Global Standards, Local Voices: Mapping Latin American Participation in the IETF Meetings

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Abstract. *The Internet Engineering Task Force (IETF) is one of the main global organizations developing and maintaining the technical standards that sustain the Internet. Although open and volunteer-based, participation remains geographically concentrated. This paper examines the dynamics of Latin American and Caribbean participation, identifying who contributes, from which institutions and sectors, and what factors shape engagement. We created a longitudinal dataset covering all IETF meetings (IETF 1-123), consolidating information on participants' names, affiliations, countries, and registration types. The analysis shows that North America and Europe dominate participation, while Latin America and the Caribbean, led by Brazil, show gradual growth since the 2010s. Regional engagement centers on NIC.br, LACNIC, and universities, supported by fellowships and remote participation hubs.*

1. Introduction

The Internet is a vast socio-technical infrastructure that depends on a set of open standards to ensure interoperability and global communication. The Internet Engineering Task Force (IETF) is the leading and largest standards development organization responsible for creating and maintaining these protocols that make the Internet function as a cohesive network of networks.

Unlike traditional standards bodies, the IETF has no formal membership or fees. It operates as a self-organized community of volunteers (individuals from academia, industry, government, and civil society) who collectively develop and evolve Internet technologies [Hoffman 2012]. While participation is open to anyone, some organizations interested in the IETF often offer institutional and financial support for their members' engagement in this process.

As highlighted by Khare et al. [Khare et al. 2022], given the Internet's central role in modern life, understanding who participates in shaping its technical standards is essential. Participants' affiliations and countries of origin matter because the IETF's open and consensus-driven model relies on diverse perspectives to produce robust and inclusive standards. Uneven participation can therefore translate into uneven influence over the Internet's future design and governance.

Over the last decades, global participation in the IETF has expanded, yet this growth has been uneven across regions. Zhang et al. [Zhang et al. 2025] analyzed twenty years of participation data (2001–2023) and found that North America and Europe continue to dominate the landscape, with a notable rise in Asia's representation. In contrast, South America and Africa remain underrepresented, although South America has shown modest but consistent growth since 2010. Latin American (LATAM) members have made concerted efforts to strengthen the region's engagement with the IETF [Retana 2013], supported by initiatives from organizations such as Latin American and Caribbean Internet Addresses Registry (LACNIC), Internet Society (ISOC), and national research networks [Braga et al. 2017].

In this work, we analyze participation across all publicly available IETF meeting datasets, with a special focus on Latin American involvement. To the best of our knowledge, this is the first comprehensive study to examine the entire corpus of IETF meeting data to characterize regional participation. Our analysis explores how Latin American participation has evolved over time, identifies key actors (institutions, sectors, and countries), and discusses barriers and opportunities for deeper engagement in Internet standardization.

Although many contributors participate primarily through mailing lists rather than attending meetings, in-person attendance remains a strong indicator of investment and institutional commitment, particularly for organizations and countries seeking to influence the creation of Internet standards. By focusing on meeting participation, this study provides valuable insights into the resource and engagement dynamics shaping Latin America's role in the IETF.

2. Related Work

Several studies have examined the participation of Latin American countries in the IETF. Collectively, these works have provided valuable insights into the evolution of engagement from the region, the role of academic and institutional initiatives, and the influence of remote participation and fellowship programs.

One of the earliest systematic efforts to map participation was conducted by Braga et al. [Braga et al. 2014], who analyzed IETF attendance data using data mining techniques applied to registration records from meetings 72 to 89. The study emphasized the influence of event location on participation, showing that meetings held within or near a region led to increased representation from that region. It also noted the limited presence of Latin American participants and highlighted the need for continued monitoring and dataset expansion. In addition to these analyses, Braga et al. [Braga et al. 2015] presented a review of Brazilian attendance at IETF meetings through 2014. The data revealed a period of stable participation until 2008, followed by a steady increase in subsequent years.Braga's analysis also categorized participation by region, enabling comparisons of engagement levels across different areas, and discussed the support provided by the ISOC Fellowship for Latin American participants.

Expanding on these analyses, Braga et al. [Braga et al. 2017] compared Brazilian participation with that of other Latin American and Caribbean countries across meetings 72 to 97. Their findings confirmed that Brazil consistently led the region in IETF participation and proposed concrete actions to strengthen engagement, including the production

of Portuguese-language materials (e.g., The Tao of IETF), the organization of Pre-IETF Workshops, and the establishment of funding initiatives such as the CGI.br/IETF Program.

Andrade et al. [Andrade et al. 2018] investigated the impact of remote participation on the IETF community, with particular attention to Latin America and Brazil. Their study compared in-person and remote participation between meetings 94 and 100, finding that the introduction of remote participation did not reduce onsite attendance. The exception was IETF 95, held in Argentina, which recorded an unusually high number of remote attendees from Asia, likely due to the long travel distance to South America. The study also found that Brazil had the highest number of remote participants in South America and that remote hubs organized by universities played a crucial role in expanding access to IETF discussions.

These works provide a historical and methodological foundation for understanding Latin American engagement in the IETF. However, they are limited to specific time spans or subsets of meetings. The present study advances this research by analyzing all publicly available IETF meeting data from IETF 1 to IETF 123, consolidating fragmented records, and systematically addressing missing or inconsistent information. It provides the first comprehensive longitudinal analysis of Latin American participation, including both geographic and institutional perspectives.

3. Data and Methods

This section details the procedures for creating and preprocessing the dataset used in our analysis of IETF meeting participation. We aimed to compile a reliable record of attendees over more than three decades, addressing issues of varying data formats and completeness. The subsections cover our data collection, preprocessing, and standardization strategies to ensure data consistency.

3.1. Data Collection

The IETF provides open access to meeting proceedings, which include detailed participant lists and related documentation. These records constitute a unique longitudinal dataset spanning several decades of Internet governance activity. However, collecting and standardizing this information poses significant challenges due to the heterogeneity of file formats, inconsistent structure, and variable completeness across meetings.

For the earliest meetings (IETF 1 to IETF 28), participant information was available only in PDF format, often without recognizable digital text, requiring the use of optical character recognition (OCR) for extraction. The proceedings of IETF 107 are also provided solely as a PDF. From IETF 29 onward, the data is typically available in HTML or TXT formats, yet variations in formatting, field names, and presentation persist. Across all editions, the only consistently available attribute is the participant's name, while additional details, such as organization, contact information, and registration type, appear irregularly.

We did not include IETF 5 in our analysis because its documentation is not available on the official IETF website. Additionally, we could not find any participant lists for that meeting in the archived proceedings or the Datatracker system. As a result, it is impossible to identify the attendees, their affiliations, or their countries.

Given these inconsistencies, we developed a flexible data collection pipeline capable of handling multiple formats and levels of structure. This pipeline was implemented in Python and integrates tools for web scraping, text processing, and OCR-based extraction. The main libraries employed were:

- **Pandas**: for tabular storage and standardization of collected data;
- **Requests and BeautifulSoup**: for automated retrieval of structured tables from HTML pages;
- **Selenium**: for interacting with pages requiring authentication;
- **PyPDF2**: for reading textual content from structured PDFs;
- **pdf2image, PIL, and pytesseract**: for converting scanned PDFs into images and performing optical character recognition;
- **re**: for applying regular expressions to standardize text and extract specific fields such as country codes or organization names.

This infrastructure enabled automated and semi-automated extraction of participant information across heterogeneous document types.

For this study, we compiled data from IETF 1 through IETF 123 (the most recent meeting available at the time of writing). The collected attributes, when present, include: first name, last name, full name, organization or affiliation, phone, fax, country, address, email, and registration type (remote or onsite). From IETF 124, held in Montreal, Canada, a new initiative from CGI.br began funding Brazilian participation, supporting 18 of the 25 Brazilian attendees (both in-person and remote). This marks an important milestone in regional engagement, reflecting Brazil's institutional commitment to strengthening its presence in the IETF community.

3.2. Data Preprocessing

Because the completeness of records varied widely across meetings, we applied multiple inference and standardization strategies to fill missing values and ensure consistency:

- **International Direct Dialing (IDD)**. When phone numbers were available, their international dialing prefixes were used to infer participants' countries of origin.
- **Email Domains and ccTLDs**. Email domains were used to extract both the organization name and, when possible, the country code top-level domain (ccTLD) (e.g., .br, .ar, .jp), enabling inference of national affiliation.
- **Cross-Meeting References**. For participants appearing in multiple meetings, the country was inferred from their entries in the two previous and two subsequent meetings to maintain temporal consistency.
- **Missing Values**. When no reliable inference could be made, the placeholder *unknown* was assigned.

Organizational affiliations appeared in diverse and inconsistent forms, such as *Huawei Technologies Co., Ltd.* and *Huawei Canada*. To consolidate these variants, we developed an embedding-based canonicalization procedure combining linguistic normalization and semantic similarity clustering. Each organization name was standardized by removing punctuation, legal suffixes (e.g., Ltda., Inc., S.A.), and country-specific or generic terms, while retaining the core brand tokens. The normalized strings were then encoded into dense vector embeddings using the all-MiniLM-L6-v2 model from Sentence-Transformers. We computed pairwise cosine similarities between embeddings and applied agglomerative clustering with a similarity threshold of 0.7, grouping semantically

related names. Within each cluster, the most frequent and concise variant was chosen as the canonical form, with minor recasing adjustments for readability.

After completing the automatic preprocessing, we conducted a manual verification process to ensure data reliability. Particular attention was given to entries related to Latin American participants and organizations, as this region is the focus of our analysis.

4. Results and Analysis

This section presents the main findings derived from the longitudinal dataset of IETF meeting participants compiled for this study.

4.1. Geographic Distribution Over Time

Figure 1 presents the overall evolution of IETF meeting participation from the first meeting to IETF 123. The total number of attendees has grown substantially over time, reflecting both the global expansion of the Internet and the increasing importance of open standardization. Participation surged in the late 1990s and early 2000s, reaching peaks of over 2,000 attendees per meeting. This growth phase was followed by a period of decline and fluctuation, eventually stabilizing at an average of approximately 1,000 to 1,500 participants per meeting.

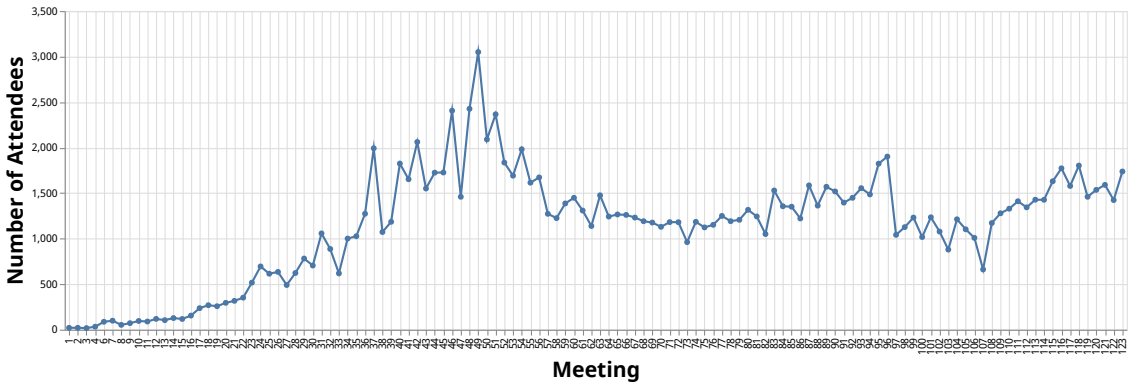

Figure 1. Total number of IETF meeting attendees over time.

Figure 2 breaks down participation by world area across all meetings. The data reveal a persistent geographic imbalance, with North America countries (US/CA) and Europe dominating attendance and together accounting for the majority of participants throughout the IETF's history. Approximately 10% of the entries are labeled as unknown (see Figure 2), due to incomplete or missing information that prevented country inference during data preprocessing. These missing values are concentrated mainly between meetings 56 and 71, a period for which the published proceedings lacked consistent affiliation and contact data.

Figure 3 further disaggregates participation by world area, excluding the United States, Canada, and unknown affiliations. The visualization highlights distinct regional trajectories. Asia exhibits a steady upward trend, reflecting increasing engagement over the decades. In contrast, Latin America and the Caribbean (LATAM and C), Oceania, and Africa maintain relatively small but visible participation levels, particularly after 2010 (IETF 77).

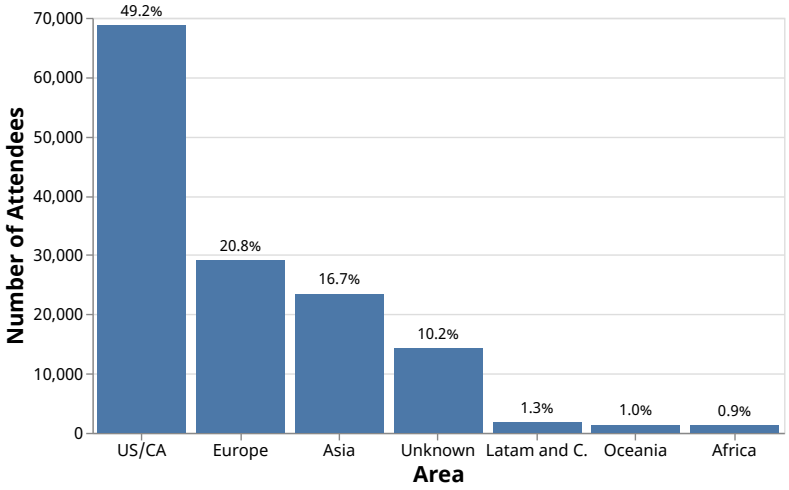

Figure 2. Total number of attendees by global region for all IETF meetings.

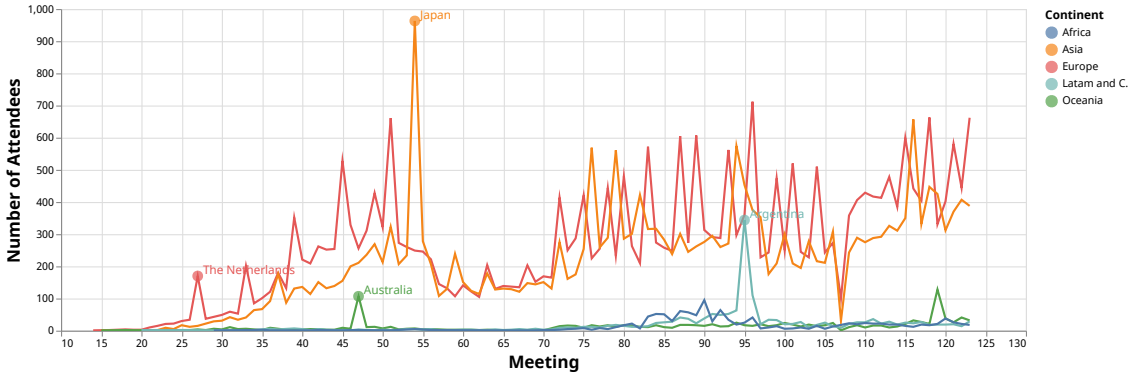

Figure 3. Number of attendees per meeting by area, excluding the United States, Canada, and unknown affiliations. The apparent reduction in participation between meetings 56 and 71 results from missing country information in the original records, where participants were assigned an unknown value during preprocessing.

It is notable that the first recorded participations from Asia and Latin America occurred around the same period, the first Asian participants in 1989 and the first Latin American participants in 1991. Yet, the trajectories of these two regions diverge significantly: while Asia has shown sustained growth, Latin America's involvement has been more sporadic at first, with a subtle increase over the years.

Figure 3 also highlights four meetings corresponding to the first participation peaks of each region: meeting 27 (The Netherlands, Europe), meeting 47 (Australia, Oceania), meeting 54 (Japan, Asia), and meeting 95 (Argentina, Latin America). In all these cases, the increase in attendance coincides with the meeting being hosted within the same region, suggesting that geographic proximity strongly influences participation. Europe and Asia show upward trends even prior to their first local meetings, reflecting broader structural growth in those regions. Africa demonstrates a temporary rise between meetings 83 and 96, surpassing Latin America and Oceania for a brief period before declining. Meanwhile, Latin America and the Caribbean display a slow but steady rise in

participation since the early 2010s, indicating a gradual yet persistent regional engagement with the IETF community.

Figure 4 shows the overall number of attendees from Latin America and the Caribbean across all IETF meetings. The region's participation is clearly led by Brazil, which accounts for more than 600 attendees, nearly twice as many as the next country, Argentina. Mexico, Chile, and Uruguay follow, forming a second tier of active countries. Smaller yet noteworthy participation is observed from Venezuela, Colombia, Peru, Costa Rica, and Ecuador, while most other countries in the region have contributed fewer than 25 attendees. This distribution reveals a strong concentration of engagement in a few countries, particularly Brazil.

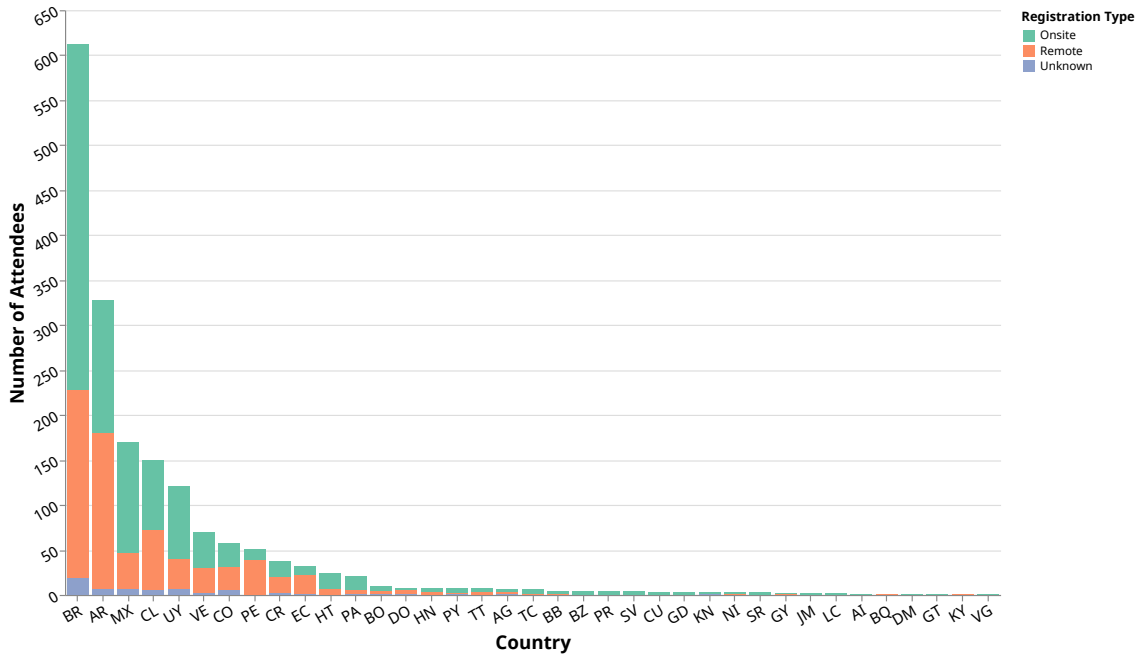

Figure 4. Participation types by country in Latin America and the Caribbean at all IETF meetings (onsite, remote, or unknown).

The Figure 4 also disaggregates participation by registration type (onsite, remote, or unknown). A small number of records remain labeled as unknown, reflecting missing information in the original proceedings. Onsite participation predominates across the region. Nevertheless, the availability of remote participation has played an important role in broadening access to IETF activities. In some countries, such as Argentina and Peru, the number of remote participants even exceeds that of in-person attendees. However, this expansion has not affected all countries equally: despite the possibility of remote engagement, most countries in the region still show minimal participation, with fewer than five recorded participants over the IETF's 39-year history.

4.2. Brazil's Participation in IETF Meetings

Figure 5 presents the evolution of Brazilian participation in IETF meetings over time, distinguishing between onsite, remote, and unknown registration types. Brazil stands out as the country with the most significant involvement in the Latin American and Caribbean region.

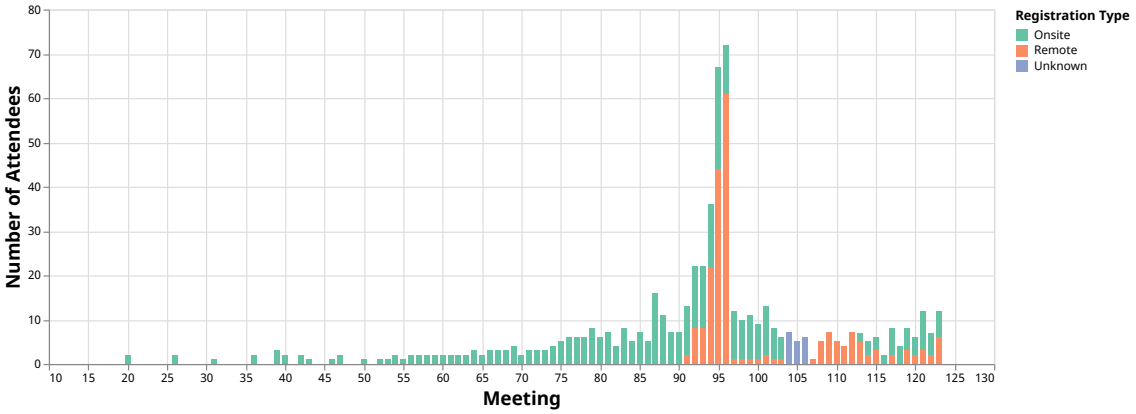

Figure 5. Number of Brazilian attendees at IETF meetings over time (onsite, remote, or unknown).

Participation begins modestly in the early years, with only a few attendees per meeting up to around IETF 70. The first Brazilian participation occurred at IETF 20 (St. Louis, Missouri, USA), where two representatives of the Brazilian Research Network (RNP) attended and delivered a presentation that provided an overview of national networking activities in Brazil. The slides from this talk remain available in the meeting proceedings (Figure 6), marking the earliest documented Brazilian contribution to IETF discussions. From meeting 70 onward, attendance gradually increased, culminating in a prominent peak between meetings 90 and 100, notably during IETF 95 in Buenos Aires. The proximity of this meeting to Brazil likely encouraged a significant rise in participation: 23 Brazilians attended IETF 95 in person, representing the highest count in the time series. The elevated numbers observed between meetings 94 and 96 were also driven by remote participation hubs organized by Brazilian universities.

Figure 7 illustrates the number of attendees from the two institutions that coordinated these hubs: the Federal University of Alagoas (UFAL) and the University of Pernambuco (UPE). Together, they facilitated broad local engagement, enabling dozens of participants to join remotely and fostering community awareness about IETF activities.

Figure 8 shows the impact of support and fellowship programs on Brazil's in-person participation in IETF meetings. These initiatives have been instrumental in lowering the financial and logistical barriers that often limit engagement from the Global South. Two main programs stand out. The first is the ISOC Fellowship to the IETF, launched by the Internet Society (ISOC) in 2007 to fund individuals from underrepresented regions to attend IETF meetings and participate in working groups. The second is the CGI.br/IETF Program, created in 2014 by the Brazilian Internet Steering Committee (CGI.br) to provide travel grants for Brazilian researchers, students, and professionals interested in contributing to the IETF's technical and policy discussions. The CGI.br Program works from IETF 91 to IETF 99. The ISOC Program started as a pilot Fellowship program at IETF 66 and concluded at IETF 104, however, only data from IETF 93 is publicly available.

Figure 8 demonstrates that both programs significantly increased Brazilian participation, especially between IETF 91 and IETF 104. During this time, the number of Brazilian attendees reached its highest levels in history, coinciding with the implementa-

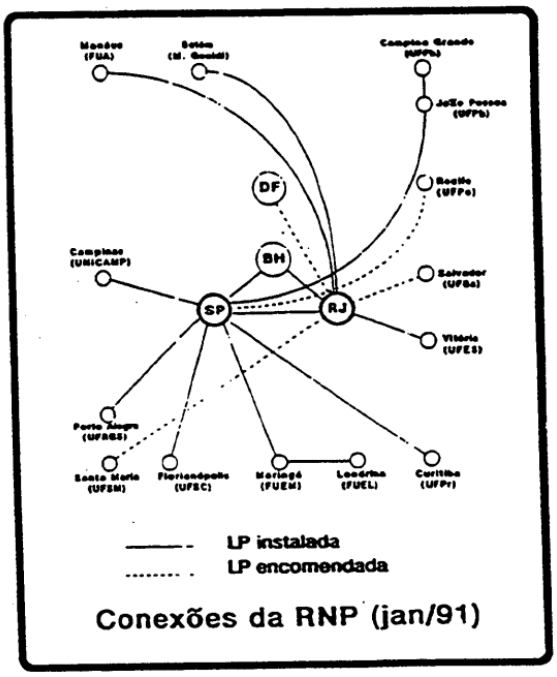

Figure 6. Excerpt from the slides presented by Brazilian participants at IETF 20 (1991). Source: [IETF 1991].

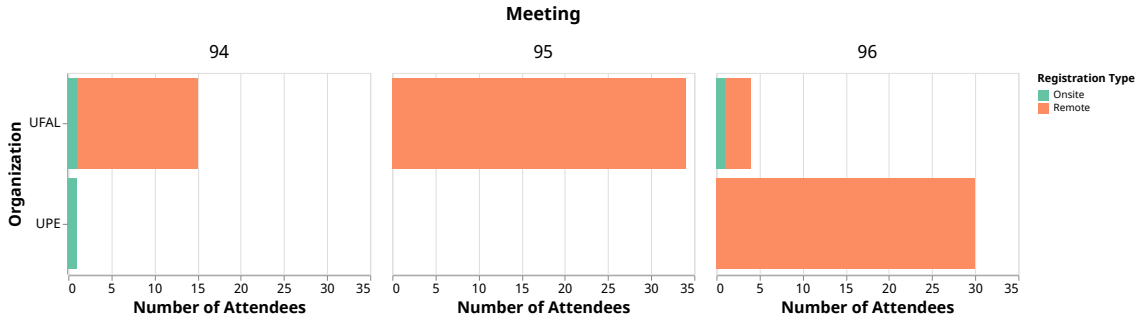

Figure 7. Number of attendees by meeting for Brazilian universities that hosted remote hubs: Federal University of Alagoas (UFAL) and University of Pernambuco (UPE).

tion and expansion of these funding mechanisms. Both programs played a vital role in enhancing and solidifying Brazilian participation.

Overall, Brazil's trajectory demonstrates how local meeting hosting, institutional initiatives, and remote access opportunities can act as powerful catalysts for regional engagement.

4.3. Institutional and Sectoral Composition

Understanding the institutional composition of IETF participants provides insight into which sectors most actively contribute to Internet standardization. To identify the type of organization associated with each participant, we categorized email domains by top-level domain (TLD). Addresses ending in *.edu* were classified as academic, *.com* as company, *.gov* as government, and *.org* as organization. Participants who used personal email in-

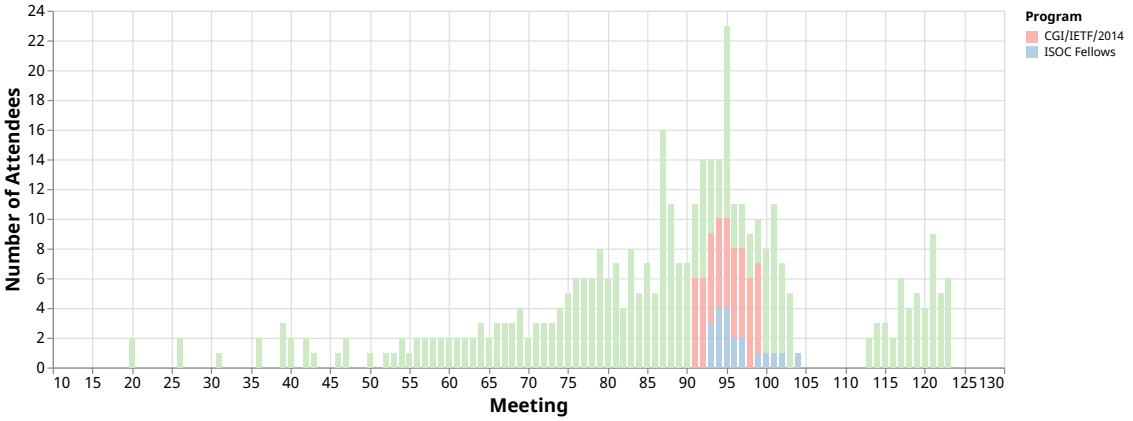

Figure 8. In-person participation by Brazilians at IETF meetings. The total number of in-person attendees is shown in green, the total attendees funded by the CGI/IETF 2014 program is shown in red, and the attendees supported by the ISOC fellowship program are shown in blue.

formation were categorized as having no affiliation. When no valid email address was available, the affiliation was classified as unknown.

Figure 9 summarizes the total number of participants per organizational type. The data reveal a strong predominance of company-affiliated participants, who account for more than one-fifth of all attendees (29.7%). This pattern aligns with the IETF's historical role as an industry-driven forum for technical standardization. The academic sector accounts for approximately 22.6% of attendees, indicating significant, though smaller, engagement from research and educational institutions. Governmental participation remains limited ($< 1\%$), reflecting the IETF's voluntary and non-regulatory nature. Similarly, nonprofit organizations (e.g., ISOC, CGI.br, NIC.br) account for just over 2.1% of participants. The largest category, however, is unknown affiliation, comprising approximately 44.9% of the dataset. This reflects the absence of email information or affiliation data in older meeting records, especially in early IETF editions.

Figure 10 details the participation regime across organizational types. Nearly all participants from companies, governments, and organizations attended onsite, suggesting that institutional or professional sponsorship plays a decisive role in enabling physical participation. In contrast, the academic and unknown categories show a more diversified participation pattern, with around 15%-18% of their attendees participating remotely. This result suggests that remote attendance mechanisms have been particularly valuable for independent researchers and unaffiliated contributors, lowering entry barriers to participation.

To better understand the institutional structure behind these patterns, Figure 11 presents the 15 organizations with the highest cumulative participation across all IETF meetings. The list is dominated by large multinational technology companies, led by Cisco, Huawei, Ericsson, Nokia, Juniper Networks, and Microsoft, all of which have long-standing involvement in the development of Internet protocols. Academic and nonprofit entities, such as the Internet Society (ISOC) and the Electronics and Telecommunications Research Institute (ETRI), also appear in the ranking. This concentration of participation within a handful of corporations underscores the central influence of private industry in

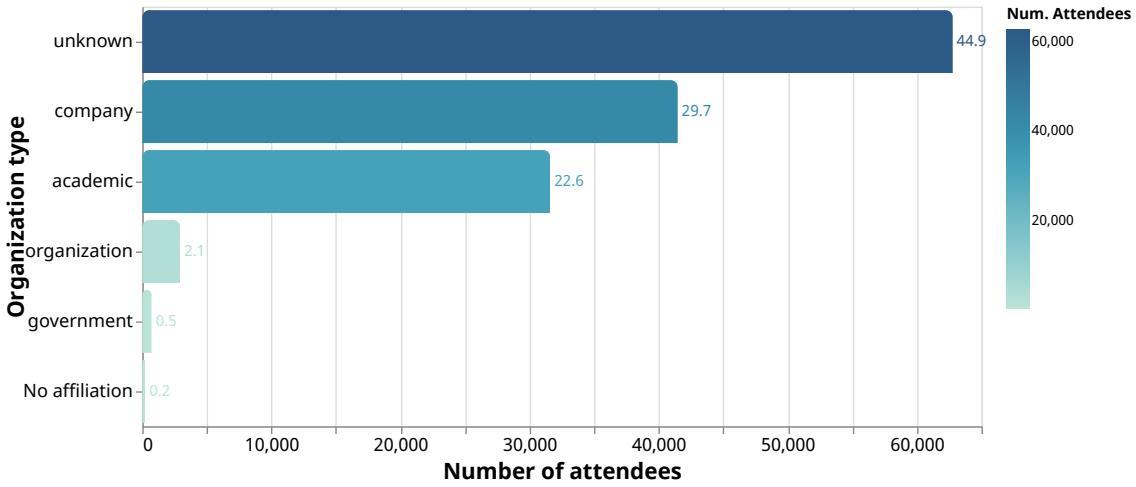

Figure 9. The total number of IETF participants categorized by their type of organization across all meetings.

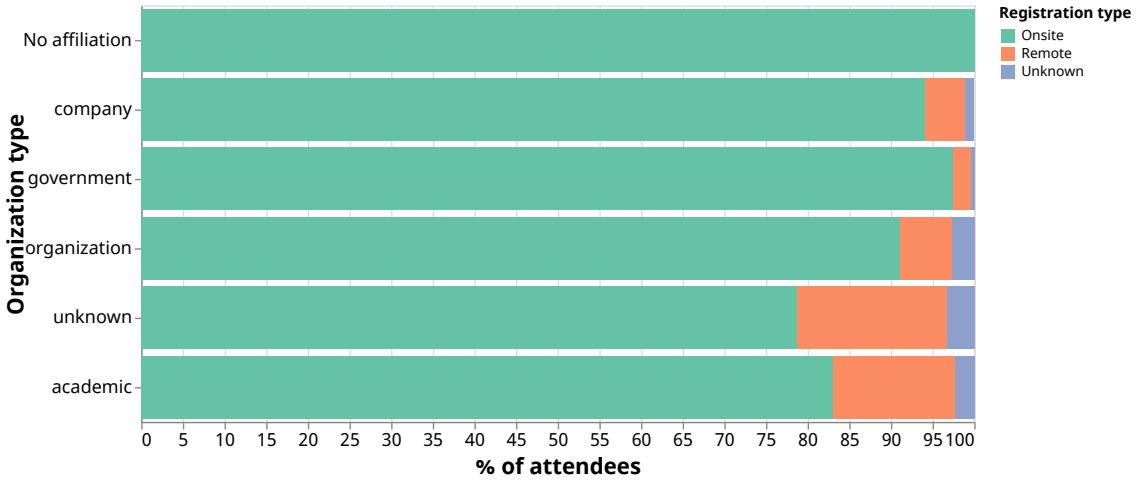

Figure 10. Analysis of participation modes (onsite, remote, or unknown) categorized by organizational type for all meetings.

shaping the technical direction of Internet standards.

4.4. Institutional Composition in Latin America and the Caribbean

To enhance our understanding of the regional dynamics influencing participation, we analyzed the organizational affiliations of attendees from Latin America and the Caribbean. Figure 12 presents the 10 organizations with the most significant cumulative number of attendees from the region across all IETF meetings.

The data reveal that participation in the region is highly concentrated in a few key institutions. NIC.br (the Brazilian Network Information Center) and LACNIC (the Latin American and Caribbean Internet Addresses Registry) lead by a substantial margin, with nearly 190 and 141 recorded attendees, respectively. Both organizations play a strategic role in the regional Internet governance ecosystem: NIC.br, the national registry responsible for domain administration and the management of Internet initiatives and services in Brazil, and LACNIC, the regional Internet registry serving the broader Latin American

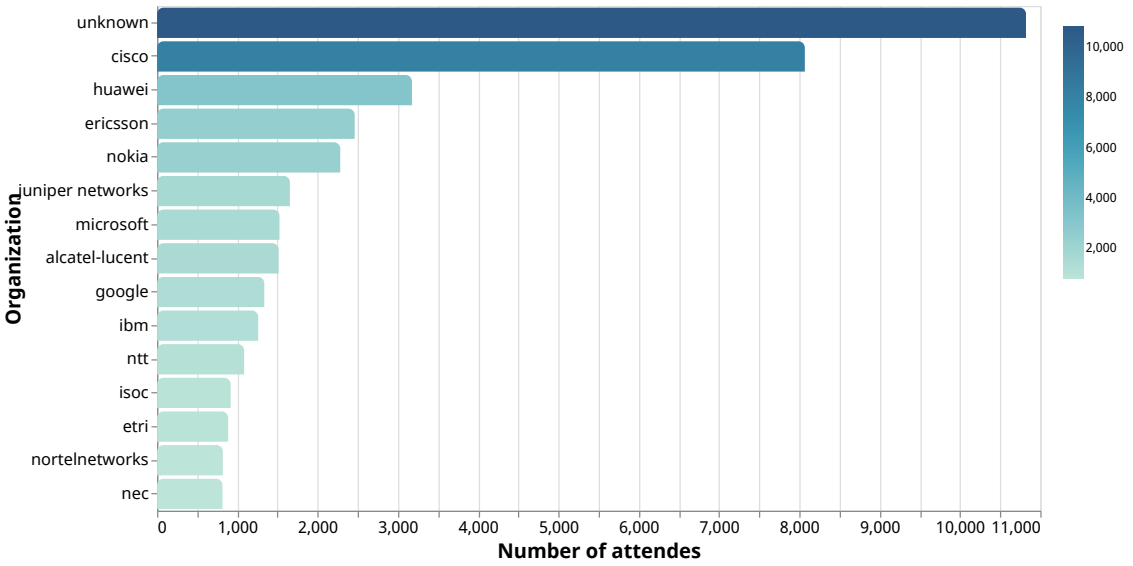

Figure 11. Top 15 organizations by total number of IETF participants (all editions).

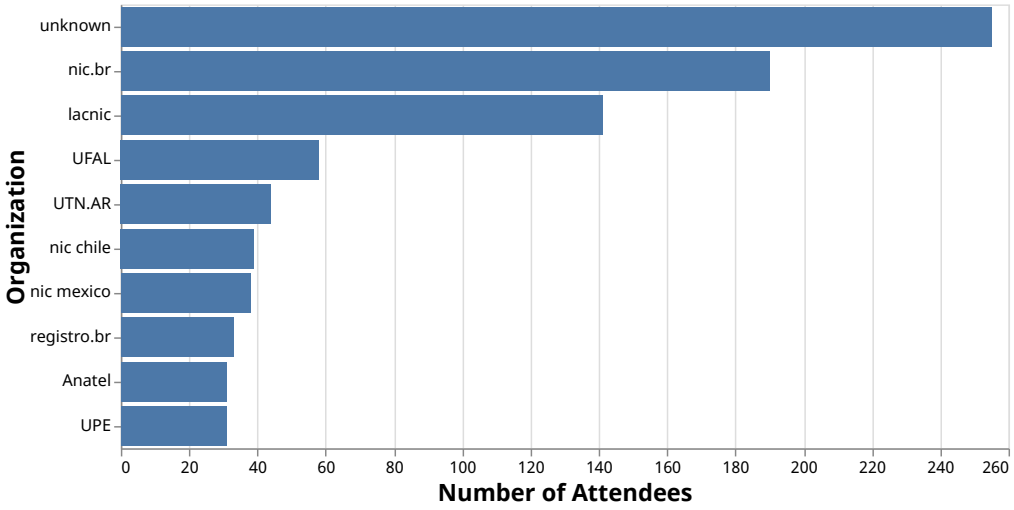

Figure 12. Top 10 organizations from Latin America and the Caribbean by total number of IETF attendees.

and Caribbean community. Other recurring institutions include UFAL (Federal University of Alagoas), Universidad Tecnológica Nacional (UTN.AR), and national network and registry entities such as NIC Chile, NIC Mexico, and Registro.br. Government and regulatory representation, such as ANATEL (the Brazilian Telecommunications Agency), also appears. This distribution indicates that IETF engagement in the region is largely driven by technical and academic organizations.

Figure 13 analyzes how participants from Latin America and the Caribbean engage in IETF meetings according to their type of organization and mode of participation. The results reveal that onsite participation predominates across all sectors, but the proportion of remote attendees varies substantially by organization type. Academic institutions show the highest relative share of remote participation, nearly half of all academic attendees joined meetings virtually (44%). This trend highlights how remote access mecha-

nisms have been instrumental in enabling the involvement of universities and researchers who often face budgetary or logistical barriers to traveling to IETF meetings.

In contrast, company-affiliated and nonprofit organizations participants are mostly onsite, reflecting stronger institutional support and the strategic importance of in-person engagement for industry stakeholders. Governmental presents intermediate profiles, combining onsite and remote participation, while the unknown category mirrors the academic pattern.

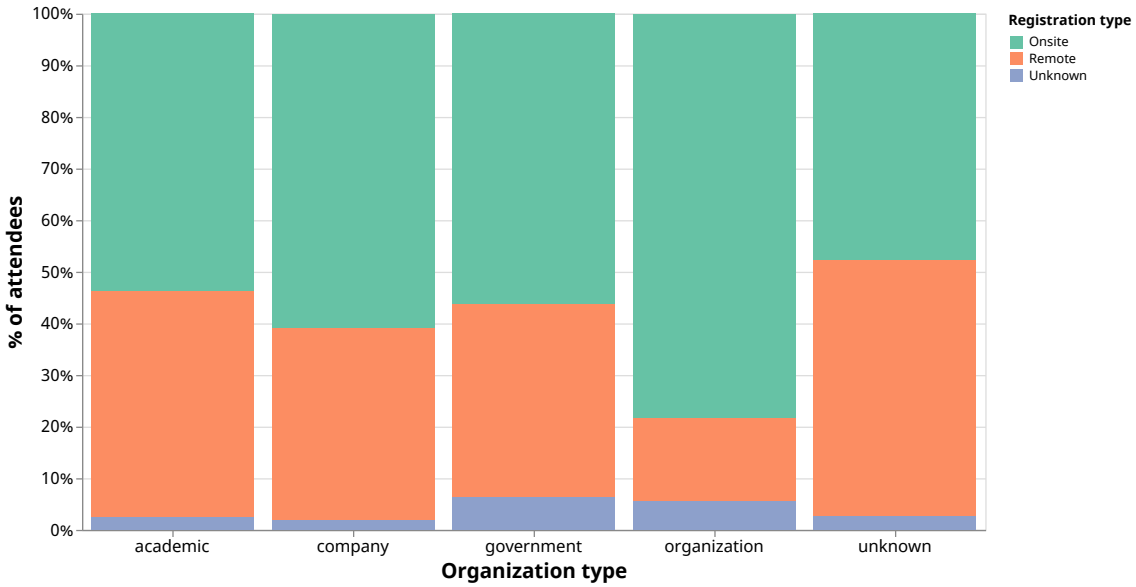

Figure 13. Participation types by organizational affiliation among attendees from Latin America and the Caribbean across all meetings.

5. Conclusion

This study offered the first comprehensive longitudinal analysis of Latin American and Caribbean participation in the IETF. The findings show gradual growth since the 2010s, led mainly by Brazil, NIC.br, LACNIC, and public universities. Fellowship programs and remote hubs proved decisive in lowering barriers and expanding access, yet representation remains uneven across the region.

To strengthen regional engagement, three priorities emerge:

- **Diversification of participation**, encouraging involvement from countries with historically low presence;
- **Sustainability of support programs**, ensuring continuity of fellowships and funding initiatives;
- **Regional integration**, fostering collaboration among universities, national networks, and technical organizations.

Enhancing Latin American and Caribbean voices in the IETF is not only a matter of inclusion, but also of ensuring that Internet standards reflect diverse realities. A stronger regional presence will contribute to building a more representative, equitable, and globally responsive Internet.

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