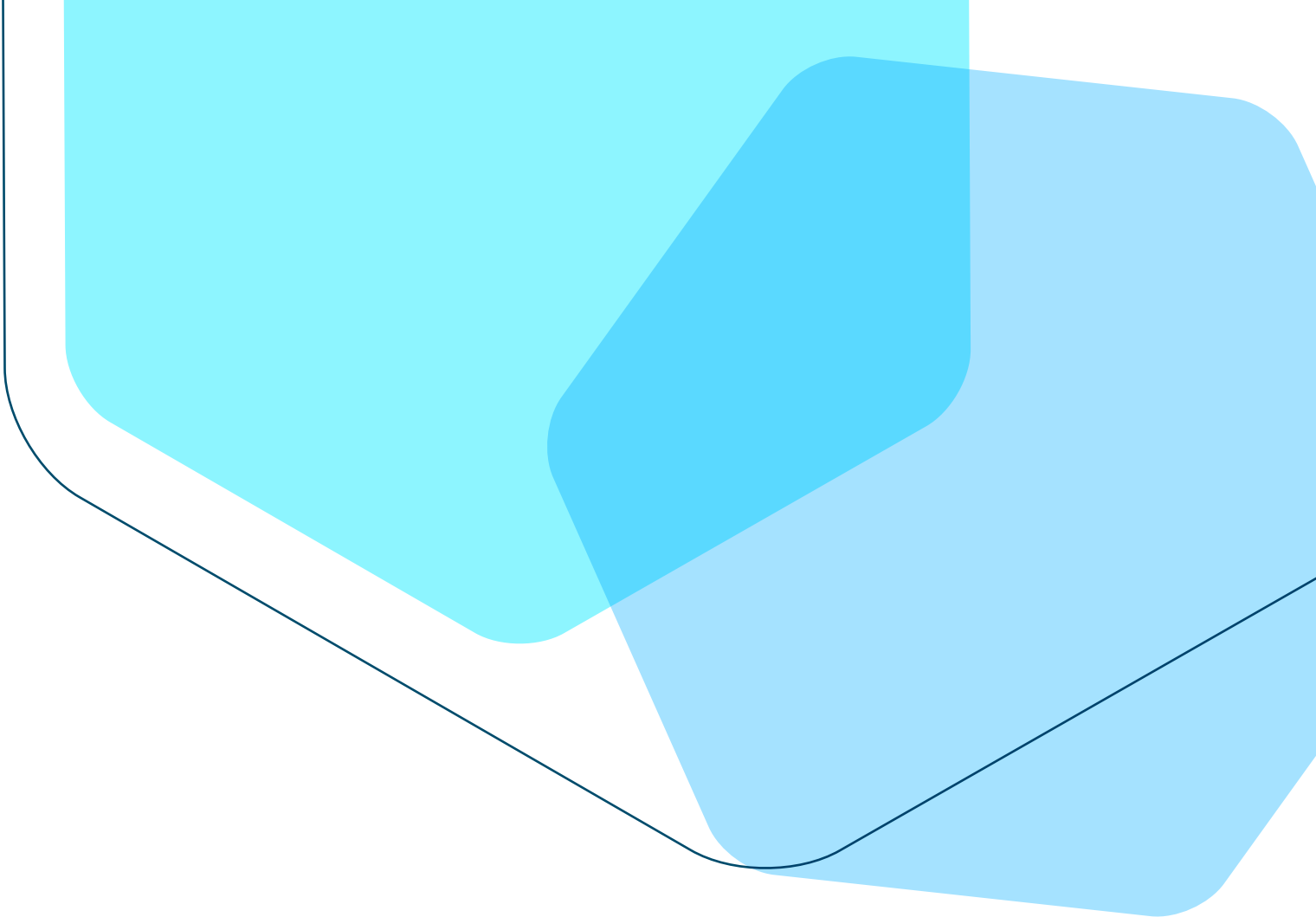




CONNECTIVITY planning

Seven steps to ensure good Wi-Fi
connection for public schools

Marcelo Pérez Alfaro • Thomaz Galvão
Ana Luiza Prado de Almeida • Lilian Raquel da Silva Costa



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Inter-American Development Bank



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Executive summary

This document was developed to help public managers from Latin America and the Caribbean by offering a clear, practical, and well-founded roadmap for planning the implementation of connectivity services in public education networks and schools.

Together with access to digital devices, educational resources and platforms, digital and pedagogical competencies of teachers, and robust governance, meaningful school connectivity is one of the five critical pillars for ensuring that investments in technology effectively contribute to improving teaching and learning processes, expand school access and retention, and increase the efficiency of educational management.¹ Successful implementation depends on networks' capacity to ensure that connectivity (1) is brought into schools; and (2) is distributed across their internal spaces, in such a way that they will effectively serve the established pedagogical purposes.

The seven steps for planning this process, suggested by this document, are based on assessments of connectivity implementation in countries of the region, as well as on lessons learned through the work of MegaEdu – a not-for-profit organization that strives to take Internet connectivity to public schools in Brazil. Table 1 below summarizes the key aspects related to each of these steps.

In turn, the process of procuring connectivity – which is also essential for taking Internet to school settings – is addressed by the document **“Procuring connectivity for public schools: pathways and lessons learned in Latin America and the Caribbean,”** which serves as a complement to the present note. Based on the lessons learned through experiences in Brazil, Chile, Colombia, Costa Rica, Peru, Suriname, and Uruguay, the complementary report also describes key steps and optimal parameters to be followed, so that procurement processes – which involve assessing the available and most adequate contracting models, as well as the design and execution of the contracting process – may enable the effective adoption of broadband connectivity as a sustainable policy.

1. Arias Ortiz et al. (2025).

These two documents serve the aims of providing detailed technical guidance on relevant processes, sharing recommendations and describing essential practices to help other Latin American and Caribbean countries overcome similar challenges, while building valuable institutional capacity for the region's educational systems and making headway towards effective, sustainable, and equitable school connectivity policies in line with the countries' pedagogical priorities.

Table 1. Seven steps to ensure robust Wi-Fi connection at schools

Planning Steps		Actions
	Diagnosing the current situation	Conducting a context diagnosis of the local connectivity reality, including the network's geospatial analysis.
	Defining parameters based on a vision of success	Establishing technical prerequisites, quality indicators, and connectivity parameters to be followed for contracting and implementing Internet connectivity, based on a clear pedagogical objective.
	Selecting connectivity technology	Understanding different technology options (wired and wireless connectivity) and defining the most appropriate one for specific territorial profiles.
	Understanding the internal network infrastructure	Being able to measure the Wi-Fi network's intensity and distribution at school; defining criteria and deadlines for maintenance services; and selecting a digital security solution.
	Conducting market research	Comparing alternatives and ensuring the technical feasibility, cost-effectiveness, and sustainability of selected solutions.
	Mapping the available resources and estimating costs	Identifying the existing funding sources and the Wi-Fi solution's financial feasibility; and estimating the necessary investments based on fixed and variable cost calculations.
	Monitoring and making continuous adjustments	Implementing a follow-up system that takes into consideration technical, pedagogical, and management data.

Source: Prepared by the authors, based on Giga & BCG (2021).

A photograph of a student with long, curly brown hair, seen from the side, sitting at a desk and working on a laptop. The student is wearing a light blue t-shirt. The desk is cluttered with various items, including a red bag and some papers. In the background, other students are visible, though out of focus. A large, semi-transparent blue hexagonal overlay is positioned in the center of the image, containing the word "Introduction" in white, bold, sans-serif font.

Introduction

The implementation of connectivity for education is a global priority, since it is the very basis for the process of digital transformation in countries.

As UNESCO has pointed out, “the right to education is increasingly synonymous with the right to meaningful connectivity, yet access is unequal.”² In a context in which digital inequality continues to be a significant challenge, the adoption of national policies to ensure Internet access at all public schools is also a crucial step for promoting educational equity.

Together with access to digital devices, resources and educational platforms, digital and pedagogical competencies of teachers, and robust governance, meaningful connectivity at schools is one of the five essential pillars to guarantee that investments in technology effectively contribute to improving educational processes, as well as to expanding school access and permanence and increasing the efficiency of educational management.³

Therefore, connectivity is not limited to technical availability of the Internet. It must be aligned with the intended pedagogical uses to ensure that digital technologies – including adaptive learning tools, AI-based tutors, and school management platforms – are effectively integrated into the school routine. In addition to strengthening administrative processes, quality Internet connectivity enables innovative educational methodologies, fosters collaborative learning, and facilitates the use of digital educational resources, thereby enhancing educational outcomes and contributing to the attainment of national objectives and goals.

Two essential components are necessary for enabling meaningful educational connectivity: adequate **connection speed** and robust **Wi-Fi infrastructure**. Adequate speed allows teachers and students to efficiently access pedagogical content, digital tools, and other online resources, whereas a well-distributed Wi-Fi network ensures that the Internet signal is available in all pedagogical spaces of schools, so that its pedagogical use is not restricted to a single space such as a computer lab.

To ensure both components for schools, a connectivity policy needs to be planned in an attentive and comprehensive way. In the present document, this process comprises seven steps that range from mapping the current network’s financial, technological, and social aspects, through the definition of parameters, market research, and estimates of costs and resources, up to continuous monitoring activities and adjustments. At each of these stages, specific recommendations, evidence, and tools are presented to help educational managers conduct their planning of connectivity deployment with more evidence and focus.

The process of putting such a plan into practice through a procurement process is the subject of the document “Procuring connectivity for public schools: pathways and lessons learned in Latin America and the Caribbean,” which provides details on different forms of procuring connectivity, including the relevance of defining the persons responsible for procurement processes and of deciding about the contracting model with service providers. **It is a document that complements the present one and closes the connectivity policy’s implementation cycle, including narratives about experiences of seven Latin American and Caribbean countries in this trajectory: Brazil, Chile, Colombia, Costa Rica, Peru, Suriname, and Uruguay.**

2. UNESCO (2023).

3. Arias Ortiz et al. (2025).



Methodology

This guide's development is based on the study conducted by MegaEdu with the support of the Inter-American Development Bank (IDB), which investigated reference practices in the implementation of effective Wi-Fi solutions in Brazilian public schools. The study included interviews with more than 50 field experts, public managers, and service providers, and reviewed over 100 public procurement contracts to systematize the current best practices.⁴

Additional experiences from the United States, Estonia, the European Union, Spain, Ireland, Uruguay, Peru, Suriname, Costa Rica, Chile, and Colombia are covered by the document.

⁴. The knowledge acquired in this study was essential to support the definition of national parameters under the National Connected Schools Strategy (ENEC), an initiative of Brazil's federal government to coordinate diverse policies and resources linked to the connectivity agenda. The parameters were formalized in July 2024, when the government published Resolution CE-ENEC-nº3. See: Brasil, Ministério da Educação (n.d.-a); Diário Oficial da União (2024b).

Step 1

Diagnosing the current situation

Taking connectivity to schools is a complex effort that encompasses much more than installing cables: it is also necessary to map each school's situation and analyze costs, as well as to know the available technological options in the region, and to structure sustainable implementation strategies.

Despite being an indispensable task, such a diagnosis is a challenging stage for several reasons. First, because the official information on connectivity – comprising data on whether there is an Internet connection, the types of technology used (fiber-optic, radio, satellite, mobile), the contracted speed and the actual service status – is largely based on self-reported data shared by school principals via institutional censuses, administrative forms or periodic surveys. And many of these professionals are not yet familiar with the topic, which is quite technical. Despite its usefulness, this data often ends up being incomplete, subjective, or non-verifiable, thus producing inconsistencies.

Furthermore, it is still common for data on school connectivity – about providers, current contracts, locations, speed, infrastructure and costs – to be dispersed across different agencies and offices (from fields such as telecommunications, education, public companies, subnational governments, regulatory bodies, and so on). A lack of transparent institutional coordination does not necessarily mean that the data itself is lacking; instead, it may mean that the data is disaggregated, inconsistent, or not interoperable.

Additional recurring issues involve difficulties in identifying the precise locations of schools and understanding the territories and contexts related to these schools as a structural part of this mapping effort.

Finally, most national assessments only verify whether a contracted service exists or not and fail to assess the necessary internal infrastructure for providing connectivity with educational aims. This includes aspects such as equipment, power supply, maintenance, and the provision of technical support. Thus, in practice, several schools continue to be “disconnected” either due to the lack of operative internal infrastructure or of local capacities.⁵

To address these issues, it is important to collect basic and relevant data, and to conduct a geospatial analysis that accurately captures the technological, geographic, financial and social reality of each school's environment.

5. This is what happens in countries such as Suriname, Colombia, and Chile, as described in detail in “Procuring connectivity for public schools: pathways and lessons learned in Latin America and the Caribbean” by Méndez et al. (2026).

1.1 Initial survey

Statistical studies with this approach may help inform the initial discussions on the theme. However, such an analysis should ideally be conducted with census data, since having this information on a school-by-school basis supports the planning and implementation of public policies. **Therefore, this initial survey must look for answers to simple but essential questions such as:**

- > How many schools are there in the public education network, and where are they located?
- > Of these schools, how many already have active contracts for Internet connectivity?
- > What is the quality of contracted services?
- > What is the average cost of the services?
- > What is the location of connectivity networks in relation to school locations?

The capacity to structure this data is critical for calculating costs, estimating demands, planning investments, and identifying the magnitude of the challenge.



IN PRACTICE: To verify whether schools have an adequate Wi-Fi solution, the study conducted in Brazil by MegaEdu with IDB support analyzed official documents related to the procurement and contracting of Wi-Fi solutions for schools (by governmental bodies) and used public data.

The Brazilian School Census⁶ – the main survey on schools nationwide – is the source of data such as Internet access and the number of pedagogical spaces at schools. In its turn, the Edutec Guide,⁷ whose coverage is also nationwide, consolidated both relevant quantitative data (e.g. the number of installed access points) and qualitative data (whether the school has Wi-Fi connectivity, whether all classrooms have Internet access, whether all students of a classroom can connect simultaneously, and so on).

Based on the cross-referencing between these sources, it was determined that, to be considered as having an “adequate Wi-Fi solution” in place, schools need to meet two criteria:⁸

- > **A qualitative criterion:** Internet access in all classrooms, and at least one entire classroom can connect and navigate simultaneously; and
- > **A quantitative criterion:** the stated number of access points (APs) meets the ratio of at least one AP for every two classrooms.

Recommendations:

- > *It is essential to have well-structured and comprehensive databases for conducting diagnostic analysis and cost estimates.*
- > *Data collection must either work with questions that are free from technical jargon or provide the necessary context to ensure that respondents of all knowledge levels will answer them accurately.*

6. INEP (n.d.).

7. CIEB (2022).

8. To evaluate the inference's accuracy, contact was made with some schools that attained the “adequate Wi-Fi solution” level, and an accuracy rate of 79% was found. New analyses and inferences were conducted after the study's conclusion, and, currently, the most widely used inference methodology even separates the qualitative and quantitative criteria. In other words, for a school to be considered as having an adequate Wi-Fi solution, it is no longer necessary to meet both criteria, but only one of them.

1.2 Geospatial analysis

International experiences have shown that effective educational connectivity policies incorporate territorial equity criteria. In Mexico, for instance, the explicit establishment of minimum assistance quotas for rural and Indigenous zones made it possible to expand the policy's scope beyond the high-yielding urban areas. In Brazil, in turn, initiatives such as the program *Norte Conectado*⁹ were developed to address the specific challenges of the Amazon, where low demographic density and geographic aspects impose high infrastructure costs.

Thus, it is essential to identify the precise location of schools, since it enables distinguishing between two types of challenges. The first challenge concerns schools located in remote or isolated areas, which often require alternative and costlier technologies such as satellite or radio connection. The second challenge, in turn, concerns the schools located in urban or easily accessible areas, where fiber-optic infrastructure is already available. In this case, the main issue is the education networks' financial capacity to contract and maintain adequate service plans.

To overcome these challenges, it is necessary not only to know the current infrastructure and available technological options in the territory, but also their location in relation to the backbone network, their deployment costs considering local topography, hydrography, and accessibility features, as well as the characteristics of the population and number of enrolled students. Without this geospatial diagnosis, the risk of making flawed decisions, prioritizing less critical areas, generating inefficiencies, deepening inequalities, and increasing costs is much higher.



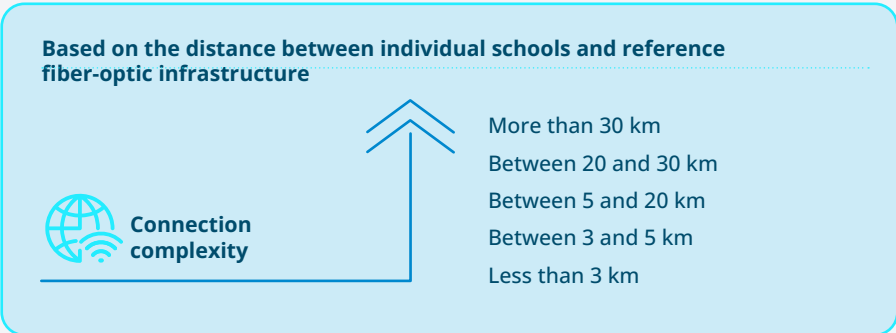
IN PRACTICE: The Inter-American Development Bank (IDB)'s Connectivity, Markets, and Finance Division (IFD/CMF) and Education Division (SCL/EDU), with the technical support of Deloitte, have developed a geospatial analysis methodology for assessing gaps and planning the deployment of digital connectivity infrastructure at schools.

The tool aggregates geospatial layers of information on schools, populations, fiber-optic networks, telecommunication infrastructure, hydrography, topography, and civil infrastructure. Educational data on topics such as student enrollment, school level or cycle, and administrative region are linked to each school building. When available, the attributes of the existing connectivity infrastructure in each school are also incorporated. If such data is not available at the school level, the model conducts estimates based on the available connectivity in the area and other context-related variables. Once these layers of educational and telecommunication data are integrated, a set of variables is structured to support decision making based on complementary perspectives.

A fundamental analysis dimension is the distance between each school and the backbone fiber-optic infrastructure, which enables categorizing schools into different ranges that correspond to different technical feasibility and economic effort levels. Therefore, the total number of disconnected schools nationwide is distributed across five groups, as described by the table below.

9. Brasil, Ministério das Comunicações (n.d.).

Table 2. Technical feasibility and economic effort levels to guarantee connectivity



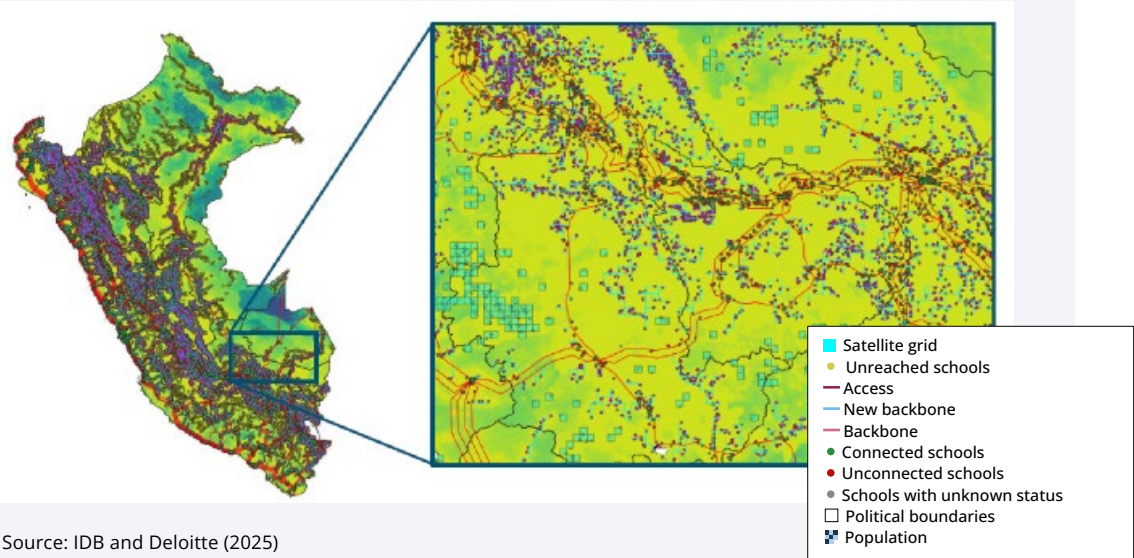
Source: IDB and Deloitte (2025).

Schools located less than 5 kilometers away from the backbone network are easier to connect, as providers only need to extend a fiber-optic node to the school. As schools move into the other ranges, connectivity becomes more complex and requires either the deployment of new fiber-optic transport and access infrastructure or alternative solutions such as radio or low-Earth-orbit satellite links.

Based on the intersection of multiple variables, an estimated annual investment is calculated for each group of schools. And investment estimates may be disaggregated by administrative level.

The model also enables estimating costs associated with each technological solution, by incorporating variables such as distance from the closest backbone network, population density, current infrastructure, topographical conditions, and natural obstacles such as rivers, forests, or mountainous areas. This makes it possible to calculate both the initial investment (CAPEX) and the recurring operation and maintenance costs (OPEX), generating comparable scenarios across different technologies and contexts.

Figure 1. Intersection of geospatial variables used in the cost estimation model



Source: IDB and Deloitte (2025)

This categorization enables identifying an optimal connectivity deployment sequence by prioritizing school groups according to criteria of efficiency, territorial equity, and educational impact. Following this prioritization logic, the tool enables projecting the potential reach of each scenario, estimating the number of schools and students that will benefit from it, and calculating the estimated resulting infrastructure area and territorial coverage.

Such a context-aware diagnosis enables public managers to understand the nature of different challenges, estimate the true scale of demand, and define the most suitable intervention strategies. On this basis, it is possible to move into subsequent stages such as sizing technical needs and analyzing different provision models.

WHY DOES IT WORK?

- > It provides symmetric, clear and relevant data to the education and telecommunication sectors as valuable inputs for their fields of activity;*
- > It enriches technical dialogues by sharing cost and impact estimates linked to different options to be considered in executive decision-making processes;*
- > It facilitates more efficient coordination with private and subnational stakeholders by enabling a clearer understanding of technical and budgetary implications associated with different school groups;*
- > It explicitly integrates an equity perspective by accurately identifying the schools and communities that face the greatest barriers to access.*

Step 2

Defining parameters based on a vision of success

After conducting the diagnosis, the next step is to define the strategic direction and a vision of success for connectivity in educational institutions. The aim, at this point, is to establish clear, measurable, and policy-aligned goals to prevent Internet contracting from being restricted only to technical parameters such as speed and bandwidth, or the market's available options.

More than merely a contracted service, connectivity must be understood as a pedagogical instrument whose planning is based on the effective needs of the educational process. For this reason, it is essential to align goals with an educational vision defined by the government, which gives answers to essential questions: who will be using it, how it will be used, and in which pedagogical contexts.

Therefore, the vision of success for Wi-Fi network solutions implemented in schools is a vision in which entire classrooms can connect simultaneously to the Wi-Fi network and maintain safe and uninterrupted access to pedagogical content and educational platforms in any pedagogical space of the school, thereby enabling the use of the contracted Internet link's full potential.

To attain such a level, it is necessary to establish quality indicators and define connectivity parameters for the use of this technology in classrooms.

2.1 Quality indicators

For the most part, Internet contracts in Latin America have only considered download rates. But there are other metrics that help measure the stability of connectivity, which affect its pedagogical use, according to the adopted technology. The table below shows how these metrics are used, in practice, depending on the activities conducted at schools.

Table 3. Connectivity quality metrics and pedagogical uses

Connectivity metrics		
Metrics	What it measures	Examples of use
TCP Download	Download speed	Watching educational videos and downloading files
TCP Upload	Upload speed	Sharing works through platforms, participating in video conferences
Latency	‘Round-trip’ time (response time between upload and download)	Running educational games, making video calls
Jitter	Latency fluctuation	Conducting synchronous lessons and video conferences
Packet loss	Percentage of data that fails to reach its destination	Affects streaming, broadcasts and overall stability

Source: GICE (2022).

Thus, watching video recordings requires a high download rate, while real-time video calls require low latency and jitter. Online games in multiplayer mode are even more latency-sensitive, while video streaming activities represent one of the biggest school infrastructure challenges. Each technology has a performance ceiling, and the selection of tools needs to take these factors into consideration.

The table below presents a categorization of reference Internet activities in educational contexts and quality indicators so that these activities may be adequately pursued. It proposes a more systemic vision of network performance by describing how different types of activities require distinct speed and stability levels.

Table 4. Internet uses in school settings and quality indicators

Types of activities	Examples	Quality indicators			Technical requirements for proper functioning
		TCP Download (minimum speed) ¹⁰	Latency (maximum delay in milliseconds) ¹¹	Packet loss ¹²	
Audio	Podcasts, streaming platforms, voice over IP (VoIP)	0.27 Mbps	128 ms	Up to 2%	– Low bandwidth; – Stable connection, without perceptible interruptions or delays
General use	Website navigation, sending and receiving e-mail messages, access to social media and messaging.	1 Mbps	300 ms	Up to 2%	– Modest requirements, except in case of simultaneous use by many users (when the school network may experience an overload)
File downloads	Educational materials in PDF format or recorded videos	5 Mbps	80 ms	Up to 2%	– Larger data transfer capacity, especially for large files
Educational games	Online games played either individually or in multiplayer mode	3.75 Mbps	90 ms	Up to 1%	– Low latency and continuous stability (small response delays may compromise the experience)
Streaming	Video calls and transmissions in HD or 4K resolution	3.44 – 8.25 Mbps	60 ms	Up to 0.5%	– Good speed, latency and jitter so that videos may be smoothly integrated – Bandwidth consumption increases exponentially as image quality increases.

Source: GICE (2022).

2.2 Connectivity parameters

After considering the necessary technical requirements and quality indicators for each school activity, it is time to establish clear connectivity parameters so that Internet contracting and deployment in schools may effectively meet the pedagogical demands. The absence of an established set of criteria implies the risk that the contracted infrastructure and connectivity may be insufficient, unstable, or incompatible with the simultaneous usage of digital resources by students and educators.

¹⁰. FCC (2019), Liu et al. (2017), OECD (2014), Stocker and Whalley (2016); Dilley (2017), Warner (2018), Gonzalez (2020), George (2019), and Slattery (2014), cited by Bettega, Marin and Kuester Neto (2020, p. 151).

¹¹. Anders (2019); Liu et al. (2017); Microsoft (2020); George (2019); OECD (2014); Slattery (2014); and Gridelli (2019), cited by Bettega, Marin and Kuester Neto (2020, p.151).

¹². John and Oyekeanu (2010); Betts (2019); Metzler and Metzler (2015); OECD (2014); and Gridelli (2019), cited by Bettega, Marin and Kuester Neto (2020, p.151).

In recent years, several countries have established minimum technical standards to guarantee meaningful educational connectivity:

- > **USA:** the organization *EducationSuperHighway* recommends that each student should have access to **at least 1 Mbps** to ensure a stable and effective digital learning experience.¹³
- > **Estonia:** a world reference in educational digitalization, the country has ensured, through the *Tiger Leap Program*, **1 Gbps per school** since 2015, providing Wi-Fi coverage to all classrooms.¹⁴
- > **European Union:** the **European Commission** recommends a **speed between 30 Mbps and 100 Mbps per classroom**, based on the maturity level of each school and the types of pedagogical activities.¹⁵
- > **Spain:** program *Escuelas Conectadas* ["Connected Schools"] established **100 Mbps per school**, following the guidelines of the country's "Digital Culture Plan for Schools".¹⁶
- > **Ireland:** the Broadband for Schools Programme connected all high schools with a minimum speed of **100 Mbps**.¹⁷
- > **Brazil:** the **National Connected Schools Strategy (ENEC)**¹⁸ led by the Ministry of Education recommends a minimum speed of **1 Mbps per student** to guarantee the effective use of digital technologies in classrooms.

These examples show that parameters can be set in different ways: by considering a school's overall demand, or average use per student, or even individual classroom needs. In all these cases, connectivity infrastructure is treated as a fundamental prerequisite for educational equity.



IN PRACTICE: In Brazil, the Interinstitutional Group for Connectivity in Education (GICE) developed a formula to help calculate the optimal Internet speed for schools, considering the number of simultaneously connected students and types of pedagogical activities conducted.

Since watching videos is the most demanding activity in terms of network requirements, the GICE formula considers this specific situation as the maximum reference. Therefore, if enough connectivity is in place for video transmissions, it will also be capable of enabling less intensive activities such as online research and the use of educational platforms.

Figure 2: GICE formula for estimating the optimal internet speed

number of students	x	% of students accessing the internet	x	% of students watching online videos	x 3	= Internet speed (Mbps) to be contracted
+ number of students	x	% of students accessing the internet	x	(1 - % of students watching online videos)		
0.8 [Assuming the provider delivers 80% of the bandwidth]						

Source: GICE (2021).

As can be seen, this is a general calculation based on the reflection about how many students will be simultaneously watching videos throughout the school routine. But in real-world conditions, it is often unrealistic to expect that school managers and technicians will be able to carry out this detailed calculation. Further, although schools may adapt this formula by estimating a maximum simultaneous usage level, the effort to apply these results to the whole education network – with its different contexts and types of infrastructure – would be impracticable for policy makers who need to define minimum speeds.

13. EducationSuperHighway (n.d.).

14. Education Estonia (n.d.).

15. European Commission (2019).

16. Red.es (n.d.).

17. HEAnet (n.d.).

18. Diário Oficial da União (2024a).

> For these reasons, and based on the GICE formula, the recommended minimum speed is 1 Mbps per student.

This parameter was designed to enable most school activities – considering simultaneous access and the frequent use of video resources, which require data-intensive technologies – and serve as a practical and objective guide for contracting Internet services, especially when a detailed analysis of all variables covered by the model would not be feasible.

The table below illustrates different possibilities of pedagogical use for the Internet, considering the recommendation of 1 Mbps per student for different types of schools, and describes three practical case scenarios, to offer public and school managers a quick and actionable reference for the planning of Internet speeds.

Table 5. Scenarios of pedagogical use of the Internet

Examples	Use scenarios	Number of students watching videos	Number of students navigating	Total number of online students (considering the activity and total Internet bandwidth provided by the school)
1 School with 500 students and 500 Mbps	Only basic navigation activities such as Internet searches or the use of educational platforms	0	500	500
	Basic navigation and streaming activities simultaneously	83	167	250
	Only video streaming	160	0	160
2 School with 200 students and 500 Mbps	Only basic navigation activities such as Internet searches or the use of educational platforms	0	200	200
	Basic navigation and streaming activities simultaneously	150	50	200
3 School with 500 students and 250 Mbps	Only basic navigation activities such as Internet searches or the use of educational platforms	0	250	250
	Basic navigation and streaming activities simultaneously	20	180	200

Source: Prepared by the authors.

The estimates above may serve both as a reference goal and as a starting point for public managers who intend to set an appropriate bandwidth for each school network context. This approach also helps avoid both underprovision (when large schools have insufficient speed, as described in Example 3) and overprovision (when small schools have overstated speeds, as in Example 2). At the same time, it provides a more realistic assumption for preparing bidding and contracting processes.

However, the reality of many schools – above all, of schools that rely only on satellite connectivity – may render the goal of 1 Mbps per student unattainable. In such situations, on an exceptional basis, lower speeds or customized parameters may be adopted.

The parameter of 1 Mbps per student enables establishing a quality benchmark to be pursued. Such a benchmark will be different for each school, due to the pedagogical context of its connectivity usage. But the important element is that each step must be aligned with the broader objective: namely, to guarantee that the Internet will be able to fulfill its pedagogical function.

Table 6. Connectivity levels and corresponding pedagogical contexts

Connectivity level	Goal of the use of connectivity	Adequate pedagogical context (it works for schools that...)
1	All students in the same school shift may make general use of the Internet at the same time, for instance, accessing e-mail messages, news sites, or performing Google searches.	Make little use of pedagogical games or videos, but intend to introduce students to the digital world.
2	Half of the students in the same school shift will be able to access the Internet at the same time, of whom one in three will be able to perform video activities.	Internet use is more frequent in pedagogical practices, with groups of students watching video resources in a shared format.
3	One quarter (1/4) of the students in the shift will be able to perform video activities on the Internet at the same time.	Students systematically use video activities at a given moment in each classroom.

Source: GICE (2022).

A recurrent pattern observed in contracting processes in Latin America and the Caribbean is that the region has tended to set parameters without aligning them with pedagogical use. For instance, countries such as Suriname and Costa Rica have established blanket speed values for individual schools (e.g. 10 Mbps per school or fixed bands of 15 to 500 Mbps per school), without considering the number of enrolled students or classrooms or their effective digital needs. Such a “symmetrical” approach may suffice for administrative purposes, but it is clearly insufficient for sustaining educational platforms, video conferences, digital libraries or generative AI tools. And when such values are incorporated into bidding processes without customized adjustments, they lead to contracts that are unable to sustain the real-world uses of technology in classrooms.

Step 3

Selecting a connectivity technology

To meet the necessary quality prerequisites, the most important decision to be made regards the type of technology to be selected. Today's market offers several Internet connectivity technology options. Selecting among them directly affects connection quality, implementation and maintenance costs and, consequently, the feasibility of educational connectivity policies.

The available technology options are divided into two main categories: wired and wireless. Each type of connection has its advantages, limitations, and costs, which must be assessed based on objective criteria such as geographic availability, stability, bandwidth, scalability and cost-effectiveness.

3.1 Wired connections

Wired technologies generally offer more stability and speed, and reduced latency. Therefore, they are the most recommended alternative whenever they are available in the region. **The following three wired options stand out within this group:**

- > **Asymmetric Digital Subscriber Line (ADSL):** uses the existing phone lines' infrastructure. ADSL technology, despite being widely used in the past, is considered insufficient for the demands of contemporary digital education, due to its low speed and high instability levels.
- > **Coaxial cable:** operates through cable TV networks and enables higher speeds than ADSL. Yet, coaxial cable technology has certain limitations of bandwidth availability and sharing among users, which may jeopardize performance.
- > **Fiber-optic:** this is the most advanced technology currently available, offering extremely high speeds (that may surpass 1 Gbps), low latency and high reliability. Fiber optic is highly scalable and is considered the priority school connectivity solution, whenever it is available in a region.

3.2

Wireless connections

Wireless technologies are essential for expanding access in regions without wired infrastructure, such as regions with low population density or terrain particularities (e.g. forests, rivers, mountains). But they tend to be marked by increased instability, latency and cost per megabit compared to wired connections. The following solutions stand out in this group:

- > **Mobile (4G/5G):** uses mobile phone networks and may be rapidly implemented through SIM cards, modems, or mobile devices. Despite being a practical option, its high cost per gigabyte, as well as data limits, and signal oscillations restrict its use as a leading connectivity solution for schools.
- > **Radio:** enables signal transmission via antennas, dispensing with the need for physical cables to connect schools. This is an interesting alternative for isolated areas, but it usually suffers from interference events related to climate, relief and physical obstacles (e.g. buildings, trees, and clouds), which may compromise connectivity quality.
- > **Satellite:** uses equipment positioned in the earth's orbit to provide connectivity. The provider sends its Internet signal to a large ground antenna, which transmits it via radio waves to the satellite. Next, the satellite reflects the signal to parabolic antennas positioned at schools, homes, and so on. This alternative must be considered when no other connectivity option is available, since it presents instability and limited download speeds. Satellites can be of two types: Geostationary Earth Orbit (GEO) or Low Earth Orbit (LEO). The table below provides comparative details about these options.

Table 7. Satellite types: Geostationary Earth Orbit and Low Earth Orbit

Features	Geostationary Earth Orbit (GEO)	Low Earth Orbit (LEO)
Altitude	35,786 km above the Earth	500 to 1,200 km (up to 2,000 km)
Latency	High: 500-700 ms (perceptible delays)	Low: 20-50 ms (similar to terrestrial broadband)
Coverage	Quite broad: a satellite may cover an entire continent	Reduced: each satellite covers a reduced area, requiring constellations of thousands of satellites
Most suitable use	In extremely remote areas, where no other option is available, and latency is not a critical factor (for instance, for having basic access to information)	Rural and remote regions that need quality Internet connection for interactive activities such as distance education and telemedicine

Source: Prepared by the authors.

In the context of schools, the general recommendation is to prioritize fiber-optic connectivity, which enables optimal stability and maximum download speed. Whenever this option is available and affordable, it must be adopted. However, in remote areas of Latin America and the Caribbean, where infrastructure is limited, alternatives such as satellite or radio connectivity are still necessary.

To facilitate comparisons among connectivity technologies, the table below summarizes the key data on possible options and describes their recommended uses.

Table 8. Key data on connectivity technologies and recommended uses

Access technology	Average speed (in megabits per second)	Latency (delay in milliseconds)	Advantages	Limitations	Recommended use
ADSL	1–24 Mbps	30–100 ms	– Low cost – Uses existing phone networks – Broad urban availability	– Low speeds – Very limited upload speed – Connection is unstable and obsolete for current digital demands	Generally, not recommended
Coaxial Cable	25–300+ Mbps	10–40 ms	– Faster and more stable than ADSL – Easily implemented in places with cable TV infrastructure	– Limited to areas with cable TV network – Shared bandwidth reduces performance during peak hours	Generally, not recommended.
Radio	1–50 Mbps	20–100+ ms	– Reaches remote areas – Rapid deployment – Does not require cabling	– Possible instabilities due to climate factors or interference – High latency – Variable speed	Recommended for schools in specific cases.
Mobile (4G)	15–50 Mbps	30–60 ms	– Mobility – Wide coverage – Simple installation	– Data caps – High cost per GB – Signal instabilities in remote or congested signal areas	Recommended for schools in specific cases.
Optical fiber	100 Mbps – 10 Gbps	<10–20 ms	– Very high speed – Low latency – Stable connection – Scalable	– High deployment costs – Coverage limited to urban and surrounding areas	Best option
Satellite GEO	10–100 Mbps	500–700 ms	– Global, stable coverage (reaches anywhere) – Few satellites are necessary – Fixed position, which facilitates satellite antenna alignment	– High latency – Not suited for real-time activities (e.g., synchronous lessons) – Lower speed compared to modern broadband – Data caps – High costs – Depends on weather conditions	Recommended in places where no other option is feasible.
Satellite LEO	50–250 Mbps	20–50 ms	– Wide coverage – Lower latency compared to GEO (appropriate for videoconferences, remote teaching and online games) – Higher and more stable speeds – Unlimited data plans	– Requires thousands of satellites – Coverage is still expanding in some regions – High initial costs – High infrastructure and maintenance costs (higher than wired networks)	Recommended for remote areas whenever fiber-optic connection is not available.

Source: Prepared by the authors.

Step 4

Understanding the internal network infrastructure

A complete wired Wi-Fi Internet solution for schools basically consists of:

- > **Reliable power supply;**
- > Core network assets such as security-enabled **firewall** and **distribution switch**;
- > Service layer for **maintenance and solution management**.
- > Wired (cabled) **access points** (APs).

Table 9. Key components of Wi-Fi solutions

Recommended solution					
Stable power supply	Internal network			Services	
	Routing and security	Distribution	Signal coverage		
					
UPS	Routing / firewall	Switch + cables	Access points	Maintenance	Management
Protects the equipment from power oscillations and serves as a battery in case of power outage.	Connects the internal network to the Internet and has security functions such as content filtering and data protection, among others.	Distributes wired access to all network devices	Distributes wireless (Wi-Fi) signal across the school's spaces	Support and maintenance service, when necessary	Dashboards and centralized remote access to schools and equipments

Source: Prepared by the authors.

It is essential to remember that all equipment and materials comprising the school's logical network up to the access points (APs) must be capable of handling the full speed of the contracted Internet link, to enable the potential use of the entire contracted bandwidth at any point in the network.

In Brazil, despite the predominance of Wi-Fi solution projects with wired APs, there are also other types of wireless network solutions.¹⁹ The table below provides a comparison among them.

Table 10. Comparison of Wi-Fi connectivity solutions for schools

Traditional wired Wi-Fi solution	Wi-Fi Mesh	5G FWA
 Solution: Access points are connected by cables with or without a switch (which enables data sharing among different devices), in addition to security-enabled firewalls or routers connected to a UPS. Advantages: - Proven track record in education in Brazil and worldwide - Safe - More economical Disadvantages: - Requires cabling	 Solution: Access points are mutually connected without cabling; only one or a few terminals receive internet input Advantages: - Safe - Does not require Internet cabling Disadvantages: - More expensive - Still requires cabling (at least, for power supply) - Signal quality is slightly lower	 Solution: Receives and retransmits the 5G signal where fiber-optic cabling fails to reach. This is considered more of an access solution, but there is a proof of concept (PoC) proposal concerning 5G FWA, which is underway with the Ministry of Communications (MCom) as a solution that must be deepened. Advantages: - Safe - Does not require cabling - Non-fixed (portable) equipment that can be moved to classrooms Disadvantages: - More expensive equipment - Requires reliable and unlimited 5G connectivity - Its Wi-Fi application is not yet consolidated
This is regarded as the optimal solution for schools	This option has no clear advantage compared to the traditional solution	This technology still needs to be validated for use in school contexts

Source: Prepared by the authors.

Although other options were considered, interviewees unanimously cited the traditional Wi-Fi solution with wired APs as the most reliable option.²⁰ **Thus – and based on the vision of success described in Step 2 above –, the components of an adequate Wi-Fi solution are listed and described below.**

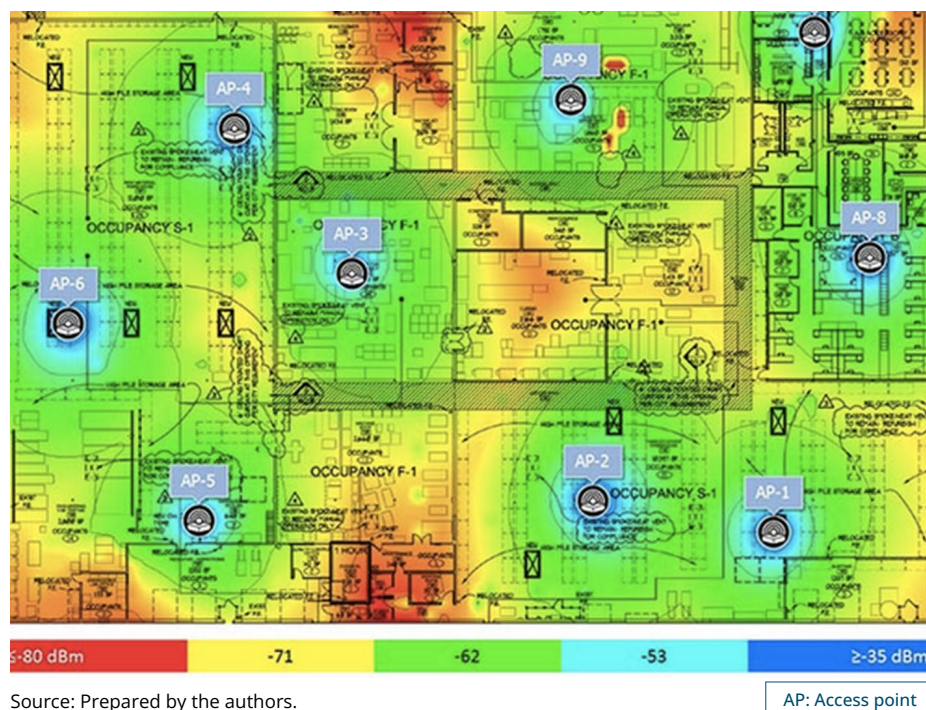
¹⁹. The Wi-Fi Mesh and 5G FWA were mentioned in the interviews of the study by MegaEdu and IDB (n.d.).
²⁰. According to the interviews of the study by MegaEdu and IDB (n.d.) on best practices in the implementation of effective Wi-Fi solutions in Brazilian public schools.

4.1 Wi-Fi signal distribution

The common way of measuring Wi-Fi signal intensity is in dBm (decibel-milliwatts), which is expressed by a negative number ranging from 0 to -100. **The farther from 0 and closer to -100 dBm, the worse the Wi-Fi signal strength.** Brazilian²¹ and international²² studies state that the Wi-Fi signal intensity of -70 dBm is the minimum level for enabling “general use” Internet activities such as web searches, news reading, and sending e-mail messages, among others.

The recommended course of action to guarantee quality Wi-Fi coverage or “illumination” in all spaces is to conduct a site survey with in-person validation after the network’s deployment. This can also be done prior to deployment remotely through heatmap software based on the school’s layout plan. In these cases, a certain margin of error is also recommended, since every software simulation estimates values that may differ from reality and lead to a scenario of school spaces with lower signal intensities than the planned values.

Figure 3. Site survey example using heatmap software



*The study conducted in Brazil by MegaEdu with IDB support recommends installing **one access point (AP) for every two school environments**, in such a way as to optimize the Wi-Fi signal distribution throughout the school. Although this ratio does not always result in the exact necessary number of APs for a given school, it is still a proxy recognized by the market and has been repeatedly cited in the interviews conducted as part of the study as a satisfactory estimate whenever logical validation is not feasible.*

21. NetSpot (n.d.)

22. MetaGeek (n.d.)

4.2 Service maintenance

When it comes to technology, the provision of support and maintenance services is essential to ensure the continuity of implemented Wi-Fi solutions. Peru and Costa Rica are examples of countries in the region where services were deployed, but no adequate maintenance mechanisms were put into operation, leading to frequent interruptions. Thus, the provision or contracting of these services must ensure the full functionality of the Wi-Fi network solutions throughout the entire term of the contract. Services may comprise preventive, scheduled, and corrective maintenance tasks.

For this reason, the criteria and timeframes for ticket response times must be well defined through Service Level Agreements (SLAs) under the contract signed with service providers. On the one hand, overly extended timeframes affect the schools' experience; on the other hand, very demanding deadlines can drive up the cost of the contract, especially when it covers remote and hard-to-reach schools.



In practice: To optimize the cost-effectiveness of SLAs, establish ticket response timeframes based on the two following variables:

- > Problem urgency;
- > Distance between the school and the capital city or nearest urban center.

Schools more closely located or more urgent problems should have shorter response times, while more remote locations or less urgent issues may allow longer timeframes, to enable additional time for service and resolution, as shown by the table below.

Table 11. Customer support and service-level agreements according to school distance

Request category	Description	Time to initial response	Resolution time for schools up to 50 km away from the closest hub city ²³	Resolution time for schools up to 100 km away from the closest hub city	Resolution time for schools beyond 100 km away from the closest hub city
1. Urgent	Unavailability of network assets and identification of failure in the solution with service interruption in the entire school	Up to 4 hours	Up to 8 hours	Up to 12 hours	Up to 24 hours
2. Highly important	Errors or recurring problems that impact access to network assets and educational content	Up to 6 hours	Up to 12 hours	Up to 24 hours	Up to 36 hours
3. Important	Reconfiguration of installed assets in the infrastructure	Up to 8 hours	Up to 24 hours	Up to 48 hours	Up to 48 hours
4. Ongoing	Technical support, general troubleshooting, infrastructure monitoring and management	Remote support			

Source: Prepared by the authors.

Recommendation: To make maintenance services viable across large territorial expanses, it is important to allow the contracted company to outsource services in certain regions through local partners. But in these cases, the SLAs signed with the contracted provider must also apply to services provided by outsourced parties.

²³. According to REGIC 2018, municipalities categorized as "Regional C-level Capital" or above are "hub cities". Similar parameters may be structured based on this methodology, according to each country's reality. IBGE (2018).

4.3 Digital security

Digital security comprises efforts to protect systems, networks, and software against virtual threats. **In the context of schools, it is recommended that digital security solutions enable, at least:**

- > **Content filtering** to control or block access to certain websites and apps;
- > **Monitoring and analysis** of the accessed content for security purposes;
- > **Protection** against internal and external threats, as well as personal data protection for users.

The use of personal data is common in educational settings for purposes of following up on students' performance, evaluating teachers, and developing educational policies. It is essential that the use of such data be made with due care and diligence, especially in cases of data related to children and adolescents. On a global scale, personal data protection has been regulated by several countries to guarantee the right to privacy and control over individual information.

Defining content filters is a crucial aspect and must be established by a multidisciplinary group of educators, managers, and technical specialists. Further, the promotion of digital citizenship is essential to raise awareness among students and teachers about the responsible and safe use of digital technologies, thereby encouraging critical reflection and best practices in the online environment.

Finally, educational networks must ensure the availability of adequate technological infrastructure, including management systems with the capacity to configure content filters, monitor safe uses, and protect users' data.

Step 5

Conducting market research

The main objective of market research is to compare options and ensure the technical feasibility, cost-effectiveness and sustainability of the adopted technological solutions. Solid research enables not only learning about which alternatives are available, but also anticipating necessary requirements, to prevent the contracting strategy from drawing on unrealistic assumptions.

The steps listed in the previous sections of this document are structured to serve as an incremental process towards market research activities. Diagnosing the reality of schools, setting technical parameters and understanding which technologies and infrastructure types are needed to take effective connectivity to classrooms are ways of bringing educational demand and the existing provision closer to each other. Yet only a well-structured market investigation enables answering the following question in realistic terms: what can the market offer – and under which conditions – to enable meaningful connectivity?

Rigorous market research must go beyond the identification of suppliers and providers to include:

- > The technology's effective availability in the territory;
- > Bandwidth and limitations of infrastructure;
- > Geographic coverage (urban, peri-urban, rural and remote);
- > Current prices, contract conditions, maintenance and service-continuity capacities.

Furthermore, market research efforts must strive to identify the actual market structure, as well as the providers' willingness to participate. Countries that pursued technical consultations and dialogues with market actors, such as Brazil and Chile, were able to adjust technical requirements and reduce the risks of failed bidding processes. On the other hand, in countries such as Peru and Costa Rica, which did not follow this course of action, certain processes were declared void or unviable.

The experiences of different Latin American countries²⁴ also show that it is misleading to assume, in the absence of prior evidence, that what the government intends to procure is technically feasible. In Chile, the intended use of fiber-optic technology in remote areas implied disproportionate costs. In Peru, the 2023 procurement process was cancelled due to lack of budget and overestimation of market capacity. Therefore, market research must draw on a realistic diagnosis of the available infrastructure and of adequate technologies for each context.

²⁴. For additional details about these experiences, see the document "Procuring connectivity for public schools: pathways and lessons learned in Latin America and the Caribbean." Méndez et al. (2026).

A combination of different technologies, as observed in Brazil – fiber-optic in densely populated areas, radio links in intermediate zones, and satellite links in remote locations – shows that market research is also an opportunity to expand solutions, not just to verify them.

Another essential component is proper zoning or lot segmentation based on technical and geographic criteria. In countries where lots were sized without considering the actual capacity of providers, participation and competitiveness were low, while costs were high. In places where segmentation was based on more homogeneous zones, as in parts of Chile and Brazil, market attractiveness was increased.

Recommendation: Several market manufacturers provide quality access point (AP) models and distribute them nationwide. This includes the entry-level models currently produced by leading market brands, which consistently meet the needs of school environments. The recommendation is to guarantee that the acquired Wi-Fi equipment effectively consists of APs (enterprise-grade hardware), instead of “home” Wi-Fi routers, which, for different reasons – including the capacity to manage simultaneous connections, and signal power – are not recommended for settings with numerous users, as in the case of schools.

Step 6

Mapping the available resources and estimating costs

This stage is critical for understanding the financial feasibility of implementing Wi-Fi solutions, as well as for ensuring their sustainability over time for all schools in each territory.

This process comprises the identification of available funding sources, in addition to estimating the necessary investments for infrastructure, equipment, and connectivity and maintenance services on a regional or national scale.

6.1 Funding sources

In addition to local-government resources, national funds and programs also perform an essential role in funding large-scale connectivity solutions, to ensure that investments will reach all schools in equitable and sustainable ways, thus enabling large-scale connectivity projects and contributing to the democratization of Internet access.

Taking the Brazilian context as an example, noteworthy national initiatives include:

- > **Telecommunication Services Universalization Fund (FUST):** the FUST was created to promote the universalization of telecommunication services and recently started to provide funds for telecommunication infrastructure in remote areas, with a cumulative potential of more than BRL20 billion;
- > **Law 14,172/2021:** provides for transfers amounting to a total of BRL3.5 billion so that states and municipalities may invest in connectivity and devices for public schools, to prioritize the digital inclusion of students and teachers;
- > **Connected Education Innovation Policy (PIEC):** is a national policy for implementing connectivity and digital infrastructure in public schools with funds provided by the federal government and partners;
- > **5G spectrum auction:** part of the sum raised through the 5G spectrum auction in 2021 aims at building fiber-optic networks to connect public schools, with an estimated total investment of BRL3.1 billion.

It is extremely relevant to reflect on the focus and scope of each funding source, to define which expenses may be incurred with each fund and establish who will receive these funds. It is also essential to avoid overlaps and cover the largest possible number of schools. The capacity to design such coordination is essential for ensuring effectiveness. Funds assigned to procuring and contracting the Internet link, for instance, must be aligned with the funds assigned to the Wi-Fi solution, since a high-speed link cannot serve students without a Wi-Fi solution, and vice versa.

In Brazil, the National Connected Schools Strategy (ENEC)²⁵ was deployed with the task, among others, of thinking through the coordination of connectivity-related policies and resources.

6.2 Cost per school

The interviews of the study conducted in Brazil by MegaEdu with IDB support found that it is essential to have data on diverse variables to establish the total cost of Wi-Fi solutions for schools. **This means considering:**

- > The **number of spaces** where Wi-Fi signal distribution is intended influences the number of network equipment items required;
- > The **area of the spaces** to be covered influences the capacity of access points (APs) to illuminate a larger or smaller area;
- > The **density of users** per space influences the necessary equipment robustness in terms of its capacity to handle more or less numerous simultaneous connections;
- > **Building features** such as the spatial arrangement of its layout plan, width and materials of the buildings' walls, and others.

However, the study shows that it is possible to estimate the deployment costs of the Wi-Fi solution by dividing them into two categories: (i) fixed costs, which are independent of the school's physical characteristics; and (ii) variable costs, which depend above all on the school's size. Each of these categories comprises different variables, shown in the table below.

Table 12. Composition of fixed and variable costs of a Wi-Fi solution per school

	Fixed costs	Variable costs
Network assets	Core network assets such as firewall and switch	Number of necessary APs for illuminating the intended spaces
Service layer	Installation and maintenance of the above-mentioned assets (only one unit per school, regardless of its size), travel to the school, etc.	Installation and maintenance increase proportionally to the number of installed network assets. That is, the larger the school, the larger the number of APs.

Source: Prepared by the authors.

²⁵. To learn more about the Brazilian experience with connectivity procurement for public schools, see Part 2 of the document "Procuring connectivity for public schools: pathways and lessons learned in Latin America and the Caribbean." Méndez et al. (2026).

Therefore, the number of spaces to be connected is the main factor for estimating the total costs of the Wi-Fi solution per school²⁶ and, consequently, for the country. **Based on the table above, this calculation follows the steps below:**

- 1 Based on the recommended parameter of one AP for every two school spaces, the necessary number of APs per school is estimated according to the number of spaces in each school.²⁷
- 2 By calculating the number of APs to be installed per school and the Wi-Fi solution's estimated cost for each set of APs,²⁸ the individual cost per school is obtained.
- 3 By adding up the individual costs of all schools, the total cost for the country is estimated.²⁹

Recommendation: *It is essential to have data sources structured with detailed and updated information on each school for diagnosing the current situation (Step 1) and for calculating the total costs of implementing Wi-Fi solutions in the country. Without this data, the complexity of estimates would be much higher.*

²⁶. A reference for calculating the deployment costs of Wi-Fi as a service in Brazilian public schools can be found in the bidding document published by CG-FUST (the official committee linked to the Brazilian government that supervises investments in connectivity). See Item 2 of "Diretrizes para abertura de convocatória de projeto não reembolsável – 1 – OGU." Costs may vary across countries. See CG-FUST (n.d.).

²⁷. In Brazil, the source of this information is the National School Census. See INEP (n.d.).

²⁸. In Brazil, the cost estimate used is described in the bidding document published by CG-FUST (the official committee linked to the Brazilian government that supervises investments in connectivity). See CG-FUST (n.d.).

²⁹. Data from the diagnosis of the starting point (Step 1) can be used to adjust the total cost estimate by subtracting the schools that already have an adequate Wi-Fi solution.

Step 7

Monitoring and making continuous adjustments

Monitoring can transform school connectivity into a living policy capable of adapting, adjusting course, and responding to schools' true needs. When countries implement permanent monitoring systems, diagnosis moves from an initial snapshot to become a dynamic management instrument.

Several cases in Latin America and the Caribbean show that effective monitoring integrates the three following layers:

- > Technical data (e.g. on speed, stability, internal network, failures);
- > Administrative data (e.g. on contracts, coverage, costs, providers);
- > Pedagogical data (e.g. on educational uses, number of users, platforms and applications).

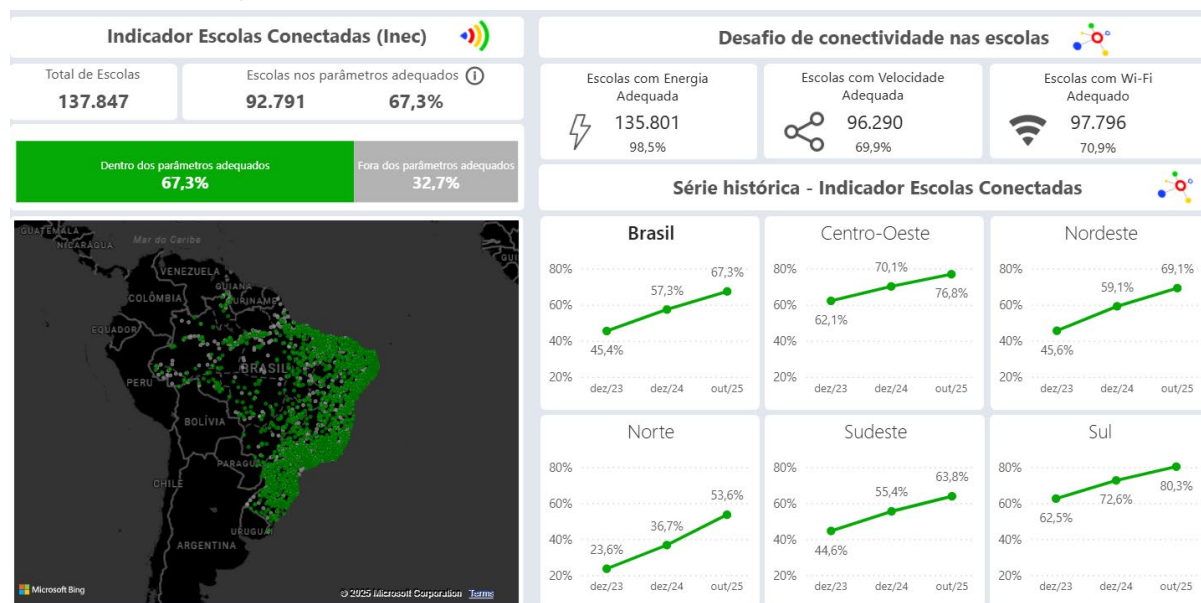
Integrating these layers enables overcoming the logic of a “connected school” as an access point, to advance towards the idea of “meaningful connectivity” as a condition for school participation, learning, and management. Several countries are already moving in this direction, as the examples below show.

7.1 International cases

Brazil: Monitoring Dashboard of the Ministry of Education (MEC)³⁰

This dashboard presents the results of the tool Indicador de Escolas Conectadas (INEC) in relation to three dimensions: power supply, Internet speed, and Wi-Fi network.

Figure 4. Results according to the tool *Indicador de Escolas Conectadas* in Brazil and per region



Source: Ministry of Education of Brazil.

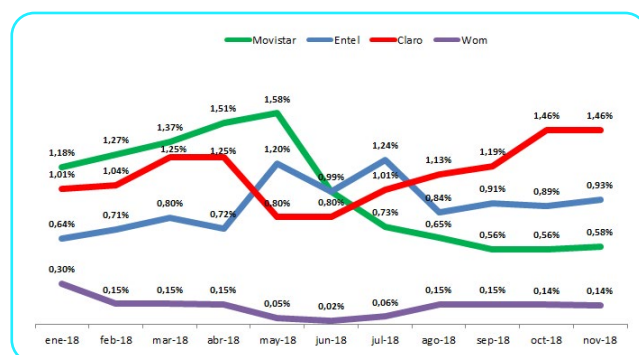
Uruguay: Plan Ceibal³¹

Plan Ceibal maintains permanent indicators of school connectivity by incorporating technical and pedagogical data into public reports.

Chile: Subtel³²

Subtel publishes data on the coverage and quality of connectivity at public schools, accessible through interactive dashboards.

Figure 5. Quality indicators of mobile urban networks, published by Subtel, Chile



Source: Chile's Undersecretariat of Telecommunications.

30. Brasil, Ministério da Educação (n.d.-b).

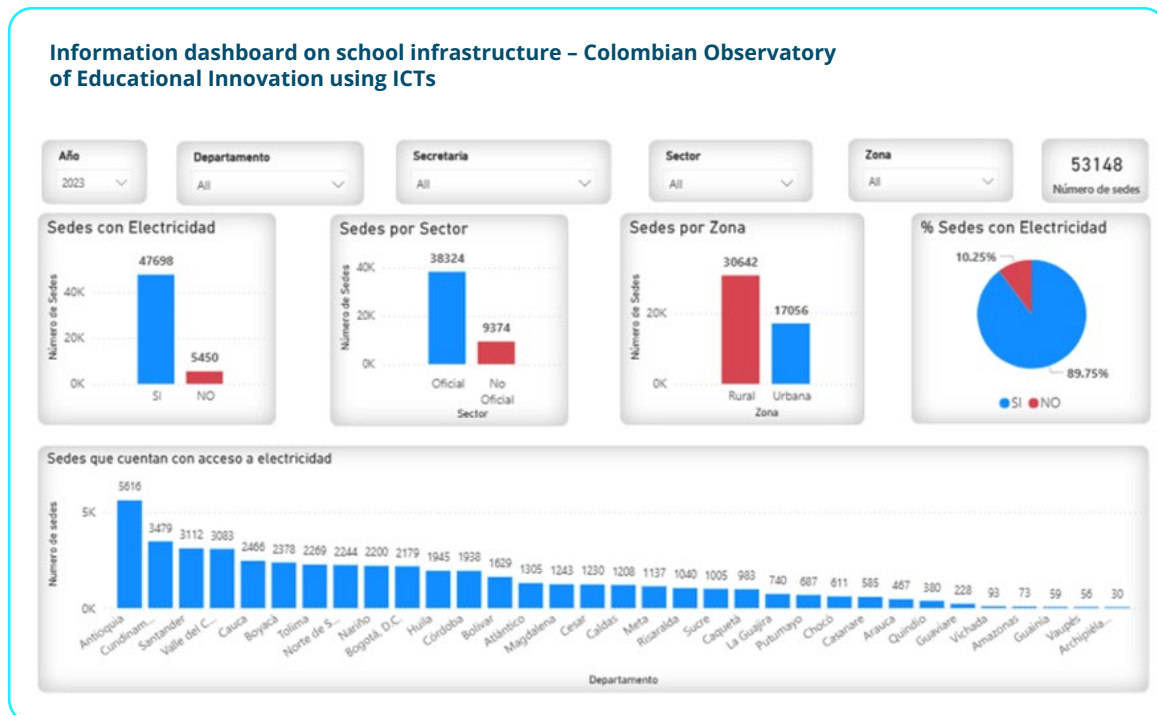
31. Plan Ceibal (2024)

32. Subtel (n.d.)

Colombia: Ministry of National Education (MEN)³³

Colombia's MEN has developed connectivity monitoring systems such as the Colombian Observatory of Educational Innovation using ICTs and linked them to educational and digital inclusion programs.

Figure 6. Access to power supply in Colombian schools



Source: Colombian Observatory of Educational Innovation using ICTs.

These experiences³⁴ show that monitoring is not merely measuring; it is governing. Thus, monitoring is the linkage that closes – and simultaneously reopens – the school-connectivity cycle to consolidate sustainable and equitable policies aligned with educational transformations.

³³. Ministerio de Educación de Colombia (n.d.).

³⁴. For additional information about all these experiences, see Part 2 of the document “Procuring connectivity for public schools: pathways and lessons learned in Latin America and the Caribbean”. Méndez et al. (2026).

Conclusion



Implementing effective Wi-Fi solutions at public schools is a crucial step for transforming education and reducing inequalities of access to technology.

This document draws on key lessons learned in Brazil and other Latin American countries, to present them in the format of seven essential steps for planning the implementation of school Wi-Fi networks that are robust and well-suited to individual pedagogical contexts.

- > **The first step (Diagnosing the current situation)** stresses the relevance of conducting an accurate diagnosis of the current infrastructure, including a geospatial analysis of the educational network. The ability to understand which schools already count on proper solutions, which ones need investments, and where they are located is crucial for prioritizing actions and optimizing resources.
- > **The second step (Defining parameters based on a vision of success)** is essential to guarantee that the adopted solutions fully meet the schools' pedagogical needs. Establishing clear quality and connectivity standards from the beginning allows us to align performance expectations and create a robust basis for the entire project.
- > **The third step (Selecting a connectivity technology)** presents the advantages, limitations, and criteria that must be assessed to understand which of the available technology options are best suited for the educational networks' specific needs and realities. Where feasible and available, the fiber-optic option must be prioritized, since it provides higher stability and optimal download speed.
- > **The fourth step (Understanding the internal network infrastructure)** draws attention to the necessary requirements for enabling school connectivity, including a uniform distribution of Wi-Fi signal, digital security and proper maintenance. An additional highlight is the key role played by access points (APs) and the superiority of traditional wired solutions in terms of reliability and efficiency.
- > **The fifth step (Conducting market research)** enables the identification of providers, technologies, and costs, to ensure sustainability and improved cost-effectiveness.
- > **The sixth step (Mapping the available resources and estimating costs)** further emphasizes the need to align different funding sources, including national funds and federal programs, with specific school demands. Furthermore, cost estimates must consider both initial investments and recurrent costs, to guarantee that the adopted solution's feasibility will be maintained in the long run.
- > Finally, **the seventh step (Monitoring and making continuous adjustments)** makes the point that only through updated data is it possible to adjust contracts, review technical standards, reassign resources, prioritize vulnerable schools, and design expansion plans.

It is our hope that by following these seven steps, governments and institutions from Latin America and the Caribbean will be better prepared for the process of contracting connectivity services,³⁵ after understanding the direct impact of adequate planning on equity. Conversely, incomplete and fragmented diagnoses lead to unfeasible bidding processes and leave remote schools excluded. In short, without an adequate starting point, there is an increased likelihood of perpetuating educational inequalities that derive from unequal access to technology.

35. To learn more about the connectivity procurement process and read about the experiences of seven Latin American and Caribbean countries with connectivity, this note recommends the document "Procuring connectivity for public schools: pathways and lessons learned in Latin America and the Caribbean". Méndez et al. (2026).

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