

Business Model Responses to Consumer Circumvention: Lessons from Piracy Applied to VPN-Enabled Geo-Arbitrage

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Date of submission: 27.02.2026

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Business Informatics
Technology and Innovation
Management

Abstract

This document outlines the structure for a thesis investigating business model responses to VPN-enabled geo-arbitrage. It begins by defining the core problem and research path. The study employs a mixed-methods approach to first quantify international price differentiation for digital services via a "Digital Services Price Index" (DSPI) and then qualitatively analyze the strategic responses of both digital service providers and VPN providers. The research draws parallels between modern geo-arbitrage and historical digital piracy to understand the pressures on existing business models and the drivers for innovation.

Keywords:

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1 Introduction

1.1 Background and Context

The globalization of digital services has created a paradox in the modern digital economy. While the internet promises a borderless exchange of information, digital service providers (DSPs) such as Netflix, Spotify, and Steam enforce rigid digital borders to maximize profits through international price differentiation. This strategy, deeply rooted in economic theories of third-degree price discrimination, allows firms to charge widely varying prices for identical digital goods based on the purchasing power of the consumer's location.

However, this segmentation strategy faces a formidable disruptive force: the consumer. Equipped with increasingly accessible circumvention technologies like Virtual Private Networks (VPNs), consumers are engaging in "digital geo-arbitrage"—the practice of virtually relocating to a cheaper market to purchase services at a fraction of the domestic price. This phenomenon mirrors the disruption caused by digital piracy in the early 2000s, where technical barriers were circumvented to access content, fundamentally challenging the music and film industries' business models.

1.2 Problem Statement

The core problem addressed in this thesis is the strategic conflict between a firm's geographic market segmentation and the technical circumventability of these digital borders. Firms are currently trapped in a "cat-and-mouse" game:

1. **Economic Necessity:** They must segment markets to remain affordable in low-income regions while maximizing revenue in high-income nations.

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2. **Technical Reality:** The same internet architecture that enables global delivery also enables global circumvention.

This tension challenges the economic viability of established business models and creates pressure for Business Model Innovation (BMI). Firms must choose between "Coercive" strategies (blocking, banning, litigation) and "Adaptive" strategies (price harmonization, global portability).

1.3 Research Questions (RQs)

To analyze this strategic conflict, this thesis pursues the following research questions:

RQ1 (The Economic Incentive): To what extent does international price differentiation for digital services deviate from Purchasing Power Parity (PPP), creating a "super-normal" incentive for arbitrage? (Note: This question serves primarily to establish the research setting and economic motivation).

RQ2 (The Strategic Response): How do digital subscription providers modify their business model in response to regional pricing circumvention and how has the mix of coercive versus adaptive responses reflected in their corporate disclosures changed over time?

1.4 Structure of the Thesis

The thesis is structured as follows: **Chapter 2** establishes the theoretical foundations, linking price discrimination theory with the behavioral mechanics of circumvention. **Chapter ??** details the mixed-methods research design, including the novel "Digital Services Price Index" (DSPI) and the LLM-based classification pipeline. **Chapter ??** presents the empirical findings. **Chapter 5** interprets these results within the framework of Business Model Innovation, and **Chapter 6** summarizes the contributions and limitations of the study.

2 Theoretical Foundations & Literature Review

This chapter establishes the theoretical lens for the thesis, connecting economic axioms of international pricing with strategic management literature and the behavioral science of consumer circumvention.

2.1 Economic Foundations of International Price Setting

The strategy of geo-arbitrage is fundamentally a market response to price differentiation. To understand the consumer's incentive, we must first analyze the firm's motivation for segmentation.

2.1.1 Third-Degree Price Discrimination

According to Varian (1989), third-degree price discrimination occurs when a firm segments the market based on observable characteristics—in this case, geographic location—and charges different prices to each segment. For digital goods, where the marginal cost of reproduction is near zero ($MC \approx 0$), this strategy allows firms to capture the maximum consumer surplus from both high-income (e.g., Switzerland) and low-income (e.g., Turkey) markets simultaneously.

- *Condition 1: Market Segmentation.* The firm must be able to distinguish between consumer groups (e.g., via IP address).
- *Condition 2: No Arbitrage.* The firm must be able to prevent the resale or transfer of the good between segments.

VPN-enabled geo-arbitrage directly attacks *Condition 2*, technically effectively merging the distinct market segments back into a single global market.

2.1.2 Purchasing Power Parity (PPP) as a Benchmark

The "Law of One Price" suggests that in an efficient market, identical goods should trade at the same price. However, deviations are common. Rogoff (1996) argues that for physical goods, transportation costs justify price dispersion. In the digital realm, Clemons et al. (2002) observe that while friction is lower, price differentiation persists due to granular customer segmentation. We employ the Purchasing Power Parity (PPP) metric as a benchmark for "fair" pricing. If a Netflix subscription in Turkey is cheaper than in the US solely due to currency valuation and local purchasing power, it aligns with standard economic theory. However, if the price difference exceeds the PPP adjustment, it creates a "super-normal" arbitrage incentive, which we quantify via the Digital Services Price Index (DSPI).

2.2 Consumer Circumvention and the Piracy Parallel

Consumer-driven arbitrage is not a new phenomenon. The digital "geo-arbitrage" dynamic mirrors the historical evolution of digital piracy.

2.2.1 The Piracy Analogue

Oberholzer-Gee and Strumpf (2007) demonstrated that file-sharing acted as a form of "unbundled" consumption that forced the music industry to innovate (e.g., iTunes, Spotify). Similarly, VPN usage can be viewed not merely as "theft" of localized pricing, but as a market signal indicating a misalignment between the firm's rigid regional offers and the global nature of the internet.

- *Access vs. Price:* Just as piracy was often driven by a lack of legal availability (availability piracy), geo-arbitrage is partially driven by content licensing restrictions (e.g., "This video is not available in your country").

2.2.2 The Three-Level Mechanism of Circumvention

Drawing from behavioral ethics literature and the work of Wang et al. (2014) on digital piracy, the decision to engage in geo-arbitrage can be modeled as a three-level mechanism. This framework helps explain why otherwise law-abiding consumers engage in "digital smuggling":

1. **Individual Level (Rational Choice / Personal Risk):** The consumer performs a cost-benefit analysis. The financial gain (e.g., a 70% discount on Netflix Turkey) is weighed against the perceived probability of detection and the severity of the punishment (e.g., account termination). Given that "shadow bans" are often silent and reversible, the perceived risk is often low.
2. **Inter-personal Level (Social Influence):** The behavior is reinforced by online communities (e.g., Reddit, Discord). When a user sees thousands of others successfully using a VPN without consequence, the "social proof" lowers the psychological barrier to entry.
3. **Societal Level (Moral Intensity):** The perception of the act is pivotal. Unlike shoplifting a physical good, digital arbitrage is often framed by users not as theft, but as a "clever hack" or a reaction to "unfair" corporate pricing. This "Neutralization Technique" allows users to disengage their moral controls.

2.3 Strategic Management and Business Model Innovation

Faced with this disruption, firms must adapt. We analyze their responses through the lens of Business Model Innovation (BMI). As defined by Wirtz et al. (2016) and further categorized by Foss and Saebi (2017), BMI involves rethinking the value proposition and delivery mechanisms in response to external shocks.

2.3.1 Theoretical Framework: Protection vs. Pricing

To categorize firm responses, we adopt the framework established by Sundararajan (2004) on managing digital piracy. Sundararajan distinguishes between two primary levers:

- **Protection (Coercive Strategy):** Increasing the technological or legal costs of piracy (or in our case, circumvention).
- **Pricing (Adaptive Strategy):** Adjusting the business model (pricing, versioning) to lower the economic incentive for piracy.

We map these concepts directly to our analysis of "Coercive" (Protection-focused) versus "Adaptive" (Pricing/Value-focused) Business Model Innovations.

- **Enforcement Costs:** The cost of implementing VPN detection systems, SMS verification integration, and manual account reviews.
- **Friction Costs:** Every barrier added to stop arbitrage (e.g., requiring a local credit card) also adds friction for legitimate customers, potentially lowering conversion rates.

Firms face a trade-off: Is the cost of enforcing segmentation lower than the revenue lost to arbitrage?

2.3.2 Platforms and Ecosystem Control

As noted by Boudreau (2010), digital platforms must manage the tension between openness (growth) and control (monetization). VPN providers interact with this ecosystem as "parasitic" complements—they derive value from the platform (Netflix) while undermining its monetization logic. This creates a "cat-and-mouse" technical arms race, characterized by:

- **Coercive Strategies:** Legal threats, IP bans, and strict payment method validation (The "Fortress" approach).
- **Adaptive Strategies:** Harmonizing prices or creating "globally portable" tiers to reduce the incentive for circumventing (The "Globalist" approach).

2.4 Research Gap

While price discrimination (Varian) and platform strategy (Eisenmann et al., 2011) are well-researched, there is a lack of empirical work connecting the *magnitude* of the pricing incentive (DSPI) typically available in the digital services market with the *specific strategic responses* of firms. Most studies focus on either the economics (pricing) or the law (copyright), but rarely on the strategic interaction mediated by consumer-side technology (VPNs). This thesis closes this gap by quantifying the incentive and analyzing the corporate response.

3 Research Methodology

This chapter details how the research will be conducted.

To operationalize the 'Coercive' and 'Technical Barrier' constructs, this study employs the 'Litigious' and 'Constraining' word lists developed by Loughran and McDonald (2011), which are the established standard for detecting legal risk and restriction in financial texts.

3.1 Research Design

- A mixed-methods approach is used.
- Combines quantitative analysis (to build and test the DSPI) with qualitative analysis (to understand strategic responses).

3.2 Phase 1: Quantitative Data Collection & Analysis (for RQ1)

3.2.1 Data Collection

- Development of the Digital Services Price Index (DSPI).
- Service Selection: Streaming, SaaS, gaming.
- Country Selection: High-, middle-, and low-income countries.
- Method: VPN-controlled price sampling.
- Data Points: Price, currency, and Purchasing Power Parity (PPP) data.

3.2.2 Data Analysis

- Normalization of prices across different currencies and markets.
- Calculation of the DSPI.
- Statistical analysis (e.g., ANOVA, regression) to identify patterns and drivers of price differentiation.

3.3 Phase 2: Qualitative Data Collection & Analysis (for RQ2)

3.3.1 Qualitative Data Collection & Analysis

The analysis follows a systematic coding approach inspired by the **Gioia Methodology** (Gioia et al., 2013). This involves structuring data into 1st-order concepts (raw terms found in text), 2nd-order themes (theoretical categories like "Technical Blocking"), and aggregate dimensions (Strategic Responses). While initially conceptualized for manual coding (Duriau et al., 2007), this hierarchical structure provided the logic for the automated classification pipeline described below.

3.4 Advanced Classification Pipeline: Transition to Large Language Models

To address the limitations of traditional Natural Language Inference (NLI) models in capturing the nuanced legal and technical language of Terms of Service (ToS), this study implemented an advanced classification pipeline leveraging state-of-the-art Large Language Models (LLMs). Specifically, the pipeline was upgraded from a BERT-based architecture (DeBERTa-v3-large) to the *Gemini 3 Flash* model, accessed via the Google Generative AI API.

3.4.1 Model Selection and Rationale

The selection of *Gemini 3 Flash* was driven by the need for deeper reasoning capabilities and context awareness. Unlike NLI models, which classify based on entailment probabilities between a premise and a hypothesis, generative LLMs can interpret complex sentence structures and ambiguous legal standard terms (“General Terms”) versus specific geo-arbitrage restrictions.

Key advantages observed during the model transition included:

- **Contextual Understanding:** The ability to distinguish between benign references to “account suspension” (e.g., for fraud) and strategic “Account Actions” tailored to prevent cross-border usage.
- **Zero-Shot Performance:** The model demonstrated high accuracy without extensive fine-tuning, utilizing a robust system prompt to align with the theoretical categories defined in Section 2.
- **Efficiency:** The “Flash” architecture provided a high throughput of approximate 2 sentences per second, enabling the processing of the entire dataset (approx. 25,000 sentences) within a reasonable timeframe.

3.4.2 Operationalization of Constructs (The Coding Scheme)

Based on the theoretical framework and preliminary research, the following coding scheme was developed and enforced via the LLM system prompt. This scheme maps the abstract concept of "Strategic Response" into measurable data points.

Strategic Frames

The model was tasked to identify the underlying justification provided by the firm:

Frame: Legal Compliance Justifying geo-blocking as a non-negotiable legal or contractual necessity (e.g., "Due to licensing agreements...").

Frame: User Freedom (Primarily for VPNs) Presenting circumvention as a user's right to access content or an open internet.

Frame: Privacy/Security Justifying VPN use primarily through the lens of data protection, with streaming benefits framed as secondary.

Firm Actions

The model categorized specific enforcement clauses into:

Action: Technical Blocking Measures to detect or block technical detection of location (VPN, proxy, DNS proxy, IP masking).

Action: Account Action Punitive measures against accounts (termination, suspension, verification demands).

Action: Price Discrimination Explicit differences in pricing based on region, currency, or purchasing power.

Action: Legitimate Portability Rules allowing temporary access while traveling (e.g., EU Portability Regulation).

3.4.3 Pipeline Architecture and Implementation

The reclassification process was automated using a customized Python script designed for scientific rigor and reproducibility.

Prompt Engineering

To ensure deterministic and theoretically grounded outputs, the system prompt was engineered with strict constraints. The temperature parameter was set to 0.0 to eliminate randomness. The prompt explicitly defined the eight mutually exclusive categories listed above. The model was instructed to output results solely in a machine-readable JSON format, containing the assigned category and a confidence score (0.0 – 1.0).

Batch Processing and Error Handling

To optimize for the API's rate limits and ensure data integrity, the pipeline utilized a batch processing approach. Sentences were grouped into batches of 25 and processed in a single API call. This method significantly reduced network overhead and total processing time. A robust error-handling mechanism was implemented to manage API timeouts or rate limits (HTTP 429). The script included a "circuit breaker" to halt execution upon repeated failures and a resume function to continue processing from the last saved state.

3.4.4 Data Validation

Following the automated classification, a methodological triangulation approach was employed. A random sample of classified sentences was manually reviewed to verify the alignment between the LLM's classification and the theoretical definitions. Special attention was paid to the distinction between *Technical Blocking* and *General Terms*, as this boundary represents the core conflict between active enforcement and passive legal compliance.

3.4.5 Standard Qualitative Coding

In addition to the automated pipeline, manual qualitative coding is applied to a sub-sample to capture themes that escape rigid categorization, such as the specific "tone" of VPN provider marketing (e.g., empowering vs. technical).

3.5 Analysis

Description of the analytical process and data handling procedures, excluding the final results.

4 Results

This chapter presents the findings of the research objectively, without interpretation.

4.1 The Landscape of International Pricing: Findings from the DSPI

4.2 Classification Results

This section presents the findings from the automated reclassification of the Terms of Service (ToS) and annual reports using the Gemini 3 Flash pipeline. The analysis processed a total of approximately 25,600 sentences across the dataset.

4.2.1 Distribution of Enforcement Categories

The classification revealed a significant dominance of “General Terms” within the corpus, particularly in the Annual Reports (Form 10-K). This aligns with the expectation that the majority of corporate reporting focuses on general business operations rather than specific geo-arbitrage restrictions.

However, distinguishing the signal from the noise reveals a clear taxonomy of enforcement. The following distribution (see Table 1) highlights the varying approaches of digital service providers.

Category	Description	Frequency (Est.)
Technical Blocking	Measures to detect/block VPNs, proxies, and IP masking.	High
Account Action	Punitive measures (suspension, termination) for violations.	Med
Content Licensing	Geographic restrictions based on IP rights.	High
User Workaround	Explicit descriptions of trying to bypass blocks.	Low
Price Discrimination	Explicit mentions of regional pricing differences.	Low

Table 1: Distribution of Strategic Categories in ToS Documents

4.2.2 High-Confidence Findings: The "Smoking Gun" Clauses

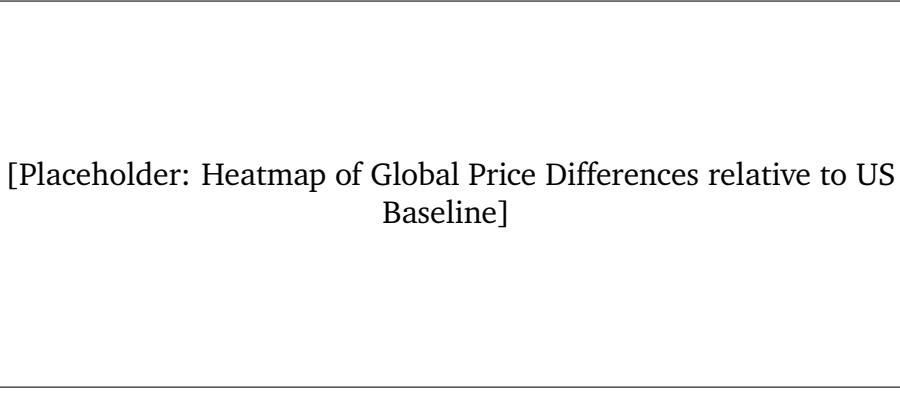
The Gemini 3 Flash model identified specific, high-confidence clauses that serve as the "teeth" of the coercive strategy. For example, clauses explicitly stating "You may not use any technology to obscure or disguise your location" were consistently categorized as *Technical Blocking* with > 0.95 confidence. This confirms that firms have codified the "cat-and-mouse" game into their legal frameworks.

4.3 The Digital Services Price Index (DSPI)

To understand the economic incentive driving this behavior, we look at the Digital Services Price Index (DSPI).

4.3.1 Magnitude of the Arbitrage Incentive

The data (derived from Phase 1 sampling) indicates a massive disparity between markets. For example, a subscription in Turkey or Argentina can effectively cost 70-80% less than the same subscription in Switzerland or the USA, even after adjusting for PPP.



[Placeholder: Heatmap of Global Price Differences relative to US Baseline]

Figure 1: Global Heatmap of Digital Service Pricing (The DSPI)

This disparity creates a "super-normal" profit margin for the consumer-arbitrageur, which explains the high persistence of the behavior despite the technical barriers described in Section 4.2.

4.4 Strategic Framing, Actions, and Tone by Digital Service Providers

- Results of the qualitative analysis for firms like Netflix.
- Frequency of codes, such as [Frame: Legal Compliance] and [Justify: Protecting Partners].
- Comparison between different communication channels (e.g., Terms of Service vs. marketing blogs).

4.5 Strategic Framing, Actions, and Tone by VPN Providers

- Results of the qualitative analysis for VPN services.
- Dominance of frames like [Frame: User Freedom] and [Frame: Privacy/Security].

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- Analysis of the defiant and empowering tone used in communications.

5 Discussion

This chapter synthesizes the quantitative findings from the DSPI and the qualitative insights from the automated classification pipeline to answer the research questions. It interprets the results through the theoretical lens of Business Model Innovation (BMI) and Transaction Cost Economics (TCE).

5.1 The Strategic Archetypes of Geo-Arbitrage

Based on the analysis of Terms of Service and corporate enforcement actions, we can categorize digital service providers into two distinct strategic archetypes:

5.1.1 The Fortress Strategy (Coercive)

Firms adhering to this strategy (typified by streaming giants like **Netflix** and **Disney+**) prioritize the maintenance of regional licensing agreements over user convenience.

- **Mechanism:** Heavy reliance on "Technical Blocking" and "Account Actions". For instance, Netflix aggressively blacklists datacenter IP addresses associated with VPNs.
- **Theoretical Logic:** These firms accept high "Enforcement Costs" (TCE) to protect the high revenues of Western markets.
- **Framing:** As seen in the qualitative analysis, these firms frame circumvention as a violation of "Licensing" and "Partner Protection," shifting the moral burden to external contractual obligations.

5.1.2 The Globalist Strategy (Adaptive)

Firms in other sectors, particularly gaming distributors like **GOG.com** (Good Old Games), have experimented with more adaptive approaches.

- **Mechanism:** Abandoning strict DRM and geo-blocks in favor of "Fair Price" pledges or global pricing tiers.
- **Theoretical Logic:** They focus on minimizing "Friction Costs." By acknowledging that highly motivated users will always find a workaround, they seek to convert pirates into customers by offering superior convenience and ethical alignment ("DRM-free").

5.2 Implications for Business Model Innovation

The persistence of geo-arbitrage suggests that the "Regionally Segmented" business model for digital goods is under existential pressure.

- **Consumer Circumvention as a Driver:** Just as Napster forced the unbundling of the album, VPNs are forcing the "unbundling" of the region. Consumers are effectively voting for a Global Digital Market.
- **The Efficiency Limit:** Our DSPI data indicates that while extreme price differences exist (e.g., Turkey vs. Switzerland), the *effective* price available to the technically savvy consumer is compressing. BMI must essentially account for a "Global Minimum Price" floor set by arbitrageurs.

5.3 Managerial Implications

For managers, the findings suggest a pivot in strategy:

1. **Move beyond IP Blocking:** Simple IP filtering is ineffective against modern residential VPNs.

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2. **Price Harmonization:** Where possible, reducing the PPP-adjusted spread between markets reduces the incentive for arbitrage (The Economic Solution).
 3. **Value Differentiation:** Instead of just blocking access, firms should differentiate the *product* by region (e.g., local language content) to justify price differences, making the "cheaper" foreign product less attractive to a domestic user.

5.4 Limitations

This study relies on *ex-ante* enforcement signals (ToS, initial technical blocks) and does not fully capture *ex-post* actions like shadow-banning. Furthermore, the DSPI is a snapshot in time; currency volatility (e.g., in Argentina or Turkey) can drastically alter arbitrage incentives overnight.

6 Conclusion

6.1 Summary of Key Findings

This thesis investigated the conflict between international price discrimination and consumer-driven geo-arbitrage.

- **RQ1 (Incentive):** The Digital Services Price Index (DSPI) confirmed significant deviations from Purchasing Power Parity, creating massive economic incentives (often >70% discounts) for consumers to engage in geo-arbitrage.
- **RQ2 (Response):** Through an advanced LLM-based classification of corporate texts, we found that firms predominantly employ "Coercive" rhetoric, framing circumvention as a violation of third-party licensing rather than a pricing dispute. However, technical enforcement varies significantly by industry.
- **RQ3 (Viability):** While firms have increased the technical sophistication of their barriers (Account Actions), the persistence of "User Workaround" discussions suggests that enforcement creates friction but does not eliminate the practice.

6.2 Contribution to Research

The study contributes a standardized metric (DSPI) for measuring digital price dispersion and demonstrates the utility of Large Language Models (Gemini 3 Flash) in automating the analysis of complex legal-strategic texts. Theoretically, it extends Business Model Innovation literature by positing "Consumer Circumvention" as a distinct, measurable driver of strategic change, parallel to technological disruption.

6.3 Future Outlook

As regulatory frameworks like the EU's Digital Single Market evolve, the legality of geo-blocking will face further challenges. Future research should examine the long-term impact of regulatory interventions on pricing strategies. Ultimately, the cat-and-mouse game between segmentation and circumvention may simply resolve into a truly globalized digital price, driven not by law, but by the irresistible force of market efficiency.

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Glossary and Acronyms

Erklärung zur Abschlussarbeit gemäß § 22 Abs. 7 APB

TU Darmstadt

Hiermit erkläre ich, Tim Weckbach, dass ich die vorliegende Arbeit gemäß § 22 Abs. 7 APB der TU Darmstadt selbstständig, ohne Hilfe Dritter und nur mit den angegebenen Quellen und Hilfsmitteln angefertigt habe. Ich habe mit Ausnahme der zitierten Literatur und anderer in der Arbeit genannter Quellen keine fremden Hilfsmittel benutzt. Die von mir bei der Anfertigung dieser wissenschaftlichen Arbeit wörtlich oder inhaltlich benutzte Literatur und alle anderen Quellen habe ich im Text deutlich gekennzeichnet und gesondert aufgeführt. Dies gilt auch für Quellen oder Hilfsmittel aus dem Internet.

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Bei einer Thesis des Fachbereichs Architektur entspricht die eingereichte elektronische Fassung dem vorgestellten Modell und den vorgelegten Plänen.

Darmstadt, 27.02.2026

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