

## **Response to European Commission**

### **Intellectual property – new framework for standard-essential patents**

#### **Call for evidence for an impact assessment**

**9 May 2022**

As legal academics, economists, and former United States governmental officials who are experts in intellectual property and competition law, we respectfully submit these views in response to the *Intellectual property—new framework for standard-essential patents: Call for evidence for an impact assessment*, published 14 February 2022, by the European Commission. We have dedicated extensive attention in academic research and governmental positions to the licensing and enforcement of standard-essential patents (SEPs) relating to wireless communication technologies and the application of those technologies in a wide range of markets and industries.

Specifically, we submit these views in response to the Commission’s statement in the Call for evidence that it “aims at seeking the views of stakeholders on various questions that are important for developing an efficient framework for SEP licensing” and “is particularly interested to hear the views of . . . academics.” In this submission, we present what we view as the principal concepts and evidence relating to the constructive role of SEPs in efficiently promoting innovation and structuring commercialization activities in mobile communications and other environments that have been and are enabled by foundational technologies such as 4G/LTE, 5G, and WiFi. We also take this opportunity to correct what we believe are certain misconceptions that have arisen in certain scholarly and regulatory commentary considering these topics. We have organized our discussion around five key topics, which pertain to the principal questions set forth in the Call for evidence.

#### **The Core Functions of Standard-Essential Patents in the Wireless Ecosystem**

A reliable legal infrastructure for the enforcement and licensing of SEPs plays three critical functions in supporting a sequence of innovation and commercialization activities in the wireless communications ecosystem.

First, it supports the investment of billions of dollars annually in the development of chip designs that result in new functionalities that benefit businesses and consumers. Without an assurance of legal exclusivity in the event of technical and commercial success, no firm can support making these types of investments. Second, it preserves incentives for those firms to dedicate thousands of personnel hours in participating, and taking leadership positions, in standard-development organizations, which in turn promotes interoperability among devices that implement technology standards. Third, it supports licensing relationships that disseminate standard-compliant wireless technologies developed by a handful of lead innovators—two of which are located in the EU—to hundreds of device producers around the world.

The result is a thriving global market that both incentivizes upstream innovators to make substantial investments in research and development and enables downstream producers to access the technologies necessary to implement the applicable standard in interoperable devices distributed to consumers. Any intervention that would limit the enforceability or licensing of SEPs in wireless device markets must take into account the existing transactional and market structures that may be affected as a result.

## Theory and Evidence: Patent Holdup and Royalty Stacking

It is often asserted that SEPs pose a threat to innovation and competition in wireless communications and other industries on the ground that SEP owners inherently exert market power and can use such power to “hold up” implementers by “imposing” one-sided terms that advantage licensors over licensees. Relatedly, it is often claimed that the rates “set” by SEP owners will result in a “royalty stack” that translates into inflated prices for consumers. It is important, however, to appreciate that these are theoretical conjectures that must be tested against real-world evidence before being treated as a reliable basis for SEP policymaking.

An extensive body of empirical research has carefully assessed the factual accuracy of these two claims. These publications, using a variety of statistical methodologies, have consistently failed to find evidence for the patent holdup and royalty-stacking theories. Most notably, rather than implementers being burdened by double-digit royalty rates, as some commentators initially predicted or claimed existed based on anecdotal reports, these studies consistently estimate that handset manufacturers pay an aggregate royalty burden in the single digits.<sup>1</sup> Moreover, these studies find that this modest rate has held approximately constant over the life of the industry,<sup>2</sup> a result that is flatly contrary to the “lock-in effects” predicted by holdup theorists. A survey of the empirical evidence appropriately concludes: “Despite the 15 years proponents of the [holdup and stacking] theories have had to amass evidence, the empirical studies conducted thus far have not shown that holdup or royalty stacking is a common problem in practice.”<sup>3</sup>

These empirical findings are unsurprising. Patent holdup and royalty stacking theories predict market failure absent regulatory intervention to restrain opportunistic behavior by SEP owners. Yet, over a period of more than three decades, wireless communications markets have failed to conform to these predictions. These markets have exhibited expanding output, continuous innovation, and rapid adoption across a broad range of income segments. Most notably, quality-adjusted prices in SEP-intensive device markets have *fallen*, rewarding consumers with greater functionality at lower prices.<sup>4</sup> This is a case of market success, not the market failure anticipated by patent holdup and royalty stacking theorists.

There is no empirical study that challenges these findings or otherwise presents credible evidence of holdup or stacking effects. A recent working paper allegedly finds evidence of “holdup

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<sup>1</sup> See Alexander Galetovic and Kirti Gupta, *The case of the missing royalty stack in the world mobile wireless industry*, 29 IND. & CORP. CHANGE 827 (2020); Alexander Galetovic, Stephen H. Haber and Lew Zaretski, *An Estimate of the Average Cumulative Royalty Yield in the World Mobile Phone Industry: Theory, Measurement and Results*, 42 TELECOMM. POLICY 263 (2018); Jason Dedrick and Kenneth L. Kraemer, *Intangible Assets and Value Capture in Global Value Chains: The Smartphone Industry*, WORLD INTELLECTUAL PROPERTY ORGANIZATION, WORKING PAPER NO. 41 (2017); J. Gregory Sidak, *What Aggregate Royalty Do Manufacturers of Mobile Phones Pay to License Standard-Essential Patents?*, 1 CRITERION J. INNOVATION 701 (2016); Keith Mallinson, *Don't Fix What Isn't Broken: The Extraordinary Record of Innovation and Success in the Cellular Industry under Existing Licensing Practices*, 23 GEORGE MASON L. REV. 967 (2016).

<sup>2</sup> Galetovic, Haber, and Zaretski, *supra* note 1.

<sup>3</sup> Anne Layne-Farrar, *Patent Holdup and Royalty Stacking: Theory and Evidence, Where Do We Stand After 15 Years of History?* DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS, COMPETITION COMMITTEE, PARIS OECD (2014).

<sup>4</sup> Alexander Galetovic, Stephen H. Haber and Ross Levine, *An Empirical Examination of Patent Holdup*, 11 J. COMP. L. & ECON. 549, 564-69 (2015).

behavior” by adopting a “broad view of potential holdup behavior by SEP owners.”<sup>5</sup> This “broad view” of holdup consists of the authors simply counting assertions by defendants sued by SEP owners in US courts for patent infringement that the plaintiff is engaging in “holdup” or simply counting when SEP owners request an injunction in filing an infringement lawsuit. This is not a rigorous research methodology. Self-interested assertions of holdup by defendants in infringement litigation are not credible statements without additional information to confirm the veracity of these claims (which is why US courts have rejected these conclusory assertions when made by defendants in SEP litigation<sup>6</sup>). It is equally unreliable to interpret every request by an SEP owner for an injunction as “evidence” of patent holdup. US courts (like EU courts) have consistently ruled that SEP owners may seek injunctions for infringement of their patent rights.<sup>7</sup> A law firm representing an SEP owner would probably be committing malpractice if it did *not* seek an injunction when bringing suit for infringement.

To avoid any possible confusion on the part of the Commission, we would also like to correct certain mistakes in a paper commissioned and published in 2019 by the European Parliament’s Policy Department for Citizens’ Rights and Constitutional Affairs. That paper states that “there are differing views among legal analysts and economists about how profound the risks of ‘hold-up’ and ‘royalty-stacking’ are in the context of SEPs, with some scholars arguing that the risk of overall economic harm can sometimes be over-stated.”<sup>8</sup> This mischaracterizes the scholarly literature in two respects. First, it suggests that there remains an open question concerning the real-world prevalence of holdup or stacking, which conflicts with the fact that *no* published empirical study has found evidence of these effects, as noted in the survey paper quoted above.<sup>9</sup> Second, it misstates the findings of scholars who reject the holdup and stacking theories. Those scholars do not take the view that the “risk of overall economic harm can sometimes be overstated”; rather, those scholars take the view that there is currently no empirical evidence to support a claim that there is a meaningful risk of patent holdup or royalty stacking in SEP-intensive markets.

It is imperative that any informed application of competition law take into account the full body of published empirical evidence, rather than relying on theoretical models that may not track real-world markets, flawed working papers that are compromised by fundamental methodological errors, or incomplete and misleading characterizations of the scholarly literature. In this spirit, we attach an Appendix of the published research identifying the numerous substantive and

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<sup>5</sup> Brian J. Love, Yassine Lefouili and Christian Helmers, *Do Standard-Essential Patent Owners Behave Opportunistically? Evidence from U.S. District Court Dockets 3* (Nov. 8, 2020), <https://ssrn.com/abstract=3727085>.

<sup>6</sup> See *Ericsson v. D-Link*, 773 F.3d 1201, 1234 (Fed. Cir. 2014) (“[W]e agree with the district court that D-Link failed to provide evidence of patent hold-up and royalty stacking . . . . [W]e see no error in the district court’s refusal to instruct the jury on patent hold-up or to adjust the instructions expressly to take patent hold-up into account.”); *id.* at 1235 (“[I]f an accused infringer wants an instruction [to the jury] on patent hold-up and royalty stacking, it must provide evidence on the record of patent hold-up and royalty stacking in relation to both the RAND commitment at issue and the specific technology referenced therein.”).

<sup>7</sup> See *Apple Inc. v. Motorola Inc.*, 757 F.3d 1286, 1331 (Fed. Cir. 2014) (ruling that trial court “erred” when it “applied a per se rule that injunctions are unavailable for SEPs”). For a representative sample of the many EU cases in which SEP owners requested or received injunctions, see “The FRAND Principle and Injunctive Relief,” *infra*.

<sup>8</sup> Luke McDonagh and Enrico Bonadio, *Standard-Essential Patents and the Internet of Things*, EUROPEAN PARLIAMENT, POLICY DEPARTMENT FOR CITIZENS’ RIGHTS AND CONSTITUTIONAL AFFAIRS (2019), at 10, <http://www.europarl.europa.eu/supporting-analyses>.

<sup>9</sup> See *supra* note 3.

methodological flaws in the patent holdup and royalty stacking theories. We also point to rigorous empirical studies that all directly contradict these theories' predictions.

### **SEP Owners and the Market Power Assumption**

Given the empirical failure of the patent holdup and royalty stacking theories, it is important to consider whether those theories rest on faulty assumptions that may lead SEP policymakers astray more generally. Specifically, it is important to consider whether, as those theories assume, SEP owners typically exert market power and can therefore dictate terms to licensees. Closer scrutiny of the mechanics of the wireless communications market shows that this assumption is unlikely to be satisfied in most cases.

There are two reasons. First, at any point prior to market adoption of a standard, SEP owners have strong incentives to offer rates that encourage adoption by implementers who often can select competing standards. Absent adoption, the billions of dollars invested by an innovator in developing a new standard will yield no returns. Second, at any point after market adoption of a standard, SEP owners that are repeat players in the wireless communications market have incentives to accrue goodwill by maintaining reasonable royalties throughout the life of any particular standard. This goodwill can then be deployed to induce adoption of the next generation in wireless technology standards. This iterative structure both conforms to the multi-generational history of wireless communications markets (2G, 3G, 4G/LTE) and explains why SEP royalty rates have generally been constant throughout the life of the industry.<sup>10</sup> (We note that the last finding is flatly inconsistent with patent holdup theory, which expects that SEP owners would increase rates once implementers are “locked in” to the standard.)

### **The FRAND Principle and Injunctive Relief**

The thriving ecosystem in wireless technologies relies on balancing the interests of innovators and implementers through good-faith negotiations of licensing terms based on fair, reasonable, and non-discriminatory (FRAND) royalty rates. Innovators require assurance that they will be able to enforce and license the SEPs that protect their technological innovations and, in the case of infringement, will be able to seek legal recourse without undue delay. Implementers require assurance that SEP owners will not demand exorbitant rates once implementers have made investments in adopting SEP-protected technologies (although we believe that is a low-probability risk for the reasons stated above). Since the inception of the industry, the FRAND principle, as reflected in the terms negotiated by sophisticated licensors and licensees and, in some cases, as interpreted by courts as a matter of contract law, has mediated between these two concerns.

Some commentators and regulators have taken the view that the FRAND principle precludes SEP owners from seeking injunctive relief. This view has been rejected by the Court of Justice of the European Union (EU), the UK Supreme Court, and the US Court of Appeals for the Federal Circuit.

In *Huawei v. ZTE*, the Court of Justice of the European Union (CJEU) held that a SEP owner may seek an injunction against ongoing infringement by an implementer unless the implementer

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<sup>10</sup> Alexander Galetovic, Stephen Haber, and Lew Zaretski, *An Estimate of the Average Cumulative Royalty Yield in the World Mobile Phone Industry: Theory, Measurement and Results* 42 TELECOMMUNICATIONS POLICY 263, 266 (2018).

responds to the SEP owner's royalty offer by submitting a specified FRAND-compliant counter-offer and provides appropriate security pending resolution of the dispute.<sup>11</sup> Following the 2015 decision in *Huawei v. ZTE*, the UK High Court of Justice and the UK Supreme Court respectively reaffirmed the right of SEP owners to receive injunctions when facing an "unwilling licensee" who engages in classic stalling tactics.<sup>12</sup> Even prior to these decisions, the European Commission had recognized concerns that "limiting SEP holders' right to seek injunctions would increase the risk that SEP holders receive sub-FRAND royalties, something that has been called . . . 'hold-out'."<sup>13</sup>

As a result of these decisions, SEP owners who file lawsuits in EU jurisdictions can request—and, if validity and infringement are demonstrated, can sometimes expect to receive (although after considerable cost and delay)—injunctive relief if an infringer is deemed by a court to be an "unwilling licensee," often as indicated by the use of "stalling" and other opportunistic bargaining and litigation tactics. Dutch and German national courts have issued injunctions to SEP owners based on a finding that the infringer had engaged in "holdout" behavior.<sup>14</sup> The same is true of UK courts.<sup>15</sup> Reflecting a similar approach, the US Court of Appeals for the Federal Circuit has held that "an injunction [for a SEP owner] may be justified where an infringer unilaterally refuses a FRAND royalty or unreasonably delays negotiations to the same effect."<sup>16</sup>

This near uniformity of judicial opinion in multiple jurisdictions reflects common sense. If SEP owners were flatly precluded from seeking injunctions, then infringers would have little reason ever to agree to, or negotiate in good faith, a license with a SEP owner. The CJEU's decision in *Huawei v. ZTE* astutely recognized this prospect of "patent holdout." A well-resourced infringer would rationally reject any license offer and compel the SEP owner to enter into a litigation that typically requires millions of dollars in legal expenses and years of patent-by-patent judicial proceedings in multiple venues around the world. In the worst-case scenario, the infringer would be compelled to pay monetary damages that are typically calculated using a methodology designed to mimic the rate in a negotiated licensing transaction. Even under the current legal regime, in which injunctive relief may be reasonably available in European courts but only after a delayed and costly litigation process, well-resourced implementers regularly decline to take licenses at the outset of negotiations with SEP owners, compelling both parties to spend millions of dollars and thousands of personnel hours on litigations in multiple jurisdictions. Those resources could have been directed more productively toward research and development to advance wireless technologies.

More generally, legal regimes that do not preserve a reasonable expectation of injunctive relief against infringers in SEP litigations have a counterproductive "domino effect" that shifts

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<sup>11</sup> *Huawei Technologies Co. Ltd. v. ZTE Corp. and ZTE Deutschland GmbH*, Court of Justice of the European Union, judgment dated 16 July 2015, Case No. C-170/13.

<sup>12</sup> *Unwired Planet International Ltd. et al. v. Huawei Technologies (UK) Co. Ltd. et al.*, [2020] UKSC 37; *Unwired Planet International Ltd. et al. v. Huawei Technologies (UK) Co. Ltd. et al.*, [2017] EWHC 2988 (Pat).

<sup>13</sup> Intellectual Property and Standard Setting, Note by the European Union, submitted to the Organization for Economic Cooperation and Development, Directorate for Financial and Enterprise Affairs, Competition Committee, Dec. 2, 2014, [https://one.oecd.org/document/DAF/COMP/WD\(2014\)117/en/pdf](https://one.oecd.org/document/DAF/COMP/WD(2014)117/en/pdf).

<sup>14</sup> *Koninklijke Philips N.V. v. Asustek Computers Inc.*, Court of Appeal of The Hague, Case No. 200.221.250/01 (May 7, 2019); *Tagivan (MPEG LA) v. Huawei*, District Court of Dusseldorf, Case No. 4a O 17/17 (Nov. 15, 2018). This is a representative, rather than a comprehensive, list of decisions in which European courts have granted injunctions to SEP owners.

<sup>15</sup> *TQ Delta v. ZyXEL Communications*, Case No. HP-2017-000045-[2019] EWHC 745 (Pat).

<sup>16</sup> *Apple Inc. v. Motorola Inc.*, 757 F.3d 1286, 1332 (Fed. Cir. 2014).

bargaining leverage to implementers in *all* SEP licensing negotiations, devaluing existing patent-protected technologies and disincentivizing firms from developing new technologies. Absent any realistic prospect of an injunction within a reasonable period of time, the implementer enjoys access to the innovator's technology, deriving revenues from the products and services that embody that technology, while, during the negotiations and litigation, the innovator earns nothing from the same technology that it developed at great cost and risk. This asymmetry is likely to lead to settlement amounts or, absent litigation, negotiated royalties that undervalue the innovator's technology. This effectively transfers wealth from firms that specialize in developing wireless technologies to firms (including some of the world's most valuable companies) that specialize in using and integrating those technologies in branded devices sold to consumers.

These are precisely the concerns that appear to have motivated the Request for Consultations recently filed by the EU on 18 February 2022 at the World Trade Organization for "dispute consultations with China concerning alleged Chinese measures adversely affecting the protection and enforcement of intellectual property rights." As observed in the Request for Consultations, several Chinese courts have issued worldwide "anti-suit" injunctions barring SEP owners—often innovators based in the EU—from seeking judicial relief outside China against alleged infringers, which are often implementers based in China. The concerns that motivated the EU's Request for Consultations are precisely the same concerns that arise in connection with any legal regime that limits the ability of SEP owners to seek injunctive relief and appropriately determined monetary damages against adjudicated infringers. Namely: absent the expectation of a sufficient remedy within a reasonable period of time, the SEP owner has no ability to deter infringers, which in turn distorts to implementers' advantage the licensing terms agreed through negotiation or settlement. That is not a recipe for a robust innovation ecosystem.

### **The FRAND Principle and the "Level of Licensing"**

Some commentators and regulators have expressed the view that the FRAND principle requires that SEP licensing take place at the component level (or more specifically, at the level of the "smallest saleable practicing patent unit"). While a royalty should reflect the value contributed by the SEP-protected technology to the product in which it is embedded, this principle does not require that the royalty rate be determined at the component level or at any other particular level in a technology supply chain.

There are two reasons. First, economically speaking, it is a matter of indifference at which point in the supply chain the royalty rate is determined since sophisticated parties, such as the firms involved in SEP licensing transactions, can adjust the percentage royalty to reflect the technological contribution attributed to the licensed SEP portfolio. Second, there is no reason to believe that there is a one-size-fits-all approach to SEP licensing. In some environments, it may be most efficient to license at the device level; in other environments, it may be more efficient to license at the component level. It is not plausible to believe that regulators or courts would be in a superior position to select (and then continuously adjust) the efficient licensing level as compared to business parties involved in the relevant market on a day-to-day basis.

Notwithstanding these considerations, it is often asserted that device-level licensing enables SEP owners to charge rates that do not comply with the FRAND principle. Aside from the fact that this argument makes a blanket assumption of market power without specific evidence, it overlooks how device-level SEP licensing, the long-standing practice in the wireless communications industry, can benefit the ecosystem as a whole. There are three reasons. First, device-level

licensing maximizes the accuracy of the royalty as a measure of the economic value of the patented technology by assessing the royalty at the point that is closest to the point of sale at which consumer demand is revealed.<sup>17</sup> Second, device-level licensing is most likely to minimize disputes among licensors and licensees by using an objective measure—sales revenue—that is easy to confirm and difficult to manipulate. Third, device-level licensing minimizes transaction costs by consolidating royalty measurement and payment at a single point, rather than at multiple points, on the supply chain. While other SEP-enabled markets may discover that alternative licensing conventions (or a mix of licensing conventions) are more efficient, there is no economic reason to require that SEP licensing take place in all cases at a particular point in the technology supply chain.

Relatedly, we would like to clarify a point of US law that may have relevance in the Commission’s policy analysis of this issue. Some commentators assert that the US mandates the “smallest salable patent-practicing unit” (SSPPU) standard for determining a reasonable royalty.<sup>18</sup> This is incorrect. In almost all cases, US courts have adopted the SSPPU standard as a precautionary evidentiary measure in certain jury trials for the limited purpose of avoiding possible confusion by a jury in its damages calculations.<sup>19</sup> The US Court of Appeals for the Federal Circuit has specifically rejected the view that damages calculations in infringement litigation involving multi-component products must use as a matter of law the SSPPU standard.<sup>20</sup> Consistent with this legal principle, US courts have rejected arguments by implementers in the FRAND context that reasonable royalty damages *must* be calculated based on the SSPPU standard, preferring instead to rely on evidence of comparable licenses consistent with patent damages jurisprudence.<sup>21</sup>

### Licensing in SME Markets

The Call for evidence asks for feedback in particular concerning the impact of SEP licensing practices on startups and other SMEs, expressing concern that such entities may have difficulty securing licenses to SEP-protected technologies. We agree with the Commission that this is an important policy concern. In our view, however, current SEP licensing markets already exhibit capacities and incentives to anticipate and address transaction-cost obstacles to licensing SMEs through tailored market-specific arrangements. Real-world information and communications technology (ICT) markets characterized by large numbers of dispersed patent owners have repeatedly exhibited the ability to engineer licensing practices that maximize adoption among producers and other intermediate users, whether through bilateral transactions, licensing consortia,

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<sup>17</sup> Alexander Galetovic and Stephen Haber, *SEP Royalties: What Theory of Value and Distribution Should Courts Apply?*, 17 OHIO STATE TECH. L. J. 189 (2021).

<sup>18</sup> See Love et al., *supra* note 5, at 9 (“U.S. courts have ruled that reasonable royalty damages should ordinarily be calculated using the ‘smallest salable patent-practicing unit’ (SSPPU) in an accused multi-component product as the royalty base . . .”).

<sup>19</sup> David Kappos & Paul Michel, *The Smallest Saleable Patent-Practicing Unit: Observations on its Origins, Development, and Future*, 32 BERKELEY TECH. L. J. 1433, 1446-47 (2018).

<sup>20</sup> Commonwealth Sci. & Indus. Research Organisation v. Cisco Sys., Inc., 809 F.3d 1295, 1301-02 (Fed. Cir. 2015) (explaining that the legal standard for determining damages is apportionment, that more than one method may be used to estimate reasonable royalties, and that “abstract recitations of royalty stacking theory . . . are insufficiently reliable”).

<sup>21</sup> See, e.g., HTC Corp. v. Telefonaktiebolaget LM Ericsson, 12 F.4th 476, 494 (5th Cir. 2021) (Higginson, J., concurring) (“Ericsson’s point—that SSPPU may not be the appropriate royalty base and should not be mandated to the jury—is well taken.”); *D-Link*, 773 F.3d at 1226-28 (permitting introduction of device-level licenses as reliable evidence of reasonable royalties for the SEP owner in this case).

or patent pools.<sup>22</sup> This result should not be surprising: a patented technology is a depreciating asset that typically faces actual or potential competition from substitute technologies, giving the patent owner (or third parties that administer patent pools) a powerful incentive to minimize any potential transaction-cost obstacles to maximal adoption of the relevant technology. While stylized economic models may anticipate that a patent owner will withhold access to its patent portfolio to extract the highest possible royalty rate, this expectation is repeatedly rebutted by licensing practices in real-world ICT markets, which tend to favor non-exclusive licensing practices at reasonable rates. This is consistent with the observation that, since the transition to a digital economy, ICT markets have exhibited not only high levels of patent issuance but, concurrently, increasing output and declining quality-adjusted prices—the classic signs of a competitive market that is both statically and dynamically efficient.<sup>23</sup>

## Conclusion

The global market in wireless communications technologies, and the wide range of secondary markets that rely on those technologies, has thrived for approximately three decades through licensing-based business models predicated on the ability to engage in arm's-length negotiations over licensing terms, to enforce those terms in the event of default by a counterparty, and to obtain injunctions in the event of deliberate patent infringement. This legal infrastructure for SEP licensing and enforcement has enabled technology pioneers—including leading innovators based in the EU—to recoup billions of dollars of investment in research and development and consequently enabled those innovators to continue attracting capital for these economically critical activities, resulting in a continuous flow of new functionalities for enterprise and individual users. This same infrastructure has promoted access to fundamental technology inputs among intermediate users around the world, dramatically lowering entry costs into the production segments of the technology supply chain and promoting competition on price and quality in the retail market for consumers' benefit. So long as courts provide robust enforcement of intellectual property rights, as well as the licensing and other contracts predicated on those rights, there is every reason to believe that the market will continue to thrive.

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<sup>22</sup> Jonathan M. Barnett, *From Patent Thickets to Patent Networks: The Legal Infrastructure of the Digital Economy*, 55 JURIMETRICS 1 (2014).

<sup>23</sup> Jonathan M. Barnett, *The Anti-Commons Revisited*, 29 HARV. J. L. & TECH. 127, 141-44 (2015).

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## APPENDIX

Jonathan M. Barnett, *Antitrust Overreach: Undoing Cooperative Standardization in the Digital Economy*, 25 MICH. TELECOMM. & TECH. L. REV. 163 (2019), <https://dx.doi.org/10.2139/ssrn.3277667>

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