

Busting Smartphone Patent Licensing Myths

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EXECUTIVE SUMMARY

Smartphones are an outstanding success for hundreds of handset manufacturers and mobile operators, with rapid and broad adoption by billions of consumers worldwide. Major innovations for these—including standard-essential technologies developed at great expense and risk primarily by a small number of companies—have been shared openly and extensively through standard-setting organizations and commitments to license essential patents on “fair, reasonable, and non-discriminatory terms.”

Despite this success, manufacturers seeking to severely reduce what they must pay for the technologies that make their products possible have widely promoted several falsehoods about licensing in the cellular industry. Unsubstantiated by facts, these myths are being used to justify interventions in intellectual property (IP) markets by antitrust authorities, as well as changes to patent policies in standard-setting organizations. This paper identifies and dispels some of the most egregious and widespread myths about smartphone patent licensing:

Myth 1: *Licensing royalties should be based on the smallest saleable patent practicing unit (SSPPU) implementing the patented technology, and not on the handset.* The SSPPU concept is completely inapplicable in the real world of licensing negotiations involving portfolios that may have thousands of patents reading on various components, combinations of components, entire devices, and networks. In the cellular industry, negotiated license agreements almost invariably calculate royalties as a percentage of handset sales prices. The SSPPU concept is inapplicable because it would not only be impractical given the size and scope of those portfolios, but it would not reflect properly the utility and value that high-speed cellular connectivity brings to bear on all features in cellular handsets.

Myth 2: *Licensing fees are an unfair tax on the wireless industry.* License fees relate to the creation—not arbitrary subtraction—of value in the cellular industry. They are payments for use of essential patented technologies, developed at significant cost by others, when an implementer chooses to produce products made possible by those technologies. The revenue generated by those license fees encourages innovation, and is directly related to the use of the patented technologies.

Myth 3: *Licensing fees and cross-licensing diminish licensee profits and impede them from investing in their own research and development (R&D).* Profits among manufacturers are determined by competition among them, including differences in pricing power and costs. Core-technology royalty fees, which are charged on a non-discriminatory basis and are payable by all implementers, are not the cause of low profitability by some manufacturers while others are very profitable. Cross-licensing is widespread: It provides in-kind consideration, which reduces patent-licensing costs and incentivizes R&D.

Myth 4: *Fixed royalty rates ignore the decreasing value of portfolio licenses as patents expire.* Portfolio licensing is the norm because it is convenient and cost efficient for licensor and licensee alike. All parties know the composition of the portfolio will change as some patents expire and new patents are added. Indeed, this myth is particularly fanciful given that the number of new patents issued greatly exceeds the number that expires for the major patentees. In fact, each succeeding generation of cellular technology has represented and will continue to represent a far greater investment in the development of IP than the prior generation.

Myth 5: *Royalty charges should be capped so they do not exceed figures such as 10% of the handset price or even well under \$1 per device.* There is no basis for arbitrary royalty caps. It is not unusual for the value of IP to predominate as a proportion of total selling prices, in books, CDs, DVDs, or computer programs. Market forces—not arbitrary benchmarks wished for or demanded by vested interests and which do not reflect costs, business risks, or values involved—should also be left to determine how costs and financial rewards are allocated in the cellular industry with smartphones.

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Smartphones are an outstanding success for hundreds of handset manufacturers and mobile operators with rapid and broad adoption by billions of consumers worldwide. Major innovations for these, including standard-essential technologies developed at great expense and risk primarily by a small number of companies, have been shared openly and extensively through standard-setting organizations such as 3GPP on the basis of fairness, reasonableness, and non-discrimination in patent licensing.

However, some manufacturers object to paying the patent licensing fees that compensate this risk-taking innovation and that are necessary to fund future research and development. In attempts to avoid or severely limit what they pay for the many patented technologies they must practice to make standard-compliant and functionally competitive products, some of them and their cohorts have propagated various unsubstantiated and false accusations about how patents are or should be licensed in the cellular industry.

Free riding on others' technologies

While the accusations are being made globally, they have been particularly pronounced in China, where more than 80% of the handsets sold throughout the world are produced. Handset manufacturers seemingly have the most to gain in the short term if the cost of licensing the patented technology embodied in those devices is crushed. That is particularly true for those manufacturers that are relatively new to mobile communications and are capitalizing on the enormous trove of preexisting and ongoing technology developments from longstanding innovators including Alcatel-Lucent, Ericsson, InterDigital, Nokia, Qualcomm, and many others. Indeed, many handset manufacturers have used this preexisting intellectual property (IP) to enter the market while owning little or no IP for the 2G and 3G technologies themselves, and only in recent years have some begun to invest significantly in 4G with LTE. Although the accusations are loudest in China, some manufacturing companies based in the U.S., Europe, and other parts of Asia are also seeking to reduce licensing fees by promulgating myths.

These myths appear to be designed to bring about antitrust authority interventions and to change standard-setting organization (SSO) patent policies. Antitrust authorities have taken action or voiced concerns about alleged harms by licensors of standard-essential patents in at least the United States, Europe, China, Korea, and Brazil. The world's largest SSO, the Institute of Electrical and Electronics Engineers (IEEE), recently changed its patent policy in response to pressure from the U.S. Department of Justice (DOJ), dating back to comments made in 2012 by Renata Hesse, Deputy Assistant Attorney General at the DOJ's Antitrust Division.¹ The change was very contentious, even among the SSO's members. With majority voting reflecting the interests of licensees above licensors, the IEEE, which standardized 802.11 (*i.e.*, Wi-Fi) among other standards, changed its patent policy regarding "Reasonable Rates" significantly on the basis of the first of the following five myths.²

Busted mythology

The following identifies and dispels some of the most egregious and commonly-stated falsehoods that have been promoted in the media and elsewhere about smartphone licensing with some facts and figures:

Myth 1: Licensing royalties should be based on the smallest saleable patent practicing unit (SSPPU) implementing the patented technology, and not on the handset

In general, parties are free to engage in bilateral negotiations to determine royalties for portfolios of patents covered by license agreements. That is how free markets work. In the case of the cellular industry, licensors and licensees often choose to value intellectual property in license agreements—corresponding to the royalty fees the licensee must pay for access to the IP—using a formula that multiplies a "royalty rate" expressed as a percentage with a "royalty base" agreed upon by the parties. The parties can negotiate the royalty rate and base they believe is appropriate for their business circumstances. In most industries it is commonplace for licensors and licensees to choose the sales of the licensee

Some commentators and interested parties who would like to reduce their licensing costs advocate taking away much of the freedom that parties have to bilaterally negotiate the value of IP and applicable royalties.

as the royalty base, and indeed this is the most common practice in the cellular industry, where royalties are almost invariably calculated as a percentage of handset sales prices. The parties use the handset sales price as the royalty base for a number of reasons (as noted below) and negotiate the appropriate royalty rate based on the IP to be licensed and in light of the selected royalty base.

What is most disturbing is that some commentators and interested parties who would like to reduce their licensing costs advocate taking away much of the freedom that parties have to bilaterally negotiate the value of IP and applicable royalties. In particular, they are advocating a mandatory “royalty base” of the so-called smallest saleable patent practicing unit (SSPPU), which they arbitrarily define as the baseband chip wholesale price rather than handset sales price. Restricting the valuation of IP in this manner is designed to result in enormous reductions in IP valuation. However, creating such mandatory rules and interfering in how sophisticated parties negotiate complex commercial contracts would distort and harm the market. Indeed, such a practice would be absolutely inconsistent with how parties have been negotiating IP licenses and doing business for decades.

The SSPPU concept is particularly inapplicable because it comes from courts and not from the real world of licensing negotiations involving patent portfolios, where the concept is seldom used, if ever, for standard-essential technologies in 2G, 3G, or 4G cellular communications. SSPPU is a term of art developed through judicial opinions in patent infringement cases in the United States as one of the many prospective ways in which juries may be asked to value a patent or a few patents that have been found to be infringed. And, even its applicability in litigation is case specific. As the name states, the concept can only be applied where the “patent practicing unit” can be defined. In a typical patent litigation, where no more than a few patents are at issue and the scope of the claims of each patent is defined by

the court, it may be possible to establish a smallest saleable patent practicing unit. But this is not a substitute for how a patent owner and a potential licensee might value a whole portfolio of patents as part of a license agreement. Cherry-picking the SSPPU concept and applying it out of context in portfolio licensing ignores the realities of licensing and how parties have valued patents and portfolios for many years.

Virtually every IP rightholder in the cellular communications industry that publicly reveals information about its licensing requirements, including EU companies (Alcatel-Lucent, Ericsson, Nokia, Siemens), North American companies (InterDigital, Motorola, Nortel, Qualcomm), and Chinese companies (Huawei, ZTE), has publicly stated in recent years that its mobile standard-essential patent (SEP) licensing rates are based on a percentage of the entire handset price, as illustrated with LTE.³ Samsung, the largest company in South Korea, justified a licensing offer for its 3G standard-essential patents in recent litigation with Apple in the U.S. International Trade Commission on the basis that royalties calculated on the price of the end product are consistent with industry practice. Licensing on this basis is a long-standing practice and was widely recognized since the introduction of 2G GSM, as noted by the International Telecommunications Standards User Group in 1998 and in 2G and 3G standards by several other observers including PA Consulting Group (2005), Credit Suisse First Boston (2005), and ABI Research (2007). European antitrust authorities and the U.S. courts also endorse this approach.⁴ The Chinese courts used this royalty base for determining a royalty rate in the Huawei-InterDigital case.

Even assuming that it is appropriate to apply the SSPPU concept to portfolio licensing, the SSPPU for many patent portfolios is likely to be the entire device. Narrowing the royalty base to the baseband processor does not reflect numerous SEP claims that extend beyond the chip, including many other components throughout the phone and elsewhere. Mobile communication is a system in which mobile devices operate in conjunction with cellular networks. For example, some patented techniques in interference mitigation are implemented in the ether in conjunction with antenna arrays (e.g., with MIMO technologies) of both phones and radio base stations.

There are other reasons why it would be unfair to try and confine the value of a portfolio to the cost of hardware components that do not represent the value

that the technology brings to the entire device. Cellular technologies are vital to much of the utility and value that consumers derive from non-cellular technologies. Cellular technology advances facilitate development of the downstream smartphone ecosystem. For example, built-in cameras would be worth much less to the user without the ability to immediately transmit photographs or live video (whether by email, text, or social media). GPS capability would be worth much less without the ability to rapidly download maps and other location-dependent data. High-resolution color screens would be worth much less without the capability to receive downloads or data streams adequate to fill those screens with photographs or video. Smartphone software applications now used globally by large numbers of consumers include Google, YouTube, Facebook, Twitter, Instagram, and Snapchat, and popular Chinese examples including Baidu, Youku Tudou, Sina Weibo, and TenCent's WeChat. These applications would be far less useful, if useful at all, without high data-rate cellular connections that provide a wide-range of immediate, on-the-go communication and content options, particularly as compared to devices that have only Wi-Fi connections or no wireless connectivity at all. A reliable, fast cellular data connection is necessary to enable the full functionality that consumers demand and now take for granted. Nowhere near as much follow-on innovation for smartphones would continue to occur if the cellular data rates remained stagnant.

Moreover, a chip-based royalty scheme incorrectly and unfairly associates royalties to costs, process economics, and competitive outcomes in the silicon chip foundry manufacturing business that have nothing to do with mobile technology development costs and the market value generated from these investments in the broader ecosystem. Similarly, the applicable royalties for software licensors are not and should never be limited to the relatively small cost of burning programs onto CD ROM media, or making them available for download over the internet. As U.S. District Judge Leonard Davis recently put it, “[b]asing a royalty solely on chip price is like valuing a copyrighted book based only on the costs of the binding, paper, and ink needed to actually produce the physical product. While such a calculation captures the cost of the physical product, it provides no indication of its actual value.”⁵ Accordingly, and for similar reasons, I was most critical of U.S. District Judge James Holderman's chip-based damages assessments in the *Innovatio* case.⁶

Creating mandatory rules and interfering in how sophisticated parties negotiate complex commercial contracts would distort and harm the market.

Cellular voice and data functionality is demonstrably very valuable to consumers as evidenced by the much higher selling prices and total sales for cellular devices in comparison to similar devices with Wi-Fi but without cellular capabilities. A particularly clear example is found in a comparison of Apple's 3G HSPA or 4G LTE iPhones against its non-cellular iPod Touch. These two different products have similar components and capabilities (processor, screen, memory, video, music, and camera), but the iPod Touch provides only a Wi-Fi connection, while the HSPA or LTE iPhone also provides a high-speed cellular data connection. The iPhone 5c 8GB models sell for \$450 (unsubsidized, as sold without service contract), while the iPod Touch 5th Generation model similar in terms of non-cellular capabilities but with 16GB of memory sells for \$199.⁷ In other words, adding the high-speed cellular connection increases the value to consumers of this device by over 125%, even though the additional manufacturing costs with necessary cellular chips and antenna are relatively small.⁸ Additional utility, appeal, and value to consumers are also most strongly illustrated by the fact that Apple's sales revenues for all iPhone models (\$102 billion) exceeded sales for all iPod models (\$2.3 billion) by a factor of 46 in 2014.

Myth 2: Licensing fees are an unfair tax on the wireless industry

License fees are payments for the benefit of incorporating necessary patented technologies in the licensee's products. They are recompense for decades of research and development (R&D) and billions of dollars in investments in fundamental technologies that enable 3G and 4G and provide a foundation for future standards. Fees are paid only by those who choose to employ the particular technologies. In contrast, taxes are imposed broadly with no choice or direct benefit in return to those who are levied.

Fair, reasonable, and non-discriminatory (FRAND) licensing fees pay for what is akin to shared outsourcing of R&D for many manufacturers. This collaborative

approach in standard-essential technologies is highly economically efficient, as illustrated by the world's 7.5 billion mobile connections with rapid and widespread upgrades to smartphones with 3G and 4G connections.⁹ So far, Chinese manufacturers are net users of others' technologies and net payers of licensing fees for cellular SEPs and other information and communication technology (ICT) standards and patented technologies. This position may change if and as their patented technologies are included in upcoming standardization and subsequent product implementations. If adequate licensing rates are maintained, Chinese companies will likely increase R&D and patenting, with some becoming predominantly licensors generating net receipts from licensing.

Licensing fees contribute to enormous R&D spending by various companies, including their extensive work in standard-setting organizations where most new technology submissions are rejected. Annual R&D spending in cellular was approximately \$48.4 billion in 2014, as indicated below in Figure 1, including figures for eleven large technology companies with a predominant or exclusive focus on mobile communications. Some of these are quite diversified and do not break out wireless R&D expenditures in public disclosures, so these figures include some R&D related to other technologies and product markets. However, my total excludes many companies who also invest significantly in cellular R&D, so I believe it provides a fair, yet approximate, representation of R&D investments by the mobile technology industry as a whole.

Cellular technologies are vital to much of the utility and value that consumers derive from non-cellular technologies.

Innovation driven by this extensive R&D spending reduces manufacturing costs and increases product and service performance. The prospect of earning licensing fees creates the incentive for technology developers to take technical and commercial risks to invest large amounts in R&D that would not be possible on the basis of product sales alone. In the absence of such incentives, devices and services would actually be more costly to produce, while less spectrum efficient, less functional, and less useful.

At the same time, not all R&D efforts are successful. According to a Signals Research study of submissions to 3GPP working groups, only one in six submissions were accepted for inclusion in the LTE standard.¹⁰ Inevitably, many developments fail before they get that far, and various completed standards (*e.g.*, WiMAX) have failed to be adopted successfully in the marketplace.

Patent licensing agreement negotiations with terms determined bilaterally in a free market have provided widespread access to patented technology for manufacturers while fostering large and increasing R&D investments. Intervention to change the basis for charging royalties with

Figure 1: Total Sales Revenues and R&D Investments for Leading Cellular Technology Companies, in U.S. Dollars and as a Percentage of Sales Revenues

	2008	2009	2010	2011	2012	2013	2014	Growth 2008– 2014
Total Sales (millions)	\$399,917	\$353,836	\$401,722	\$510,840	\$559,173	\$582,011	\$614,459	74%
Total R&D (millions)	\$27,990	\$27,854	\$30,829	\$37,922	\$39,970	\$42,073	\$48,386	74%
R&D/Sales	7.0%	7.9%	7.7%	7.4%	7.1%	7.2%	7.9%	

Sources: Includes public disclosures for Alcatel-Lucent, Apple, BlackBerry, Ericsson, Huawei, LG Electronics, MediaTek, Nokia, Qualcomm, Samsung Electronics, and ZTE.

the overt objective of reducing them will be a disincentive to ongoing investment, risk-taking, and SSO participation by technology developers.

Myth 3: Licensing fees and cross-licensing diminish licensee profits and impede them from investing in their own R&D

According to Credit Suisse, from 2007 to 2013, handset operating profits tripled to \$51 billion on \$326 billion revenues.¹¹ This was achieved while many manufacturers made substantial R&D investments, signed cross-licenses, and paid patent licensing fees. Some handset manufacturers struggle or fail to make profits because their finished-goods products are undifferentiated and competition is fierce as a result of low market entry barriers and widely-available inputs, including merchant baseband chips (*i.e.*, those which comply with standards but are proprietary designs sold to third parties) and commodities such as memory. This drives manufacturers to pricing at marginal cost as predicted by basic economic theory. Licensing fees are just another common input cost such as that for chips, batteries, or displays.

Profits among manufacturers are determined by competition with differences in pricing power and differences in costs, not by common input costs. It is the economies of scale, scope, vertical integration, brand value, and the IP that manufacturers will not license that puts the likes of Apple and Samsung at advantage with regard to their costs and pricing power. Apple and Samsung generate substantial smartphone profits (up to nearly 60% gross margins for Apple's iPhones) while patent fees are paid to various licensors on these products.¹²

Cross-licenses are common commercial terms in patent licenses providing in-kind consideration. Cross-licensing can reduce licensing costs with an offset in recognition of the patents owned by the licensee. But this effect is rather small for most Chinese manufacturers because virtually all of them have limited R&D history in mobile devices. To illustrate this, Figure 2 below provides a comparison between a major holder of potentially essential patents, Qualcomm, and Chinese leaders, based on the disclosure of potentially essential patents for WCDMA. Ericsson, InterDigital, Motorola, Nokia, and several others also have significant history with SEPs on this standard. The cross-licensing of manufacturers' patents is a contribution in the

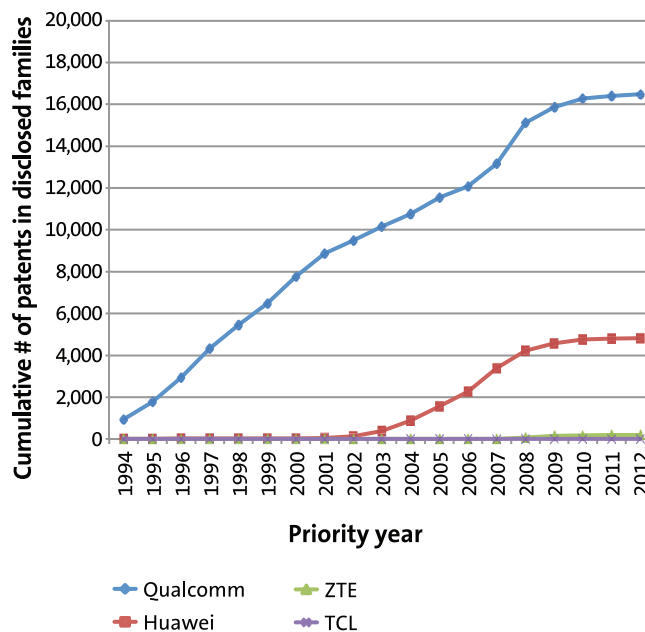
Licensing fees contribute to enormous R&D spending by various companies.

overall licensing agreement terms including up-front fees, running royalties, and other factors. Manufacturers often negotiate for some patents, including future applications and grants in particular, to be excluded from cross-licenses. This also maintains incentives to invest in innovation.

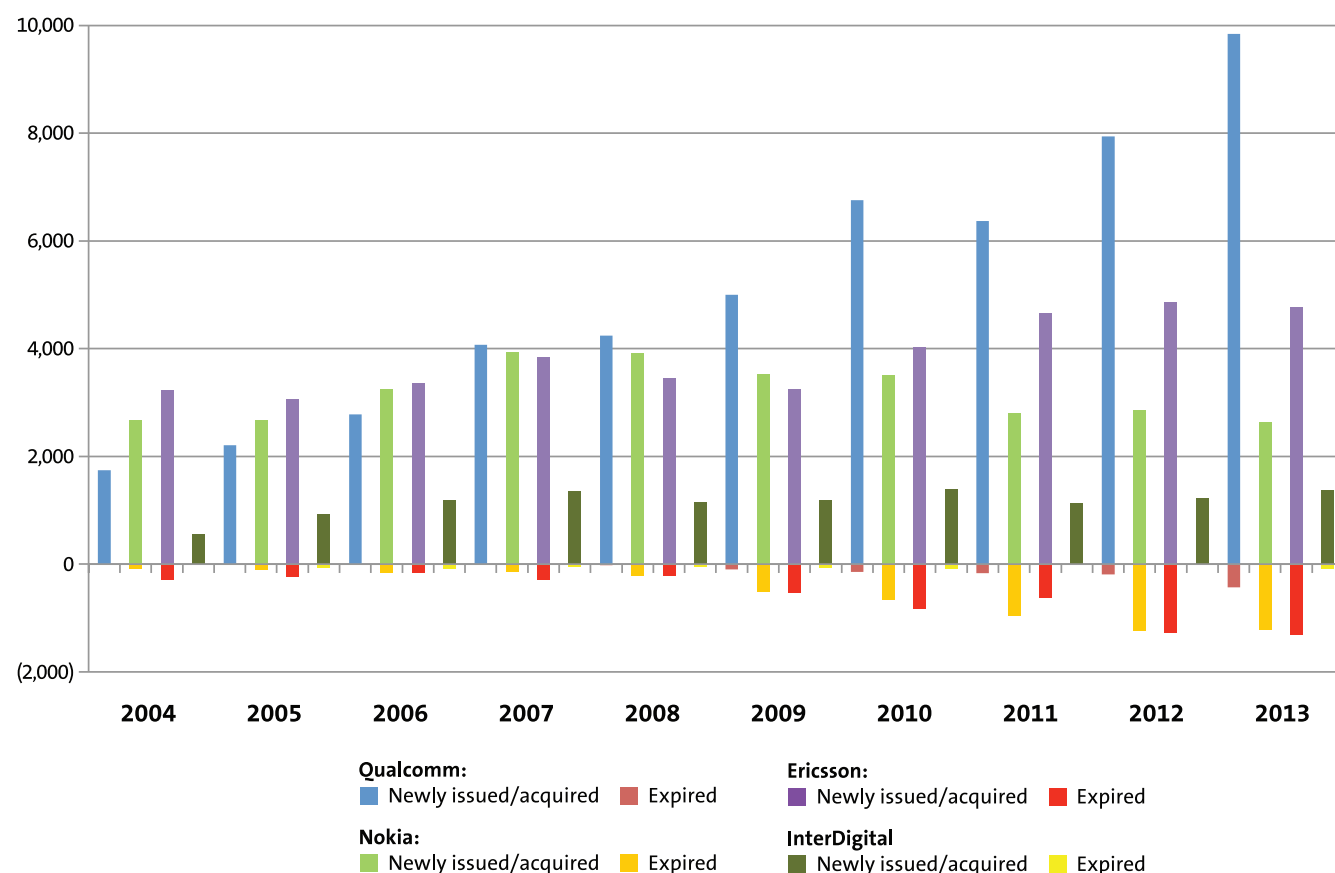
Myth 4: Royalty rates do not reflect reduced value with expiring patents in portfolio licenses

Portfolio licensing is the norm with standards because this unified approach is most convenient and cost efficient for licensor and licensee alike. Mobile SEP portfolios licensed may include multiple standards (*e.g.*, 3G WCDMA/HSPA and 4G LTE) and sometimes include non-SEPs. As indicated above, many owners of LTE SEPs have published

Figure 2: Number of Worldwide Patents/ Applications Disclosed to ETSI for WCDMA Standards



Source: ETSI Disclosure Data.

Figure 3: Worldwide newly issued/acquired vs. expired patents

Source: Thomson Innovation.

their licensing rates on a portfolio licensing basis. In the case of popular patent pools such as MPEG LA's for the H.264 video used in Blu-Ray players, cable and satellite receivers, PCs, and smartphones, the growing portfolio of 2,500 patents is the aggregation of the patent portfolios owned by thirty licensors that is licensed to over 1,000 licensees.¹³

R&D investments and the rates of patenting are increasing, so the number of patents net of expired patents is also still increasing. This is true for all the major going concerns in cellular, including Ericsson, InterDigital,

Nokia, and Qualcomm. Consequently, it makes great commercial sense for manufacturers to execute long-term portfolio licenses, particularly with companies who have a track record of contributing innovative technologies to standards. This ensures the licensee's technology access, including smooth transitions to newer technologies, while also providing certainty on royalty obligations.

Publicly-available patent data for major patent owners in the cellular industry shows that new patents greatly exceed expired patents for major cellular patentees. As shown above in Figure 3, in 2013, for example, according to the Thomson Innovation patent database, a total of 430 Qualcomm patents expired worldwide. In the same year, nearly 10,000 new patents were granted to or acquired by Qualcomm. Likewise, between 2011 and 2013, fewer than 800 Qualcomm patents expired worldwide, whereas over 24,000 new patents were granted or acquired. Based on this data, the number of patents newly incorporated into Qualcomm's portfolio over the last ten years is 48 times

Market forces determine how financial rewards are allocated, not arbitrary benchmarks wished for or demanded by vested interests.

Depriving technology developers of licensing income based on these myths will remove their incentives to invest and take risks in new technology developments.

higher than the number of patents that expired in that same period. Similar patterns, with new patents greatly exceeding expired patents, are also evident for other major patent holders, including Ericsson, Nokia, and InterDigital.

Myth 5: Royalty charges should be capped so they do not exceed figures such as 10% of the handset price or even well under \$1 per device

There is no basis for these arbitrary price caps other than a manufacturers' desire to minimize costs by accessing as much patented technology as they can while paying as little as possible. There is no price cap on the proportion of value for intellectual property rights in a book, CD, DVD, or computer program. In those examples, the total value of the IP (including royalties paid to authors, musicians, movie studios, and software publishers) tends to predominate as a proportion of total selling prices. Market forces determine how financial rewards are allocated, not arbitrary benchmarks wished for or demanded by vested interests, and which do not reflect costs, business risks, or values involved.

While hardware manufacturing costs are declining, soft costs in technology development, software, and services are increasing. Licensing charges must enable recovery of these costs and should also reward licensors for the success of their risky R&D investments so that they can cover losses from some inevitable failures. If technology developers are

deprived risk-adjusted returns on previous investments they will cease investing for the future, or do so in ways that better protect their intellectual property. For example, technology developers will return to favoring their own proprietary technologies over contributing to standards.

A big bust up for everyone

There has been a major and widely beneficial shift from proprietary to open and collaborative standards with FRAND licensing of SEPs in ICT over the last thirty years. Diminishing licensing returns, however, may prompt a swing back in the opposite direction away from open and collaborative technology development on the basis of FRAND licensing to manufacturers. Unintended consequences of antitrust interventions and SSO policy changes based on the above myths may include reversion to closed and proprietary technology developments so that technology developers might, once again, be properly rewarded for their considerable investments and risks.

Competition authorities in the US, Europe, China, and Korea, and certain SSOs such as IEEE, are undermining well-established global principles and practices in patent licensing in the wireless communications industry based on these myths. Other competition authorities and other SSOs might well follow suit and further expropriate significant value in existing patented technology from patent owners and gift it to manufacturers downstream. However, there is no evidence of structural problems in licensing IP rights in the cellular communications industry, and the alleged faults that have been identified by IP licensees are illusory. Rather, depriving technology developers of licensing income based on these myths will remove their incentives to invest and take risks in new technology developments. It will bite off the hands that feed manufacturing-oriented cellular technology companies, the very parties pressing for these changes.

ENDNOTES

- 1 See Renata Hesse, *Six “Small” Proposals for SSOs Before Lunch* (Oct. 10, 2012), <http://www.justice.gov/atr/file/518951/download>; see also J. Gregory Sidak, *The Antitrust Division’s Devaluation of Standard-Essential Patents*, 104 Geo. L.J. Online 48, 49 (2015).
- 2 According to IEEE’s new patent policy, “determination of such Reasonable Rates *should include*, but need not be limited to, *the consideration* of: [i] The value that the functionality of the claimed invention or inventive feature within the Essential Patent Claim contributes to the value of the relevant functionality of the smallest saleable Compliant Implementation that practices the Essential Patent Claim. [ii] The value that the Essential Patent Claim contributes to the smallest saleable Compliant Implementation that practices that claim, in light of the value contributed by all Essential Patent Claims for the same IEEE Standard practiced in that Compliant Implementation.” *IEEE-SA Standards Board Bylaws* 16 (Mar. 2015), http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf (emphasis added).
- 3 *Royalty Rates And Licensing Strategies For Essential Patents On LTE (4G) Telecommunication Standards* (September 2010), <http://www.investorvillage.com/uploads/82827/files/LESI-Royalty-Rates.pdf>.
- 4 *Commission Notice – Guidelines on the application of Article 81 of the EC Treaty to technology transfer agreements* (Apr. 2004), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2004.101.01.0002.01.ENG.
- 5 *Commonwealth Scientific & Indus. Research Organisation v. Cisco Sys., Inc.*, No. 11-CV-343, 2014 WL 3805817, at *11 (E.D. Tex. July 23, 2014).
- 6 Keith Mallinson, *Absurd (F)RAND licensing-rate determinations for SEPs*, IP finance (Nov. 15, 2013), <http://ipfinance.blogspot.co.uk/2013/11/absurd-frand-licensing-rate.html>.
- 7 The iPhone 5c 8GB and iPod Touch 5th Generation 16GB both possess front- and rear-facing cameras, the same display with touch screen functionalities, and the same visual and audio playback capabilities. *Apple iPhone 5c*, PhoneArena, http://www.phonearena.com/phones/Apple-iPhone-5c_id7983 (last visited Aug. 17, 2015); *Apple iPod touch 5th generation*, PhoneArena, http://www.phonearena.com/phones/Apple-iPod-touch-5th-generation_id7545 (last visited Aug. 17, 2015).
- 8 The additional value to consumers from a cellular connection can also be seen in the Apple iPad. Apple charges approximately an additional \$130 for an iPad Air 2 or iPad mini 3 with a 4G cellular connection than the same device without a cellular connection. According to IHS iSuppli, the cost of adding cellular connectivity (including 2G, 3G, and 4G LTE) to an original iPad Air is \$35 in components plus \$1 in manufacturing. *New iPad Air Costs Less to Make Than Third-Generation iPad Model, IHS Teardown Reveals* (Nov. 5, 2013), <https://technology.ihs.com/463579/new-ipad-air-costs-less-to-make-than-third-generation-ipad-model-ihs-teardown-reveals>.
- 9 The number of connections tends to significantly exceed the number of subscribers because a single user may use more than one phone, or a phone plus a tablet, eReader, or PC with a cellular connection.
- 10 *The Essentials of Intellectual Property: Quantifying Technology Leadership in the Development of the LTE Standard* (Sept. 2010), Signals Research Group, LLC, http://www.ericsson.com/res/docs/2010/101220_lte_contribution_whitepaper.pdf.
- 11 *The Wireless View 2014: Smartphones – A Slowing Disruptive Force* (Jan. 6, 2014), Credit Suisse, https://doc.research-and-analytics.csfb.com/docView?language=ENG&source=emfromsendlink&format=PDF&document_id=805847640&extdocid=805847640_1_eng_pdf&serialid=VKIqPfyGKvPXILC6%2bF%2bpFCXU1PjBAqhenh6L1IN6AVE%3d.

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- 13 MPEG LA, *AVC/H.264 Introduction*, <http://www.mpegla.com/main/programs/AVC/Pages/Intro.aspx>.

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