© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1717538

The Evolution of Regional Internet Service Providers (ISPs): From the Brazilian Experience to the American Landscape

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Abstract- ***The trajectory of regional Internet Service Providers constitutes an empirically relevant case for understanding how technology, market structure, and territorial diffusion interact in broadband expansion. This article examines the historical and technological evolution of regional ISPs in Brazil, from the dial-up era to the current phase of high-capacity optical networks, and contrasts this trajectory with the structural configuration of the broadband market in the United States. Drawing upon empirical evidence regarding spatial distribution of infrastructure, local competitive dynamics, regional productivity effects, and FTTH/PON architectures, the study argues that decentralized entry into commercially unattractive municipalities was associated with increased territorial capillarity in Brazil. In contrast, the persistence of duopolistic market structures in the United States conditioned broadband diffusion patterns. The comparative analysis underscores the importance of competitive architecture in determining the pace and breadth of infrastructure expansion.***

Keywords: Regional ISPs, Broadband Markets, FTTH, Market Structure, Brazil–United States

I. INTRODUCTION

During the 1990s, commercial internet access in both Brazil and the United States was predominantly based on dial-up connections over public switched telephone networks, with ISPs acting primarily as intermediaries responsible for authentication and traffic routing (1). In this phase, providers did not control last-mile infrastructure, limiting both speed and technological differentiation.

In the United States, the transition to broadband was closely linked to vertical integration among cable and telecommunications operators, shaping the spatial distribution of service availability (2,3,4). Evidence from spatial distribution studies between 1999 and 2004 shows that broadband deployment was uneven and strongly influenced by infrastructure ownership (3).

In Brazil, broadband expansion occurred in a context marked by regional heterogeneity and identifiable market gaps, particularly outside major metropolitan centers (5,6).

Policy analyses indicate that numerous Brazilian municipalities were considered commercially unattractive for large incumbent operators due to investment-return constraints (6). This scenario enabled entry by smaller providers whose cost structures and operational scale allowed broadband deployment in lower-density regions.

Schiavon and Moreira (5) document disparities between capital cities and interior municipalities in terms of connectivity diffusion. Regional ISPs therefore emerged as actors filling these market gaps, generating a decentralized pattern of broadband expansion.

The initial broadband expansion phase in Brazil relied heavily on fixed wireless access and Ethernet-based networks over copper cabling. Although technically limited compared to optical architectures, these solutions reduced entry barriers and enabled relatively rapid territorial expansion (5).

In contrast, early broadband diffusion in the United States was strongly conditioned by DSL and cable infrastructure controlled by incumbent operators (2,3). Empirical research indicates that entry threats influenced rollout timing and offered speeds (4), yet structural concentration persisted across many local markets.

As bandwidth demand increased, network architectures evolved toward more stable and higher-

capacity solutions. Optical point-to-point links represented a step toward greater operational reliability and transmission capacity, anticipating broader adoption of scalable passive optical systems.

Literature on the broadband access market documents a structural shift in the functional role of ISPs, from pure intermediaries toward greater infrastructure involvement (1). In Brazil, this transition occurred alongside continued decentralized deployment dynamics.

The adoption of FTTH networks based on GPON architecture introduced significant gains in bandwidth efficiency, aggregated capacity, and economic viability for large-scale residential service provision (7,8). Abdellaoui et al. (7) demonstrate the technical advantages of GPON-based networks, while Sultan and Arefin (8) highlight their suitability for high-capacity multi-service delivery.

Urban mapping studies in Brazil indicate substantial improvements in connectivity capacity, although intra-urban heterogeneity remains present (9). Moreover, econometric analyses associate broadband expansion in less developed Brazilian regions with measurable regional productivity gains (10).

Next-generation architectures such as XGS-PON increase symmetric capacity and network scalability, aligning with the growing bandwidth demands of digital applications (13). These systems build upon GPON foundations while enhancing throughput and future-proofing network infrastructure.

The expansion of high-capacity networks responds to service-layer transformations and intensifying digital demand, reinforcing the strategic importance of scalable optical systems (13).

The U.S. residential broadband market remains characterized by limited provider diversity in many local markets (11,12). Flamm and Varas (11) identify durable duopolistic structures that influence pricing behavior and investment incentives.

Spatial distribution analyses further demonstrate that broadband availability has been closely tied to pre-existing infrastructure ownership patterns (2,3), contrasting with the decentralized deployment observed in Brazil (6).

The Brazilian trajectory suggests that decentralized entry in contexts of market failure may be associated with expanded territorial coverage (6). While such structures do not eliminate inequalities, empirical evidence indicates that broadband diffusion in Brazil has been linked to regional productivity improvements (10) and enhanced urban connectivity resilience (9).

These findings highlight the relevance of competitive architecture and entry conditions in shaping broadband diffusion outcomes.

The evolution of ISPs from dial-up intermediaries to operators of optical infrastructure reflects structural transformation documented in broadband market studies (1). Understanding this progression requires integrating technological change with competitive and regulatory dynamics.

Broader structural differences between Brazil and the United States in service-sector evolution provide additional context for divergent broadband trajectories (14). Furthermore, evolving telecommunications revenue models in Brazil underscore the increasing role of value-added services in sustaining infrastructure expansion (15).

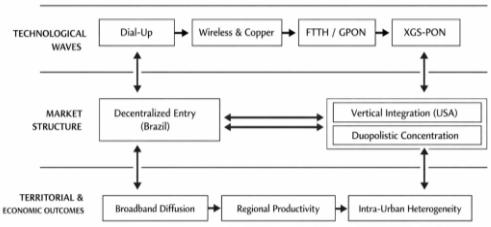

Figure 1. Conceptual Flowchart of the Evolution of Regional Internet Service Providers

Source: Created by author.

In conclusion, the evolution of regional ISPs in Brazil illustrates how decentralized entry combined with progressive technological adoption was associated with expanded territorial broadband diffusion. Technological transitions—from copper and wireless systems to GPON-based FTTH (7,8) and subsequently

to next-generation PON architectures (13)—altered deployment economics and scalability conditions.

In contrast, the persistence of concentrated market structures in the United States conditioned distinct rollout patterns and provider diversity (11,12). Spatial analyses indicate that broadband availability has remained closely linked to incumbent infrastructure ownership (2,3), while competitive threats influenced timing without eliminating structural concentration (4).

The comparison underscores that broadband expansion is shaped not only by technological capability but also by market architecture and entry incentives. The Brazilian case suggests that decentralized participation in contexts of identifiable market gaps may materially influence national connectivity outcomes, whereas the American experience highlights the structural implications of concentrated infrastructure ownership. Recognizing these divergent trajectories contributes to a deeper understanding of how technological waves and competitive structures jointly determine the pace, geography, and inclusiveness of broadband expansion.

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