiver stations (BTS) in the municipalities where the networks are located, it is usual that the only reliable and/or affordable connectivity is that provided by a community network, especially in regions that are geographically more distant or isolated from large urban centers.

In other words, in areas where connectivity is available through community networks, it indicates that their users are part of a population group with greater socioeconomic vulnerability and lower educational attainment, with historically marginalized populations. And just as the people most affected by the lack of connectivity are the most vulnerable, these same profiles are the main targets in terms of lack of online security.

To reinforce this point, the national indicators of meaningful connectivity (CGI.br, 2024), which consider factors such as infrastructure, affordability, devices, skills, protection, and security, show that 78% of Brazilian Internet users do not have meaningful connectivity. The data also confirms socioeconomic profiles of people that show less significant connectivity similar to those found in community networks, where poor people, Black and Brown people, and residents of rural regions have the most precarious access. Part of the framework considered to qualify meaningful connectivity includes technical skills such as installing applications or programs and attaching files to messages, and skills for safe and reliable use of the Internet, including measures for security of use, safeguarding privacy, and verifying the information accessed (CGI.br, 2024). This confirms that, in general, less schooling means less access to information and/or information integrity, less ability to process information, fewer digital skills, and less privacy. Also, economic precariousness means shared and/or older devices, with fewer resources and that are potentially more vulnerable to attacks.

Although users of community networks may have access to basic connectivity, they do not fit into the national profiles of users who access meaningful connectivity, i.e., those with fast and reliable signals, their own suitable devices, secure browsing, and adequate skills (CGI.br, 2024). Poor privacy settings on social media accounts and messaging apps, insecure browsing, and email, viruses, ransomware, and malware make these profiles more susceptible to phishing for personal information and passwords. It also results in

greater exposure to malicious content, financial scams, gambling websites and promises of easy money that lead to debt, spread of misinformation, among other things.

Just like offline, there is an intersection of vulnerabilities when we add other forms of power imbalances to all the problems already faced by women, racialized bodies, people with disabilities, LGBTQIAPN+ communities, and immigrants in online environments. So, once again as a reflection of the profiles most targeted by other forms of violence and insecurity offline, people in community networks are also susceptible to sexism, ableism, xenophobia, misogyny, racism, and the various other forms of prejudice and violence we fight against every day, reinforced by the Internet and intertwined with the profiles described above.

Combined commons

As we have seen, the mapping of community networks in Brazil indicates that they are mostly found in traditional communities—such as *quilombolas*, indigenous, and riverside communities. The 1988 Brazilian Constitution recognizes the rights of traditional peoples and guarantees the demarcation of the territories they occupy. In both indigenous and *quilombolas* cases, the process is collective, starting with a group of residents who benefit from the individual and collective right to use the land and are responsible for its collective management. The land may continue to be owned by the Federal government (in the case of Indigenous lands), or a collective ownership regime may be adopted for associations of residents (in the case of *quilombola* lands). In this way, these territories can be considered common goods, both because of the nature of their ownership and/or usage rights, and because of the collective governance of their resources, which are mostly exploited for family farming and livestock, artisanal fishing, and agroecological extraction.

This notion of commons is also seen in community networks, from their conception to their maintenance, with the involvement of both the community and partner organizations, with financial donations, equipment, and technical support. The participation of community members in decisions is notable in most networks, which reinforces them as a fundamental element for the sustainability of these experiences (CGI.br, 2022). In addition, the non-profit nature and collective management of the networks reinforce their nature as commons.

We can thus see that, in Brazilian community networks, most of which are located in traditional territories and/or are managed by traditional populations, there is an overlap between both these notions of commons, where the collective governance of territories serves as the basis for the collective governance of community networks. In this context, while community networks are common goods managed collectively by the community and its leaders, they also serve the purpose of ensuring that the other common goods of these territories—such as the preservation of the land, local culture, ways of life, and traditional knowledge—benefit from online communications and advocacy, in an active and communal way.

This is because most active community networks have Internet access, and the communities, in the perceptions of their managers, use them for various functions,

such as promoting cultural activities, spreading campaigns, mobilizing members, reading the news, studying, and working (CGI.br, 2022). While ensuring the governance of the commons of their connectivity infrastructure, community networks have the potential to use the Internet and local value-added services to also reinforce the other commons of these territories.

Socio-environmental protection and community networks

It is well known that, in regions where connectivity is lacking, the vast majority also lack other essential rights, such as the right to housing, to work and income, to sanitation, drinking water and electricity, to land, to gender and racial equality, and to leisure and culture. Against this backdrop, community networks are an alternative form of connectivity that can support access to communication and the Internet, and the exercise of social, economic, and political rights. They weave networks that are not only digital but also social (APC, 2021). That is why it is not uncommon for territories that promote community networks to also do so to support local activists and human rights advocates, climate justice and the right to land, and the struggles of Black, Indigenous, and women's movements.

The same Internet that serves as a tool for basic communication, access to education, health, work and income, and socio-environmental protection, may additionally play a central role in enabling processes to denounce human and environmental rights violations. However, it can also be an instrument for exposing and making communities and their advocates vulnerable, spreading disinformation, encouraging cultural alienation through harmful content, manipulating public debate and democracy, and even recruiting and protecting perpetrators of environmental crimes, such as illegal mining and deforestation.

An example of this is the use of Starlink by gold miners and illegal logging in the Amazon region, where seizures of their antennas are a constant occurrence in government operations to repress environmental crimes. In Yanomami Indigenous Land alone, 50 Starlink antennas were seized from March to July 2024.[2] Due to the ease of transportation and the lack of control over who is actually responsible for the equipment, 90% of seized Starlink antennas are registered by straw men, an easy and inexpensive process the government has been trying to address unsuccessfully with Starlink.[3] In regions with connectivity restricted to low-orbit satellites or a single local provider, as is the case of some community networks, the result is a lack of communication alternatives in the event of a connection failure or intentional depredation of the infrastructure. This is in addition to Internet packages being more limited than fixed broadband, and security vulnerabilities being present in their low-orbit satellite connection, for example.[4]

[2] More information available at https://apublica.org/nota/ibama-apreendeu-antenas-starlink-em-3-terras-indigenas-e-garimpos-ilegais-em-4-estados/

[3] More information available at https://apublica.org/2024/07/elon-musk-starlink-resiste-a-mudar-identificacao-de-compradores-de-antenas-na-amazonia/

[4] More information available at https://www.wired.com/story/starlink-internet-dish-hack/

At the same time, this infrastructure is often used, but in a legalized way, by members of community networks in the Brazilian Amazon region and in indigenous and *quilombola* territories to denounce violations of their land and territorial and human rights—risking their lives, as many have already repeatedly received death threats from local militias. In this context, knowledge about cyber security can literally save lives and play a key role in strengthening social and environmental movements and expanding their capacities and reach.

Common ways of reporting these socio-environmental violations are to take photos and videos of crimes in the act with mobile phones, to record audios of clandestine meetings that gather people to commit crimes, and to communicate with journalists and socio-environmental protection organizations through online messaging. All of this, if done without taking the necessary digital precautions and identity protection, can serve as a death sentence for activists when they fall into the hands of local militias. And it is not even necessary for them to physically access devices in order to identify them. Often, the use of social networks and messaging apps without due care and identity protection, making it easier to locate them and leaving their profiles publicly exposed, can already serve as a trigger for identifying and locating them. This is in addition to the aforementioned challenges of old cell phones, which are often outdated and vulnerable, lacking the memory to install new apps, and also to the lack of literacy and training to use anonymity apps and secure media and reporting apps, which are often only available in foreign languages and may be hard to use for some users.

Thus, the difficulties faced by human rights and environmental activists are multiple and complementary. In addition to those mentioned on a personal level, they are reinforced by the lack of efficient public support and structures for reporting and rapid response for threatened people, coupled with the presence of violent local militias that have abundant economic and informational resources. This reinforces the fact that threats that happen online can escalate to physical threats, understanding that it is no longer possible to treat the online environment as being disassociated from its offline consequences, since what happens on the Internet is a reflection of the world outside it.[5]

Precisely because they are people who are already targeted and/or deal with sensitive topics, it is essential that they have at least basic knowledge of how the Internet works and what potential risks and exposure they are subject to online. Particularly important are the use of secure communication apps, awareness of how to use social media and commercial platforms in a way that mitigates their exposure and protects their personal identities, and knowing how to manage safe data storage and sharing.

[5] Action-research developed by a group of people, including the author, that supported the implementation of a women-led community network in the *quilombola* territory of Ribeirão Grande/Terra Seca, part of the Feminist Internet Research Network, has reflected upon digital security and created a digital care zine to distribute to the community. Available at https://firn.genderit.org/sites/default/files/2022-03/zine01.pdf

Conclusion

As we have seen, the mapping of community networks in Brazil indicates that they are mostly found in traditional communities—such as *quilombolas*, indigenous, and riverside communities—with high levels of vulnerability, in terms of both access to broadband and socioeconomic factors, with a lack of access to meaningful connectivity. It is essential to keep in mind that online safety and digital care is a difficult subject for most people, not just those in community networks.

The information presented in this article allows us to understand the profiles of people who use community networks and guardians of their territories. It is clear that it is very necessary for those who develop training resources to consider methodologies that can really get close to people and understand their culture and ways of learning, such as the popular education framework.[6] This is because it is not uncommon to hear reports of activists and community network users who have been through digital security courses but have ended up feeling more confused and insecure and less able to deal with digital exposures and secure their daily tasks. A holistic approach to digital security that involves information security, digital care, and continuous training that is culturally relevant is urgent in this context.

In addition, it has been documented that the factors that guarantee the sustainability of the community networks are: the participation of local actors in decisions about the functioning of the networks; the training and education of people from the community to maintain the activities; the promotion of self-management; and the support of external organizations that promote the agenda to maintain the activities and access resources and information that are not available in the localities (CGI.br, 2022). It is therefore necessary to include digital care as another axis to guarantee not only community network sustainability, but also the online and offline security of their users.

It is also fundamental to understand that connectivity and the Internet are not an end in themselves. In most communities, they are used as tools in socio-environmental struggles and to promote other human and environmental rights. Therefore, there is no point in guaranteeing that only the physical and logical infrastructure of community networks is secure. It is necessary for their users to have the ability to make meaningful and secure use of the networks so they do not become yet another element of vulnerability, adding more fragility to communities that are already historically marginalized.

This does not diminish the need to also make efforts to ensure that all infrastructure, and especially local and sensitive data, is secure in its storage and sharing, especially considering the benefits that local value-added services can bring to communities, such as local mapping through geolocation and the use of sensors to generate socio-environmental data and strengthen local production, access to local platforms with

[6] Popular education is an educational framework in Latin America that values people's prior knowledge and their cultural realities in the construction of new knowledge. Educator Paulo Freire was a great supporter of this approach, which encourages the development of a critical look at education and the participation of the community as a whole, encouraging dialogue and guided by the perspective of realizing all the rights of the people. The teaching-learning process is seen as an act of knowledge and social transformation, recognizing the importance of popular and scientific/technological knowledge.

relevant content on the solidarity and circular economy, health and education, and the production and dissemination of local and culturally meaningful content. This must not only follow best practices in relation to data management but also comply with national data protection laws, since non-compliance can be a weak point in cases of targeted persecution of community networks.

In addition, the combined commons nature of most community networks pointed out above could greatly benefit training in digital care and the adjustments needed to ensure online and offline security. This is because the logic and practices of collectivity, when well worked out, facilitate the local dissemination of information, and collective organization mobilizes the community socially and politically to address the needs raised.

Thus, based on the reality of each territory and community network, and considering all its complexities and historical legacy, it is a matter of working to mitigate the risks of connectivity based on the uses relevant to each community network, using the notion of informed consent, where the choices made about the digital technologies and resources to be used consider both their benefits and their risks. This will ensure that digital security and meaningful access will also include the right to self-determination of networks, considering greater autonomy and co-participation not only in the connectivity infrastructure but also in its uses, enhancing its benefits and mitigating its harmful consequences.

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Information and communication technologies and just climate governance in Brazil: Inspiration from the Amazon

Coalizão Tecnopolíticas Pan-Amazônicas[1]

The 2030 Agenda promoted by the United Nations (UN, 2015) is a structured action plan that seeks to concretely integrate social, economic, and environmental dimensions to promote sustainable development on a global scale. Composed of 17 Sustainable Development Goals (SDG), it establishes specific targets and measurable indicators to guide public policies and global actions until 2030. SDG 13, focused on climate action, is central to addressing the challenges posed by climate change by proposing targeted measures for mitigation, adaptation, and resilience. This goal establishes guidelines for reducing greenhouse gas (GHG) emissions, strengthening adaptive capacity in land-use-intensive sectors such as agriculture and infrastructure, and implementing mechanisms that empower exposed communities to respond and adapt to extreme weather events.

In the North region of Brazil, implementing climate adaptation measures requires an approach that considers the location's specific conditions and socio-environmental challenges, as populations live with direct impacts of climate change and pressures of territorial exploitation. The application of information and communication technologies (ICT) in this context, with functionalities such as environmental monitoring, data management, and expansion of connectivity, offers concrete possibilities to improve early warning systems and prediction of extreme events. These systems can strengthen local capacity to respond to changing climate and ecological conditions, while facilitating coordination among communities, environmental bodies, and regional governance policies.

In the territories of the Amazon biome, the dynamics of social and economic exclusion, accentuated by colonial exploitation, have left deep marks that continue to influence the socio-environmental conditions of the region. Indigenous, riverine, and *quilombola* populations live with the impacts of environmental degradation caused by development

[1] The Coalizão Tecnopolíticas Pan-Amazônicas (Pan-Amazonian Technopolitics Coalition) is a group of activists, researchers, organizations, and social movements gathered in favor of digital rights in the horizon of socio-environmental and climate justice for populations of the Pan-Amazon. Participating in events, producing knowledge inside and outside academia, and focusing on decision-making spaces, the group is guided by an integrated and systemic vision of the territory. The article includes contributions from Bianca Galvão, Jessica Botelho, Hemanuel Veras, Lorena Regattieri, and Thiane Neves.

models that have disregarded their traditional practices of sustainable land management. Although these communities have historically played a key role in preserving forests and biodiversity, their knowledge and ways of life are often marginalized in climate debates. As analyzed by Guerreiro Neto (2023), by favoring external economic interests, environmental colonialism excludes these populations from decision-making processes, resulting in policies that rarely consider their needs and knowledge.

This article investigates how ICT can be reappropriated to strengthen the active and fair participation of Amazonians in climate adaptation and mitigation policies. Based on the historical series of the ICT Households survey, we discuss the idea of meaningful connectivity—which goes beyond the simple presence of infrastructure and encompasses access quality, economic accessibility, and adaptation to regional needs. In a region historically marked by colonialism and environmental racism, digital exclusion intensifies the challenges of climate adaptation and reduces the capacity for action on the territory itself. In alignment with the 2030 Agenda and SDG 13, this analysis argues that when critically and situationally appropriate, ICT can pave the way for climate governance that values the voices and protagonism of the Amazon and the people who inhabit it, enabling the development of solutions and a just transition anchored in local realities.

Twenty years of ICT Households: Historical digital inequality

Research such as the ICT Households survey—which has been produced since 2005 by the Brazilian Internet Steering Committee (CGI.br)—points to regional disparities in Internet access. It mentions inequality in access in the region of the Legal Amazon, formed by the seven states in the North, along with the states of Mato Grosso and Maranhão. In its first edition (CGI.br, 2005), these disparities were already evident: While 31% and 27% of households located in the Federal District and in the metropolitan region of São Paulo, respectively, had computers, this percentage was only 11% and 8% of households in the metropolitan region of Belém and the other northern regions of the country, respectively.

At that time, computers were essential for Internet access, since only 5% of people who had mobile phones used them to access the Internet in 2005. In the 2024 edition (Brazilian Network Information Center [NIC.br], 2024b), the results of the ICT Households survey showed that Brazil was moving towards universal Internet access, with 84% of Brazilian individuals and 81% of the inhabitants of the North connected. However, other studies focusing on Internet access skills and quality have shown hidden or invisible disparities in the overall data. This is the case for research that discusses the concept of meaningful connectivity, which considers indicators grouped into dimensions of economic accessibility, devices, connection quality, and the usage environment.

A study by NIC.br (2024a) investigated digital skills and created a scale ranging from 0 to 9 for meaningful connectivity for the Brazilian population. When measuring the quality of Internet access, the survey found that only 22% of the Brazilian population fell into the group with the most meaningful connectivity, while 33% were in the worst group. In the North, which includes seven of the nine states of the Legal Amazon, 11% of households were in the best connectivity group and 44% were in the worst connectivity

group. Among the nine states of the Legal Amazon, those with the highest percentage of households with better connectivity were Rondônia (18.7%), Tocantins (17.9%), and Acre (13.4%). Among the states with the highest percentage of households with the worst connectivity were Roraima (55.3%), Amazonas (48.5%), and Maranhão (48.3%).

Digital inequality in the region deepens other systemic inequalities, limiting access to essential services such as health and education, in addition to restricting opportunities for work and professional development. Insufficient connectivity conditions hinder the organization and coordination of local communities, weakening the capacity for mobilization and collective strengthening. Access to the Internet is a requirement for the full exercise of citizenship and an essential reporting tool and, as such, is essential in the defense of the territorial rights of the Indigenous and traditional peoples of the Amazon, as well as in the preservation of their ways of life (Baniwa, 2024; Barros, 2024). In this context, the Internet allows these mobilizations to overcome geographical and social barriers, expanding the fight for climate policies that respond to the specific challenges faced in the region.

Another effect of digital inequality is the proliferation of exploitative business practices by companies providing Internet access in the region. Taking advantage of the limited and insufficient supply, these companies charge extortionate prices (Brazilian Institute of Consumer Protection [Idec], 2022), seek to consolidate monopolies over certain types of services (Duchiade, 2024), or simply do not deliver working connections (Veras, 2023). At the same time, the Amazon is facing a record drought (Nascimento, 2024), accompanied by an increase in fire outbreaks, whose smoke has raised air pollution to worrying levels in capitals such as Manaus (Sassine, 2024), Rio Branco (Redação Varadouro, 2024) and Porto Velho (Sinimbú, 2024).

The precariousness of Internet access poses a significant challenge for individuals and organizations seeking to organize politically and demand responses to the climate crisis. This limitation compromises not only the mobilization of local communities but also the ability to accurately identify and record the territories and populations affected, as well as the collection and dissemination of critical data, whether cartographic information, atmospheric measurements, or remote sensing data on fires, droughts, and other phenomena that threaten the region.

Environmental racism and ICT: A Sankofa methodology of reparation

Environmental racism predates the contemporary wave of concerns about the climate emergency. It is a reality that crosses territories due to negligence ranging from social and economic structural precariousness to digital rights. The portal of the New Social Cartography of the Amazon Project (PNCSA) has been keeping track of this debate since approximately 2013. At that time, in meetings with *quilombola* communities in Amapá, it sought to draft a dossier on how political decisions endanger the social and cultural existence of traditional peoples and communities that are the target of contamination and deterioration, such as the impact of waste treatment plants (PNCSA, 2013).

Mariana Belmont stated that "environmental racism arrived with the caravel ships" (2023, p. 17), highlighting the historical links between colonization, racism, and unequal distribution of the climate crisis. Andressa Dutra deepened this understanding by defining environmental racism as the "absence of practical environmental public policies or directives that differently affect or intentionally or unintentionally harm individuals or communities of color or race" (2023, p. 93). Izabela Penha de Oliveira Santos also contributed to the discussion by recalling the writer Maria Carolina de Jesus, who already denounced these injustices in her work. Santos emphasized that, since the 2001 Durban Conference, the Brazilian Black movement has highlighted the urgency of effective strategies to combat racial discrimination and racism at the intersections of health and the environment (Santos, 2023).

These authors have also addressed the debate on technology transfer between countries, emphasizing the importance of making content available in accessible formats adapted to different local realities. Santos (2023) emphasized that digital communication needs to access hard-to-reach regions, enabling people to record their stories and promote the exchange of solutions to the challenges faced. Aligned with this vision, we defend the need for digital infrastructure that considers the specificities of these territories and respects the times and ways of technological appropriation of the populations that live there (Barros, 2024). However, the demand for the use of ICT to mitigate the impacts of climate emergencies is not new: At the 2016 Global Forum, the UN had already discussed this possibility.

We understand that political decisions are conscious choices to implement already existing rights: to land and decent housing, education, health, communication, and water and food security. However, the development model we follow allows these rights to be fully guaranteed to some but not many others. Therefore, we emphasize the importance of thinking about climate justice in dialogue with digital rights. When we insist that it is necessary to retrace some paths in these understandings of justice and reparation regarding territorial populations, it is really about remaking the world system in an integrated and systemic way, as directed by philosopher Olúfẹmi Táíwò (2022). We propose rethinking the notion of the future according to Sankofa's methodology,[2] going back to recover what has been forgotten, relearning, rebuilding, and, most importantly, recreating together. Furthermore, we must recognize that, beyond governance, people and their lands are inseparable beings.

[2] As explained by Elisa Nascimento (2008), Sankofa belongs to a set of graphic symbols of Akan origin called *adinkra*. Adinkras express complex philosophical concepts and sayings of the Ashante peoples. The Sankofa adinkra means "to go back and seek again what is left behind", that is, to go back to the past and learn with it to build the future on its foundations. For Irislane Moraes (2021) this "going back" is intentional and materialized through memories and information of those who are and were before us in the struggle for the land and for the right to life and the sovereignty of their territories.

Pressures on territories and GHG emissions

The increase in deforestation in Brazil reveals the need to integrate ICT into environmental governance, especially in the Amazon, to improve monitoring and protection of territories. By facilitating detailed tracking of activities such as deforestation and GHG emissions, ICT provides an infrastructure for informed analysis and response. In the Amazon, the Real-Time Deforestation Detection System (Deter) of the National Institute for Space Research (Inpe) uses high-resolution satellite images to detect changes in forest cover and provide up-to-date data on the progress of degradation.

In addition to monitoring deforestation, ICT is also applied in tracking fires through remote sensing, which allows the rapid identification of heat sources in areas of forests and agriculture. Geospatial models integrate soil moisture and temperature data to predict burn intensity and seasonality. In initiatives such as the Laboratory of Geoprocessing Applied to the Environment (LabGAMA) (Anderson et al., 2020) from the Federal University of Acre (UFAC), geoprocessing techniques and sensors are used to map environmental impacts in regions under strong pressure of degradation and air pollution. Tools such as remote sensing and geoprocessing create an information base that directs control and surveillance actions, adapting them to the characteristics of Amazonian territories, optimizing the use of resources, and enabling environmental management that responds directly to local pressures and transformations.

The protection of Indigenous territories gains strength with the integration of digital technologies and traditional knowledge, exemplified by initiatives such as the Hãmugãy platform and Indigenous Territorial Monitoring Management (Gemti), developed by the National Confederation of Family Farmers and Rural Family Entrepreneurs (Conafer). The Hãmugãy platform[3] empowers Indigenous populations, riverine peoples, and small farmers to monitor their territories, recording environmental occurrences with photos and GPS coordinates. This data is sent to Conafer's monitoring center and displayed on an interactive map, facilitating quick and informed responses to environmental threats. Gemti, directed by the Coordination of Indigenous Organizations of the Brazilian Amazon (Coiab),[4] seeks to ensure the information security and autonomy of Indigenous peoples in managing their territories. Structured around four axes—security and access to information; rights and territorial protection; emergency support; and climate justice—, Gemti organizes a monitoring network with Indigenous representatives in the nine states of the Legal Amazon. These focal points, qualified to operate geoprocessing and data collection technologies, monitor invasions and threats, consolidate territorial information, and produce reports and maps to subsidize public policies and the defense of Indigenous rights in national and international forums.

[3] To learn more about the platform, visit https://conafer.org.br/agora-e-hamugay-aplicativo-lancado-pela-conafer-vai-revolucionar-protecao-dos-territorios-originarios/

[4] More information available at https://coiab.org.br/gerencias/monitoramento/

Digital governance and climate justice: The local protagonism of the various Amazons

Milton Santos, in his well-known phrase, "Space is the unequal accumulation of times" (1986, p. 209), invites us to read territories as plots crossed by textures, multiple temporalities, and historical layers that manifest themselves in the present. In the Amazon, this idea gains strength by revealing a space where ancestral practices, traditional knowledge, and ICT coexist, establishing a territory in which rhythms and relationships are not integrated linearly or homogeneously. As discussed above, this view allows us to think of the Amazon not as a homogeneous block, but as multiple "Amazons," where each is built based on times and experiences.

The notion of the future that permeates many of the external environmental interventions often disregards the Sankofa methodology that we propose here: that of looking back, recovering what has been forgotten, relearning, rebuilding, and valuing the process of collective re-creation. Santos' approach allows us to see that the Amazon is not a "landscape" ready to be protected from the outside, but a lived space, constantly re-created by its inhabitants. As observed by Barros (2024), when attributing to the Amazon the role of "saving the world," the protagonism and experiences of the people who live there are ignored, yet these are the people who not only live with the territory but who also make it their own space of existence and re-creation. This exogenous perspective projects a time of conservation that imposes itself on local times, interfering with the practices and ways of life that sustain the Amazon territory.

The Amazon's traditional communities—Indigenous, *quilombola*, riverine, and others—are among those most impacted by the climate crisis. In addition, they face an informational void arising, not only from the challenges of meaningful connectivity, but also from the "absence of public policies and infrastructure that really meet the informational needs of the Amazonian people" (Botelho, 2024, para. 9). When questioning who has access to information during the climate collapse, Jessica Botelho, coordinator of the Popular Center for Communication and Audiovisual (CPA), reveals that the predominant narratives about the crisis do not much reflect the Amazonian reality, since "they are centered on communication groups that are spatially distant and ideologically dissonant, even when it comes to Amazonian media" (Botelho, 2024, para. 9).

The primer *Norteando a Governança da Internet no Brasil* (Guiding Internet Governance in Brazil) (Marques & Pereira, 2024) showed a significant gap in Amazon representativeness in the composition of CGI.br: None of the 21 members of the committee represents the northern Amazon. The document questions this absence with the following question: "In a committee composed of 21 members, is there no room for a representative from the North?" At the same time, the primer maps out more than 12 organizations and 57 individuals who already work with Internet governance in the various Brazilian Amazons. This study shows the presence of an active network of engaged local actors who remain invisible in formal decision-making bodies. It emphasizes the urgency of including these voices in digital governance, recognizing the contribution of these regional initiatives to an Internet that meets Amazonian demands and specificities.

Reflecting on the concept of meaningful connectivity, the *Carta de Recomendações para Políticas Digitais na Amazônia* (Charter of Recommendations for Digital Policies in the Amazon) (Gomes & Botelho, 2023) argued that, in addition to filling the infrastructure deficit, it is necessary to ensure that the quality and use of the Internet meet local realities and needs. The letter relates this need to the climate crisis and environmental racism, highlighting that the digital exclusion in the Amazon intensifies socio-environmental inequalities, limiting the ability of communities to act and participate in climate mitigation and adaptation policies. Instead of just providing access, the letter advocates the creation of infrastructure that promotes the autonomy of local populations to mobilize their territories, integrating digital networks into the struggle for socio-environmental justice.

Talking about a digital policy in the Amazon necessarily means talking about and living the space for the local protagonism of the Amazonian people, given that the absence of participation and local representation are means of perpetuating the exclusion of the various Amazons in discussions about climate justice. This issue has been brought up by the *Carta de Recomendações para Políticas Digitais na Amazônia,* by the primer *Norteando a Governança da Internet no Brasil,* and in the debates carried out by the organizations that make up the Coalizão Tecnopolíticas Pan-Amazônicas. We advocate that, in these contexts, policies be designed by listening to communities, for it is not enough to bring technology to the Amazon: To achieve Internet governance by and for the Amazon, it is necessary to think about the socio-environmental and communicational impacts that such technologies will have on the territory.

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List of Abbreviations

A4AI – Alliance for Affordable Internet

Abep – Brazilian Association of Research Companies

Abranet – Brazilian Internet Association

AI – Artificial Intelligence

Anatel – National Telecommunication Agency

APC – Association for the Progress of Communications

CAPI – computer–assisted personal interviewing

Cetic.br – Regional Center for Studies on the Development of the Information Society

CGI.br – Brazilian Internet Steering Committee

CNIS – National Register of Social Information

Coiab – Coordination of Indigenous Organizations of the Brazilian Amazon

Conafer – National Confederation of Family Farmers and Rural Family Entrepreneurs

CPA – Popular Center for Communication and Audiovisual

Deter – Real-Time Deforestation Detection System

DPGA – Digital Public Goods Alliance

DPI – Digital Public Infrastructure

FGV – Getulio Vargas Foundation

GDC – Global Digital Compact

Gemti – Indigenous Territorial Monitoring Management

GHG – greenhouse gas

GNI – gross national income

IBGE – Brazilian Institute of Geography and Statistics

ICT – information and communication technologies

Idec – Brazilian Institute of Consumer Protection

INDA – National Open Data Infrastructure

INDE – National Spatial Data Infrastructure

Inpe – National Institute for Space Research

IoT – Internet of Things

IPU – iterative proportional updating

ITU – International Telecommunication Union

LabGAMA – Laboratory of Geoprocessing Applied to the Environment

LLM – large language models

MC – meaningful connectivity

MW – minimum wage

NIC.br – Brazilian Network Information Center

OECD – Organisation for Economic Co-operation and Development

PNCSA – New Social Cartography of the Amazon Project

pp – percentage points

PSU – primary sampling units

SDG – Sustainable Development Goals

UN – United Nations

UNESCO – United Nations Educational, Scientific and Cultural Organization

UNICEF – United Nations Children's Fund

UNPD – United Nations Development Programme

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