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978-1-009-27427-2 — 5G and Beyond
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PART I

Intellectual Property and Competition Policy in Global Wireless Markets

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Restoring and Revitalizing Technology Markets for Mobile Wireless

Geopolitical Dimensions of Patented Technology Embedded in Standards

David J. Teece

I. INTRODUCTION

Standards are important to the further development and rollout of technologies, including 5G and the Internet of Things (IoT), self-driving cars, and artificial intelligence (AI). The United States' technological leadership is no longer assured in many frontier technologies. Indeed, America's strategic rivals, and in particular China, are focused on and committed to taking away American, European, and Japanese technological and marketplace leadership in emerging technologies. Standards will play a role in such outcomes. This chapter focuses mainly on the licensing of standard-essential patents (SEPs) in foundational or "enabling" 5G wireless technology.

Many policy issues are at hand, have tremendous geopolitical consequences, and cannot be looked at in isolation. For instance, the US Department of Justice (DOJ) is reviewing its antitrust policies toward SEPs. These issues are complicated.

The best way forward with technology development is to incent business enterprises operating in the United States and in allied nations to invest heavily in research and development (R&D), as several of them have done in the past. Success in this regard will promote competition and is the best chance the liberal democracies have to maintain technological leadership – and, along with it, achieve long-term economic growth and national security while advancing long-term consumer welfare.

Given US industrial weakness in manufacturing, it is especially important that the research-intensive sector of the US economy remains viable and robust. The development of the foundational technologies stage of the value chain has anchored US competitive advantage in recent decades, and this advantage needs to be sustained and enhanced, if possible. Doing so will require maintaining the viability of the open innovation model in technology development under guidance from the

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European Telecommunications Standards Institute (ETSI).[1] Competition authorities tend to applaud open innovation models,[2] because they favor new entrants (as compared to the vertically integrated model, which is in effect a closed model because research by the implementer is done in-house).

This chapter endeavors to scope the true nature of SEP issues. It will focus almost entirely on ETSI, whose intellectual property (IP) policy, and its functioning as a standards development organization (SDO), is important to the world economy. In particular, the development and future evolutions of 5G (and 6G that may follow it[3]) have considerable economic and geopolitical implications for the United States, Europe, and Japan. The chapter also explores the implications for US global technology leadership, competitiveness, and national security of taking a step backward by reinjecting specious antitrust concepts into the analysis.

II. INTELLECTUAL PROPERTY RIGHTS MATTER

In policy circles, there is an all-too-common failure to understand that the weakening of IP results in less innovation and undermines open innovation approaches, thereby favoring vertical integration. At a time when many policymakers and analysts are concerned about (integrated) Big Tech,[4] it is paradoxical that many of the same individuals favor the weakening of IP. Yet it is the SEP licensing model that enables open innovation and new entry into existing ecosystems. This policy contradiction indicates a lack of clear understanding that standards development, at least for mobile wireless, is an expensive undertaking that requires spending billions of R&D dollars to create new technologies, which get folded into technological ensembles that become next-generation standards technologies available for licensing to industry. The interoperability and interconnections aspect of SEP licensing is just the wrapper. In particular, five issues are often misunderstood and are addressed in this chapter. These issues arose from:

[1] David J. Teece & Edward F. Sherry, The IEEE's New IPR Policy: Did the IEEE Shoot Itself in the Foot and Harm Innovation? (Tusher Center for the Management of Intellectual Capital, Working Paper Series No. 13, Aug. 2016), https://businessinnovation.berkeley.edu/wp-content/uploads/2014/07/Tusher-Center-Working-Paper-No.-13.pdf.

[2] Open innovation is defined by Henry Chesbrough as the use of purposeful inflows and outflows of knowledge to accelerate internal innovation and expand the market for the external use of innovations. Open innovation eschews the model of closed or vertically integrated R&D where a company relies overwhelmingly on in-house R&D to build its technological capabilities. Henry Chesbrough, Open Innovation: The New Imperative for Creating and Profiting from Technology (Harvard Business School Press 2003).

[3] For a proposal for cooperative research efforts on 6G, see Bruce Guile & Albert Pisano, International 6G R&D and Innovation Consortium (BRG Institute, Project Working Paper 2, Oct. 2020), https://static1.squarespace.com/static/5d5f0079ed0caf00014c2fe2/t/5ff4cb44af41aa3cf58d2c19/1609879244797/6G-Case-Statement_10-12-20_v2.pdf.

[4] Vertically integrated, not only with respect to the research function but also with respect to design and manufacturing too.

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(i) An implicit belief that new standards technology arrives more or less like "manna from heaven." The reality is that royalties from SEP licenses provide the income stream that supports the R&D that improves the underlying technology. If the royalty rate is reasonable, and if unlicensed use is minimized, the required R&D can be funded. Absent a robust patent licensing model, vertical integration (closed innovation) is the model that technology implementers would be forced to adopt.

(ii) An implicit belief that standards development is little more than a matter of agreeing on interconnection protocols. It is quite different. In the case of mobile wireless, the SDO provides the platform for what is likely the largest cooperative R&D endeavor the world has ever seen – bigger and arguably even better than Bell Labs of yesteryear, the disappearance of which was unnecessary collateral damage from an antitrust-driven divestiture of AT&T, which paid too little attention to the future funding of breakthrough innovation.

(iii) A failure to understand that only four to five companies, most of them in the United States and Europe, provide more than 80% of the most important technology that gets embedded in standards, and that there are over 1,000 implementers, a number that is likely growing with 5G and IoT.

(iv) A failure to understand that unlicensed use of standards technology is common. Its presence threatens the technology licensing model and hence the open innovation business model that undergirds it.

(v) A failure to understand that patents are not self-enforcing. Nor is there a unified global enforcement mechanism for SEPs. As a consequence, there is not only unlicensed usage but also forum shopping. Implementers try to "divide and conquer."

These misunderstandings reflect a lack of appreciation that technological contributions to standards development (with the process managed under ETSI governance rules) require innovators to license their technology (and associated patent rights) to implementers, thereby giving up the right to sole use. This bargain works only if there is the expectation and the reality of royalty income sufficient to support past and future technology development activities. If this aspect is not understood and is not at the core of US public policy deliberations, then companies that seek to avoid paying market rates for the use of standards technology will likely succeed and, in doing so, undermine the long-term viability of the ecosystem. If policymakers and the courts allow even quasi free riding, the United States would be playing into the hands of those who have undermined US technological leadership, manufacturing capacity, and economic security.

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A balanced approach is needed. If policy favors either side too much (implementers or upstream innovators), then the robust innovation ecosystem that has historically supported mobile wireless is put at risk.

In the early days of mobile wireless (that is, 2G and 3G), standardization activity was dominated or heavily influenced by vertically integrated firms. Today, the success of the open innovation global standards model has enabled nearly seamless wireless compatibility around the globe and allowed hundreds of new implementers to enter the mobile wireless ecosystem. These companies (for example, Apple, Samsung) typically do not contribute significant patented technology to assist in the creation of high-performance standards. They would prefer to use standards technology for free or for a nominal fee. Inasmuch as implementers can lobby government agencies, their sheer numerosity has tended to drown out the voice and perspective of technology developers. In 5G, for instance, the numbers of likely implementers are in the thousands, whereas the majority of the quality contribution comes from a small handful of companies (most notably, Qualcomm, Ericsson, Nokia, Interdigital, and Huawei) that spend heavily on R&D.[5]

In sum, for decades now interoperability standards have also incorporated technology covered by IP. However, this system is now at risk because the licensing landscape has changed somewhat: (1) The ratio of technology developers/contributors to implementers has diminished; and (2) US (and some foreign) antitrust agencies have injected antitrust issues[6] into FRAND[7] deliberations, creating uncertainty that has compromised the functioning of the market for technology. Some of this confusion was cleared up under Makan Delrahim's tenure as head of the DOJ Antitrust Division, but such progress is under threat of reversal under the Biden Administration.

III. THE GEOPOLITICAL ENVIRONMENT

A. *Complex System*

It is no longer acceptable – indeed, it is incredibly risky for Western democracies – for antitrust agencies to formulate policy without consideration of geopolitical consequences. Potential short-term domestic consumer welfare issues pale in comparison to many potentially existential geopolitical threats. Fortunately, dealing presciently with these issues will aid competition and innovation in the United States and elsewhere.

[5] Huawei's success was aided by low-cost prior access to Western technology achieved by theft and antitrust actions. If the United States and other Western companies do not have the means to support ongoing R&D at the appropriate levels, then Huawei is likely to become the world's dominant technology provider in mobile wireless and related technologies.

[6] At least in Europe, antitrust agencies intervened based on complaints submitted by implementers concerning licensor behavior.

[7] FRAND stands for fair, reasonable, and nondiscriminatory (royalty rates).

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There is reason for concern. In the past, antitrust enforcement actions (including by the Federal Trade Commission (FTC)) in the global technology marketplace have been misadventures in terms of their impact on not only competition but also US global competitiveness. Many are by now aware that China is endeavoring to stack international standards bodies with individuals who swear fealty to China. "China Standard 2035" lays out objectives for blockchain, quantum computing, AI, and other technologies. Impacting and controlling 5G standards development is also part of China's national mission. The Western democracies must be mindful of these activities and the underlying strategy. It is important to prevent the politicization of the standards development process.[8] The *14th Five-Year Plan for National Informatization* released in December 2021, for example, restates China's goals to "create a closed-loop innovation mechanism" to promote "standards building" in prioritized areas such as 5G, Big Data, AI, blockchain, industrial Internet, and so forth, and accelerate the completion and perfection of existing data sharing and data application standard systems. It also anticipates greater integration of China's information standards efforts into all sectors of the Chinese economy relying upon this "closed-loop" innovation system.[9] Policymakers and executives and members of standards bodies must be mindful of these activities and the underlying strategy.

The United States' antitrust policy, if the FTC is to be used as a guide, already has inadvertently strengthened the hand of China. The problems associated with standards technologies are not unlike the problems that the Western democracies are confronting with all emerging technologies. David Delpy, University College London, put it this way:

> Now, it's very difficult for countries to make sure that they get at least a fair share of the return on investment on emerging technologies .... If everybody's playing by the same rules, it's fine. But everybody isn't playing by the same rules. The issue is, value capture: how do liberal economies capture value in a world where not everybody is liberal?[10]

Western democracies must double down on R&D and strengthen the technological capabilities of business firms. That is a big – but necessary – task. The required R&D must, in the main, be private sector funded. For private sector R&D investment to occur, national policy must make sure that SEP owners receive fair compensation, sufficient to support the business models of those Western firms

[8] China may be somewhat delusional if it believes that providing monetary incentives for Chinese companies to put forward technologies will in and of itself sway professional bodies into not choosing the best technologies to incorporate in a standard.

[9] DigiChina, *Translation: 14th Five-Year Plan for National Informatization – Dec. 2021* (Jan. 24, 2021), https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/.

[10] Richard Hudson, *New Year's Resolution: Research Group Aims to Fix the Way the World Collaborates on Technology*, SCI. BUS. (Jan. 4, 2022), https://sciencebusiness.net/news/new-years-resolution-research-group-aims-fix-way-world-collaborates-technology.

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that generate the technology that ends up as part of the standards technology ensemble. Supporting the SEP licensing process so that it can, in turn, support the R&D necessary for technology development ought to be the critical policy objective of the DOJ, the United States Patent and Trademark Office, and the US National Institute of Standards and Technology. If achieved, it also will support subsidiary goals with respect to competition and consumer welfare.

B. *The Changing Geopolitical Landscape*

"China Standards 2035," mentioned in Section III.A, was a galvanizing publication that can serve to remind executives and policy analysts that they need to develop a broader perspective with respect to standards development and standards setting. This initiative builds on "Made in China 2025" and heralds plans and financial and regulatory support for Chinese enterprises, public and private, to take control of the decentralized private (and substantially professionally driven) global standard development process. If successful, China will change the governance of global business, which in turn will augment China's geostrategic power. There are far-reaching consequences for international business, national security, and competition.

Chinese firms have already obtained substantial representation in the international standard-setting process. Unlike Western representatives, Chinese representatives, whether corporate or government, are held accountable to the nation-state. The Swedish Institute of International Affairs recently noted:

> For decades, and almost unnoticed by the general public and politicians, technical standards have been a driving engine behind globalization . . . they [now] run the risk of turning into a core subject of great power competition over high technology . . . Europe emphasizes its commitment to rules-based institutions in world affairs. Hence, it cannot simply adapt the new power approach to technical standards, since this undermines the existing institutional framework.[11]

The report further noted that China's state-directed approach to standards development "radically breaks with both the U.S. and European approaches that are both industry driven." Other sources draw attention to China, noting:

> The CCP has seized on the importance of these [standards development] bodies for the dual and mutually reinforcing objectives of increasing national competitiveness and building international influence on technology adoption.[12]

[11] Tim Nicholas Ruhling, *Technical Standardization, China and the Future International Order: A European Perspective*, Swedish Inst. Int'l Affs. (Feb. 2020), at 4–5, https://eu.boell.org/sites/default/files/2020-03/HBS-Techn%20Stand-A4%20web-030320.pdf.

[12] Lindsay Gorman, *The U.S. Needs to Get into the Standards Game – With Like-Minded Democracies*, Law Fare (Apr. 2, 2020), www.lawfareblog.com/us-needs-get-standards-game—-minded-democracies.

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As a result, one might say that China is "inventing patents," in the sense that it is diligent about filing for both minor and major inventions. It also is very active at standards-setting meetings and on standards-setting governance.

Unfortunately, there is sometimes limited sophistication in understanding what is going on in the global technology marketplace. Some of this flows from the misreading of patent statistics.

Citing patent analytics company iPlytics, an article in the *Wall Street Journal* recently noted that companies from China own "36% of all 5G standard essential patents" and that "U.S. firms including Qualcomm and Intel hold just 14%." The article went on to state:

> Chinese companies own such a significant share of the patents [that] the Western companies need to pay to license from them, that is, the net royalty payments will be from Western companies to Chinese companies.[13]

This statement could be true only if the quality of Chinese patents is equivalent to or better than Western companies' patents, or if the infringing sales of Western firms are greater than that of Chinese firms. The licensing jurisdictions also need to be similar for such equivalences to be drawn.[14] The famous quote "not everything that can be counted counts, and not everything that counts can be counted" seems relevant in this context. However, it would be very imprudent to assume that all Chinese patents are valueless.

Patent statistics can be misleading. Regardless, the United States and its allies – including other liberal democracies, particularly Sweden, Finland, South Korea, and Japan – still maintain a fragile lead, even as the trends do not favor liberal democracies. Policy mistakes now could lead to the rapid dissipation of this fragile leadership by the liberal democracies, with very negative knock-on effects for the US economy and competition. In the next section, I step back and review the context in which SEPs need to be understood – at least with respect to mobile wireless.

C. *The 5G Technological Ensemble*

The mobile wireless industry has a remarkable track record of developing continuously evolving and improving interoperable systems technology. GSM, Wideband Code Division Multiple Access (WCDMA), and, more recently, Long Term Evolution (LTE) are examples of successful technologies developed privately and separately, but combined by the 3rd Generation Partnership Project (3GPP), using consensus-driven governance, into a platform with massive economies of scale and scope.

Technology development for 5G occurs in a distributed manner with limited overall end-to-end supervision. A very few companies – such as Qualcomm, Nokia,

[13] Don Strumpf, *Where China Dominates in 5G Technology*, Wall St. J. (Feb. 26, 2019), www.wsj.com/articles/where-china-dominates-in-5g-technology-11551236701.
[14] *Id.*

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and Ericsson – work hard to help ensure a high degree of end-to-end operability. Without these special efforts, 3GPP could fail. As an organization, 3GPP does not have its own resources to sponsor the development of "gap-filling" technology that, on a standalone basis, may not be financially viable. The real contributions of individual members are hard to calibrate and are not measured merely by counting the number of technical contributions made or patents declared by particular companies.

With 5G, 3GPP has the task of governing a collaborative effort among hundreds of different entities with different interests and incentives. Governance comes in at the time technologies are to be considered for inclusion in a standard. It oversees an iterative, nonlinear, consensus-based approach to technology selection and resulting standards development – systems engineering managed privately and in a decentralized manner. It has worked well, in part because the professionals involved are engineers. Historically, an engineering culture and commercial considerations dominated, and politics were held at bay. Members collectively (by vote) decided on the best technologies to go into a "standard" or new technological ensemble. This may change as Chinese national politics intervene.

Participating firms need confidence that each technology advanced for consideration is robust, has been or will be tested, and can be manufactured, and that the requisite software and applications support will be available. Sponsors of technology then are required to demonstrate that the technology is or can be commercially viable. Hence, by the time that patented technology becomes embedded in the standard, it already has undergone an early assessment as to commercial viability. Licensing executives need to understand this process, as it indicates that patents that are "truly essential" have in all probability passed a litmus test of commercial viability, and thus are likely to have value if indeed they are truly essential and not just "declared essential" by the patent owner.

Feedback from the validation and testing activities is critical and often leads to further development of the technology and/or changes in specification. This process is shown in Figure 1.1. Steps in validation include review, modeling, prototyping, and "plug tests/plug fests," where designers of equipment or software using the technology proposed for the standard test interoperability of products and designs with those of manufacturers. As standards go through revisions, multiple firms may submit proposals and work together toward final adoption of the standard.

The standard-setting for 5G is a continuous process. Updates are issued periodically. Licensing practices have evolved to support the open interoperable mobile wireless ecosystem, with royalties being set in the marketplace via negotiation at levels sufficient to encourage at least a few companies to make the large investment required to develop new 5G technologies.[15]

[15] Qualcomm alone spends over five billion dollars a year mainly on foundational wireless technologies.

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