

# SEP/FRAND as Instruments of Technological Sovereignty: Rethinking Global IP Governance in an Era of Geoeconomic Fragmentation

## SEP/FRAND como Instrumentos de Soberanía Tecnológica: Repensando la Gobernanza Global de la Propiedad Intelectual en una Era de Fragmentación Geoeconómica

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### Abstract

The SEP/FRAND regime has become one of the most sophisticated structures of private coordination within the digital economy, designed to reconcile patent protection with the technological standardization necessary for market interoperability. The geoeconomic transformations of recent decades, however, have placed increasing pressure on this institutional architecture, shifting the debate beyond traditional concerns related to economic efficiency, competition, and the licensing of essential technologies. In strategic sectors such as telecommunications, artificial intelligence, the Internet of Things, and semiconductors, the ownership of standard-essential patents and the definition of access conditions to standardized technologies have come to influence broader dynamics of strategic autonomy, industrial competitiveness, and the distribution of power within the global economy. In this context, the SEP/FRAND system no longer operates exclusively as a mechanism of private innovation governance, but assumes a relevant role in structuring technological dependencies and shaping the critical infrastructures of the digital economy. Based on bibliographical, documentary, and jurisprudential research, this article argues that the politicization of technological governance requires a reinterpretation of the SEP/FRAND regime as an instrument of technological sovereignty, revealing a reconfiguration of global intellectual property governance in a context marked by geoeconomic fragmentation.

**Keywords:** SEP/FRAND; Technological sovereignty; Intellectual property governance; Geoeconomic fragmentation; Technological governance.

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## Resumen

El régimen SEP/FRAND se ha consolidado como una de las estructuras más sofisticadas de coordinación privada dentro de la economía digital, concebida para compatibilizar la protección patentaria con la estandarización tecnológica necesaria para la interoperabilidad de los mercados. Sin embargo, las transformaciones geoeconómicas de las últimas décadas han tensionado esta arquitectura institucional, desplazando el debate más allá de las preocupaciones tradicionales relacionadas con la eficiencia económica, la competencia y la concesión de licencias sobre tecnologías esenciales. En sectores estratégicos como las telecomunicaciones, la inteligencia artificial, el Internet de las Cosas y los semiconductores, la titularidad de patentes esenciales para estándares y la definición de las condiciones de acceso a tecnologías estandarizadas han pasado a influir en dinámicas más amplias de autonomía estratégica, competitividad industrial y distribución del poder en la economía global. En este contexto, el sistema SEP/FRAND deja de operar exclusivamente como un mecanismo de gobernanza privada de la innovación para asumir un papel relevante en la estructuración de dependencias tecnológicas y en la configuración de las infraestructuras críticas de la economía digital. A partir de una investigación bibliográfica, documental y jurisprudencial, este artículo sostiene que la politización de la gobernanza tecnológica exige una reinterpretación del régimen SEP/FRAND como instrumento de soberanía tecnológica, revelando una reconfiguración de la gobernanza global de la propiedad intelectual en un escenario marcado por la fragmentación geoeconómica.

**Palabras clave:** SEP/FRAND; Soberanía tecnológica; Gobernanza de la propiedad intelectual; Fragmentación geoeconómica; Gobernanza tecnológica.

## 1 Introduction

The infrastructure of the digital economy is, by definition, shared. Smartphones, 5G and 6G networks, artificial intelligence systems, and Internet of Things applications only function in an integrated manner because they operate under common technical standards. It is this standardization that ensures global interoperability among economic actors located in different markets and jurisdictions.

At the center of this ecosystem are standard-essential patents (SEPs) and commitments to license them on fair, reasonable, and non-discriminatory (FRAND) terms. Conceived as a sophisticated mechanism of private coordination, the SEP/FRAND regime was designed to balance two competing objectives: the financial incentives necessary to foster innovation and the need for the broad dissemination of these technologies. Today, the system is indispensable to strategic sectors of the global economy.

Historically, the understanding of this framework was shaped by the logic of globalization, market integration, and the pursuit of efficiency and reduced transaction costs. As a result, traditional debates surrounding SEPs have largely revolved around economic and competition-related concerns, such as hold-up, hold-out, royalty stacking, and the governance of standard-setting organizations.

This scenario, however, has changed. The geoeconomic fragmentation of recent decades and the intensification of technological rivalry among major powers have raised concerns regarding economic security and strategic autonomy. With the reorganization of global supply chains and increasing disputes over critical digital infrastructures, technology is no longer

viewed merely as a driver of growth and innovation. It has come to represent an important dimension of power, influence, and state sovereignty.

Consequently, control over SEPs has expanded beyond the mere remuneration of inventive activity. Control over technologies incorporated into global standards may influence the structuring of technological dependencies and the ability of states and economic actors to exercise autonomy in strategically important sectors. Likewise, disputes concerning global licensing and royalty determination have ceased to be merely private commercial controversies; they now play an important role in shaping international technological governance.

Against this backdrop, this study is guided by a central question: can the SEP/FRAND regime still be understood exclusively as a private mechanism oriented toward market efficiency, or has it come to play a significant role in technological sovereignty and in the reconfiguration of global intellectual property governance?

The hypothesis advanced here is that the politicization of technology has transformed the SEP/FRAND regime into an institutional arena for disputes over normative leadership and strategic autonomy. Although it continues to mediate the relationship between inventors and implementers within a contractual framework, the system now produces political effects that shape the critical infrastructures of the digital economy.

To develop this argument, the article is structured into three sections.

The first section maps the traditional architecture of the SEP/FRAND ecosystem. Its purpose is to demonstrate how its institutional foundations and FRAND commitments were designed to balance intellectual property protection and market efficiency, thereby consolidating a predominantly private model of governance.

The second section investigates the effects of contemporary geoeconomic fragmentation. It analyses how industrial policies, national security concerns, and jurisdictional conflicts have affected the historical assumptions that supported the regime of standard-essential patents.

The third section proposes a theoretical reinterpretation of the system through the lens of technological sovereignty. It examines how ownership of these patents and the governance of digital standards have come to distribute economic power and create structural dependencies among states and economic blocs, highlighting the normative challenges arising from this transformation.

Methodologically, this research adopts a qualitative and exploratory approach based on bibliographical, documentary, and jurisprudential analysis. By combining the literatures on intellectual property, competition law, and geoeconomics with recent judicial precedents and emerging regulatory initiatives, the study seeks to understand how the growing centrality of technology in disputes over strategic autonomy and economic influence has been reconfiguring the role of the SEP/FRAND regime in the global governance of innovation.

## **2 The traditional architecture of the SEP/FRAND ecosystem: private coordination mechanisms and market efficiency**

The institutional architecture of SEPs and FRAND commitments constitutes one of the most sophisticated examples of transnational private governance within the digital economy.

The SEP/FRAND regime emerged from the need to reconcile two potentially conflicting objectives: on one hand, patent protection, structured around the granting of temporary

exclusivity rights designed to incentivize investments in research and development; on the other hand, technological standardization processes, whose purpose is to promote interoperability, reduce transaction costs, and enhance the efficiency of markets characterized by network effects (MÉNIÈRE, 2015).

SEPs can be understood as patents whose utilization becomes unavoidable for the implementation of a given technical standard. Once incorporated into a specification approved by a Standard-Setting Organization (SSO) or a Standard Development Organization (SDO), the protected technology ceases to be merely a competing technical solution and becomes an indispensable requirement for accessing the corresponding market. In practical terms, Silva (2023) posits that any economic agent intending to manufacture products compatible with the established standard must necessarily utilize the patented technology, under penalty of rendering product interoperability unfeasible or incurring patent infringement.

This phenomenon occurs within specialized private institutions, such as the European Telecommunications Standards Institute (ETSI) and the Institute of Electrical and Electronics Engineers (IEEE), which are responsible for coordinating collaborative processes for defining technological standards. These organizations bring together competing companies, technology developers, implementers, and other stakeholders to build common technical specifications. By establishing rules regarding participation in standardization processes, the disclosure of intellectual property rights, and the licensing conditions of the technologies incorporated into the standards, these entities exercise a significant private coordination function in technological markets (DUARTE, 2025).

The underlying economic rationality of this model rests on the understanding that technological standards constitute true infrastructures of the digital economy. By enabling communication between devices developed by different manufacturers, standards facilitate economies of scale, broaden competition among implementers, and reduce technological fragmentation. Consequently, consumers enjoy a greater variety of products, lower switching costs, and increased quality resulting from competition based on price and innovation (DUARTE, 2025). This is an essentially collaborative process, in which multiple economic agents contribute to the formation of shared technological ecosystems.

However, the incorporation of patented technologies into technical standards generates a structural tension. Once the market adopts a standard, implementers become dependent on the technologies embedded within it, facing high switching costs should they wish to migrate to alternative solutions. Consequently, the SEP holder can acquire significant bargaining power resulting from the collective adoption of the technical standard itself. It is precisely to mitigate the risks associated with this privileged position that SSOs require essential patent holders to undertake FRAND commitments.

FRAND commitments can be defined as voluntary declarations by which an SEP holder pledges to the standardization organization to make licenses available on fair, reasonable, and non-discriminatory conditions to potential implementers of the technology. Legal doctrine, however, diverges regarding the legal nature of these commitments. While some authors view them as contractual obligations undertaken before SSOs, with effects benefiting third-party implementers, others emphasize their function as instruments capable of limiting the abusive exercise of economic power arising from the patent's essentiality (CONTRERAS, 2015).

The core objective of the FRAND regime is to preserve the delicate balance between incentives for innovation and efficient access to standardized technologies. On one hand, it seeks to ensure that patent holders are adequately compensated for investments made in research and

development; on the other, it aims to guarantee that implementers can access indispensable technologies without the imposition of economic barriers incompatible with the competitive dynamics of technological markets (MÉNIÈRE, 2015).

In this context, the literature identifies two opportunistic behaviors that threaten the functionality of the system. The first is known as patent hold-up, characterized by the demand for excessive royalties after the consolidation of the technical standard, exploiting the high switching costs faced by implementers already established in the market. The second consists of patent hold-out, a situation in which implementers deliberately delay negotiations, refuse to enter into good-faith agreements, or employ litigation strategies to postpone the payment of due royalties, seeking to impose rates below the actual economic value of the licensed technology (PICHT; LODERER, 2019).

The traditional architecture of the SEP/FRAND regime therefore seeks to convert a potential technological monopoly into a predictable and efficient licensing environment. However, the lack of objective mechanisms to assess the actual essentiality of declared patents, combined with the limited transparency of licensing agreements, can produce scenarios of high informational complexity, increasing transaction costs and hindering the identification of technologies that are truly indispensable for implementing the standards (ERIXON; BAUER, 2017).

It is precisely the interaction between antitrust law and industrial property that acts as a supervisory mechanism for this private coordination. In several jurisdictions, the unjustified refusal to negotiate FRAND licenses or the pursuit of injunctive relief against willing implementers may configure an abuse of a dominant position. In this context, the *Huawei v. ZTE* precedent, adjudicated by the Court of Justice of the European Union (2015), consolidated minimum procedural frameworks of good faith, establishing reciprocal behavioral duties between SEP holders and implementers during licensing negotiations (DUARTE, 2025). The case became an international benchmark by demonstrating the importance of cooperative mechanisms for the stability and predictability of the SEP/FRAND ecosystem.

In addition to the procedural parameters subsequently developed by European jurisprudence, the *Microsoft v. Motorola* case represented a milestone in substantiating the economic content of FRAND commitments. By adapting the *Georgia-Pacific* factors to the context of essential patents, the District Court for the Western District of Washington sought to ensure that remuneration reflected the incremental value of the technology prior to its incorporation into the standard, preventing the capture of value resulting from the collective adoption of the standard itself. The decision also highlighted that the FRAND commitment constitutes a mechanism designed to mitigate the risks of patent hold-up and royalty stacking, recognizing that the functionality of technological ecosystems depends on the simultaneous preservation of incentives for both innovation and the widespread dissemination of technical standards (UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF WASHINGTON, 2013).

The *Unwired Planet v. Huawei* case represents a landmark in the evolution of the SEP/FRAND regime, as it evidences the transition from a model predominantly centered on private coordination to a system in which national courts have come to play an increasingly relevant role in the global governance of standardized technology licensing.

By recognizing the possibility of judicial determination of the terms of a global FRAND license and admitting the granting of injunctions in the event of an implementer's unjustified refusal, British jurisprudence reinforced the necessity of compliance with FRAND commitments and significantly expanded the influence of national courts over transnational contractual relationships (PICHT, 2017).

More than merely resolving a specific licensing dispute, the decision demonstrated that defining the economic and legal parameters of SEP licenses can transcend the territorial limits of individual patents, projecting effects onto global markets and onto the governance of standardized technological ecosystems themselves. In this sense, the precedent not only contributed to the predictability of the SEP/FRAND system but also anticipated discussions that would later gain centrality regarding jurisdictional authority, transnational coordination, and the strategic relevance of technological standards in the digital economy (ERIXON; BAUER, 2017).

Finally, it is important to highlight that the SEP/FRAND regime has surpassed the boundaries of a mere contractual licensing technique. Its consolidation enabled the expansion of global production chains and facilitated the development of core technologies for the digital economy, including mobile telecommunications, the internet of things, artificial intelligence, and connected systems.

From this perspective, FRAND commitments constitute crucial private coordination instruments designed to ensure that patent exclusivity does not convert into an insurmountable obstacle to interoperability and technological diffusion on a global scale.

This observation, however, reveals only the function originally assigned to the SEP/FRAND system. As will be demonstrated in the following chapter, the geopolitical and geoeconomic transformations of recent decades have begun to strain this private coordination model, shifting the SEP regime from a logic predominantly oriented toward market efficiency to a broader arena of dispute over technological leadership, strategic autonomy, and normative influence over the critical infrastructures of the digital economy.

### **3 The transformation of the SEP/FRAND ecosystem: geoeconomic fragmentation and the politicization of technological governance**

The traditional understanding of SEP/FRAND is grounded in a relatively stable account of private ordering. In that account, standard-essential patents are treated as necessary legal complements to technical standardisation: patents reward innovation, standards ensure interoperability, and FRAND commitments reduce the risk that the owner of an essential patent will exploit lock-in once its technology has been incorporated into an industry standard. Within this conventional framework, the central legal and economic concerns are familiar. Scholars and courts have focused on patent hold-up, royalty stacking, access to standards, and the interaction between patent rights, competition law, and the internal rules of standard-setting organisations. That framework still matters, but it no longer captures the broader strategic context in which SEP licensing now operates (PATRA; RAJU, 2021; SPULBER, 2019).

What has changed is not the formal existence of SEPs or FRAND, but the environment within which they function. Contemporary globalisation is increasingly marked by geoeconomic fragmentation: a condition in which cross-border economic integration persists, yet is progressively shaped by rivalry, security concerns, industrial policy, and efforts to reduce strategic dependency. In such an environment, technology is no longer treated simply as a field of commercial innovation. It is also understood as an arena of power, resilience, and jurisdictional influence. This shift has direct consequences for standardisation. Once standards become embedded in communications infrastructure, digital platforms, advanced manufacturing, and

emerging computational systems, they cease to be only technical coordination devices and become strategic assets in their own right (EDLER *et al.*, 2023a).

This broader change is especially visible in sectors such as 5G, artificial intelligence, the Internet of Things, and semiconductors. In these industries, standards determine far more than compatibility between products. They influence which firms can participate on competitive terms, which technologies become embedded across supply chains, and which jurisdictions or regional blocs gain leverage over the rules of access to innovation ecosystems. Control over standards therefore has distributive consequences. It affects bargaining power, rate-setting expectations, access to implementation markets, and the ability of firms to translate technical influence into wider commercial and political advantage. A large SEP portfolio accordingly becomes significant not only because it generates licensing revenue, but because it can anchor a strategic position within critical technological systems (EDLER *et al.*, 2023a; VON LAER; BLIND; RAMEL, 2022).

The rise of industrial policy intensifies this transformation. States increasingly intervene in technology markets through subsidy programmes, procurement strategies, investment screening, export controls, and resilience-oriented supply-chain measures, all designed to secure domestic or regional capacity in sectors considered strategically sensitive. In that setting, SEP ownership is not merely a matter of private commercial success. It can also be understood as part of a wider architecture of technological capability. Firms with strong SEP positions in standard-dependent sectors may contribute to national or regional strategies aimed at reducing dependency, enhancing competitiveness, or preserving influence over core infrastructures. Even where governments do not directly control SEP assertion, the strategic value of these portfolios becomes legible within a broader geoeconomic agenda focused on autonomy and leverage (EDLER *et al.*, 2023b; SILVA; FELTRIN, 2020).

Litigation patterns confirm that SEP/FRAND now operates in this changed strategic setting. Contemporary disputes are increasingly transnational, procedurally complex, and jurisdictionally competitive. They involve not just arguments over royalty rates, but also contests over the appropriate forum, the scope of injunctive relief, anti-suit and anti-anti-suit injunctions, and the authority of national courts to shape the terms of global licences. The UK jurisprudence has been especially important in crystallising this evolution. In *Unwired Planet v Huawei*, the UK Supreme Court confirmed that an English court could determine the terms of a global FRAND licence and, if those terms were refused, grant an injunction in relation to the UK patent rights. That decision has structural significance. It effectively transformed the national court from an adjudicator of local patent rights into a central actor in the ordering of global SEP licensing relations (EDITORIAL OFFICE, 2021; LAWRENCE; BROOKS; BATSFORD, 2020).

Subsequent disputes reinforce the same tendency. The UK case-law guidance identifies a series of cases dealing with global FRAND licences, anti-suit injunctions, jurisdictional challenges, competition claims, and the strategic conduct of SEP litigation. Cases such as *Huawei v Conversant*, *Optis v Apple*, *Panasonic v Xiaomi*, and *Lenovo v Ericsson* illustrate that litigation in this field is not simply about settling a private dispute over a royalty. It is also about determining where authority lies, who can create settlement pressure, and which courts will exercise influence over transnational licensing norms. Once seen in that light, SEP disputes begin to resemble contests over legal infrastructure as much as contests over patent compensation (EDITORIAL OFFICE, 2021; LAWRENCE; BROOKS; BATSFORD, 2020).

This does not mean that FRAND has lost all normative coherence. The framework developed in *Huawei v ZTE* remains central because it seeks to discipline SEP enforcement

through a sequence of obligations concerning notice, willingness, negotiation, and abuse of dominance. That doctrine still structures much of the legal analysis in Europe. Yet its practical operation has become more complex because it now functions in an environment where strategic conduct is shaped not only by bilateral bargaining incentives but also by jurisdictional rivalry and industrial-policy concerns. The core question is no longer merely whether the parties behaved as a willing licensor and a willing licensee. It is also whether FRAND, as a governance framework, can still plausibly be described as neutral when it operates within sectors increasingly treated as strategically vital.

At this point, the character of the transformation becomes clearer. SEP/FRAND has not ceased to perform its classical role in market coordination. It still mediates access to standardised technologies and helps organise transactions between patentees and implementers. But that is no longer its only role. As standards become economically and politically consequential, FRAND also becomes a site through which broader struggles over technological leadership, strategic dependency, and legal influence are pursued. Geoeconomic fragmentation therefore should not be understood as external background noise. It is part of the operating logic of the contemporary SEP landscape.

This transformation also explains why proposals for institutional reform have grown in prominence. Regulatory debates around transparency, essentiality assessment, aggregate royalties, and dispute-resolution mechanisms reveal a growing sense that SEP governance has moved beyond the internal management of private licensing frictions. Even where specific initiatives fail or are withdrawn, the fact that they were proposed demonstrates a shift in perception: SEP governance is increasingly viewed as a policy problem with systemic consequences for innovation, competition, and strategic autonomy. The critical point, then, is that the environment of SEP/FRAND has become structurally politicised. The legal framework remains recognisable, but the function it performs is now inseparable from a wider geoeconomic struggle over control of technological infrastructures (BRACHTENDORF; GAESSLER; HARHOFF, 2023; OPANY, 2025).

## 4 SEP/FRAND as an instrument of technological sovereignty: reconfiguring the global governance of innovation

If established that the environment of SEP/FRAND has changed, the next question is conceptual. How should SEP/FRAND be understood once standards, patents, and licensing disputes are located within a fragmented geoeconomic order? The central claim advanced here is that SEP/FRAND must now be analysed not only as a private-law mechanism of market governance, but also as an institutional instrument of technological sovereignty. This does not mean that SEP regimes are equivalent to state ownership or that every licensing dispute directly expresses national policy. Rather, it means that the governance of standard-essential technologies increasingly affects the capacity of states and regional blocs to preserve autonomy, reduce dependence, and exert influence over strategically significant sectors (EDLER *et al.*, 2023c; VAN DER POL, 2024).

Technological sovereignty is best understood in qualified rather than absolute terms. It does not require complete independence from global markets or total domestic control over all relevant technologies. In an interdependent world, such an aspiration would be unrealistic. A more useful definition is functional: technological sovereignty refers to the capacity to retain

meaningful control over critical technological choices, infrastructures, and dependencies, especially in areas where external reliance can generate vulnerability or reduce political room for manoeuvre. In the context of SEP/FRAND, this definition is particularly useful because standard-dependent sectors are precisely those in which access, interoperability, and control are mediated through complex legal and institutional arrangements rather than through simple ownership alone (EDLER *et al.*, 2023a; POLIDO, 2024).

Seen from this perspective, SEP portfolios matter because they sit at a key junction between innovation, standardisation, and market access. A firm that controls a substantial portfolio of essential patents does not merely possess a collection of exclusionary rights. It occupies a structurally important position within the governance of a technical ecosystem. Where implementation depends on access to those patented technologies, the patent holder can shape the terms under which others enter the market, compete within it, or scale their operations across jurisdictions. The strategic importance of such control does not lie only in the extraction of royalties. It lies in the ability to influence how dependence is organised, how value is distributed, and how legal leverage is exercised within infrastructures that are central to contemporary digital economies (BLIND, 2025; POLIDO, 2024).

This is why SEP ownership can contribute, indirectly but materially, to technological sovereignty. States concerned with strategic autonomy have strong reasons to care whether domestic or regionally anchored firms play a meaningful role in the ownership and licensing of standard-essential technologies. Where they do, those states may enjoy greater resilience, more bargaining leverage, and stronger influence over the evolution of critical sectors. Where they do not, they may become more reliant on foreign-controlled portfolios and on legal norms produced elsewhere through litigation and licensing practice. SEP governance therefore enters the field of sovereignty not because patents replace public authority, but because control over standard-essential technologies affects the distribution of power within transnational markets that increasingly resemble critical infrastructure (BLIND, 2025; VAN DER POL, 2024).

The implications for global IP governance are significant. Traditional accounts of international intellectual property law typically emphasise incentive structures, diffusion of innovation, and balance between exclusivity and competition. Those elements remain indispensable, but they no longer exhaust the function of the regime. In sectors organised around standards, intellectual property rights can also shape strategic dependency, influence industrial capacity, and condition participation in technologies treated as economically or politically indispensable. The governance of SEP licensing thus becomes part of the governance of power itself. It influences who sets the terms of access, who benefits from standard adoption, and which institutions acquire authority to mediate conflict across borders.

Recent institutional developments make this reconfiguration especially visible. WIPO has framed SEPs as an area requiring neutral support mechanisms, data tools, dialogue, and dispute-resolution services, reflecting an understanding that SEP governance generates cross-border coordination problems of broad systemic importance. Likewise, the EU's attempt to create a dedicated SEP regulation, although later withdrawn, is revealing precisely because it sought to redesign the institutional architecture of the field through registration mechanisms, essentiality checks, royalty-related information, and FRAND conciliation. These developments show that regulators and international institutions increasingly see SEP governance as something more than a collection of private bargains. It is a field of policy design that can affect competitiveness, legal certainty, and strategic autonomy at a structural level.

At the same time, recognising SEP/FRAND as an instrument of technological sovereignty introduces serious normative risks. If sovereignty becomes the dominant interpretive frame, there is a danger that legal coordination will give way to intensified strategic rivalry. States and firms may come to treat SEP assertion, forum selection, and regulatory intervention as tools of positional advantage rather than as components of a stable system for enabling interoperability and innovation. The likely consequences include increasing jurisdictional conflict, fragmented remedies, duplicative oversight, higher transaction costs, and growing distrust among market participants. In a field built on the promise of coordination, those outcomes would be deeply destabilising.

This risk is especially acute because standardisation depends on a delicate balance between openness and control. Technical standards succeed when they facilitate broad implementation across markets, but the patents embedded within them create inevitable points of leverage. FRAND was designed to manage that tension by disciplining exclusion without eliminating reward. If the surrounding geopolitical environment pushes actors to *weaponise* that leverage, FRAND may lose some of its coordinating function and become a more openly contested terrain of strategic bargaining. The result would not simply be more litigation. It could be a weakening of the transnational interoperability logic that has historically justified the centrality of standards in global innovation systems.

The normative challenge, then, is not to deny the sovereignty dimension of SEP/FRAND, but to govern it in ways that preserve the cooperative foundations of standardisation. A credible path forward would involve stronger transparency, more reliable mechanisms for assessing essentiality, clearer and more predictable dispute-resolution pathways, and forms of international or inter-institutional coordination capable of reducing unilateral escalation. The attraction of this approach is that it does not ask legal systems to ignore the strategic stakes of standards. Instead, it seeks to contain those stakes within a governance framework that still values interoperability, legal certainty, and broad market access.

The article's broader theoretical contribution follows from this analysis. SEP/FRAND has evolved beyond its earlier role as a mechanism primarily concerned with market efficiency and coordination. Without losing that dimension, it now also functions as an institutional site where technological sovereignty is negotiated, contested, and partially constituted.

## 5 Final Remarks

This investigation has demonstrated that the traditional understanding of the SEP/FRAND regime, although still relevant, is no longer sufficient to explain the role of standard-essential patents in the digital economy. The principal finding of this study reveals that these frameworks no longer operate solely as private coordination mechanisms designed to promote innovation, interoperability, and market efficiency. Today, they play a central role in shaping technological dependencies, advancing strategic autonomy, and influencing the distribution of power on a global scale.

Geoeconomic fragmentation, technological competition among major powers, and the strategic significance of digital infrastructures have altered the rules of the game. Disputes concerning the licensing of standardized technologies now extend far beyond disagreements over royalty rates or contractual breaches between inventors and implementers. Increasingly,

such disputes reflect broader struggles over technological leadership, normative influence, and control of sectors that are vital to economic development and national security.

The research has also shown that technological sovereignty should not be understood as an aspiration for complete self-sufficiency. Rather, it refers to the ability of a state or regional bloc to preserve meaningful autonomy over critical technologies, infrastructures, and supply chains. From this perspective, the ownership and licensing of standard-essential patents transcend the traditional proprietary logic of intellectual property. They directly influence how technological dependencies are structured, managed, and sustained within the international system.

At the same time, this strategic dimension entails significant risks. Transforming the SEP/FRAND regime into an instrument of sovereignty may encourage regulatory fragmentation, intensify jurisdictional conflicts, and turn intellectual property into a tool of geopolitical competition. If taken to its extreme, this dynamic could undermine the very foundations that have historically sustained technological standardization: interoperability, legal certainty, and global cooperation.

This constitutes the central normative challenge of the present moment. The future of global intellectual property governance will depend on the ability to balance the strategic significance of emerging technologies with the preservation of the cooperative structures that enable their diffusion. To prevent the pursuit of technological autonomy from undermining the benefits of global integration, transparency, regulatory predictability, clear essentiality criteria, and effective dispute-resolution mechanisms become indispensable.

Ultimately, the SEP/FRAND regime has consolidated itself at the intersection of intellectual property, technological governance, and geoeconomics. Without abandoning its role in mediating market relations, the system has become an institutional arena in which sovereignty, autonomy, and normative influence are continuously negotiated. Future disputes involving standardized technologies are unlikely to concern only contracts and the remuneration of innovation; they will increasingly reflect broader conflicts over the distribution of power within the digital economy.

Analyzing the SEP/FRAND regime solely through the lenses of patent law or competition law is therefore no longer sufficient. The global governance of innovation now requires a broader analytical framework capable of recognizing that essential technologies are simultaneously economic assets, strategic infrastructures, and instruments of power.

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