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Patent Counting and the "Top-Down" Approach to Patent Valuations: An Economic and Public Policy Appraisal of Reasonable Royalties

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The valuation of standard-essential patent portfolios has in recent years attracted the interest of analysts, experts, and the business press. This is in large measure because of the importance of the open (standardized) technology development process that anchors innovation in mobile wireless foundational technologies.[1]

The open innovation model for fast paced innovation in mobile wireless only works if there are sufficient incentives for the developers of foundational technologies to invest in research and development (R&D) dollars to improve the underlying foundational technologies which in turn enable downstream innovation in equipment and devices. This global R&D enterprise in mobile wireless requires billions of dollars to be spent each year to maintain rapid innovation. Through their efforts, technology providers of foundational wireless inventions accumulate patent portfolios that are licensed to others in the ecosystem. These patents are usually made available to downstream implementers on a portfolio basis and may include standard-essential patents (SEPs) and non-SEPs. The business models of some key technology providers depend importantly on the timely payment of reasonable royalties on these patent portfolios to support past and ongoing R&D. Establishing reasonable royalties for non-exclusive access to SEP portfolios is thus very important.

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[1] *See also* David J. Teece, *Technological Leadership and Patent Portfolios: A Framework to Guide 5G Licensing Executives and Policy Analysts*, CAL. MGMT. REV. (forthcoming).

When litigation occurs, users of standard-essential patents (usually device makers such as mobile phones, tablets, laptops, and now automobiles) have sought methodologies to minimize royalties (and damages in the context of litigation) associated with their unlicensed use (which is usually patent infringement). This has been the genesis of the so-called "top-down" approach to determine patent portfolio valuations. The approach usually begins with some assumed total (maximum) value (tantamount to an implied regulatory ceiling) that is untethered from the total value of the relevant technology. It then apportions that total value among the owners of standard-essential patents based on numerical proportionality (that is, number of patents), sometimes weighted by patent citations and other factors which attempt to proxy for the value of the patents.

This article finds this approach inappropriate as it is untethered from the market value or use value of the technology. Nor is it a substitute for up-close patent-by-patent and claim-by-claim review of "star" or "proud" patents. Royalty offers and royalty rates that do not pass this "top-down" test are very likely to be reasonable. Comparable licenses and value-based approaches are far superior benchmarks for determining reasonable royalties. There is much at stake because the open innovation cooperation model of innovation that has powered the mobile wireless ecosystem globally could be destroyed if there is not a proper balancing of interests between technology developers and implementers of valuable intellectual property (IP).

In this article I first describe the "top-down" approach. I then give its historical lineage and explain the absence of a proper grounding in economic principles. This is especially true with respect to the idea that there is some natural maximum or ceiling that competitive markets would impose on total cumulative royalties. I also explain that there is no sound way to use proper valuation principles to apportion any maximum cumulative royalty among the various providers of technology to a (standard) development consortium. There are also important measurement issues associated with differentiating between standard-essential and non-standard-essential patents, weighting them, and estimating their value. Finally, I look at not just better but far superior ways to value patented technology—methodologies that connect the market-determined value of the technology to the user.

I. The "Top-Down" Approach

The litigation context where the "top-down" approach and some type of "numerical proportionality" has surfaced is with respect to the valuation of SEPs. The "top-down" approach as applied begins with little more than a declaration (the "maximum cumulative royalty") as to the total amount implementers should pay for use of the individual patents and portfolios of

patents implicated by a standard. A particular licensor's royalty share is then calculated as the ratio of the firm's patents to the total patents implicated in the standards. This ratio is then multiplied by the "maximum cumulative royalty" to get the royalty rate supposedly applicable to any one firm with SEPs. While there have been efforts to refine aspects of this approach, the essence of it is as described.

A number of different and mutually inconsistent approaches have been described as "top-down" approaches. They differ both with respect to (1) how the total royalty "pie" is determined and (2) how that pie is apportioned across various patent holders. Rarely is the basis for choosing a maximum cumulative royalty, the size of the overall "pie," clearly articulated. In one leading U.S. case, the court pointed to public statements that the patent holder, Ericsson, had previously made (both by itself and with others) as to a single-digit percentage-based cumulative royalty.[2] Other patent holders who have not made such statements are not in the same position.

The "top-down" approach is not a methodology that has evolved from years of licensing experience or from industry practices. Nor did it arise in the academic literature. Rather, it is a creation of various economists retained in litigation by technology implementers (putative licensees) crafting a methodology to support low royalties. The approach eschews what economists usually rely on for valuation—namely market comparables. In its place is a "head-counting" approach to patents, notwithstanding that it is well-known that patents are very heterogeneous, that the values are, in fact, highly skewed,[3] and that it is unclear whether a patent declared essential by its owner is actually essential to a technology standard. Accordingly, patent counting can be, and usually is, grossly inaccurate.

Without being explicit about it, proponents of the "top-down" approach justify using the inappropriate-on-its-face methodology because of two theories or beliefs they harbor, neither of which has evidence to support it. The first is that the methodology prevents "royalty stacking." The second is that transaction values (that is, market data) are unreliable because of the ubiquitous presence of alleged (but never proven) "holdup" market power by patent owners.

I will not address these two theories here, as they are dealt with in the literature. Suffice it to say that even if these two concerns were valid, which they are not, they do not justify adopting a methodology that is deeply flawed in other ways.

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[2] *See* TCL Commc'n Tech. Holdings, Ltd. v. Telefonaktiebolaget LM Ericsson, Nos. SACV 14-341 JVS, CV 15-2370 JVS, 2018 WL 4488286 (C.D. Cal. Sept. 14, 2018). It is an interesting legal and public policy question why (or whether) such statements should be binding on the patent holder.

[3] Mark Schankerman, *How Valuable Is Patent Protection? Estimates by Technology Field*, 29 RAND J. ECON. 77 (1998).

The "top-down" approach may carry an aura of accurate measurement. However, while it may be precise, it is not accurate. Indeed, the measure is specious. Economists from John Maynard Keynes to Alan Greenspan are reputed to have remarked that it is better to be roughly right than precisely wrong. The comparable-market-transactions approach is put forward here as being roughly right; the "top-down" approach is likely precisely wrong.

II. How Did the "Top-Down" Approach Arise?

A "top-down" approach is usually advanced in litigation by implementers who want to cap the cumulative royalty burden they will be expected to pay. Put simply, paying anything but token royalties is anathema to some new entrants, as well as to some incumbents. In theory, the "top-down" approach is not limited to SEPs or the fair, reasonable, and nondiscriminatory (FRAND) licensing terms on which SEPs are often licensed, but the issues have arisen in the FRAND context.[4]

That said, the "top-down" approach does broaden the inquiry with respect to royalties beyond a myopic focus on the particular patents in suit that can occur in patent infringement damages cases. It acknowledges the existence of other patent holders who may make claims, even though those patent holders are not parties to a current suit. However, this feature does not rescue the concept, as there are other ways of avoiding a myopic focus.

The phrase "top-down" approach has long been used in a wide variety of fields, ranging from computer programming and system analytics to ecological planning to project management and investing. But the "top-down" approach for calculating reasonable royalties for standard-essential patents did not arise from academic or policy research. Nor did it come from business practice. As noted, it is a creation of litigants—many of whom are angling for a "free ride," or at least a partial free ride.

Indeed, I was a little surprised, when first beginning my research on this topic to find *not a single article* discussing the use of a "top-down" approach in a patent damages or reasonable royalty context, especially given its linkage to frequently discussed "royalty stacking." This did not occur until *after* the first court cases using a "top-down" approach (discussed in Part VIII below) began to be cited and discussed. Further, other than articles commenting on the cases, I found only two other published articles, the earliest from

[4] *See* Peter Georg Picht, *FRAND Determination in TCL v. Ericsson and Unwired Planet v. Huawei: Same Same But Different?* (Max Planck Inst. for Innovation & Competition Research Paper No. 18-07, 2018).

2017: one by Jorge Contreras[5] and another by Contreras and Jason Bartlett[6] (neither of which cites any earlier articles directly on point).

Given the voluminous literature on royalties and patent damages, I would have thought that there would have been more in the way of an existing literature, but a search for combinations of the terms "top-down" or "top-down approach" and "patents" or "patent value" or "patent damages" found no earlier articles.[7] That absence is disturbing. As Jonathan Barnett has noted,

> well-supported economic principles hold with little qualifications that reasonably secure property rights, and the associated pricing mechanisms, are an institutional precondition for achieving efficient resource allocation, translating into increased investment and growth. Given this analytical presumption, any significant deviation from the market pricing principles in an area of commercially vital activity should rest on strongly persuasive grounds.[8]

A "top-down" approach requires being able to identify virtually all of the relevant patents across which the total royalty is to be allocated. That typically is feasible only in standards-setting contexts where the standards-development organization (SDO) has asked patent holders to identify declared-essential patents (DEPs). In non-standards contexts, no such list of potentially relevant patents is available. Even in FRAND contexts, as a general matter, no one tries to examine other (non-standards-related) patents that may be used in making products. Moreover, some patent holders do not list their SEPs, instead making a "blanket" commitment to license whatever patents they may have that turn out to be essential to practicing the standard on (unspecified) FRAND terms.

It is worth reiterating that the "top-down" approach with its ceiling on and the idea of a "maximum aggregate royalty" burden purportedly was designed to address a problem—royalty stacking—that is largely a myth when applied to mobile SEP licensing.[9] First, the idea that Antoine Cournot's insight about multiple mark-ups applies in this context rests on the flawed assumption that every patent conveys a certain right to an injunction—that is, that the patent owner can automatically enforce its patents in quite the same way as

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[5] Jorge L. Contreras, *Aggregated Royalties for Top-Down FRAND Determinations: Revisiting "Joint Negotiation,"* 62 Antitrust Bull. 690 (2017).

[6] Jason R. Bartlett & Jorge L. Contreras, *Rationalizing FRAND Royalties: Can Interpleader Save the Internet of Things?*, 36 Rev. Litig. 285 (2017).

[7] J. Gregory Sidak, *The Meaning of FRAND, Part I: Royalties*, 9 J. Competition L. & Econ. 931 (2013), discussed the issues of "patent counting" and "aggregate royalty burden" but did not in any way sanctify a "top-down" approach in the way some consulting economists have applied it in patent litigation.

[8] Jonathan Barnett, *Has the Academy Led Patent Law Astray?*, 32 Berkeley Tech. L.J. 1313, 1317–18 (2017).

[9] See David J. Teece, *The "Tragedy of the Anticommons" Fallacy: A Law and Economics Analysis of Patent Thickets and FRAND Licensing*, 32 Berkeley Tech. L.J. 1489 (2018).

Cournot's separate monopoly producers of, say, copper and zinc can exclude buyers who are not prepared to pay the monopoly price. Second, even setting aside that basic point, the theory used to justify concerns of royalty stacking rests on the idea that multiple providers of "complements" (for example, zinc and copper) set fixed, per-unit prices, and do so simultaneously. Recent literature introduces reasonable and realistic modifications to this model, such as allowing for negotiated royalties—that is, bargaining over royalty rates (or payments) to happen sequentially rather than simultaneously (frequently the case in the real world), and the possibility of recourse to litigation—and finds that the theory of stacking is not robust to reasonable modifications to the standard assumptions.[10] Third, and even more importantly, there is simply no empirical evidence that royalty stacking is a significant concern in today's mobile industry.[11] This is not surprising given that SEP holders, engaging in one-on-one negotiations in the real world, are constrained by factors ranging from cross-licensing, the existence of the FRAND commitment, and the much more circumscribed path to obtaining injunctive relief for SEPs relative to non-SEPs. The thriving and successful mobile phone ecosystem of

[10] Damien Geradin, Anne Layne-Farrar, and Jorge Padilla showed that the simplest theoretical models predicting a royalty stacking problem are not robust to a relaxation of their underlying assumptions that (1) all IP owners are symmetric—that is, they charge the same royalty rates, and (2) in effect, royalty rates are set in a single swoop, instead of being set through the process of multiple, staggered negotiations occurring over a period of time. Damien Geradin, Anne Layne-Farrar & A. Jorge Padilla, *Royalty Stacking in High Tech Industries: Separating Myth from Reality* (CEMFI Working Paper No. 0701, 2007). Gerard Llobet and Padilla introduced the threat of litigation and showed that this threat leads owners to moderate royalty rates when firms vary in the quality of their patent portfolios. Gerard Llobet & Jorge Padilla, The Inverse Cournot Effect in Royalty Negotiations with Complementary Patents (Feb. 28, 2017) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2866389. In the conventional Cournot model, although all sellers of complementary patents would benefit from a reduction in the total royalty burden, individual firms acting in their individual self-interests will not have incentives to cut their own royalties. By contrast, in Llobet's and Padilla's model, the possibility of litigation provides incentives for licensors with strong portfolios (that is, patents more likely to be validated in the litigation process) to cut royalties and, by doing so, induce licensors with weaker portfolios to also cut royalties. If the strong licensors reduce their royalty demands, that increases the benefits to licensees from pursuing the weaker licensors via the litigation process, which in turn induces the weaker licensors to also reduce their royalty rates. By this mechanism, the total royalty burden falls. Daniel Spulber showed that when royalties are set through individual bilateral negotiations between individual inventors and individual implementers (as happens in the real world), rather than posted per-unit prices announced by the patent owners, total royalties are no higher than they would be if intellectual property rights were sold as a bundle by a monopolist. Daniel F. Spulber, *Patent Licensing and Bargaining with Innovative Complements and Substitutes*, 70 Res. Econ. 693 (2016). In bargaining situations between an individual licensor and licensee, the licensor and licensee will act to maximize the total surplus (that is, pool of profits) to divide between them, taking into account that the surplus available will depend also on the royalties that are paid to all other licensors. Thus, negotiations between individual licensors and licensees will now take total "stacked" royalties into account, unlike in the conventional stacking model where the problem identified by Cournot arises because individual firms do not take the price of the "stack" into account when setting their own prices.

[11] Three articles show that the aggregate royalty stack is, in practice, modest. Keith Mallinson, *Cumulative Mobile SEP Royalty Payments No More Than Around 5% of Mobile Handset Revenues*, IP Fin., Aug. 19, 2015; J. Gregory Sidak, *What Aggregate Royalty Do Manufacturers of Mobile Phones Pay to License Standard-Essential Patents?*, 1 Criterion J. on Innovation 701 (2016); Alexander Galetovic, Stephen Haber & Lew Zaretzki, *An Estimate of the Average Cumulative Royalty Yield in the World Mobile Phone Industry: Theory, Measurement and Results*, 42 Telecomms. Pol'y 263 (2018).

the present day is inconsistent with the existence of any significant stacking problem.

III. Upper Bounds on the Maximum Cumulative Royalty?

Deriving a defensible value for the maximum cumulative royalty associated with all of the patented technology incorporated into a product is a challenge inherent in the "top-down" approach. There are numerous, and perhaps insurmountable, problems with industry participants setting any particular maximum cumulative royalty. The maximum cumulative royalties historically chosen or proposed when implementing a "top-down" approach seem to have been selected largely out of thin air, with little or no economic justification.[12]

There is a sense, seemingly trivial, in which one might argue that the maximum cumulative royalty must be *less than 100 percent* of the wholesale *selling price* of the end-user product, as otherwise there would be nothing left over out of which to pay for the raw materials, labor, capital equipment, entrepreneurial activity, unpatented technology, and the design, manufacturing, marketing, and distribution effort associated with bringing the product to market.[13] Basically, firms need to expect to be able to earn a profit in order to be willing to supply goods. If they *anticipate* that all of their revenues will be taken up by having to pay for the tangible and intangible inputs into production, they will have no incentive to produce the goods in the first place.

This should not be interpreted as suggesting that, *ex post*, firms need to earn positive profits. Firms can and do underestimate costs or overestimate revenues, so that, *ex post*, they end up losing money.

It might be conjectured that the maximum cumulative royalty should be less than the implementers' *historic profit margin*. Yet, such an approach turns unpaid patent holders effectively and unjustifiably into what might be termed "residual claimants," rather than suppliers of a key, often primary, input. They get paid only from the residual left over after the claims of other input suppliers have been paid. This tenuousness of a patent holder's claim is due to the intangible and otherwise non-excludable nature of intellectual property.

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[12] As discussed below in Part IX, value-based approaches such as BLP (named after Steven Berry, James Levinsohn, and Ariel Pakes), properly implemented, could produce good estimates for a value of the technology in a standard. However, even if the total value is estimated satisfactorily, apportionment challenges still remain.

[13] However, as discussed below, infringers might choose to price their product "as if" the technology were free. If so, and it turns out that a licensing fee is due, the owner of the patent should not be disadvantaged on account of that omission. However, should infringers "price in" a royalty even if they are not paying it, prices in the marketplace should reflect all input costs, including technology royalties.

But such conjectures are not valid. Plenty of patent-infringement cases hold that reasonable royalty damages are *not* capped by the seller's existing profit margins on an infringing product, because the unlicensed seller (infringer) did not pay royalties and likely set its price without factoring in the need to pay royalties, suggesting that the infringer could have increased its price above what it charged historically if it had paid for the patented technology it used (especially if its rivals were licensed and paying royalties).[14] Another concern with the "top-down" approach is that not all patent holders are likely to *collect* the royalties that the "top-down" approach allocates to them. Unlike suppliers of tangible inputs, patent holders cannot physically withhold their patented technology from those who do not pay. Instead, patent holders have to resort to the legal system to enforce their rights. Many firms that believe they have valid patents elect not to sue nonpaying infringers because patent litigation is costly, time consuming, and risky. Similarly, implementers often elect not to pay anything unless and until faced with a credible threat to litigate. As a result, a significant fraction of any "maximum cumulative royalty" is likely to end up not being actually paid. Implementers will simply pocket the unpaid royalties.

This scenario in turn affects the plausibility of the arguments for any particular maximum cumulative royalty, and the plausibility of allegations of "royalty stacking" as a practical (as contrasted with purely theoretical) matter.[15] Before condemning a particular proposed maximum cumulative royalty as excessive, it is worth considering what fraction of that maximum cumulative royalty will actually end up being *collected* from implementers. Though data are difficult to come by, patent enforcement costs are such that it is extremely unlikely that that fraction is anywhere near 100 percent. Analyses of a "top-down" approach that omit this point are likely to be (seriously) misleading.

It is also important to recognize that the intellectual property (whether patents, copyright, trademarks, or trade secrets) associated with a product may account for 80 to 90 percent of the selling price of the product. One well-known example involves patented (brand name) pharmaceuticals. During the life of the patent, the patent holder is likely the single provider of the patented drug. Once a drug goes off patent, and generic versions of the drug enter the market, prices often fall on the order of 80 to 90 percent, implying that only 10 to 20 percent of the selling price of the patented drug is due to manufacturing, marketing, and distribution costs, with the other 80 to 90 percent reflecting a return to investment in R&D. Other examples

[14] *See, e.g.*, Aqua Shield v. Inter Pool Cover Team, 774 F.3d 766, 771–72 (Fed. Cir. 2014) (Taranto, J.).

[15] *See* Michael P. Akemann, John A. Blair & David J. Teece, *Patent Enforcement in an Uncertain World: Widespread Infringement and the Paradox of Value for Patented Technologies*, 1 Criterion J. on Innovation 861 (2016).

include brand-name cosmetics (where the intellectual property being used is not patented technology, but rather brand names and trademarks) and software and movies (where the intellectual property is the copyrighted content). Some software of course also involves patented features, not just copyrighted code. The physical cost of making and marketing a copyrighted movie on DVD or distributing copyrighted software on a CD is small compared with the selling price, which instead is almost entirely due to the copyrighted content. Digital downloads are an even starker example: the marginal cost of physical reproduction/distribution is effectively zero. (Although there can be significant fixed costs associated with running the distribution system, those costs generally do not vary significantly with volume, so the marginal cost of distribution is *de minimis*.)

All of the court cases with which I am familiar that have applied a "top-down" approach have involved communications products. Given the massive improvement in performance of cellular telephony over the last several decades, virtually all of which is due to newly developed patented and copyrighted technology, it would not be unreasonable to infer that as much as 70 to 80 percent of the value of a smartphone is attributable to the totality of the patented technology and copyrighted content incorporated in the products, especially since the selling price of the cellphone is only a small fraction of the *total cost of ownership* (which includes the price paid for cellular service).

By way of illustration, consider a cellphone that sells for (say) $400. To be useful, cellphones have to be used in conjunction with cellular service. Cellular service costs a significant multiple of the selling price of the cellphone. For example, a colleague of mine pays $110 per month for cellular service with Verizon. Over the two-year economic life of a cellphone, the cellular service costs $2,640,[16] making the total cost of ownership $3,040.[17] (To simplify, I ignore discounting.) The cellphone accounts for only a small fraction (13.15 percent[18]) of the total cost of ownership. (If the economic life of a cellphone is longer, the price of the cellphone as a fraction of total cost of ownership is lower.) Even a 30-percent royalty applied to the cellphone ($120[19]) amounts to only a tiny fraction of the total cost of ownership (3.95 percent[20]).

In my view, this kind of total-cost-of-ownership consideration should be at least considered when determining a maximum cumulative royalty or applying a "top-down" approach. Obviously, the prices of cellphones and cellular service depend on the degree of competitiveness in the cellphone

16 That is, $110 per month × 24 months = $2,460.
17 That is, $400 + $2,640 = $3,040.
18 That is, $400 ÷ $3,040 = 0.1315.
19 That is, $400 × 0.3 = $120.
20 That is, $120 ÷ $3,040 = 0.0395.

and cellular service markets. Many "top-down" approach advocates have latched onto historically distant public statements about a maximum cumulative royalty, such as those made by the proponents of the so-called "minimum change optimum impact" (MCOI) proposal made to the European Telecommunications Standards Institute (ETSI) in the early 2000s by three major cellular handset makers (Ericsson, Nokia, and Motorola) that also held significant cellular patent portfolios. The MCOI proposal spoke of "aggregate reasonable terms" and statements by the MCOI proponents advocated a single-digit percentage royalty on the wholesale selling price of cellular handsets.[21] No principles or methodology were ever advanced to support this proposal.

ETSI rejected the MCOI proposal, in part because several major firms opposed it. It never achieved the kind of consensus needed for approval of ETSI policies.[22] Moreover, competition policy concerns were raised by the Directorate General for Competition of the European Commission (DG Comp), the European competition authority. As one author put it in 2008 pertaining to prospective adoption of the LTE technology standard:

> [A]n earlier proposal—called Minimum Change Optimum Impact (MCOI), submitted to ETSI by Ericsson, Motorola, and Nokia some years ago—also asked for aggregated reasonable rates and proportionality but fell afoul of the European Commission on competition grounds. The Commission's antitrust directorate sent a letter to ETSI in 2006 saying that proposals being discussed internally might end up contravening European Competition Law. The Commission stated: "A collective ex-ante royalty cap regime in combination with the royalty allocation mechanism does not appear to allow for price competition, since the price of each essential patent is fixed in advance." ETSI later threw out the proposals[.][23]

[21] Tim Frain, Paper Presented at the World Intellectual Property Organization (WIPO) Colloquium on Standards and Patents: Patents in Standards & Interoperability 8 (Nov. 29, 2006), https://www.wipo.int/export/sites/www/meetings/en/2006/patent_colloquia/11/pdf/frain_paper.pdf. Frain was, and is as of October 2020, the Director of IPR, Regulatory Affairs for Nokia.

[22] "Consensus" is deemed by ETSI to have the International Organization for Standardization meaning "general agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. NOTE Consensus need not imply unanimity." ISO/IEC Guide 2:2004: Standardization and Related Activities—General Vocabulary 8 (2004), https://www.iso.org/standard/39976.html; *see also* Dirk Weiler, Chairman, ETSI Board, Presentation to LES FRAND Licensing Standard Committee: ETSI Standardization—Consensus and Cooperation 18 (Oct. 29, 2018), https://docbox.etsi.org/ETSI_presentations/ETSI_presentations/2018/181029-LES-FRAND-ETSI-presentation.pdf.

[23] Tatum Anderson, *Mobile Phone Manufacturers Seek to Control Rising IP Costs*, Intell. Prop. Watch, Apr. 21, 2008; *see also* Letter from Angel Tradacete Cocera, Director, DG Comp, to Karl Heinz Rosenbrock, Director General, ETSI (June 21, 2006).

In other words, DG Comp's criticism was that the MCOI proposal might amount to oligopsonistic (demand-side) price fixing in technology markets for standards-essential technology.

The MCOI proponents were advocating a maximum cumulative royalty in the single-digit range. In addition to the fact that no economic principles were advanced to support the proposal, the MCOI proponents all "wore multiple hats." They all owned significant patented IP related to cellular technology. This was clearly true for Ericsson and Nokia. Google paid $12.5 billion for Motorola Mobility (including its patent portfolio) in 2011.[24] Exactly how much of this purchase price was allocated to Motorola's patents is not entirely clear; but (at the time of the MCOI proposal, at least) Motorola was primarily a handset manufacturer. (Subsequently, all three firms lost significant market share in the cellphone market.) From the fact that these firms proposed the MCOI, one can *infer*, perhaps, that they believed that they stood to gain more from *limiting* the cumulative royalties they would have to *pay* for *their* use of *others'* IP than they would lose from limiting the royalties *they* could *charge* for others' use of their *own* IP.

It is worth noting that the MCOI proponents did not include any firms that were primarily out-licensors of their own patented technology. Qualcomm, a major holder of SEPs relating to cellular communications, opposed the MCOI proposal, which was ultimately rejected by ETSI.[25] Put differently, they had a business model that had multiple revenue streams in addition to technology licensing.

IV. Apportionment in General

Besides the total size of the pie, any principled maximum-cumulative-royalty approach must offer a defensible apportionment methodology. First, I provide some history with respect to apportionment.

It is widely acknowledged that patents have *widely dispersed* values: some are a major improvement over the next-best noninfringing alternatives, and others provide only *minor* or *trivial* improvements.[26] The distribution of patent values is highly *skewed*, with most of the value resting in a relatively small fraction of the total number of patents, and many, if not most of the patents, having little or no value.[27] Using any kind of "numerical-proportionality" approach, whether weighted by citations or otherwise, to apportion total

[24] Amir Efrati & Spencer E. Ante, *Google's $12.5 Billion Gamble*, Wall St. J., Aug. 16, 2011; Press Release, Google Inc., Google Acquires Motorola Mobility (May 22, 2012).

[25] Damien Geradin & Miguel Rato, *FRAND Commitments and EC Competition Law: A Reply to Philippe Chappatte*, 6 Eur. Competition J. 129 (2010).

[26] Bronwyn H. Hall, Adam Jaffe & Manuel Trajtenberg, *Market Value and Patent Citations*, 36 RAND J. Econ. 16 (2005).

[27] *See* Alfonso Gambardella, Dietmar Harhoff & Bart Verspagen, *The Value of European Patents*, 5 Eur. Mgmt. Rev. 69 (2008).

value to particular groups of patents ignores this reality by imposing a nonexistent equality or near equality among patents.

As already noted, apportionment typically involves calculating a "value share" for the technology at issue as a fraction of the total "value" of the relevant patented technology. Some have advocated one form or another of what is commonly termed "numeric proportionality."[28] This is the idea that the value of a group of patents is proportional to the number of patents (and/or patent families) included in that group, relative to the total number of applicable patents/families.

Some have advocated weighting each patent by either (1) its number of claims or (2) its number of forward patent citations (citations in later patents that refer to the patent in question), often time-weighted to acknowledge that older patents have had a longer period of time in which to accumulate citations. Some have proposed disregarding "self-citations" (citations to older patents held by the same patent holder).[29] The (claimed) justification for citation-weighting patents is that key patents might likely be more heavily cited than less important patents. I acknowledge that citation counts have been used in the academic literature as one potential metric for patent value, though their significance and predictive/explanatory power is disputed. In my opinion, they are not a good proxy for commercial value.

One reason patent citations are used is data availability: the *fact* of citation is easily identified and collected at relatively low cost (and in an objective fashion) from public sources, and their use does not rely on technological knowledge or subjective assessments. By contrast, determining the incremental *value* of being able to use some patented technology relative to the next-best noninfringing alternative technology is a complex (and likely controversial) task beyond the expertise of many scholars, especially those without detailed technological and commercial familiarity with the patented technology and its alternatives.

The "top-down" approach supposedly avoids the inconsistencies inherent to a fragmented, piecemeal, patent-by-patent (or patent-portfolio-by-patent-portfolio) approach to portfolio valuation.[30] For example, the median patent is by definition a patent for which half of patents are above the median and half are below the median, by whatever criteria have been used to rank the patents and identify the median. But separate

[28] *See, e.g.*, Damien Geradin & Anne Layne-Farrar, *Patent Value Apportionment Rules for Complex, Multi-Patent Products*, 27 Santa Clara High Tech. L.J. 763 (2012).

[29] Hall, Jaffe, and Trajtenberg have demonstrated that (controlling for other factors) self-citations are positively correlated with the value of the company. Hall, Jaffe & Trajtenberg, *Market Value and Patent Citations*, *supra* note 26.

[30] Bartlett and Contreras urge the increased use of interpleader as a procedural mechanism for consolidating what would otherwise be separate patent suits into a single proceeding in a single forum. In my experience, their proposal has not been taken up in practice. Bartlett & Contreras, *Rationalizing FRAND Royalties: Can Interpleader Save the Internet of Things?*, *supra* note 6.

patent-by-patent evaluations may falsely conclude that more (or less) than half of the patents considered are above the median. This is especially likely because the scope of any given patent litigation is limited to the relatively small number of patents in suit, and the other relevant patents are generally not considered or evaluated, other than possibly at the most cursory level.

For concreteness, I will focus on cellular communications and the 2G, 3G, and 4G cellular standards. Some firms develop technology and license their technology to others for use in making cellular products. With cellular communication, the cellular chipset is sometimes carelessly represented to be the "smallest saleable patent-practicing unit" (SSPPU),[31] though a standalone chipset frequently fails to satisfy all of the elements of the claims of some cellular communications patents. For example, in *Innovatio* the patent licensor (patentee), Innovatio, argued that the chipset did not satisfy the "patent-practicing" part of the SSPPU test for some of the asserted patents; for example, claim 1 of Innovatio's '771 patent reads (in relevant part):

> A radio frequency data communication system that supports data collection within a premises, the radio frequency data communication system comprising: a plurality of roaming terminals operational within the premises; one or more base stations, each having a radio frequency transceiver, located within the premises; each of the one or more base stations transmitting a pending message list at each of selected time intervals[.][32]

A standalone chipset is not a "system" and does not involve either "a plurality of roaming terminals" or "one or more base stations." Consequently, it would appear undisputed that a chipset does not satisfy all of the elements of this claim of the '771 patent, and thus would not satisfy the "patent-practicing" prong of the SSPPU test if that prong were interpreted literally. Nonetheless, Judge James Holderman examined the profit margins on chipsets as the basis for his damages calculations, in part because he concluded that "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."[33]

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[31] The SSPPU doctrine is a court-made doctrine. Only after being used in a number of early court cases has it been discussed in the economics literature. For a discussion of the SSPPU, see Jonathan D. Putnam & Tim Williams, The Smallest Salable Patent-Practicing Unit (SSPPU): Theory and Evidence (Sept. 6, 2016), https://ssrn.com/abstract=2835617; David Kappos & Paul R. Michel, *The Smallest Salable Patent-Practicing Unit: Observations on Its Origins, Development, and Future*, 32 Berkeley Tech. L.J. 1433 (2017); J. Gregory Sidak, *The Proper Royalty Base for Patent Damages*, 10 J. Competition L. & Econ. 989 (2014).

[32] *In re* Innovatio IP Ventures, LLC Patent Litig., No. 11-cv-09308, 2013 WL 5593609, at *13 (N.D. Ill. Oct. 3, 2013) (Holderman, J.) (quoting U.S. Patent No. 5,940,771, at [57] (filed Oct. 19, 1995)).

[33] *Id.* at *14 (emphasis added).

Put another way, Judge Holderman's analysis was based on what he determined was Innovatio's *failure of proof* on an important topic (apportionment) on which it bore the burden of proof, rather than on an *affirmative* conclusion that the approach he adopted was correct or legally mandated. In my view, his opinion should be read in that light. Using the chip price as the royalty base was an improvisation, not a solidly constructed position that focuses on the criticality of SEP technology to the system.[34]

V. Essentiality Issues

As noted above, one key issue in the context of the "top-down" approach for SEPs is that many DEPs are not actually essential. Estimates of the degree of such "overdeclaration" differ, but there are estimates that perhaps 80 percent of DEPs are not SEPs.[35]

In assessing proportionality, how does one deal with the likelihood of overdeclaration? Moreover, depending on how "essential" is defined, there is a possibility that patents are "essential" but not infringed because they are not used (for example, the patent covers an optional feature of a standard). The answer depends on the definition of "essentiality." Different SDOs define "essentiality" differently. For example, the ETSI IPR (intellectual property rights) policy defines "essential" as follows:

> "ESSENTIAL" as applied to IPR means that it is not possible on technical (*but not commercial*) grounds, taking into account normal technical practice and the state of the art generally available at the time of standardization, to make, sell, lease, otherwise dispose of, repair, use or operate EQUIPMENT or METHODS which comply with a STANDARD without infringing that IPR.[36]

By contrast, the IEEE IPR Policy defines "essential patent claim" as follows:

> "Essential Patent Claim" shall mean any Patent Claim the practice of which was necessary to implement either a mandatory or *optional* portion of a normative clause of the IEEE Standard when, at the time of the IEEE Standard's approval, there was no *commercially* and technically *feasible*

[34] Further discussion of how the "top-down" approach has been handled in the courts can be found in Part VIII.

[35] Robin Stitzing, Pekka Sääskilahti, Jimmy Royer & Marc Van Audenrode, Over-Declaration of Standard Essential Patents and the Determinants of Essentiality (Sept. 4, 2018), https://ssrn.com/abstract=2951617.

[36] European Telecommunications Standards Institute (ETSI), ETSI Intellectual Property Rights Policy, Annex 6, cl. 15.6 (Dec. 4, 2019) [hereinafter ETSI IPR Policy], https://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf (emphasis added).

> non-infringing alternative implementation method for such mandatory or optional portion of the normative clause.[37]

Note two fundamental differences between the ETSI definition of "essential" and the IEEE definition of "essential patent claim," shown by the emphasis in the language quoted from the ETSI and IEEE IPR policies. The IEEE, but not ETSI, looks at what is "commercially feasible." (ETSI explicitly *rejects* looking at "commercial grounds.") The IEEE definition, but not the ETSI definition, includes technology relating to "optional" features of the standard.

Determining whether or not a patent is "essential" to some standard can be difficult. Determining whether a DEP is an SEP involves comparing the claims of the patent with the features of the standard, which may require claim construction and a combination of legal and technical expertise. Different analysts can and do disagree about which patents are essential.

As noted above, it seems that there is a significant degree of "overdeclaration." Some of this may be due to the fact that standards change over time, so that a patent may have been declared essential to an early version of a standard, only to have the standard change so that it is no longer essential. Patent holders are asked to declare patents that they believe "might be essential" to practice the standard. Or new technology may have been developed since the standard was originally adopted, making it possible to comply with the standard without using the formerly essential technology. Patent applications may have been declared as potentially essential, only to have the claims of the application modified during the patent prosecution process so that the patent as ultimately issued is not essential. Or firms may simply be pursuing a "better safe than sorry" policy of overdeclaration, for fear that they will be accused of misleading the SDO or implementers if they fail to disclose a patent that later turns out to be essential (especially if they subsequently wish to assert the patent against infringers).

This last is especially likely because there are virtually no costs of, nor penalties for, overdeclaration. At present, the only cost of declaring a patent is the (trivial) cost of sending a notice to the SDO. By contrast, imagine what would happen if some SDO were to adopt a rule charging a fee of $10,000 per patent for each patent declared as potentially essential to some standard, or if an SDO were to impose a fine of $30,000 if a declared patent was subsequently found not to be essential to a standard. One would expect to see a significant reduction in the number of DEPs and a significant reduction in the "overdeclaration" rate. But no SDO has adopted either policy. To my knowledge, no SDO has even contemplated adopting such policies.

[37] *Id.* Annex 6, cl. 6.1 (emphasis added).

In a 2011 article, telecommunications industry analyst Keith Mallinson compared the results of a number of different studies by technical industry analysts that attempted to determine which DEPs are essential to the LTE cellular standard.[38] The results of his analysis show that the proponents of the studies disagree significantly on which patents they believe are essential. Mallinson found an *extremely* weak correlation coefficient (a commonly used statistical measure of the linear relationship between data sets) *of 0.0008* between the results of two such studies, by Jeffries & Co. and Fairfield Resources International.[39] To put this into context, a correlation coefficient of zero implies that there is *no* (linear) relationship between the two sets of data, while a correlation coefficient of one indicates that the data are perfectly linearly correlated.

Mallinson has since compared the results of a larger number of eight other such studies conducted by six different firms (three by Cyber Creative; one each by Article One, Jeffries, iRunway, Fairfield, and ABI Research), which reinforce his conclusion that there is very little consensus on which patents are essential.[40] Excluding the correlation coefficients between the three Cyber Creative studies, which he says "are evidently substantially the same study," his average correlation coefficient across the results of the different studies is 0.285.[41] He found a correlation of only 0.0774 between the Cyber Creative and Fairfield studies.[42] He observed:

> Expanding my analysis to include many more publicly available studies since then [his 2011 study] also reveals *very wide disparities*. For instance, LG's share of LTE patents judged essential by various assessors range from 2.9 percent to 23 percent—a factor of *eight*. Huawei's share of judged-essential LTE patents range from 0.6 percent to 10 percent—a factor of *seventeen*. Nokia's share of judged-essential LTE patents range from 2.3 percent to 54 percent—a factor of *23*.[43]

Mallinson correctly noted "that these wide ranges are not exceptions. To the contrary, they are typical and reveal major shortcomings in patent counting. They cast doubt on the accuracy and reliability of patent counting and any implied measurements of relative patent strength among different SEP holders."[44] He went on to note that "the widely different results . . .

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[38] *See* Keith Mallinson, *Analyst Angle: No Consensus on Which Patents Are Essential to LTE*, RCR Wireless News, Nov. 16, 2011.

[39] *Id.*

[40] Keith Mallinson, *Do Not Count on Accuracy in Third-Party Patent-Essentiality Determinations*, IP Fin., May 12, 2017, https://www.wiseharbor.com/wp-content/uploads/2017/05/Patent-Counting-article-for-IPFinance-12-May-2017.pdf.

[41] *Id.* at 16.

[42] *Id.* at 14.

[43] *Id.* at 2 (emphasis added).

[44] *Id.* at 11.

are the result of differences in how the studies have been conducted, as well as the significant variations in specific assessments of the companies being studied."[45]

The implications of wide disagreements as to what patents are SEPs indicates a complete lack of robustness to any "top-down" approach and associated apportionment. Though lip service has been paid to the "overdeclaration" issue, I am not aware of any proponent of a "top-down" approach who has acknowledged these criticisms or assessed their significance.

Given the difficulty of reaching agreement on the yes/no question about whether particular patents are or are not essential, finding agreement on the more complicated issue of patent value/strength (and, in particular, of the relative values/strengths of different patent portfolios owned by different entities) is even harder.

Obviously, one does not want to treat "truly essential" patents as equivalent in value to similar patents that, though declared essential, are not in fact essential. Put another way, true SEPs are more valuable, *ceteris paribus*, than nonessential DEPs.

In my view, the combination of these two factors—a substantial proportion of "overdeclaration," coupled with the inability of analysts to reach agreement as to which patents are in fact "essential"—is a strong reason to be extremely skeptical of attempts to use a top-down approach to setting royalties or assessing damages. Simply put, the second "apportionment" prong of a "top-down" approach is full of potential pitfalls that are not properly recognized by the advocates of a "top-down" approach.

I acknowledge that a court faced with the task of reconciling the opinions of different experts about the essentiality issue will hear and review their testimony, will benefit from cross examination of their positions, will be in a position to compare and contrast what they did and try to understand the sources of their disagreements, and ultimately will have to come to its own conclusions about the "overdeclaration" issue and about relative patent strengths. But the fact that different analysts reach significantly different conclusions does not leave one sanguine about a court's ability to reconcile their differences in an accurate manner.

VI. Weighting of Essential Patents

Not all patents are equally valuable, and not all patents are equally likely to withstand court challenges on validity or infringement grounds. This holds even within both DEPs and SEPs. Does one use a "strict-numerical-proportionality" approach counting the number of *patents* and/or patent *families* and/or patent

[45] *Id.* at 16.

claims, and dividing the number of patents/families/claims held by the plaintiff in a particular case by the total number of patents/families/claims held by all relevant patent holders combined to determine the plaintiff's "share"? The three counts (patents, patent families, and patent claims) are likely to lead to different conclusions, and I am not aware of any persuasive argument or evidence that one unit of analysis is systematically better at assessing importance or value than the other two approaches.

One can consider weighing the different patents/families/claims differently in some fashion, and apportion the total pie according to the weights given to various patents/portfolios. Possible weighting approaches include backward patent citation count (whether including "self-citations" (citations to earlier patents held by the same patent holder) or not), and forward citation count (either time weighted (acknowledging that older patents have had a longer time period in which to accumulate citations than newer patents have had) or not). Another weighting approach involves trying to assess the relative strengths of various patents individually, assessing factors such as the likelihood that the patent (if challenged in court) would be found invalid, not infringed, not essential, or some combination thereof. That is likely to entail a contested effort at claim construction and technical evaluation of the patented technology in light of the prior art. In order to calculate a "share" using such an approach, it is likely to be necessary to perform virtually the same "relative strength" assessment for all relevant patents, not just the patent(s) in suit.

Still another weighting approach, and one which is *conceptually* very important, looks at the *incremental value* to the implementer of being able to use the patented technology *relative to* the value to the implementer of using the next-best noninfringing alternative, which requires an assessment of what the various noninfringing alternatives are and the respective merits (on a cost-*versus*-performance basis) of the patented and alternative technologies.

It also must be acknowledged that different implementers (especially at different levels in the value chain) receive different value (and thus different incremental value) from being able to use patented technology relative to the next-best noninfringing alternative.

A. Estimating Incremental Value in Theory and in Practice

Endeavoring to estimate incremental value is a far cry from actually succeeding at doing it. Given that (1) the performance of various alternatives is often measured along a number of dimensions, some of which may be subjective and/or difficult to measure; (2) combining multidimensional assessments into a single one-dimensional assessment is difficult and controversial; and (3) different analysts can have different assessments of both (i) the costs

and benefits of the various alternatives and (ii) the *tradeoffs* between various costs and benefits that need to be considered before reaching an overall assessment, different analysts may well (and often do) disagree. Analysts are likely to disagree as to (1) which non-patented alternative they think is the "best" noninfringing alternative, and (2) what the incremental value of being able to use the patented technology relative to the next-best noninfringing alternative is. Even addressing these sorts of disagreements is a complex and controversial task; reconciling or resolving the disagreements is even more complex and controversial.

1. *Unpatented and Patented Alternative Technologies for Purposes of Estimating Incremental Value*

Many economists, analysts, and courts have advocated the use of such an incremental value approach in assessing reasonable royalties for the use of patented technology. As the Federal Circuit has explained, "[t]he 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."[46]

In implementing this approach, does one consider the incremental value relative only to other *un*patented (public domain) alternative technologies or to other *patented* technologies as well? How should one address the prospect that the other patented alternatives may themselves be royalty-bearing, especially when the royalties charged for the various alternatives are not set in stone but are likely to be endogenously determined (so that the royalty rate that each patent holder can charge depends on the royalty rates that others charge, and vice versa)?

The one judge that (to my knowledge) has addressed the issue, Judge Holderman, in *Innovatio* noted:

> [E]ven assuming that patent holders agreed to essentially give away their technology so that it will be adopted into the standard, such a low return for the patent holders would discourage future innovators from investing in new technology and from contributing their technology to future standards.[47]

He concluded that a patented alternative "will not drive down the royalty in the hypothetical negotiation by as much as technology in the public domain. In other words, the existence of patented alternatives does not provide as much reason to discount the value of Innovatio's patents as does the existence of alternatives in the public domain."[48]

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[46] Ericsson, Inc. v. D-Link Sys., Inc., 773 F.3d 1201, 1226 (Fed. Cir. 2014).

[47] *In re* Innovatio IP Ventures, LLC Patent Litig., No. 11-cv-09308, 2013 WL 5593609, at *20 (N.D. Ill. Oct. 3, 2013) (Holderman, J.).

[48] *Id.*

There are problems with an incremental value approach that advocates sometimes overlook. To see this, suppose that there is a freely available public domain technology (call it *PD*) that enables firms to make some good at a cost of $100 per unit. Suppose that there is a patented alternative technology (call it *P*) that enables firms to make the same good at a cost of $80 per unit. Then the incremental value of the patented technology relative to the public domain technology is $20 per unit.

Now suppose that there is a second patented alternative technology (call it *Q*) that enables firms to make the same good at a cost of $78 per unit. In this example, the incremental value of *Q* relative to the public domain technology *PD* is $22 per unit. But the incremental value of *Q* relative to *P* is only $2 per unit. Unless one believes that the royalty for *P* will be $0, there is no reason to believe that the royalty for *Q* will be driven down to $2 per unit. I acknowledge that there are models of licensing negotiations (involving Bertrand competition) that predict such an outcome, but their applicability is questionable, as they rely on fairly strong assumptions.

Now consider a different example in which both *P* and *Q* lower the cost of making the given good to $78 per unit. Now the incremental value of each relative to the public domain technology is $22 per unit, but the incremental value of each patented technology relative to the other patented technology is $0. Suggesting that the royalty rates for both *P* and *Q* "should" be $0 because the incremental value of each patented technology relative to the other is $0 allows no return to the innovation, despite the fact that both innovations yield considerable value (of $22 per unit) relative to the public domain technology.

Such an outcome is seriously problematic from a public policy perspective. It effectively treats the inventors of *P* and *Q* as though they had made no advance over the public domain technology *PD*, which is clearly not true.

Society is better off (to the tune of $22 per unit) with *P* and *Q* relative to the situation in which *P* and *Q* had not been invented.

2. Compensating Successful Innovators

Though a strong argument can be made that the royalty rate for any patented technology should be no more than its incremental value relative to the freely available public domain alternative, I believe that the argument that the royalty rate for a patented technology "should" be no more than its incremental value relative to another patented technology, potentially includible in a standard, is much weaker and much more controversial from a public policy perspective. In particular, as my second ($78/$22) example indicates, such a rule will seriously undercompensate successful innovators. Similarly, if innovators think such a rule will be applied, such a rule will significantly

reduce innovators' willingness to invest in R&D, and/or to participate in the standardization process, and/or to make FRAND licensing commitments. Given the widespread acknowledgement that the social returns from innovation exceed the private returns, such a rule will only exacerbate the tendency to underinvest in innovation.[49]

I testified on this issue in *Innovatio*,[50] and Judge Holderman cited that testimony favorably in support of his analysis.[51]

B. The Complexity of the Evaluation Task

The value differential varies across SEPs, depending as it does on both the patented technology and the next-best noninfringing alternative. To determine the "share" of any given patent/patent family/patent claim, we would have to look at not only this incremental value for the patents/families/claims at issue (in order to evaluate the *numerator* of the "share" fraction), but the incremental values for all other patents/families/claims as well (in order to evaluate the *denominator* of the "share" fraction).

Determining the incremental value relative to the next-best freely available public domain alternative is a complex enough task, but if one has to consider the incremental value relative to other *patented* alternatives that may *themselves* be royalty bearing, and bearing in mind that royalties (both for the technology being considered and for the other technologies) are not set in stone but generally are *endogenously* determined, the complexity of the evaluation task increases dramatically. I suspect that those who advocate a simple patent-counting approach to apportionment have ignored almost entirely this incremental value issue. I have never seen the issue in any discussion of a "top-down" approach.

More significant, if one *has* assessed the incremental value of being able to use the patented technology relative to the next-best noninfringing alternative, then what is the *point* of doing a "top-down" approach analysis? Why not stop with the incremental value itself, and use that to assess a reasonable royalty? What is gained by trying to determine the size of an overall "pie" of royalties to be apportioned across relevant patents, and then apportioning? I see no benefit to be gained by doing so, especially given the likely disagreements about essentiality and the apportionment fraction discussed above.

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[49] For further development of these examples, see David J. Teece, *Profiting from Innovation in the Digital Economy*, 47 Res. Pol'y 1367 (2018); Teece, *The "Tragedy of the Anticommons" Fallacy: A Law and Economics Analysis of Patent Thickets and FRAND Licensing*, *supra* note 9.

[50] *Innovatio*, 2013 WL 5593609, at *2.

[51] *Id.* at *9 ("At the same time, the court finds Dr. Teece's testimony regarding the difficulty of distinguishing between the intrinsic value of the technology and the value of standardization to be persuasive.").

Given the large number of DEPs associated with many standards, the time and effort associated with adequately evaluating patents, and the fact that non-parties to a given lawsuit have virtually no incentive to devote the resources needed to assess their patents, it is not feasible to give the same scrutiny to all potentially relevant DEPs that one gives to the patents involved in a given lawsuit. Some approaches, such as strict numerical proportionality or citation counting, are carried out mechanically using readily obtainable public data that simply do not map well to the valuation issues at the heart of the exercise. Qualitative assessments of the technical merits of various patented technologies, or evaluation of the next-best noninfringing technology, or of the likelihood that the patent would be found valid and infringed if challenged in court, cannot be mechanized and instead require a complicated and controversial analysis calling for considerable expertise in various fields.

VII. A Limited-Time Maximum Cumulative Royalty for (Patent-Owning) Proponents of a "Top-Down" Approach?

As noted, a highly controversial issue in implementing a "top-down" approach involves assessing the size of the "pie," the maximum cumulative royalty. From an economic perspective, we have noted that there is generally no economic basis for any particular value of (or cap on) the maximum cumulative royalty. For any given product or standard, the relevant patented technology taken as a whole can account for a high or low percentage of the value of (standard-compliant) products. It depends on the availability and worth of public-domain technology and its aggregate contribution to the product.

One can consider how a particular maximum cumulative royalty might be justified by appealing to public statements made by relevant patent holders advocating the use of a particular maximum cumulative royalty. One example involves the MCOI proposal discussed above. Ericsson made a number of similar subsequent proposals.

However, I note that it is one thing to hold the *proponents* of such a proposal to their statements. It is another to hold to the terms of the proposals those who *opposed* the proposals, especially if the proposals were rejected by the SDO. It is also quite another to hold proponents to their statements years after they were made.

It is also important to note that the proponents of MCOI were not making a *unilateral* proposal to limit the royalties *they* would charge for their patents, but instead were proposing what might be termed a "mutual forbearance" proposal, whereby ETSI would adopt a general policy under which *all* patent holders would *collectively* restrict the royalty rates they charged to be in line

with the proposal. Since ETSI never adopted the MCOI proposal, and thus the proponents never got the *benefit* of the "mutual forbearance" proposal (in the form of reductions in the royalties they have to *pay* to other patent holders), it is hard to see why they should pay the *cost* (in the form of limitations on the royalties *they* can *charge* for others' use of their own patents), or why they should be bound as though the proposal *had* been adopted given that it was *not*.

If there are no "top-down" approach-based proposals like the MCOI proposal made to ETSI—and in my experience such proposals are rare—one will generally not expect to see any public statements in favor of a maximum cumulative royalty cap, except possibly by firms with small or nonexistent patent portfolios that also anticipate they will be major implementers and are seeking to reduce the royalties they will be asked to pay. The self-serving justification for advancing such proposals is transparently obvious. As noted above, the three main MCOI proponents "wore two hats." Their business model was one in which they had significant patent portfolios relating to the standard (and thereby likely to collect less money in the form of royalties from others for use of the proponents' patents, if their proposal were adopted), but also being major implementers who would *benefit* (in the form of lower royalties they would have to pay for their use of others' patented technology) should the proposal be adopted. Statements in support of such a proposal from firms with little in the way of patent portfolios of their own, and which therefore have little or nothing to lose, but much to gain, should the proposal limiting royalty rates be adopted—are transparently self-serving. They should be given no weight when the patent holder is employing a different business model dependent on embedding the technology in devices and not contributing to standards development.

VIII. The "Top-Down" Approach in the Courts

The relatively small number of courts that have to date used a "top-down" approach have not sought to inquire as to its economic foundations. Since the "top-down" approach is not anchored in economic principles, it is perhaps not surprising that courts have adopted different versions of a "top-down" approach. In my assessment, the courts have been rudderless. There is not a single "top-down" approach, but multiple alternatives, depending on how you (1) assess the size of the "pie" and (2) apportion across the various claimants.

As already noted, the courts must deal with some critical issues when contemplating the concept of maximum cumulative royalty. Where and how does one start in assessing the size of the pie, the maximum cumulative royalty? Does one start with the handset (cellphone), chipset, or provision of cellular service? Does one start with (a fraction of) the selling price

or (a fraction of) the profit margin? Does one look at historical prices/profit margins or attempt to estimate future prices/profit margins? Does one acknowledge the potential (or actual) price-depressing effect of widespread infringement,[52] or take the actual prices/profit margins as fixed?

When apportioning across the various patent-holder claimants, the court must consider the number of claimants or the number of patents. In non-standardization contexts, it is difficult to identify the number of potentially relevant patents. Firms are often reluctant to investigate whether their products may be infringing patents belonging to others, in part because they may be liable for enhanced damages (up to treble damages for "willful infringement") if they infringe a patent they have actual knowledge about. In the standards-development context, many SDOs ask holders of patents they believe are or will be "essential" to practice an actual or pending standard (so-called SEPs) to identify such patents, and commit to making licenses available for those patents to those wishing to make standard-compliant products on "reasonable and nondiscriminatory" (RAND) or FRAND licensing terms if and when a standard incorporating the patented technology is adopted.[53] In response, some patent holders identify particular patents, but others make "blanket" FRAND declarations (agreeing to make licenses available on FRAND terms for *any* patents they have that turn out to be essential) *without* identifying particular patents. In such "blanket-declaration" situations, it may be difficult to get a good estimate of the total number of SEPs.

Some of the patents that have been declared potentially essential to a given standard (DEPs) will turn out not to be essential. As discussed earlier, some have pointed to what they term "overdeclaration," the likelihood that not all DEPs are actually SEPs. The European Commission identified studies that found only between 20 percent and 28 percent of patent families "declared 'essential' were actually essential."[54] Other estimates of the overdeclaration percentage that we have seen range from 45 percent to 82 percent.[55]

If a court is to accept the "top-down" approach at all, it ought to insist that the expert start with a properly determined total cumulative royalty and be limited to offering a very specific type of cross-check on other determinations of a proposed royalty offer. It would need to be made with full recognition

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[52] *See* Akemann, Blair & Teece, *Patent Enforcement in an Uncertain World: Widespread Infringement and the Paradox of Value for Patented Technologies*, *supra* note 15.

[53] FRAND is not a compulsory licensing regime because patent holders have the option of not making FRAND commitments.

[54] European Commission, Patents and Standards: A Modern Framework for IPR-Based Standardization 147 & n.238 (2014).

[55] Jorge L. Contreras, *Essentiality and Standards-Essential Patents*, *in* The Cambridge Handbook of Technical Standardization Law: Competition, Antitrust, and Patents 209, 224 (Jorge. L. Contreras ed., Cambridge Univ. Press 2017) (citing two studies by Fairfield Resources International and one by Cyber Creative Institute Co.); *see also* Cyber Creative Institute, Evaluation of LTE Essential Patents Declared to ETSI Version 3.0 (2013), https://www.cybersoken.com/file/lte03EN.pdf.

of the self-interest—and consequent bias—that went into designing the key concepts used by proponents of the "top-down" approach. Consequently, royalty offers that do not pass this top-down cross-check may very well be reasonable; but if they do pass the cross-check they are likely reasonable even by a particularly licensee-friendly interpretation of reasonableness.[56]

IX. Comparable Licenses and Value-Based Approaches

I have indicated that the "top-down" approach is conceptually flawed. As implemented so far, the results have been spurious. Patent counts may be precise; but, even when weighted in some fashion, they are not a good proxy for value—even assuming one could come up with a justifiable maximum cumulative royalty. What, then, is the right way to value patents and patent portfolios? The answer is, as always, comparable market transactions if available—otherwise some type of value-based approach.

A. Comparable Licenses

Comparable running royalty licenses are likely the most reliable indicators of FRAND rates. Comparable licenses are the gold standard for benchmarking patent value.

Part VIII assumed there were no market transactions and/or no comparable license agreements. This may happen early in the development of new technologies. For instance, while licensing was occurring for 5G used in mobile devices and in autonomous or semi-autonomous vehicles, many market segments had not yet launched licensing programs. When comparable licenses exist, the task at hand is simplified—assuming the transaction is between unrelated partners and unencumbered by broader strategic issues. One is likely to find three types of licenses for air interface technologies: one-way running royalty licenses, lump-sum licenses, and cross-licenses.

Running (per-unit) royalties are a cleaner benchmark than lump-sum licenses. One complication with lump-sum licenses is that some part of the payment may reflect compensation for past use, which may be discounted or compounded. Discounts for portfolio licenses can relate to time period, geography, or different patents in a portfolio.

License agreements and associated royalty rates may decline with the size or scale of the licensee. This cannot be explained well on strict competitive grounds, as no scale economies are associated with licensing an additional

[56] The "cross-check" in question will typically involve calculating the aggregate royalty implied by a particular proposed royalty rate. A proper implementation of BLP methodology briefly discussed in Part IX could generate reliable estimates.

unit, as the marginal cost of licensing an additional unit is zero in almost all circumstances. Volume or scale discounts, when they occur, usually reflect the considerable bargaining power of some licensees and their ability to bring unrelenting high-cost litigation against the patent owner.

Lump-sum licenses may be less reliable as an indicator of value, because they are driven often by idiosyncrasies of the situation and particularities of the parties. In theory, lump sums can be converted to an economically equivalent running royalty by calculating a royalty rate that, when applied to past and expected future sales of royalty-bearing units, would provide a licensor with cash flow whose net present value is equal to the lump sum. The net present value is calculated as of the effective date of the license or whenever the lump sum is expected to be received. A discount rate for future sales is needed to complete this calculation.

Cross-licenses are more difficult to value, because any money that changes hands is likely to be for balancing payments. The value of a portfolio is not usually observable from the licensing agreement.

B. Value-Based Approaches

I begin by noting that in the economy more generally, licensing is not the most common business model used by firms to capture value from the technology they develop.[57] Generally, firms capture value by implementing technology themselves. Profits come through the development and sale of components and products into which the technology is embedded. Management then avoids the hazards of licensing as a lynchpin of a company's revenue and profit model. However, firms with technology have a (theoretical) choice between productization and licensing. Some companies may not productize their technology, and some may productize to a limited degree.

However, in the case of air interface communication technologies offered by firms for patented adoption by ETSI into standards, patent licensing is encouraged by the "FRAND commitment." The ETSI IPR policy states explicitly that ETSI "seeks a balance between the needs of standardization for public use in the field of telecommunications and the rights of the owners of IPRs."[58] The IPR policy does not prescribe a formula—merely that there must be "balance" to allow the ecosystem to flourish and support the continuous generation and adoption of new technologies.

The FRAND commitment does not require that one must offer technology to be incorporated into standards. But if technology is offered for consideration to the standard-setting body and is covered by patents, SSO rules

[57] This Part draws in part on Teece, *Technology Leadership and Patent Portfolios: A Framework to Guide 5G Licensing Executives*, *supra* note 1.

[58] ETSI IPR Policy, *supra* note 36, Annex 6, cl. 3.1.

typically require the patent owner to disclose the existence of the patent and also agree to FRAND licensing. While own use is not foreclosed, it must be in conjunction with "making licenses available," "for some period of time, to technology implementers."[59]

Because of the world's adoption of the open innovation (that is, "licensing") model for mobile devices, it is necessary to look downstream to ascertain the value of the upstream technology tendered for license. However, this is not unique to mobile devices and the 2G, 3G, 4G, and 5G standards. Looking downstream to observe the patent technology at work is what licensing executives do and what courts usually do when patent-infringement disputes arise. Put simply, content matters.

Consider 5G. The value created by 5G in the Internet of Things (IoT) will differ across use cases and application areas. Licensing structures and royalty rules will need to recognize this heterogeneity. Use value may depend on how a "thing" is commonly used by its owner and the nature of the services provided to others. New and creative ways may be needed to monitor and measure the use of patented technology so that licenses can be structured in new and different ways. Such organizational innovation is evident in the formation of Avanci to simplify (through "bundling" and fixed rates) the licensing of wireless technology for the IoT.

Avanci licensors and licensees include well-known technology developers and OEMs that have endeavored to "streamline the technology sharing process" through a "fixed price royalty model."[60] This approach "accommodates the wide range of uses in IoT" devices.[61] It implements licensing through a fixed-rate (that is, per-unit) royalty structure. Avanci notes, in the spirit of what is advanced in this part, that

> [w]hen it comes to valuing technology, context is everything. To address this reality, Avanci launched its platform with prices that reflect the value cellular connectivity brings to a specific application. Although there is no explicit formula, some of the considerations when determining the value of a license for a particular application include (1) the need for wide area connectivity (2) the amount of use and the required bandwidth.[62]

There are at best three classes of accepted methodologies for taking context into account.

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[59] The patent exhaustion doctrine allows, as a practical matter, for a licensor to select the place in the value chain (for example, components or devices) to collect royalties; it does not allow such rights to be exercised at multiple levels.

[60] *Marketplace*, Avanci, https://www.avanci.com/marketplace.

[61] *Id.*

[62] Avanci, Accelerating IoT Connectivity 7 (2020), https://www.avanci.com/wp-content/uploads/2020/03/Avanci-White-Paper.pdf.

1. Discrete Natural Experiments

As noted, the need to look downstream to vector in on the value of a technology is important in valuing technology.[63] It is sometimes possible to glean the value of patents if there is a close association or linkage between the patented technology and a product feature.

If one needed to determine a (reasonable) royalty rate for certain Wi-Fi technology protected by patents, one would look to the market success of products using the technology at issue. The value of a patent (or a portfolio) can be gleaned sometimes if it is incorporated into an add-on feature or accessory that is priced separately in the market. For instance, WiLAN patented technology provided the backbone of (Wi-Fi) 802.11 standards. Network interface cards (NICs) enabled users to access the patented technology (in an incremental sense) to boost network performance.

To the extent that other proprietary technologies are not also implicated in the NIC, the price of the NIC is a good indicator of the point at which to begin the exercise of calculating the contribution to profit made by the patented technology. Bargaining between the implementer/user and the patent owner will then determine how the gains might be split.[64] The exercise requires imputing a return to relevant complementary assets and complementary technologies used by the implementer.

2. Choice Experiments

Most situations are complex, and no natural experiment can be observed directly. In some circumstances, one or more patented technologies might be critical to a particular service or performance feature of a product. The value consumers attach to particular features can be used as an indicator of the value of the patented technologies. The patented technology might support new and otherwise unavailable business models or revenue streams for the user. These can usually be observed and quantified. If multiple technologies are needed to support a particular functionality, that needs to be recognized to value device performance "with and without" a particular attribute.

In many cases, survey techniques can be used to seek assessments from respondents with respect to how they value product features. The survey design seeks assessments from respondents that are connected to the features supported by the patented technology. Once a change in willingness to pay

[63] Greg M. Allenby, Jeff Brazell, John R. Howell & Peter E. Rossi, *Valuation of Patented Product Features*, 57 J.L. & Econ. 629 (2014) (applying standard choice methods).

[64] *See* Rebecca Reed-Arthurs, Michael P. Akemann & David J. Teece, *Resolving Bargaining Range Indeterminacy in Patent Damages After* VirnetX, 30 Res. L. & Econ. (forthcoming 2020).

has been determined, this can be translated, under certain assumptions, into changes in price, quantities, and profits.[65]

3. Econometric Approaches Using Aggregate (Non-Discrete) Market-Observed Choice Data

Aggregate data can be used with a technology known as BLP (named for Steven Berry, James Levinsohn, and Ariel Pakes).[66] It is a rather elegant methodology and uses an economic model of demand, supply, and competition within an equilibrium framework (that is, it allows for adaptation and adjustment). It employs price and quantity data from the actual market and simulates the profit impact of patented technologies.

The approach is highly technical and employs a random coefficient logit methodology. According to Scott Hiller, Scott Savage, and Donald Waldman, the BLP methodology softens concerns about price endogeneity.[67] It constructs "counterfactual markets where the potential patent infringement is absent and present."[68] The methodology takes price erosion into account and simulates prices, profits, and market shares in a scenario in which a particular firm did not have access to the patented technology in question.

The BLP methodology is data-hungry and unlikely to be widely used but is impressive in its power to illuminate the value of technologies. It might leave apportionment issues among patent holders unanswered if multiple patent portfolios support certain product features/attributes. Accordingly, as with other methodologies, it needs to be applied carefully.

A less elegant econometric approach is hedonic analysis. This is a revealed preference method of estimating the value of certain attributes of a product. Those attributes are then connected to the patented technology that enables/allows the provision of those attributes. Coefficients are estimated that can help in the calibration of the value of the technology that underpins desired features/attributes of a device/final product.

The BLP approach may still leave apportionment issues unanswered. Hedonics may be able to ascertain the value of particular features; but issues are likely to remain. These considerations simply underscore the superiority of market-based approaches.

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[65] Assumptions might include monopsonizing competitive markets, linear demand (in the region of interest), and constant marginal cost within the region of interest. These are standard simplifying assumptions used by many economists.

[66] *See* Steven Berry, James Levinsohn & Ariel Pakes, *Automobile Prices in Market Equilibrium*, 63 Econometrica 841 (1995).

[67] R. Scott Hiller, Scott J. Savage & Donald M. Waldman, *Using Aggregate Market Data to Estimate Patent Value: An Application to United States Smartphones 2010 to 2015*, 60 Int'l J. Indus. Org. 1 (2018).

[68] *Id.* at 5.

Conclusion

The "top-down" approach is explicitly designed to address the theoretical problem of so-called "royalty stacking." The "royalty-stacking" problem arises (in certain theoretical models) because the models employed assume that individual negotiations between an SEP licensor and licensee are conducted without regard to the fact that a typical licensee may, of necessity, be negotiating with numerous other SEP licensors. Different licensors' portfolios of SEPs are complements to each other, not substitutes for each other; and each licensor is the only possible supplier of its portfolio, which according to proponents of the theory of royalty stacking confers a monopoly position (requiring an additional flawed assumption that ownership of an SEP automatically conveys the power to enjoin the licensee). The "problem" of Cournot complements discussed earlier has long been recognized in economic theory. It helps explain cross-licensing and the development of patent pools. There is sometimes concern that "stacking" may result in prices for final products (for example, handsets that incorporate the SEPs) that are too high. There is also concern that royalties that are too high might retard entry and competition in the downstream industry that uses the SEPs.

The "top-down" approach is based on the idea that one can meaningfully identify a maximum reasonable aggregate royalty rate—that is, a type of cap that aggregate or cumulative royalties should not exceed in order to keep the total royalty burden at a "reasonable" level. A share of this capped amount can then be allotted to each individual licensor. It is immediately clear that there are two steps—both vulnerable to subjective assumptions—involved with this approach: (1) the process of identification of a reasonable maximum level of total royalties and (2) the method (typically reliant on patent counts) used to allocate that royalty among different licensors.

No SDO has endorsed the use of a "top-down" approach in setting FRAND royalties. The one proposal (to an SDO) to adopt a "top-down" approach that I am aware of, the MCOI proposal made to ETSI in 2006, was *rejected* by ETSI, reportedly in part because of opposition from certain significant patent holders (leading the proposal not to have the "consensus" support ETSI demands for changes to its policies)—and in part because of competition policy concerns raised by DG Comp, the European Commission antitrust authority, about the prospect that such an approach could facilitate or amount to oligopsonistic (demand-side) price fixing in the relevant technology markets. In my view, if a "top-down" approach is to ever have applicability, then it will be in a "clean slate" (no existing licenses circumstance). The use of a "top-down" approach is likely difficult to reconcile with existing licenses with bilaterally negotiated royalty rates, especially if those licenses involve patents subject to a commitment to license on FRAND terms.

Where there are existing licenses, many may be structured in a fashion different from what the "top-down" approach proposes. In particular, many industry licenses are cross-licenses, in which each party grants an out-license to use its own patents and in turn receives an in-license to use the other party's patents. Such licenses may have some royalty payment or may be (nominally) "royalty free," but that does not mean that the technology being cross-licensed has no value; instead, it means that the cross-licensed technology is roughly of equal value. Payments in cross-licenses tend to reflect not the total value of being able to use the licensed technology, but rather what are best seen as *balancing payments* reflecting the *difference* in value between the two one-way licenses.[69]

There is a sense in which the use of a "top-down" approach is similar to the use of the now-discredited "25-percent rule" for assessing patent damages, rejected on *Daubert* grounds by the Federal Circuit in *Uniloc v. Microsoft* in 2011, which critiqued the 25-percent rule as a "fundamentally flawed tool."[70] As the Federal Circuit put it in *Uniloc*, "[b]eginning from a fundamentally flawed premise . . . results in a fundamentally flawed conclusion."[71] My analysis above of limitations of and flaws in *both* parts of the "top-down" approach as so far implemented—setting a maximum cumulative royalty and apportioning total royalties across patent holders—suggests to me that the "top-down" approach is flawed just as the "25-percent rule" was flawed. The "top-down" approach is seemingly more scientific, but at least as implemented to date it is riddled with scores of (usually hidden) problematic assumptions.

In my view, patent royalties ought to be set at a level that reflects the contribution of the technology to value in use, and is sufficient to encourage business firms and individuals to make the necessary investment in developing new technologies so as to be able to sustain a societally efficient level of innovation. I am not sanguine that a "top-down" approach will ever satisfy that desideratum, especially since it is widely acknowledged that the societal returns to innovation exceed the private returns, and the "top-down" approach makes no attempts to determine the value to the user, or to consider whether the technology provider is adequately rewarded, let alone look at spillover benefits. Its only utility is as a limited type of cross-check described in Part VIII.

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[69] *See* Peter Grindley & David J. Teece, *Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics*, 39 CAL. MGMT. REV. 8 (1997).

[70] Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1315 (Fed. Cir. 2011).

[71] *Id.* at 1317.

Appendix A. Difference in Valuations: A Numerical Example

A simple numerical example demonstrates that different approaches to apportioning value across patents can lead to different outcomes. Suppose for concreteness that there are a total of 100 relevant patents, and that the total value of being able to use all of the relevant patented technology is $100, measured by comparing the total incremental value of being able to use the patented technologies measured relative to the total value of using the next-best noninfringing alternatives to each of the patented technologies. Using a "simple-numerical-proportionality" approach, each of the 100 patents would be assigned 1 percent of the total $100 value, or $1 per patent.

Using a different approach can result in very different valuations. Consider Judge Holderman's adoption of the "top-down" method propounded by *Innovatio* defendants' economics expert, Dr. Gregory Leonard.[72] Dr. Leonard asserted that an earlier study by Mark Schankerman had found the "top 10 percent" of patents (10 out of 100 in my example) account for some 84 percent of the total value ($84 out of $100 in my example).[73] Then the top 10 patents would account for $84 in value, yielding an average "top 10" value of $8.40 per patent,[74] 8.4 times the $1-per-patent value assigned under a "simple-numerical-proportionality" approach. The other 90 patents (the "bottom 90 percent") would account for the remaining 16 percent of the $100 in total value, or $16. Thus the "bottom 90 percent" of patents would each be assigned an average value $0.1778 per patent,[75] less than *one-fifth* the value (of $1 per patent) assigned by a "simple-numerical-proportionality" approach.[76] The "top 10 percent" patents are assigned an average value of $8.40 per patent, some *47.24 times* the average value assigned to each of the "bottom 90 percent" patents.[77] This result is extremely sensitive to the assessment of whether a particular patent is or is not "in the top 10 percent" when the value distribution is left-skewed (as when few patents account for most of the value).

Judge Holderman reached his conclusion that the *Innovatio* patents in suit were in the "top 10 percent" on the basis of his (non-quantitative) assessment that they were of "moderate to high" significance to the standard (despite the fact that he did not perform any similar analysis for the thousands of patents

[72] *In re* Innovatio IP Ventures, LLC Patent Litig., No. 11-cv-09308, 2013 WL 5593609, at *37–39 (N.D. Ill. Oct. 3, 2013) (Holderman, J.).

[73] Schankerman, *How Valuable Is Patent Protection? Estimates by Technology Field*, *supra* note 3.

[74] That is, $84 ÷ 10 = $8.40.

[75] That is, $16 ÷ 90 = $0.1778.

[76] That is, $1 ÷ $0.1778 = 5.624.

[77] That is, $8.40 ÷ $0.1778 = 47.24.

belonging to firms *other* than Innovatio), a slender reed on which to base his analysis.[78]

If instead of using the results of Schankerman's study, one had used the results of another similar published academic study (by Jonathan Putnam)[79] that estimated that the "top 10 percent" of patents accounted for 65 percent (rather than Schankerman's 84 percent) of the total value of all relevant patents, leaving 35 percent (rather than 16 percent) for the "bottom 90 percent" of patents, the numbers would be an average value of $6.50 per patent for the "top 10 percent" patents[80] (or *6.5 times* the $1-per-patent value assigned using "simple numerical proportionality") and an average value of $0.389 per patent for the "bottom-90-percent" patents,[81] or less than 40 percent of the $1-per-patent value assigned using "simple numerical proportionality." The divergence between the average value assigned to the "top-10-percent" patents (of $6.50 per patent) and the average value assigned to the "bottom-90-percent" patents (of $0.389 per patent) is *16-fold* (rather than 47-fold using the results of the Schankerman study). The valuation results using the estimates given in the Putnam study are still significantly skewed, though less so than the results using the Schankerman study. Given Schankerman's stellar academic record, a judge would have good reason to favor Schankerman over Putnam. Of course, the court would also wish to probe the experts as to their assumptions and their calculations; the point is simply that it makes a significant difference which study is used.

Other apportionment approaches that have been suggested—including weighting using forward and/or backward citation counts; apportioning based on the number of patent families rather than the number of separate patents; apportioning based on the number of patent claims; apportioning on the basis of the number of U.S. Patent and Trademark Office (USPTO) categories; apportioning based on an assessment of the likelihood that the patent, if litigated, would be found valid and infringed; apportioning based on the incremental value of being able to use the patented technology rather than the next-best noninfringing alternative; apportioning based on the likelihood that the patent is "essential"; and so on—would likewise yield different numbers (and, I suspect, *very* different numbers), yet all of these have been proposed under the general "top-down"-approach rubric.

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[78] *Innovatio*, 2013 WL 5593609, at *23 ("Innovatio Channel Sharing family patents are of moderate to high importance to the standard."); *id.* at *27 ("Innovatio's patents in the Multi-Transceiver family are of moderate to high importance to the 802.11 standard."); *id.* at *43 ("[T]he court has found that Innovatio's patents are all of moderate to moderate-high importance to the standard, meaning that they provide significant value to the standard.").

[79] Jonathan D. Putnam, Value Shares of Technologically Complex Products (Apr. 16, 2014), http://www.competitiondynamics.com/wp-content/uploads/Value-Shares-20140416.pdf.

[80] That is, $65 ÷ 10 = $6.50.

[81] That is, $35 ÷ 90 = $0.389.

This numerical example shows that, despite the fact that both Judge Holderman in *Innovatio* and Judge James Selna in *TCL v. Ericsson*[82] said that they were applying a "top-down" approach, the two approaches used—Judge Selna's "simple-numerical-proportionality" approach and Judge Holderman's "top-10-percent"/Schankerman-study approach—yield *dramatically different* conclusions ($8.40 versus $1) about the value that is apportioned to any given patent.

Despite their (superficial) similarity, these two very different approaches are both called a "top-down approach." The over *8-fold* difference ($8.40 versus $1) between the values assigned by the two approaches leads to the conclusion that, *as applied*, the two approaches in fact *differ drastically*. They illustrate that there is no such thing as *the* "top-down" approach, but rather a number of *very different* approaches that go under that general heading.

Similar differences arise in the other part of the "top-down" approach, namely the assessment of the maximum cumulative royalty. Judge Holderman in *Innovatio* started with his (mis)estimate of chipset manufacturers' average profit margins on a dollars-per-unit basis, despite the fact that he was setting a FRAND royalty for device manufacturers (entities at an entirely different level in the "value chain," selling very different products at very different prices and profit margins), and apportioned that. Judge Selna in *TCL v. Ericsson* started with Ericsson's public statements about a maximum cumulative royalty as a single-digit percentage of the selling price of cellular handsets. Both conceptually and empirically, these two approaches bear *no resemblance* to one another. Similarly, if both approaches were to be applied to the same factual situation, I expect that they would yield numbers that would bear no resemblance to one another.

Put another way, *both* halves of the "top-down" approach—setting the maximum cumulative royalty and apportioning the "pool" of available money over the relevant patents—are subject to significant discrepancies and significant disputes.

Despite the (purported) superficial appeal of the "top-down" approach, its non-robust character means that in practice the approach is an exercise that is unlikely to give reliable or realistic valuations. Judge Selna in the United States was presented with evidence apparently similar to that before Mr. Justice Birss in the United Kingdom,[83] but Judge Selna came up with less

[82] TCL Commc'n Tech. Holdings Ltd. v. Telefonaktiebolaget LM Ericsson, Nos. SACV 14-341 JVS, CV 15-2370 JVS, 2018 WL 4488286 (C.D. Cal. Sept. 14, 2018) (Selna, J.), *rev'd*, 943 F.3d 1360 (Fed. Cir. 2019), *petition for cert. filed*, No. 19-1269 (U.S. May 6, 2020).

[83] Unwired Planet Int'l Ltd v. Huawei Techs. Co. [2017] EWHC (Pat) 2988 (Birss, J.), *aff'd*, [2018] EWCA (Civ) 2344, *aff'd*, UKSC 2018/0214 (Eng.); *see also* J. Gregory Sidak, *Judge Selna's Errors in* TCL v. Ericsson *Concerning Apportionment, Nondiscrimination, and Royalties Under the FRAND Contract*, 4 Criterion J. on Innovation 101, 154–58 (2019).

than half the rates. Judge Selna's decision was vacated by the Federal Circuit in 2019. It ruled that Ericsson was entitled to a jury trial.

Having two different courts applying the "top-down" approach to factually similar situations and coming up with significantly different conclusions (such as one rate being "less than half" the rate of the other) is seriously problematic and casts doubts on the merits and the reliability of the "top-down" approach.