THE
CRITERION
JOURNAL ON INNOVATION

VOL. 1 2016

Reevaluating Patent Damages in the Knowledge Economy: The Intellectual Value Chain and the Royalty Base for Standard-Essential Patents

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Patent valuation is a complex and imprecise process exemplified by the long, contentious history regarding the determination of patent damages in U.S. jurisprudence. This process is made even more difficult as products increasingly undergo technology convergence and market actors deploy divergent business strategies to extract value from their intellectual property.[1] This has led to an increase in patent litigation and a greater demand for courts to calculate patent value more accurately.[2] U.S. courts have deployed several principles, including the use of the smallest saleable patent-practicing unit (SSPPU) and the entire market value rule (EMVR), as a means to reduce the complexity when attempting to apportion patent value in multicomponent products.[3] However, as these principles affect the determination of the royalty base, which can differ by orders of magnitude, the applicability of their use in different market contexts and norms requires investigation, because

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1 *See* David L. Schwartz & Jay P. Kesan, *Analyzing the Role of Non-Practicing Entities in the Patent System*, 99 CORNELL L. REV. 425, 426 (2014) (noting that "patent litigation is undergoing a seismic change" due to increased litigation by nonpracticing entities).

2 *See* PRICEWATERHOUSECOOPERS, 2015 PATENT LITIGATION STUDY: A CHANGE IN PATENTEE FORTUNES 3 (2015), https://www.pwc.com/us/en/forensic-services/publications/assets/2015-pwc-patent-litigation-study.pdf (showing a 7.1-percent CAGR in patent case filings since 1991).

3 *See* Michael A. Greene, *All Your Base Are Belong to Us: Towards an Appropriate Usage and Definition of the "Entire Market Value" Rule in Reasonable Royalties Calculations*, 53 B.C. L. REV. 233, 235 (2012); *see also* Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc., 809 F.3d 1295, 1302 (Fed. Cir. 2015).

their use by the courts could have systemic effects on industrial dynamics and economic efficiency in specific markets, especially those reliant on open standards created by firms with heterogeneous business models.

This article focuses on the telecommunications sector as a prime example of an industry with a major impact on economic development undergoing technology convergence and business model divergence. Not only have mobile phones transformed into multi-media devices incorporating cameras and other product and service functions, but almost every imaginable physical artifact, from cars to clothing, is being equipped for communication into what has been termed the "Internet-of-Things."[4]

In the telecommunications sector, technology standards are critical for reducing complexity and facilitating widespread technology convergence and adoption. Standards deliver both interoperability and performance, facilitating market creation and growth.[5] Examples of widespread, successful telecommunications standards include 802.11 (Wi-Fi) for short-range wireless communication and GSM (2G) for cellular communications. Many convergent products are completely reliant on standards (for example, one study identified 251 standards and estimated many more relevant standards in a laptop computer).[6]

Although some standards are proprietary, most are open, although not necessarily free. In addition, some standards are designed through the consensus of multiple actors (that is, de jure) while other achieve adoption through market competition against competing technologies (that is, de facto).[7] Microsoft Windows is an example of a proprietary, de facto standard, whereas the 802.11 and GSM standards mentioned above are examples of open, consensus-based standards. Some standards, such as TCP/IP for the Internet, are completely free to use.

Open, consensus-based standardization processes can involve hundreds of actors and can require access to thousands of patents that are essential to the implementation of a standard owned by different stakeholders. For example, the MPEG-LA patent pool for the ITU H.264/AVC standard consists of 38 licensors, over 4000 essential patents, and 1415 licensees.[8]

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[4] Ericsson predicts that 28 billion devices will be connected by 2021. Ericsson, Ericsson Mobility Report 3 (2015), https://www.ericsson.com/res/docs/2015/mobility-report/ericsson-mobility-report-nov-2015.pdf.

[5] For a thorough economic treatment of standards, see Knut Blind, The Economics of Standards: Theory, Evidence, Policy (Edward Elgar 2004).

[6] *See* Brad Biddle, Andrew White & Sean Woods, *How Many Standards in a Laptop? (And Other Empirical Questions)*, *in* International Telecommunication Union, Proceedings of the 2010 ITU-T Kaleidoscope Academic Conference 123 (2010).

[7] *See* Carl Shapiro & Hal R. Varian, *The Art of Standards Wars*, 41 Cal. Mgmt. Rev., Winter 1999, no.2, at 9–13 (providing a historical overview of standards wars among competing technologies in the United States, including color television and electric power).

[8] *AVC/H.264 Licensors*, MPEG-LA, http://www.mpegla.com/main/programs/AVC/Pages/Licensors.aspx; *AVC/H.264 Patent List*, MPEG-LA, http://www.mpegla.com/main/programs/AVC/Pages/PatentList.

These complex standardization processes are typically governed formally or by voluntary participation by specific standard-setting organizations (SSOs) run by industry consortiums, professional associations, and national or international NGOs.[9] SSOs are focused solely on developing the best technical specifications and typically forbid issues concerning patents and licensing from arising in standard deliberations.[10] However, as the creation of standards could generate a lock-in effect on the market,[11] holders of patents essential to the execution of the standard could possess a much higher degree of market power than would normally be attributed to actors in a competitive market.[12] As each patent could theoretically be used to block or delay the implementation, many SSOs have developed intellectual property rights (IPR) policies to govern the open use of the standard on fair, reasonable, and nondiscriminatory (FRAND) terms.[13] These policies are meant to increase the adoption and diffusion of the standard by both providing an adequate return to innovative firms and reducing the risk of holdup[14] among implementers of the standard, who will make irreversible, standard-specific investments before having obtained licenses from all the actors holding standard-essential patents (SEPs).[15]

aspx; *AVC/H.264 Licensees*, MPEG-LA, http://www.mpegla.com/main/programs/AVC/Pages/Licensees.aspx.

[9] Examples of SSOs include Bluetooth (an industry consortium), IEEE (a professional association), and ITU-T (an international NGO). Standards can also be developed and governed by individual firms (for example, Microsoft Windows), and competing standards can emerge, leading to standards wars. *See* Shapiro & Varian, *supra* note 7, at 9–15.

[10] *See, e.g.*, *Common Patent Policy ITU-T/ITU-R/ISO/IEC*, International Telecommunication Union, http://www.itu.int/en/ITU-T/ipr/Pages/policy.aspx.

[11] *See* Michael L. Katz & Carl Shapiro, *Network Externalities, Competition, and Compatibility*, 75 Am. Econ. Rev. 424, 424–25 (1985) (describing the concept of positive consumption externalities based on network effects); Joseph Farrell & Paul Klemperer, *Coordination and Lock-In: Competition with Switching Costs and Network Effects*, *in* 3 Handbook of Industrial Organization 1970, 1971–77 (Mark Armstrong & Robert H. Porter eds., North-Holland 1st ed. 2007) (explaining the role of compatibility on switching costs and network effects in generating lock-in).

[12] *See* Rudi Bekkers, Bart Verspagen & Jan Smits, *Intellectual Property Rights and Standardization: The Case of GSM*, 26 Telecomm. Pol'y 171, 177–82 (2002) (describing the impact of SEPs on the formation of the GSM standard by ETSI in the late 1980s and early 1990s).

[13] In the United States, the term "RAND" is typically used, where the word "fair" is dropped or assumed in the meaning of reasonable. *See* Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations*, 90 Cal. L. Rev. 1889, 1973–75 (2002); Rudi Bekkers & Andrew S. Updegrove, U.S. National Academies of Science, A Study of IPR Policies and Practices of a Representative Group of Standards Setting Organizations Worldwide (2012), http://home.tm.tue.nl/rbekkers/nas/Bekkers_Updegrove_NAS2012_main_report.pdf (evaluating IPR policies in SSOs).

[14] Joseph Farrell, John Hayes, Carl Shapiro & Theresa Sullivan, *Standard Setting, Patents, and Hold-up*, 74 Antitrust L.J. 603, 603–04 (2007) ("In very broad terms, opportunism or hold-up arises when a gap between economic commitments and subsequent commercial negotiations enables one party to capture part of the fruits of another's investment, broadly construed. Hold-up can arise, in particular, when one party makes investments specific to a relationship before all the terms and conditions of the relationship are agreed. Hold-up generally leads to economic inefficiency that contracting parties, and courts interpreting contracts, often try to avoid.").

[15] The IEEE defines an "Essential Patent Claim" as "any Patent Claim the practice of which was necessary to implement either a mandatory or optional portion of a normative clauses of the IEEE Standard when, at the time of the IEEE Standard's approval, there was no commercially and technically feasible non-infringing alternative implementation method." Institute of Electrical and Electronics Engineers

In addition to the challenges of convergence and SEPs, the telecommunications value chain has also undergone a transformation to make room for changes in the division of labor and associated business models. In particular, a new division of innovative labor focused heavily on research and development (R&D) and intellectual property (IP) licensing has emerged, creating competition between actors with weaker SEP portfolios that primarily sell products and services, and actors with stronger SEP portfolios whose core business model is licensing technology. In effect, two related but distinct value chains have emerged: a material value chain (MVC) focused on the traditional industrial supply chain, and an intellectual value chain (IVC) focused on leveraging knowledge through license-based business models.[16] Although actors operate in only one value chain, many operate across both, but typically with distinct value propositions. This can be seen as a fundamental change in corporate strategy from competition in the product market to competition in the technology market, leading to the question of how value should be distributed among actors providing different tangible and intangible value propositions in the telecommunications market. Economically, this question concerns both the share of rent streams among horizontal competitors (substitutes) and vertical collaborators (complements) in the value chain, as well as the competitive nature of the market as a whole. This creates a new form of "co-opetition"[17] within standards-enabled markets, which raises both strategic management and economic efficiency issues at the interface of patent, contract, and antitrust law.

When parties cannot agree on FRAND terms and conditions in bilateral negotiations, a court (or arbitration panel) will need to determine FRAND royalty rates. Thus, one of the core issues at the heart of the FRAND debate is how courts should determine the royalty base when deciding on FRAND royalty rates. Should royalties (that is, value) be apportioned on the basis of the markets for end products, or the markets for the components that comprise the end products? The choice of the royalty base can have a major impact on the distribution of value to different actors in the value chain, which in turn can impact the economic efficiency of standard-enabled markets. Important U.S. court rulings that will be examined in Part II have provided new case law, as the courts have tried to grapple with the issue of FRAND-based SEP licensing in a fragmented telecommunications value chain consisting of new divisions of labor and business models. Legal norms

[IEEE], IEEE-SA Standards Board Bylaws § 6.1, at 15 (2015), http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf.

[16] The concept of the material value chain is based on Michael E. Porter, Competitive Advantage: Creating and Sustaining Superior Performance 33–61 (Free Press 1985). The intellectual value chain is based on Ulf Petrusson, Intellectual Property & Entrepreneurship: Creating Wealth in an Intellectual Value Chain 70–85 (CIP 2005).

[17] Adam M. Brandenburger & Barry J. Nalebuff, Co-opetition (Currency Doubleday 1997).

to support apportionment, such as the SSPPU and the EMVR, have proven difficult to apply evenly across diverse business models and market norms.[18] Thus, the goal of this article is to investigate the applicability and implications of the current legal norms for the choice of royalty base in relation to the prevailing market norms regarding SEP transactions in the telecommunications industry. This issue will be examined from economic, legal, and strategic perspectives, where the following complementary research questions have been formulated as a guide: (1) How can value creation and market norms be characterized in a knowledge economy? (2) What are the historical and current legal norms for setting the royalty base in the determination of patent damages in general, and also for SEPs in particular? (3) What are the current market norms and roles for patents in the telecommunications industry in relation to standards-enabled markets? (4) How do the market norms in the telecommunications industry affect the applicability of legal norms in the determination of the royalty base in patent damages? (5) How does the determination of the royalty base in patent damages affect historical and future market norms?

Methodologically, the empirical investigation of the transformation of the telecommunications value chain and the development of knowledge-based business models was conducted mainly through trusted primary sources, including official public documents such as antitrust investigations, SEC Form 10-K filings, and court cases, as well as previous case studies and news articles. Industry interviews were also used to confirm analysis of information gathered through primary sources. Two short case studies were conducted to provide a more detailed understanding of current business practice. Differences in the computing and telecommunications industries were highlighted in those cases to show that divergent market norms exist across industries, and to illustrate how these different norms are related through the convergence of the semiconductor and the telecommunications value chains in the mobile devices sector.

The U.S. law on patent damages—in particular, the determination of the royalty base through legal norms such as the SSPPU and the EMVR—is analyzed through an empirical review of relevant case law, as well as pertinent patent legislation and academic literature, to build a picture of the current norms in the context of historical developments. A qualitative analysis of the relevance of market norms to the determination of the royalty base in FRAND royalty calculations is conducted on the basis of the empirical

[18] As the relationship between legal and market norms is a key focus area of this article, a short set of definitions may be in order. Legal norms denote the practical set of legal principles, rules, and behaviors that define the decision-making process of the legal system. Market norms denote the practical set of business principles, rules, and behaviors that define the strategic and operational decision making of market actors in an industry. Industry norms will used to distinguish between the market norms of different industries.

information gathered on the telecommunications industry in relation to the U.S. case law and recent literature.

Part I provides a theoretical overview of value creation in the knowledge economy and introduces the concept of the intellectual value chain as a distinctive element. Part II presents a review of U.S. legal norms regarding patent damages in the context of the determination of the royalty base. Part III describes standardization in the context of the telecommunications value chain, with a focus on exemplifying the role of IP and the intellectual value chain through a description of industry practice in general, as well as two specific case studies. Part IV provides an analysis of IVC-based market norms in relation to legal norms. Part V examines economic transformation, the implications for firms and markets of determining the royalty base, and the ability of U.S. courts to adapt legal norms to new market norms and contexts.

I. Value Creation in the Knowledge Economy

The transformation of the telecommunications industry and the current debate over SEP value is part of a larger societal transformation from an industrial to a knowledge-based economic paradigm. To evaluate the system for adjudicating patent damages in this transition, it is critical first to understand how value is created, captured, and commercialized by firms employing knowledge-based business models. This part seeks to define knowledge as both an input and output of business activities through two distinct commercial modes—the material value chain and the intellectual value chain, opening up for an interpretation of the value of knowledge both related to and separate from the traditional industrial mode of production. This will re-frame the understanding of competitive advantage by shifting the focus from the product market to the technology market, which facilitates the emergence of a new division of innovative labor. It is through the understanding of the separation and interaction of the MVC and IVC that a framework for evaluating patent damages can be developed for a knowledge economy.

A. Defining the (Control of the) Knowledge Economy

Certainly, there is nothing new about the observation that knowledge plays a critical role in economic development.[19] Because business cannot exist without knowledge, the existence of knowledge itself cannot be the defining characteristic of the knowledge economy in relation to an industrial

[19] The term *knowledge economy* is not perfect in this regard, but is used to contrast the strong reification of the physical product as the center of economic activity in the industrial economic paradigm.

economy, which was obviously also based on knowledge.[20] Thus, the need to understand how firms use knowledge in different ways to create value and achieve a competitive advantage is central to defining the knowledge economy.[21] There are two important perspectives, one of which is related to the nature of firm resources, and the other is related to how the value of these resources is appropriated through IP-based transactions.

From a resource-based perspective, competitive advantage is typically defined in terms of the firm's organizational control over key tangible and intangible resources.[22] Over the past 40 years, there has been a significant shift in the proportion of tangible resources in relation to the market value of firms on the S&P 500—from 83 percent in 1975 to 16 percent in 2015.[23] This is a strong indication that intangible resources are now responsible for most value creation across a broad range of U.S. firms, supporting the premise that knowledge has replaced the traditional factors of production as the primary source of value.[24] This, in turn, puts a greater emphasis on the management of knowledge to better understand the exact contribution of the firm's intangible resources relative to its value propositions, which will be discussed further in Part I.B. As the value of knowledge becomes increasingly recognized and objectified, the control of knowledge moves from an administrative process to a key strategic process of the firm. In fact, one way to differentiate the industrial economy from the knowledge economy is to say that we are moving from the control of the means of production to the control of knowledge as the core driver of competitive advantage.

From a transactional perspective, one defining aspect of the growth of knowledge-based business is that objectified knowledge (for example, patented technology) is growing as an activity of market exchange. Thus,

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[20] *See* Robert Grant, *Toward a Knowledge-Based Theory of the Firm*, 17 Strategic Mgmt. J. (Special Issue) 109, 112 (1996) ("Fundamental to a knowledge-based theory of the firm is the assumption that the critical input in production and primary source of value is knowledge. Indeed, if we were to resurrect a single-factor theory of value in the tradition of the classical economists' labor theory of value or the French Physiocrats land-based theory of value, then the only defensible approach would be a knowledge-based theory of value, on the grounds that all human productivity is knowledge dependent, and machines are simply embodiments of knowledge.").

[21] For a discussion on the complex role that knowledge plays in the creation of innovations, ventures, and markets, see Petrusson, *supra* note 16, at 247–48.

[22] For early discussions on the so-called resource-based view with respect to the firm and competitive advantage, see Edith Penrose, The Theory of the Growth of the Firm (Oxford Univ. Press 4th ed. 2009); Birger Wernerfelt, *A Resource-Based View of the Firm*, 5 Strategic Mgmt. J. 171 (1984); Jay B. Barney, *Firm Resources and Sustained Competitive Advantage*, 17 J. Mgmt. 99 (1991).

[23] *See* Press Release, Ocean Tomo, Annual Study of Intangible Asset Market Value from Ocean Tomo, LLC (Mar. 5, 2015), http://www.oceantomo.com/2015/03/04/2015-intangible-asset-market-value-study/.

[24] However, it is difficult to understand exactly what is meant by intangible resources, as the measurement is only a calculated residual. In other words, tangible assets are calculated from the balance sheet of the firms, and the market value is determined by the stock exchange, but the value of intangible assets is only obtained by subtracting these two values (that is, there is no accounting or direct market valuation of the intangible assets of firms). Similar to the calculation of Solow's residual in the 1950s, the revelation that the S&P 500 is mostly intangible-capital intensive only defines the extent of our ignorance. *See* Robert M. Solow, *Technical Change and the Aggregate Production Function*, 39 Rev. Econ. & Stat. 312 (1957).

the transformation from an industrial economy to a knowledge economy can also be characterized by a fundamental shift in the role of intellectual property from a static to a dynamic approach, where intellectual property is used not only to block others (that is, a static approach) but also is used as an object in commercial transactions (that is, a dynamic approach).[25] This affects how knowledge is created, controlled, and commercialized, opening up the prospect of new knowledge-based business models and facilitating the development of the division of innovative labor.[26] As the value of knowledge is contextual in nature, the means by which it is utilized through different business models and market norms will ultimately define its actual value-in-use.[27] Thus, the value of knowledge is business-model specific, where license-based models are increasingly used as a means of capturing this value in the knowledge economy. Below is an attempt to define knowledge-based business that incorporates both a resource approach and a transactional approach (that is, input and output), independent of the dominant industrial logic.

Knowledge-based business can be defined as commercial activity where *proprietary knowledge* is its main resource input or output, characterized by the following:

1. Value Addition of Knowledge

The key value drivers are mainly determined by the knowledge component (that is, objectified intellectual assets such as technology, brands, content, designs, know-how, and so on) of the value proposition. When knowledge itself is the value proposition, such as in an IP license, then this distinction is obvious. However, this is not as intuitive when the value proposition is delivered as a physical or virtual product. Branded products are a good example of when the value addition of the brand is worth far more than the cost of production of the product itself. Another example would be the delivery of software on a DVD or a cure for a disease in the form of a pill. In these cases, the material value proposition is of much less value than the knowledge-based

[25] *See* Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 Cal. L. Rev. 1293, 1302–03 (1996) [hereinafter Merges, *Contracting into Liability Rules*] (describing the "dynamic," transactional perspective of IPRs in the context of property and liability rules).

[26] *See* Robert P. Merges, Intellectual Property Rights, Input Markets, and the Value of Intangible Assets 1, 31–32 (Feb. 9, 1999) (unpublished manuscript), https://www.law.berkeley.edu/files/iprights.pdf [hereinafter Merges, Intellectual Property Rights] (describing how strong IPRs can facilitate specialization and input markets for knowledge).

[27] *See* Ulf Petrusson & Bowman Heiden, *Assets, Property and Capital in a Globalized Intellectual Value Chain*, *in* From Assets to Profits: Competing for IP Value & Return 275, 283–90 (Bruce Berman ed., John Wiley & Sons 2008) (presenting examples of how different types of knowledge are leveraged across different business models and market contexts).

value proposition. The physical object is simply the carrier of the real knowledge-based value proposition.[28]

2. Control of Knowledge

Maintaining control over the key intellectual assets of the value proposition is critical to creating competitive advantage. Knowledge, once created, is neither a rival nor a scarce resource. The control of knowledge through various mechanisms, including intellectual property rights, is essential to the claiming of knowledge in property transactions as well as allowing for freedom to operate in knowledge-intensive industries.

3. Business-Model Specific

Knowledge-based businesses are business-model specific, not sector specific (though some sectors—for example, IT, creative industries, and so on—use mainly knowledge-based business models). Knowledge is important in all economic paradigms, but what differentiates a knowledge-based business is the increasing role played by knowledge as discrete commercial objects in market transactions.

The next part will elaborate on the transformation from an industrial to a knowledge-based business paradigm in relation to changes in the structure of the firm and industry value centered on an increased dynamic use of intellectual property.

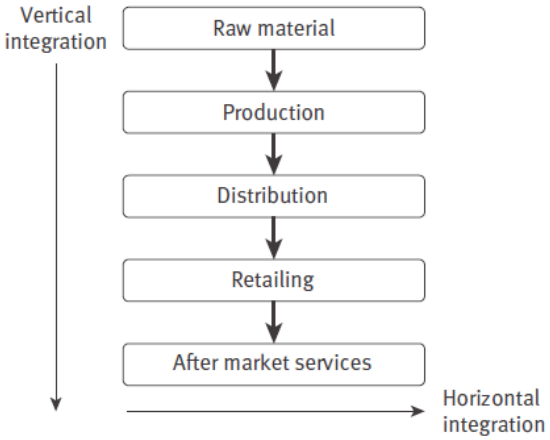
B. Material Versus Intellectual Value Chain

The industrial economy is typified by a (relatively) few, well-known commercial means from which to create and extract value through the production, distribution, sales, and repair of physical goods.[29] Figure 1 depicts the classic material value chain, where firms can occupy multiple stages in the chain (that is, vertical integration), or occupy the same stage in multiple value chains (that is, horizontal integration). However, if proprietary knowledge is the key to competitive advantage in the knowledge economy, the traditional focus on the MVC will need to be supplemented with what could be termed as an intellectual value chain.

[28] Stephen L. Vargo & Robert F. Lusch, *Evolving to a New Dominant Logic for Marketing*, 68 J. MKTG. 1, 5–12 (2004) (arguing that the distinction between products and services is a social construction based on a historical focus on operand resources such as land and physical goods as opposed to the underlying operant resources). Vargo and Lusch contend that all economic activity is service-based—a fact that has been hidden by the indirect exchange of the market for physical goods—and call for a change in the dominant marketing logic from a focus on goods to service provision as the core to economic exchange. *Id.* at 5. Here, *service* denotes a value proposition to customers instead of an economic activity where knowledge is the key operant resource.

[29] *See* PORTER, *supra* note 16.

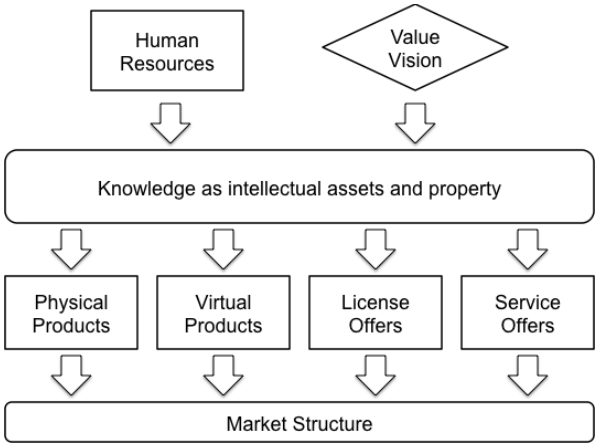
Figure 1. Generic Industry Value Chain



Source: PORTER, *supra* note 16.

In Figure 2, the intellectual value creation process makes explicit the source of value as the knowledge of human resources captured as intellectual assets and property, which can then be commercialized through different business models that, in turn, affect the norms and structure of the market. This includes the use of traditional physical products as the carrier of value, in which case the traditional material value chain shapes the market. In addition, knowledge can be delivered through virtual products (for example, information technology solutions such as software), as a transfer of knowledge through license agreements (for example, patent licenses), as a professional service (for example, consulting), or through a combination of all of those mechanisms. These different means of knowledge exploitation involve the creation of completely different market norms and business models. For example, the packaging of music in an iTunes or Spotify solution creates quite different firm and market norms than the historical model of retailing music through CDs or records (that is, through physical products). In both business models, proprietary knowledge is the key underlying asset. The change from a physical product to a virtual product or service serves to unveil the true value creation object and to expose the industrial paradigm as simply one mode of commercial distribution among others.

Figure 2. Intellectual Value Creation Process



Sources: PETRUSSON, *supra* note 16; Petrusson & Heiden, *supra* note 27.

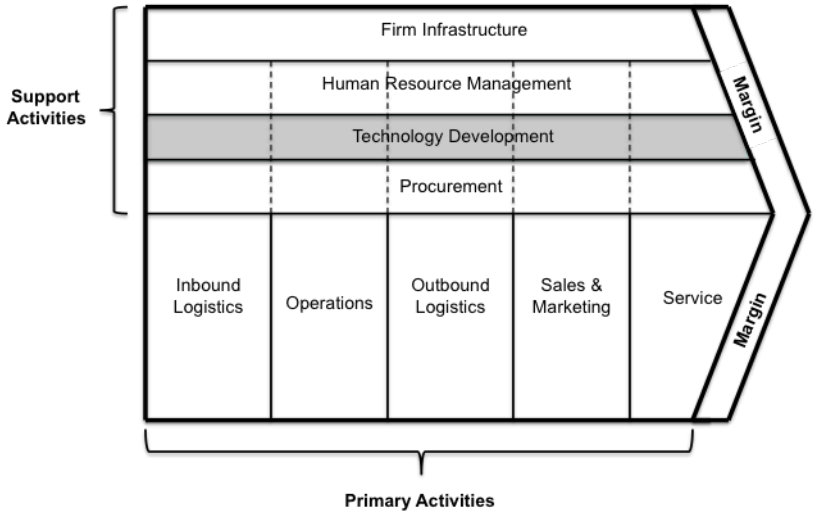
The intellectual value creation process clarifies the creation and capture of valuable knowledge as the core resources (that is, intellectual assets and property) of knowledge-based business in alignment with the resource-based view of the firm. It also focuses on the dynamic movement of knowledge from the minds of individuals to its explicit objectification and packaging as property through various commercial delivery mechanisms. Knowledge thus moves from being an abstract concept to being an objectified asset and property to be managed and transacted. The key activity of the firm in turn becomes the maximization of the value of knowledge through the development of innovations, markets, and ventures through the function of knowledge management as an integration of human resource management and intellectual asset or property management, differing greatly from the focus on the production and distribution of physical resources in the MVC.[30]

The transition from an MVC to an IVC perspective can be exemplified using Porter's generic firm value chain, shown in Figure 3. In this industrial model, the primary activities of the firm are related to the movement, development, and servicing of the physical product. Technology development is considered a support activity, not a profit center activity of its own. However, once knowledge is put as the focal point for value creation and extraction, technology development could be considered the primary activity of the firm, whereby the MVC becomes only one of several commercial options available to the firm, as shown in Figure 2. This, in turn, creates opportunities for both the outsourcing of MVC activities and the specialization in

[30] For a description of the core capabilities to manage the intellectual value chain, see PETRUSSON, *supra* note 16, at 248–50.

technology development and innovation, facilitating the development of a division of innovative labor.[31]

Figure 3. Generic Firm Value Chain



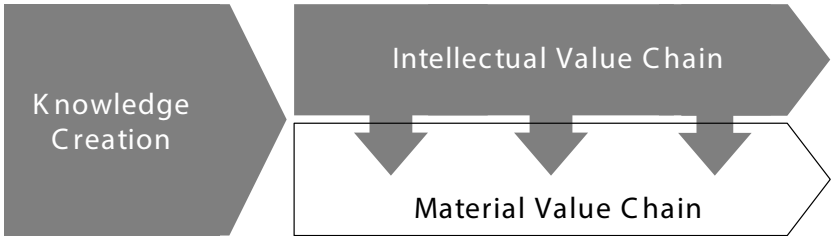
Source: PORTER, *supra* note 16.

For this article, the focus will be on the key operational differences between competition on a product market (that is, an MVC) versus a technology market (that is, an IVC), where the former is primarily concerned with the production and sale of physical products, and the latter with the packaging of knowledge as intellectual property and commercialization through license-based transactions. While the material value chain (MVC) can be seen as a component of a more holistic intellectual value creation process as depicted in Figure 2, this article will define the two value chains as separate but complementary, as a means to better illustrate the different commercial logic and strategies deployed by market actors. This is particularly relevant, considering the changing role of IP licensing from simply an alternative to in-house production to a primary means of generating revenue and facilitating access in standards-enabled markets with multi-technology products, where IP ownership is often distributed among many actors.[32]

[31] The lack of marginal cost of knowledge combined with the market power created through its control (for example, through a patent) allows for knowledge to operate separately from its embodiment in physical products and capture value through its own value chain (that is, the IVC).

[32] For a discussion on the differences in licensing a product concept versus specific intellectual elements, see PETRUSSON, *supra* note 16, at 77–79.

Figure 4. Commercialization of Knowledge on Both a Material and Intellectual Value Chain



Source: Adapted from PETRUSSON, *supra* note 16.

Figure 4 depicts how knowledge can be commercialized through both a material and an intellectual value chain as products, license offers, or both. In this article, particular attention is given to the transaction of intellectual property in the IVC versus the transaction of physical property—with or without the associated intellectual property—in the MVC. As technology or patent licensing is often directed at producers of physical products, special interest will be given to the intersection of the two value chains (that is, the position in the material value chain where licensing takes place), as this is particularly relevant in the determination of a royalty base.

II. THE LEGAL DETERMINATION OF THE ROYALTY BASE FOR THE CALCULATION OF PATENT DAMAGES

As the telecommunications sector has undergone technological convergence and business divergence, courts have struggled with the determination of patent damages, not least in cases where standards and FRAND are at the center of attention. The courts have developed certain norms, such as the SSPPU and the EMVR, to help determine the base upon which damages are calculated, thus reducing the complexity of calculating damages and helping both the courts and the juries to handle these cases. This part examines both the development of these legal norms and the question of whether this development has resulted in a set of norms well adapted to the needs of the complex industry and business realities.

A. The Legislative Development

According to Article I of the U.S. Constitution, Congress shall have the power "[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."[33] This so-called "patent and copyright clause" is the constitutional basis for U.S. patent and copyright law. The first federal patent legislation, "An Act to promote the Progress of Useful Arts," was enacted in 1790, but it was not until the enactment of the Patent Act of 1952 that U.S. patent law got its modern framing.[34] The 1952 legislation provides:

> Upon finding for the claimant the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court.[35]

The Patent Act does not specify further how the damages should be calculated. Thus, Congress left it to the courts to decide the framework for calculating damages.

B. Development of Legal Doctrine

When interpreting the Patent Act, the courts have created a framework with two types of patent damages.[36] A patentee that can establish loss of sales due to the infringement may claim lost profits. All other patentees may claim, at least, a reasonable royalty.

1. Lost Profits: "But For" Causation

A patentee will be given compensation for lost profits only if it can establish causation in fact—that, but for the infringement, it would have made additional profits. This is not easy to prove. The courts set a high bar and often reject claims for lost profits.[37] In principle, any type of evidence can be used to prove lost profits. However, the most frequently cited framework is found in *Panduit Corp. v. Stahlin Bros. Fibre Works, Inc.*[38] According to this case, a patentee seeking compensation for lost profits must establish: (1) the demand for the patented products; (2) the absence of noninfringing

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33 U.S. Const. art. 1, § 8, cl. 8.

34 The time span between 1790 and 1952 saw its fair share of patent law reform. The Patent Act of 1790, ch. 7, 1 Stat. 109–12 (1790) was repealed and replaced by the Patent Act of 1793, ch. 11, 1 Stat. 318–23 (1793). The 1793 act was amended several times and was then replaced by the Patent Act of 1836, ch. 357, 5 Stat. 117 (1836). This act was also subject to several amendments and then replaced by the Patent Act of 1870, ch. 230, 16 Stat. 198–217 (1870), which in its turn was amended several times before being replaced by the Patent Act of 1952, 35 U.S.C. §§ 1–376 (2006 & Supp. V 2011).

35 35 U.S.C. § 284 (2012).

36 *See, e.g.*, Mark A. Lemley, *Distinguishing Lost Profits from Reasonable Royalties*, 51 Wm. & Mary L. Rev. 655 (2009).

37 *Id.* at 658–60.

38 Panduit Corp. v. Stahlin Bros. Fibre Works, Inc., 575 F.2d 1152, 1156 (6th Cir. 1978).

substitutes; (3) its manufacturing and marketing capability to meet the additional demand; and (4) the size of the profits absent the infringement.

Because it is not our primary purpose to analyze the issue of lost profits, we will go no further, and will instead turn our attention to reasonable royalties and to the question of the royalty base.

2. *A Reasonable Royalty:* Georgia-Pacific *and Apportionment*

The leading U.S. precedent on patent damages analysis is still *Georgia-Pacific Corp. v. U.S. Plywood Corp.* from 1970.[39] Before *Georgia-Pacific*, courts generally decided reasonable-royalty rates by analyzing the value of the infringed technology in relation to noninfringing substitutes.[40] However, in *Georgia-Pacific*, the U.S. District Court for the Southern District of New York created a 15-factor framework for calculating patent damages. The Federal Circuit, which subsequently adopted *Georgia-Pacific*'s 15-factor test, turned the test into what is sometimes described as "the gold standard" for determining a reasonable royalty.[41]

Despite its considerable length, the *Georgia-Pacific* list does not say much about how the royalty base should be established. However, *Georgia-Pacific* factor 13 has been considered to include the requirement of "apportionment." Specifically, *Georgia-Pacific* factor 13 states that "[t]he portion of the realizable profit that should be credited to the invention as distinguished from any non-patented elements, manufacturing process, business risks or significant features or improvements added by the infringer."[42] The rule of apportionment is supposed to prevent the patentee from being overcompensated by receiving damages for product features that go beyond the value of the patented technology. Thus, it is a rule that takes aim directly at assessing the base for calculating patent damages.

Apportionment is an old patent law phenomenon that was originally developed for calculating lost profits, not a reasonable royalty.

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[39] Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970), *modified and aff'd*, 446 F.2d 295 (2d Cir. 1971), *cert. denied*, 404 U.S. 870 (1971).

[40] *See* Jorge L. Contreras & Richard J. Gilbert, *A Unified Framework for RAND and Other Reasonable Royalties*, 30 Berkeley Tech L.J. 1451 (2015); J. Gregory Sidak, *Bargaining Power and Patent Damages*, 19 Stan. Tech. L. Rev. 1 (2015).

[41] *See, e.g.*, Daralyn J. Durie & Mark A. Lemley, *A Structured Approach to Calculating Reasonable Royalties*, 14 Lewis & Clark L. Rev. 627 (2010). For Durie and Lemley, the label "gold standard" is not a token of their appreciation, because they are among the many commentators who have heavily criticized the *Georgia-Pacific* test. For a brief description of criticism by several prominent intellectual property scholars, see Christopher B. Seaman, *Reconsidering the* Georgia-Pacific *Standard for Reasonable Royalty Patent Damages*, 2010 BYU L. Rev. 1661, 1704.

[42] *See id.* at 1697.

a. Tracing the Apportionment Rule Back to 1853 in Seymour v. McCormick

In *Seymour v. McCormick*,[43] the plaintiff had two patents covering the improvements of a grain-reaping machine. Only one of the patents was invoked in the infringement proceedings. The trial court instructed the jury that it did not matter for the calculation of damages whether the patent covered the whole machine or only an improvement. On appeal, the Supreme Court agreed with the applicant that this would mean that the patentee would get the same damages as if he would have invoked both his patents. According to the Supreme Court, it constituted a "grave error to instruct a jury 'that as to the measure of damages the same rule is to govern, whether the patent covers an entire machine or an improvement on a machine.'"[44] The Supreme Court therefore established that the patent damages calculation should be based on the patented invention.

b. The "General Rule" of Apportionment Established in 1884 in Garretson v. Clark

However, a "general rule" for apportionment was not established until 1884, in *Garretson v. Clark*.[45] In *Garretson*, the plaintiff's patent covered an improved mop-head. The plaintiff claimed damages amounting to both his own entire lost profits and the defendant's entire profits. The lower court rejected the plaintiff's claim on the ground that the plaintiff had not shown that the entire value of the mop could be attributed to the patent. The lower court's judgment was upheld in the Supreme Court, which quoted the lower court:

> The patentee . . . must in every case give evidence tending to separate or apportion the defendant's profits and the patentee's damages between the patented feature and the unpatented features, and such evidence must be reliable and tangible, and not conjectural or speculative; or he must show, by equally reliable and satisfactory evidence, that the profits and damages are to be calculated on the whole machine, for the reason that the entire value of the whole machine, as a marketable article, is properly and legally attributed to the patented feature.[46]

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[43] Seymour v. McCormick, 57 U.S. 480 (1853).

[44] *Id.* at 491.

[45] Garretson v. Clark, 111 U.S. 120, 121 (1884); *see* Eric E. Bensen, *Apportionment of Lost Profits in Contemporary Patent Damages Cases*, 10 Va. J.L. & Tech., Summer 2005, no. 8, at 1.

[46] *Garretson*, 111 U.S. at 121 (internal quotation marks omitted).

The apportionment rule was often a central question in patent damages cases during the second half of the 1800s and the beginning of the 1900s.[47] However, during the 20th century, the use of the apportionment rule declined.

C. The Fall and Rise of Apportionment

It is hard to say exactly why the use of apportionment declined, but the reason was probably something in line with Judge Learned Hand's statement in *Cincinnati Car Co. v. New York Rapid Transit Corp.*:

> The difficulty of allocating profits in such cases has plagued the courts from the outset, and will continue to do so, unless some formal and conventional rule is laid down, which is not likely. Properly, the question is in its nature unanswerable.[48]

However, in 2016, with the heated debate about what is often described as excessive patent damages—because of the increase of multicomponent products and high-profile litigation over patents included in technology standards covered by FRAND obligations—apportionment is experiencing something of a revival. Some commentators go as far as to say that we now have an "apportionment movement."[49]

Reintroducing apportionment in the present day's very complex technological landscape once again brings Judge Hand's reflections to the fore. Is apportionment a workable solution to the problem of determining patent damages in today's world of multi-technology products? Or will we once again need to conclude that "the question is in its nature unanswerable"? Recent cases in which apportionment has been used suggest that the question is not necessarily unanswerable, but rather is the wrong question to pose when determining patent damages.

1. Lucent Technologies, Inc. v. Gateway, Inc.

The Federal Circuit applied an apportionment-inspired argument in 2009 in *Lucent Technologies, Inc. v. Gateway, Inc.*[50] In 2002, Lucent sued Gateway

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[47] *See* Bensen, *supra* note 46, at 3 ("Historically, apportionment was often a central issue in patent cases. Indeed, between 1853 and 1915, the Supreme Court addressed apportionment more than thirty-five times in patent damages decisions, sometimes in two or three decisions in the same year.").

[48] Cincinnati Car Co. v. N.Y. Rapid Transit Corp., 66 F.2d 592, 593 (2d Cir. 1933).

[49] *See* Elizabeth M. Bailey, Gregory K. Leonard & Mario A. Lopez, *Making Sense of Apportionment in Patent Damages*, 12 Colum. Sci. & Tech. L. Rev. 255, 257 (2011). This is not, however, a development noticed by all. According to Seaman, *supra* note 42, at 1697, "modern patent damages cases rarely address apportionment," which probably is still true on the whole. *See also* Thomas F. Cotter, Comparative Patent Remedies: A Legal and Economic Analysis 116 (Oxford Univ. Press 2013) (referring to the apportionment doctrine as a "dead letter," which, in the light of the cases analyzed in this segment, seems to be somewhat of an exaggeration).

[50] Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301 (Fed. Cir. 2009).

and Dell for infringement of a patented method to enter information on a computer screen without using a keyboard. In 2003, Microsoft intervened on behalf of the defendants. In 2007, a jury ruled against Microsoft, which was ordered to pay $1.52 billion in damages to Alcatel-Lucent (Lucent had by then been acquired by Alcatel). After appeals, Microsoft was ordered in 2008 to pay a considerably smaller amount—approximately $358 million—in damages to Lucent. Vacating and remanding the damages calculation back to the district court, the Federal Circuit clearly used an apportionment-inspired argument when considering *Georgia-Pacific* factor 13:

> The parties presented little evidence relating to [*Georgia-Pacific* factor] 13. Nonetheless, the only reasonable conclusion is that most of the realizable profit must be credited to non-patented elements, such as "the manufacturing process, business risks, or significant features or improvements added by [Microsoft]." As explained by Microsoft's expert Mr. Kennedy, Outlook consists of millions of lines of code, only a tiny fraction of which encodes the date-picker feature. Although the weighing of Factor 13 cannot be reduced to a mere counting of lines of code, the glaring imbalance between infringing and non-infringing features must impact the analysis of how much profit can properly be attributed to the use of the date-picker compared to non-patented elements and other features of Outlook. Here, numerous features other than the date-picker appear to account for the overwhelming majority of the consumer demand and therefore significant profit.[51]

Lucent is an example of a case where the apportionment assessment likely appeared unproblematic to many. For most people with a general knowledge of Outlook, it is probably hard not to agree with the court's assumption that "numerous features other than the date-picker appear to account for the overwhelming majority of the consumer demand and therefore significant profit."[52]

2. Cornell University v. Hewlett-Packard Co.

Another case featuring an apportionment-inspired argument was *Cornell University v. Hewlett-Packard Co.*[53] Hewlett-Packard was found guilty of infringing Cornell's patent for an "Instruction Issuing Mechanism For Processors With Multiple Functional Units," which allegedly improved the function of a processor. Cornell argued that the royalty base should be the complete Hewlett-Packard servers and work stations. Judge Rader, sitting by designation in the district court, ruled in a pre-trial motion that the servers and work stations were an inappropriate royalty base. Cornell then argued

[51] *Id.* at 1332.
[52] *Id.* at 1333.
[53] Cornell Univ. v. Hewlett-Packard Co., 609 F. Supp. 2d 279, 284 (N.D.N.Y. 2009).

that the royalty base should be the so-called CPU bricks, resulting in a damages award of $184 million. In the end, Judge Rader reduced the royalty base to the processor, the SSPPU, resulting in a damages award of $53 million.

Without specialized knowledge about the technology in question in this case, the assessment of the royalty base probably does not appear to be as obvious as the assessment in *Lucent*. The same might be said about the following two cases that featured apportionment arguments—*In re Innovatio* and *CSIRO v. Cisco*.

3. In re Innovatio IP Ventures, LLC

Innovatio IP Ventures, LLC sued a large number of commercial users (for example, coffee shops, hotels, restaurants, supermarkets, and so on), claiming that by providing wireless network services, the commercial users infringed some of Innovatio's patents. A number of manufacturers of electronic devices used by wireless network users sued Innovatio for a declaratory judgment that the manufacturers' products, and the networks or systems of which the products were a part, did not infringe Innovatio's patents, and that the patents were invalid. To enhance the possibility of settlement, the parties and the court decided to pause the dispute and to evaluate the potential damages available to Innovatio.

The prior owners of Innovatio's patents had all agreed with the IEEE to license all patents that were essential to the 802.11 standard on RAND terms. The court decided that all of Innovatio's patents were essential to the 802.11 standard, and thus were subject to the RAND obligation.

When deciding the RAND licensing rate for infringement by the manufacturers (not the commercial users), Judge Holderman started by determining the royalty base, saying that "the court must first determine the proper royalty base before proceeding to the rest of the RAND analysis."[54]

The parties in *Innovatio* had argued for completely different royalty bases: on the one hand, the system including all of the end-product devices,

[54] In re Innovatio IP Ventures, LLC Patent Litig., MDL No. 2303, 2013 WL 5593609, at *12 (N.D. Ill. Oct. 3, 2013). As a general framework for the analysis, Judge Holderman declared that the court would use Judge Robart's adapted *Georgia-Pacific* 15-factor test from Microsoft Corp. v. Motorola, Inc., No. C10-1823, 2013 WL 2111217, at *18–20 (W.D. Wash. Apr. 25, 2013) (Robart, J.), starting with the apportionment of the patent portfolio's importance to the standard:

> First, a court should consider the importance of the patent portfolio to the standard, considering both the proportion of all patents essential to the standard that are in the portfolio, and also the technical contribution of the patent portfolio as a whole to the standard. . . . Second, a court should consider the importance of the patent portfolio as a whole to the alleged infringer's accused products. . . . Third, the court should examine other licenses for comparable patents to determine a RAND rate to license the patent portfolio, using its conclusions about the importance of the portfolio to the standard and to the alleged infringer's products to determine whether a given license or set of licenses is comparable.

In re Innovatio, 2013 WL 5593609, at *6.

and on the other, the Wi-Fi chip.[55] Drawing on the overall goals of patent damages, Judge Holderman's analysis stressed the risk of overcompensation when using a large royalty base:

> The argument over the appropriate royalty base to calculate patent damages is not unique to the RAND context, but is instead common to non-RAND patent cases. The overall goal of patent damages is to "award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer." . . . The Federal Circuit has explained that "[w]here small elements of multicomponent products are accused of infringement, calculating a royalty on the entire product carries a considerable risk that the patentee will be improperly compensated for non-infringing components of that product." . . . Accordingly, the court must calculate royalties "not on the entire product, but instead on the 'smallest salable patent practicing unit.'"[56]

Emphasizing that Innovatio had not succeeded in convincingly showing that the patents were to be apportioned to the end products, Judge Holderman concluded that the correct royalty base was the Wi-Fi chip: "Innovatio's application of its approach did not credibly apportion the value of the end-products down to the patented features. In light of that failure of proof, the court has no choice based on the record but to calculate a royalty based on the Wi-Fi chip."[57]

4. CSIRO v. Cisco Systems, Inc.

During the 1990s, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) developed certain wireless communication technologies. In 1996, CSIRO was awarded the '069 patent for this technology. The '069 patent's technology was included in the IEEE 802.11a standard, and CSIRO pledged to license the patent on RAND terms. The '069 technology is also relevant for later versions of the 802.11 standard. The IEEE sought assurances from CSIRO that these later versions would also be licensed on RAND terms, but CSIRO declined to make new pledges.

In 2001, Cisco acquired Radiata, a company started by a number of researchers involved with the '069 technology. Radiata paid licensing fees to CSIRO according to a Technology Licensing Agreement. After amendments, Cisco took Radiata's place in the agreement. Between 2001 and 2009, when Cisco stopped using Radiata-based chips in its production, Cisco paid over $900,000 in royalties to CSIRO. In 2004 and 2005, negotiations over

[55] *Id.* at *13–14.

[56] *Id.* at *13 (quoting Cornell Univ. v. Hewlett-Packard Co., 609 F. Supp. 2d 279, 283, 287–88 (N.D.N.Y. 2009)) (internal citations omitted).

[57] *Id.* at *14.

licensing fees for the '069 patent took place between CSIRO and Cisco. The negotiations did not result in any agreement.

In 2011, CSIRO sued Cisco Systems for infringement of its '069 patent. In February 2014, the district court tried the damages question (after Cisco had stipulated that it would not contest infringement or validity). In its order, the district court rejected both the plaintiff's and the defendant's damages models. Instead, the district court constructed its own model based on circumstances from the negotiations between the parties in 2004 to 2005 and an analysis of the *Georgia-Pacific* factors. The result was a judgment in favor of CSIRO that ordered Cisco to pay $16,243,067.

When reviewing the district court's judgment, the Federal Circuit analyzed the importance of apportionment:

> Under § 284, damages awarded for patent infringement "must reflect the value attributable to the infringing features of the product, and no more." . . . This principle—apportionment—is "the governing rule" . . . "where multi-component products are involved." . . . Consequently, to be admissible, all expert damages opinions must separate the value of the allegedly infringing features from the value of all other features. . . . Apportionment is not a new rule. Indeed, it dates at least to *Garretson v. Clark*.[58]

The Federal Circuit then stressed that the parties have great financial incentives to "exploit the inherent imprecision in patent valuation" and that "courts must be proactive to ensure that the testimony presented—using whatever methodology—is sufficiently reliable to support a damages award."[59]

The "essential requirement" for such reliability is said to be apportionment: "as [the Federal Circuit] ha[s] repeatedly held, '[t]he essential requirement' for reliability under *Daubert* 'is that the ultimate reasonable royalty award must be based on the incremental value that the patented invention adds to the end product.' . . . In short, apportionment."[60]

As in *Cornell*, the assessments in *Innovatio* and *CSIRO* are probably not obvious to those without specialized knowledge about the technology in question, and maybe not even to those few experts. However, the main problem with apportionment is not that the assessments can sometimes appear to be less than obvious. It is in the nature of patent law that things often become very complex and require specialized technological knowledge. The main problem is that apportionment is a crude tool to use to come

[58] Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc. (*CSIRO*), 809 F.3d 1295, 1301 (Fed. Cir. 2015) (quoting Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1226 (Fed. Cir. 2014)) (internal citations omitted).

[59] *Id.*

[60] *Id.* (quoting *Ericsson*, 773 F.3d at 1226).

to terms with (supposedly) inflated patent damages awards. The royalty base matters only if the royalty rate is the same, no matter the base.

D. The Royalty Base Matters Only If the Royalty Rate Is the Same, No Matter the Base

The importance of the royalty base rests on the assumption that the royalty rate will remain the same no matter the base. Of course, this is not a realistic assumption, given a negotiation between rational, informed, and at least somewhat equally powerful market actors. The Federal Circuit in Lucent also identified the potential fallacy of assuming the same royalty rate no matter the base:

> There is nothing inherently wrong with using the market value of the entire product, especially when there is no established market value for the infringing component or feature, so long as the multiplier accounts for the proportion of the base represented by the infringing component or feature.[61]

In this regard, the apportionment rule is accompanied by complementary rules, the entire market value rule (EMVR), and the smallest salable patent-practicing unit rule (SSPPU). As the names suggest, the SSPPU suggests the smallest possible royalty base, and the EMVR suggests the exact opposite.

1. The Smallest Saleable Patent-Practicing Unit

In *CSIRO v. Cisco*, the Federal Circuit described the SSPPU as a principle developed to aid the court in its assessment of the reliability of an expert's apportionment model. The SSPPU implies that "where a damages model apportions from a royalty base, the model should use the smallest salable patent-practicing unit as the base."[62] The Federal Circuit in *CSIRO v. Cisco* gave two justifications for the SSPPU:

> First, "[w]here small elements of multi-component products are accused of infringement, calculating a royalty on the entire product carries a considerable risk that the patentee will be improperly compensated for non-infringing components of that product" . . . Second is the "important evidentiary principle" that "care must be taken to avoid misleading the jury by placing undue emphasis on the value of the entire product" . . . As we stated in *Uniloc USA, Inc. v. Microsoft Corp.*, disclosure of the end product's total revenue

[61] *See* Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1339 (Fed. Cir. 2009).
[62] *See CSIRO*, 809 F.3d at 1302.

> "cannot help but skew the damages horizon for the jury, regardless of the contribution of the patented component to this revenue."[63]

However, in *CSIRO*, the Federal Circuit also made it clear that the SSPPU is not a rule that must be the starting point for all damages models. Or, in other words, it is possible to adhere to the apportionment principle without starting with the SSPPU. One way of doing this is to value the patent based on comparable licenses, as the district court did in *CSIRO*.[64] Another exception to the SSPPU is the EMVR.

2. The Entire Market Value Rule

According to the EMVR, the patentee may claim damages based on the value of the complete product only if the complete value of the product can be attributed to the infringed patent. The EMVR got one of its early expressions in *Garretson*. According to the Supreme Court in *Garretson*, the plaintiff in a patent-damages case could be allowed to use the whole market value of the infringed product as a base for calculating damages if he, by reliable and satisfactory evidence, showed that "the entire value of the whole machine, as a marketable article, is properly and legally attributed to the patented feature."[65]

More than one hundred years after *Garretson,* the EMVR was summarized in *Rite-Hite Corp. v. Kelley Co.*[66] There, the Federal Circuit held that a royalty reward may be based on the entire market value of the product if the infringing component constitutes the basis for customer demand for the entire product: "the entire market value rule permits recovery of damages based on the value of a patentee's entire apparatus containing several features when the patent-related feature is the basis for customer demand."[67] The court further held that, for the EMVR to apply, the patented and the unpatented components in question should typically be part of the same machine or assembly of parts, constituting a functional unit:

> The entire market value rule has typically been applied to include in the compensation base unpatented components of a device when the unpatented and patented components are physically part of the same machine. . . . The rule has been extended to allow inclusion of physically separate unpatented components normally sold with the patented components. . . . However,

[63] *Id.* (first quoting LaserDynamics, Inc. v. Quanta Comput., Inc., 694 F.3d 51, 67 (Fed. Cir. 2012); then quoting Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1226 (Fed. Cir. 2015); and then quoting Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1320 (Fed. Cir. 2011)).

[64] *Id.* at 1299–1300; *see* J. Gregory Sidak, *Apportionment, FRAND Royalties, and Comparable Licenses After* Ericsson v. D-Link, 2016 U. Ill. L. Rev. (forthcoming).

[65] Garretson v. Clark, 111 U.S. 120, 121 (1884).

[66] 56 F.3d 1538 (Fed. Cir. 1995).

[67] *Id.* at 1549 (internal quotation marks and citations omitted).

> in such cases, the unpatented and patented components together were considered to be components of a single assembly or parts of a complete machine, or they together constituted a functional unit.[68]

In *Ericsson v. D-Link*,[69] the Federal Circuit explained the deeper rationale underlying the EMVR. According to the court, the EMVR has two sides.

First, the EMVR is a substantive legal rule, which pertains to apportionment:

> As we explained recently in *VirnetX, Inc. v. Cisco Systems, Inc.*, . . . where multicomponent products are involved, the governing rule is that the ultimate combination of royalty base and royalty rate must reflect the value attributable to the infringing features of the product, and no more. . . . As a substantive matter, it is the value of what was taken that measures a reasonable royalty under 35 U.S.C. § 284. . . . What is taken from the owner of a utility patent (for purposes of assessing damages under § 284) is only the patented technology, and so the value to be measured is only the value of the infringing features of an accused product.[70]

The Federal Circuit is clear that it is possible to calculate "the value of what was taken" in different ways, either adjusting the royalty rate or the royalty base. The "essential requirement" is "that the ultimate reasonable royalty award must be based on the incremental value that the patented invention adds to the end product."[71]

Second, the EMVR is an evidentiary principle that aims to prevent a large royalty base from misleading a jury into overcompensating the patentee:

> [C]are must be taken to avoid misleading the jury by placing undue emphasis on the value of the entire product. It is not that an appropriately apportioned royalty award could never be fashioned by starting with the entire market value of a multi-component product—by, for instance, dramatically reducing the royalty rate to be applied in those cases—it is that reliance on the entire market value might mislead the jury, who may be less equipped to understand the extent to which the royalty rate would need to do the work in such instances.[72]

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[68] *Id.* at 1549–50.
[69] Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201 (Fed. Cir. 2014).
[70] *Id.* at 1226 (internal quotation marks and citations omitted).
[71] *Id.*
[72] *Id.* at 1226–27; *see also* J. Gregory Sidak, *The Proper Royalty Base for Patent Damages*, 10 J. Competition L. & Econ. 989 (2014).

The Federal Circuit then cited the *Laser Dynamics* court, which had

> barr[ed] the use of too high a royalty base—even if mathematically offset by a "low enough royalty rate"—because such a base "carrie[d] a considerable risk'" of misleading a jury into overcompensating, stating that such a base "cannot help but skew the damages horizon for the jury" and "make a patentee's proffered damages amount appear modest by comparison."[73]

It is clear that the apportionment rule, the SSPPU, and the EMVR are fundamentally about avoiding overcompensating the patentee. The question is, however, to what extent the rules might lead to the opposite problem, namely undercompensation. If juries tend to overcompensate when presented with a very large royalty base, there is probably a risk that they instead undercompensate when presented with a very small base. This raises the question of whether apportionment and the EMVR really are sufficient tools for deciding patent damages in today's multicomponent product setting. We suggest that apportionment and the EMVR are designed from the perspective of an industrial value chain and may require further adaption to the new roles of IP and knowledge-based business models.

III. The Transformation of the Telecommunications Value Chain

The telecommunications industry is experiencing a concomitant transformation from a vertically integrated industrial structure to a more fragmented value chain with distinct divisions of labor. This transformation creates new tensions between vertical actors looking to competitively capture value from different innovation and implementation activities, particularly in relation to SEPs. This part provides a brief historical context and describes the recent market norms for the licensing of SEPs in the telecommunications industry. Two short case studies of Qualcomm and ARM exemplify both the integration and separation of the MVC and the IVC.

A. Standardization and the Role of Patents in the Development of an Intellectual Value Chain

Historically, the role of patents in the electronics industry has been strongly associated with the use of cross-licensing agreements between competing manufacturers, which has been a norm in the industry since the very

[73] *Ericsson v. D-Link*, 773 F.3d at 1227 (citing LaserDynamics, Inc. v. Quanta Computer, Inc., 694 F.3d 51, 67, 68 (Fed. Cir. 2012) (quoting Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1320 (Fed. Cir. 2011))).

beginning.[74] The relatively free flow of technology and the use of cross licensing as a means to facilitate freedom-to-operate was augmented by a licensing strategy focused on generating royalty income, which generated hundreds of millions of dollars annually for pioneering firms such as IBM and Texas Instruments in the late 1980s and early 1990s.[75] This strategy exemplifies the early shift from an MVC to an IVC logic, as technology development moved from only a support activity for product development, to a bargaining chip to access external technology, to its own profit center activity. However, the electronics industry contains multiple segments with varying norms based on different historical roots. In particular, the semiconductor and computer industries and the wireless telecommunications industry have developed different market norms for IP based on the evolution of their respective industries, and the latter will be discussed in further detail below.[76]

Standards, especially open, consensus-based standards, have played an important role in the growth of the telecommunications sector. One key development in the creation of an IVC in the telecommunications sector can be traced back to the change in the role of patents that occurred during the development of the GSM standard for mobile telephony. Using a relative advantage from a small portfolio of SEPs, Motorola altered the structure of the nascent GSM market in the late 1980s and early 1990s by forcing implementing firms to enter into licensing agreements in order to produce GSM standard-compliant equipment.[77] The recognition of the potential power of SEPs generated a movement within the European Telecommunications Standards Institute (ETSI), as well as within other SSOs, to develop IPR policies to govern the role of patents in the development and commercialization of standards.[78] These efforts resulted in the widespread use of what is known as a FRAND agreement, whereby patent holders contractually agree to license their SEPs on fair, reasonable, and nondiscriminatory terms

[74] *See* Peter C. Grindley & David J. Teece, *Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics*, 39 Cal. Mgmt. Rev., Winter 1997, no 2, at 8, 10–18 (providing a historical description of licensing practice in the semiconductor and electronics industry).

[75] *Id.*

[76] *See* Bekkers, Verspagen & Smits, *supra* note 12; Sven Lindmark, Evolution of Techno-Economic Systems—An Investigation of the History of Mobile Communications (2002) (unpublished Ph.D. dissertation, Chalmers University of Technology) (on file with authors) (summarizing the history of technology, IP, and market development in the mobile communication industry); Grindley & Teece, *supra* note 76; Bronwyn H. Hall & Rosemarie Ham Ziedonis, *The Patent Paradox Revisited: An Empirical Study of Patenting in the US Semiconductor Industry, 1979-1995*, 32 RAND J. Econ. 101, 101–05 (2001) (chronicling the history of technology, IP, and market development in the semiconductor industry).

[77] For an early example of the power of SEPs to affect the structure of the nascent GSM market in the late 1980s and early 1990s, see Bekkers, Verspagen & Smits, *supra* note 12.

[78] *See* Eric J. Iversen, *Standardization and Intellectual Property Rights: ETSI's Controversial Search for New IPR-Procedures*, 1 Proceedings of the IEEE Conference on Standardisation and Innovation 3 (Kai Jakobs & Robin William eds., 1999), https://core.ac.uk/download/files/455/12177191.pdf (providing a historical account of ETSI's struggle to develop an effective and acceptable IPR policy in its formative years from 1989 to 2004).

to members of the SSO and third parties.[79] Thus, FRAND has facilitated the transition from a static use of patents (that is, blocking) to a dynamic use of patents (that is, licensing) in the telecommunications value chain. In essence, FRAND provides a market-based governance structure to balance the complex interests of diverse actors in the value chain, both to provide an incentive for technology contributions and to facilitate market diffusion of the standard.[80]

For many reasons, patents and standards have traditionally been depicted at odds with one another. However, it could be said that an increased dynamic use of patents and division of innovative labor in the knowledge economy make patents essential to the development of most standards, as many knowledge-based firms increasingly compete in the upstream technology market, not only the downstream product market.[81] Figure 5 shows the creation of a new industrial dynamic within the telecommunications sector, which has resulted in a greater division of labor, including innovation specialists and implementation specialists together with integrated firms, who all compete in the same value chain with very different strategies and incentives.[82] These actors interpret the patent system and antitrust regulations to the standardization process in very different ways in their search to maximize economic performance. In particular, the division of innovative labor, represented by Firm B in Figure 5, illustrates the full transition from an MVC to an IVC logic, while many integrated firms have increasingly developed strong licensing programs in the IVC to complement their MVC offerings. When all market actors are integrated firms, cross licensing and patent pools can often be used to facilitate freedom-to-operate and competition in the product market.[83] However, it is easy to understand why a fragmented value chain creates different perceptions of the value of SEPs, as implementation specialists use standards to develop markets where they can sell their products, while innovation specialists look for a return on investment for the technology in the standard itself. For implementation specialists, SEPs are viewed as an added cost to their end product, whereas for innovation

[79] *See* J. Gregory Sidak, *A FRAND Contract's Intended Third-Party Beneficiary*, 69 Fla. L. Rev. (forthcoming 2017).

[80] Thus, FRAND can be seen as a mechanism to manage two competing theories of market failures: public-goods dilemma and holdup.

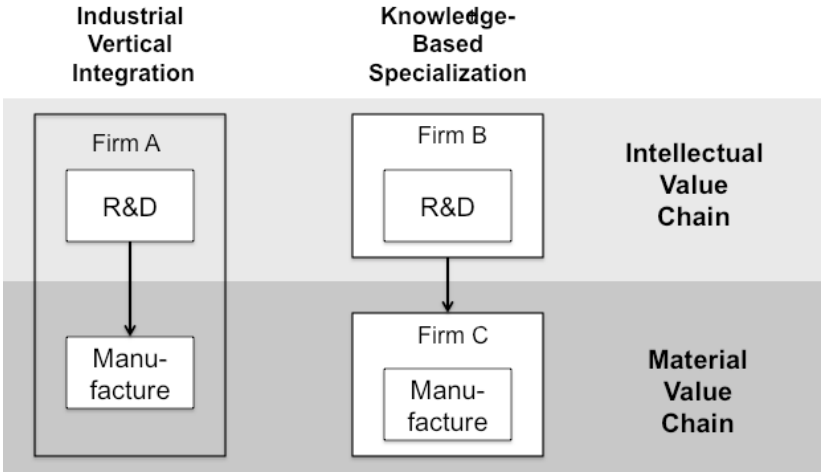
[81] It should be noted that the concepts of "upstream" and "downstream," as well as "vertical" and "horizontal," arise from an MVC logic and are not directly transferable to an IVC, which operates under a different logic. However, those concepts can be useful when describing the IVC in relation to the MVC in an integrated value chain or network.

[82] *See* Richard Schmalensee, *Standard-Setting, Innovation Specialists and Competition Policy*, 57 J. Indus. Econ. 526, 527 (2009); Damien Geradin & Miguel Rato, *Can Standard-Setting Lead to Exploitative Abuse? A Dissonant View on Patent Hold-Up, Royalty Stacking and the Meaning of FRAND*, 3 Eur. Competition J. 101, 104–06 (2007).

[83] *See* Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting*, *in* 1 Adam B. Jaffe, Josh Lerner & Scott Stern, Innovation Policy and the Economy 119 (MIT Press 2001).

specialists, the standard is their product and SEPs are the means by which to benefit from their R&D investment.[84]

Figure 5. Transformation of the Telecommunications Value Chain



Sources: Adapted from Petrusson, *supra* note 16; Schmalensee, *supra* note 84; Bowman Heiden, *Valuing Standard Essential Patents in the Knowledge Economy: A Comparison of F/RAND Royalty Methodologies in US Courts*, 13 Int'l J. Standardization Res. 19 (2015).

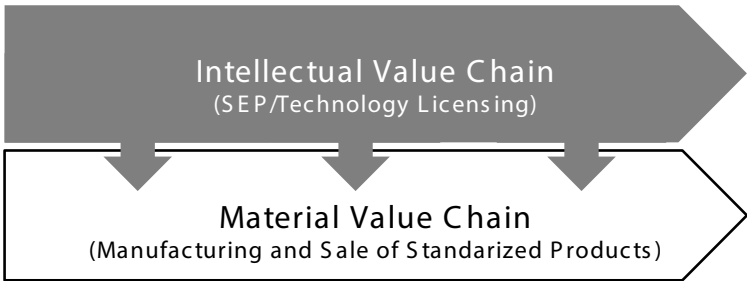
From a standardization perspective, firms operating in this new division of innovative labor (that is, innovation specialists) are completely dependent on having their patented technology included in the open standards on terms that enable them to receive a return on their R&D investment.[85] This changes the traditional pre-competitive nature of standards development focused on product market competition into a high-stakes game of poker on the technology market. In this new IVC logic, the inclusion of a firm's technology in the standard creates a competitive bargaining position against rival product firms operating downstream, and creates a significant opportunity for royalties for upstream technology firms. Hybrid firms with both strong patent positions and strong product manufacturing benefit, with lower costs on the product side and additional income from royalties from product actors

[84] The fragmentation of the value chain provides a good illustration of the alienation of the value of knowledge in traditional, integrated, industrial firms. A division of innovative labor forces a separate accounting of value for the knowledge contribution and the manufacturing contribution (that is, the intellectual and the material value chain), which was previously hidden in the end-product price in vertically integrated firms. The transformation from a hierarchical relationship to a market transaction forces the value of knowledge to be unveiled.

[85] Firms operating under this division of labor are often labeled nonpracticing entities (NPEs) to distinguish them from actors that produce goods and services. This distinction is tenuous, given the fact that many firms traditionally viewed as practicing have outsourced most of their manufacturing and have developed extensive patent and technology licensing programs.

with smaller patent positions in the standard. In the context of standards, patents have taken on the role of enabling a new division of innovative labor by providing upstream actors a claim on their R&D contributions outside of the sale of products, as well as offering a means for all actors to receive a return on their investment for their innovative efforts.[86] Thus, SEPs based on FRAND commitments have facilitated the development of an IVC, whereby value is distributed through license transactions to the owners of the underlying technology in parallel to the MVC for the manufacture and distribution of physical products, as depicted in Figure 6.[87]

Figure 6. Development of Complementary Value Chains to Facilitate Telecommunications Standards



Source: Petrusson, *supra* note 16 (adapted to the context of standards-enabled telecommunications markets).

B. Licensing Dynamics and Division of Labor

The telecommunications sector exemplifies the successful development of global markets based on open innovation enabled by standard-setting organizations. Open innovation within consensus-based standards (for example, 802.11, H.264, and LTE) consists of technology competition among stakeholders within the SSO to define the standard's specifications and licensing of SEPs associated with the final technical specifications outside of the SSO, through bilateral market negotiations in compliance with the FRAND commitment.[88] On the market, these standards are typically implemented

[86] *See* Merges, Intellectual Property Rights, *supra* note 26; Hall & Ziedonis, *supra* note 78. This is particularly true for NPEs. For operating companies, the inclusion of in-house technology in the standard could also provide manufacturing advantages, as the contributing company has more tacit knowledge related to its own technology. This discussion does not include non-SEPs, which represent innovative, valuable solutions outside of the implementation of the standard.

[87] Compare to Porter's generic value chain in Figure 3, where the process of technology development is transformed from a supporting to a primary activity, now depicted as a separate, yet complementary, IVC (as shown in Figure 4).

[88] *See* Aija Leiponen, *Competing Through Cooperation: The Organization of Standard Setting in Wireless Telecommunications*, 54 Mgmt. Sci. 1904, 1906–08 (2008) (describing the standard-setting process in wireless communications, specifically within 3GPP).

by technology providers, component manufacturers, Original Equipment Manufacturers (OEMs), Original Design Manufacturers (ODMs), brand owners, and operators, which can be categorized as innovation specialists, integrated firms, and implementation specialists, as discussed above.[89]

SEP licensing typically takes on two different models based on the relative strength of the SEP portfolio and the business model of the market actor (that is, MVC versus IVC).

1. Cross Licensing to Reduce Transaction Costs

The cross-licensing model for SEPs in the telecommunications industry is typically characterized by horizontal competitors operating on the MVC, where each possesses relative bargaining power based on its SEP portfolios in relation to another's product offering. In this scenario, firms cross license access to each other's SEP portfolios, primarily to reduce transaction costs and to negotiate over balance of payment depending on the relative strength of their respective SEP portfolios.[90] Successful patent pools may emerge when SEPs are widely distributed primarily among integrated actors, or for standards that have been developed primarily pre-competitively to facilitate markets for products and services (for example, audio or video compression standards). However, for standards for which several key actors hold asymmetric SEP positions, patent pools often fail to succeed, and SEP licensing takes on the characteristics of FRAND licensing—for example, as with cellular standards.

2. FRAND Licensing to Generate Revenue

SEP licensing between different market actors engaged in FRAND licensing can occur in different directions based on their relative positions in the IVC. Although integrated firms, innovation specialists, and implementation specialists represent diverse commercial positions on the market, relative to one another they are "vertical" competitors between the IVCs and MVCs from an SEP perspective (that is, their relative relationship is similar to that of nonpracticing entities and practicing entities). Cross licensing is not possible, as innovation specialists do not produce physical products and implementation specialists do not have SEP portfolios. Although both integrated firms and implementation specialists produce physical products (that is, they are both practicing entities), the integrated firm possesses all the bargaining

[89] It should be noted that operators are product users, not manufacturers, and could be considered outside of the categories used. However, several operators do have SEP portfolios that they actively license.

[90] Cross licensing can also occur in relation to implementation patents (that is, non-SEPs) to generate freedom-to-operate. The difference between implementation patents and SEPs is often described in the context of property versus liability rules. *See* Merges, *Contracting into Liability Rules*, *supra* note 25.

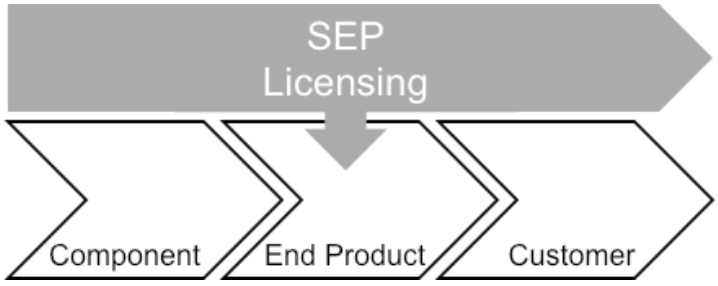
power from the SEP perspective, and thus will be viewed in the negotiation in the same way as would an innovation specialist. In these circumstances, difficult negotiations over the FRAND royalty rate typically ensue based on the disparate goals of the actors involved, leading to typically long negotiation periods, which, as examined in Part II, have required litigation and courts to determine FRAND royalty rates.[91]

Over the past three decades, licensing norms in the telecommunications market have evolved to match the changes in industry dynamics—in particular, the evolution of the division of labor. What follows is an analysis of the consequences of new actors and license-based business models on the implantation of license agreements.

C. Positioning of License Agreements in the Telecommunications Value Chain

In the telecommunications industry, the predominant market norm regarding the location of SEP licensing is at the position of the end product in the value chain, as shown in Figure 7. On the lower layer, the figure depicts a generic telecommunications value chain, consisting of component manufacturers (for example, chipset producers), end-product suppliers (for example, brand owners and OEMs or ODMs), and customers (for example, operators and end users). On the upper layer, the figure shows how the results of R&D activities (for example, SEPs) are managed as intellectual property transactions (for example, SEP licenses) through the intellectual value chain to end-product suppliers in the material value chain.

Figure 7. Position of SEP Licensing in the Telecommunications Value Chain



Source: *See supra* and *infra* notes 94–100.

[91] Besides the obvious desire of the SEP licensor and licensee to maximize and minimize the royalty payment, respectively, the timing of the FRAND negotiation, which often occurs not only after the release of the standard but well after products are already on the market, transforms what is actually *ex ante* licensing (that is, technology transfer) into an *ex post* patent-licensing situation.

The choice of FRAND licensing to end-product suppliers has evolved as the predominant market norm for the reasons that follow.

1. Historical Norms

The history of cross licensing among integrated firms in the telecommunications industry has created a strong norm among actors to license SEPs at the end-product supplier position in the value chain.[92] This norm has persisted even as the value chain has transformed and fragmented to include new divisions of labor.[93] This norm can be seen in how firms make royalty declarations,[94] in the specification of "fully compliant" product licensing in FRAND commitments,[95] in the licensing unit of patent pools,[96] in recent rulings by the U.S. International Trade Commission (ITC),[97] and in the recent SEP court cases in the United States, in which the end-product supplier has typically been the defendant.[98]

2. Risk Management

For integrated firms that both maintain strong SEP portfolios and produce physical products, the position of SEP licensing is important for managing

[92] In the cellular value chain, the customer could be either the mobile phone consumer or the network operator. Although the operator is a potential position for licensing, it has not been the historical norm.

[93] Historically, many handset manufactures produced their own baseband modems, but most have since closed them down or spun them out (for example, Freescale, Infineon, Renesas, and NXP were spun out from Motorola, Siemens, Nokia, and Philips, respectively). In addition, Broadcom and Ericsson have closed their baseband chip production. Simon Rockman, *Ericsson Follows Broadcom to Modem Mordor*, Register (Sept. 22, 2014), http://www.theregister.co.uk/2014/09/22/ericsson_follows_broadcom_to_modem_mordor/.

[94] *See* Eric Stasik, *Royalty Rates and Licensing Strategies for Essential Patents on LTE (4G) Telecommunication Standards*, les Nouvelles, Sept. 2010, at 114 (reviewing SEP royalty rate declarations).

[95] *See* Ericsson, Inc. v. D-Link Sys., Inc., No. 6:10-cv-00473, 2013 WL 4046225, at *46–47 (E.D. Tex. Aug. 6, 2013) (citing no right to equitable relief based on the licensing of fully compliant products).

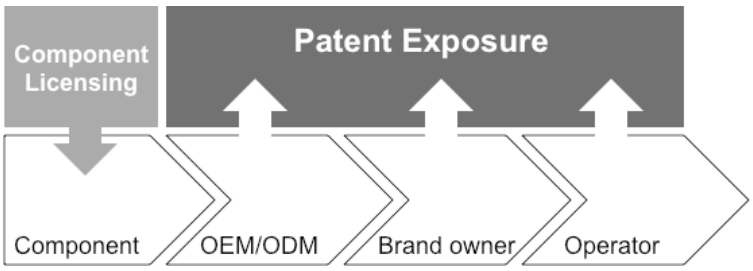
[96] Sisvel and Via identify the end product as the licensing unit (that is, the royalty base). *See LTE/LTE-A License Terms*, Sisvel, http://www.sisvel.com/lte-ltea/license-terms; *LTE License Fees*, Via Corp., http://www.via-corp.com/licensing/lte/licensefees.html; *802.11 (a-j)*, Via Corp., http://www.via-corp.com/licensing/ieee-80211/overview.html.

[97] *See* Certain Electronic Devices, Including Wireless Communication Devices, Portable Music and Data Processing Devices, and Tablet Computers at 60 n.19, Inv. No. 337-TA-794, USITC Pub. 2824 (July 5, 2013) ("[T]he record supports a conclusion that a common industry practice is to use the end-user device as a royalty base.").

[98] In *Ericsson*, the defendants were mainly Wi-Fi product and computer suppliers, including D-Link, Netgear, Belkin, Dell, HP, Acer, Toshiba, and Intel (the exceptional chipset manufacturer that asked to be a party in the suit). In *In re* Innovatio IP Ventures, LLC Patent Litig., MDL No. 2303, 2013 WL 5593609 (N.D. Ill. Oct. 3, 2013), the defendants were Wi-Fi network users and product suppliers, including Cisco, Motorola Solutions, SonicWALL, Netgear, and HP. Innovatio initially sued the network users (that is, the customers of the Wi-Fi product suppliers), but the end-product suppliers agreed to be the defendants. In addition, even though the court based its ruling on a component-level royalty base, Cisco, the end-product supplier, not the component supplier, agreed to a settlement with Innovatio after the trial. In Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc., No. 6:11-cv-343, 2014 WL 3805817 (E.D. Tex. July 23, 2014), Cisco was again the defendant, and the court said that all of CSIRO's licensing agreements since 2009 regarding the SEP in suit were licensed on the basis of end products sold.

their exposure to the SEP portfolios of other integrated firms. As Figure 8 shows, as the licensing position in the value chain can determine patent exhaustion, firms that license further upstream would be in a weak bargaining position from a cross-licensing perspective in relation to downstream actors. For example, if an integrated firm were to license its SEPs at the component level, it could not use those SEPs to negotiate against the SEP portfolios of end-product suppliers, because the integrated firm's SEPs would already be exhausted in the component, leaving the firm with a greatly reduced bargaining position and resulting, for example, in a larger potential balance of payment. By licensing at the end-product position in the value chain, integrated firms can limit their exposure and thus better manage their risk in the IVC.

Figure 8. Potential Exposure from Upstream SEP Licensing in the Telecommunications Value Chain



Note: Figure 8 is based on interviews with licensing executives from SEP-holding, integrated firms operating in the telecommunications sector. Figure 8 illustrates the potential exposure of a product manufacturer licensing its SEPs on the component level in the mobile telecommunications market.

3. Value Capture

SEP-holding firms are profit maximizers, the same as all commercial firms. Given the opportunity to choose the position of the value chain in which to license SEP portfolios, a rational firm would choose a position that best reflects the value of the contribution of their technology. For large, system-based telecommunications standards, the price to customers of fully compliant end products arguably offers the best representation of the cumulative value of the technology underpinning telecommunications standards. This is particularly obvious for products whose sole function is to implement the standard, such as wireless routers using the 802.11 standard and mobile phones using cellular standards such as GSM. For more complex devices such as smart phones and computers, the contribution of SEP portfolios is more complicated, but is still best represented by the value to the customer.

Although the value of the standard to the product and the contribution of the SEP portfolio to the standard will need to be apportioned in relation to the noninfringing elements of the product, the market price of the end product is still the only market-generated value that contains the full underlying added value of the SEPs delivered through the standard to the customer.[99] Thus, end-product suppliers are in the best position to determine the relative value of the technology embedded in their products as experienced by customers. As components do not encompass the entirety of the system-based functionality of a standard, nor do they provide the ultimate market value based on customer preferences, fully compliant end products offer the best opportunity for SEP holders to capture value and maximize their return on R&D investments for the development the standard.[100]

D. Case Studies

To better understand knowledge-based business models in the context of the telecommunications value chain, in both the MVC and the IVC, two short cases will be examined, first individually and then collectively to illustrate their interaction. The first case is Qualcomm, which exemplifies a leading company originating from the telecommunications sector that operates in both the MVC and the IVC, and sells both components and licensing SEPs as separate but interrelated business models to OEMs and ODMs.[101] The second case is ARM, exemplifying a leading company originating from the semiconductor and computer industry that operates exclusively in the IVC through a pure IP-based business model to semiconductor and chip providers.[102]

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[99] This article contends that knowledge does not need to be valued on the basis of its inclusion in a physical product. Thus, with respect to cellular, one could argue for licensing at the operator level in the value chain linked to service offerings, but this has not been the historical norm.

[100] In addition, if the royalty on an SEP portfolio is set as a fixed price per unit, licensing at the end-product position in the value chain would eliminate the double marginalization that would occur if that price were charged at the component position.

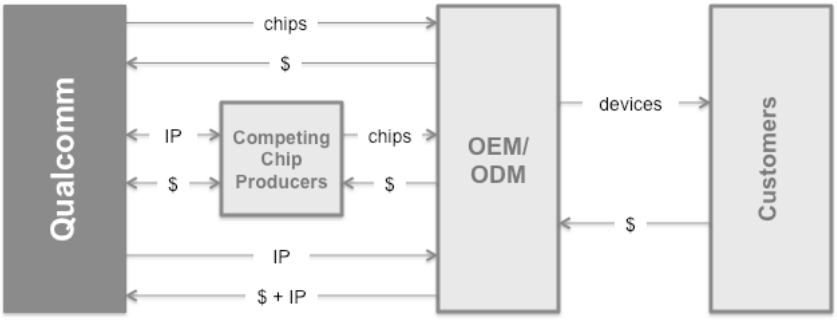
[101] Qualcomm was chosen because it represents a pioneering effort in the development of SEP licensing as a primary business model in telecommunications. Its dual value proposition of chipsets and SEPs also provides an example of an integrated firm, though at the component level instead of the more common end-product level. Furthermore, Qualcomm's business model has been tested in several antitrust investigations, allowing for a better understanding of its operation and viability.

[102] Though ARM does not license SEPs, it does license IP and has become a major actor in the telecommunications value chain through convergence of the mobile computing segment. It is used here to illustrate differences in IP-licensing norms in relation to Qualcomm and other SEP-licensing telecommunications firms. It is a particularly relevant example, given that ARM's licensing practice was used as a comparable industry license in determining the FRAND royalty range and rate in the landmark case Microsoft Corp. v. Motorola, Inc., No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013), whose ruling the U.S. Court of Appeals for the Ninth Circuit recently upheld in Microsoft Corp. v. Motorola, Inc., 795 F.3d 1024 (9th Cir. 2015).

1. Qualcomm Inc.

Qualcomm is an industry leader in digital communications technology, supplying chipsets, software, and technology licenses to the telecommunications industry. The multinational company is headquartered in San Diego, California and employs approximately 31,000 employees in over 150 locations worldwide.[103] In fiscal year 2014, Qualcomm posted revenues of $24,487 million and a net income of $7,967 million. Qualcomm CDMA Technologies (QCT), which supplies integrated circuits (that is, chipsets) and systems software, accounted for 70 percent of the revenue, whereas Qualcomm Technology Licensing (QTL) accounted for 29 percent of revenue but nearly two-thirds of the profit.[104] Both QCT and QTL began operations in 1995 and represent the key segments of Qualcomm's business, after having divested both the handset and infrastructure activities in 1999.[105] Qualcomm became a public company in 1991 and by the end of fiscal year 2014 had a market value of $118 billion.[106]

Figure 9. Qualcomm's Dual MVC-IVC Business Model



Source: Based on Qualcomm 2014 10-K Report, *supra* note 105. This is a simplification focused on illustrating the dual value propositions offered to end-product manufacturers.

Figure 9 represents the dual MVC-IVC business model employed by Qualcomm in the telecommunications value chain. Qualcomm invested $5,477 million in R&D, representing 21 percent of its total revenue for 2014, for a total of $31 billion since its inception.[107] Its cumulative R&D results are packaged into two primary value propositions: chipsets and IPR licenses.

103 Qualcomm Inc., Annual Report (Form 10-K) (Nov. 5, 2014) [hereinafter Qualcomm 2014 10-K Report].
104 *Id.* Most of the current licensing revenue is based on 3G standard-compliant products (that is, CDMA2000 and WCDMA).
105 *Id.* The history of Qualcomm as a fully integrated telecommunications company supplying both handsets and infrastructure equipment relates to the historical norms examined in Part III.C.1.
106 *Id.*
107 *Id.*

a. Chipset Sales

QCT is the leading supplier of chipsets for CDMA (3G) and OFMDA (4G) wireless applications in mobile phones, tablets, and laptops, among other voice and data communication solutions. In 2014, QCT maintained a dominant position, controlling 66 percent of the cellular baseband chip market, bolstered by a 95 percent share in the LTE market.[108] Qualcomm employs a fabless production model whereby it outsources its chip manufacturing to independent third parties.[109] QCT's competitors have historically included leading chip manufacturers such as Broadcom, Ericsson, HiSilicon Technologies, Intel, Lantiq, Marvell Technology, Maxim Integrated Products, MediaTek, nVidia, Realtek Semiconductor, Samsung Electronics, Spreadtrum Communications (which is controlled by Tsinghua Unigroup), Texas Instruments, and VIA Telecom.[110] The gross profit margin for QCT in 2014 was 20 percent.[111]

b. IPR Licenses

QTL licenses its IPR portfolio of primarily standard-essential and implementation patents predominantly to end-product manufacturers, representing a broad variety of wireless consumer devices and infrastructure products for most of the main cellular standards.[112] Revenues generated by QTL include fixed-licensing fees and royalty payments based on a percentage of the licensee's wholesale price of fully compliant products. QTL also executes license agreements with chipset competitors to create freedom-to-operate within its QCT business, as Figure 9 depicts, showing QCT's interaction with competing chip manufacturers.[113] However, those licenses do not prevent QTL from obtaining royalty payments from the end-product manufacturers employing the competing firms' chipsets. QTL has over 260 licensees, including cellular-subscriber product and infrastructure product firms.[114] Qualcomm rarely

[108] Trefis Team, *Why Qualcomm Remains the No. 1 Player in Cellular Baseband*, Forbes (July 11, 2014), http://www.forbes.com/sites/greatspeculations/2014/07/11/why-qualcomm-remains-the-no-1-player-in-cellular-baseband-2/.

[109] Qualcomm 2014 10-K Report, *supra* note 105.

[110] *Id.* Samsung Electronics is one of Qualcomm's foundry partners, chipset customers, and licensees, and is also a chipset competitor, which is an example of the co-opetition environment in the telecommunications industry.

[111] *Id.*

[112] Qualcomm's licensing program is targeted at infrastructure, test equipment, subscriber unit, small cell, and OFDMA products. *See Qualcomm Technology Licensing*, Qualcomm, https://www.qualcomm.com/invention/licensing.

[113] Qualcomm cites Broadcom, MediaTek, Texas Instruments, and VIA Telecom as instances of such arrangements. *See* Qualcomm 2014 10-K Report, *supra* note 105. In the case of Broadcom, IP litigation was settled in 2009 such that Qualcomm paid an $891 million settlement. Press Release, Broadcom, Qualcomm and Broadcom Reach Settlement and Patent Agreement (Apr. 26, 2009), https://www.broadcom.com/press/release.php?id=s379764.

[114] Qualcomm 2014 10-K Report, *supra* note 105.

pays royalties on the sale of its own products based on its strong market and IPR positions.[115] Qualcomm states that it requests royalties on FRAND terms for 3G devices (and multiple 3G/4G) and for 4G/LTE-only devices at different rates.[116] QTL's gross profit margin was 87 percent in 2014.[117]

In effect, Qualcomm deploys a dual business model, offering physical products (that is, chipsets) in the MVC, and IPR licenses primarily to end-product manufacturers in the IVC. Even when the component position of the value chain is licensed, Qualcomm avoids patent exhaustion and maintains its ability to collect licensing revenue downstream from the end-product manufacturers, even for devices employing competitors' chipsets.[118] Furthermore, Qualcomm requires purchasers of its chipsets first to accept the IPR license from QTL,[119] which prevents infringement and addresses the problem of delayed or no compensation of its SEP portfolio on FRAND terms, as discussed in Part III.B.1. In addition, Qualcomm's numerous cross-licensing agreements could allow for a competitive advantage through lower aggregate royalty rates associated with its own chipset offer relative to its competitors. That is, when a customer buys a chipset from QCT and takes a license from QTL, it could include access to both Qualcomm technology as well as a pool of rights from Qualcomm's licensees.[120] Thus, although the chipsets and IPR licenses represent two distinct value propositions, potential interdependencies between the two have been leveraged to enhance the aggregate output of the dual business model.[121]

Qualcomm's dual MVC-IVC business model represents a departure from the traditional industrial model of manufacturing and selling physical products in a linear material value chain. It is not unusual that the adoption of a new model focused on the IVC would raise antitrust issues, as the model is based on norms of competition different from those employed in

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115 *Id.*

116 Qualcomm's Rectification Plan based on the 2015 Chinese National Development and Reform Commission (NDRC) antitrust decision specified a 5-percent royalty for 3G (and 3G/4G) and a 3.5-percent royalty for 4G-only devices, calculated on a royalty base of 65 percent of the net selling price of the device. Press Release, Qualcomm, Qualcomm and China's National Development and Reform Commission Reach Resolution (Feb. 9, 2015) [hereinafter Qualcomm-China Press Release], http://files.shareholder.com/downloads/QCOM/3864235320x0x808060/382E59E5-B9AA-4D59-ABFF-BDFB9AB8F1E9/Qualcomm_and_China_NDRC_Resolution_final.pdf. It should be noted that a firm's licensing terms can differ between countries.

117 The high revenue-to-cost ratio is typical for IPR-licensing operations.

118 Qualcomm 2014 10-K Report, *supra* note 105.

119 This practice was allowed to continue under the Chinese NDRC antitrust decision with Qualcomm as long as the terms were compliant with the NDRC conditions.

120 Qualcomm's cross-licensing practice was mentioned in the Chinese NDRC decision and altered to specify that, "if Qualcomm seeks a cross license from a Chinese licensee as part of such offer, it will negotiate with the licensee in good faith and provide fair consideration for such rights" as part of the Qualcomm Rectification Plan. Qualcomm-China Press Release, *supra* note 118.

121 The fact that Qualcomm decided not to spin off its chip or licensing divisions in late 2015 is a sign of the value of the synergy. Don Clark, *Qualcomm Decides Against Breakup*, Wall St. J. (Dec. 15, 2015), http://www.wsj.com/articles/qualcomm-decides-to-keep-current-structure-1450182818.

the MVC.[122] However, although many antitrust complaints have been raised against Qualcomm, the primary aspects of the dual business model remain intact.[123] The fact that the QCT and QTL divisions have been operating since 1995 and that CDMA-based standards have been operational since the early 2000s is an indication of the long-term viability of their competitive strategy based on the combination of a physical and an IPR-based value proposition with interrelated but distinct revenue models.

2. ARM Holdings plc

Advanced RISC Machines (ARM) is the world's leading semiconductor intellectual property (IP) company, providing integrated circuit designs and solutions incorporated in 37 percent of all processors sold in 2014, including an 86 percent market share in the main applications processors of mobile computing devices.[124] In total, more than 80 percent of the world's population uses an ARM-based device.[125] The multi-national company is headquartered in Cambridge, England, and employs approximately 3300 people in 18 countries.[126] In fiscal year 2014, ARM posted revenues of $1,293 million and a net income of $414 million.[127] ARM was founded in 1990 as a spin-out of a collaborative effort between Acorn Computer Group and Apple Computer to create a new microprocessor standard.[128] ARM became a publicly traded firm in 1998 and posted a market value of $14.2 billion at the end of fiscal year 2014.[129]

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122 Rambus is another firm employing a similar business model in the memory chip segment, which has also been engaged in several inquires by competition authorities. It should also be noted that software licensing was once considered a non-viable business model, and Microsoft endured major antitrust challenges that altered but did not eliminate the ability to package and sell software primarily as an IPR transaction.

123 Qualcomm has been involved in investigations by competition authorities in the United States, the European Union, Japan, and South Korea. A major investigation was concluded in 2015 by the Chinese NDRC that addressed most of the issues involved in previous and current complaints, including excessive royalties on patent licenses, the equity of exchange in cross licenses, the bundling of essential and non-essential patents in license agreements, the licensing of expired patents, tying chipset sales only to IPR licensees, and refusal to grant patent licenses to chipset competitors. Although the decision resulted in a record fine of $975 million and some restrictions to the practices discussed above, it did not alter the fundamental practice of offering both chipsets and IPR licenses as two distinct value propositions, and it continued to allow for Qualcomm's right to sell chipsets only to firms that have agreed to a license.

124 ARM Holdings plc, Shaping the Connected World: Strategic Report 26 (2014) [hereinafter ARM Strategic Report].

125 *Id.* at 42.

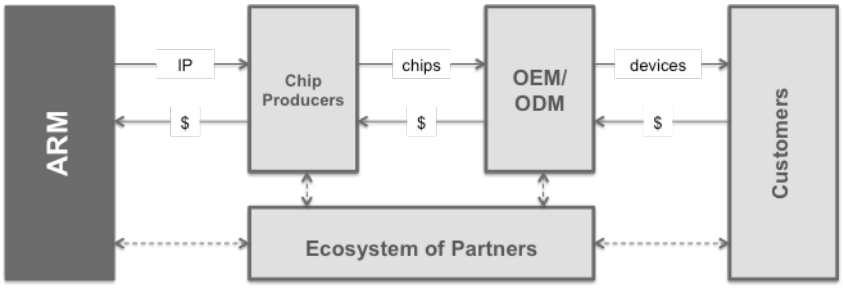
126 *Id.* at 42.

127 *Id.* at 58. For comparison, Intel had revenues of $55,870 million and net income of $15,347 million, including a $4,206 million loss in the mobile sector in 2014.

128 *See* Elizabeth Garnsey, Gianni Lorenzoni & Simone Ferriani, *Speciation Through Entrepreneurial Spin-Off: The Acorn-ARM Story*, 37 Res. Pol'y 210, 214–19 (2008) (providing a case study of the Acorn-ARM story); Markus Levy, *The History of the ARM Architecture: From Inception to IPO*, 4 ARM IQ (2005) (for a brief history of the ARM architecture).

129 ARM Strategic Report, *supra* note 126.

Figure 10. ARM IP-based Partnership Business Model



Source: Figure 10 is based on *ARM Strategic Report*, *supra* note 126.

Figure 10 represents the IVC business model employed by ARM in the telecommunications value chain.[130] ARM invested $364 million in R&D, representing 28 percent of its total revenue for 2014,[131] for a total of $2.6 billion since it went public in 1998.[132] Its R&D activities are focused on the rapid development of new processor designs delivered primarily as semiconductor intellectual property cores, or, simply, IP cores at different levels of customization.[133]

ARM engages in an IP-based partnership business model whereby it actively builds an ecosystem to facilitate the development of new computing solutions utilizing its IP cores.[134] This ecosystem includes an interaction between semiconductor firms (that is, chip designers such as Qualcomm, Samsung, and Apple), silicon foundries, OEMs and ODMs (that is, producers of mobile devices such as Apple, Samsung, and Microsoft), and the OS and application developer community (that is, Android, iOS, and Windows Phone and their app communities).[135]

ARM is what is called an IP vendor in the fabless semiconductor ecosystem, delivering IP cores as hardware and software IP to the semiconductor firms, as well as providing testing and design optimization support to silicon foundries, and engaging in software optimization with software developers so that products employing the ARM cores have the highest application performance.[136] Given the importance of application performance in mobile

130 This is a simplification focused on illustrating the dual value propositions offered to end-product manufacturers.

131 ARM Strategic Report, *supra* note 126, at 58.

132 *See ARM Holdings Research and Development Expense (Quarterly)*, YCharts, https://ycharts.com/companies/ARMH/r_and_d_expense.

133 ARM Strategic Report, *supra* note 126, at 16.

134 *Id.*

135 *Id.*

136 Since its development in the 1960s, the semiconductor industry has become less vertically integrated. Companies such as Hewlett-Packard, Rockwell, Siemens, Fairchild, Motorola, and Texas Instruments sold off their semiconductor manufacturing, facilitating the creation of fabless chip companies utilizing

devices, ARM's dominant position in IP cores creates a switching cost for chip designers when considering alternative IP cores with less software optimization.[137] It also works to facilitate interoperability among the hardware and software solutions of different actors in its ecosystem to support collaboration and rapid deployment of new product solutions on the market.[138]

ARM offers various licensing terms based on the type of IP core and the level of flexibility to make design modifications.[139] Hard IP cores offer specific implementations of production-ready processor cores with verified performance, whereas soft IP cores allow for architectural modifications so that chipmakers can optimize the processor cores for their specific applications. By focusing on processor-core R&D and providing IP licenses, ARM is able to spread the development cost of new processors over numerous chipmakers, allowing for high performance at a lower cost.[140] This, combined with the optimization benefits of the ARM ecosystem, creates a sustainable competitive advantage that discourages chipmakers from developing their own processor cores, at least in areas where customization is not critical. In effect, ARM's IP-based partnership model has created a de facto standard in processor cores, particularly in the mobile segment, where it holds an overall 86-percent market share and a 95-percent market share for mobile phones. To succeed in building a de facto standard within a heterogeneous ecosystem, ARM IP cores are designed as basic building blocks to be process agnostic toward different fabrication techniques, extremely configurable toward different applications, flexible in relation to other hardware components (even competitors), and provide a long life capable of performance upgrades over time.[141]

IP core licensees are charged both an up-front fee and a royalty on each chip sold, typically based on the chip price (that is, the chip is the royalty base).[142] The amount of the fees and royalty rates is typically based on the level of performance of the processor cores, ranging from $100 thousand to $1 million and 1 to 2 percent.[143] Applying the chip price as the royalty base

contract manufacturing as well a new IP-based business model. *See* Greg Linden & Deepak Somaya, *System-on-a-Chip Integration in the Semiconductor Industry: Industry Structure and Firm Strategies*, 12 Indus. & Corp. Change 545, 546–50 (2003).

137 For information on ARM software optimization, see ARM & Qualcomm, Enabling the Next Mobile Computing Revolution with Highly Integrated ARMv8-A Based SoCs (2014).

138 *See, e.g.*, Press Release, ARM, Cadence and ARM Announce Strategic IP Interoperability Agreement (Mar. 18, 2015), https://www.arm.com/about/newsroom/cadence-and-arm-announce-strategic-ip-interoperability-agreement.php.

139 *See Licensing ARM IP*, ARM, http://www.arm.com/products/buying-guide/licensing.

140 ARM estimates that a major semiconductor company would need to spend over $100 million each year to develop and maintain its own processor architecture. ARM Strategic Report, *supra* note 126, at 21.

141 *Id.*; Alexandru Voica, *When SoC Met IP*, Alexvoica (June 17, 2015), http://www.alexvoica.com/when-soc-met-ip/.

142 ARM Strategic Report, *supra* note 126, at 20.

143 *See* Paul Sandle, *ARM Sees Royalties Accelerating with Latest Smartphone Chips*, Reuters (Feb. 11, 2015), http://www.reuters.com/article/2015/02/11/us-arm-holdings-results-idUSKBN0LF0FS20150211#LpcT6X

is consistent with the historical business norms of the semiconductor sector, where integrated firms traditionally developed, fabricated, and sold chips as part of the MVC to product manufacturers.[144] The role of the IP vendor is part of a division of innovative labor in an increasingly fabless chip development ecosystem, where semiconductor IP is transferred as part of the IVC to actors operating within the semiconductor and chip-manufacturing segment of the MVC.[145] Although the performance of the ARM processor affects the operation of both the chip and the product, the market norm for ARM and other IP vendors is to license their IP to the chipmakers in the value chain. In 2014, ARM posted licensing revenues of $581 million, based on the sale of 12 billion ARM-based chips, which is approximately $0.21 per chip.[146] ARM is a good example of the vast impact that a small firm can have with only several thousand employees, a relatively small R&D budget, and an IP-based business model.

3. ARM-Qualcomm Convergence in the Telecommunications Value Chain

Although this article has described how different business models in the MVC and IVC operate and interact, it is also helpful to illustrate how different knowledge-based business models interact in the telecommunications value chain. Figure 11 shows how the ARM and Qualcomm IP-based business models interface in the IVC, whereby ARM processor IP cores are licensed to Qualcomm, which integrates them with other technology blocks to provide full system-on-a-chip (SoC) solutions for mobile devices.[147] Qualcomm subsequently licenses its SEP portfolio to OEMs or ODMs manufacturing end products.

4gbSGbe45Z.97; Anand Lal Shimpi, *The ARM Diaries, Part I: How ARM's Business Model Works*, AnandTech (June 28, 2013), http://www.anandtech.com/show/7112/the-arm-diaries-part-1-how-arms-business-model-works/2; Microsoft Corp. v. Motorola, Inc., No. C10-1823JLR, 2013 WL 2111217, at *93–95 (W.D. Wash. Apr. 25, 2013).

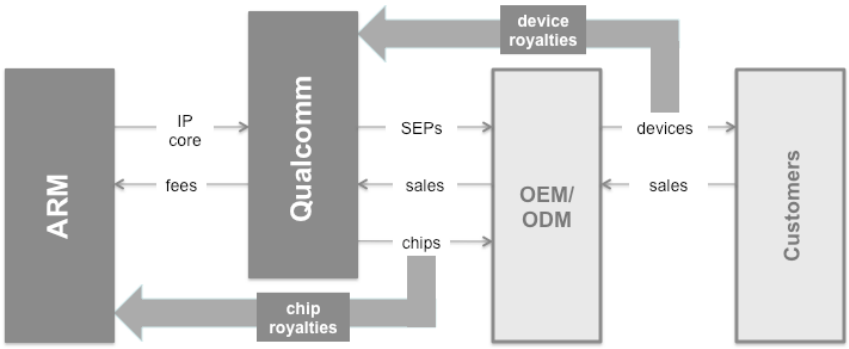
144 *See* Daniel Nenni & Paul McLellan, Fabless: The Transformation of the Semiconductor Industry (Beth Martin & Shushana Nenni eds., CreateSpace 2014) (explaining the history of the transformation of the semiconductor industry).

145 Synopsis, Imagination Technologies, Cadence, Silicon Image, Ceva, Sonic, and Rambus are other leading IP licensing firms that also license to chip manufacturers.

146 ARM Strategic Report, *supra* note 126, 53.

147 An example of ARM-Qualcomm collaboration is in the Qualcomm Snapdragon SoC that contains both customized ARM instruction sets and ARM processor implementations (that is, both soft and hard IP cores). Through the configuration of custom processors and integrated ARM processors, Qualcomm is able to provide differentiating high-end performance, as well as plug into the ARM ecosystem and benefit from the optimizations of partners firms, such as Android and related application software tuned to ARM cores. *See* Adam Kerin, *How ARM Architecture and Snapdragon Processors are Supporting the 64-bit Future of Mobile*, Qualcomm: Snapdragon Blog (Aug. 26, 2014), https://www.qualcomm.com/news/snapdragon/2014/08/26/how-arm-architecture-and-snapdragon-processors-are-supporting-64-bit.

Figure 11. Interrelationship of ARM and Qualcomm IP-Based Business Models



Source: Figure 11 is based on *ARM Strategic Report, supra* note 126; Qualcomm 2014 10-K Report, *supra* note 105; Kerin, *supra* note 149.

The location of licensing in the telecommunications value chain (that is, the royalty base) of both the ARM and Qualcomm licensing models represents the influence of historical norms, where ARM has its roots as a semiconductor company in the computer industry and Qualcomm has its roots as a fully integrated telecommunications company. These different histories also manifest themselves in relation to the nature of the scope of their different IP portfolios. Whereas ARM's IP relates primarily to the function and implementation of processor-based chips, Qualcomm's standard-essential IP relates to the entire telecommunications system (for example, the 3G or Wi-Fi communication system) with some functionality implemented on the chip level and some on the device and system level. Thus, historical industry norms and the scope of the relevant technical system together with strategic business considerations based on bargaining power in the value chain have all influenced the current configuration and roles played by ARM and Qualcomm in the telecommunications value chain. The implications of these different market norms and historical industry norms outlined in Part III will now be analyzed and discussed in relation to the contentious debate on legal norms regarding apportionment and the royalty base outlined in Part II.

IV. Analysis of IVC-Based Principles and Market Norms in Relation to Current Legal Norms for Determination of SEP Damages

This part analyzes the impact of IVC principles and prevailing market norms on the interpretation of legal norms regarding apportionment and royalty-base determinations in the adjudication of patent damages for SEPs. Five

relevant areas of consideration have been highlighted to advise courts, regulators, SSOs, and other policymakers when interpreting and setting norms related to SEPs, FRAND, and standard-enabled markets. In particular, these five areas are meant to generate a better understanding of how the nature of the value of knowledge and the evolution of market practice in the telecommunications value chain could normatively influence the interpretation of legal norms to provide greater equity and economic efficiency.

A. The Value of Knowledge Is Not Constrained by the Material Value Chain

One key characteristic of a knowledge economy is the increased value of the knowledge component of value propositions, as discussed at the beginning of this article. This is exemplified by the increase in new knowledge-based business models that allow knowledge to be transacted as a standalone value proposition (for example, as an IP license) or delivered in non-physical, digital form as virtual products (for example, as software). This illustrates how the value of knowledge can be separated from physical implementations (that is, knowledge objectified as intellectual property can be commercialized in either the material or the intellectual value chain). Even for physical products, the value of the IP component of many physical value propositions commonly exceeds the value of the cost of the physical products in which they are embedded (for example, patented compounds in pharmaceuticals, copyrighted movies on DVD, trademarked clothing, and so forth). Thus, physical artifacts may contain or carry knowledge-based value propositions, but the value of the knowledge cannot be subsumed within the cost of manufacture of its physical carrier.

Although the evidence of the value of knowledge is all around us these days, we still struggle to escape the captivity of the industrial mindset and the preoccupation with the material value chain as the reference for value creation.[148] As an example, a 2014 working paper on the smartphone royalty stack explicitly compared the price of the physical components to the hypothetical price of SEP licenses as its main criterion to suggest that a royalty-stacking problem exists.[149] Putting aside their method for calculating the royalty stack, the more fundamental problem is in defining the price of components linked to the cost of manufacturing as the main determinant of value creation for standard-enabled products.[150] This comparison becomes

[148] *See* Petrusson, *supra* note 16, at 86–90 (discussing structural captivity in the material value chain).

[149] *See* Ann K. Armstrong, Joseph J. Mueller & Tim Syrett, The Smartphone Royalty Stack: Surveying Royalty Demands for the Components Within Modern Smartphones 69 (Working Paper, 2014), https://www.wilmerhale.com/uploadedFiles/Shared_Content/Editorial/Publications/Documents/The-Smartphone-Royalty-Stack-Armstrong-Mueller-Syrett.pdf ("Indeed, the royalty data shows that potential royalt[y] demands on a smartphone could equal or even exceed the cost of the device's components.").

[150] It should be noted that "royalty-stacking" is an IVC phenomenon based on the market norms for SEP licensing examined in Part IV. From an MVC perspective, the gross profit margin of a physical product

even more problematic when the price of components does not include the payment for IP embedded in the components, as will be discussed in the next part.

When we move from an MVC to an IVC logic, one key challenge will be determining how to value different knowledge-based contributions delivered through multiple interrelated value propositions, such as knowledge embedded in physical products, and knowledge packaged as license offers. In the context of patent damages, this would fall within the general category of the challenge of apportionment, where the court has developed several rules to help manage the complexity, such as the SSPPU and the EMVR discussed in Part II. From a value-chain perspective, these rules could be viewed as a means to simplify IVC-based transactions into an MVC logic by linking the damage calculations to specific physical objects in different positions in the MVC. However, the value of IP cannot always be defined by simply looking to the MVC. For example, the market norms in the telecommunications industry show that firms license SEPs separately from physical value propositions (for example, chipsets) through the IVC to end-product suppliers, as discussed in Part III above, making the component level an inappropriate royalty base without a necessary adjustment to account for customary business practice.[151]

The Android operating system for mobile devices provides another good example to illustrate the challenge of determining the value contribution from intangible value propositions based on the price or profit of the component itself. In this case, the value of Android cannot be measured through an apportionment of its price, profit margins, or marginal cost, because as a free, open-source software solution, all of these prices are zero. However, Android does create value, and actors with IP claims to the technical functions in Android have nonetheless extracted non-zero licensing royalties based on the value of its use in mobile devices, despite its lack of market pricing at the component level.[152]

Finally, the fact that the SSPPU rule was devised as a pragmatic solution to simplify the assessment of damages for jury trials is not a good reason to apply a rule that fails to provide a logical apportionment of value based on the observable market norms of business actors. To apply a simple MVC

could provide an analogy where any gross margin over 50 percent would represent a profit greater than the actual cost of manufacturing the component. For comparison, Intel's gross profit margin for the last four quarters ending in June 2015 was 63.34 percent. Should this be labeled as a profit-stacking problem?

[151] Furthermore, these licenses are often executed many years after products and services for standards-enabled markets are formed, leading to pricing and profit distributions based on the technical performance of the standard, but external to the cost of the use of technology.

[152] Microsoft has licensed most major mobile handset suppliers based on their IP related to Android. *See* Press Release, Microsoft Corp., Microsoft Signs Power Licensing Agreement with Qisda Corp to Cover BenQ Android Devices and More (Apr. 25, 2015), http://microsoft-news.com/microsoft-signs-patent-licensing-agreement-with-qisda-corp-to-cover-benq-android-devices-and-more/.

logic to a complex value-creation process is not conducive to the advancement of innovation in the knowledge economy. Whether an end-product or component-level royalty base is used should be informed by the nature of the role that the IP plays in the context of the market environment in which it operates. In industries with new knowledge-based business models, hard-and-fast rules will likely produce unsatisfactory results given heterogeneous contexts. Furthermore, as the royalty base changes in patent damage determinations, so will the need to alter the royalty rate to compensate for the change in scope of IP in relation to the base.[153] As difficult as apportionment may be, the first step must be to acknowledge that the MVC is not the only means to measure the value of knowledge, especially knowledge that is transacted in the IVC.

B. Royalty Lacking: Components Are Not Licensed in the Telecommunications Value Chain

Building on the previous part above, the use of the SSPPU rule becomes increasingly challenging when the IP in question has not been licensed on the component level. As discussed in Part III, the norm in the telecommunications industry is to license SEPs at the end-product position in the value chain, which effectively means that the component level is left unlicensed. This creates a downward pressure on the price of components, creating what could be termed a reverse royalty stacking or "royalty lacking" problem if a component-level royalty base is chosen in an industry that doesn't license SEPs at the component level.[154]

In *Innovatio*, the court applied the component-level profit margin as the FRAND royalty base.[155] The use of profit margins at the component level to define the value of SEPs is problematic from a value chain perspective in three respects. First, market norms are to license SEPs at the end-product level, as described in Part III.[156] Second, given that the majority of SEPs are not licensed at the component level, the profit margin of components would be quickly obliterated if the component licensee would be required to license

153 For example, the royalty rate as a proportion of the base for Wi-Fi SEPs would be different for a car, a computer, a router, or a chip.

154 Hypothetically, in a highly competitive, unlicensed market, component prices could conceivably approach marginal costs, which shows the weakness of applying patent damage calculations based on the price of components as well as profits.

155 *See In re* Innovatio IP Ventures, LLC Patent Litig., MDL No. 2303, 2013 WL 5593609, at *14 (N.D. Ill. Oct. 3, 2013) ("Innovatio's application of its approach did not credibly apportion the value of the end-products down to the patented features. In light of that failure of proof, *the court has no choice* based on the record but to calculate a royalty based on the Wi-Fi chip.") (emphasis added).

156 This is particularly true for cellular standards, but the lack of SEP licensing in Wi-Fi creates a more ambiguous industry practice.

all SEP holders, forcing component makers to raise prices.[157] Third, SEP royalties are conventionally based on revenue, not profit, which is unrelated to the profit margin of a component industry competing on cost in an MVC logic.[158]

The *Innovatio* court stated that "where, for example, the patentee can show that widespread infringement made the established royalty rate artificially low, the court may award a reasonable royalty that is higher than the established rate." However, the court decided that this was not the situation in this particular case.[159] This is contrasted against *CSIRO*, where the court cited widespread infringement of SEPs in the Wi-Fi chip industry, leading to the following argumentation on the suitability of the component level as the proper royalty base for the SEP in suit:

> Although it is largely undisputed that the inventive aspect of the '069 Patent is carried out in the PHY layer of the wireless chip, the chip itself is not the invention. The '069 Patent is a combination of techniques that largely solved the multipath problem for indoor wireless data communication. The benefit of the patent lies in the idea, not in the small amount of silicon that happens to be where that idea is physically implemented. Compounding this problem is the depression of chip prices in the damages period resulting from rampant infringement which occurred in the wireless industry. . . . It is simply illogical to attempt to value the contributions of the '069 Patent based on wireless chip prices that were artificially deflated because of pervasive infringement. Basing a royalty solely on chip price is like valuing a copyrighted book based only on the costs of the binding, paper, and ink needed to actually produce the physical product. While such a calculation captures the cost of the physical product, it provides no indication of its actual value.[160]

Given that the industry norm is to license SEPs at the end-product level of the value chain, the component market remains largely unlicensed with respect to SEPs, and thus is built on pricing that primarily reflects only the

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[157] In his expert testimony, David Teece also advised the court on this point. *See In re Innovatio*, 2013 WL 5593609, at *39 ("[T]he court agrees that the profit margin on an accused product is not always dispositive for determining a RAND rate. . . . This court has held that an infringer's net profit margin is not the ceiling by which a reasonable royalty is capped.") (internal quotation marks and citations omitted).

[158] In fact, given that SEPs are licensed nonexclusively industry wide on FRAND terms, the licensing of an entire industry would likely affect only price and costs, with no systemic net impact on profit margins.

[159] Judge Holderman justified the use of the chip profit margin on the basis of testimony that the Innovatio patents were licensed to several of the major chip firms. *See In re Innovatio*, 2013 WL 5593609, at *39. However, as Broadcom was the previous owner of the Innovatio patents, the license could simply reflect a cross-licensing agreement among chip manufacturers.

[160] Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc., No. 6:11-cv-343, 2014 WL 3805817, at *11 (E.D. Tex. July 23, 2014), *vacated and remanded*, 809 F.3d 1295 (Fed. Cir. 2015). In addition to the issue of depressed chip process, this statement also provides a clear opinion on the relation between the value of an invention and its physical implementation, showing the court's willingness to separate the MVC and IVC in its interpretation of patent damages.

cost of manufacturing. Thus, the telecommunications context makes the use of the component level (that is, the chip) as the SSPPU problematic for several pragmatic reasons that are elaborated on below.

C. Market Norms Are to License SEPs on Fully Compliant End Products

Based on historical industry norms and strategic behavior, SEP holders in the telecommunications value chain primarily license SEPs on fully compliant products sold by end-product suppliers. This practice has existed for quite some time, especially in cellular standards, and increasingly in Wi-Fi standards—however, with less evidence of traditional licensing activity. Although numerous antitrust inquires have examined SEP licensing practices, as of 2016 no competition authority has found the practice of SEP licensing to the end-product position of the value chain to be anticompetitive.[161] However, it is possible that different industries and industry segments may have different norms, as the Qualcomm and ARM cases in Part III.D demonstrate. In particular, the ARM case exemplifies the specific context of the semiconductor and computer industry, for which licensing IP (that is, non-SEPs in this case) to chipmakers is the market norm, which stands in contrast to the telecommunications context, in which companies such as Qualcomm license to the end producer. Industry differences, such as those exemplified in the Qualcomm and ARM cases, make it imperative that historical market norms be factored into the determination of the proper royalty base.

The simple question is: if norms of practice matter in the determination of the royalty base in the market, should they not also inform legal norms for the determination of patent damages? This reasoning is, of course, not new, and the importance of industry norms can be found in several key areas regarding patent damages, such as the *Georgia-Pacific* factors.[162]

The *Georgia-Pacific* factors could be viewed in their entirety as a means to understand the nature of the value of the patent in suit through investigating different dimensions that define the context of its use. For example, *Georgia-Pacific* factor 15 frames the investigation by defining the circumstances of a hypothetical agreement between a willing licensor and licensee. Certainly, a hypothetical agreement would take its starting point in market norms. In fact, the potential situation of an SEP holder as licensor and an OEM as licensee is not hypothetical at all, so it would be strange to discuss the component level as the proper royalty base when determining a reasonable royalty between two actors that represent the typical licensor (that is,

[161] In fact, the recent Qualcomm decision by the Chinese NDRC upheld the end product as an appropriate royalty base.

[162] The *Georgia-Pacific* factors could certainly be considered to be a means to assess patent damages from an MVC logic, not multi-technology products and SEPs licensed through an IVC logic. This discussion will focus mainly on a few fundamental principles of the *Georgia-Pacific* factors.

the SEP holder) and the licensee (that is, the end producer) consistent with industry practice. Choosing a component-level royalty base when market norms dictate the product level would in effect be a court-imposed, *ex post*, economic exhaustion of rights, which would contradict previous court opinions that have recognized the right of SEP holders to contractually define the licensing position in the value chain.[163] In addition, *Georgia-Pacific* factors 1, 2, 4, 5, 8, and 10 through 13 all specifically relate to the understanding of the commercial context of the patent and the market norms.[164]

FRAND commitments and agreements are another example of legal norms shaped by market practice. FRAND is contextual, in that the concept of reasonableness is predicated on expectations based on existing norms used as inputs into decisions regarding investments both in R&D and manufacturing, as well as whether or not to join standardization processes. Thus, the meaning of FRAND for all actors volunteering to join an SSO is determined before participation in the standardization process, as its meaning has direct consequences on the financial forecasts that underpin strategic management decisions.[165] A minor redefinition of FRAND *ex post* of the investment decision-making process would obviously have an impact on the short-term performance of the affected firms; however, a major redefinition of FRAND could challenge the viability of the existing market dynamics. Whether one agrees with the current practice or not, moving the royalty base from the end product to the component would qualify as a major redefinition of FRAND. For example, using the numbers put forward by Ann Armstrong, Joseph Mueller, and Tim Syrett, a change in the royalty base would result in a 30 to 40 times reduction in the royalties received by cellular SEP holders on smartphones.[166] It would seem reasonable to consider this a major change in expectations that would disrupt short-term income and affect future strategic decisions on standard participation, especially for innovation specialists as well as integrated firms that have strong IP-licensing business models and submit significant technical contributions to SSOs.[167]

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163 *See* MPEG LA v. Audiovox Elecs., 33 Misc. 3d 802 (N.Y. Sup. Ct. 2011); Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201 (Fed. Cir. 2014).

164 *See* Sidak, *Bargaining Power and Patent Damages*, *supra* note 41. Although *Georgia-Pacific* factor 13 has traditionally been discussed in relation to the concept of apportionment, most *Georgia-Pacific* factors can be used to inform on the market context of the patent in suit and thus inform on both apportionment and royalty base in the general sense.

165 *See* J. Gregory Sidak, *The Meaning of FRAND, Part I: Royalties*, 9 J. Competition L. & Econ. 931, 983 (2013) (criticizing that the *ex ante* evaluation of SEPs is "not *ex ante* enough" and should be placed at the time of the R&D investment decision, not the decision by the SSO).

166 *See* Armstrong, Mueller & Syrett, *supra* note 151, at 3, 13 (stating a baseband chip price of $10 to $13 and a smartphone price of $400).

167 The high-margin business of IP licensing based on operating expenses is misleading from a dynamic perspective because previous R&D investments were required to generate the revenues. Although initial reductions in income will not necessarily create immediate losses on the income statement, such income reductions will certainly affect future R&D investment and standardization decisions.

The nature of FRAND as an incomplete contract creates the normative space for different standards contexts to have different FRAND norms based on the actions and expectations of the actors in the particular standardization setting. In other words, the concept of fair, reasonable, and nondiscriminatory can take on different meanings across different market contexts. The development of standards and concomitant FRAND expectations can differ based on several dimensions, including the examples that follow.

1. Performance Requirements of the Standard

Different standards will have different performance profiles related to the level of R&D investment. High-performance standards requiring large R&D investments will likely create greater market value, which will be reflected in the value of the underlying technical contributions that deliver the performance. Whereas interoperability facilitates market growth, performance can create new sources of value. The new market opportunities created in the transformation from 2G to 3G provide a good example of how performance differs from interoperability from a value-creation perspective.

2. Business Models of the SSO Actors

When actors with homogeneous business models participate in standard setting, the development of IPR policies and norms is usually easier to resolve. For example, if all of the actors in a standard are integrated firms, often cross licensing or patent pooling can resolve the SEP issues by reducing transaction costs, where the focus of the standard is to support market growth, which is in the best interests of all firms that sell products and services. However, when firms with heterogeneous business models—such as innovation specialists, integrated firms, and implementation specialists—participate in standard setting, there is a mismatch of incentives that creates different value expectations among the different actors. For example, innovation specialists relying on SEP licensing for a return on their R&D investment need to receive a royalty that reflects the value of their contribution, as they have no market products or services to rely on. Thus, standards created by firms with heterogeneous business models will likely experience a strong conflict regarding the value of SEPs and associated FRAND royalties, which is what is currently experienced in both cellular and Wi-Fi standards.[168]

[168] In cellular, the technical contributions by firms with a strong IP-licensing model is rather large. For Wi-Fi, SEP ownership is more fragmented, though recent Wi-Fi SEP court cases represent actors with stronger SEP portfolios operating in the IVC (for example, Motorola, Ericsson, Innovatio, and CSIRO) against weaker MVC actors in the context of the Wi-Fi standard (for example, Microsoft, D-Link, Cisco, and so forth).

In conclusion, the market characteristics of standards are based on the nature of the development (performance and business model characteristics) of the standard, and therefore, different standardization contexts will likely produce different FRAND expectations and different SEP values.[169]

D. Standards Drive Market Demand by Definition

The modern economy runs on standards. For consensus-based telecommunications standards, it is particularly difficult to separate the standard-setting process from the construction of the market. However, different actors view standards in different ways. For implementation firms, the standard is a means to facilitate the sale of products and services, whereas for innovation specialists and large SEP portfolio holders, the standard is viewed as a product itself. This "productification" is evident even in how standards are branded with word marks and logos identifying the standard as an important value proposition in itself, reminiscent of the Intel Inside strategy (for example, consider the Wi-Fi, 4G, and LTE standards).[170] Thus, although interoperability facilitates market growth, increased performance generates new value propositions linked to customer needs. For instance, earlier generations of the Wi-Fi and cellular standards delivered interoperability, but at a performance lower by orders of magnitude.[171] Thus, for example, interoperability can exist with 2G cellular standards, but smartphones cannot.

The combination of interoperability, technical performance, and brand recognition defines standards as drivers of market demand in terms of the size and scope of value propositions delivered on the market. Reducing interoperability, such as through competing standards, would slow market growth, but not affect performance-related demand, such as the adoption of newer mobile devices with greater functionality. This has the following implications for legal norms regarding the proper royalty base.

1. SSPPU

For a system innovation such as a telecommunications standard, it is very difficult to break down the value of the performance of the standard into its individual components, as customers experience the overall value in relation

[169] *Cf.* Bekkers & Updegrove, *supra* note 13, at 9 ("Moreover, different contexts can call for different solutions. Every SSO operates within the unique and often significantly divergent realities of its specific technological domain and commercial practices; geography, business model and other important differentiators exist as well. . . . An IPR policy that fits perfectly in one setting might therefore be unlikely to work as well in another, making any ranking or grading of IPR policies on an absolute or comparative basis highly problematic at best.").

[170] *See, e.g.*, *Our Brands*, Wi-Fi Alliance, http://www.wi-fi.org/who-we-are/our-brands. For LTE, 3GPP and numerous operators and other telecom actors have their own 4G/LTE trademarks.

[171] For example, estimations suggest that Wi-Fi performance has increased 500 times since its inception in 1997, and 4G/LTE cellular performance is 12,000 times greater than 2G.

to end products and services that are part of a multifaceted, interconnected system. Thus, it could be argued that for telecommunications standards that deliver high performance through an aggregated system, the end product or service level is the smallest saleable patenting-practicing unit when considering the standard as a whole.[172]

2. EMVR

Given that a standard provides value as a complete system, it is very difficult to evaluate a standard by comparing individual or small subsets of SEPs to the market demand for the end product. Although each individual SEP would not drive the demand for the end product, such as a Wi-Fi router or mobile phone, the entire set of SEPs would certainly have that potential. For example, the entire set of Wi-Fi SEPs that define the performance of the latest version of the standard could certainly be seen as driving the demand for Wi-Fi routers, whose main value proposition is to deliver Wi-Fi functionality.

The use of the SSPPU and the EMVR can be seen as a means by which the court manages the complexity of determining patent damages in multicomponent products; however, the distinction is too digital. The EMVR requirement that the end product cannot be used as the base if the patents in suit are not proven to drive the demand for the product is not applicable for standards that drive market demand by definition. Certainly, the value of major standardized technologies in the end product, such as cellular and Wi-Fi functionality, can be apportioned without resorting to the default scenario of applying the SSPPU. Furthermore, the litigation practice of adjudicating a small subset of the total SEPs in a standard could make the sum of the parts less than the whole (that is, it could be possible for each individual SEP to invoke the SSPPU and be valued at the component level, while the entire SEP portfolio of the standard invokes the EMVR and is valued at the product level). Doing so would likely create completely different valuations in one direction or the other, depending on the method used. Again, we see that the relevant market norms are critical when trying to interpret legal norms originally created from an MVC perspective but applied to standard-enabled market contexts.[173]

E. Market Norms Are Embedded in SEP License Agreements

As mentioned in Part IV.C, the *Georgia-Pacific* factors provide an opportunity for market norms to be integrated into the determination of patent

[172] *See also* Sidak, *The Meaning of FRAND, Part I: Royalties*, *supra* note 167, at 967.

[173] For example, the prescriptive use of the EMVR would restrict the use of the end product as a royalty base only to products with low patent-to-product ratios, such as pharmaceuticals.

damages—in particular, *Georgia-Pacific* factors 1 and 2, as follows: (1) The royalties received by the patentee for the licensing of the patent in suit, proving or tending to prove an established royalty; (2) The rates paid by the licensee for the use of other patents comparable to the patent in suit.[174]

It is no coincidence that these are the first two factors, as courts have long acknowledged that the best measure of a reasonable royalty is an established royalty rate in the industry (that is, market norms).[175] Existing comparable licenses have market norms related to the royalty base and apportionment embedded intrinsically within the agreements.[176] Existing licenses eliminate the need to determine these factors hypothetically, as they have been determined in practice through an actual market transaction.

Valuations determined through existing licensing agreements are called market methods by patent damages experts.[177] This is in contrast to income methods that require assumptions to be made about key valuation factors in the absence of an existing market transaction. Thus, the hypothetical determination of the royalty base, such as through the application of the SSPPU and the EMVR, is necessary only when relying on income methods.

Recent court rulings regarding the determination of FRAND royalties have shown mixed results regarding the application of various market methods.

*1. Prior License Agreements to the Patents in Suit (*Georgia-Pacific *Factor 1)*

The courts in *Microsoft* and *Innovatio* both rejected the prior license agreements submitted by the SEP holders primarily based on the inability to separate the SEPs in suit from other objects in the agreements and the execution of the agreements under the duress of litigation. However, the courts in *Ericsson* and *CSIRO* both accepted prior license agreements as evidence probative of a reasonable royalty.[178]

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[174] *See* Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1119 (S.D.N.Y. 1970), *modified and aff'd*, 446 F.2d 295 (2d Cir. 1971), *cert. denied*, 404 U.S. 870 (1971).

[175] *See* LaserDynamics, Inc. v. Quanta Comput., Inc., 694 F.3d 51, 79 (Fed. Cir. 2012) (stating in reference to *Georgia-Pacific* factor 1 that "actual licenses to the patented technology are highly probative as to what constitutes a reasonable royalty for those patent rights because such actual licenses most clearly reflect the economic value of the patented technology in the marketplace").

[176] *See id.* at 79–80 ("[A]ctual licenses to the patents-in-suit are probative not only of the proper amount of a reasonable royalty, but also of the proper form of the royalty structure."); *see also* Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc., 809 F.3d 1295, 1303–04 (Fed. Cir. 2015) (citing the validity of comparable licenses regardless of the royalty base of the agreement).

[177] *See* Russell L. Parr & Gordon V. Smith, Intellectual Property: Valuation, Exploitation, and Infringement Damages (John Wiley & Sons 2005) (describing various patent valuation methods applied to different valuation contexts, such as the difference between market and income methods).

[178] In Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc., No. 6:11-cv-343, 2014 WL 3805817 (E.D. Tex. July 23, 2014), a prior licensing program and an actual licensing agreement were investigated as comparable licenses, each using different royalty bases.

*2. Prior License Agreements for Comparable Patents (*Georgia-Pacific *Factor 2)*

The Microsoft court accepted and applied the standard licensing terms for ARM IP cores for use in a Marvell Wi-Fi chip in the determination of an applicable comparable FRAND royalty. As demonstrated in Part III, the market norms of ARM and the semiconductor industry are different with respect to royalty rates and base. It is therefore difficult to justify the use of licensing norms from one market context to another completely different market context without detailed comparative analysis proving otherwise.

*3. Patent Pools (*Georgia-Pacific *Factor 2)*

The use of patent pools as market comparables was presented to both the *Microsoft* and *Innovatio* courts. The *Microsoft* court strongly accepted the MPEGLA H.264/AVC pool and weakly accepted the Via 802.11 pool as probative, whereas the *Innovatio* court rejected the use of the Via 802.11 pool on the basis of its lack of market success. The difference in the level of market success of the two patent pools is a possible indication of different market norms for the development of the MPEG4/AVC versus the Wi-Fi standard supporting the argumentation in Part IV. This would suggest that patent pool rates should be used as market comparables only when they are closely connected to the market norms under which the standard was created. Furthermore, using patent pool rates from one standard to another would typically not be applicable.

In new areas where little case law exists, historical market agreements are valuable resources in supplying courts with important information on market norms. However, it is important that comparable licenses be in fact comparable, so caution should be used when applying norms across different markets. The struggle to produce credible prior license agreements in *Microsoft* and *Innovatio* further supports the proposition that Wi-Fi does not have a strong tradition of SEP licensing as a market norm, which in turn makes the determination of FRAND royalties more difficult than in the case of cellular standards, where SEP licensing has a more established practice.

V. Legal Norms and the Epistemological Lens of the Intellectual Value Chain

This part seeks to consolidate the different threads in the preceding parts, highlighting the usefulness of evaluating the determination of the royalty base in patent damages, as well as legal norms in general, from the epistemological lens of the intellectual value chain to support the creation of wealth

and welfare in a knowledge economy. In particular, this part considers the openness of the U.S. courts to apply this lens in their recent rulings regarding SEPs.

A. Value Chain Transformation and the Impact on Legal Norms

Traditionally, the value of investments in knowledge was appropriated through the sale of physical products in a material value chain. Market power was created through the control of resources, such as the factors of production—land, labor, and physical capital—and through the bargaining power associated with the industry structure and the positioning of the firm in the MVC. Intellectual property in the MVC was used as a means to gain market power by blocking competition. Because of the focus on physical capital and products, the understanding of the role of knowledge remained elusive in economic and management theory until the later half of the twentieth century.[179]

The shift from an industrial to a knowledge-based economic paradigm challenges the dominance of the traditional MVC through new knowledge-based business models that operate through an intellectual value chain as a means to appropriate value from knowledge, creating the opportunity for a new division of innovative labor and the development of technology markets in addition to traditional product markets. This changes the nature of competition in the market from control over the MVC to control over the IVC, challenging the dominance of product firms by redefining how the allocation of value should be distributed among different actors with differing market roles and knowledge-based contributions. Thus, the knowledge economy favors the creator of knowledge as the key source of innovation that is critical to drive economic growth and prosperity, creating conflict in relation to incumbent industry structures based on an MVC logic, as well as between knowledge-based firms operating in different positions in the value chain and with different IVC-based business models. In particular, the concepts of patent holdup, royalty stacking, and royalty base are all fundamentally IVC phenomena linked to IP-based business models and a new division of innovative labor. In the knowledge economy, IVC-based market norms need to be considered in the interpretation of legal norms, in the determination of patent damages in general, and in SEP royalty determinations in particular.

[179] *See* David Warsh, Knowledge and the Wealth of Nations: A Story of Economic Discovery (W. W. Norton 1st ed. 2007).

B. Implications of Determining the Royalty Base

Determining the royalty base is a critical issue in the determination of SEP damages and FRAND royalties. The shifting of the royalty base can affect the value of SEPs by more than an order of magnitude, which can have a systemic effect on the standardization process. For example, several leading technology firms in 2015 refused to license under the terms of the IEEE standards, owing to the new IPR policy that specified the FRAND royalty base at the component level.[180] This example provides insight into the implications and consequences that altering the royalty base has on actors with knowledge-based business models and the development of future standards.

These implications and consequences are even more severe when a court decision alters the royalty base in contradiction to existing market norms, as the decision would, in effect, retroactively redefine the IPR policy of the whole industry, and implicitly define an economic exhaustion of rights at the component level. This would in turn alter the financial assumptions under which R&D and standardization decisions were initially made.[181] This will then force technology firms, regardless of stated SSO IPR policy and industry licensing norms, to alter their strategic actions. From an economic efficiency perspective, a change in the royalty base from existing market norms could have several effects.

First, the change would have no effect on static efficiency. A royalty base change would simply facilitate a transactional transfer of producer surplus from one producer to another. This would occur if the reduction in costs by implementing firms represented by lower SEP royalties would only result in increased profits by the implementing firms (that is, rent shifting). Second, we would observe an improvement in static efficiency. A royalty base change would facilitate a reduction in producer surplus and increase in consumer surplus, thus lowering the deadweight loss. Third, there would be a reduction in dynamic efficiency. A royalty base change would facilitate a reduction of producer surplus to SEP holders, incentivizing new strategic actions that produce a negative impact on the timing and performance of future standards.

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[180] Richard Lloyd, *Ericsson and Nokia the Latest to Confirm That They Will Not License Under the New IEEE Patent Policy*, IAM: Blog (Apr. 10, 2015), http://www.iam-media.com/blog/Detail.aspx?g=d07d0bde-ebd6-495a-aa72-4eecb9dac67d (reporting that Ericsson, Nokia, Qualcomm, and InterDigital have refused to license under the new IEEE IPR policy); *see also* J. Gregory Sidak, *The Antitrust Division's Devaluation of Standard-Essential Patents*, 104 Geo. L.J. Online 48 (2015).

[181] This is the same logical argument made by Wi-Fi chipmakers when they claim that the 802.11 standard was defined and implemented at the semiconductor chip level, and that indemnification of royalty awards directed toward end producers would "disrupt the basic economics of the Wi-Fi industry." *See* Brief for Broadcom Corp. et al. as *Amici Curiae* Supporting Appellants at 4–5, Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201 (2013) (No. 13-1626).

The net result on economic efficiency would need to factor both the static and dynamic impacts of legal decisions that could substantially change market norms. Thus, court rulings have the impact of not only defining future market norms that can alter subsequent strategic economic behavior for better or worse, but also of retroactively imposing historical market norms on market actors. This requires that courts both apply historical market norms and consider evidence of the full range of economic consequences when interpreting legal norms in new market contexts characterized by different business models and divisions of labor in an IVC.

C. Socio-Legal Theory and the Openness of U.S. Courts to an IVC Perspective

FRAND-enabled standards have been around for a long time—roughly twenty years in the cases of Wi-Fi and cellular standards. Only recently have disputes over FRAND royalties required a final determination by courts in the United States.[182] Despite a short case-law history regarding SEPs, there is a long history of legal norms developed in practice by the market, in what could be termed *Market Law*.[183] Thus, there is a great deal of Market Law precedent for the courts to draw upon in their interpretation of legal norms defined by the state (that is, *State Law*).[184] Thus, an interesting question addressed in this article is, what happens when the precedent of Market Law intersects with the adjudication of State Law. Here we see the value in the further development of a socio-legal theory of law that combines the internal, doctrinal approach to law with the external, constructive approach that is formed in reality of the marketplace so as to support legal decisions that build a better society.[185]

The SEP court cases discussed in this article show a willingness of U.S. courts to interpret the legal norms of the state in relation to the legal norms developed by the market (that is, what this article has described primarily as market norms). Regarding the context of the royalty base, the courts have shown openness in allowing damage experts the opportunity to make their apportionment arguments on the basis of a chosen royalty base, and then, founded on the credibility of the analysis, decide whether the testimony is sufficiently reliable for admissibility under *Daubert* as well as credible enough to influence their argumentation in their final decision or instructions to the jury. Although different courts have ultimately supported FRAND royalty

[182] This can be seen as a consequence of the limitation on injunctive relief for SEP holders, as the courts (or possibly arbitration panels) are now a primary means to execute FRAND license agreements.

[183] *See* Ulf Petrusson & Mats Glavå, *Law in a Global Knowledge Economy—Following the Path of Scandinavian Sociolegal Theory*, *in* 53 Scandinavian Studies in Law 94, 119–29 (Peter Wahlgren ed., 2008) (describing a socio-legal theory for Market's Law).

[184] *Id.*

[185] *Id.* at 112–19 (defining the distinction between an internal and external approach to law).

determinations on the basis of both MVC and IVC logics, it could be argued that these decisions were based more on the quality of the testimony of damages experts than on the application of substantive legal principles such as the SSPPU and the EMVR. This would lead to the conclusion that the burden of implementing an IVC perspective in the legal norms of the state may fall primarily on the ability of legal and valuation professionals to supply the court with detailed evidence of market norms and provide prior agreements and apportionment arguments that illustrate those norms in a manner credible to the court.[186]

VII. Conclusion

We have examined the issue of apportionment through the determination of the proper royalty base in the adjudication of patent damages, or, more precisely, FRAND royalties for standard-essential patents. Through the use of an intellectual value chain framework, we have illustrated the market norms of actors in standards-enabled telecommunications markets and analyzed the alignment of those market norms with legal norms in the U.S. courts. In particular, case studies of Qualcomm and ARM exemplify different market and industry norms regarding patent licensing. The main findings suggest that rote use of rules such as the smallest saleable patent-practicing unit and the entire market value rule are not well adjusted for use in markets characterized by an intellectual value chain logic, and could lead to a reduction in dynamic efficiency in certain markets in the telecommunications industry. However, other U.S. legal norms, such as the use of the *Georgia-Pacific* factors, provide courts with the ability to effectively incorporate market norms in the determination of the SEP royalty base. Recent SEP court cases showed a mixed application of royalty bases, though the courts did demonstrate an openness to a variety of apportionment theories, basing their decisions primarily on the credibility of the testimony and market context as opposed to rote application of legal norms. This indicates that the U.S. legal system possesses the requisite normative space to effectively account for the value of SEPs applied through different market structures and competitive business models. Finally, our methodology suggests the usefulness of an epistemological approach to law that combines market norms (that is, Market Law) with doctrinal legal norms (that is, State Law), particularly in technology markets operating at the interface of law and innovation.

[186] Although the four cases studied showed signs of flexibility, there have been signals from the community of patent damages experts that legal rules of apportionment have been crowding out sound economic analysis. This issue obviously requires further research on more cases to draw conclusions.