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# Balancing Incentives to Innovate in Upstream Wireless Technology Markets with Exit Concerns in Midstream Component Product Markets

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## Abstract

*We consider the merits of recent complaints about the common industry practice in many technology industries, including the wireless industry, of licensing patents at end-device level (as opposed to at component-part level), and the use of the entire value of the end device as the royalty base for the calculation of compensation. We identify the exceptional circumstances under which mandating licensing at component level may be justified from a welfare perspective. We also explain why using the entire value of the end device as the royalty base is optimal.*

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## I. Introduction

Competition enforcers in many jurisdictions have expressed concerns about enforcement actions and policies, e.g. the compulsory licensing of intellectual property (IP), that threaten to harm incentives to innovate in upstream technology markets, such as the market for the licensing of wireless technology. Yet, many appear to struggle with how to weigh and balance these incentives against concerns that certain downstream manufacturers, which may need access to that IP at reasonable prices, may exit the market if there is no intervention.

To be sure, the task of measuring and balancing potential harms to upstream incentives to innovate against potential downstream exit is complex. For example, while the large body of literature on the economics of innovation teaches us that measures that negatively impact the return on investment are likely to reduce incentives to innovate, determining how much of a reduction is likely to result in decreased incentives (and by how much) is incredibly difficult, if not impossible.

The complexity of this balancing exercise is increased in multi-layered vertical industries where (upstream) IP holders, (midstream) component manufacturers and (downstream) end-product manufacturers coexist. This is the case, for example, in the wireless industry, which is populated by owners of standard-essential patents (SEPs), chipset manufacturers and end-user device manufacturers. In industries like this, competition enforcers may not only worry about the terms and conditions under which patents are licensed, but also about the identity of the licensees. Specifically, they may be concerned about the implications of the common industry practice of licensing patents at end-user device level as opposed to at component-parts level.

Some have complained that this industry practice substantially forecloses competition midstream and may allow patent holders to set excessively high royalty rates downstream.<sup>1</sup> Some of these complainants, mainly chipset makers,<sup>2</sup> may demand component-level licensing. Others, mainly end-device makers,<sup>3</sup> may demand that royalties be calculated using the value of the component (and not the value of their end devices) as the royalty base.<sup>4</sup>

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1 See Karl D. Belgium, *The Next Battle Over FRAND: The Definition of FRAND Terms and Multi-Level Licensing*, 39 NEW MATTER 2 (2014) available at [https://www.law.berkeley.edu/files/Belgium\\_Karl\\_IPSC\\_paper\\_2014.pdf](https://www.law.berkeley.edu/files/Belgium_Karl_IPSC_paper_2014.pdf). See also *Federal Trade Commission v. Qualcomm Inc.*, No. 5:17-cv-00220-LHK (N.D. Cal. Jan. 17, 2017) (Federal Trade Commission's Complaint for Equitable Relief) available at [https://www.ftc.gov/system/files/documents/cases/0038\\_2017\\_02\\_01\\_redacted\\_complaint\\_per\\_court\\_order\\_dkt.pdf](https://www.ftc.gov/system/files/documents/cases/0038_2017_02_01_redacted_complaint_per_court_order_dkt.pdf).

2 Diana Goovaerts, *Intel, Samsung Back FTC in Its Lawsuit Against Qualcomm*, WIRELESS WEEK (May 5, 2017), available at <https://www.wirelessweek.com/news/2017/05/intel-samsung-back-ftc-its-lawsuit-against-qualcomm>.

3 *Id.*

4 A royalty payment typically comprises two components: a royalty base and a royalty rate. The royalty base is the unit base to which the royalty rate is applied. The royalty rate is the percentage that determines the proportion of the royalty base the licensor will receive.

In this paper we review these concerns and consider whether the proposed interventions – mandating licensing at component level and/or requiring royalties to be calculated using the value of the component as the royalty base – are justified on welfare grounds or whether, instead, they are likely to undermine investment incentives without leading to lower end-device prices and, therefore, are likely to hurt consumers.

Relying on the work of Layne-Farrar, Llobet and Padilla,<sup>5</sup> we find that mandating component-level licensing will not have a positive impact on competition unless the licensor is vertically integrated midstream, i.e. unless it is also a competitor in the relevant component market. A non-integrated licensor has no incentive to foreclose midstream (and/or downstream) manufacturers; on the contrary, it will benefit from more competition midstream (and downstream) as that will increase sales volumes and, therefore, royalty payments. Furthermore, provided royalties are negotiated efficiently, a non-integrated licensor will not be able to extract higher royalty rates by licensing at end-device level only.

Vertical integration is a necessary but not sufficient condition for intervention, though. First, as we demonstrated in an earlier paper,<sup>6</sup> a refusal to license at component level cannot and will *not* result in anticompetitive foreclosure, provided the vertically integrated licensor offers (a) contractual protection against component-level suits and (b) non-discriminatory terms to end-device manufacturers, i.e. it offers the same terms whether the licensee purchases its components or those of its rivals.

But what if the evidence shows component manufacturers exiting the markets even when the conditions listed above fail to hold? Does that suggest that anticompetitive foreclosure is possible even when conditions (a) and (b) hold? We do not think so. It is important to remember the typical cycles of entry and exit in markets in general and to determine whether a particular licensing practice is in fact the but-for cause of a departure in these normal cycles. Given that end-user device licensing has been the industry practice for as long as we can remember, and it is adopted by both vertically integrated and non-integrated licensors, it is not logical to presume that this industry practice actually caused any recent exit (or threat of exit). Rather, the logical assumption is that such an industry practice has nothing to do with possible midstream exit, which may instead be caused by a host of other factors, such as quality and strength of technology or an inherently risky business model premised on high volume sales at low profit margins.

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5 A. Layne-Farrar, G. Llobet & J. Padilla, *Patent Licensing in Vertically Disaggregated Industries: The Royalty Allocation Neutrality Principle*, 95 COMMUNICATIONS & STRATEGIES, no. 3, 2014, at 61–84.

6 Jorge Padilla & Koren Wong-Ervin, *Portfolio Licensing at the End-User Device Level: Analyzing Refusals to License FRAND-Assured Standard-Essential Patents at the Component Level*, 62.3 ANTITRUST BULL. 494 (2017).

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When (a) and (b) hold, an obligation to license at component level is bound to be detrimental to welfare. On the one hand, even if such an intervention does not affect negatively the magnitude of the royalty payments, it will increase transaction costs and, as a result, cause harm to investment and competition to the ultimate detriment of consumers. End-user device licensing allows for easy monitoring and enforcement and thus reduces the transaction costs of licensing. It also reduces the number of licenses required, thereby reducing costly technology identification and negotiation costs. The resulting increase in overall surplus benefits both patent holders (licensors) and downstream implementers (licensees). It also benefits midstream component suppliers and end-users, since the reduction in transaction costs will expand the demand for end devices and components. Market demand goes up because the additional surplus will increase the licensors' incentives and ability to invest as well as the licensees' operating margins, and hence their willingness to compete more aggressively.

Of course, the economic implications of mandating access at component level would be different if that intervention not only implies a change in the identity of the payer but if it results in a reduction in royalty payments. In that case, when conditions (a) and (b) hold, the intervention would necessarily reduce upstream incentives to invest without any offsetting procompetitive effect in the midstream and/or downstream markets.

Second, even if conditions (a) and (b) fail to hold, the risk of anticompetitive foreclosure needs to be balanced against the potentially adverse impact of compulsory licensing on the incentives to innovate. Relying on established principles in the economics of innovation, we believe that the decision to compel patent holders to license at component level would only be justified if, absent that intervention, all effective competition would be eliminated, thus preventing the emergence of new products for which there is potentially substantial demand. Our position in this regard is consistent with the position adopted by the European Court of Justice (ECJ) in *Magill*<sup>7</sup> and *IMS Health*,<sup>8</sup> where it stated that compulsory licensing is only justified under certain exceptional circumstances, which are equivalent to those identified in this paper.

We also find no welfare justification for mandating a narrow royalty base. More precisely, we find that *ad valorem* royalties based upon the price of the end-user

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7 Joined Cases C-241/91 P and C-242/91 P, RTE and Independent Television Publications Ltd v. Comm'n, 1995 E.C.R. I-743, para. 54.

8 Case T-184/01 R, IMS Health Inc v. Comm'n, 2001 E.C.R. II-3193, para. 102. The order was confirmed on appeal by the President of the ECJ in Case C-481/01 P(R), NDC Health GmbH & Co KG and NDC Health Corp. v. Comm'n and IMS Health Inc., 2002 E.C.R. I-3401. IMS Health's appeal was discontinued following the withdrawal of the interim decision by the Commission in 2003 on the grounds that the appeal had no further object. See NDC Health/IMS Health: Interim measures, Comm'n Decision 2003/741/EC, 2003 O.J. (L 268) 69, and Order of the General Court in Case T-184/01, IMS Health Inc v. Comm'n, 2005 E.C.R. II-217.

device lead to more upstream and downstream innovation and greater welfare than royalties based on the price of the component, whether the latter take the form of royalties based on the price of the component, per-unit component royalties or per-unit end-device royalties.<sup>9</sup> As demonstrated by Llobet and Padilla,<sup>10</sup> in industries where components are used in fixed proportions, *ad valorem* royalties calculated on the price of the end device lead to lower end-device prices and greater sales of end devices by mitigating the double marginalization problem that characterizes all vertical industries, including all licensing markets.<sup>11</sup> The resulting increase in demand benefits upstream licensors, downstream producers and, likewise, midstream manufacturers. This effect is more significant in industries like the wireless industry where there are multiple upstream developers with complementary innovations.

The remainder of this paper is structured as follows. In Section II we briefly describe the “use-creation” trade-off that is at the heart of the economics of innovation and identify the exceptional circumstances under which compulsory licensing could be justified from a welfare viewpoint. In Section III we consider the competitive implications of the common practice in technology industries, such as the wireless industry, of licensing at end-device level rather than at component level. Then, in Section IV, we investigate the welfare implications of using alternative royalty bases in licensing negotiations. Section V concludes.

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9 As a matter of economics, provided the overall royalty payment reflects the value of the technology, using per-unit component royalties (royalties based on the price of the component), or per-unit end-device royalties makes no difference in an industry where components and devices are manufactured in fixed proportions. This is precisely the case in the wireless industry where typically each end device embeds one component.

10 Gerard Llobet & Jorge Padilla, *The Optimal Scope of the Royalty Base in Patent Licensing*, 59.1 J. L. & ECON. 45 (2016).

11 The double marginalization problem can be explained as follows. Consider a licensing market with one licensor and one licensee. The licensor charges a royalty to the licensee and the licensee sets the price for the final product it sells, taking that royalty as given. Because the royalty charged by the licensor reduces the licensee’s price – cost margin, the licensee will increase the price of the final product in response to an increase in the royalty. In effect, the licensee passes through a fraction of the royalty increase to final consumers in order to maintain its price – cost margin. Therefore, any increase in the royalty payment (and thus the licensor’s margin) will trigger an increase in the price of the final product in order to maintain the licensee’s margin. This double marginalization will result in a reduction in the quantity sold of the final product and will make consumers worse off. The double marginalization problem essentially arises because (a) the licensor sets its royalty with its profit margin in mind, but without fully taking into account the impact of its decision on the licensee’s price – cost margin, and (b) the licensee sets the price of the final product in order to protect its margin without regard to the impact of that decision on the profits made by the licensor. This results in royalties and prices that are too high from a consumer welfare perspective. The problem can thus be mitigated (and possibly resolved) by aligning the incentives of licensor and licensee.

## II. The Simple Economics of Innovation and Compulsory Licensing

Economists have discussed for years the optimal trade-off between the ability to use an invention and the incentives to innovate in the first place.<sup>12</sup> Because inventions and works protected by IP rights are non-rivalrous, one firm using a specific IP right does not diminish the ability of another firm to use the same IP right. Also, the cost of having another firm use an existing IP right is effectively zero. Thus, from a static welfare perspective, it is desirable to disseminate IP rights to every firm (or consumer) that has a positive valuation for it.

Of course, doing so would create a strong disincentive to innovate in the first place, to the great detriment of dynamic efficiency, which refers to the gains that result from entirely new ways of doing business. Economic theory and empirical evidence suggest that the promise of monopoly profits, at least in the short term, stimulates risk-taking behavior involving investment and innovation.<sup>13</sup> Indeed, given that most new businesses fail, monopoly profits can be the prize for winning competitions that most people lose.

Society must therefore strike a balance between the incentives for innovation (dynamic efficiency) and inefficiencies stemming from the exercise of market power (static efficiency). The pragmatic resolution of this trade-off is, in the first instance, the subject of IP law. In fact, the decision to grant IP rights for a limited period only already involves a balancing of the interest in free competition with that of providing an incentive for research and development and creativity. In order to ensure consistency with the balancing decision struck by IP law, there should be no obligation to license IP rights during that limited period of exclusivity granted by IP law unless a refusal to license, as a result of some other factor, causes the exclusion of competitors in a separate (or secondary) market. However, from an economic standpoint, the exclusion of competitors in a secondary market is a necessary condition for intervention. It may not be sufficient, because it is generally efficient to allow a company to retain its own facilities for its own use, even if that causes the exclusion of some competitors. While static efficiency may increase consumer welfare in the short run, economics teaches that the societal gains from innovation are an even greater driver of consumer welfare.<sup>14</sup>

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12 See, e.g., Koren Wong-Ervin & Joshua D. Wright, *Intellectual Property and Standard Setting*, 17 FEDERALIST SOC'Y REV., 52, 53–56 (2016), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2878955](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2878955).

13 See, e.g., D.W. Carlton & K. Heyer, *Extraction vs. Extension: The Basis For Formulating Antitrust Policy Towards Single-Firm Conduct*, 4(2) COMPETITION POL'Y INT'L 285 (2008).

14 Robert Solow won the Nobel Prize in economics for demonstrating that gains in wealth are due primarily to innovation – not to marginal improvements in the efficiency of what already exists. See Press Release, The Royal Swedish Academy of Sciences (Oct. 21, 1987), [http://www.nobelprize.org/nobel\\_prizes/economic-sciences/laureates/1987/press.html](http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1987/press.html).

As a matter of economics, compulsory licensing should therefore be restricted to those situations where the prospective social benefits of licensing are so large as to offset the negative effects of forced sharing on the incentives to innovate and create new IP. However, this balancing exercise is both complex and prone to produce errors. In practice this means that intervention must be limited to those circumstances where the procompetitive effects (static efficiencies) of compulsory licensing are greatest and the disincentive effects (dynamic inefficiencies) of the obligation to license are minimal or non-existent.

Economic theory tells us that the procompetitive effects of compulsory licensing are largest when **(a)** the requested IP is indispensable to compete, **(b)** the refusal to deal causes the complete foreclosure of the market, and **(c)** the refusal prevents the emergence of markets for new products for which there is potentially substantial demand. Economic theory also tells us that the disincentive effects of compulsory licensing are less significant when **(d)** the products to be developed by the licensors are not in direct competition with those of the IP holder. So compulsory licensing should be restricted to situations where conditions **(a)** – **(d)** hold.<sup>15</sup> These are precisely the “exceptional circumstances” identified by the ECJ in *Magill*<sup>16</sup> and *IMS Health*<sup>17</sup> to conclude that a refusal to license infringes competition laws.<sup>18</sup>

### III. The Competitive Effects of End-Device Licensing Practices

As explained in the Introduction, some implementers and policy pundits have argued that the common industry practice of licensing patents at the end-user device level as opposed to the component-parts level should be regarded and dealt with as an anticompetitive refusal to license. In this section we explore under which conditions that concern is justified from a welfare perspective.

In order to do so, we consider a vertically disaggregated industry where three firms operate. A patent holder *U*, whose IP covers the component produced and sold by the midstream producer. A midstream producer *M*, which sells an input (or component) that is required to create the final product sold by a downstream supplier *D*. For every unit of the final product that *D* produces, it needs one unit

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15 C. Ahlborn, D.S. Evans & J. Padilla, (2004) *The Logic and Limits of the Exceptional Circumstances Test in Magill and IMS Health*, 28(4) *FORDHAM INT'L L. J.*, 1109–1156 (2004).

16 *Supra* note 7.

17 *Supra* note 8.

18 Instead, in the US, at least with respect to refusals to license, courts have essentially concluded that US IP laws have already struck a balance between the use-creation trade-off, and that antitrust law should not second guess that balancing. *See, e.g.*, *Data General Corp. v. Gruman Systems Support Corp.*, 36 F.3d 1147, 1186–89 (1<sup>st</sup> Cir. 1994), 125 F.3d 1195 (9<sup>th</sup> Cir. 1997).



of  $M$ 's intermediate product, for which  $M$ . charges  $s$ .<sup>19</sup> Finally,  $D$ , which sells a final product (or end device) to consumers according to a demand function  $D(p) + v$ ; where  $p$  is the price charged to consumers for the final product and  $v$  is the extra willingness to pay for that product if it includes a component embedding the technology of the patent holder. Importantly, the patent holder is not vertically integrated midstream (or downstream).

The patent holder licenses both the midstream and downstream producers and charges them royalty rates  $r_M$  and  $r_D$ , respectively. The downstream producer's incremental cost of production is  $c + s + r_D$ , where  $c$  denotes the variable operating costs associated to the production of one unit of the final product. We assume that the royalty rates  $r_M$  and  $r_D$  are determined through efficient negotiations between the patent holder and the midstream producer and between the patent holder and the downstream producer, respectively. An efficient negotiation is one that reaches an outcome without delay and does not leave money on the table.<sup>20</sup>

## 1. The Royalty Neutrality Principle

Layne-Farrar, Llobet and Padilla<sup>21</sup> demonstrate that under the assumptions above, the downstream price and quantity are decreasing in the aggregate royalty rate,  $r_M + r_D$ , but are independent of how that royalty burden is split between the midstream and downstream producers. In other words, they find that consumer welfare is the same whether the patent holder licenses the midstream producer, the downstream producer, or both. They called this result the “royalty allocation neutrality principle.” They show that this principle holds whether the component price  $s$  is set unilaterally by the midstream producer or it is the result of a balanced and efficient negotiation between the midstream and downstream producers.

What happens if the patent holder shifts part of the royalty burden midstream, raising the midstream royalty but lowering the downstream one so as to leave the aggregate royalty unchanged? It turns out that the intermediate price the midstream manufacturer charges the downstream party will rise to accommodate the increase in costs suffered by the midstream manufacturer. In other words, the midstream manufacturer passes on the additional royalty payment, exactly offsetting the cost-savings enjoyed by the downstream producer from the lower royalty rate. Alternatively, if the patent holder reduces the midstream royalty and increases the downstream one, leaving the aggregate royalty rate unchanged, the component price will fall in response to the midstream manufacturer's reduced

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19 The intermediate product and the end product are thus consumed in fixed proportions: more precisely 1 to 1.

20 These assumptions require that (A1) no negotiating party enjoys an informational advantage (e.g. both the patent holder and the two producers have symmetrical information regarding the prices of the components and final product and the number of units of the component and final product sold); and (A2) the component price  $s$  and the final price  $p$  are flexible (i.e. not subject to regulation or other technical or economic limitations).

21 *Supra* note 5.

costs, so that it offsets the increase in the downstream royalty. That is, the component price  $s$  responds to changes in  $r_M$  and  $r_D$  that leave the aggregate royalty rate unchanged, and leaving  $s + r_D$  unchanged.

This means that the incremental cost of production faced by the downstream manufacturer,  $c + s + r_D$ , is a function of the aggregate royalty rate, but independent of how that the total royalty burden is distributed between the two layers of production. This in turn implies that the price and the quantity sold of the final product are also a function of the aggregate royalty rate *only*, and not of the way that such rate is split between midstream and downstream producers. Because the quantity sold of the final product is a function of the aggregate royalty rate and not of that rate as distributed, the profits of the patent holder, which are equal to the product of the aggregate royalty rate and the number of units sold of the final product, will also be a function of the aggregate royalty rate *only*. As a result, the patent holder will be indifferent in choosing to license to the midstream producer, the downstream producer or both. Likewise, since the price of the final product is an increasing function and the quantity sold is a decreasing function of the aggregate royalty rate only, consumer welfare falls with the aggregate royalty rate, but is independent of how that aggregate royalty rate is distributed. In conclusion, when royalty rates are negotiated efficiently, the profits of the patent holder and consumer welfare are the same whether the patent holder licenses the midstream producer, the downstream producer or both.

Note, in addition, that the upstream patent holder has no incentives to foreclose the midstream and downstream manufacturers, as otherwise its technology would never reach the final consumers. This conclusion applies equally to many midstream and downstream producers. A non-integrated patent holder will maximize its royalty revenues when the midstream and downstream markets are competitive. The more competition in those markets, the greater the volume of sales and, therefore, the larger the royalty revenues accrued by the IP owner.

There is, therefore, no justification for requiring the non-vertically integrated patent holder to license at the component level. Mandating component-level licensing will not have a positive impact on competition and welfare unless the licensor is vertically integrated midstream, i.e. unless it is also a competitor in the relevant component (or chipset) market.

## **2. Conditions for Anticompetitive Foreclosure with Vertically Integrated Licensors**

Is it justified to presume that when the decision to license at end-device level only is made by a vertically integrated licensor, that choice is necessarily driven by anticompetitive motivations? The answer is “no,” as we proceed to explain, relying on the arguments developed by Padilla and Wong-Ervin.<sup>22</sup>

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22 *Supra* note 6.

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One possible concern would be that by refusing to license at component level the vertically integrated patent holder may, in effect, be bundling its component (the bundled product) with its patent portfolio (the bundling product) in order to monopolize the midstream component market. It is true that any end-device manufacturer that buys the vertically integrated firm's component simultaneously acquires a license to its patents, but, when it buys components sold by the licensor's non-integrated rivals it still needs to negotiate a license for the vertically integrated patent holder's patents. As with other bundling strategies, the use of this strategy by a vertically integrated IP owner might in principle marginalize or evict its non-integrated component rivals. That will be the case when end-device manufacturers find it more economical to purchase the bundle rather than mix and match, i.e. if the strategy involves a sufficiently large bundled discount. However, as demonstrated by Padilla and Wong-Ervin, this will not happen when the vertically integrated patent holder (i) does not assert its component-level patents and (ii) licenses its patents portfolio to downstream end-device manufacturers on non-discriminatory terms, i.e. offering the same terms irrespective of whether they source components from its own subsidiary or from the non-integrated rival.

Intuitively, when these conditions hold, the bundled product offered by the vertically integrated patent holder can be replicated at no greater cost for end-device manufacturers. They can mix and match the component sold by the non-integrated component supplier and the patent portfolio of the integrated IP holder, paying no more than for the bundle. This is because the patents (the bundling products) are offered on a stand-alone basis (i.e. outside the bundle) on competitive terms and, therefore, the end-product manufacturers can choose either the vertically integrated patent holder's bundle or create their own bespoke bundle by purchasing the component from a non-integrated component manufacturer and still license the patent of the vertically integrated patent holder at the same cost. As a result, the bundle is effectively constrained by the unbundled products and *vice versa*, hence bundling causes no distortion of the competitive process.

A related concern would be that the refusal to license could increase the costs of the vertically integrated patent holder's rivals in the component market because they would have to offer indemnification to its customers from patent infringement liability in order to compete with the vertically integrated patent holder effectively. It is easy to see, however, that a covenant from the vertically integrated firm not to sue at component level could resolve the issue, provided that manufacturers of end-user devices are licensed on the same terms irrespective of whether they source components from their own subsidiary or from a non-integrated rival. When that is the case, the component price of the vertically integrated firm is effectively constrained by the prices offered by the non-integrated component manufacturers, since the latter need not offer indemnification to their customers to be competitive. It follows that, under those circumstances, the decision not to license at the component level causes no distortion of the competitive process either.

## IV. Comparing Alternative Royalty Bases

Licensing agreements between licensors and implementers typically specify a royalty payment (though some licensing agreements are royalty-free). The royalty payment is often calculated as the product of a royalty base and a royalty rate.<sup>23</sup> The royalty base can be determined in two main ways. First, royalties may be calculated by reference to the value of the sales of the entire final product incorporating the patented technology. Royalties calculated on this basis are known as *ad valorem* royalties. Royalties based on the net average selling price of the final product can be shown to have the same price and volume effects, and hence the same welfare impact, as royalties calculated by reference to the value of the sales of the final product. Second, royalties may be determined as a fraction of the value of the product components incorporating the patented technology. Importantly, when components and end products are sold in fixed proportions, the impact on final prices and volumes is identical whether royalties are calculated using the value of the components incorporating the technology as the royalty base, or if they are calculated using per-unit royalties – i.e. royalties determined as a fixed amount for each unit of the end product sold (or what amounts to the same for each unit of the component sold). Thus, component-value royalties and per-unit royalties will have the same welfare implications. This is because both types of royalties increase the licensee’s marginal cost of producing and commercializing the final product.

An extraordinarily large proportion of mutual agreements between licensors and licensees set royalties based on the sales price of the entire final product. One of the most comprehensive surveys to date considered the licensing practices of CNET (Centre national d’études des télécommunications, later part of France Télécom R&D, now Orange Labs), and showed that out of the 225 licensing contracts involving CNET’s patents, only nine contracts specified per-unit royalties, or royalties assessed against specific components of a final product, while the remaining contracts (96% of them) specified *ad valorem* royalties.<sup>24</sup> Similarly, using data collected between 1990 and 2012 from license agreements, Parr and Smith found that the vast majority (91%) of license agreements examined involved *ad valorem* royalties and only 9% involved per-unit royalties or component-level royalties.<sup>25</sup> Moreover, in a review of declarations to ETSI (the European Telecommunications Standards Institute) and announced patent licensing statements for LTE 4G communications standards, Stasik found that every announced rate was expressed as a percentage of the sales price of the end

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23 See *supra* note 4.

24 Alain Bousquet, Helmuth Cremer, Marc Ivaldi & Michel Wolkovicz, *Risk Sharing in Licensing*, 16 INT’L J. INDUS. ORG. 535 (1998).

25 RUSSELL L. PARR & GORDON V. SMITH, *INTELLECTUAL PROPERTY: VALUATION, EXPLOITATION AND INFRINGEMENT DAMAGES* – 2013 CUMULATIVE SUPP. (11th ed. 2013).

device.<sup>26</sup> Notably, the rates considered by Stasik were announced by innovators all over the world, including Huawei, Qualcomm, Ericsson, and Nokia. The *ad valorem* nature of most royalty payments has also been acknowledged by the courts. In *Lucent Techs v. Gateway*, the US Court of Appeals for the Federal Circuit noted that “sophisticated parties routinely enter into license agreements that base the value of the patented inventions as a percentage of the commercial products’ sales price.”<sup>27</sup>

The fact that an overwhelming number of licensing contracts are voluntarily set with *ad valorem* royalties strongly suggests that both licensees and licensors find *ad valorem* royalties mutually beneficial. Not everyone agrees, however. Some commentators have argued that in cases involving complex products, calculating a royalty base that is broader than the value of the components covered by the patent may overcompensate patent holders when the patent at issue covers only some components *and* the components covered by the patent are not the sole drivers of consumer demand for the product (even though they might contribute to demand).<sup>28</sup> In our opinion, this allegation is conceptually wrong because it (i) presumes that royalty rates will be the same irrespective of the choice of royalty base, (ii) ignores relevant practical considerations that militate in favor of royalties calculated by reference to the price of the final product, and (iii) fails to consider the (efficiency) implications for end-product prices and innovation incentives and, hence, for consumer and total welfare. We explain each of these arguments in greater detail in the remainder of this section.

## 1. Royalty Rates Are Not Independent of the Royalty Base

The distinction between royalties calculated using the entire value of the product and royalties calculated using the value of the components that integrate the technology is, in principle, arbitrary. This is because, as noted above, a royalty consists of a royalty rate and a royalty base. The royalty rate is a simple percentage that identifies what proportion of the base the licensor receives. Since the royalty rate can be adjusted downwards as the base expands, the final royalty payment can be mathematically identical irrespective of the royalty base. As stated by the US Court of Appeals for the Federal Circuit, “there is nothing inherently wrong with using the market value for the entire product for the infringing component or feature, so long as the multiplier accounts for the proportion of the base represented by the infringing component or feature.”<sup>29</sup>

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26 Eric Stasik, *Royalty Rates and Licensing Strategies for Essential Patents on LTE (4G) telecommunication standards*, LES NOUVELLES – THE JOURNAL OF THE LICENSING EXEC. SOC’Y INT’L, 2010, at 114.

27 *Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1338–39 (Fed. Cir. 2009).

28 Brian Love, *Patentee Overcompensation and the Entire Market Value Rule*, 60 STAN. L. REV. 263–294 (2007).

29 *Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d at 1338–39.

Those who argue that *ad valorem* royalties may overcompensate the licensor thus fail to understand that the royalty rate will have to adjust in response to changes in the royalty base. To the extent commentators or manufacturers argue that the royalty base should be the value of an individual component with no adjustment to the royalty rate, they are simply advocating lower total royalties rather than presenting a position about the appropriate method of calculation.

## 2. Practicability

There are a number of practical circumstances that make *ad valorem* royalties easier to apply and prone to fewer errors and subjective calls than royalties based on the price or value of the components covered by particular patents. Most importantly, apportioning value, either within a product or to particular patents, is a highly difficult and subjective task.

First, it may not be possible to separate the product into distinct components. In products driven by innovative technology, the value for a customer comes largely from the bundling of different features. For example, smartphones contain a telephone, photos and video upload/download, email, calendar functions and a range of other features. Further, implementation of features also cut across components. For example, the battery, screen, speakers, microphone and certain chipsets (e.g., the processors, RF chipsets, memory chipsets, etc.) contribute to implementing many of the aforementioned features (and may or may not implement all or portions of patents utilized to implement such features). Bundling is of value to customers since it allows them to have all the features on one device. The interactions between the various components make the value of the final product larger than the sum of the values of the different components. On this basis, any attempt to apportion value would in fact under-reward the innovation in each and every component, thereby reducing incentives for firms to invest and innovate.

Second, ascertaining the value of each component is a subjective task. This is particularly difficult for components that are not sold in wholesale markets or are developed in house. The practical realities limit the usefulness of using the value of the components that embed the technology as the royalty base.

Third, the component in question might enable other components to function. For example, the high data transmission rates provided by 4G mobile communication standards, and the underlying patented technologies contained therein, enable several different applications in smartphones that consumers value. Again, determining whether one component enables value for other components and assessing the value that this externality contributes to the product involves strong, highly complex, subjective considerations. Moreover, the precise choice of the component used to calculate the royalty will be arbitrary as it will not capture the underlying externality. *Ad valorem* royalties therefore provide a more practical approach to calculating appropriate royalty payments when some components are pivotal for others to work.

Fourth, the value of the component that embeds a patented technology is, in most circumstances, not a valid proxy for the value of that patented technology. This is because the patent, while covering a particular component, imparts value beyond that particular component. Consider, for example, a chipset used within a smartphone. The chipset is a distinct component, which has a discrete cost. However, it would be wrong to use that cost as a proxy for value because that chipset controls and facilitates many different functionalities, and the value of those enabled functionalities greatly exceeds the cost of the chipset. Just as it is impossible to separate the product into distinct components, it is just as hard, if not more so, to describe a particular patent as covering a single component.

In short, practical considerations suggest that *ad valorem* royalties are likely to be superior to royalties based on component value, particularly in technology markets where final products are often complex and the result of multiple patented components.

### 3. Efficiency Considerations

*Ad valorem* royalties are superior to royalties based on component value, even when we set aside the practical considerations discussed above. *Ad valorem* royalties lead to higher consumer welfare than component-value royalties (and hence per-unit royalties), because they reduce the final product price, encourage investment and, therefore, lead to more output and innovation. These effects are compounded in the case of complex products containing multiple patented components.

This is shown in a model by Llobet and Padilla.<sup>30</sup> In that model, licensors and licensees are allowed to modify their strategic choices – i.e. the royalty rates, the price of the end products and their investment decisions – in response to a change in the choice of royalty base. The model is structured as follows: licensors and licensees first decide their investment levels. Then the licensors are assumed to set royalty rates to maximize their profits. Finally, the licensees, taking as given the royalty rates, decide the volume to be sold of the end product, which in turns determines the price in the final market. This model is set up to describe with particularity the behavior of participants in markets where licensors develop technology that is embedded in complementary components of a final product, and where the probability of commercial success of the invention of a licensor is a function of all licensors' investment decisions.

Using this model, Llobet and Padilla investigate which method of determining the royalty base leads to higher consumer and total welfare. In particular, they consider (i) the price and volume outcomes for the end product obtained and (ii) the level of investment made by the licensors and the licensees under each royalty base. Of course, consumers prefer lower prices and greater volumes and, all else being

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30 Llobet & Padilla, *supra* note 10.



equal, consumers also prefer higher investment that brings products they value to the market. Llobet and Padilla find that *ad valorem* royalties yield higher consumer and total welfare. Specifically, they show that *ad valorem* royalties result in a relative reduction in the final product price and a relative increase in investment in R&D.

The use of *ad valorem* royalties reduces the problem of double marginalization that arises in markets involving vertically related firms where an upstream firm (here the licensor) sells an intermediate product (here the technology) to a downstream firm (here the licensee) who then sells a final product to consumers.

The double marginalization problem is more severe when the licensor uses per-unit royalties (or component-value royalties) rather than *ad valorem* royalties, because the licensee's incentive to increase the price of the product it sells in order to pass on the increase in its royalty burden is greater with per-unit royalties than with *ad valorem* royalties. As mentioned above, a per-unit royalty increases the marginal cost of the licensee. The licensee therefore has an incentive to increase the final price charged to consumers in order to maintain its margin. This incentive is smaller with *ad valorem* royalties, since an increase in the final price increases the value of sales and, given that the royalty base is given by this value, it also increases the royalty payment. The use of *ad valorem* royalties is therefore beneficial from a static welfare perspective: it results in an increase in the quantity sold in the final market and a lower price, both of which are beneficial for customers and society as a whole.

However, as explained in Section II above, consumer welfare is not only determined by short-run price and quantity outcomes, but also by the investment decisions made by firms in the long run. High investment in R&D leads to technological development, which results in new, better products valued by consumers in the market. This is welfare-enhancing for the customers and it is also beneficial for the industry.

Llobet and Padilla demonstrate that the expected return to investment for both licensors and licensees is greater when royalty payments are based on the price of the final product. Because *ad valorem* royalties mitigate the double marginalization problem, less economic surplus is wasted due to inefficient design of the royalty contract. While some of this economic surplus contributes to higher welfare for customers, some of that incremental surplus is appropriated by licensors and licensees. This increases their rate of return from investment and, hence, their incentives to invest.

This positive effect is even greater in the case of complex products using technologies from multiple licensors, since an increase in the amount each licensor invests has a positive impact on the other licensors' investment decisions. Since the success of a particular innovation depends on the investment made by all the licensors and licensees, when a licensor increases the amount it invests it creates a positive effect on all other investors, licensors and licensees, and hence causes an increase in overall investment both upstream and downstream.



## V. Concluding Remarks

In this paper, we have carefully considered the merits of recent complaints against the common industry practice in many technology industries, including the wireless industry, of licensing patents at end-device level rather than at component-part level, as well as complaints against the use of the entire value of the end device as the royalty base for the calculation of compensation.

We conclude that practice will not produce anticompetitive effects unless a licensor that is unwilling to license at component level is vertically integrated midstream (i.e. in the manufacturing of components), refuses to offer contractual protection against component-level suits, and offers better licensing terms when the licensee purchases its components.

In our opinion, these necessary conditions are not sufficient to justify the decision to compel patent holders to license at component level because such a decision may result in an increase in transaction costs, reduce the return to investment and, therefore, undermine dynamic efficiency. Instead we believe that, consistently with other refusal to license scenarios, compulsory licensing at component level would only be justified if, absent that intervention, all effective competition would be eliminated, thus preventing the emergence of new products for which there is potentially substantial demand. Our position in this regard is consistent with the position adopted by the ECJ in *Magill* and *IMS Health*.<sup>31</sup>

Our conclusions regarding the concerns that royalty payments may be excessive when the royalty base used in licensing agreements is the entire value of the end device are even more drastic. We find no welfare justification for mandating a narrow royalty base. Such an intervention would harm static and dynamic efficiency because *ad valorem* royalties based upon the price of the end device lead to more upstream and downstream innovation, lower prices and greater sales than royalties based on the price of the component, whether the latter takes the form of royalties based on the price of the component, per-unit component royalties or per-unit end-device royalties.

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31 *Supra* notes 7 and 8.

Nicolas Charbit  
Thomas Moretto  
*Editors*

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