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TV 3.0 in Brazil: From Technical Robustness to Business Model Sustainability

Jaqueline de Jesus Cerqueira and Soraia Vanessa Matarazzo

Abstract—This paper analyzes the adoption of TV 3.0 in Brazil as a technological transition in which physical-layer performance, regulatory design, and business sustainability are mutually dependent dimensions. Using a documentary, descriptive, and analytical approach based on public reports from the SBTVD Forum and normative documents on TV 3.0 deployment, the study examines three axes: the technical evidence from Phase 3 testing, covering real-time video coding with VVC configurations and physical-layer field tests at 28 measurement points in Rio de Janeiro using MIMO, LDM, and TxID; the application-layer governance functions, namely the Audience Measurement Manager and the Privacy Manager, that operationalize platform-level data collection and consent enforcement; and the business monetization potential associated with addressable advertising, datacasting, T-commerce, and broadcast-broadband integration. The paper argues that TV 3.0 should be understood not merely as an engineering advancement but as a platform reconfiguration of terrestrial broadcasting, whose economic viability depends on converting technical robustness into new revenue streams.

Index Terms—ATSC 3.0, VVC, terrestrial broadcasting, business model, datacasting, addressable advertising, DTV+, Brazil

I. INTRODUCTION

THE evolution of television broadcasting in Brazil has been driven by successive waves of technological change aimed at improving audiovisual quality, spectrum efficiency, and user experience. From the first black-and-white broadcasts in 1950 to the consolidation of digital terrestrial television, each transition has preserved backward compatibility while introducing new capabilities in image quality, sound, and service delivery. The first major structural shift occurred in 2006, when Brazil adopted the ISDB-Tb standard for its first-generation digital terrestrial television system, enabling high-definition video, mobile reception, and interactive services [12], [13]. Later upgrades, including HDR and immersive audio, extended this platform into what is often referred to as TV 2.5 [12].

In recent years, the spread of OTT platforms and broadband-based audiovisual consumption has intensified pressure on terrestrial broadcasting business models [17], [20]. In this environment, where terrestrial broadcasting reaches approximately 80% of the Brazilian population [27], TV 3.0 emerges not merely as a technical upgrade but as a strategic response

to the need for convergence between broadcast and broadband [16], [18], with the potential to support personalized content, addressable advertising, and datacasting [19]. The Brazilian SBTVD Forum formalized this transition through the TV 3.0 project, whose call for proposals and subsequent test phases established the requirements for the next generation of the national digital terrestrial television system [12], [13].

A central milestone in this process was the selection of ATSC 3.0 as the physical-layer technology for TV 3.0 [1], [10]. By August 2025, experimental DTV+ broadcasts were already on air in Rio de Janeiro and São Paulo, with the presidential decree signed on the same date establishing the regulatory framework for full deployment [14], [27]. Complementary work on video coding, especially with VVC-based configurations [7], [8], sought to determine the minimum bitrate required to achieve quality levels superior to those of the previous Brazilian system while preserving efficient use of the channel [9], [12]. These technical choices indicate that the new platform is being designed around a careful balance between audiovisual performance and spectral economy [1], [11].

The regulatory environment reinforces this transition. Decree No. 12 595/2025 formalized TV 3.0 as the second generation of the Brazilian Digital Terrestrial Television System and established that its deployment must occur without interrupting free-to-air access [14]. The decree further links the shutdown of the previous generation to the effective coverage of the new standard in each locality, making infrastructure maturity a condition for migration rather than a purely formal deadline [14].

This paper argues that TV 3.0 should be understood as a system-level innovation [23], [24] in which technical robustness and business sustainability are mutually dependent. Rather than treating physical-layer performance and revenue models as separate domains [19], [21], [26], the article integrates them into a single analytical framework centered on the transformation of broadcast infrastructure into a hybrid platform for content, data, and services [16], [18]. The paper is organized as follows: Section II presents the theoretical and regulatory framework; Section III describes the methodology; Section IV reports the technical results; Section V analyzes business sustainability; Section VI discusses the findings; and Section VII concludes the study.

II. THEORETICAL AND REGULATORY FRAMEWORK

A. Broadcast-Broadband Convergence

The architecture of ATSC 3.0 is designed around the coexistence of over-the-air broadcast and broadband delivery within

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a unified service framework [1], [10]. Unlike its predecessors, the standard natively supports IP-based transmission, enabling broadcasters to deliver linear content and data services through the same physical-layer infrastructure [10], [11]. This convergence is structural: the physical layer protocol explicitly defines mechanisms for hybrid service delivery, including MIMO, Layered Division Multiplexing (LDM), and Transmitter Identification (TxID) to optimize coverage, capacity, and robustness under varying reception conditions [1], [11].

Brazil's implementation goes beyond standard adoption: the DTV+ system integrates VVC over HEVC, MPEG-H Audio over AC-4 for immersive and personalized sound, and DTV Play over generic HTML5 interactivity, a strategic adaptation that configures a distinct national profile within the ATSC 3.0 ecosystem [12], [15], [27]. Hybrid broadcast-broadband systems, including those built on standards such as HbbTV, have demonstrated the viability of combining one-to-many transmission efficiency with the personalization capabilities of unicast delivery [16], [18]. In the ATSC 3.0 ecosystem, these capabilities are foundational to the deployment of addressable advertising, datacasting, and interactive applications [19], making convergence a prerequisite for business model innovation.

B. Regulatory Framework

In Brazil, the regulatory foundation for TV 3.0 is established by Decree No. 12 595/2025, which designates the new system as the second generation of the Brazilian Digital Terrestrial Television System (SBTVD) [14]. The decree sets three binding operational principles: continuity of free-to-air access throughout the transition period; progressive deployment conditioned on effective coverage in each locality; and coordination between the shutdown of the first-generation system and the verified availability of the new standard [14]. These principles transform infrastructure maturity into a legal condition for migration, linking technical performance directly to public policy outcomes.

C. Technology Transition and Business Model Theory

The analytical framework draws on three complementary bodies of theory. First, Rogers' diffusion of innovations model provides a basis for interpreting the adoption curve of TV 3.0 across broadcast markets [23]. Second, Christensen's theory of disruptive innovation offers a lens for understanding how ATSC 3.0 challenges the incumbent broadcast model through the introduction of a new value architecture [24]. Third, the Business Model Canvas framework [26] maps the revenue vectors enabled by TV 3.0, including addressable advertising [19], datacasting, and hybrid services, against the cost structure and partnerships required to sustain them.

Together, these lenses situate TV 3.0 as a platform reconfiguration of terrestrial broadcasting whose economic viability depends on converting physical-layer capabilities into recurring revenue streams [17], [20], [21].

TABLE I
MINIMUM BITRATE CONFIGURATIONS: TV 3.0 PHASE 3 [12]

Test	Resolution	Codec	Profile	Bitrate (Mbps)
TO-1	720p	VVC	HDR10	4.30
TO-2	1080p	VVC	HDR10	7.52
TO-3	2160p	VVC	HDR10	12.54
TO-4	1080p	VVC	Base	5.25
TO-5	2160p	LCEVC	VVC Base	8.08

III. METHODOLOGY

This study adopts a documentary, descriptive, and analytical research design, structured as a single-case study with multiple documentary sources. The case under analysis is the adoption of TV 3.0 in Brazil, understood as a technological transition with interdependent technical, regulatory, and economic dimensions.

The primary corpus consists of two technical reports produced by the Brazilian SBTVD Forum during the third phase of the TV 3.0 project: the real-time video coding subjective quality assessment report [12] and the over-the-air physical-layer field tests report [13]. These documents represent the most recent publicly available empirical evidence on the performance of the candidate technology under real deployment conditions in Brazil. The regulatory dimension is anchored in Decree No. 12 595/2025 [14] and in the official ATSC institutional communication on Brazil's adoption [27]. International benchmarks are drawn from publicly available deployment data [15].

The analytical strategy combines three procedures. First, quantitative data extraction is applied to the technical reports to retrieve performance metrics, including bitrate configurations by resolution and coding profile, and field measurement parameters from the 28 test points in Rio de Janeiro. Second, interpretive reading identifies the technical capabilities that each measured parameter enables at the service layer. Third, conceptual comparison maps these capabilities against the revenue vectors identified in the business sustainability literature [19], allowing technical robustness to be reinterpreted as a precondition for economic viability.

The scope of this study is limited to publicly available documentary sources. Primary research involving broadcast industry stakeholders, audience surveys, or receiver market data was not conducted and is acknowledged as a boundary of the present analysis.

IV. TECHNICAL RESULTS

A. Video Coding Performance

The real-time video coding phase of the TV 3.0 project aimed to determine the minimum bitrate required to deliver audiovisual quality that demonstrably exceeds that of the first-generation Brazilian system, establishing a performance floor for physical-layer design [12]. The assessment covered five test object configurations combining resolution, coding standard, and HDR profile, as summarized in Table I.

The results confirm that VVC achieves significantly higher coding efficiency than the H.264-based profiles used in the

TABLE II
PHYSICAL LAYER FIELD TESTS: RIO DE JANEIRO, 2024 [13]

Parameter	Value
Points	28 (fixed + portable)
Area	Rio de Janeiro metropolitan
Features	MIMO, LDM, TxID
Distance	0.4–11.0 km
C/N (dB)	Outdoor: 12–14 (med. 13); Indoor: 14–16 (med. 15)
PER	MIMO 2×2: QEF at most points LDM robust layer: C/N $\gtrsim$ 0 dB
Efficiency	5.1–5.4 bps/Hz (single layer)

first-generation system, consistent with findings in the standardization literature [7], [8]. The bitrate range across tested configurations, from 4.30 Mbps at 720p to 12.54 Mbps at 2160p HDR10, demonstrates that 4K delivery is viable within standard channel allocations, while the LCEVC-enhanced 4K configuration (TO-5) achieves 8.08 Mbps by combining a VVC base layer with a lightweight enhancement stream [9]. Alongside video, the Brazilian DTV+ system adopts MPEG-H Audio as the immersive audio standard, enabling object-based personalization, such as independent narrator level control, as a native broadcast feature [12], [27].

B. Physical Layer Field Tests

Field evaluation of the ATSC 3.0 candidate solution was conducted across 28 measurement points in the metropolitan area of Rio de Janeiro, covering a range of propagation environments, receiver distances, and obstruction levels [13]. The test campaign included both outdoor fixed and indoor portable reception scenarios (Table II). Key physical-layer features exercised included Multiple Input Multiple Output (MIMO) antenna configurations [2], Layered Division Multiplexing (LDM) for simultaneous delivery of fixed and mobile services [3], [4], and Transmitter Identification (TxID) for network monitoring [1], [11].

The candidate solution demonstrated robustness and flexibility across all evaluated scenarios. Outdoor C/N measurements ranged from 12 to 14 dB (median $\approx$ 13 dB), while indoor scenarios showed slightly higher values of 14–16 dB (median $\approx$ 15 dB), consistent with the propagation gain provided by MIMO [1], [13]. In the single-layer 30 Mbps configuration, spectral efficiency reached 5.1–5.4 bps/Hz; the two-layer LDM configuration achieved approximately 3.5 bps/Hz total, allocating $\sim$ 1.8 bps/Hz per layer within a 6 MHz channel [3], [4]. MIMO 2×2 sustained quasi-error-free (QEF) reception at most of the 28 test points, with packet error rate (PER) degradation observed only at C/N below $\sim$ 8–10 dB or RSSI below $\sim$ -75 dBm. The field results confirm that the physical layer, as configured for TV 3.0, is technically capable of supporting the hybrid service architecture described in Section II.

C. Application Coding Layer

The technical evidence presented in Sections IV-A and IV-B establishes the physical-layer and video-coding conditions

under which TV 3.0 operates, but the monetization vectors discussed in Section V, particularly addressable advertising and datacasting, are enacted at the application coding layer, through the TV 3.0 Application-oriented Platform (AoP). Recent SET IJBE work specifies this layer in detail. The Audience Measurement Manager (AMM) is defined as a native AoP middleware component responsible for collecting, structuring, and delivering audience usage data to broadcasters through dedicated APIs, without requiring tracking logic embedded in individual broadcaster applications [28]. This architecture directly operationalizes the audience-data foundation on which the addressable-advertising argument in Section V depends, moving data collection from an application-level responsibility to a platform-level guarantee.

Complementing this, the TV 3.0 Privacy Manager mediates all AMM and application access to viewer data through a standardized Privacy Record Request Description (PRRD), transmitted as part of Service Layer Signaling and interpreted independently of Broadcaster Applications' own logic [29]. Access to audience-measurement and advertising-relevant APIs is conditioned on the viewer's recorded privacy state, enforced at the middleware level rather than left to each application's self-declaration. This governance layer is a necessary, though frequently overlooked, precondition for the addressable-advertising and datacasting vectors argued in Section V: without platform-enforced consent and access control, household-level targeting would rest on an application-dependent, unauditable basis.

Both mechanisms sit within the broader application coding layer that has been under continuous specification since the earliest phases of the TV 3.0 project, encompassing DTV Play's HTML5-based interactive environment and its supporting infrastructure for advertising and transactional services [30]. Taken together, AMM and the Privacy Manager provide the missing operational bridge between the physical-layer robustness demonstrated in Sections IV-A and IV-B and the business-sustainability argument developed in Section V.

V. BUSINESS SUSTAINABILITY ANALYSIS

The technical capabilities demonstrated in the field tests and video coding phase create conditions for a significant expansion of the revenue base of terrestrial broadcasting. This section identifies four primary monetization vectors enabled by TV 3.0, mapped against the Business Model Canvas framework [26] and grounded in evidence from international deployments and market data.

The first and most commercially immediate vector is addressable advertising. The broadcast-broadband architecture of ATSC 3.0 enables household-level ad targeting within over-the-air transmissions, commanding significantly higher CPMs than conventional linear inventory [19]. Recent industry research values the global addressable TV advertising market in the low single-digit billions of USD in the mid-2020s, with projections exceeding USD 20 billion by the early 2030s and compound annual growth rates above 15% [22]. These figures indicate that data-driven, privacy-compliant targeting is not a marginal innovation but a rapidly expanding revenue pool that TV 3.0-enabled broadcasters can tap into.

The second vector is datacasting, which exploits the broadcast channel's one-to-many efficiency to deliver large data volumes (firmware updates, emergency alerts, public service content, and B2B data distribution) independently of broadband infrastructure [15]. In a country with persistent connectivity gaps and heterogeneous broadband quality, broadcast-based data delivery can serve both as a commercial service (for example, software distribution or content delivery to retail points of presence) and as a public-interest infrastructure for alerting and education. By decoupling capacity from unicast network congestion, TV 3.0 datacasting can lower per-bit delivery costs for specific classes of traffic, especially in scenarios with many receivers and predictable content.

The third vector combines interactive commerce and app-based navigation. DTV Play enables T-Commerce, direct purchase transactions triggered from the remote control, while the elimination of channel numbers in favor of an app-driven interface aligns the broadcast experience with streaming conventions [15], [19]. This repositioning has direct implications for user engagement metrics and advertiser targeting: broadcasters can monetize not only impressions but also clicks, interactions, and completed transactions, creating hybrid revenue models that mix classical spot sales, performance-based campaigns, and affiliate arrangements.

The fourth vector is the broader hybridization of broadcast and broadband services. In this configuration, linear channels, VOD catalogs, data services, and third-party applications coexist in a unified environment, where ATSC 3.0 provides high-reliability delivery of mass-audience content and broadband supplies personalized assets, backchannel data, and long-tail libraries [16], [18]. International experience with NextGen TV deployments shows that such hybrid offerings are becoming central to competitive positioning: in the United States, for example, ATSC 3.0 services have been launched in dozens of metropolitan markets, with coverage already reaching tens of millions of TV households, and with broadcasters explicitly framing addressability, data services, and enhanced interactivity as core value propositions for advertisers and audiences [15], [22].

Taken together, these vectors indicate that TV 3.0 repositions terrestrial broadcasting from a single-revenue linear platform into a multi-layered service architecture [20], [21]. In this architecture, spectrum is no longer devoted exclusively to linear audiovisual streams, but shared among high-value targeted advertising, datacasting contracts, T-Commerce, and hybrid applications. The sustainability of this model depends on three enabling conditions: the availability of compatible receivers at scale; the development of measurement and attribution infrastructure for addressable campaigns; and the consolidation of industry standards and governance mechanisms for data service delivery, conditions that the Brazilian transition timeline must address alongside coverage milestones [17].

VI. DISCUSSION

The findings support the interpretation of TV 3.0 as a system-level innovation rather than an incremental upgrade. The evidence from Phase 3 reports [12], [13] demonstrates that

the physical layer and video coding components have achieved maturity sufficient for large-scale deployment. The regulatory framework established by Decree No. 12 595/2025 [14] provides institutional continuity by linking migration to coverage rather than to a fixed calendar, thereby reducing the risk of stranded investments and service disruption. The institutional framing of this transition is itself worth noting: ATSC's own communication describes the decree as the outcome of a rigorous evaluation of next-generation broadcast technologies for long-term deployment [27]. Read as a stakeholder statement rather than a neutral technical assessment, this framing is unsurprising: ATSC has an evident interest in presenting Brazil's adoption as validation of the standard's own design choices. Its relevance here lies less in confirming the technical merit already documented in Sections IV-A and IV-B, and more in illustrating how international standard-setting bodies mobilize national adoption decisions as evidence of their standard's competitive positioning.

International experience with NextGen TV reinforces this system-level reading. In the United States, ATSC 3.0 services have been launched in more than sixty metropolitan markets, and coverage is estimated to reach roughly half of U.S. TV households, with broadcasters explicitly positioning addressable advertising, enhanced audio-visual quality, and hybrid services as central elements of their competitive strategies [15], [22]. These figures indicate that the technology package adopted for TV 3.0 is not an experimental outlier but part of a broader global movement toward IP-native, data-enabled terrestrial broadcasting.

From a theoretical standpoint, the adoption trajectory of TV 3.0 in Brazil aligns with Rogers' diffusion of innovations model [23]. The technology is transitioning from early-adopter evaluation to the conditions required for early-majority adoption, with receiver availability, ecosystem readiness, and regulatory clarity functioning as critical threshold variables. Christensen's framework [24] adds a further dimension: the new platform introduces a distinct value architecture that renders previous monetization logic progressively obsolete, shifting the emphasis from single-stream linear advertising to multi-sided platform revenues based on data, interactivity, and service layering.

One boundary of this study requires acknowledgment: the analysis is grounded in documentary sources and does not include primary data from broadcasters, advertisers, or consumers. The translation of technical capability into actual revenue remains contingent on market conduct, competitive responses, and institutional factors that lie beyond the scope of the present evidence base and constitute a priority agenda for future empirical research. In particular, the pace at which compatible receivers are adopted, how measurement and attribution systems for addressable campaigns are implemented, and how regulators and industry associations govern data use will largely determine whether the potential business vectors identified in Section V become structurally embedded or remain confined to pilot projects.

VII. CONCLUSION

This paper examined the adoption of TV 3.0 in Brazil as an integrated technological transition encompassing physical-layer performance, regulatory design, and business model sustainability. The evidence drawn from SBTVD Forum Phase 3 reports demonstrates that the ATSC 3.0-based DTV+ solution achieves the technical robustness required for real-world deployment, while VVC-based video coding [7] provides the coding efficiency needed to support high-resolution services within the available channel capacity [1]. Field tests in Rio de Janeiro confirmed that the chosen physical-layer configuration can deliver quasi-error-free reception across heterogeneous propagation conditions, supporting the hybrid service architecture described in this work [12], [13].

International experience with NextGen TV reinforces the strategic relevance of this transition: ATSC 3.0 services in the United States have already been launched in dozens of metropolitan markets and are estimated to reach roughly half of U.S. TV households, signaling that IP-native terrestrial broadcasting is moving beyond the experimental stage [15], [22]. In parallel, global and regional markets for addressable TV advertising and ad-supported streaming are growing at double-digit compound annual rates, indicating that data-driven, hybrid monetization models are becoming central to audiovisual economics [19], [22].

The central argument of this study, that technical performance and economic viability are mutually constitutive, is supported by the convergence of three dimensions: the physical-layer capabilities that enable new service architectures, the regulatory framework that guarantees continuity and consumer protection [14], and the monetization vectors that transform infrastructure investment into recurring revenue [19], [26]. The diffusion of TV 3.0 across the Brazilian market will ultimately depend on the rate at which this cycle between technology, regulation, and business model becomes self-reinforcing [23].

Future work should examine receiver market penetration, broadcaster revenue modeling under hybrid service scenarios, and consumer adoption patterns across different socioeconomic segments, as well as the governance of data and privacy in addressable services, dimensions that require primary empirical data beyond the scope of documentary analysis.

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