5G AND BEYOND

5G communications technologies will transform entire industries around the world and are already a core element of the mobile communications and automotive ecosystems. 5G *and Beyond* brings together some of the world's leading thinkers in law, economics, and competition policy, drawn from academia, government, and industry, to lay the intellectual foundation for sound innovation and competition policy in wireless-enabled environments. Contributors include former heads of the United States Patent and Trademark Office, commissioners of the US Federal Trade Commission and International Trade Commission, distinguished academics, and industry leaders. Chapters provide economically grounded and empirically informed analyses of the innovation policy issues involved in the development and adoption of 5G-enabled computing and communications technologies in the Internet of Things. This title is also available as open access on Cambridge Core.

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5G and Beyond

INTELLECTUAL PROPERTY AND COMPETITION POLICY IN THE INTERNET OF THINGS

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This book is dedicated to the memory of Alexander Galetovic, who passed away in July 2022. Alex was a dear friend and pioneering scholar who challenged conventional wisdom on patent and competition policy through the meticulous pursuit of knowledge, truth, and evidence.

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Foreword

Why Patents Are Critical for Standards-Based Technologies

Andrei Iancu

On the morning of February 7, 1904, not far from Washington, DC, a dry goods store in downtown Baltimore, Maryland, burst into flames. The fire alarm sounded, and firefighters from several units throughout the city rushed to answer the call. As they smashed through the burning building, explosions shot embers through the broken windows and onto neighboring structures. Before long, the fire – believed to have been ignited by a discarded cigarette in the building's basement, near a pile of wood shavings – fueled a blaze that would go on to destroy much of central Baltimore.

Firefighters from other cities, including Washington, DC and Philadelphia, were sent to help battle the inferno, but they quickly encountered a serious problem. Because there were no national standards for firefighting equipment in those days, firefighters from one city could not effectively use the equipment from another city. Poorly matched hoses emitted weak streams of water. And so, Baltimore burned. All in all, this was the most destructive conflagration in the United States since the Great Chicago Fire of 1871. A real tragedy, aggravated by the lack of standards.

But as often happens with crises, powerful lessons were learned. When the fire first started that fateful February morning, the US patent system had no shortage of firefighting innovations. Indeed, as of 1904, nearly 1,000 patents relating to fire-fighting, including those for fire hydrants, hoses, and connectors, were in force. But there were no standards. That was about to change.

Within two months, legislative bills and conferences were held to standardize fire hoses, and many cities began replacing their fire hose couplings. The National Fire Protection Association (NFPA) and National Board of Fire Underwriters (NBFU) established certain standards, such as thread size, in an effort to prevent further incidents like the one faced by the out-of-state fire units during the Baltimore Fire. And though it took time for these standards to truly catch on, today we have the National Standard Thread, along with standardized hydrants, as well as hose adapters that firefighters carry to avoid another disaster like the Great Baltimore Fire.

Government mandates are one way to ensure standardization of technology. But in a free-market economy, depending entirely on the government taking action is neither feasible nor desirable. The United States greatly benefits from private industry investing resources and developing technology on its own, without government mandates. This is particularly true for technology that eventually becomes standardized.

Our country's founders realized early on the value of patents as drivers of innovation. This is why intellectual property rights are enshrined in the Constitution itself, giving Congress the right "[t]o promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." Backed by the patent system envisioned by the Constitution, American technology has progressed in the last two and a half centuries at rates that are unparalleled at any other time in human history or in any other place on Earth. As Thomas Jefferson observed, "patents have given a spring to invention beyond any comprehension." And Abraham Lincoln explained why: "the patent system adds the fuel of interest to the fire of genius."

Developing technology that might get adopted into a standard, however, is risky and expensive, and without the proper incentives and protections, industry might not choose to invest in it. First of all, and like all new technologies, it might not work. By definition, disruptive new technologies are untried and have no proven track record of success. These innovations can fail for myriad reasons, such as technical failures or market rejection.

On top of all this, for standards-based innovation there is risk even if the technology does work. In the standards world, it is often the case that multiple solutions are proposed by different companies for a particular problem to be solved by the standard. Only one of those solutions will typically be adopted into the standard. If your technology is not adopted, even if it works, your investment and development is largely for naught. Furthermore, even if an innovative technology has merit and is adopted into a standard, that standard may never gain traction in the market.

And if your technology is adopted into a widely implemented standard, multiple implementers will certainly use it – that is the whole point of having a standard in the first place. In the standards context, therefore, unlike many other inventions, the inventor is not assured of exclusive use. To the contrary, the hope is that the standard will be successful and the inventions incorporated into the standard will be broadly used.

This is why patents are more important for technology to be used in standards than in almost any other field. In order to overcome these risks, inventors and investors need to be assured that if their technology is in fact adopted into the standard and broadly used, they will be appropriately compensated and their investment will be protected. Patents can and should serve that role.

Patents historically provide a quid pro quo arrangement between the inventor and the public. The public gets the benefit of the invention that is described in the

patent document and brought to market for use by and for the benefit of the public. In exchange, the inventor gets a period of market exclusivity to commercialize her invention. Among other things, the inventor can license her technology to companies who want to implement the technology in their products. For technology used in standards, this is the best tool to ensure that successful inventors can be rewarded for the risks they took, the investments they made, and the technical contributions they brought.

But this is true only if such patents are reliable and meaningfully enforceable. In other words, the patents issued by the Patent Office need to be robust enough to withstand challenge down the line – that is, the original examination should be thorough enough so that courts and other tribunals that review patents years after their issue will find them to have been correctly issued in the first place. Plus, the system must enable patent owners to enforce their patents if others infringe them. A patent serves little purpose if others can ignore it and the owner cannot practically stop them or secure timely and adequate compensation.

The American patent system has grown increasingly complex over the past few decades, adding hoop after hoop that patent owners need to jump through to enforce their patents. For example, there are now multiple tribunals where the validity of a patent can be challenged, leaving patent owners to defend their patents again and again, drastically increasing expenses and time to resolution. In addition, many courts take a very long time to bring a case to trial, often delaying resolution for years. And even if the patent owner prevails, it is now very difficult to obtain an injunction to enforce the promised market exclusivity a patent is meant to convey. These and many other hoops make it practically difficult to enforce any patent, thereby diminishing its value.

Standard-essential patents (SEPs) add another complexity to an already complex field. When a standard is adopted, patent owners usually agree to offer to license their patents to potential implementers on fair, reasonable, and nondiscriminatory (FRAND) terms. Some have interpreted this promise to mean that patent owners can never get an injunction for SEPs. The practical inability to exclude makes voluntary license agreements even more difficult to secure, thereby increasing the likelihood of litigation. After all, one accused of infringement has little to lose if they refuse to license a patent when the worst that happens after years of litigation is to pay the same royalty the patent owner offered during initial license negotiations.

On the other hand, it is difficult to argue that patent owners who have agreed to submit their technology to a standard and made a commitment to license their patents on FRAND terms should be able to exclude those who actually want to implement the technology under license and pay FRAND royalties. This is especially true if the implementer negotiates in good faith for a FRAND license, yet the patent owner refuses. After convincing a standards setting organization to adopt its patented technology, a patent owner should work in good faith to ensure reasonable access to that technology by those who want to implement it.

Patent policy, therefore, must be carefully balanced to protect the interests of both patent owners who contribute their innovations to a standard, and those who seek to implement those technologies into actual products that are brought to the market. On the one hand, our IP systems should be robust enough to incentivize, protect, and remunerate fairly the developers of standards-based technology. On the other hand, our IP systems should not unduly burden users of such technology with overvalued royalties or threats of unjustified injunctions.

Our IP systems should also be balanced to incentivize good-faith negotiations between innovators and implementers. In the end, a well-functioning IP-backed standards system encourages voluntary transfer of the technology adopted into the standard. That can only happen if innovators and implementers negotiate in good faith toward a voluntary license. Licensors should not unreasonably deny a license ("hold up"), and licensees should not unreasonably refuse to take a license ("hold out"). Government policy and the law should make clear that the presence or absence of good faith during negotiations on both sides is important and will be taken into account.

Our policymakers need to ensure that the United States remains the best place in the world for innovation that will be adopted into worldwide standards, and the best place in the world for implementing that innovation. Maintaining a proper balance of incentives will benefit the United States and humanity in general.

Preface

The global technology ecosystem stands at a historical point of transition between the 3G- and 4G-enabled wireless technologies that launched transformative changes in audio–video communications and 5G-enabled technologies that will enable transformative changes across the entire Internet of Things (IoT). Thus, beyond general communications, broad industries such as transportation, health care, and industrial production are likely to be transformed. The vast increases in bandwidth – and decreases in latency – enable novel business models that cultivate dense networks of person-to-person, person-to-machine, and machine-to-machine pathways. In 2021, the Federal Communications Commission's (FCC) "C-Band Auction 107" sold 280 megahertz of airwaves for $81 billion, reflecting the immense value the market places on the adoption and deployment of 5G technologies.

This book contains the dedicated efforts of a distinguished group of scholars, former government officials, and industry practitioners to set forth a theoretical and empirical basis for sound policymaking in the vital 5G and IoT sector. The chapters are drawn from a conference held in December 2021 by the Center for Intellectual Property x Innovation Policy (C-IP^2) at Antonin Scalia Law School, George Mason University. The contributions are informed by not only economic and legal concepts but also a practically informed perspective on the challenges of securing returns on innovation – an asset that is inherently exposed to expropriation – and the realities of enforcing and licensing IP rights in real-world technology markets. This point is of considerable importance since, in our view, scholarly and regulatory discussions in this area often rely on theoretical models that make little inquiry into "on the ground" conditions in real-world technology markets. Collectively, the contributors to this book bring decades of policymaking experience (at agencies such as the United States Patent and Trademark Office, the US Federal Trade Commission, and the US International Trade Commission), industry experience, and scholarly analysis concerning the legal, economic, and technological issues

involved in formulating and implementing efficient "rules of the game" in global 5G-enabled markets.

While the contributors deploy different approaches to, and reach different conclusions on, these complex issues, the project rests on two common foundational principles. First, responsible policymaking must be grounded in economic theory and empirical evidence, rather than rhetoric, narrative, or ideology. Second, meaningful enforcement of property rights and contracts is a critical predicate for enabling the formation of efficient markets in technological innovations. Just as it is widely agreed that these two key legal inputs have supported unprecedented rates of wealth creation in physical-goods industries in market-oriented economies, so too these same legal inputs – with appropriate modification for the intangible-goods environment – are necessary to support wealth creation in the wireless computing and communications markets that will drive IoT. While this perspective may seem elementary to much of the business community, it has been surprisingly overlooked by much of the regulatory and scholarly community.

The book is divided into five parts that complement each other but can be read separately based on a reader's interests.

Part I, Intellectual Property and Competition Policy in Global Wireless Markets, addresses "big picture" issues underlying past and future development of IP and competition policies relating to mobile communications technologies. In "Restoring and Revitalizing Technology Markets for Mobile Wireless: Geopolitical Dimensions of Patented Technology Embedded in Standards" (Chapter 1), David Teece argues that the transition to IoT will demand a renewed appreciation by policymakers of the critical function played by a robust IP infrastructure in facilitating the research and development, standard-setting, and licensing activities of lead innovators in the global wireless industry. This includes standard-essential patents (SEPs). In "Antitrust Convergence on Substantive Norms for SEP Licensing Negotiations: Should and Could It Be?" (Chapter 2), Maureen Ohlhausen and Jana Seidl similarly underscore the importance of robust patent rights (and caution in using antitrust law to limit those rights) in supporting wireless innovation in general, and US technological leadership in particular, as markets make the investments necessary to develop and adopt IoT technologies. The authors describe incremental steps taken by US policymakers that suggest a growing acceptance of legal innovations in Europe that have promoted a more even playing field in licensing negotiations between innovators and implementers of SEP-protected technologies.

Part II, Patent Holdup, Royalty Stacking, and the FRAND Standard, addresses critical empirical questions that must be addressed to provide a reliable basis for policymaking and adjudication concerning SEP licensing and enforcement. In "Cellular SEP Royalties and 5G: What Should Competition Policy Be?" (Chapter 3), Alexander Galetovic, Stephen Haber, and Lew Zaretzki review a transformative body of empirical research (in which the authors have played a

central role) that has reassessed the factual basis for widely adopted patent holdup and royalty stacking theories in SEP licensing markets. The authors show that empirical studies have repeatedly failed to find evidence for these theoretical assertions of market failure. Rather, the evidence favors the view that SEP licensing represents a case of exceptional market *success*, as indicated by declining quality-adjusted prices, expanding output, and continuous innovation in SEP-dependent technology markets. In "The Fair Division of Surplus from a FRAND License Negotiated in Good Faith" (Chapter 4), Gregory Sidak takes on a difficult theoretical challenge with practical implications for SEP licensing and litigation: Is it possible to reconcile the standard of "fair, reasonable, and nondiscriminatory" (FRAND) licensing with the efficiency objective that underlies contract law? In a novel analysis, Sidak shows that, under certain behavioral assumptions, the "fairness" principle embodied by the FRAND standard can promote efficiency by truncating the range of "reasonable" royalty terms, which in turn can promote mutually beneficial transactions between innovators and implementers.

Part III, Patent Holdout and the Rise of "Efficient" Infringement, addresses the consequences of the stringent limitations that regulators and some courts have imposed on SEP owners' ability to secure injunctions against infringing users. In "Efficient Infringement in the SEP Space" (Chapter 5), Kristen Osenga documents how theoretical concerns over patent holdup have supported limitations on infringement remedies that encourage infringers, especially the most well-resourced infringers, to engage in patent "holdout" and compel SEP owners to undertake costly and lengthy litigation around the world. The unfortunate result: Successful innovators are increasingly unable to secure positive returns on investments in research and development. In "Restoring Deterrence: The Case for Enhanced Damages in a No-Injunction Patent System" (Chapter 6), Jonathan Barnett and David Kappos propose a policy innovation to deter patent holdout even in a legal environment in which injunctive relief is largely unavailable. Specifically, the authors propose requiring the award of enhanced damages against adjudicated infringers to mimic the deterrence effect of the "missing" injunction, adjusted to reflect potential underenforcement and overenforcement effects. The predicted fortunate result: The market will shift away from value-depleting litigation and toward value-enhancing dealmaking.

Part IV, Transactional Solutions: Redesigning SEP Licensing Markets, leverages theoretical analysis and industry experience to present practical proposals to mitigate the litigation-related and other transaction costs that can encumber SEP licensing negotiations between innovators and implementers. In "Designing SEP Licensing Negotiation Groups to Reduce Patent Holdout in 5G/IoT Markets" (Chapter 7), Bowman Heiden, Igor Nikolic, and Ruud Peters assess recent proposals to enable licensees to negotiate collectively with SEP owners through licensing negotiation groups (LNGs). Whereas LNGs have been proposed to mitigate the risk of patent holdup, the authors argue that LNGs may be a useful tool to mitigate the risk of

patent holdout, especially in light of the fact that the licensee population for 5G technologies, which extend across various industries, is expected to be more numerous and heterogenous than has been the case in 3G and 4G wireless technologies (which have mostly been applied in mobile communications). In "How to Create a Smoother SEP Licensing Ecosystem for IoT" (Chapter 8), Ruud Peters, Fabian Hoffmann, and Nikolaus Thumm propose modifications to SEP licensing practices to address the expected increase in transaction costs in the 5G/IoT ecosystem. These modifications seek to mitigate the risk of negotiation failure and ensuing litigation through a suite of mechanisms designed to increase transparency in SEP licensing, to increase assurance that a licensed SEP is valid and essential, to enhance implementers' incentives to negotiate a license (rather than "use and then litigate"), and to increase the likelihood that a licensee ultimately bears a "reasonable" aggregate royalty for use of the total SEP stack.

Finally, Part V, Patent Enforcement, Wireless Markets, and Global Competitiveness, addresses the geopolitical issues that are being increasingly raised by IP and competition policy in wireless communications markets. In "The Geopolitical Implications of Patent Holdout and the Ensuing Race to the Home Court" (Chapter 9), Jorge Padilla and Andrew Tuffin discuss the danger posed to standardization in wireless technology markets by strategic efforts to initiate SEP-related litigation in courts that are perceived to favor the interests of innovators or implementers. These global forum-shopping strategies have been promoted by certain courts' willingness to determine FRAND royalty rates on a global basis and to issue "anti-suit" and "anti-anti-suit" injunctions to interfere with litigants' ability to seek injunctions, or initiate related SEP litigation, in foreign jurisdictions. In "China's Practice of Anti-suit Injunctions in SEP Litigation: Transplant or False Friend?" (Chapter 10), Mark Cohen provides a comprehensive account, using primary Chinese sources, of the proliferating use of anti-suit injunctions by Chinese courts, usually for the purpose of barring SEP owners (typically, foreign companies) from pursuing infringement actions against implementers (typically, Chinese device makers) in courts outside China. Showing how these legal developments are part of a larger and long-standing effort by Chinese policymakers to secure technological independence and leadership in critical industries, this contribution delivers important and novel insights as SEP policy discussions increasingly integrate geopolitical considerations into the conventional focus on competition and innovation policy concerns. Finally, in "Patents and Competition: Commercializing Innovation in the Global Ecosystem for 5G and IoT" (Chapter 11), Scott Kieff and Thomas Grant close out our book with a return to the "big picture" issues with which it starts. In particular, the authors emphasize the enabling function played by a secure IP infrastructure in facilitating surplus-enhancing cooperative activities between the holders of innovation and non-innovation assets in technology markets. This "win-win" enabling effect stands in contrast to the conventional emphasis on the "win-lose" exclusionary effect of IP rights in the litigation context. The constructive

transactional role played by patents and other IP rights, in conjunction with contract, is demonstrated by the standardization and licensing structure that supports 3G and 4G wireless markets and is expected to continue and intensify as wireless technologies are applied across a broader variety of markets as the digital economy migrates to the IoT.

We conclude on a sad note. During the editing of this book, our dear colleague, Alexander Galetovic, passed away. Alex's untimely passing has left a hard-to-fill void in the economic and empirical analysis of IP and competition policy issues in global wireless markets. Alex's unparalleled dedication to meticulous empirical scholarship yielded breakthrough results that challenged settled assumptions – widely accepted but never rigorously tested – in this economically and socially critical industry. This achievement has promoted a more balanced discussion of the complex IP and antitrust policy issues raised by wireless communications markets, leading to incremental policy changes by US and European regulators. We hope that this book (including Alex's coauthored contribution) will similarly provide an economically and factually informed foundation on which policymakers and scholars can build when proposing and taking action in this vital sector of the global digital economy.

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