

The Smartphone Royalty Stack: Surveying Royalty Demands for the Components Within Modern Smartphones

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[WORKING PAPER²]

Competition in the smartphone industry is fierce, and for smartphone suppliers, achieving profitability is highly challenging. Indeed, few suppliers are meeting the basic goal of selling devices for more than the costs incurred in supplying them.³ This article examines one category of such costs: the cumulative royalty demands for the patents claimed to cover technologies in a smartphone.

The authors have years of experience studying such costs, as an in-house attorney at a supplier of components for mobile devices, and as litigators who have worked on many patent cases involving smartphones. For this article, we report only publicly-available information. To the extent that we have knowledge of confidential licensing information through our in-house or litigation work, we do not report it in this article, in any way. But, our collective experience has allowed us to effectively canvass publicly-available information to sketch the royalty landscape for smartphones.

Using exclusively this public information, the article presents a “bottom-up” analysis of smartphone royalties by examining the potential royalty burden on the major technologies and components in smartphones. We are unaware of any similar study. Some studies have focused on royalties on discrete technologies (*e.g.*, cellular communication functionality), rather than the broad range of components across the entire device.⁴ Others have quantified relevant intellectual

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² The authors intend to submit the final version of this article for publication in a journal. That version may incorporate additional new data as well as refinements of the analysis set out herein. The authors invite comments and suggestions for improvement, which they will consider while finalizing the article. Their email addresses are ann.k.armstrong@intel.com; joseph.mueller@wilmerhale.com; and timothy.syrett@wilmerhale.com. Please send any comments and suggestions to all three in an email titled “Royalty Stack Working Paper.”

³ Philip Elmer-DeWitt, *Apple had 57% of mobile profits in Q1, Samsung 43%*, CNNMoney, May 7, 2013, <http://tech.fortune.cnn.com/2013/05/07/apple-samsung-profits-canaccord/> (reporting figures from Canaccord Genuity showing Apple and Samsung earning almost all of the profits in the smartphone industry in 2012 and the first quarter of 2013) (last visited Feb. 20, 2014).

⁴ See *e.g.*, Eric Stasik, *Royalty Rates and Licensing Strategies for Essential Patents on LTE (4G) Telecommunications Standards*, LES NOUVELLES, at 116 (September 2010) available at <http://www.investorvillage.com/uploads/82827/files/LESI-Royalty-Rates.pdf> (last visited Feb. 20, 2014) (collecting announced LTE royalty rates).

property rights but have not attempted to capture the royalty demands that may accompany them.⁵

The data collected in this article are relevant not only to better understanding the dynamics of the smartphone market but also to the ongoing development of the law and business principles for determining a “reasonable royalty” under the patent laws and/or under commitments to license on “fair, reasonable, and non-discriminatory” (“FRAND”) or “reasonable and non-discriminatory” (“RAND”) terms.

In particular, there has been significant recent focus on “royalty stacking,” in which the cumulative demands of patent holders across the relevant technology or the device threaten to make it economically unviable to offer the product.⁶ This article is intended to provide insight into the royalty stack that smartphone suppliers face. The data show that royalty stacking is not merely a theoretical concern. Indeed, setting aside off-sets such as “payments” made in the form of cross-licenses and patent exhaustion arising from licensed sales by component suppliers, we estimate potential patent royalties in excess of \$120 on a hypothetical \$400 smartphone—which is almost equal to the cost of device’s components. Thus, the smartphone royalty stack across standardized and non-standardized technology is significant, and those costs may be undermining industry profitability—and, in turn, diminishing incentives to invest and compete.

We first explain the assumptions we have made and the limitations inherent in our public data collection. Next, we give context to the origins of royalty demands that smartphone suppliers face by briefly reviewing the wave of patent litigation involving smartphone suppliers. Finally, with that background, we present the data that we have collected in our component-by-component survey of royalty demands.

⁵ See, e.g., Brad Biddle, Andrew White & Sean Woods, *How Many Standards in a Laptop? (And Other Empirical Questions)*, 1 (Sept. 10, 2010), available at SSRN: <http://ssrn.com/abstract=1619440> (last visited Feb. 20, 2014); RPX Corp., Registration Statement (Form S-1), 59 (Sept. 2, 2011), available at <http://www.sec.gov/Archives/edgar/data/1509432/000119312511240287/0001193125-11-240287-index.htm> (“Based on our research, we believe there are more than 250,000 active patents relevant to today’s smartphones”) (last visited Feb. 20, 2014).

⁶ See, e.g., *In re Innovatio IP Ventures, LLC Patent Litigation*, No. 11 C 9308, 2013 WL 5593609, at *10 (N.D. Ill. Sept. 27, 2013) (“the court concludes that royalty stacking may be a concern when setting a RAND rate to ensure that the asserted patents are not overvalued compared to the technological contribution they make to the standard. Practically speaking, that means that the court should consider royalty stacking as a way of checking the accuracy of a proposed RAND royalty’s correspondence to the technical value of the patented invention.”); *Microsoft Corporation v. Motorola, Inc.*, No. C10-1823JLR, 2013 WL 2111217, ¶ 66 (W.D. Wa. April 25, 2013) (the “RAND commitment . . . addresses royalty stacking and the need to ensure that the aggregate royalties associated with a given standard are reasonable.”). See also *Georgia-Pacific Corp. v. U.S. Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970) (determination of reasonable royalty may take into account commercial aspects of the accused device, including “[t]he established profitability of the product made under the patent; its commercial success; and its current popularity” and “[t]he portion of the realizable profit that should be credited to the invention as distinguished from non-patented elements, the manufacturing process, business risks, or significant features or improvements added by the infringer”).

Assumptions and Limitations

The Smartphone

To the extent possible, we have attempted to express the royalty demands addressed in this article in dollar figures. To do so, we have based our analysis on a hypothetical smartphone selling for \$400. (Note that this is not the carrier-subsidized price to consumers but the full price that carriers would pay to the smartphone supplier.) High-end, advanced smartphones sell for \$600 or more, but according to a recent estimate, the average price of a smartphone fell to \$375 from \$450 at the beginning of 2012.⁷ We assume that all major technology categories would be included in a \$400 phone.

Similarly, where a royalty is expressed in a form requiring an annual sales volume assumption to determine a per-product rate, we have assumed annual smartphone sales of 30 million units. That sales levels would make the hypothetical smartphone supplier a successful player in the market, but is still far below what market leaders sell.⁸

For some technologies, we have a considerable body of data regarding public license demands. When license royalty data are not available for a particular component or technology, we have provided information drawn from damages disputes in relevant litigations.

To put in context the royalty demands, we note the costs of the relevant physical components. Depicted below are the estimated costs—according to Nomura Securities, which in turn relied on Gartner data—of the components in a smartphone on a component-by-component basis.⁹ According to this set of estimates, the sum of the components shown is approximately \$120 to \$150:

⁷ Peter Burrows, *High-End Smartphone Boom Ending as Price Drop Hits Apple*, Bloomberg (July 21, 2013), <http://www.bloomberg.com/news/2013-07-21/high-end-smartphone-boom-ending-as-price-drop-hits-apple.html> (last visited Feb. 20, 2014).

⁸ IDC Press Release, *Strong Demand for Smartphones and Heated Vendor Competition Characterize the Worldwide Mobile Phone Market at the End of 2012*, IDC.com (Jan. 24, 2013), <https://www.idc.com/getdoc.jsp?containerId=prUS23916413> (last visited Feb. 20, 2014).

⁹ Nomura Securities 2012 Smartphone Guide (citing Gartner data), *available at* http://images.businessweek.com/bloomberg/pdfs/nomura_smartphone_poster_2012.pdf (last visited Feb. 20 2014) (images from Nomura revised for clarity).



These component costs are relevant not only for painting a more complete picture of the total costs for a smartphone but also for providing useful context for the royalty demands discussed below. We find, for example, that announced royalty demands for LTE cellular functionality approach \$60 for a \$400 smartphone but the average cost of the baseband processor that implements cellular functionality is as little as \$10 to \$13. The disparity between patent royalty demands and component prices is an issue that courts will increasingly confront as they apply the Federal Circuit’s apportionment jurisprudence, which requires that damages be based on (at most) the smallest salable patent-practicing unit.¹⁰

Cross Licenses and Pass-Through Rights

We express royalty costs purely in monetary terms. We have not attempted to account for a smartphone supplier’s potential to reduce its cash payments for royalties through cross-licenses and pass-through or exhaustion of patent rights.

A smartphone supplier could “pay” for patent rights through non-monetary payments in the form of a cross-license to its own patents. Entering such cross-licenses would reduce the cash the smartphone supplier would have to spend on licensing. For companies with a strong

¹⁰ See, e.g., *GPNE Corp. v. Apple, Inc.*, No. 12-CV-02885-LHK, 2014 WL 1494247, at *13 (N.D. Cal. April 16, 2014) (“[T]he Court holds as a matter of law that in this case, the baseband processor is the proper smallest salable patent-practicing unit.”).

patent portfolio, this could eliminate cash payments altogether for certain licenses. But granting non-monetary patent rights is still a form of compensation and, presumably, a licensor would demand equal compensation no matter the form in which it is received.

The smartphone supplier's royalty burden might be further reduced because of patent rights that accompany components it purchases—such as the baseband processor that provides cellular functionality. The component supplier is likely to have contracted for rights to at least some patents relevant to the component it is selling; such patents are then exhausted through “authorized sales” of the components.¹¹ The patent rights are thus “passed through” to the component customers. In the 2012 *Apple v. Samsung* trial in the Northern District of California, for instance, Apple prevailed on a patent exhaustion defense against Samsung's two declared-essential cellular patents, because a cross license between Intel and Samsung meant that Samsung's patent rights were exhausted through Intel's authorized sales to Apple of baseband processors substantially embodying those patents.¹²

This article does not try to quantify the potential impact that cross licenses and pass-through rights would have on the amount of royalties paid by a smartphone supplier in money (as opposed to consideration in the form of patent rights). Conducting such an analysis on an industry-wide basis presents significant practical challenges, because of the paucity of publicly-available information about the scope of many existing cross-licenses. Cross-licenses and pass-through rights could be expected to significantly decrease the monetary payments made by companies with large patent portfolios.

Geographic Scope

We focus predominately on U.S. data, particularly when it comes to litigation outcomes. Most smartphone suppliers would presumably want worldwide patent rights under their licenses, unless they supply devices to only a few countries. We understand that when global companies negotiate worldwide patent licenses, they often focus on U.S. patents as a proxy for overall portfolio strength. But a fuller accounting of worldwide data could be expected to increase the royalties reported.

Limitations

In addition to the assumptions noted above, we acknowledge the obvious limitation of this project—it is not possible to capture all relevant licensing demands and we make no claim to have done so. Most licensing agreements are confidential because patent holders and licensees alike have an intense interest in keeping that information out of the public view. Royalty information could provide a powerful advantage to third parties in subsequent negotiations with the parties to the license. This article is limited to presenting publicly-available information that

¹¹ See *Quanta Computer, Inc. v. LG Electronics, Inc.*, 552 U.S. 1060 (2007) (“The longstanding doctrine of patent exhaustion provides that the initial authorized sale of a patented item terminates all patent rights to that item.”).

¹² The district court later vacated the jury's exhaustion finding because it was inconsistent with its finding of non-infringement for the two patents. *Apple, Inc. v. Samsung Electronics Co., Ltd.*, 920 F.Supp.2d 1079, 1112-13 (N.D. Cal. 2013). But the court found that all the other elements of exhaustion had been established. *Id.*

inherently does not provide a complete picture. Further, even as to the publicly-available information, we have neither addressed every technology or component in a smartphone nor have we found all relevant royalty data for those we do address.

There are also limitations to the public information we have found through our research. As an example, when patent holders publicly announce the rates they intend to charge for a patent portfolio—sometimes referred to as “headline rates”—there is reason to suspect that rates go down during the back and forth of negotiation. In addition, for certain technologies, particularly standardized ones, such as cellular and Wi-Fi, there is significantly more available public royalty data than for other technologies, for which we have found limited or no information.

In evaluating the data that we present, it is important to consider not only the magnitude of the potential royalty demands, but also the probability demands will be made at all—which varies according to the technology area or type of component in a smartphone. That variation in probability of having to pay royalties falls on a continuum, as illustrated by the graphic below, with certain categories of patents carrying a greater level of royalty risk than others¹³:



On the far right, a smartphone supplier will inevitably have to pay royalties for certain declared-essential patents for cellular and other standards. Patent holders of allegedly standard essential patents (SEPs) often have well-established licensing programs and routinely seek licensing fees for those patents. Moreover, holders of declared SEPs can easily spot when new entrants are supporting a particular standard (if not specific patents).

Next, there are patents that may be considered “commercially necessary” because they cover features or aspects of a device (such as its operating system and camera) that, although not standardized formally, customers typically demand. These patents carry a lesser but still significant risk of royalty demands.

Moving left on the spectrum, user interface patents present a lower likelihood of royalty assertions, because the variability of design choices in creating a “look and feel” for a particular smartphone reduces the odds that a given smartphone design will be covered by another party’s patents. Put another way, the universe of options for creating a user interface is greater than for standardized features or commercially necessary technologies. That is even more true with respect to the outer design of the product—design patents carry major remedies (including disgorgement of infringers’ profits) for infringement but are limited to product-differentiating designs that allow room for innovators to create their own unique, non-infringing designs.

¹³ Graphic prepared by Fulcrum Legal Graphics.

By analogy, the royalty exposure for features on the right side of this spectrum is like a tax that a smartphone supplier should expect to pay at some level. The royalty exposure for features on the left side of this spectrum is more like a lightning strike—an event that can be highly costly if it occurs, but is unusual and less predictable. We have not attempted to adjust the potential royalties described below to account for the likelihood that a smartphone supplier would actually face a demand, but this perspective nonetheless is important context for evaluating our data.

Smartphone Patent Litigation

The smartphone market has been the battleground for an enormous amount of litigation over the past few years. Two primary factors have driven the pace of these suits.

First, the modern smartphone is a “converged” device integrating many functions that were once in separate devices. Convergence has brought into competition companies that historically operated in distinct markets. For example, companies that had traditionally dominated telecommunications (such as Nokia, Ericsson, and Motorola) have faced new competition from companies like Apple and Microsoft with backgrounds in computing. The introduction of cameras in smartphones is another example of the merging of two previously distinct industries and sets of players. This trend has precipitated frequent assertions of declared SEPs subject to commitments to license on FRAND terms by the old-line telecommunications companies, which have storehouses of such patents. For their part, the new entrants have largely asserted patents that cover technologies that were not present in older mobile devices—such as computer-driven features and new forms of design patents.

Given the large number of discrete technologies in the modern converged smartphone, the volume of potentially relevant patents is vast. Indeed, one estimate suggests there are 250,000 current patents relevant to the modern smartphone.¹⁴ The large number of technologies provides a correspondingly large number of targets not only for smartphone competitors, but also non-practicing entities (NPEs).

Second, the market for smartphones has exploded. Smartphones sales for 2013 topped one billion units globally for the first time ever.¹⁵ In addition, global revenues for smartphone and tablet sales in 2013 are estimated to have surpassed for the first time revenues for the entire consumer electronics markets (*e.g.*, televisions, audio equipment, cameras, and home appliances).¹⁶ The amount of money at stake has created strong incentives for patent holders to assert their patents, either for long-term strategic gains or immediate financial rewards. Again, these incentives drive both competitor and NPE suits. As the bank robber Willie Sutton is

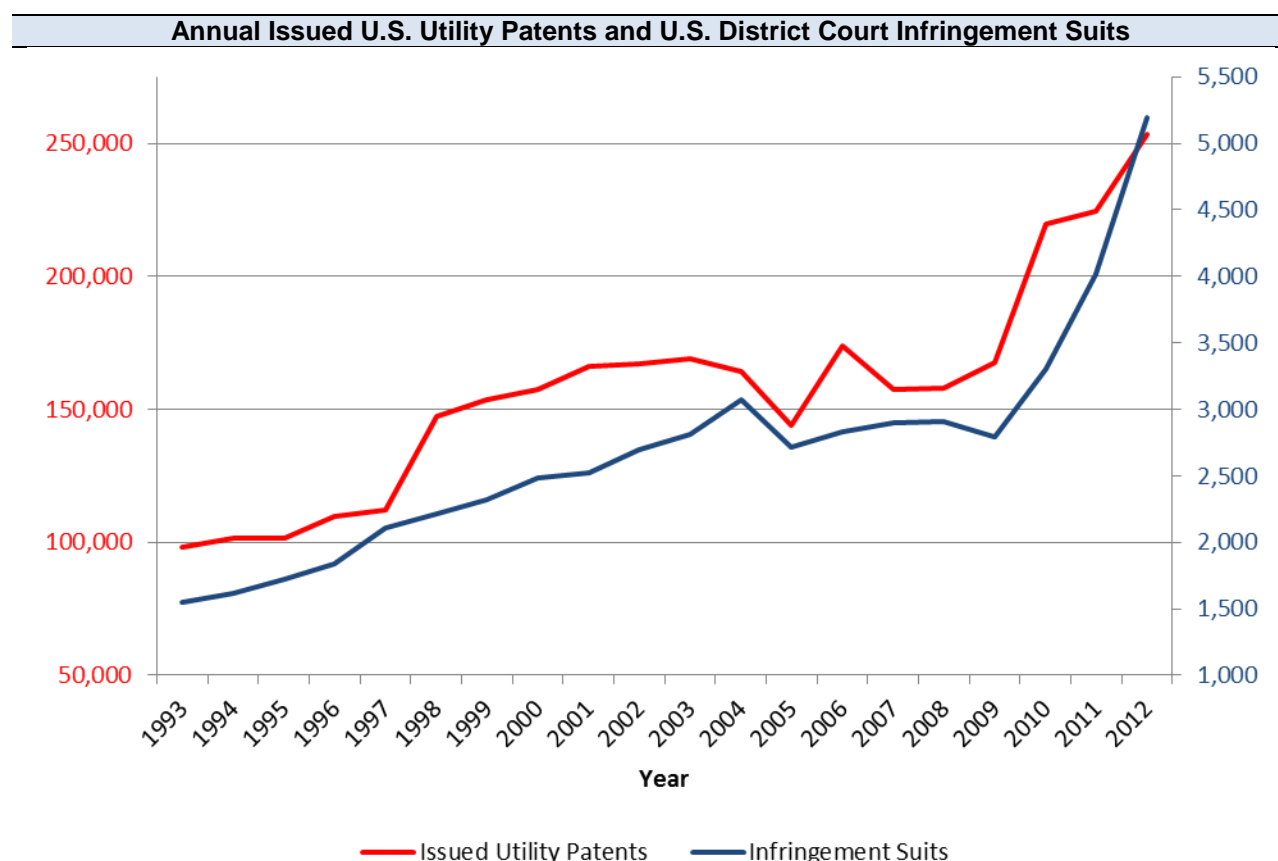
¹⁴ RPX Corp., Amendment No. 3 to Form S-1, 59 (Apr. 11, 2011), *available at* <http://www.sec.gov/Archives/edgar/data/1509432/000119312511240287/ds1.htm> (last visited Feb. 20, 2014).

¹⁵ IDC Press Release, *Worldwide Smartphone Shipments Top One Billion Units for the First Time, According to IDC*, Jan. 27, 2014, *available at* <http://www.idc.com/getdoc.jsp?containerId=prUS24645514> (last visited Feb. 20, 2014).

¹⁶ IHS Press Release, *Combined Smartphone and Tablet Factory Revenue to Exceed Entire Consumer Electronics Market This Year*, Oct. 25, 2013, *available at* <http://press.ihs.com/press-release/design-supply-chain-media/combined-smartphone-and-tablet-factory-revenue-exceed-entire> (last visited Feb. 20, 2014).

reported to have said, he robbed banks “because that’s where the money is”—so too of smartphones for patent holders.

These dynamics also reflect—and have contributed to—the larger trends of increasing patent grants and patent litigation in recent years. The graph below depicts the number of annual issued utility patents since 1993 through 2012 as well as the annual number of infringement suits filed in U.S. district courts.¹⁷ The trend for each shows a sharp rise in 2010. Patents related to smartphones and suits accusing smartphones of infringement have played a role in that growth.



Competitor Suits

The disputes between smartphone competitors have been extensively documented and we do not recount the full history here.¹⁸

¹⁷ U.S. Patent and Trademark Office, *Table of Annual U.S. Patent Activity Since 1790*, available at http://www.uspto.gov/web/offices/ac/ido/oeip/taf/h_counts.htm (last visited Feb. 20, 2014); United States Courts, *Judicial Business Archive*, C-2A tables, available at <http://www.uscourts.gov/Statistics/JudicialBusiness/archive.aspx> (last visited Feb. 20, 2014).

¹⁸ See, e.g., Fred Williams & Rehan M. Safiullah, *The Smartphone Patent Wars: A U.S. Perspective*, The METROPOLITAN CORPORATE COUNSEL, Nov. 2012; Michael Carrier, *A Roadmap to the Smartphone Patent Wars and FRAND Licensing*, CPI ANTITRUST CHRONICLE, April 2012; Jorge Contreras, *The Frand Wars: Who’s on First*,

Competitor suits and their impact on royalties are distinctive in two ways. First, unlike most NPE suits, competitor suits can result in injunctive relief, at least as to patents that have not been declared essential to a standard.¹⁹ (For SEPs, the possibility of obtaining an injunction or exclusionary order is far lower, no matter the identity of the patent holder.²⁰) Second, competitor suits can allow for damages in forms other than conventional royalties—such as lost profit damages to compensate the patent holder for money lost because of infringement.²¹ Both of these possibilities increase the risks of litigating against a competitor and may either increase the royalties that are required to settle a case or raise the costs of a finding of infringement.

NPE Suits

NPEs are another major source of litigation for smartphone suppliers. As the data below demonstrate, NPE suits in the United States have grown dramatically in recent years. Consistent with the overall litigation trend shown above, there was a particularly sharp uptick in NPE suits starting in 2010²²:

PATENTLYO.COM (Apr. 17, 2012), <http://www.patentlyo.com/patent/2012/04/the-frand-wars-whos-on-first.html> (last visited Feb. 20, 2014).

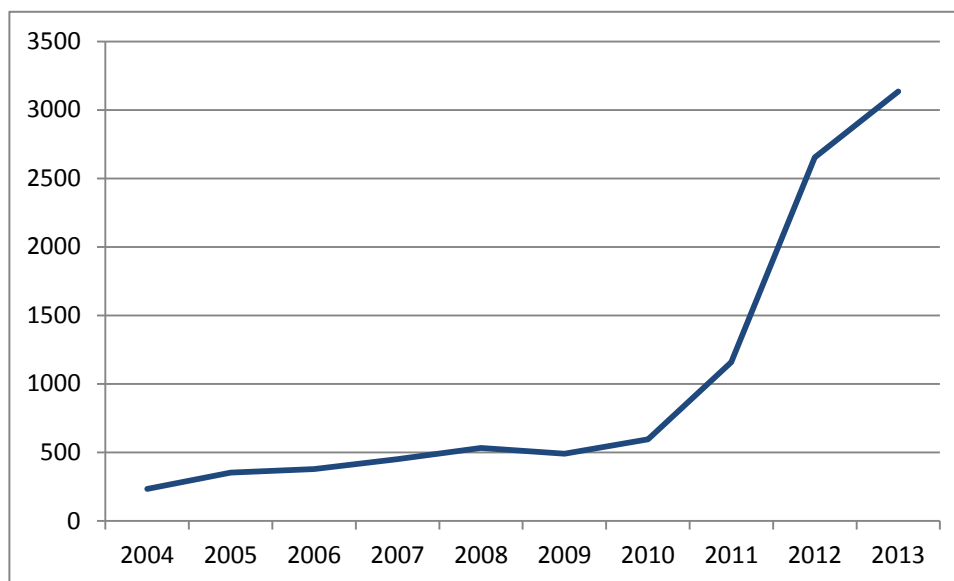
¹⁹ See *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 391 (2006) (grant of injunctive relief requires a plaintiff to show “(1) that it has suffered an irreparable injury; (2) that remedies available at law, such as monetary damages, are inadequate to compensate for that injury; (3) that, considering the balance of hardships between the plaintiff and defendant, a remedy in equity is warranted; and (4) that the public interest would not be disserved by a permanent injunction.”).

²⁰ See, e.g., Letter from U.S. Trade Representative to ITC Commissioner Williamson, Aug. 3, 2013, at 3, available at http://www.ustr.gov/sites/default/files/08032013%20Letter_1.PDF (last visited Feb. 20, 2014) (disapproving ITC exclusion order granted to Samsung against Apple on a SEP based on “policy considerations . . . as they relate to the effect on competitive conditions in the U.S. economy and the effect on U.S. consumers”); *Apple, Inc. v. Motorola, Inc.*, 869 F. Supp. 2d 901, 914-15 (N.D. Ill. 2012) (“I don’t see how, given FRAND, I would be justified in enjoining Apple from infringing the ’898 unless Apple refuses to pay a royalty that meets the FRAND requirement.”).

²¹ *Panduit Corp. v. Stahl Bros. Fibre Works, Inc.*, 575 F.2d 1152, 1156 (6th Cir. 1978), cert. denied, 439 U.S. 856 (1978) (permitting an award of lost profits on the establishment of four elements: “(1) demand for the patented product, (2) absence of acceptable noninfringing substitutes, (3) manufacturing and marketing capability to exploit the demand, and (4) the amount of the profit he would have made”).

²² *Litigations Over Time*, PATENTFREEDOM.COM, <https://www.patentfreedom.com/about-npes/litigations/> (last visited Feb. 20, 2014). Some of the increase in 2011-2013 is attributable to changes in joinder provisions with the America Invents Act. *Id.*

Annual U.S. Patent Lawsuits Involving NPEs



Smartphone suppliers are frequent targets of NPE suits. The table below shows the frequency of suits against the top thirty NPE targets from 2009 through 2013.²³ This list includes a significant number of smartphone suppliers. To be sure, many of these smartphone suppliers, such as Apple and LG, sell a range of products that attract NPE suits beyond smartphones. Still others, like Lenovo, have traditionally sold mostly outside of the United States. But a company like BlackBerry (formerly Research In Motion), which has focused principally on smartphone sales and has faced an average of about 20 NPE suits a year over this period, presents a clear example of the frequency with which NPEs target smartphones.

<u>Rank</u>	<u>Company Name</u>	<u>2009</u>	<u>2010</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>Total</u>
1	Apple	27	35	43	44	42	191
2	Samsung	12	22	42	38	38	152
3	HP	27	37	33	20	33	150
4	AT&T	16	22	34	24	51	147
5	Dell	28	24	35	21	32	140
6	Google	16	14	40	26	31	127
7	Amazon.com	14	20	39	22	30	125
7	Sony	24	21	31	23	26	125
9	Verizon	14	17	26	25	42	124
10	LG	12	24	28	26	27	117
11	HTC	12	23	30	23	27	115

²³ *Most Pursued Companies*, PATENTFREEDOM.COM, <https://www.patentfreedom.com/about-npes/pursued/> (last visited Feb. 20, 2014).

Rank	Company Name	2009	2010	2011	2012	2013	Total
12	Microsoft	22	12	35	18	27	114
13	BlackBerry	11	13	29	19	29	101
14	Toshiba	16	13	21	16	23	89
15	Sprint Nextel	14	8	19	15	31	87
16	Nokia	15	16	24	9	15	79
16	Panasonic	22	13	19	10	15	79
18	Motorola Mobility	3	9	31	18	15	76
19	Deutsche Telekom	10	9	17	8	31	75
20	Huawei	2	6	17	13	30	68
21	Asus	9	5	19	14	20	67
21	Best Buy	14	14	17	9	13	67
23	Lenovo	7	10	10	13	26	66
24	Cisco	13	15	16	8	11	63
25	Walmart	5	12	16	11	17	61
25	ZTE	5	4	6	16	30	61
27	Acer	10	7	11	18	14	60
28	Motorola Solutions	13	18	10	9	8	58
29	Fujitsu	13	7	11	9	16	56
29	IBM	13	12	10	9	12	56
29	Kyocera	8	10	13	10	15	56

The number of NPE suits does not account for NPE royalty demands that never make it to court and the associated costs. One survey of operating companies found that two-thirds of their NPE-related costs were for patent litigation (including legal fees, costs, settlements and judgments), with another 28% of costs related to non-litigation assertions (including legal fees and license fees paid to NPEs), and 5% related to other NPE costs (including payments for patent acquisition, reexaminations outside of litigation, and patent clearance searches).²⁴

Patent Privateering

Recent years have seen the growth of “patent privateering,” where operating companies monetize their patents by selling or licensing them to a third-party company or trust, which then asserts the patents and returns a portion of any proceeds to the original patent holder. MobileMediaIdeas, LLC is exemplary of this trend. MobileMedia is owned by Sony, Nokia, and an MPEG LA subsidiary and holds more than 300 patents. MobileMedia won an infringement verdict against Apple and settled litigation with HTC with a license.²⁵

²⁴ See *RPX 2012 NPE Cost Study: High-Level Findings*, at 8, (2013) available at <http://www.rpxcorp.com/siteFiles/SiteManager/2A01E1CD29DA06AB8C95399AE5D04919.pdf> (last visited Feb. 20, 2014).

²⁵ MobileMedia Ideas, *MobileMedia Ideas, HTC Settle Litigation*, MOBILEMEDIAIDEAS.COM (Sept. 12, 2013), <http://www.mobilemediaideas.com/MMIHTCPrsRls09.1213.pdf> (last visited Feb. 20, 2014); MobileMediaIdeas,

The privateering model may look increasingly attractive to companies that struggle in the smartphone marketplace. Nokia, for instance, engaged in a number of privateering efforts before deciding to exit the handset business entirely by selling that business to Microsoft. (After the sale to Microsoft, Nokia plans to focus on licensing its remaining patents, its mapping and location services, and its network infrastructure business.²⁶)

Our survey does not account for the costs of all this litigation apart from damages or royalties. The costs of defending or asserting patents are substantial, easily running into the millions of dollars per case.²⁷ Moreover, in certain jurisdictions (*e.g.*, in certain European countries) where the loser pays the cost of litigation, a smartphone supplier faces not only the risk of paying damages and its costs but also those of the patent holder. On top of the out-of-pocket litigation expenses, there are also significant expenditures of employee time and energy during the course of litigation, as well as business risks.²⁸ All told, these costs can be substantial.

Component-by-Component Royalty Estimates

Against that backdrop, we turn to a component-by-component analysis of the royalty demands on smartphones. We begin with internal components and proceed to externally visible features and functionalities.

Inside the Phone

Cellular Baseband Chip (Standardized)

There are currently three generations of cellular standards: 2G, 3G, and 4G. The dominant (and in many places, sole) 2G standard is Global System Mobile (GSM), which was commercialized in the early 1990s. Since that point, GSM has become the basic cellular standard available nearly worldwide. The Universal Mobile Telecommunications System (UMTS) is a third generation standard based on GSM. The term UMTS is often used interchangeably with WCDMA (which is the acronym for the “air interface” portion of the UMTS standard and some other 3G standards). UMTS/WCDMA along with CDMA2000 are the dominant 3G standards. Finally, the leading fourth generation cellular standard is Long-

Apple’s iPhones Found to Have Infringed MobileMedia Ideas Patents, MOBILEMEDIAIDEAS.COM (Dec. 13, 2012), <http://www.mobilemediaideas.com/MMIApplePrsRls12.13.12.pdf> (last visited Feb. 20, 2014).

²⁶ Nokia, *Nokia to sell Devices & Services business to Microsoft in EUR 5.44 billion all-cash transaction*, Sept. 3, 2013, available at <http://press.nokia.com/2013/09/03/nokia-to-sell-devices-services-business-to-microsoft-in-eur-5-44-billion-all-cash-transaction/>.

²⁷ See James Bessen & Michael J. Meurer, *The Private Costs of Patent Litigation*, 9 J.L. ECON. & POL’Y 59, 80 (2012) (finding based on fee awards from 1985 to 2004, mean fees for alleged infringers through trial of \$2.46 million in 1992 dollars).

²⁸ *Id.* at 60, 62 (noting the significance of “[i]ndirect business costs of patent litigation,” including “the time managers and researchers spend producing documents, testifying in depositions, strategizing with lawyers, and appearing in court” and finding that “alleged infringers lose about half a percentage point of their stock market value when sued for patent infringement”).

Term Evolution (LTE).²⁹ Because LTE appears to have won out as the 4G standard that will be most widely adopted, we focus on LTE royalties below.

Cellular functionality in a smartphone is implemented in the baseband processor, many of which cost around \$10-13.³⁰

In the table below, we identify the companies that have publicly disclosed royalty rates for their LTE portfolios. For each company, we then calculated the royalty that would be applicable to a \$400 device based on the announced rate.

Company	Announced LTE Rate	Royalty (\$400 device)
Qualcomm	3.25% of device ³¹	\$13.00
Motorola	2.25% of device	\$9.00
Alcatel-Lucent	Up to 2% of device	\$8.00
Huawei	1.5% of device	\$6.00
Ericsson	1.5% of device	\$6.00
Nokia	1.5% of device	\$6.00
Nortel ³²	1% of device	\$4.00
ZTE	1% of device	\$4.00 ³³
Siemens	0.8% of device	\$3.20

²⁹ WiMAX (Worldwide Interoperability for Microwave Access) is another fourth generation standard, but the popularity of LTE has threatened to make WiMAX obsolete. See, e.g., Sascha Segan, *WiMAX v. LTE: Should You Switch?*, PCMag.COM (May 16, 2012), <http://www.pcmag.com/article2/0,2817,2403490,00.asp> (last visited Feb. 20, 2014). Accordingly, we do not examine royalty rates for WiMAX.

³⁰ Nomura Securities 2012 Smartphone Guide, *supra* note 9.

³¹ Stasik, *supra* note 5 at 116; Qualcomm Press Release, *LTE/WiMax Patent Licensing Statement*, Qualcomm.com (Dec. 1, 2008), <http://www.qualcomm.com/media/documents/files/lte-wimax-patent-licensing-statement.pdf> (last visited Feb. 20, 2014). Unless otherwise indicated, all references in this table are to Stasik.

³² Nortel is now bankrupt and its portfolio has been sold off. We nonetheless include Nortel's announced rate for completeness.

³³ ZTE is also a member of the Via Licensing LTE pool. *LTE Licensors*, ViaLicensing.com, <http://www.vialicensing.com/licensecontent.aspx?id=1514> (last visited Feb. 20, 2014). Accordingly, we have not counted the \$4 rate in the total.

Company	Announced LTE Rate	Royalty (\$400 device)
Via Licensing	Per Unit Sliding-Scale Fee Based on Volume ³⁴	\$2.10 per unit (sales over 10M units)
Sisvel Patent Pool	0.99 Euros per device ³⁵	\$1.36
Vodafone	Free ³⁶	\$0.00
Total		\$54.30

Based on the above, the total announced rates for LTE royalties is about \$54 per smartphone (again, assuming a \$400 device). There are reasons to think that this total both under- and over-states the potential total royalties.

The list of parties above with declared LTE rates accounts for only approximately 50-60% of LTE SEPs declared essential to the European Telecommunications Standards Institute (ETSI) and therefore omits many LTE SEP holders, including parties with large portfolios.³⁷ Of the top ten holders of declared LTE SEP families, three are missing from this list because they have not publicly announced LTE rates: Samsung (ranked 2nd at 11%), InterDigital (ranked 5th at 7.1%), and LG (ranked 8th at 5.4%).³⁸ If the demands of the other LTE SEP holders that have not publicly announced rates were factored in, the total might rise significantly.

³⁴ See *LTE License Fees*, VIALICENSING.COM, <http://www.vialicensing.com/licensecontent.aspx?id=1516> (last visited Feb. 20, 2014) (for the first 500,000 units, licensees pay \$3 per unit, for units 500,001 to 2,500,000, licensees pay \$2.55, and the per-unit fee continues to decrease to \$2.10 per unit for units 10,000,001 or more). Companies participating in the patent pool include AT&T, China Mobile Communications Corp., Clear Wireless LLC, Deutsche Telekom AG, DTVG Licensing, Inc., Hewlett-Packard, KDDI, NTT DOCOMO, SK Telecom, Telecom Italia, Telefónica, and ZTE. See *LTE Licensors*, VIALICENSING.COM, <http://www.vialicensing.com/licensecontent.aspx?id=1514> (last visited Feb. 20, 2014).

³⁵ *Introduction and Royalty Rate*, SISVEL.COM, <http://www.sisvel.com/index.php/lte> (last visited Feb. 20, 2014). Pool members include Cassidian, China Academy of Telecommunication Technology, Electronics and Telecommunications Research Institute, KPN, Orange, and TDF. In addition, Sisvel acquired LTE SEPs from Nokia that are included in the pool. *Patent Owners*, SISVEL.COM, <http://www.sisvel.com/index.php/lte/patent-owners> (last visited Feb. 20, 2014).

³⁶ Vodafone Press Release, *IPR Statement On Next Generation Mobile Network Technologies*, Lteportal.com (June 30, 2008) http://www.lteportal.com/MediaChannel/Articles/Operators;1/Europe,_Middle_East,_Africa;1/IPR_statement_on_next_generation_mobile_network_technologies;114?PHPSESSID=5bbcb66e9cedcf20acbb4f85b4eae4 (last visited Feb. 20, 2014). According to the ETSI IPR Online Database, Vodafone has not yet declared any patents essential to LTE. *ETSI IPR Online Database*, ETSI.org, <http://ipr.etsi.org/> (last visited Feb. 24, 2014).

³⁷ Based on data from: Cyber Creative Institute Co. Ltd., *Evaluation of LTE essential patents declared to ETSI*, CYBERSOKEN.COM (June 2013), at 6, available at <http://cybersoken.com/research/pdf/lte03EN.pdf> (last visited Feb. 20, 2014) (study of declarations of patent families to ETSI for LTE as of November 2012).

³⁸ *Id.* (study of declarations to ETSI as of November 2012). The study omits certain members of the Via and Sisvel patent pools. See also Marshall Phelps & Cheryl Minone, *LTE Standard Essential Patents Now and in the Future*, at 3, ARTICLEONEPARTNERS, available at http://newsletters.articleonepartners.com/news_f1317eac-ee13-5a66-d0f5-38ea99a4c1eeLTE-Standard-Essential-Patents-Now-and-in-the-Future.pdf (last visited Feb. 20, 2014) (identifying Qualcomm, Nokia, InterDigital, Ericsson, Samsung, Motorola, LG, NTT DoCoMo, Huawei, and ZTE

Patent privateering also threatens to increase royalties above even the listed rates. Following Nokia's announcement of its 1.5% LTE rate, it has divested a number of its alleged LTE patents. One destination for those patents was Sisvel, which now charges a separate LTE rate for those former Nokia patents and others in its pool. Likewise, the non-practicing entity Core Wireless Licensing is now publicly seeking to license alleged LTE SEPs transferred to it from Nokia.³⁹ Thus the alleged LTE patents at Nokia that would have been licensed at a maximum rate of 1.5% may now end up costing more.

In addition, focusing only on LTE rates may understate the cost of licensing cellular standardized technology, because smartphones must be backwards-compatible with earlier standards.⁴⁰ In terms of announced rates for backwards compatibility, Nokia has said it will charge up to 2% of a "multi-mode" device's sales price—as opposed to 1.5% for just LTE.⁴¹ And when a court in India recently set temporary royalty rates in a cellular standard patent dispute launched by Ericsson, it required Mercury Electronics to pay higher royalty rates for multi-mode devices than for single-mode.⁴²

Qualcomm, though, has committed that it will "not charge a royalty rate on ... multi-mode devices ... that is greater than Qualcomm's standard 3G CDMA royalty rate."⁴³ A Chinese court recently held that InterDigital's royalty rate for 2G, 3G, and 4G essential patents could not exceed 0.019% of the sales price of a Huawei device.⁴⁴ More generally, it seems likely that smartphone suppliers will refuse to pay "additive" royalties that simply aggregate the new LTE rates with the rates for prior generations. This is particularly likely given that the patents on prior generations will progressively expire over time.

There are other reasons to believe a royalty stack of \$54 overstates the actual total. Presumably not all of the patent holders that have publicly announced an LTE rate will necessarily stick to that rate. It seems likely that certain of these rates are aspirational and intended to set the opening mark for negotiations.

as the top holders of U.S. patents and patent applications declared essential to ETSI as of September 30, 2011, and accounting for 2,952 of 3,116 such patents and applications).

³⁹ Core Wireless Licensing, *Core Wireless Launches Patent Litigation Against Apple*, CONVERSANTIP (Feb. 29, 2012), <http://www.conversantip.com/blog/patent-category/core-wireless/> (last visited Feb. 20, 2014).

⁴⁰ ABI Research News Release, *Mobile Device Royalties Approaching the \$20 Billion Mark*, ABI RESEARCH (Jan. 9, 2012), <http://www.abiresearch.com/press/mobile-device-royalties-approaching-the-20-billion> (last visited Feb. 20, 2014).

⁴¹ Stasik, *supra* note 5.

⁴² *Ericsson v. Mercury Electronics*, Order issued by the High Court of Delhi at New Delhi, CS(OS) 442/2013 (Mar. 19, 2013) available at http://delhihighcourt.nic.in/dhcqrydisp_o.asp?pn=46519&yr=2013 (last visited Feb. 20, 2014).

⁴³ Stasik, *supra* note 5.

⁴⁴ Shylah R Alfonso and Kevin A. Zeck, *Chinese Court Issues Landmark Decision Determining a FRAND Royalty Rate*, TIDBITS, Section of Antitrust Law, ABA (April 1-5, 2013) available at http://www.americanbar.org/content/dam/aba/publications/antitrust_law/at315000_tidbits_20130405.authcheckdam.pdf (last visited Feb. 24, 2014).

That said, certain patent holders have pursued such rates on the total cost of smartphones through litigation notwithstanding the implications for the cumulative royalty stack—and notwithstanding that royalty demands based on a percentage of a smartphone’s full price are almost certain to conflict with governing Federal Circuit precedent on limiting use of the entire market value to cases where it is established that the patented feature is responsible for driving consumer demand.⁴⁵ Samsung, for example, made a 2.4% demand from Apple for its declared-essential UMTS patent portfolio during the parties’ negotiations.⁴⁶ At the parties’ 2012 trial, Samsung’s damages expert testified that a FRAND royalty for even just one of Samsung’s declared-essential UMTS patents could be between 2 and 2.75% of the full sales price of the device.⁴⁷ (The jury found Apple did not infringe Samsung’s alleged SEPs.)

It is worth noting that when actually litigated the SEP success rate is very poor. A recent study shows that of 58 SEPs asserted in litigation globally by InterDigital, Motorola, and Samsung, only 7 were found valid and infringed, with 18 found invalid, 17 found not infringed, and a further 16 withdrawn or dismissed.⁴⁸ But given the proliferation of alleged cellular SEPs—of which there are thousands—the royalty demands (and litigation) for such patents are expected to continue.

Memory

Mobile devices, such as smartphones, generally have two memory types: volatile memory and non-volatile memory. The non-volatile memory is the flash memory and the volatile memory is the random access memory (RAM), most often dynamic random access

⁴⁵ E.g., *Laser Dynamics, Inc. v. Quanta Computer, Inc.*, 694 F.3d 51, 67 (Fed. Cir. 2012) (“Where small elements of multi-component products are accused of infringement, calculating a royalty on the entire product carries a considerable risk that the patentee will be improperly compensated for non-infringing components of that product.”). See also, e.g., *Micromax Informatics Limited and Telefonaktiebolaget LM Ericsson*, No. 50/2013, Competition Commission of India, Dec. 11, 2013, at 7 available at <http://infojustice.org/wp-content/uploads/2013/12/CCI-Case-no-50-2013.pdf> (last visited Feb. 20, 2014) (directing investigation of Ericsson’s licensing practices because “[t]he royalty rates being charged by [Ericsson] had no linkage to patented product, contrary to what is expected from a patent owner holding licences on FRAND terms. [Ericsson] seemed to be acting contrary to the FRAND terms by imposing royalties linked with cost of product of user for its patents.”).

⁴⁶ Transcript of Record at 3144-45, *Apple Inc. v. Samsung Electronics Co.*, No. 11-cv-01846-LHK (N.D. Cal. filed on Apr. 15, 2011) (discussing Plaintiff’s Exhibit 80, July 25, 2011 Samsung letter to Apple with 2.4% demand).

⁴⁷ Transcript of Record at 3125, *Apple Inc. v. Samsung Electronics Co.*, No. 11-cv-01846-LHK (N.D. Cal. filed on Apr. 15, 2011). Samsung later claimed in litigation against Apple before the International Trade Commission that its 2.4% demand was merely an “initial headline rate for a unilateral license to its declared-essential UMTS patents” consistent with the practice of “other companies with declared-essential patent portfolios [to] publish headline rates at which they state they are willing to license their patents” but “[i]n practice, these companies do not enter into licenses at these rates[.]” Samsung’s Initial Submission in Response to the Commission’s March 13, 2013 Notice on Remedy and the Public Interest, *In re Certain Electronic Devices, Including Wireless Communication Devices, Portable Music and Data Processing Devices, and Tablet Computers*, Inv. No. 337-TA-794 (April 3, 2013 public version) at 17.

memory (DRAM).⁴⁹ The flash memory can either be a removable Secure Digital (SD) memory card or an integrated component of the device. Below we focus on three memory standards used in smartphones: removable flash storage (SD memory cards), integrated flash storage (eMMC), and DRAM.

Flash memory is estimated to cost \$20-22 per smartphone and DRAM \$8-10.⁵⁰

Flash: SD Memory Card (Standardized)

Secure Digital (SD) memory cards are flash memory cards used in a variety of devices such as smartphones. In 1999, Toshiba, SanDisk, and Panasonic joined forces to develop the SD Memory Card.⁵¹ In 2000, they formed the SD Card Association (SDA) to develop and promote memory card storage standards.⁵² The three companies also established SD-3C, LLC to license SD Memory Card technology.⁵³ According to SD-3C, there are at least nine standard essential patents required to implement SD technology owned by Toshiba, SanDisk, and Panasonic.⁵⁴ SD standards are available in three capacities with a variety of speed options: SD, SDHC (High Capacity) and SDXC (eXtended Capacity).⁵⁵ There is also a microSD card, which was designed especially for mobile phones.⁵⁶

The SDA and SD-3C require that companies wanting to offer products that interoperate with SD cards—including the microSD card—(1) join the SDA, with membership ranging from \$2,000 to \$4,500, (2) execute the SDA License Agreement with the SDA, and (3) pay a \$3,000 per year licensing fee to SD-3C.⁵⁷ As a condition of the SDA License Agreement, members are required “to license in a non-discriminatory fashion, and on reasonable terms, to all other

⁴⁹ Victor Tsai, *Embedded and Removable Memory Solutions*, FLASH MEMORY SUMMIT (Aug. 2007), http://www.flashmemorysummit.com/English/Collaterals/Proceedings/2007/20070808_WA2_Tsai.pdf (last visited Feb. 21, 2014).

⁵⁰ Nomura Securities 2012 Smartphone Guide, *supra* note 9.

⁵¹ *About the SD Association*, SD ASSOCIATION, https://www.sdcard.org/about_sda/ (last visited Feb. 21, 2014).

⁵² *Id.*

⁵³ *Welcome to SD-3C, LLC*, SD-3C, LLC, <http://www.sd-3c.com/Default.aspx> (last visited Feb. 21, 2014).

⁵⁴ *Intellectual Property Information*, SD-3C, LLC, <http://www.sd-3c.com/IPInformation.aspx> (last visited Feb. 21, 2014).

⁵⁵ *SD Standards Overview*, SD ASSOCIATION, <https://www.sdcard.org/developers/overview> (last visited Feb. 21, 2014).

⁵⁶ *See Toshiba Announces New microSD Memory Card Family*, TOSHIBA (June 28, 2006), http://www.toshiba.com/taec/news/press_releases/2006/memy_06_332.jsp (last visited Feb. 21, 2014).

⁵⁷ *Frequently Asked Questions, Join the SD Association*, SD ASSOCIATION, <https://www.sdcard.org/join/faq/#sdproducts> (last visited Feb. 21, 2014); *Use and Licensing*, SD ASSOCIATION, <https://www.sdcard.org/developers/licensing/> (last visited Feb. 21, 2014); *Frequently Asked Questions*, SD-3C, <http://www.sd-3c.com/FrequentlyAskedQuestions.aspx#HALA> (last visited Feb. 21, 2014).

Members and non-member licensees[], such Member's Patent Claims which are required to implement the Adopted Specifications.”⁵⁸

We have not identified additional royalty claims for hosting an SD card, although there may well be patents beyond the nine identified by the SD-3C.⁵⁹

Flash: eMMC (Standardized)

An Embedded Multimedia Card (e-MMC) flash device is a non-volatile, rewritable mass storage device used in smartphones. The e-MMC standard is maintained by JEDEC.⁶⁰ e-MMC is the leading industry standard for embedded memory in smartphones.⁶¹

We have not located any public royalty information or royalty demands for e-MMC technology. There are some suggestions that the e-MMC standard (and the predecessor MMC standard developed by the MultiMediaCard Association that formed the basis for e-MMC) is royalty free.⁶² But there has been litigation related to e-MMC products.

Talon Research, LLC has brought three suits against suppliers of memory cards. In 2011, Talon sued Toshiba Corporation and two American subsidiaries on two patents it claimed were infringed by Toshiba's e-MMC multi-chip package memory products and products incorporating

⁵⁸ *Schedule D, SD Association Intellectual Property Policy*, SD ASSOCIATION, <https://www.sdcard.org/developers/licensing/SDA-License-Agreement.pdf> (last visited Feb. 21, 2014).

⁵⁹ If a smartphone maker wanted to manufacture its own SD cards—as opposed to simply providing the functionality to allow the use of SD cards in the smartphone—there could be additional costs. For example, according to a Samsung Electronics complaint filed in 2010, the SD Group and SD-3C (which pools patent rights) require companies to enter into an SD Memory Card License Agreement and pay a six percent royalty on their net sales of SD Cards. Complaint at 18-19, *Samsung Electronics Co. v. Panasonic Corp.*, No. 10-cv-03098 (N.D. Cal. July 25, 2010). And on March 25, 2013, an NPE, Pendrell, announced that it had acquired 125 patents from Nokia related to memory technology, including SD cards. PR Newswire, *Pendrell Acquires Foundational Memory Technology Patent Portfolio From Nokia*, March 25, 2013, available at <http://pendrell.com/sites/default/files/Pendrell%20Nokia%20FINAL%20032413.pdf> (last visited Feb. 21, 2014).

⁶⁰ Janine Love, *Tablet and Smartphone Demand Drives New Trends in Mobile Memory*, EETimes.com (Aug. 2, 2011), http://www.eetimes.com/document.asp?doc_id=1278978 (last visited Feb. 21, 2014).

⁶¹ *e-MMC*, JEDEC, <http://www.jedec.org/standards-documents/technology-focus-areas/flash-memory-ssds-ufs-emmc/e-mmc> (last visited Feb. 21, 2014); *Toshiba Timeline: 25 Years of NAND Flash*, TOSHIBA, <http://www.flash25.toshiba.com/downloads/toshiba-timeline.pdf> (last visited Feb. 21, 2014); *Update Defines Performance and Reliability Improvements for Embedded Mass-Storage*, JEDEC.ORG (June 15, 2011), <http://www.jedec.org/news/pressreleases/jedec-announces-publication-e-mmc-standard-update-v45> (last visited Feb. 21, 2014).

⁶² See *eMMC FLASH Programming User's Guide*, at 7, LAUTERBACH GMBH (June 11, 2013), available at <http://www2.lauterbach.com/pdf/emmcflash.pdf> (last visited Feb. 21, 2014) (“The eMMC standard developed by the MMCA and the JEDEC is an open, royalty-free standard.”); Press Release, *Samsung Electronics Develops World's First 2GByte Memory Card for Mobile Phones*, SAMSUNG (April 19, 2006), <http://www.samsung.com/global/business/semiconductor/news-events/press-releases/detail?newsId=4230> (last visited Feb. 21, 2014) (“The new MMC, in a format standardized by the MultiMediaCard association (MMCA) and being standardized by JEDEC, can be obtained by manufacturers without royalties or licensing fees.”).

eMMC compliant controllers.⁶³ Talon also sued SanDisk in 2011 on the same two patents and alleged that one patent was infringed by SanDisk selling products incorporating eMMC compliant controllers.⁶⁴ In 2012, Talon sued Hynix Semiconductor asserting the same patents, and like the SanDisk complaint, alleged that Hynix infringed one of its patents by selling products incorporating eMMC compliant controllers.⁶⁵ Each of these suits has been dismissed, and there is no public information about whether settlements were reached.

In addition, patent assertion entities have included within their portfolios patents relating to eMMC, presumably with the expectation that they will be licensed or litigated. These include Helsinki Memory Technologies, which was formed by Pendrell to manage patents acquired from Nokia. Helsinki Memory claims that its eMMC portfolio “represents approximately 25% of declared essential patents in eMMC.”⁶⁶ Similarly, patent assertion entity MOSAID Technologies Inc. claims to have eMMC patents in its semiconductor portfolio.⁶⁷

DRAM

Random-access memory (RAM) is a smartphone’s “working memory” used to support multitasking or video playback, as opposed to long-term storage that occurs in flash memory. The main form of RAM currently used in smartphones is dynamic random access memory (DRAM), although efforts are being made to adopt static random access memory (SRAM) for mobile devices because of its potential benefits for battery life.⁶⁸ There are various types of DRAM, with double data rate synchronous DRAM (DDR SDRAM) (of which there are multiple generations) the most common in smartphones.⁶⁹

The JEDEC Solid State Technology Association (JEDEC), formerly known as the Joint Electronic Device Engineering Council, is the standard setting organization for multiple DRAM

⁶³ Complaint at 3, *Talon Research, LLC v. Toshiba America Electronic Components, Inc. et al.*, No. 4-11-cv-04819 (N.D. Cal. Sept. 29, 2011).

⁶⁴ Complaint at 2, *Talon Research, LLC v. Sandisk Corporation*, No. 11-cv-06172 (N.D. Cal. Dec. 8, 2011).

⁶⁵ Complaint at 2-3, *Talon Research, LLC v. Hynix Semiconductor America Inc. et al.*, No. 11-cv-05058 (N.D. Cal. Oct. 14, 2011).

⁶⁶ Helsinki Memory Technologies, *Technologies*, HELSINKIMEMORYTECH, <http://www.helsinkimemorytech.com/technologies> (last visited Feb. 21, 2014).

⁶⁷ MOSAID, *Semiconductor Licensing – Driving Value* at 8 (Sept. 2013), available at http://lesusacanada.org/docs/high-tech-sector/mosaid-semiconductor-licensing_les_shaer.pdf?sfvrsn=0 (last visited Feb. 21, 2014). MOSAID has recently changed its name to Conversant Intellectual Property Management Inc.

⁶⁸ See Ina Fried, *Mobile DRAM—The Smartphone Component You’ve Never Heard Of—Is Big Business*, ALLTHINGS.D (Mar. 16, 2011), available at <http://allthingsd.com/20110316/mobile-dram-the-smartphone-component-youve-never-heard-of-is-big-business/> (last visited Feb. 21, 2014); *Toshiba Develops Low Power Technology for Embedded SRAM*, BUSINESSWIRE, Feb. 21, 2013, available at <http://www.businesswire.com/news/home/20130221005634/en/Toshiba-Develops-Power-Technology-Embedded-SRAM> (last visited Feb. 21, 2014).

⁶⁹ Tim Schiesser, *Guide to smartphone hardware: Memory and Storage*, NEOWIN (March 12, 2012), <http://www.neowin.net/news/guide-to-smartphone-hardware-37-memory-and-storage> (last visited Feb. 21, 2014).

standards.⁷⁰ JEDEC develops publicly-available standards and imposes a RAND obligation on patents declared essential to the standards.⁷¹ JEDEC's patent policy applies to entities that participate in JEDEC Committees but are not JEDEC members, and continues as long as the entity is a member of or a participant in a JEDEC committee.⁷² The disclosure and licensing obligations of member companies and their representatives are limited to standards developed in the particular JEDEC committees in which they are members or participate. All member companies agree to disclose all known potentially essential patent claims owned or controlled by the member company. They also agree to license their essential patent claims on RAND terms and conditions; if a member refuses to do so, it must notify the committee chair and withdraw from the committee within 120 days after giving notice.⁷³

The available licensing information for DRAM and related memory standards centers on Rambus, a technology licensing company that has been active in licensing and litigating its patents. Rambus's licensing has focused on component suppliers as opposed to end device suppliers (*e.g.*, of computers or mobile devices). Information about Rambus's licensing is nonetheless relevant insofar as it reflects royalty demands that may ultimately be passed on to smartphone suppliers in component costs.

While Rambus was formerly a member of JEDEC during the 1990s, it declined to agree to JEDEC's patent policy requiring members to license standards-essential patents on RAND terms. Accordingly, it withdrew from membership in JEDEC in 1996.⁷⁴ In the last fifteen years, it has sued many of the large memory chip manufacturers for patent infringement, including Infineon, Micron Technology, Samsung, IBM, NVIDIA, Freescale Semiconductor, Mediatek, and IBM.

In August 2006, the Federal Trade Commission (FTC) ruled that Rambus engaged in deceptive conduct by participating in the standard-setting process with JEDEC in the 1990s without disclosing that it was developing patents that involved the specific technology ultimately approved by JEDEC.⁷⁵ Following the order, the FTC imposed on Rambus RAND licensing rates for three years based on the record developed in the proceeding: a maximum royalty rate of 0.5% on Rambus's licensing of DDR SDRAM chips and 0.25% for SDRAM chips.⁷⁶ In order to reach these rates, the FTC extrapolated SDRAM and DDR SDRAM royalty rates from negotiated

⁷⁰ *Technology Focus Areas*, JEDEC.ORG, <http://www.jedec.org/standards-documents/technology-focus-areas> (last visited Feb. 21, 2014).

⁷¹ *See Why JEDEC Standards Matter*, JEDEC.ORG, <http://www.jedec.org/standards-documents/about-jedec-standards> (last visited Feb. 21, 2014).

⁷² *Patent Policy*, JEDEC.ORG, <http://www.jedec.org/about-jedec/patent-policy> (last visited Feb. 21, 2014).

⁷³ *Id.*

⁷⁴ *In the Matter of Rambus*, FTC File No. 9302, Aug. 2, 2006, Opinion of the Commission at 45-46, *available at* <http://www.ftc.gov/sites/default/files/documents/cases/2006/08/060802commissionopinion.pdf> (last visited Feb. 21, 2014).

⁷⁵ *Id.*

⁷⁶ *In the Matter of Rambus*, FTC File No. 9302, Feb. 2, 2006, Opinion of the Commission on Remedy, *available at* <http://www.ftc.gov/sites/default/files/documents/cases/2007/02/070205opinion.pdf> (last visited Feb. 21, 2014).

license agreements involving Rambus's RDRAM technology—Rambus's proprietary standard that competed with DDR SDRAM.⁷⁷ According to the documents submitted to the FTC, "Rambus licensed its proprietary RDRAM technologies at high-volume rates averaging 1-2% for use in DRAM chips, with the rates declining significantly over time and with increased in the number of shipped units."⁷⁸ The FTC used these comparable rates along with information that JEDEC's strong preference was to have patent-free standards and that its members were highly cost sensitive to determine appropriate maximum rates for DDR SDRAM (0.50%) and SDRAM (0.25%).⁷⁹ After three years at these rates, the FTC imposed a requirement that Rambus's royalty rate for these technologies would go to zero.⁸⁰

In April 2008, the U.S. Court of Appeals for the D.C. Circuit overturned the FTC's decision. The appellate court agreed with Rambus's argument that even if Rambus violated JEDEC's rules by not disclosing the existence of patent interests that were relevant to the memory standards under consideration, the FTC failed to demonstrate that Rambus's conduct was exclusionary and therefore constituted monopolization.⁸¹ The Supreme Court denied a petition for certiorari, and the FTC later dropped its suit against Rambus.

In the European Union, Rambus has faced similar regulatory scrutiny. On July 30, 2007, the European Commission sent Rambus a Statement of Objections expressing the Commission's preliminary view that Rambus was abusing a dominant position in the DRAM market.⁸² To address the Commission's concerns, Rambus put a worldwide cap on its royalty rates for JEDEC standard-compliant products for five years. Rambus agreed to charge zero royalties for SDR and DDR DRAM chip standards that were adopted while Rambus was a JEDEC member, and a maximum 1.5% royalty rate applied to DRAM chips for the later JEDEC DRAM standards (DDR2 and DDR3).⁸³ On December 9, 2009, the Commission adopted a decision accepting the commitments offered by Rambus.⁸⁴

Rambus has also brought litigation seeking to enforce its patents on DDR DRAM, SDRAM, and DDR2 DRAM standards. During a 2006 trial against SK Hynix, Rambus's expert "testified that appropriate royalty rates were 0.75% for Hynix's SDRAM device and 3.50% for the DDR SDRAM . . . device."⁸⁵ In April 2006, the jury found that Hynix infringed six of Rambus's patents and awarded Rambus damages in the amount of \$306,967,272, which the court

⁷⁷ *Id.* at 18-25.

⁷⁸ *Id.* at 20.

⁷⁹ *Id.* at 22-24.

⁸⁰ *Id.*

⁸¹ *See Rambus Inc. v. F.T.C.*, 522 F.3d 456, 462 (D.C. Cir. 2008).

⁸² Ruben Schellingerhout & Piero Cavicchi, *Patent Ambush in Standard-Setting: The Commission Accepts Commitments from Rambus to Lower Memory Chip Royalty Rates*, at 32, Competition Policy Newsletter (2010), http://ec.europa.eu/competition/publications/cpn/2010_1_11.pdf (last visited Feb. 21, 2014).

⁸³ *Id.*

⁸⁴ *Id.*

⁸⁵ *See SK Hynix, Inc. et al. v. Rambus, Inc.*, No. 5:00-cv-20905-RMW (N.D. Cal. filed on Aug. 29, 2000) ECF No. 2197.

reduced to \$133,584,129.⁸⁶ In 2013, Rambus and SK Hynix signed a \$240 million patent licensing agreement to settle their 13-year dispute.⁸⁷

In 2010, Rambus and NVIDIA signed a patent license agreement that granted NVIDIA a patent license for SDR memory controllers at a 1% royalty rate and for other memory controllers, including DDR, DDR2, DDR3, LPDDR, LPDDR2, GDDR2, GDDR3, GDDR4, and portions of GDDR5 memory controllers, at a 2% royalty rate.⁸⁸ The agreement went into effect on August 12, 2010, but it did not resolve the litigation between Rambus and NVIDIA.⁸⁹ In 2012, Rambus and NVIDIA finally settled their litigation by signing a five-year licensing agreement.⁹⁰ Details of the settlement and agreement were not publicly disclosed.⁹¹

Similarly in 2010, Samsung and Rambus agreed to a settlement to end years of litigation regarding Rambus's patents on SDRAM and DDR DRAM memory types. Samsung agreed to pay Rambus a lump sum of \$200 million, plus future payments of \$25 million per quarter for five years, and purchase \$200 million worth of Rambus stock.⁹² Given that Samsung's 2009 Q3 DRAM revenues were approximately \$3 billion, a payment of \$25 million per quarter comes out to a royalty rate of approximately 0.8%.⁹³

Most recently, on December 10, 2013, Rambus and Micron ended their 13 years of litigation by agreeing to a licensing deal.⁹⁴ Micron agreed to pay Rambus \$280 million over seven years, which amounts to approximately a 0.6% royalty rate according to Rambus's chief marketing officer, Jerome Nadel.⁹⁵ Micron will be paying Rambus quarterly royalty payments capped at \$10 million per quarter.⁹⁶ With Micron's license, Rambus now has signed licensing

⁸⁶ *Id.*

⁸⁷ *Rambus Settles Patent Infringement Suit with SK Hynix*, PCWORLD.COM (Jun. 11, 2013), <http://www.pcworld.com/article/2041491/rambus-settles-patent-infringement-suit-with-sk-hynix.html> (last visited Feb. 21, 2014).

⁸⁸ Press Release, *Rambus and NVIDIA Sign Patent License Agreement*, NVIDIA.COM (Aug. 13, 2010), http://pressroom.nvidia.com/easyir/customrel.do?easyirid=A0D622CE9F579F09&version=live&prid=651594&releasejsp=release_157 (last visited Feb. 21, 2014).

⁸⁹ *Id.*

⁹⁰ Ryan Smith, *Rambus and NVIDIA Bury the Hatchet, Sign 5 Year Agreement*, ANANDTECH.COM (Feb. 9, 2010), <http://www.anandtech.com/show/5526/rambus-and-nvidia-bury-the-hatchet> (last visited Feb. 21, 2014).

⁹¹ *Id.*

⁹² Objective Analysis, *Lengthy Contest Comes to a Close*, OBJECTIVE-ANALYSIS.COM http://www.objective-analysis.com/uploads/2010-01-21_Objective_Analysis_Alert_-_Samsung___Rambus_Settle.pdf (last visited Feb. 21, 2014).

⁹³ *Id.*

⁹⁴ Don Clark, *Micron, Rambus End Long-Running Legal Battles*, THE WALL STREET JOURNAL (Dec. 10, 2013), <http://online.wsj.com/news/articles/SB10001424052702304744304579249030450777094> (last visited Feb. 21, 2014).

⁹⁵ *Id.*

⁹⁶ *Id.*

agreements with all the major memory manufacturers.⁹⁷ At least according to one article,⁹⁸ the 0.6% rate appears to be the close to the new royalty rate that Rambus is seeking from its licensees. Regarding the DRAM litigation, Rambus CMO Jerome Nadel, is quoted as saying “We have learnt not to charge too much. We used to charge royalties of 6%. Now it’s 1%.”⁹⁹

While Rambus has been the main company involved in RAM/DRAM litigation,¹⁰⁰ Round Rock Research LLC has also initiated litigation that appears to include a DRAM-related patent titled “Data Communication for Memory.”¹⁰¹ Round Rock is a non-practicing entity that was created after its founder acquired a portfolio of 4,200 patents from Micron Technology in 2009.¹⁰² In October 2010, Round Rock began pursuing litigation on memory patents and, unlike Rambus, has focused on end-device suppliers.¹⁰³ Its first suit, alleging infringement by HTC smartphones, was dismissed by Round Rock after just six months without any disclosure of a settlement or licensing agreement.¹⁰⁴ Similarly, lawsuits against Dell and Asustek were dismissed without any information about a licensing agreement or settlement payment.¹⁰⁵ Litigation against Lenovo and Acer is still ongoing.¹⁰⁶

⁹⁷ Ryan Smith, *Memory Rambus and Micron Bury the Hatchet; All Memory Players Now License Rambus Tech*, ANANDTECH.COM (Dec. 11, 2013), <http://www.anandtech.com/show/7579/rambus-and-micron-bury-the-hatchet-all-memory-players-now-license-rambus-tech> (last visited Feb. 21, 2014).

⁹⁸ David Manners, *Rambus Diversifies*, ELECTRONICSWEEKLY.COM (Aug. 8, 2013), <http://www.electronicsworld.com/mannerisms/manufacturing/rambus-diversifies-2013-08/> (last visited Feb. 21, 2014).

⁹⁹ *Id.*

¹⁰⁰ See Commission Decision, *Case COMP/38.636 – RAMBUS*, at 5, EUROPEAN COMMISSION (Sept. 12, 2009), available at http://ec.europa.eu/competition/antitrust/cases/dec_docs/38636/38636_1203_1.pdf (last visited Feb. 21, 2014) (“Rambus has been and remains the only company asserting patents on DRAM interface technology.”).

¹⁰¹ See Ryan Davis, *HTC Sued by Ex-Kirkland Partner’s Patent Holding Co.*, LAW360.COM (Oct. 4, 2010), <http://www.law360.com/articles/198549> (last visited Feb. 21, 2014); Douglas Perry, *IP Firm Sues Over Core Products from Dell, Acer, Asus*, TOMSHARDWARE.COM (Oct. 17, 2011), <http://www.tomshardware.com/news/patent-infringement-lawsuit-memory-storage-patent,13726.html> (last visited Feb. 21, 2014); Complaint at 38, *Round Rock Research, LLC v. Acer, Inc.*, No. 13-cv-01480 (D. Del. Aug. 27, 2013) ECF. No. 1.

¹⁰² Ashby Jones, *Patent ‘Troll’ Tactics Spread*, THE WALL STREET JOURNAL (July 8, 2012), available at <http://online.wsj.com/news/articles/SB10001424052702303292204577514782932390996> (last visited Feb. 21, 2014); Ryan Davis, *HTC Sued by Ex-Kirkland Partner’s Patent Holding Co.*, LAW360.COM (Oct. 4, 2010), <http://www.law360.com/articles/198549> (last visited Feb. 21, 2014).

¹⁰³ Ryan Davis, *HTC Sued by Ex-Kirkland Partner’s Patent Holding Co.*, LAW360 (Oct. 4, 2010), <http://www.law360.com/articles/198549>; Ashby Jones, *Patent ‘Troll’ Tactics Spread*, THE WALL STREET JOURNAL (July 8, 2012), <http://online.wsj.com/news/articles/SB10001424052702303292204577514782932390996>.

¹⁰⁴ See Patrick, *HTC Quietly Dismissed From Round Rock Patent Litigation*, GAMETIME IP (Apr. 28, 2011), <http://gametimeip.com/2011/04/28/htc-quietly-dismissed-from-round-rock-patent-litigation/>.

¹⁰⁵ *Round Rock Research LLC v. Dell Inc.*, No. 11-cv-00976 (D. Del. filed on Oct. 14 2011); *Round Rock Research LLC v. Asustek Computer Inc.*, No. 13-cv-01480 (D. Del. filed on Aug. 27, 2013).

¹⁰⁶ See *Round Rock Research LLC v. Lenovo Holding Co. Inc.*, No. 13-cv-01196 (D. Del. filed on July 8, 2013); *Round Rock Research LLC v. Lenovo Holding Co. Inc.*, No. 11-cv-01011 (D. Del. filed on Oct. 21, 2011);

Combo Chip

We have assumed that our hypothetical \$400 smartphone would have a “combo chip” that supports several communication functions, including Wi-Fi, Bluetooth, GPS, and NFC. The cost of such a combo chip can be approximately \$3-4.¹⁰⁷

Wi-Fi / 802.11 (Standardized)

Wireless Local Area Networking (WLAN) is a method for transmitting data using high frequency radio waves. WLAN technology enables mobile computing devices, like tablets, laptops, or smartphones, to communicate large amounts of data rapidly without facing the bandwidth problems associated with cellular communication. The IEEE’s 802.11 standards, branded as Wi-Fi, are the dominant WLAN standards.¹⁰⁸ Patents declared essential to the 802.11 standard are subject to RAND commitments under the IEEE IPR Policy.¹⁰⁹

There are relatively few announced rates for Wi-Fi but three recent court decisions setting RAND rates provide helpful information. Between the announced rates and court decisions, a picture emerges of the potential total royalties for Wi-Fi patents.

The table below summarizes rates that parties have either announced or sought in licensing negotiations/litigation (noted as “requested”) and rates set by courts (“court awarded”). These demands span generations of the 802.11 standard and are presented as exemplary of the type of demands that a smartphone supplier may face. In the Royalty column, we have indicated the highest royalty for a \$400 smartphone given the requested and court-awarded rates:

Company	Royalty (\$400 device)	Royalty Rate/Unit
Lucent Technologies	\$10,000 + 5% of product ¹¹⁰ (requested)	~\$20.00

Round Rock Research LLC v. Acer Inc., No. 13-cv-01480 (D. Del. filed on Aug. 27, 2013); *Round Rock Research LLC v. Acer Inc.*, No. 11-cv-00977 (D. Del. filed on Oct. 14, 2011).

¹⁰⁷ Nomura Securities 2012 Smartphone Guide, *supra* note 9.

¹⁰⁸ There are a variety of generations of the 802.11 standard. The original standard, 802.11-1997, is now obsolete. The current dominant standards are 802.11b, 802.11g and 802.11n. 802.11n is backwards compatible with 802.11a/b/g and is the most commonly used in smartphones today. See Valerie Sarnataro, *Wi-Fi 802.11ac to Be the New Norm in Smartphones by 2015*, BRIGHTHAND (Oct. 28, 2012), <http://www.brighthand.com/default.asp?newsID=19423&news=Wi-Fi+802.11ac+Smartphones>.

¹⁰⁹ IEEE-SA BOARD OF GOVERNORS, IEEE-SA Standards Board Bylaws, § 6 (Dec. 2013), *available at* http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf.

¹¹⁰ Letter from Roger E. Stricker, Intellectual Prop. Vice President, Lucent Tech., to Chairman, IEEE 802.11 (Apr. 29, 1998), *available at* http://standards.ieee.org/about/sasb/patcom/loa-802_11a-lucent-29Apr1998.pdf.

Company	Royalty (\$400 device)	Royalty Rate/Unit
Agere	5% of product (requested) ¹¹¹	\$20.00
Motorola	2.25% of product (requested)	\$9.00
	\$0.008 (court awarded) ¹¹²	
	\$0.03 (court awarded for Xbox) ¹¹³ \$3.39 - \$36.90 ¹¹⁴ (requested)	
Innovatio IP Ventures	\$0.0956 per Wi-Fi chip (court awarded)	\$7.20 ¹¹⁵
Sisvel Patent Pool ¹¹⁶	€0.71 per device (if licensee grants Nokia a license to its 802.11 SEPs) (requested)	\$1.18
	€0.86 per device (if licensee does not grant Nokia a license to its 802.11 SEPs) (requested)	

¹¹¹ *Realtek Semiconductor Corp. v. LSI Corp.*, No. C-12-03451-RMW, 2013 WL 2181717, at *2 (N.D. Cal. 2013) (noting a 2002 demand by Agere of 5% on all 802.11b products sold by Realtek).

¹¹² The court found that a RAND royalty rate could fall between 0.8 cents and 19.5 cents. Because Motorola did not assert at trial that Microsoft products other than the Xbox used Motorola's 802.11 patents, the court could not determine the correct RAND rate with specificity and defaulted to the lower bound for "all other Microsoft products" besides the Xbox. *See Microsoft Corp. v. Motorola, Inc.*, No. C10-1823JLR, 2013 WL 2111217, at *101 n.28 (W.D. Wash. Apr. 25, 2013).

¹¹³ This rate was set based on the court's application of its RAND royalty rate analysis to the \$400 Xbox.

¹¹⁴ *In re Innovatio IP Ventures, LLC Patent Litig.*, No. 11-C-9308 2013 WL 5593609 at *12 (N.D. Ill. Oct. 3, 2013), MDL No. 2303 (Innovatio advocated a damages methodology of determining a "Wi-Fi feature factor" for a device that takes into account the value of Wi-Fi to the product, multiplying that feature factor by the end device price and then applying a 6% rate to that figure, resulting in "royalties on average of approximately \$3.39 per access point, \$4.72 per laptop, up to \$16.17 per tablet, and up to \$36.90 per inventory tracking device (such as a bar code scanners)").

¹¹⁵ Calculated using a 30% "Wi-Fi" feature factor, based on the 20-30% range Innovatio advocated for tablets, and then 6% royalty rate to a \$400 smartphone. *See Innovatio*, 2013 WL 5593609 at *12, 17.

¹¹⁶ The patent owners for the Sisvel pool are Nokia Corporation, Ericsson, Electronics and Telecommunications Research Institute (ETRI), Sanyo Electric Co., Ltd., and Hera Wireless S.A. *Wi-Fi Patent Owners*, SISVEL, <http://www.sisvel.com/index.php/wi-fi/patent-owners> (last visited Feb. 20, 2014).

Company	Royalty (\$400 device) Per Unit Sliding-Scale Fee Based on Volume, ranging from \$0.55 to \$0.05 (requested) ¹¹⁸	Royalty Rate/Unit
Via Licensing ¹¹⁷		\$0.55
Ericsson	\$0.50 (requested) \$0.05 per patent per product (court awarded)	\$0.50 ¹¹⁹
Total		\$50.23

As with LTE, the announced totals add up to an amount—of about \$50—that far exceeds the cost of the component at issue. And as with LTE, this total both omits the demands of many Wi-Fi patent holders and reflects that particular requested rates are likely to be significantly higher than actual negotiated rates. That latter point is made particularly clear by the divergence between the requested rates and recent court-determined RAND rates in *Microsoft Corp. v. Motorola, Inc.* and *In re Innovatio IP Ventures*. In both, the RAND rate set by the court is orders of magnitude below what the patent holder sought.

Microsoft v. Motorola involved claims by Microsoft that Motorola breached its RAND obligations as to patents declared essential to the H.264 and 802.11 standards, by demanding excessive royalties and seeking an injunction.¹²⁰ Specifically, Motorola sought 2.25% of the end price of Microsoft’s devices (primarily the X-Box) for both its H.264 and 802.11 patents—which would have translated to up to \$9 in royalties for a \$400 Xbox.¹²¹ The district court held a bench trial and issued a 207-page decision setting RAND rates and RAND ranges for Motorola’s H.264 and 802.11 patent portfolios. For Motorola’s eleven 802.11 patent families relevant to the Xbox, the court set a RAND rate of \$0.03471 per unit.¹²² To calculate these rates and ranges, the court

¹¹⁷ The Via Licensing Pool covers the older 802.11(a-j) standard. Licensors include Electronics and Telecommunications Research Institute (ETRI), Japan Radio Co., Ltd., Koninklijke Philips N.V., LG Electronics, Inc., and Nippon Telegraph and Telephone Corporation. *802.11 (a-j) Licensors*, VIA LICENSING, <http://www.vialicensing.com/licensing/ieee-80211-licensors.aspx> (last visited Feb. 20, 2014).

¹¹⁸ *802.11(a-j) License Fees*, Via Licensing, <http://www.vialicensing.com/licensing/ieee-80211-fees.aspx> (last visited Feb. 20, 2014).

¹¹⁹ We have not included Ericsson’s demand in the total figure because at least some of its patents are also licensed through Sisvel. See *supra* note 116.

¹²⁰ *Microsoft Corp. v. Motorola, Inc.*, No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013).

¹²¹ See *id.* at *2.

¹²² *Id.* at *99-100.

applied a modified version of the *Georgia-Pacific* framework used to set reasonable royalties for patent damages, and analyzed a series of “comparables” proffered by the parties.¹²³

In *Innovatio*, Innovatio sued a wide variety of defendants—including electronics manufacturers, coffee shops, hotels, restaurants, and other commercial users of Wi-Fi—for infringement of its portfolio of nineteen patents related to IEEE’s 802.11 standard.¹²⁴ The accused products ranged from wireless access points to laptops. The cases were consolidated for pretrial proceedings before a single district court judge. The court and the parties agreed to address damages before any determination of validity or infringement in the hopes of encouraging settlement.¹²⁵

The court first held a bench trial to resolve the parties’ dispute over whether some of the patents were essential to the standard and therefore covered by a RAND commitment.¹²⁶ The court ruled that all the asserted patents were essential to the 802.11 standard. It then held a separate trial to determine the amount of a RAND royalty if infringement and validity were proven. The court’s ultimate RAND royalty rate of \$0.0956 per unit was, as in *Microsoft v. Motorola*, several orders of magnitude lower than the range of \$3.39 to \$36.90 sought by Innovatio.¹²⁷ The court calculated these RAND rates following much of the same methodology as the *Microsoft* court with certain key methodological differences. In particular, rather than relying on “comparables,” *Innovatio* sets as a common royalty base the profit margin on a Wi-Fi chip (found to be \$1.80) and incorporates an adjustment factor to reflect the court’s view that more technically important patents hold a disproportionate percentage of the value of a portfolio.¹²⁸

In a third recent Wi-Fi case, *Ericsson v. D-Link Corp.*, Ericsson brought suit against computer and electronics manufacturer Acer/Gateway and three wireless router manufacturers, Netgear, D-Link, and Belkin.¹²⁹ Later, it added computer manufacturers Dell and Toshiba to the lawsuit, targeting both their computing products and other Wi-Fi-enabled products such as printers, monitors, and televisions.¹³⁰ Intel intervened in the suit because the infringement allegations targeted its customers Acer/Gateway, Dell, and Toshiba.¹³¹ At trial, Ericsson advocated a \$0.50 royalty per product for the five asserted patents as to the OEM defendants; Ericsson did not seek damages from Intel. Its expert testified that although only five patents

¹²³ *Id.* at *90-100.

¹²⁴ *In re Innovatio IP Ventures, LLC Patent Litig.*, No. 11-C-9308, 2013 WL 5593609 (N.D. Ill. Oct. 3, 2013), MDL No. 2303.

¹²⁵ *Id.* at *1.

¹²⁶ *Id.* at *2.

¹²⁷ *See id.* at *12, 43.

¹²⁸ *Id.* at *7-8, 12-18, 43.

¹²⁹ *See* Complaint, *Ericsson Inc. v. D-Link Sys., Inc.*, No. 6:10-cv-473 (E.D. Tex. Sept. 14, 2010) ECF No. 1..

¹³⁰ *See* Amended Complaint, *Ericsson Inc. v. D-Link Sys., Inc.*, 6:10-cv-473 (E.D. Tex. June 8, 2011) ECF No. 77.

¹³¹ Intel Corporation’s Partially Unopposed Motion to Intervene, *Ericsson Inc. v. D-Link Sys., Inc.*, 6:10-cv-473 (E.D. Tex. Nov. 18, 2011) ECF No. 151.

were asserted—rather than Ericsson’s entire portfolio—those five patents represented at least half the value of the Ericsson portfolio.¹³² The jury ultimately found infringement of three patents and awarded lump sums against the OEM defendants that worked out to a royalty of \$0.15 per product or \$0.05 per patent/per product based on the stipulated number of products at issue.¹³³ After trial, the defendants’ challenges to the jury’s award were denied. In particular, the court dismissed defendants’ arguments about royalty stacking based on Ericsson’s demand, stating: “The best word to describe Defendants’ royalty stacking argument is theoretical.”¹³⁴ (The district court decision is presently on appeal to the Federal Circuit.)

The table below provides a detailed breakdown of the rates from the *Microsoft*, *Innovatio*, and *Ericsson* decisions. The table shows the number of patents in suit, the RAND rate set by the court (or the jury in the case of *Ericsson*), the per-patent rate, and, finally, the implied industry rate. The implied industry rate is the rate for licenses across the entire industry based on the RAND rate from the case. The *Innovatio* court found that the chipset profit margin of \$1.80 should serve as the aggregate industry-wide royalties.¹³⁵ Accordingly, \$1.80 serves as the implied industry rate for *Innovatio*. For *Microsoft* and *Ericsson*, we use 3,000 Wi-Fi SEPs—the number of SEPs the *Innovatio* court found to exist in the industry¹³⁶—to extrapolate industry-wide costs based on the per-patent rate (*i.e.*, 3,000 x per patent rate). Using this methodology for the *Microsoft* and *Ericsson* rates does not account for differing value among patents and also assumes that all SEPs are actually essential and will be asserted. Even with these limitations, it is a useful exercise to gauge the potential magnitude of industry-wide demands based on these decisions.

¹³² See Memorandum Opinion and Order at 30, *Ericsson Inc. v. D-Link Sys., Inc.*, No. 6:10-cv-473 (E.D. Tex. Aug. 6, 2013) ECF No. 615 (quoting sealed transcript).

¹³³ *Id.* at 45.

¹³⁴ *Id.* at 36.

¹³⁵ See *In re Innovatio*, 2013 WL 5593609, at *43.

¹³⁶ See *id.*

Case	Patents In Suit	RAND Rate	Per-Patent Rate	Implied Industry Rate
<i>Innovatio</i>	19 (3 families)	\$0.0956	\$0.00503	\$1.80 ¹³⁷
<i>Microsoft</i>	24 US patents (5 families) ¹³⁸	\$0.03471	\$0.001446	\$4.34 ¹³⁹
<i>Ericsson</i>	3 patents (3 families)	\$0.15	\$0.05	\$150.00

Bluetooth (Standardized)

Bluetooth is a wireless technology used to exchange data over short distances using radio transmissions that was developed by Ericsson in 1994.¹⁴⁰

A royalty-free license to Bluetooth technology is available with a free Adopter membership in the Bluetooth Special Interest Group (SIG), the standard-setting organization that maintains the Bluetooth standard.¹⁴¹ Membership in the Bluetooth SIG requires agreeing to grant a royalty-free, worldwide license to other SIG members for any patents that are necessary to practice the Bluetooth standard. In return, a member is granted a reciprocal royalty-free license by the other SIG members.¹⁴²

While the majority of companies choose the Adopter membership, some may choose to purchase a SIG membership that provides additional benefits, such as having a seat at the table to shape Bluetooth technology. As of November 2013, there were more than 15,000 Adopter members and more than 200 Associate members.¹⁴³ Associate membership requires a \$7,500

¹³⁷ This is what the court determined to be the average profit margin on a \$14.85 Wi-Fi chip, which the court treated as the appropriate royalty base to be divided among all the Wi-Fi essential patent holders. *Id.*

¹³⁸ The Court found that only 11 of the 24 patents were relevant to the accused Xbox product, but some of his calculations and language appear to include the full 24 patents—we focus on those rates. *See Microsoft Corp. v. Motorola, Inc.*, No. C10-1823JLR, 2013 WL 2111217 (W.D. Wash. Apr. 25, 2013).

¹³⁹ This assumes that the royalty rate determined is for Motorola's full Wi-Fi portfolio of 24 patents (notwithstanding the Court's finding that certain Motorola patents were not used by Microsoft), and that Motorola's Wi-Fi patents are of average value. *See id.* at *99. This approach then estimates Motorola's share of the industry's total patents based on the data presented in the *Innovatio* case (the *Microsoft* decision does not state the total number of 802.11 patents), and extrapolates using Motorola's 0.8% share of total industry Wi-Fi patents.

¹⁴⁰ *Fast Facts*, BLUETOOTH, <http://www.bluetooth.com/Pages/Fast-Facts.aspx> (last visited on Feb. 24, 2014.).

¹⁴¹ *SIG Membership*, BLUETOOTH, <http://www.bluetooth.com/Pages/SIG-Membership.aspx>, <http://www.bluetooth.com/Pages/SIG-Membership.aspx> (last visited on Feb. 23, 2014).

¹⁴² Patent & Copyright License Agreement § 5, BLUETOOTH, *available at* <https://www.bluetooth.org/login/register/> (last visited on Feb. 23, 2014).

¹⁴³ *See What Is the Bluetooth SIG?*, BLUETOOTH, https://www.bluetooth.org/ticketing/view_article.cfm?action=article_comment&aid=39 (last modified Nov. 20, 2013).

annual membership fee for companies with annual revenues under \$100 million and a \$35,000 annual membership fee for companies with annual revenues exceeding \$100 million.¹⁴⁴

Although the grant of royalty-free licenses through the Bluetooth SIG promises to keep down the cost of using Bluetooth, there has been litigation related to the technology. While there has been little public information regarding damages, royalty payments, or licensing terms, below we provide a summary of this litigation. The amount of litigation illustrates that even for a technology that is ostensibly royalty free, there may well still be significant costs.

The Washington Research Foundation (WRF) has asserted patents that it claims relate to high frequency broadband tuning against a number of suppliers of mobile devices that incorporate Bluetooth. The primary WRF patent dates to 1999 and is titled “simplified high-frequency broadband tuner and tuning method.”¹⁴⁵ The technology purportedly improves on basic Bluetooth technology but is not considered by WRF to be essential. WRF’s attorney acknowledged that Bluetooth could be implemented without necessarily infringing WRF’s patent.¹⁴⁶ WRF’s suits have generally followed the same pattern. WRF sues end-device suppliers but ultimately agrees to a license with the component supplier that is providing Bluetooth functionality and the suit is dismissed.

In December 2006, WRF filed suit against Nokia, Samsung, and Panasonic based on four Bluetooth patents.¹⁴⁷ The lawsuit made headlines because of its significance for Bluetooth: “a standard which everyone assumes to be royalty free is now at risk of becoming a chargeable element inside mobile phones and other devices.”¹⁴⁸ Although the suit was filed against Nokia, Samsung, and Panasonic, it targeted products containing Bluetooth chips from a British chip maker, Cambridge Silicon Radio (CSR), a company that then had more than 50 percent of the

¹⁴⁴ *SIG Membership Benefits*, BLUETOOTH, <https://www.bluetooth.org/en-us/members/membership-benefits> (last visited Feb 23, 2014). Associate members can serve on working groups and influence the direction of Bluetooth technology. They also receive discounts on SIG products and access to ABI Research market reports. *Id.*

¹⁴⁵ See Lucas van Grinsven, *U.S. Group Sues Nokia, Samsung Over Bluetooth*, WASHINGTON POST (Jan. 3, 2007), <http://www.washingtonpost.com/wp-dyn/content/article/2007/01/03/AR2007010300152.html>.

¹⁴⁶ See Tricia Duryee, *Patent Suit Filed Against Cellphone Makers over Bluetooth*, THE SEATTLE TIMES (Jan. 3, 2007), available at http://seattletimes.com/html/business/technology/2003506916_bluetooth030.html.

¹⁴⁷ Eric Sylvers, *Wireless: Patent Suit Could Stunt Bluetooth’s Growth*, NY TIMES (Jan 7, 2007), http://www.nytimes.com/2007/01/07/technology/07iht-wireless08.4124622.html?_r=0.

¹⁴⁸ See Lucas van Grinsven, *U.S. Group Sues Nokia, Samsung over Bluetooth*, WASH. POST (Jan. 3, 2007), <http://www.washingtonpost.com/wp-dyn/content/article/2007/01/03/AR2007010300152.html>; Eric Sylvers, *Wireless: Patent Suit Could Stunt Bluetooth’s Growth*, NY TIMES (Jan 7, 2007), http://www.nytimes.com/2007/01/07/technology/07iht-wireless08.4124622.html?_r=0; Paul Miller, *Bluetooth Patent Suit Hits Nokia, Samsung and Panasonic*, ENGADGET (Jan. 3, 2007), <http://www.engadget.com/2007/01/03/bluetooth-patent-suit-hits-nokia-samsung-and-panasonic/>; Camden Swita, *Chip Designer Moves to Invalidate Bluetooth Patent*, DAILY U. WASH. (Feb. 1, 2007), <http://dailyuw.com/archive/2007/02/01/imported/chip-designer-moves-invalidate-bluetooth-patent#.UrK8oPSUHfU>.

world's market share for Bluetooth chips.¹⁴⁹ Broadcom, which also sells chips that incorporate Bluetooth technology, negotiated a licensing agreement with WRF before the litigation began.¹⁵⁰

In March 2007, WRF added Apple, Dell, Sony and five other companies to the litigation.¹⁵¹ Just a couple of months later, WRF dismissed the case after CSR and WRF settled for a \$15 million license fee on May 2, 2007.¹⁵² The dismissal was with prejudice as to products with CSR chips, but without prejudice as to other products.¹⁵³

In June 2010, WRF also sued Silicon Laboratories for infringement and added its customers to the complaint in July 2010.¹⁵⁴ The companies settled all claims and entered into a licensing agreement for an undisclosed amount.¹⁵⁵

The following year, in April 2011, WRF sued Sony, LG Electronics, Samsung, and Nokia for patent infringement of one of its Bluetooth-related patents.¹⁵⁶ This lawsuit was again dismissed just a few months later after WRF concluded settlement and license agreements with ST Ericsson SA and its subsidiaries.¹⁵⁷

Next, in December 2011, WRF sued Sharp and Samsung in two separate actions.¹⁵⁸ WRF dismissed both lawsuits after a few months when it concluded settlement and license

¹⁴⁹ See Lucas van Grinsven, *U.S. Group Sues Nokia, Samsung over Bluetooth*, WASH. POST (Jan. 3, 2007), <http://www.washingtonpost.com/wp-dyn/content/article/2007/01/03/AR2007010300152.html>.

¹⁵⁰ *Id.* No public information could be found regarding the licensing rates Broadcom pays WRF for the Bluetooth technology.

¹⁵¹ Grover Saunders, *Bluetooth Patent Lawsuit Turns Its Sights on Apple*, Ars Technica (Mar. 28, 2007), <http://arstechnica.com/apple/2007/03/bluetooth-patent-lawsuit-turns-its-sights-on-apple/>; Jeff St. Onge & Connie Guglielmo, *Apple, Dell and Sony Added to Bluetooth Patent Suit (Update2)*, BLOOMBERG (Mar. 27, 2007), <http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aba7x1sdhmOg>.

¹⁵² Naomi Graychase, *CSR Settles Bluetooth Lawsuit*, WI-FI PLANET (May 31, 2007), <http://www.wi-fiplanet.com/news/article.php/3680801>; Richard Wilson, *CSR Pays \$15m to Settle Bluetooth Patent Case*, ELECTRONICS WKLY (Apr. 19, 2007), <http://www.electronicweeky.com/news/design/communications/csr-pays-15m-to-settle-bluetooth-patent-case-2007-04/>.

¹⁵³ *Id.*

¹⁵⁴ See Complaint, *Wash. Research Found. vs. Silicon Labs., Inc.*, No. 2:10-cv-1050 (W.D. Wash. June 24, 2010); ECF No. 1, Amended Complaint, *Wash. Research Found. vs. Silicon Labs., Inc.*, Case No. 2:10-cv-1050 (W.D. Was. July 23, 2010) ECF No. 10.

¹⁵⁵ Notice of Dismissal, *Wash. Research Found. vs. Silicon Labs., Inc.*, No. 2:10-cv-1050 (W.D. Wash. Sept. 7, 2010), ECF No. 35.

¹⁵⁶ Complaint, *Wash. Research Found. v. Sony Ericsson Mobile Commc'n*, Case No. 2:11-cv-00651 (W.D. Was. Apr. 15, 2011), ECF No. 1.

¹⁵⁷ Stipulated Notice of Dismissal, *Wash. Research Found. v. Sony Ericsson Mobile Commc'ns AB*, No. 2:11-cv-00651 (W.D. Was. Oct. 20, 2011), ECF No. 24.

¹⁵⁸ *Wash. Research Found. v. Samsung Elecs. Co.*, Case No. 2:11-cv-02079 (W.D. Wash. filed Dec. 12, 2011); *Wash. Research Found. v. Sharp Co.*, Case No. 2:11-cv-02080 (W.D. Wash. Filed Dec. 12, 2011).

agreements with NXP Semiconductors NV and its subsidiaries.¹⁵⁹ The terms of the agreements were not made public.

Finally, in December 2012, WRF sued Apple, D-Link Systems, Hewlett-Packard, Logitech, Microsoft, Samsung, and Parrot Inc., again alleging infringement related to use of Bluetooth.¹⁶⁰ Just a month after filing suit, WRF dismissed the case after Qualcomm and its subsidiaries reached a settlement and license agreement with WRF.¹⁶¹ WRF has not brought any further lawsuits and it is likely that it is currently licensing all major manufacturers of Bluetooth chips.

Wi-Lan, Inc. is another company that has been very active in Bluetooth-related litigation. In April 2010, Wi-Lan, initiated lawsuits against many companies in the mobile and laptop industry over Bluetooth technology.¹⁶² The companies included, among others, Intel, Acer, Apple, Dell, Hewlett-Packard, Lenovo, Motorola, Sony, and Toshiba.¹⁶³ Wi-Lan's lawsuits were based on one patent, which was issued in 1996 and titled "method for frequency sharing and frequency punchout in frequency hopping communications network."¹⁶⁴ The patent purportedly addresses technology by which a wireless system, like Bluetooth, avoids interfering with other wireless systems, like Wi-Fi.¹⁶⁵ In June 2010, Wi-Lan amended the complaint to include CSR as a defendant and assert a second patent titled "asymmetric adaptive modulation in a wireless communication system."¹⁶⁶

In January 2011, Intel reached a settlement agreement with Wi-Lan, agreeing to make a series of payments under a multi-year license of Wi-Lan's entire patent portfolio.¹⁶⁷ The financial terms of the settlement were not made public.¹⁶⁸ That same month, Wi-Lan settled with Broadcom, signing a memorandum of understanding that gave Broadcom a multi-year

¹⁵⁹ Notice of Dismissal, *Wash. Research Found. v. Samsung Elecs. Co.*, Case No. 2:11-cv-02079 (W.D. Wash. Feb. 13, 2012); ECF No. 8, Notice of Dismissal, *Wash. Research Found. v. Sharp Co.*, Case No. 2:11-cv-02080 (W.D. Wash. Feb. 14, 2012), ECF No. 9.

¹⁶⁰ Complaint, *Wash. Research Found. v. Apple Inc.*, No. 2:12-cv-02092 (W.D. Wash. Nov. 30, 2012), ECF No. 1; see David Kemp, *Apple, Samsung, and Others Sued over Bluetooth Patents*, JUSTIA.COM (Dec. 4, 2012), <http://onward.justia.com/2012/12/04/apple-samsung-and-others-sued-over-bluetooth-patents/>.

¹⁶¹ Notice of Dismissal, *Wash. Research Found. v. Apple Inc.*, No. 2:12-cv-02092 (W.D. Wash. Dec. 28, 2012), ECF No. 11.

¹⁶² Robin Wauters, *Wi-LAN Files Patent Lawsuit Against Just About Every Portable Device Manufacturer*, TECH CRUNCH (Apr. 8, 2010), <http://techcrunch.com/2010/04/08/wilan-lawsuit/>.

¹⁶³ Lance Whitney, *Wi-LAN Sues Everybody over Bluetooth*, CNET (Apr. 8, 2010), http://news.cnet.com/8301-1035_3-20002015-94.html.

¹⁶⁴ *Id.*

¹⁶⁵ *Id.*

¹⁶⁶ See Allison Grande, *CSR to License Wi-LAN Bluetooth Patents*, LAW360 (Feb. 18, 2011), <http://www.law360.com/articles/226967/csr-to-license-wi-lan-bluetooth-patents>.

¹⁶⁷ Alastair Sharp & Frank McGurty, *Intel Settles with WiLAN Over Patent Litigation*, INT'L BUS. TIMES (Jan. 14, 2011), <http://www.ibtimes.com/intel-settles-wilan-over-patent-litigation-449461>.

¹⁶⁸ *Id.*

license to Wi-Lan's patent portfolio.¹⁶⁹ The financial details to the settlement were also not made public.¹⁷⁰ In February 2011, CSR settled the infringement claims by agreeing to license Wi-Lan's patent portfolio, but the financial terms of the agreement were also kept confidential.¹⁷¹ By the end of 2011, Wi-Lan had dismissed all defendants after settlement agreements had been reached, and the case was terminated.¹⁷²

In January and December 2012, Wi-Lan filed lawsuits against RIM for patent infringement related to its Bluetooth technology.¹⁷³ The patents purportedly relate to a frequency hopping system used by phones in Bluetooth communications and technology that helps provide more efficient voice data transmission.¹⁷⁴ In October 2013, Wi-Lan settled with RIM and dismissed all pending patent litigation.¹⁷⁵ The terms of the settlement were not disclosed.¹⁷⁶ The settlement includes a license on certain Wi-LAN wireless technology patents and the companies plan to discuss potential licensing for additional patents.¹⁷⁷

Another active litigant recently is SmartPhone Technologies LLC, an affiliate of Acacia Research Corporation. SmartPhone sued a number of companies in different lawsuits starting in March 2010, including RIM, Nokia, HTC, Amazon, Dell, Huawei, ZTE, and Apple.¹⁷⁸ The companies were accused of infringing a variety of patents, including one that is claimed to relate to power conservation in Bluetooth devices.¹⁷⁹ In March, July, and August 2011, and January

¹⁶⁹ *Broadcom Settles with Wi-Lan*, SOC. TECH (Jan. 20, 2011), http://www.socaltech.com/broadcom_settles_with_wi_lan/s-0033370.html.

¹⁷⁰ *Id.*

¹⁷¹ *See Allison Grande, CSR to License Wi-LAN Bluetooth Patents*, LAW360 (Feb. 18, 2011), <http://www.law360.com/articles/226967/csr-to-license-wi-lan-bluetooth-patents>.

¹⁷² *See Civil Docket, Wi-Lan Inc. v. Acer, Inc.*, No. 2:10-cv-00124 (E.D. Tex. Filed Apr. 7, 2010); *Wi-LAN Settles Bluetooth Suit with TI*, CIOL (July 4, 2011), <http://www.ciol.com/ciol/news/40957/wi-lan-settles-bluetooth-suit-ti>.

¹⁷³ Reuters, *Wi-LAN Drops on LG Ruling, Sues RIM for Bluetooth Patent Infringement*, FIN. POST (Dec. 11, 2012), http://business.financialpost.com/2012/12/11/wi-lan-sues-rim-for-bluetooth-patent-infringement/?__lsa=1b00-2389.

¹⁷⁴ *See Steven Melendez, Wi-LAN Says BlackBerry Functions Violate Patents*, LAW360 (Jan. 20, 2012), <http://www.law360.com/articles/302119/wi-lan-says-blackberry-functions-violate-patents>; Nathan Hale, *Wi-LAN Says RIM's Bluetooth Products Infringe Patent*, LAW360 (Dec. 11, 2012), <http://www.law360.com/articles/400410/wi-lan-says-rim-s-bluetooth-products-infringe-patent>.

¹⁷⁵ Garima Goel, *Wi-Lan, BlackBerry Settle All Patent Litigation*, REUTERS (Oct. 9, 2013), <http://www.reuters.com/article/2013/10/09/us-wilan-blackberry-idUSBRE9980FO20131009>.

¹⁷⁶ *Id.*

¹⁷⁷ *Id.*; Chelsea Naso, *Blackberry and Wi-LAN Reach Deal to End Patent Feud*, LAW360 (Oct. 09, 2013), <http://www.law360.com/articles/479239/blackberry-and-wi-lan-reach-deal-to-end-patent-feud>.

¹⁷⁸ Sindhu Sundar, *Apple, AT&T Strike Deal with Patent Co. in Smartphone IP Row*, LAW360 (Mar. 25, 2013), <http://www.law360.com/articles/427219/apple-at-t-strike-deal-with-patent-co-in-smartphone-ip-row>; Meghan Stride, *SmartPhone Hits Cell Phone Makers with IP Suit*, LAW 360 (Nov. 1, 2010), http://www.law360.com/articles/205625/smartphone-hits-cell-phone-makers-with-ip-suit?article_related_content=1.

¹⁷⁹ Meghan Stride, *SmartPhone Hits Cell Phone Makers with IP Suit*, LAW360 (Nov. 1, 2010), http://www.law360.com/articles/205625/smartphone-hits-cell-phone-makers-with-ip-suit?article_related_content=1.

2012 SmartPhone settled and dismissed its lawsuit against Samsung, Pantech, and RIM, and Amazon, respectively, but did not provide any information regarding the settlements.¹⁸⁰ More recently, in March 2013, Apple and AT&T were dismissed from the litigation after a settlement, but no information on the terms of the settlement was disclosed.¹⁸¹

Other companies have also litigated patents that are alleged to involve Bluetooth technology.¹⁸² Some are currently in litigation, such as DSS Technology Management's lawsuit against Apple filed in November 2013¹⁸³ and Rembrandt Wireless Technologies lawsuits against Research In Motion and Samsung filed in March 2013.¹⁸⁴ No information regarding whether the patents-in-suit are declared essential has been provided yet, and there still has been no disclosures regarding damages or licensing/royalty information.

Global Positioning System (Standardized)

The Global Positioning System (GPS) service is provided by the U.S. federal government without charge.¹⁸⁵ A federal statute directs the Secretary of Defense to provide civil GPS service

¹⁸⁰ Leigh Kamping-Carder, *RIM Settles in SmartPhone's Bluetooth Patent War*, LAW360 (Aug. 2, 2011), http://www.law360.com/articles/262129/rim-settles-in-smartphone-s-bluetooth-patent-war?article_related_content=1; Sindhu Sundar, *Amazon Resolves Kindle Patent Feud*, LAW360 (Jan. 4, 2012), http://www.law360.com/articles/296771/amazon-resolves-kindle-patent-feud?article_related_content=1.

¹⁸¹ Sindhu Sundar, *Apple, AT&T Strike Deal with Patent Co. in Smartphone IP Row*, LAW360 (Mar. 25, 2013), <http://www.law360.com/articles/427219/apple-at-t-strike-deal-with-patent-co-in-smartphone-ip-row>.

¹⁸² In March 2011, April 2012, and October 2012, Azure Networks sued a variety of companies, including Qualcomm, Marvell, MediaTek, HTC, Dell, Intel, Samsung, over a personal area network patent claimed to be used in various Bluetooth networking devices. See Pete Brush, *Azure Sues Qualcomm, Others over Networking Patent*, LAW360 (Mar. 23, 2011), <http://www.law360.com/articles/233992/azure-sues-qualcomm-others-over-networking-patent>. Based on claim construction, the defendants were found not to infringe the patent and the cases have been dismissed. See, e.g., Final Judgment, *Azure Networks, LLC v. CSR PLC*, No. 6:11-cv-139 (E.D. Tex. May 30, 2013); ECF No. 296, Joint Motion to Dismiss Claims and Counterclaims Without Prejudice, *Azure Networks, LLC v. MediaTek Inc.*, No. 6:12-cv-00252 (E.D. Tex. June 6, 2013), ECF No. 194. Azure is currently appealing the non-infringement ruling.

¹⁸³ *DSS Tech. Mgmt., Inc. v. Apple, Inc.*, Case No. 6-13-cv-00919 (E.D. Tex. Filed Nov. 26, 2013). DSS claims that Apple is infringing two patents through the ability of Apple's products that provide wireless Bluetooth to connect to a plurality of wireless peripherals. Complaint *DSS Tech. Mgmt., Inc. v. Apple, Inc.*, No. 6-13-cv-00919 (E.D. Tex. Nov. 26, 2013), ECF No. 1. Both patents are titled "Personal data network." *Id.*, see also Jack Purcher, *Apple's iMac and Mac Mini Targeted in New Patent Lawsuit Regarding Wireless Networks Using Low Duty Cycle RF Bursts*, PATENTLY APPLE (Nov. 27, 2013), <http://www.patentlyapple.com/patently-apple/2013/11/apples-imac-and-mac-mini-targeted-in-new-patent-lawsuit-regarding-wireless-networks-using-low-duty-cycle-rf-bursts.html>.

¹⁸⁴ *Rembrandt Wireless Techs. LP v. Samsung Elecs. Co.*, Case No. 2-13-cv-00213 (E.D. Tex. Filed March 15, 2013). Rembrandt Wireless is accusing these companies of infringing its patent titled "System and method of communicating using at least two modulation methods" by manufacturing and marketing products that comply with Bluetooth standards. Complaint, *Rembrandt Wireless Techs. LP v. Samsung Elecs. Co.*, No. 2-13-cv-00213 (E.D. Tex. March 15, 2013), ECF No. 1. Rembrandt Wireless claims that there is infringement because the Bluetooth standards support "Enhanced Data Rate" mode and therefore use at least two modulation methods. *Id.*, see also Elizabeth Varghese, *Rembrandt Wireless Technologies Sues RIM and Samsung Over Bluetooth Technology*, MAXVAL (Mar. 19, 2013), <http://maxval-ip.blogspot.com/2013/03/rembrandt-wireless-technologies-sues.html>.

¹⁸⁵ POSITIONING, NAVIGATION & TIMING EXEC. COMM., DEP'T OF DEF., GLOBAL POSITIONING SYSTEM STANDARD POSITIONING SERVICE PERFORMANCE STANDARD (4th ed. 2008), available at <http://www.gps.gov/technical/ps/2008-SPS-performance-standard.pdf>.

on a “continuous, worldwide basis, free of direct user fees.”¹⁸⁶ A GPS receiver¹⁸⁷ calculates a position by finding and acquiring a signal from satellites in a navigation system and decoding the satellites’ data.¹⁸⁸ The mandate to provide free service reflects the need for reliable and accessible positioning information. To that end, the United States has entered a series of agreements with countries and organizations throughout the world to cooperate on development of GPS and sharing of systems.¹⁸⁹

In addition to basic GPS, smartphones frequently implement Assisted Global Positioning System (AGPS) because it creates faster location acquisition.¹⁹⁰ The Federal Communications Commission requires that a cell phone’s location be made available to emergency call dispatchers.¹⁹¹ This requirement has led many cellular companies to use AGPS to assist in more accurate positioning.¹⁹² AGPS uses separate wireless communications channels to enhance GPS signals.¹⁹³ Cellular towers, which have GPS receivers that are constantly retrieving satellite information to obtain time and location information, pass this information on to a smartphone.¹⁹⁴ 3GPP and 3GPP2 standards include “specifications of the minimum required performance for A-GPS in a mobile phone.”¹⁹⁵ 3GPP includes GSM, UMTS, and LTE systems and 3GPP2 includes

¹⁸⁶ 10 U.S.C. § 2281; (2012) *United States Code*, GPS. <http://www.gps.gov/policy/legislation/uscode/#title10> (last visited Feb 23, 2014)

¹⁸⁷ See Brenton Greene, Lucent Technologies, Wireless Cellular Communications and Next Generation GPS 4 (Jan. 2006), available at <http://www.space.commerce.gov/library/workshops/2006-01-25/greene.ppt> (“CDMA cellular technology critically relies on GPS for everyday operations . . . Almost all CDMA and GSM cell phones manufactured today contain an embedded GPS receiver to support E911.”).

¹⁸⁸ FRANK STEPHEN TROMP VAN DIGGELEN, A-GPS: ASSISTED GPS, GNSS AND SBAS 1 (2009).

¹⁸⁹ *International Cooperation*, GPS, <http://www.gps.gov/policy/cooperation/> (last visited Feb. 24, 2014). A commercial affiliate of the British government recently threatened to disrupt this cooperation by seeking patents on a GPS system designed in cooperation with the United States with the intent of seeking royalties from users. The United States and United Kingdom reached an agreement that the agency would not assert the patents and “affirmed their joint commitment to ensuring that GPS civil signals will remain perpetually free and openly available for users worldwide.” *UK Drops Patent Efforts on GPS, GNSS Signal Design*, InsideGNSS (Jan. 17, 2013), <http://www.insidegnss.com/node/3359>; *Joint United Kingdom–United States Statement Regarding Global Positioning System (GPS) Intellectual Property*, GPS (Jan. 17, 2013), <http://www.gps.gov/policy/cooperation/uk/2013-joint-statement/>.

¹⁹⁰ See, e.g., *GPS vs. aGPS: A Quick Tutorial*, WINDOWS PHONE CENTRAL (Jan 3, 2009), <http://www.wpcentral.com/gps-vs-agps-quick-tutorial>.

¹⁹¹ FED. COMM’NS COMM., FACT SHEET, FCC WIRELESS 911 REQUIREMENTS (Jan. 2001), available at http://transition.fcc.gov/pshs/services/911-services/enhanced911/archives/factsheet_requirements_012001.pdf.

¹⁹² See Brenton, *supra* note 193, at 10-12.

¹⁹³ Tromp Van Diggelen, *supra* note 194, at xiii.

¹⁹⁴ See *id.*; Jonas Willaredt, *WiFi and Cell-ID Based Positioning - Protocols, Standards and Solutions*, 4 available at http://www.snet.tu-berlin.de/fileadmin/fg220/courses/WS1011/snet-project/wifi-cellid-positioning_willaredt.pdf (last visited Feb. 23, 2014).

¹⁹⁵ See Tromp Van Diggelen, *supra* note 194, at 278-80.

CDMA cellular systems.¹⁹⁶ Any royalties for use of these GPS-related aspects of the cellular standards appear to be included within the cellular royalties.

There has, however, been litigation over the use of AGPS in cellular devices. ITT Corporation, for example, announced in 2010 that it had settled infringement suits against Nokia and Motorola accusing mobile devices that incorporated AGPS.¹⁹⁷ We have not located any publicly-available information about royalty rates for AGPS.

Near Field Communications (Standardized)

NFC is a form of contactless communication between devices using electromagnetic radio fields.¹⁹⁸ It can be used for applications such as in-store payment through a so-called “mobile wallet.” NFC technology has been standardized by several standard-setting organizations. The ISO/IEC, EMCA and ETSI have all promulgated standards that address NFC (ISO 18092, ECMA-340, and ETSI TS 102 190, respectively).¹⁹⁹ A non-profit industry group called the Near Field Communication Forum also promulgates proposed standards.²⁰⁰ The NFC Forum specifications are based on the NFC standards created and maintained by the ISO/IEC, EMCA and ETSI.²⁰¹

NFC technology was developed by Sony and NXP Semiconductors in 2002.²⁰² The technology was first standardized by the ISO/IEC in 2004.²⁰³ In the same year, in order to advance the use of NFC technology, the NFC Forum was formed.²⁰⁴ Currently, the NFC Forum has more than 170 members, including manufacturers, application developers and financial

¹⁹⁶ See *id.*; see, e.g., Ericsson, *Positioning with LTE 7* (White Paper No. 284-23-3155, Sept. 2011), available at <http://www.sharetechnote.com/Docs/WP-LTE-positioning.pdf>; *3GPP Specification Series, LTE, 36 Series*, 3GPP, <http://www.3gpp.org/ftp/Specs/html-info/36-series.htm> (last visited Feb. 24, 2014); *About 3GPP*, 3GPP, <http://www.3gpp.org/About-3GPP> (last visited Feb. 24, 2014); *About 3GPP2*, 3GPP2, http://www.3gpp2.org/Public_html/Misc/AboutHome.cfm (last visited Feb. 24, 2014).

¹⁹⁷ See Press Release, ITT Corporation, ITT Corporation Reaches Patent Settlement Agreement with Nokia (Mar. 2, 2010), [http://www.itt.com/News/Releases/2010/ITT-Corporation-Reaches-Patent-Settlement-Agre-\(1\)/](http://www.itt.com/News/Releases/2010/ITT-Corporation-Reaches-Patent-Settlement-Agre-(1)/); Press Release, ITT Corporation, ITT Corporation Reaches Patent Settlement Agreement with Motorola (July 16, 2010), <http://www.itt.com/News/Releases/2010/ITT-Corporation-reaches-patent-settlement-agreemen/>.

¹⁹⁸ NEAR FIELD COMM., <http://www.nearfieldcommunication.org/> (last visited Feb. 23, 2014).

¹⁹⁹ A number of other standards relate to NFC including ISO/IEC 18092 (ECMA-340), ISO/IEC 21481 (ECMA-352), ISO/IEC 22536 (ECMA-356), ISO/IEC 23917 (ECMA-362), ISO/IEC 13157-1 (ECMA-385), ISO/IEC 13157-2 (ECMA-386), and ISO/IEC 16353 (ECMA-390). See *Index of ECMA Standards*, ECMA INT’L, <http://www.ecma-international.org/publications/standards/Stnindex.htm> (last visited Feb. 23, 2014).

²⁰⁰ See *NFC and Interoperability*, NFC FORUM <http://members.nfc-forum.org/aboutnfc/interop/> (last visited Feb. 23, 2014).

²⁰¹ See *id.*

²⁰² See, e.g., *About NFC*, CISTEMS NFC, <http://cistems.com/about-nfc/> (last visited Feb. 23, 2014).

²⁰³ See *ISO/IEC 18092:2004*, ISO, http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=38578 (last visited Feb. 23, 2014).

²⁰⁴ *Our Mission & Goals*, NFC FORUM, <http://nfc-forum.org/about-us/the-nfc-forum> (last visited Feb. 23, 2014).

services institutions.²⁰⁵ NFC Forum members must execute an Intellectual Property Rights Policy, which commits them to licensing their declared essential NFC patents on RAND terms.²⁰⁶

NFC technology has only recently become popular, and data about royalties is limited. The only royalty data we have located for NFC patents are the rates charged by Via Licensing for an NFC patent pool it ran from June 2007 through June 2012. Over the course of its existence, the pool contained the patents of France Telecom, NXP, Inside Secure (formerly known as Inside Contactless), and Motorola.²⁰⁷ The Via Licensing pool royalty rate was for a license to patents that Via determined were actually essential.²⁰⁸ The pool reportedly closed because NXP and Inside Secure withdrew their patents based on dissatisfaction with Via's licensing efforts.²⁰⁹ Accordingly, the Via NFC pool rates may diverge from what patent holders like NXP and Inside Secure believe they are entitled to for their NFC patents.

Via's rates for a pool license for consumer devices were as follows:²¹⁰

<u>Annual Volume of Device</u>	<u>License Fee Per Device</u>
Up to 1,000,000 devices	\$0.490
1,000,001 - 10 million devices	\$0.368
10,000,001 - 50 million devices	\$0.245
50,000,001 - 100 million devices	\$0.098

²⁰⁵ *Id.*

²⁰⁶ *Intellectual Property Rights Policy*, NFC FORUM, (Nov. 9, 2004), <http://nfc-forum.org/wp-content/uploads/2013/11/NFC-Forum-IPR-Policy.pdf> (last visited Feb. 23, 2014); *see Why Does the NFC Forum Have an IPR policy at All?*, NFC FORUM, <http://nfc-forum.org/resources/why-does-the-nfc-forum-have-an-ipr-policy-at-all/> (last visited Feb. 23, 2014).

²⁰⁷ *See* Press Release, Via Licensing, Via Licensing and Participating Licensors Announce Availability of Discounts or Caps on NFC Essential Patent License Fees for NFC Consumer Device Manufacturers (Feb. 12, 2008), http://www.vialicensing.com.cn/uploadedFiles/US/News_and_Events/News/02_12_2008%20NFC%20Licensing%20Program%20Market%20Maker%20Incentives%20Announced.pdf; *see also Via Licensing - Near Field Communications Licensor*, VIA LICENSING (archived May 2011), <http://web.archive.org/web/20110507233251/http://www.vialicensing.com/licensing/nfc-licensors.aspx> (describing France Telecom, Inside Secure, Motorola, Inc., and NXP Semiconductors as Via Licensing pool members).

²⁰⁸ *See* Press Release, Via Licensing, Motorola Joins NFC Licensing Program (June 30, 2009), http://www.vialicensing.com/uploadedFiles/US/News_and_Events/News/06_30_2009%20Motorola%20Joins%20NFC%20Licensing%20Program.pdf ("Any entity owning patents that may be deemed essential to NFC is invited to submit its patent for evaluation by an independent expert with a view toward contributing its essential patents to the pool license.").

²⁰⁹ *See* Dan Balaban, *NFC Joint Patent Program Ends; No Disruption to Licensing, Say Chip Makers*, NFC TIMES (June 22, 2012), <http://nfctimes.com/news/nfc-joint-patent-program-ends-no-disruption-licensing-say-chip-makers>.

²¹⁰ *NFC License Fees*, VIA LICENSING, <http://www.vialicensing.com/licensing/nfc-fees.aspx> (last visited Feb. 23, 2014).

<u>Annual Volume of Device</u>	<u>License Fee Per Device</u>
More than 100 million devices	\$0.049

To date, we have located only one case in which a party sought to enforce what is claimed to be an NFC-essential patent, *OTI v. T-Mobile*.²¹¹ In addition to this suit, a number of other cases have involved patents related to use of NFC but not where the patents were claimed to be essential to the standard.²¹²

Given that NFC functionality is increasingly popular in cellular devices, it is reasonable to expect that there will be increased focus on NFC licensing and litigation in the future.

Battery and Power Management

The cost of a smartphone battery is estimated to be \$5 and \$6-8 for power management hardware, including the power amplifier (\$3-4 per unit) and the power management controller (also \$3-4 per unit).²¹³

Battery (Non-Standardized)

Patents for battery technologies may relate to the battery itself as well as hardware and software attributes that are specifically designed to manage the delivery of power to a smartphone such as the battery charger, and the method of transferring power from the battery to the smartphone.

We have identified a limited amount of public licensing information regarding licensing of battery technology.

In a 2006 suit brought by Power Integrations against Fairchild Semiconductor related to technology for charging cell phones, the jury awarded reasonable royalty damages of \$4,028,681 for sales of approximately 3,000,000 infringing units on a royalty base of approximately \$8.95 per unit.²¹⁴ This yields a royalty rate of 15%.

There are also a handful of publicly-available license agreements, which are summarized below. These data points are varied and include lump sums and other forms of payment that do not lend themselves to easy comparison:

²¹¹ See Press Release, On Track Innovations Ltd., OTI Announces Results of Markman Hearing in Patent Infringement Suit Against T-Mobile (June 20, 2013), <http://www.otiglobal.com/press-releases/oti-announces-results-of-markman-hearing-in-patent-infringement-suit-against-t-mobile/>; *On Track Innovations Ltd. v. T-Mobile USA, Inc.*, No. 12-cv-02224 (S.D.N.Y.).

²¹² See Erin Fonté & Charles Salmon, *The Rise of Patent Lawsuits in the Mobile Payments Arena*, 6 E-FIN. & PAYMENTS L. & POL'Y 7 (May 2012), available at <http://www.coxsmith.com/portalresource/lookup/wosid/intelliun-104-18303/media.name=/EFPLP%20May%20-%202012.pdf>.

²¹³ Nomura Securities 2012 Smartphone Guide, *supra* note 9.

²¹⁴ *Power Integrations v. Fairchild Semiconductor*, No. 1:04-cv-01371, 2006 WL 3223651 (D. Del. Oct. 10, 2006).

- AER Energy Resources, Inc.: Duracell will pay a running royalty based on a percentage of the net sales of products covered by AER patents or patent applications (percentages redacted in disclosure).²¹⁵
- Ultralife Batteries: In 2003, Ultralife agreed to a license from Saft for tooling on battery cases that amounts to approximately \$1 per battery.²¹⁶
- Highpower International, Inc.: License fees of \$0.2 million in 2010 and \$0.3 million in 2011 to Ovonic Battery Company, Inc. to manufacture Ni-MH batteries for portable consumer applications in China to sell worldwide.²¹⁷

Power Management (Non-Standardized)

Power management patents consist of patents that relate to the battery as well as patented hardware and software attributes that are specifically designed to manage the consumption of power in a smartphone. Although we identified a number of lawsuits where a power management patent was asserted by or against a smartphone manufacturer, we did not find any instance where the suit resulted in a damages award or publicly-disclosed license.

In 2010 and 2011, the non-practicing entity St. Clair Intellectual Property Consultants sued a number of smartphone and tablet suppliers, including Samsung, LG, Apple, and Motorola.²¹⁸ Among the asserted patents are four that St. Clair had previously asserted in a 2009 case against a number of computer suppliers, including Acer, Toshiba, Lenovo, Apple, and Dell, and in which Intel intervened.²¹⁹ In the 2009 case, St. Clair sought a royalty of \$4.50 per device for the asserted patents based on claims of its experts that they were responsible for extending the battery life of the accused computers by an hour.²²⁰ The district court denied the defendants' *Daubert* motions challenging the bases for the \$4.50 royalty.²²¹ Following that decision, all but one of the defendants settled with St. Clair.²²²

A suit between SynQor and competing manufacturers of power converters (Artesyn Technologies, Bel Fuse, Delta Electronics, Power-One, Murata, Cherokee International, and

²¹⁵ AER Energy Resources, Inc., Current Report (Form 8-K), 9 (Sept. 24, 1998).

²¹⁶ Ultralife Batteries, Inc., Annual Report for 2012 (Form 10-K) 10 (Mar. 15, 2013).

²¹⁷ HIGHPOWER INTERNATIONAL, INC., ANNUAL REPORT FOR 2011 (FORM 10-K) 8 (Mar. 30, 2012); HIGHPOWER INTERNATIONAL, INC., ANNUAL REPORT (FORM 10-K) 9 (Apr. 2, 2013).

²¹⁸ See Civil Docket, *St. Clair Intellectual Prop. Consultants v. Apple Inc.*, No. 1-10-cv-00982 (D. Del. Filed Nov. 16, 2010) (docket lists related cases naming other defendants).

²¹⁹ *St. Clair Intellectual Prop. Consultants v. Acer, Inc.*, No. 1-09-cv-00354 (D. Del. filed May 15, 2009) (consolidated).

²²⁰ Opening Brief of Defendants' *Daubert* Motion No. 1: Ted Drake and Michael Wagner, *St. Clair Intellectual Prop. Consultants v. Acer, Inc.*, No. 1-09-cv-00354 (D. Del. May 25, 2012), ECF No. 664.

²²¹ Memorandum Order, *St. Clair Intellectual Prop. Consultants v. Acer, Inc.*, No. 1-09-cv-00354 (D. Del. Mar. 29, 2013), ECF No. 876.

²²² See Civil Docket, *St. Clair Intellectual Prop. Consultants v. Acer, Inc.*, No. 1-09-cv-00354 (D. Del. filed May 15, 2009).

Lineage Power), which make power components for larger applications, such as cellular base stations, also provides some royalty information. The jury awarded SynQor damages based on a model that included both lost profits and a reasonable royalty component.²²³ The lost profits and royalty rates were based on evidence that SynQor had sold its own products for prices from “the [\$]60s to as high as \$110.”²²⁴ Given the difference between the technologies at issue in that case and smartphone components, however, the relevance of the data may be limited.

Audio Module

Modern smartphones act as portable media playback devices, replacing dedicated media devices like portable MP3 players. Because smartphones have limited drive space, standardized audio compression formats are a practical necessity in order to accommodate large audio files. In particular, a smartphone must have access to a media player application with a coder-decoder (or codec) that is able to decode and play popular audio formats.

Modern digital media, like CDs, Blu-ray, DVD, and MP3 store audio information in the form of an electronic file. Media players decode these files to produce an audio signal, which is passed to speakers that play the signal as a sound. Generally, the more data contained in the electronic audio file, the higher the quality of the sound on playback. The purpose of modern audio compression technology is to reduce the size of the audio file without undermining the quality of the sound during playback.

Audio compression works by coding the audio information in special, standardized formats for storage.²²⁵ To turn the digital information into an audio signal, a playback device must decode audio files. Software for encoding and decoding file formats is commonly called a codec—a portmanteau of coder-decoder.

Audio compression formats come in two kinds—lossless and lossy.²²⁶ Lossless compression formats retain all of the audio information in the uncompressed source. In other words, it produces smaller audio files without losing any of the data in the original audio file, and thus without any loss of sound quality. The same information simply takes up less space.

Lossy compression does not retain all of the audio information from the original digital file, resulting in poorer sound.²²⁷ An extreme example of lossy compression is the compression of voice data over a phone, which can often sound “tinny” and unnatural. However, lossy compression has one major advantage over lossless compression—lossy compression can

²²³ *SynQor, Inc. v. Artesyn Techs. Inc.*, 709 F.3d 1365, 1380-81 (Fed. Cir. 2013).

²²⁴ *Id.* at 1381.

²²⁵ See N.V., *Difference Engine: Music to Their Ears*, BABBAGE, ECONOMIST (Feb. 10, 2012), <http://www.economist.com/blogs/babbage/2012/02/audio-compression>.

²²⁶ See Matt Peckham, *Can You Hear the Difference Between Lossless and Lossy Audio?*, TIME TECH (Mar. 2, 2012), <http://techland.time.com/2012/03/02/can-you-hear-the-difference-between-lossless-and-lossy-audio/>.

²²⁷ See N.V., *Difference Engine: Music to Their Ears*, BABBAGE, ECONOMIST (Feb. 10, 2012), <http://www.economist.com/blogs/babbage/2012/02/audio-compression>.

produce much smaller file sizes with only minimal degradation of sound quality. For this reason, lossy formats like the well-known MP3 have become ubiquitous.

Codecs for the two dominant lossless audio compression formats, Apple Lossless and FLAC, are both available royalty-free.²²⁸

The most popular lossy codecs are based on standards promulgated by the Motion Picture Experts Group (MPEG) and are covered by SEPs.²²⁹ The most notable lossy compression format is the MPEG 1 Layer 3 or MP3 format and its successor format, Advanced Audio Coding.²³⁰ The MP3 standard began the audio compression revolution that enabled digital music downloads. It is still the format used by many digital music providers, including Amazon.com. Compared to MP3, AAC typically produces audio quality in smaller file sizes.

AAC (Standardized)

Advanced Audio Coding, or AAC, is a successor to MP3 audio compression.²³¹ AAC allows for higher quality audio playback at smaller file sizes than MP3. It is the format supported by, for example, the iTunes store. AAC was first defined in the MPEG 2 Part 7 specification (ISO/IEC 13818-7), and it was updated in the MPEG 4 Part 3 specification (ISO/IEC 14496-3).

Via Licensing, a subsidiary of Dolby Laboratories, Inc., maintains an AAC patent pool.²³² The pool license has been widely adopted—the list of licensees numbers over 750.²³³ We have not identified any litigation in which non-pool licensors have sued to enforce patents declared essential to the AAC standards.

The Via Licensing pool offers the following range of rates for smartphones:²³⁴

²²⁸ See Josh Lowensohn, *Apple's Lossless Audio Format Goes Open Source*, CNET (Oct. 28, 2011), http://news.cnet.com/8301-27076_3-20127129-248/apples-lossless-audio-format-goes-open-source/; *License*, FLAC, <https://xiph.org/flac/license.html> (last visited Feb. 23, 2014).

²²⁹ *Audio Coding*, MOVING PICTURE EXPERTS GROUP, <http://mpeg.chiariglione.org/technologies/media-coding/audio-coding> (last visited Feb. 24, 2014).

²³⁰ See N.V., *Difference Engine: Music to Their Ears*, BABBAGE, ECONOMIST (Feb. 10, 2012), <http://www.economist.com/blogs/babbage/2012/02/audio-compression>.

²³¹ See *ACC Audio and the MP4 Media Format*, JISC DIGITAL MEDIA, <http://www.jiscdigitalmedia.ac.uk/guide/aac-audio-and-the-mp4-media-format> (last visited Feb. 23, 2014).

²³² *Advanced Audio Coding – AAC*, VIA LICENSING, <http://www.vialicensing.com/licensing/aac-overview.aspx> (last visited Feb. 23, 2014).

²³³ *AAC Licensees*, VIA LICENSING, <http://www.vialicensing.com/licensing/aac-licensees.aspx> (last visited Feb. 23, 2014).

²³⁴ *ACC License Fees*, VIA LICENSING, <http://www.vialicensing.com/licensing/aac-fees.aspx> (last visited Feb. 23, 2014).

Volume (per unit ²³⁵ /annual reset)	Per Unit Fee
For the first 1 to 500,000 units	\$0.98
For units 500,001 to 1,000,000	\$0.76
For units 1,000,001 to 2,000,000	\$0.62
For units 2,000,001 to 5,000,000	\$0.52
For units 5,000,001 to 10,000,000	\$0.42
For units 10,000,001 to 20,000,000	\$0.24
For units 20,000,001 to 50,000,000	\$0.20
For units 50,000,001 or more	\$0.15

The per-unit fees are calculated based on the number of AAC products sold within the year, starting at the quantity of one.²³⁶ In addition to the license fees, there is an initial, one-time, fee of \$15,000 due upon the execution of the AAC license.²³⁷

MP3 (Standardized)

The MP3 format, which uses an advanced type of audio compression, became an International Organization for Standardization (ISO) standard in 1993.²³⁸ MP3 is the short name for the MPEG-1/MPEG-2 Layer 3 standard, and it is a format for storing digital audio.²³⁹ MP3 is used in digital audio players, including smartphones. MP3 is backward and forward compatible, thereby ensuring that all MP3 files can be played in current (or older) and future digital audio players.²⁴⁰

Fraunhofer IIS has been recognized as the most important SEP holder for MP3 technology because it was the primary developer of the MP3 format.²⁴¹ Fraunhofer has combined its MP3 patent portfolio with another significant contributor, Thomson Multimedia (now Technicolor).²⁴² Together, they license their MP3 standard essential patents. Italian

²³⁵ Consumer products with more than two channels count as 1.5 units. *Id.*

²³⁶ *AAC Frequently Asked Questions*, VIA LICENSING, <http://www.vialicensing.com/licensing/aac-faq.aspx> (last visited Feb. 23, 2014).

²³⁷ *Id.*

²³⁸ *See About Mp3*, TECHNICOLOR, <http://mp3licensing.com/mp3> (last visited Feb. 23, 2014).

²³⁹ *See id.*

²⁴⁰ *See id.*

²⁴¹ John Schmid, *German Creators of MP3 March to Different Tune*, N.Y. Times (Nov. 5, 2001), http://www.nytimes.com/2001/11/05/business/worldbusiness/05iht-itmp3_ed3_.html.

²⁴² *Royalty Rates*, TECHNICOLOR, <http://www.mp3licensing.com/royalty> (last visited Feb. 23, 2014).

company Sisvel has formed another MP3 patent pool with patents from Philips, TDF S.A.S., and France Telecom, among others.²⁴³ The rates that both of these pools charge are shown below:

Pool	Annual Units	Fee Per Device
Technicolor ²⁴⁴ (Thomson and Fraunhofer)	N/A	\$0.75
Sisvel ²⁴⁵ (Bayerische Rundfunkwerbung GmbH; Institut für Rundfunktechnik GmbH; Koninklijke Philips N.V.; Orange; TDF S.A.S.; U.S. Philips Corporation; formerly France Telecom)	1 to 800,000 800,001 to 4,000,000 4,000,001 to 8,000,000 8,000,001 to 12,000,000 12,000,001 to 20,000,000 More than 20,000,000	\$0.60 ²⁴⁶ \$0.40 \$0.36 \$0.32 \$0.28 \$0.20

Although approximately 35 other companies beyond those represented by the patent pools above have declared ownership of patents essential to ISO/IEC 11172-3 and ISO/IEC 13818-3²⁴⁷, we have identified only Alcatel-Lucent,²⁴⁸ Texas MP3 Technologies,²⁴⁹ and Hybrid Audio²⁵⁰ as having attempted to enforce their MP3 technology patents through litigation.

The Texas MP3 Technologies and Hybrid Audio litigations settled out of court and the terms of the settlement, including any royalty payments, are confidential.²⁵¹ The Alcatel-Lucent litigation is well known for its \$1.5 billion jury award against Microsoft, which the district court ultimately overturned.²⁵² The district court set aside the verdict and entered a judgment of non-infringement as a matter of law in favor of Microsoft. It found that one patent was not infringed

²⁴³ *About MPEG Audio*, SISVEL, <http://www.sisvel.com/index.php/mpeg-audio/introduction> (last visited Feb. 23, 2014).

²⁴⁴ *Royalty Rates*, TECHNICOLOR, <http://www.mp3licensing.com/royalty> (last visited Feb. 23, 2014).

²⁴⁵ *MPEG Audio License Terms*, SISVEL, <http://www.sisvel.com/index.php/mpeg-audio/license-terms> (last visited Feb. 23, 2014).

²⁴⁶ We assume that smartphones will have two mono channels: left and right channel. The fee for a single mono channel is half of the fees provided in the chart for Sisvel.

²⁴⁷ *ISO Standards and Patents*, ISO, http://www.iso.org/iso/standards_development/patents (last visited Feb. 23, 2014) (spreadsheet available listing patent declarations made to ISO).

²⁴⁸ Litigated in *Lucent Techs. v. Gateway Inc.*, No. 3:02-cv-02060 (S.D. Cal. filed Oct. 17, 2014).

²⁴⁹ Litigated in *Texas MP3 Techs., Ltd. v. Samsung Elecs. Co.*, No. 2:07-cv-00052 (E.D. Tex. filed Mar. 3, 2009).

²⁵⁰ Litigated in *Hybrid Audio LLC v. High Tech Computer Corp.*, No. 6:11-cv-00195 (E.D. Tex. filed Apr. 19, 2011).

²⁵¹ See Joint Motion to Dismiss with Prejudice, *Hybrid Audio LLC v. High Tech Computer Corp.*, No. 6:11-cv-00195 (E.D. Tex. Jan. 22, 2013), ECF No. 293; Motion to Dismiss with Prejudice Pursuant to F.R.C.P. 41(a)(2), *Texas MP3 Techs., LTD. v. Samsung Elecs. Co.*, No. 2:07-cv-00052 (E.D. Tex. Jan. 21, 2009), ECF No. 169; Stipulation of Dismissal with Prejudice, *Texas MP3 Techs., LTD. v. Samsung Elecs. Co.*, No. 2:07-cv-00052 (E.D. Tex. Feb. 27, 2009), ECF No. 185.

²⁵² See David Blackburn & Mario A. Lopez, *Where's the Economics Behind Lucent v. Gateway et al.?* NERA ECON CONSULTING (March 22, 2007), http://www.nera.com/extImage/PUB_Microsoft-Lucent_paper_0708.pdf.

and that Alcatel-Lucent lacked standing to bring suit over the second patent because it was jointly owned with Fraunhofer.²⁵³ The court also ruled that the jury erred by awarding a percentage of the value of the entire computer.²⁵⁴ On appeal, the Federal Circuit affirmed the district court's non-infringement and lack of standing rulings but did not address the damages issues.²⁵⁵

In addition, the initial MP3 specification, ISO/IEC 11172-3, was first published in 1993, and the patents essential to the standard have begun to expire. As a result, net royalty exposure is likely to decline over time.

Non-Standards Based Audio

This category includes patents related to hardware and software for voice (microphones, non-essential voice software), audio players (hardware software for managing and playing music) and messaging (including software for threading SMS texts and software for call control). We also include in this category suits related to basic, non-cellular telephony technologies, which use the underlying audio hardware.

The estimated cost of smartphone audio hardware is approximately \$1.90 to \$2.20 per device, including the microelectromechanical systems (MEMs) microphone (\$0.70-0.80 per unit), audio codecs (\$0.70-0.80 per unit), and speakers (\$0.50-0.60 per unit).²⁵⁶

Companies have been relatively successful asserting and licensing patents relating to basic, non-standardized cellular and telephony technologies. Such suits have involved patents related to various technologies, including controls for incoming and outgoing calls; push-to-talk functions; internal antennae; microphones; audio program players; methods for creating, distributing, and managing playlists; music-players that allow music to be played in the background while the user completes other tasks; digital audio players; video functionality; video codec; recording and playback of voice messages; incoming call rejection; and audio/video playback and storage.

In *Broadcom Corp v. Qualcomm, Inc.*, Broadcom accused Qualcomm's baseband chips of infringing U.S. Patent Nos. 6,389,010 (related to push-to-talk "PTT" function); 6,657,317 (related to handoff); and 6,847,686 (related to video functionality).²⁵⁷ Broadcom's expert testified that a reasonable royalty for the '317 patent would be 1.5% and a reasonable royalty for the '686 patent would be 2%. The court enhanced the royalty rates to account for Qualcomm's willful infringement—thus increasing the royalty rates to 4.5% for the '317 patent and 6% for the

²⁵³ *Lucent Techs., Inc. v. Gateway, Inc.*, 509 F. Supp. 2d 912, 924 (S.D. Cal. 2007).

²⁵⁴ *Id.* at 937-38.

²⁵⁵ *Lucent Techs., Inc. v. Gateway, Inc.*, 543 F.3d 710, 712 (Fed. Cir. 2008) (Order in appeal from the United States District Court for the Southern District of California in consolidated case nos. 02-CV-2060, 03-CV-0699, and 03-CV-1108).

²⁵⁶ Nomura Securities 2012 Smartphone Guide, *supra* note 9.

²⁵⁷ *Broadcom Corp v. Qualcomm, Inc.*, No. 8:05-cv-00467 (C.D. Cal).

'686 patent during a sunset period.²⁵⁸ The total jury award was \$22,829,596, comprised of: \$3,785,414 for infringing and inducing the infringement of the '317 patent; \$13,638,173 for infringing and inducing the infringement of the '686 Patent; and \$5,406,009 for infringing, inducing the infringement and contributing to the infringement of the '010 patent.

Such technologies have also been licensed under “freedom-to-operate” licenses, involving a one-time lump-sum payment, as explained in greater detail below. The demands for such licenses have been as high as \$5 million. However, a number of such licenses have been granted for lump-sum payments ranging from \$400,000 to \$1.75 million, depending on the technology at issue.

On the high end of fees paid, a jury awarded a lump-sum payment of \$8 million, in *Personal Audio, LLC v. Apple, Inc. et al.*, for infringement of a patent involving an audio program player that allowed a user to skip forward and backward in the sequence of a playlist.²⁵⁹ Personal Audio requested a per-unit running royalty of \$0.90 per unit on 93 million infringing products.²⁶⁰ Apple offered a damages theory based on a lump-sum “freedom-to-operate” license, “meaning that in exchange for the \$5 million lump sum payment, Apple would be granted a fully paid up license giving it the freedom to incorporate the patented technology in any product currently existing or developed in the future.”²⁶¹ Apple’s expert based his opinion on a number of past Apple licenses as well as conduct by one of the named inventors of the asserted patent²⁶²:

- In 2004, Apple entered into a “freedom-to-operate” patent license with E-Data for \$500,000.²⁶³ (The E-Data license covered “any product, hardware service, or software that is or was made, used, sold, offered for sale, leased, licensed, imported or otherwise disposed of by Apple or an Apple subsidiary at any time.”)²⁶⁴ The technology related to downloading material from the Internet.
- In 2006, Apple entered into a “freedom-to-operate” patent license with Diego for \$1.75 million.²⁶⁵ (The Diego license covered “any Apple-branded or Apple affiliate-branded (including co-branded) product, service, device, system, hardware, software, or other offering”.)²⁶⁶

²⁵⁸ Memorandum of Decision re Injunctive Relief, *Broadcom Corp. v. Qualcomm Inc.*, No. 8:05-cv-00467 (C.D. Cal. Dec. 31, 2007), ECF No. 996.

²⁵⁹ *Personal Audio, LLC v. Apple, Inc.*, No. 09-cv-00111, 2011 WL 3269330, at *1 (E.D. Tex. July 29, 2011).

²⁶⁰ *Id.* at *3.

²⁶¹ *Id.*

²⁶² *See id.* at *3-*4 (internal citations omitted).

²⁶³ *Id.* at *3 (internal citations omitted).

²⁶⁴ *Id.* (internal citations and quotation marks omitted).

²⁶⁵ *Id.* at *4 (internal citations omitted).

²⁶⁶ *Id.* (internal citations and quotation marks omitted).

- In 2008, “one of the named inventors on the patents-in-suit, sold another patent on which he is also the named inventor at an auction for \$400,000.”²⁶⁷ Apple’s expert testified that, according to the inventor, “the auctioned patent[] was ‘complementary’” to the patents-in-suit and covered “methods for creating, distributing, and managing playlists.”²⁶⁸
- In 2008, the named inventor offered to sell the 6,199,076 patent and the pending application for what would become the 7,509,178 patent application to a patent holding company for \$5 million.²⁶⁹

In 2011, the jury found infringement and awarded Personal Audio \$8 million in damages, apparently adopting something close to Apple’s damages theory.²⁷⁰ Taken together, the cited lump sum licenses and damages awards average \$3.03 million per license.

Although the *Apple v. Samsung* 2012 trial ended with a finding of noninfringement for Apple, Samsung asserted U.S. Patent No. 7,698,711 entitled “Multi-tasking apparatus and method in portable terminal.”²⁷¹ The patent purported to cover a multi-tasking apparatus in which a smartphone played music in the background while the user completed other tasks.²⁷² Samsung’s expert opined that a reasonable royalty for the ’711 patent would be \$0.19 per iPhone sold, totaling approximately \$3.1 million in royalties for all the units actually sold.²⁷³

Camera and Video Related Technology

Non-Standards Based Camera and Video

The non-standardized camera and video related technology consists of patents related to hardware and software for capturing, displaying, modifying, storing and sharing still images and videos. Cameras and display screens are included in this category. The average cost of smartphone camera components is approximately \$11 to \$14, including the smartphone camera module (\$9-10 per unit); camera lens (\$1-2 per unit); and, image sensors (\$1-2 per unit).²⁷⁴

Kodak owned one of the largest portfolios of camera and video-related technology.²⁷⁵ In 2009, Samsung and LG paid \$550 million and \$414 million, respectively, to Kodak to settle

²⁶⁷ *Id.* (internal citations omitted).

²⁶⁸ *Id.* (internal citations and quotation marks omitted).

²⁶⁹ *Id.* (internal citations omitted).

²⁷⁰ *Id.* at *1.

²⁷¹ U.S. Patent No. 7,698,711 (filed July 16, 2007) (issued Apr. 13, 2011).

²⁷² *Id.*

²⁷³ Transcript of Record at 3111-12, *Apple, Inc. v. Samsung Electronics Co., Ltd.*, No. 5-11-cv-01846 (N.D. Cal. Aug. 16, 2012), ECF No. 1842.

²⁷⁴ Nomura Securities 2012 Smartphone Guide, *supra* note 9.

²⁷⁵ See Jonathan Skillings & Jim Kerstetter, Kodak Sells Its Imaging Patents for \$525M, CNET (Dec. 19, 2012), [http://news.cnet.com/8301-1001_3-57559965-92/kodak-sells-its-imaging-patents-for-\\$525m/](http://news.cnet.com/8301-1001_3-57559965-92/kodak-sells-its-imaging-patents-for-$525m/)

claims related to Kodak's digital imaging patent portfolios.²⁷⁶ In January 2013, a consortium of twelve companies acquired 1,100 Kodak digital imaging patents for a total cost of \$527 million, or an average of approximately \$43.92 million per member of the consortium or about \$479,000 per patent.²⁷⁷ The consortium was organized by RPX and Intellectual Ventures and included Apple and Google.²⁷⁸

Other players in the camera and video arena include Samsung Electronics, which sued Apple for patents covering, for example, a method for attaching photos to an email;²⁷⁹ and Multimedia Patent Trust, which also sued Apple over video compression technology.²⁸⁰ In *Apple v. Samsung*, Samsung's expert opined that a reasonable royalty for Samsung's U.S. Patent No. 7,577,460 patent, which related to emailing photos, would be \$0.19 per iPhone sold, \$0.16 per iPad sold and \$0.13 per iPod touch sold for a total royalty of approximately \$14.6 million.²⁸¹ Samsung also asserted U.S. Patent No. 7,456,893 entitled "Method of controlling digital image processing apparatus for efficient reproduction and digital image processing apparatus using the method."²⁸² The patent purported to cover a method for bookmarking a user's location in a photo gallery of a smartphone. For this patent, Samsung's expert opined that a reasonable royalty would be \$0.12 per unit for the iPhone, \$0.15 per unit for the iPad and \$0.11 per unit for the iPod touch.²⁸³

In another case, *Summit 6 LLC v. Research In Motion Corp.*, Summit 6 asserted U.S. Patent No. 7,765,482 against Samsung.²⁸⁴ The '482 patent, entitled "Web-based media submission tool," purports to cover software that automatically processes digital photos before they are transmitted over a network by client devices, such as smartphones. Summit 6 had accused Samsung phones that support MMS photo messaging of infringement.²⁸⁵ According to Summit 6's counsel, Summit 6 had requested a royalty rate of \$0.28 per unit, and the jury's verdict of \$15 million represented "a little more than half" of what Summit 6 had asked for

²⁷⁶ Ben Dobbin, *Delay in Kodak patent case*, USA TODAY (June 23, 2011), http://usatoday30.usatoday.com/tech/news/2011-06-23-Kodak-patent-battle_n.htm.

²⁷⁷ Joseph Checkler, *Judge Approves Sale of Kodak Patents*, WALL STREET J. (Jan. 11, 2013), <http://online.wsj.com/article/SB10001424127887324081704578235873073906146.html>.

²⁷⁸ Jon Fingras, *Kodak Closes Its Digital Imaging Patent Sale, Settles Disputes*, ENGADGET (Feb. 1, 2013), <http://www.engadget.com/2013/02/01/kodak-closes-its-digital-imaging-patent-sale/>.

²⁷⁹ See David Kravets, *Who Cheated Whom? Apple v. Samsung Patent Showdown Explained*, WIRED (July 27, 2012), <http://www.wired.com/gadgetlab/2012/07/apple-v-samsung-explained/>.

²⁸⁰ See Roxanne Palmer, *Apple, Canon, Others Face Video Compression IP Suit*, LAW360 (Dec. 21, 2010), <http://www.law360.com/articles/216536>.

²⁸¹ Transcript of Record at 3111-12, *Apple, Inc. v. Samsung Electronics Co., Ltd.*, No. 5-11-cv-01846 (N.D. Cal. Aug. 16, 2012), ECF No. 1842.

²⁸² *Apple, Inc. v. Samsung Electronics Co., Ltd.* No. 5-11-cv-01846 (N.D. Cal. filed Apr. 15, 2011).

²⁸³ Transcript of Record at 3111, *Apple, Inc. v. Samsung Electronics Co., Ltd.*, No. 5-11-cv-01846 (N.D. Cal. Aug. 16, 2012), ECF No. 1842.

²⁸⁴ See *Summit 6 LLC v. Research In Motion Corp. et al.*, No. 3:11-cv-00367 (N.D. Tex. filed Feb. 23, 2011).

²⁸⁵ See Press Release, McKool Smith, McKool Smith Secures \$15 Million Verdict for Summit 6 (Apr. 5, 2013), <http://www.mckoolsmith.com/news-pressreleases-201.html>.

(approximately \$0.14-0.15 per unit).²⁸⁶ On June 26, 2013, the district court issued final judgment awarding Summit 6 its \$15 million jury award and prejudgment interest, but declining to award an ongoing compulsory royalty.²⁸⁷

Standards-Based Photo Formats (e.g., JPEG)

There is not likely to be any royalty exposure for new products that store images as JPEG files. The JPEG standard was first published in 1992.²⁸⁸ Accordingly, it is likely that almost all relevant patents have now passed their 20-year statutory term.²⁸⁹

Indeed, all of the assertions of patents claimed to cover the JPEG standard that we have identified involved patents that have now expired or been found invalid and thus present no threat to suppliers of future smartphones.²⁹⁰ In 2002, Forgent Networks (now Asure Software) began approaching companies with requests for royalties on a patent that it claimed covered the JPEG standard.²⁹¹ After receiving over \$90 million in licensing fees, Forgent sued 31 companies in the Eastern District of Texas.²⁹² Many claims in Forgent's patent were ultimately found invalid on reexamination because of prior art that Forgent hid from the Patent Office.²⁹³ Forgent ultimately settled the new claims for \$8 million.²⁹⁴ All told, Forgent obtained over \$100 million during the course of its JPEG patent campaign.²⁹⁵ But the claims that remained of Forgent's patent after litigation have now expired because the patent issued in 1987.²⁹⁶

²⁸⁶ See Lance Murray, *Summit 6 Seeks Samsung Royalties After Getting \$15M Verdict*, DALL. BUS. J. (Apr. 12, 2013), <http://www.bizjournals.com/dallas/blog/2013/04/summit-6-seeks-samsung-royalties-after.html>; Jess Davis, *Samsung Hit with \$15M Jury Verdict for Phone Photo Patent*, LAW360 (Apr. 8, 2013), <http://www.law360.com/articles/430841/samsung-hit-with-15m-jury-verdict-for-phone-photo-patent>.

²⁸⁷ Final Judgment, *Summit 6 LLC v. Research In Motion Corp.*, No. 3:11-cv-00367 (E.D. Tex. June 26, 2013), ECF No. 662.

²⁸⁸ See Int'l Telecomm. Union, T.81: Information Technology – Digital Compression and Coding of Continuous-Tone Still Images – Requirements and Guidelines (Sept. 1992), *available at* <http://www.itu.int/rec/T-REC-T.81-199209-I/en>.

²⁸⁹ See 35 USC § 154(a)(2) (2013).

²⁹⁰ In addition, we have located no continuation application for these patents resulting in additional patents.

²⁹¹ See Press Release, Asure Software, Forgent Announces Expansion of Successful Intellectual Property Program; New Agreement for Representation and Enforcement of 40 Patents, (July 27, 2004), <http://investor.asuresoftware.com/releasedetail.cfm?ReleaseID=533316> (“Over the last two years, the intellectual property business has generated approximately \$90 million from licensing the '672 Patent to 30 different companies in Asia, Europe and the United States.”).

²⁹² See *id.*

²⁹³ See Press Release, Public Patent Foundation, Patent Asserted Against JPEG Standard Rejected by Patent Office as Result of PubPat Request (May 26, 2006), <http://www.pubpat.org/Chen672Rejected.htm>.

²⁹⁴ Michael Kanellos, *Forgent Settles JPEG Patent Cases*, CNET NEWS (Nov. 1, 2006), http://news.cnet.com/Forgent-settles-JPEG-patent-cases/2100-1014_3-6131574.html.

²⁹⁵ See Nate Anderson, *Forgent Settles JPEG Patent Claims, Keeps Suing*, ARS TECHNICA (Nov. 3, 2006), <http://arstechnica.com/business/2006/11/8146/>.

²⁹⁶ See U.S. Patent No. 4,698,672 (filed Oct. 27, 1986).

Global Patent Holdings LLC filed many lawsuits based on a 1993 patent that it claimed read on the use of the JPEG standard.²⁹⁷ In 2009, the Patent Office canceled all claims of the patent as invalid.²⁹⁸

In 2011, Princeton Digital Image Corporation filed suit against many companies including retailers, websites, and device manufacturers seeking damages for past infringement of an expired patent that it claimed read on the JPEG standard.²⁹⁹ Those suits are ongoing, but because the patent expired in 2007, it poses no threat to sales after 2013.³⁰⁰

Although subsequent parts of the ISO/IEC 10918 have defined new features related to JPEG, such as formats for sharing JPEG images, we are not aware of any lawsuit filed for infringement of patents claimed to read on these features.

H.264 (Standardized)

The H.264 Standard is a video coding standard, also known as MPEG-4 Part 10, or AVC (Advanced Video Coding). Video compression uses modern coding techniques to reduce redundancy in video data by transforming video into a compressed form that requires less data storage. The first version of the H.264 Standard was adopted in May 2003 by the Joint Video Team (JVT), which was a collaboration between the ITU-T Video Coding Experts Group (VCEG) together with the ISO/IEC JTC1 Moving Picture Experts Group (MPEG).³⁰¹

There are at least 2,500 patents worldwide declared essential to the H.264 Standard, including over 360 U.S. patents.³⁰² Approximately thirty U.S. companies have identified patents as essential to the H.264 standard and all of those patents are subject to RAND commitments.³⁰³

²⁹⁷ Mike Masnick, *Infamous Niro JPEG Patent Smacked Down Again*, TECHDIRT (June 30, 2009), <http://www.techdirt.com/articles/20090628/1533475384.shtml>.

²⁹⁸ *See Ex Parte* Reexamination Communication Transmittal Form, U.S. Reexamination Control No. 90/008,972 (Mar. 5, 2008), *available at* https://upload.wikimedia.org/wikipedia/commons/a/ab/2008-03-05_USPTO_Determination_Granteeing_Reexam_of_5,253,341_C1.pdf; U.S. Patent No. 5,253,341 (Filed Apr. 11, 1991).

²⁹⁹ *See* Richard Mescher, *Update on Patent Trolls*, TECH. L. SOURCE (May 15, 2013), <http://www.technologylawsource.com/2013/05/articles/intellectual-property-1/patents/update-on-patent-trolls/>.

³⁰⁰ The patent at issue, U.S. Patent No. 4,813,056 expired on December 8, 2007. *See* U.S. Patent No. 4,813,056 (filed Dec 8, 1987). Six years later, on December 8, 2013, Global Patent Holdings was barred from seeking patent damages for any infringement of U.S. Patent No. 4,813,056. *See* 35 U.S.C. § 286 (1952) (“[N]o recovery shall be had for any infringement committed more than six years prior to the filing of the complaint or counterclaim for infringement in the action.”).

³⁰¹ *See Joint Video Team*, <http://www.itu.int/en/ITU-T/studygroups/com16/video/Pages/jvt.aspx> (last visited Feb. 20, 2014).

³⁰² *See Microsoft Corp. v. Motorola, Inc., et al.*, No. 10-cv-1823, 2013 WL 2111217, at *26 ¶ 156 (W.D. Wash. Apr. 25, 2013).

³⁰³ *See id.*; *see also ITU-T Patent Statements Database*, ITU, <http://www.itu.int/ipr/IPRSearch.aspx> (last visited Feb. 20, 2014).

There are two leading sources of information about H.264 royalties. First, the court in *Microsoft v. Motorola* set a RAND rate for Motorola’s H.264 patents, based on an extensive analysis conducted by the court. Second, the MPEG LA H.264 patent pool, which the *Microsoft* court addressed, accounts for the bulk of essential H.264 patents. The *Microsoft* court found that the MPEG LA H.264 pool currently includes 2,400 of the 2,500 worldwide patents declared essential to H.264 and, within that group, approximately 275 of the 360 U.S. patents.³⁰⁴ The patents in the MPEG LA H.264 patent pool have been contributed by twenty-six licensors, including firms such as Apple, Cisco, Ericsson, Fujitsu, LG, Microsoft, and Sony.³⁰⁵ Significantly, the Telenor Group, which the Microsoft court found “contributed many of the core innovations of H.264” did not seek patent protection for its H.264 contributions.³⁰⁶ Accordingly, between the MPEG LA H.264 pool and Telenor, licensing rates are known for the vast majority of the relevant H.264 patents.

In addition, we have gathered information from an infringement suit brought by the Multimedia Patent Trust (MPT) against Apple and LG on two patents it claimed were essential for H.264 and for which it sought \$1.50 per unit.³⁰⁷

Summarized below are the maximum rates that a supplier of a new smartphone would pay for an H.264 codec. Notably, in *Microsoft*, the court found that the Windows Phone 7 and Windows Phone 7.5 do not use the H.264 standard and instead use hardware decoders from third parties.³⁰⁸ But a variety of other cellular phones do incorporate the standard.³⁰⁹

³⁰⁴ *Microsoft Corp.*, 2013 WL 2111217, at *78 ¶ 488.

³⁰⁵ *See id.*

³⁰⁶ *See id.* at *26 ¶ 155.

³⁰⁷ *See Multimedia Patent Trust v. Apple Inc.*, No. 10-cv-2618 (S.D. Cal. filed Dec. 20, 2010).

³⁰⁸ *See id.* at *49 ¶ 302.

³⁰⁹ *See, e.g., iPhone 5S Tech Specs*, APPLE, <http://www.apple.com/iphone-5s/specs/> (last visited Feb. 20, 2014); *Samsung Galaxy S4 Specs*, SAMSUNG, <http://www.samsung.com/global/microsite/galaxys4/> (last visited Feb. 20, 2014); Christine Smith, *Supported Video Formats by HTC Android Phones* (Apr. 18, 2013), <http://www.wondershare.com/convert-video-audio/htc-video-format.html>.

Company	Maximum Royalty Rate	Royalty (\$400 device)	Share of Standard ³¹⁰
MPEG LA	Per unit sliding-scale fee based on annual volume: - for unit volumes between 100,000 and five million, the royalty is \$0.20 per unit; and - for unit volumes above five million, the royalty rate is \$0.10 per unit.	\$0.10 (assuming sales of 30 million units per year) ³¹¹	76% ³¹²
MPT	\$1.50	\$1.50	0.6% ³¹³
Motorola	2.25% of device price	\$9.00	4% ³¹⁴
Total		\$10.60	80.6%

In *Microsoft*, the court rejected Motorola's 2.25% demand as not being RAND and set a RAND royalty range for Motorola's H.264 patent portfolio—consisting of 16 patents—of 0.555 cents to 16.389 cents per unit. The court indicated that the lower end—0.555 cents per unit—was the appropriate rate for Microsoft's products because Motorola was a modest contributor to the technology of the standard and the H.264 technology was not of great significance to Microsoft's products.³¹⁵

In *Multimedia Patent Trust v. Apple Inc.*, the jury found against MPT's infringement claims for its two patents that MPT claimed were essential to the H.264 standard. Although MPT's damages expert advocated a royalty of \$1.50 per unit for the two patents, he conceded at trial that for the small set of licenses under which MPT had granted licenses that involved running royalties (as opposed to lump sum payments), the average rate that MPT received was

³¹⁰ Based on 360 U.S. H.264 SEPs. See *Microsoft Corp.*, 2013 WL 2111217, at *26 ¶ 156.

³¹¹ See MPEG LA, *Summary of AVC/H.264 License Terms*, at 2, http://www.mpegla.com/main/programs/AVC/Documents/AVC_TermsSummary.pdf. The MPEG LA H.264 pool imposes a royalty cap of \$6.5 million per year. *Id.*

³¹² See *Microsoft Corp. v. Motorola, Inc.*, No. 10-cv-1823, 2013 WL 2111217, at *78 ¶ 488 (W.D. Wash. Apr. 25, 2013). The share of MPEG LA patents is significantly higher on a global basis (94% = 2,400/2,500) than for the United States alone (76% = 275/360).

³¹³ MPT owned 2 patents declared essential to the H.264 standard that are not included in the 2,552 patents in the MPEG LA H.264 pool. See *Multimedia Patent Trust v. Apple Inc.*, No. 10-cv-2618, 2012 WL 6863471, at *23 (S.D. Cal. Nov. 9, 2012).

³¹⁴ Motorola had 16 U.S. H.264 SEPs not included in the 360 U.S. MPEG LA SEPs. See *Microsoft Corp.*, 2013 WL 2111217, at *27 ¶ 163.

³¹⁵ See *id.* at *85 ¶ 536. Testifying experts offered no opinion in their testimony on whether Motorola's H.264 Patents are more valuable than the average patent in the H.264 pool. *Id.* at ¶ 529.

only \$0.86 per unit.³¹⁶ Given that the jury found no infringement against Apple and LG when the patents were tested, the \$0.86 per unit figure appears to overstate significantly the value of MPT's patents, if any.

Applications Processor (Non-Standardized)

The applications processor is the central processing unit in a smartphone. It runs a wide range of non-cellular programs, including the “applications” or “apps” that give the processor its name. The estimated cost of an applications processor can be \$15-17 per unit.³¹⁷

We have identified two pieces of publicly-available data on royalty rates relevant to the applications processors.

ARM Holdings, which designs processors, receives an up-front fee of several million dollars for access to its designs and a per-unit running royalty.³¹⁸ Published reports put this per-unit rate at approximately \$0.75 per unit.³¹⁹ ARM is licensing the design for an entire applications processor, and moreover it purports to offer “pass-through” rights to patents it has licensed from other companies.³²⁰

OPTi sued Apple on technology purportedly governing the interaction between the applications processor and the RAM in both PC and mobile applications. The jury awarded OPTi a royalty of \$0.75 per unit, effectively adopting OPTi's damages theory.³²¹ Apple and OPTi settled before the Federal Circuit heard an appeal on the case, including the damages award.³²²

Beyond this available royalty data, there has been significant litigation activity involving applications processors that has not yielded public royalty information. As an example, in 2010, MicroUnity asserted patents against twenty-two defendants, spanning smartphone suppliers (*e.g.*, Apple, Motorola, LG), processor makers (*e.g.*, Texas Instruments and Qualcomm), and network operators (*e.g.*, SprintNextel and AT&T). MicroUnity contended that its patents relate to

³¹⁶ *Multimedia Patent Trust*, 2012 WL 5873711, at *3.

³¹⁷ Nomura Securities 2012 Smartphone Guide, *supra* note 9.

³¹⁸ ARM Holdings 2011 Annual Report at 14, <http://ir.arm.com/phoenix.zhtml?c=197211&p=irol-reportsannual> (“The companies who choose ARM technology pay an up-front license fee to gain access to a design. They incorporate the ARM technology into their chip—a process that often takes 3–4 years. When the chip starts to ship, ARM receives a royalty on every chip that uses the design. Typically our royalty is based on the price of the chip.”).

³¹⁹ Drew Sandholm, *Apple's Preferred Chipmaker?*, CNBC (June 7, 2010), <http://www.cnbc.com/id/37554533>.

³²⁰ *Licensing ARM IP*, ARM, <http://www.arm.com/products/buying-guide/licensing/index.php> (last visited Feb. 20, 2014) (“The perpetual license offers an ARM Partner the necessary rights to perpetually design and manufacture ARM technology-based products.”).

³²¹ *See* Trial Tr., *OPTi, Inc. v. Apple Inc.*, No. 2:07-cv-21 (E.D. Tex. Apr. 20, 2009), ECF No. 167, at 33-37.

³²² *See* Susan Decker, *Apple Drops Appeal of \$19 Million OPTi Patent Victory*, BLOOMBERG (Dec. 7, 2010), <http://www.bloomberg.com/news/2010-12-07/apple-dismisses-appeal-of-opti-patent-verdict-it-lost.html>

microprocessor optimization for handling media data.³²³ It had previously asserted patents from the same portfolio in separate suits against Intel and Dell, Sony, and Advanced Micro Devices. Each of those suits settled, with Intel reportedly paying \$300 million and the other two cases settling for confidential sums.³²⁴ All of the defendants in the 2010 case have now apparently settled with MicroUnity and the case is closed.

In November 2012, Apple settled with VIA Technologies Inc. and S3 Graphics Co. Ltd. in two investigations before the U.S. International Trade Commission (ITC).³²⁵ VIA had asserted three patents related to the microprocessors in the iPhone, iPad, iPod Touch, and Apple TV.³²⁶ S3 had asserted two patents related to image processing.³²⁷

Software (Non-Standardized)

Operating System

Unlike many of the other technology areas addressed in this paper, the operating system (OS) category offers two likely and diverging scenarios for determining potential costs. Under the first scenario, a smartphone market entrant purchases software and a license from Microsoft for Windows Phone, which brings with it Microsoft indemnification. Under the second scenario, a smartphone supplier implements an open-source OS like Android or Tizen and faces a risk of suits from Microsoft, NPEs, and other competitors. Of course, a smartphone supplier could develop its own operating system but there are steep barriers to successful entry, including large initial investments and the advantages of entrenched mobile ecosystems (including the availability of “apps”).

Under the first scenario, a smartphone supplier could purchase the Windows Phone operating system software from Microsoft at a rate of around \$15 to \$23 per device, which is in line with the range of publicly-reported fees charged by Microsoft.³²⁸ The purchase price to Microsoft presumably covers both the cost of the software itself as well as payment for Microsoft’s intellectual property rights related to Windows Phone. Unlike Google and Android users, Microsoft reportedly indemnifies its Windows Phone 7 licensees, so purchase of a Windows Phone license should provide assurance that OS-related licensing costs should be

³²³ See MicroUnity’s Second PR 4-5(A) Opening Claim Construction Brief, *MicroUnity Sys. Engineering, Inc. v. Apple, Inc.*, No. 02:10-cv-91 (E.D. Tex. June 18, 2012), ECF No. 443, at 2.

³²⁴ *Id.* at 1.

³²⁵ See Ama Sarfo, *Apple Resolves ITC Dispute Over iPhone, iPad Imports*, LAW360 (Nov. 20, 2012), <http://www.law360.com/articles/395682/apple-resolves-itc-dispute-over-iphone-ipad-imports->.

³²⁶ See *id.*

³²⁷ See *id.*

³²⁸ See Woody Leonhard, *Microsoft Makes More from Android than Windows on Smartphones*, INFOWORLD (June 1, 2011), <http://www.infoworld.com/t/android/microsoft-makes-more-android-windows-smartphones-707>; Andy Weir, *ZTE Reveals Cost of Windows Phone OS Licensing* (Jan. 19, 2012), <http://www.neowin.net/news/zte-reveals-cost-of-windows-phone-os-licensing>.

limited to the upfront cost of licensing Windows Phone.³²⁹ Microsoft has been reported to charge smartphone suppliers not using Windows Phone a royalty rate of \$5 to \$8 per unit.³³⁰ We presume that Microsoft values its intellectual property rights for smartphone operating systems equally between its customers and parties using other operating systems. Accordingly, the reported \$15 to \$23 payment to Microsoft can likely be broken down as follows: \$5 to \$8 in royalties to Microsoft and \$10 to \$15 for the software itself and indemnification from Microsoft against third parties.

The \$15 to \$23 total per device may well decrease depending on the volume of sales and the business relationship between the smartphone supplier and Microsoft. Microsoft, for instance, has provided rebates—so-called “platform support payments”—to Nokia to promote the Windows Phone platform. Indeed, Microsoft seems to have offered Nokia a special deal to be an early and large adopter of Windows Phone 7, and Microsoft’s platform support payments to Nokia largely negated the licensing fees Nokia has paid to Microsoft.³³¹

Alternatively, a smartphone supplier could adopt the royalty-free Android operating system from Google. In that scenario, the smartphone supplier could also be required to pay a licensing fee to Microsoft. Microsoft has been quite successful at licensing Android handset manufacturers—reportedly obtaining royalties on over 70 percent of Android handsets—at rates estimated to be \$5 to \$8 per unit.³³² Other open-source options may be available, such as Tizen, but have not yet been widely adopted.³³³

³²⁹ *Microsoft Intellectual Property Indemnification* (Oct. 18, 2007), available at <http://download.microsoft.com/download/9/D/0/9D0A6265-A509-416C-80AE-BB6C0A9D1B99/IP%20Indemnification%20Policy.docx>.

³³⁰ See Liam Tung, *Microsoft Is Making \$2bn a Year on Android Licensing - Five Times More Than Windows Phone*, ZDNET (Nov. 7, 2013), <http://www.zdnet.com/microsoft-is-making-2bn-a-year-on-android-licensing-five-times-more-than-windows-phone-7000022936/>; Geoff Duncan, *Is Microsoft Trying To Snuff Out Android with Its ‘Tax,’ or Just Milking It?*, DIGITAL TRENDS (Apr. 30, 2013), <http://www.digitaltrends.com/mobile/is-android-being-stifled-by-a-microsoft-tax/#ixzz2ZGGYMHJQ>; Woody Leonhard, *Microsoft Makes More from Android Than Windows on Smartphones*, INFOWORLD (June 1, 2011), <http://www.infoworld.com/t/android/microsoft-makes-more-android-windows-smartphones-707>; John Paczkowski, *Microsoft’s Lucrative New Revenue Stream? Android.*, ALL THINGS D (May 27, 2011), <http://allthingsd.com/20110527/microsofts-lucrative-new-revenue-stream-android/>.

³³¹ Nokia’s SEC filings describe Microsoft’s quarterly “Platform Support Payments” and indicate that “Over the life of the agreement the total amount of the platform support payments is expected to slightly exceed the total amount of the minimum software royalty commitment payments.” See Nokia Corp. Form 20-F at 85 (Mar. 7, 2013), available at <http://www.sec.gov/Archives/edgar/data/924613/000119312513095072/d484054d20f.htm>; see also *Nokia Corporation Q1 2013 Interim Report* at 5 (Apr. 18, 2013), available at http://www.results.nokia.com/results/Nokia_results2013Q1e.pdf; *Nokia Corporation Q1 2012 Interim Report* at 6 (Apr. 19, 2012), available at http://www.results.nokia.com/results/Nokia_results2012Q1e.pdf.

³³² See *supra* note 330; Dan Graziano, *LG and Microsoft Sign Patent Agreement over Android and Chrome OS*, BGR (Jan. 12, 2012), <http://bgr.com/2012/01/12/lg-and-microsoft-sign-patent-agreement-over-android-and-chrome-os/> (“‘Together with our 10 previous agreements with Android and Chrome OS device manufacturers, including HTC, Samsung and Acer, this agreement with LG means that more than 70 percent of all Android smartphones sold in the U.S. are now receiving coverage under Microsoft’s patent portfolio,’ said Horacio Gutierrez, corporate vice president and deputy general counsel of Intellectual Property Group at Microsoft.”).

³³³ Rich McCormick, *Samsung and Intel find 36 more companies to back Tizen, their Android competitor*, THE VERGE (Nov. 12, 2013), <http://www.theverge.com/2013/11/12/5093588/tizen-open-operating-system-partners-with->

In addition, without the benefit of indemnification from Microsoft, a smartphone supplier adopting Android or a proprietary operating system may face additional royalties from assertion of operating system patents. Acacia, for instance, has asserted patents formerly owned by Palm against Huawei.³³⁴ Similarly, MobileMedia has asserted patents formerly owned by Nokia and Sony against Apple and Research In Motion (now Blackberry).³³⁵ MobileMedia has already won an infringement verdict against Apple on three patents, but damages were bifurcated and we do not yet have data on damages awards for these suits.³³⁶

Other Pre-Installed Software (i.e., Non-Standards Based)

In addition to the non-standardized software related to browsers and communications (discussed below) and software related to audio and video management software (discussed above), there is a wide array of pre-installed software in smartphones, such as document management software, device remote control software, navigation software, search software, and security software. The non-standardized, pre-installed software technology consists of software that does not cleanly fit into the above categories. Specific examples include Apple's FaceTime, CoverFlow, and Siri; the Google Now search platform; and the security and remote device management software used by BlackBerry.

The sheer volume of software patents means that there are a wide variety of smartphone software features that are susceptible to suit or royalty demands. Because the smartphone software features often cut across a variety of smartphone components and features (*e.g.*, a patent related to emailing photos encompasses the camera component, software, applications processor, and baseband processor), plaintiffs often attempt to claim a broad royalty base against which to assert a royalty rate. District courts frequently, but not always, take steps to apportion the royalty base appropriately, but the variability in royalty base means that there has been a significant range in actual damages awarded. Below we review some of the more notable verdicts in this area, not all of which have held up in post-trial proceedings.

In 2011, Mirror Worlds, LLC obtained a jury award of \$208.5 million against Apple relating to document stream and information management systems. The verdict was later overturned. Mirror Worlds alleged that the CoverFlow feature in Apple's iPhone, iPod Touch,

36-companies (reporting additional backing of Tizen project from major technology companies but noting the only device currently sold that uses Tizen is a Samsung camera).

³³⁴ See *Futurewei Tech., Inc. v. Acacia Research Corp.*, No. 8:12-cv-00511 (C.D. Cal. filed Apr. 4, 2012); *SmartPhone Tech. LLC v. Huawei Tech. Co.*, No. 6:12-cv-00245 (E.D. Tex. filed Apr. 3, 2012) (asserting Palm OS related patents).

³³⁵ In MobileMedia's suits, it has asserted patents that relate to the OS (*e.g.*, U.S. Patent No. 6,725,155, "Method and apparatus for information processing, and medium for information processing"), as well as patents for basic phone functions (*e.g.*, U.S. Patent No. 6,253,075 on a "method and apparatus for incoming call rejection"), audio software (*e.g.*, U.S. Patent No. 6,549,942, "Enhanced delivery of audio data for portable playback"), video (*e.g.*, U.S. Patent No. 6,441,828, "Image display apparatus") and user interface (*e.g.*, U.S. Patent No. 6,002,390 "Text input device and method"). See *MobileMedia Ideas LLC v. Apple Inc.*, 885 F. Supp. 2d 700 (D. Del. 2012); *MobileMedia Ideas LLC v. Research In Motion Ltd.*, No. 3:11-cv-02353 (N.D. Tex. filed Sept. 9, 2011).

³³⁶ See *MobileMedia Ideas LLC v. Apple Inc.*, No. 10-258 (D. Del. Oct. 3, 2013), ECF No. 546 (entering judgment on issues of liability, but not issues of willfulness and damages).

and other iPods infringed its patents. Mirror Worlds demanded \$625 million based on \$72 billion in sales of both the accused software and the hardware incorporating that software, implying a royalty rate of 8.7-8.8% on Apple software and a rate of 0.81% on the accused Apple hardware.³³⁷ Apple's expert testified that a reasonable royalty determined through a hypothetical negotiation would be a lump-sum of between \$210,000 and \$4 million for purchase of the patents.³³⁸ Ultimately, the district court overturned the damages award for failure to apportion the royalty base and failure to justify its running royalty rates.³³⁹ (On appeal, the Federal Circuit affirmed.) If one were to apply the 0.81% royalty used by the jury against a \$400 device, it would yield a per-unit royalty of approximately \$3.25 per device.

VirnetX also recently obtained a significant judgment—\$368.16 million—against Apple relating to a networking method to establish a secure connection between two computers.³⁴⁰ VirnetX accused Apple's FaceTime feature of infringing the asserted patents. Specifically, Apple's iPhone 5, iPad Mini, fourth-generation iPad, fifth-generation iPod Touch, and the latest Mac computers were found to infringe claims of three asserted patents. VirnetX initially demanded over \$700 million,³⁴¹ based on a 1% royalty rate applied against (1) the \$29 software upgrade fee that enabled the FaceTime feature in a Mac (*i.e.*, about \$0.29 per unit)³⁴² and (2) the entire sales price of the iOS product (*e.g.*, the entire sales price of the iPhone, representing a per-unit royalty of about \$6.49 assuming a \$649 price for the iPhone).³⁴³ In November 2012, the jury awarded damages to VirnetX for Apple's infringement of the asserted claims in the amount of approximately \$368 million,³⁴⁴ roughly half the rate requested by the plaintiff. Apple's appeal to the Federal Circuit is pending.³⁴⁵

Although the *Mformation Techs., Inc. v. Research In Motion Ltd.* case ultimately ended with a judgment as a matter of law of noninfringement in favor of Research In Motion (RIM, now known as BlackBerry), it first yielded a jury damages award of \$147.2 million, reflecting a per-unit royalty of \$8 for two patents.³⁴⁶ The technology related to a system for remote control

³³⁷ See *Mirror Worlds, LLC v. Apple, Inc.*, 784 F. Supp. 2d 703, 726-27 (E.D. Tex. 2011), *aff'd*, 692 F.3d 1351 (Fed. Cir. 2012), *cert. denied*, 133 S. Ct. 2856 (U.S. June 24, 2013), and *appeal dismissed in part*, 439 F. App'x 908 (Fed. Cir. 2011).

³³⁸ Transcript of Record, *Mirror Worlds, LLC v. Apple, Inc.*, No 6:08-cv-00088 (E.D. Tex. Sept. 30, 2010), ECF No. 424, at 25.

³³⁹ *Mirror Worlds*, 784 F. Supp. 2d at 727.

³⁴⁰ *VirnetX Inc. v. Cisco Systems, Inc.*, No. 6:10-cv-00417 (E.D. Tex. filed Aug. 11, 2010).

³⁴¹ *Id.* at Transcript of Record (Nov. 1, 2012), ECF No. 612, at 213.

³⁴² *Id.* at 178.

³⁴³ *Id.* at 206.

³⁴⁴ *Id.* at ECF No. 598, at 2.

³⁴⁵ See *VirnetX, Inc. v. Cisco Sys. Inc.*, No. 13-cv-1489 (Fed. Cir. appeal filed July 1, 2013).

³⁴⁶ See *Mformation Techs., Inc. v. Research in Motion Ltd.*, No. 08-cv-04990, 2012 WL 3222237, at *1 (N.D. Cal. Aug. 8, 2012).

and management of wireless devices.³⁴⁷ Mformation's expert proposed a rate of \$0.50 per device, per month (or \$12 per device over the 2-year average lifespan of the device) and relied on a 2007 Intel/Mformation (software) license for \$0.50 per device from one to four million subscribers, then \$0.20 per device above four million subscribers.³⁴⁸ Mformation's suit was based on two asserted patents; adjusting on a per patent basis, the royalty would be \$4 per unit per patent.

As further context, RIM's expert proposed a \$0.05 royalty per device. She relied on five RIM (software) licenses:

- RIM-CPA license, which covered 10 or more U.S. patents, including security and authentication technology, resulting in a calculation of \$0.14 per device;
- RIM paid Certicom (encryption technology) \$1.50 per unit for first 250,000 units then \$1 per unit for approximately 18 million devices;
- RIM paid 4thPass (browser feature) \$0.50 per device for the first 500,000 devices, and \$0.25 per device for the remainder;
- RIM paid Tele Atlas (map functionality) \$0.50 per device; and
- RIM paid Glyph & Cog (software to view .pdf attachments) a total of \$18,000 for the software (or less than \$0.01 per device).³⁴⁹

Further, RIM's expert relied on other Mformation (software) licenses:

- T-Mobile agreed to pay a total of \$13.1 million for 30-plus million subscribers: \$5.65 million for devices, and the remainder for support and maintenance (or \$0.39 per subscriber); and
- Sprint paid \$10.4 million for 50-plus million subscribers: \$5.753 million covered license for software, maintenance and support (or \$0.31 per subscriber).³⁵⁰

Communication & Internet

SMS

Short Message Service (SMS) technology, which allows sending of text messages up to 160 characters long, is reportedly available on a royalty-free basis.³⁵¹ SMS text messages are

³⁴⁷ U.S. Patent No. 6,970,917 entitled "System and method for remote control and management of wireless devices"; U.S. Patent No. 7,343,408 entitled "System and method for wireless data terminal management using telecommunication signaling network."

³⁴⁸ See Transcript of Record, *Mformation Techs.*, No. 08-cv-04990, (June 27, 2012), ECF No. 1009, at 39-41.

³⁴⁹ See *id.* at Transcript of Record (July 3, 2012), ECF No. 1012, at 1904-1909.

³⁵⁰ *Id.* at 1910-1911.

sent through cellular networks. The SMS standard was originally defined as part of the GSM cellular standard by the European Telecommunications Standards Institute.³⁵² Both 3GPP and 3GPP2 have issued specifications for SMS technology.³⁵³

A smartphone supplier may still be subject to suit for non-essential patents for add-on SMS features. For example, Helferich Patent Licensing LLC, a non-practicing entity, claims to have patented the process for sending a hyperlink in a text message,³⁵⁴ although a court recently found that Helferich could not prevail on its claim because it had exhausted its rights under the patent.³⁵⁵ In addition, Microsoft obtained an injunction against Motorola in Germany for a patent allowing the splitting of a long text message into several separate SMS messages.³⁵⁶

MMS

Multimedia Messaging Service (MMS) allows multimedia content—such as pictures, video, and audio—to be sent from one mobile device to another using a text message.³⁵⁷ The dominant creator of MMS standards is the Open Mobile Alliance (OMA).³⁵⁸ OMA requires that members must license declared-essential patents on FRAND terms.³⁵⁹ A search of publicly-available information has located no public FRAND royalty rates for MMS.

³⁵¹ Mark Milian, *Why Text Messages Are Limited to 160 Characters*, L.A. TIMES (May 3, 2009), <http://latimesblogs.latimes.com/technology/2009/05/invented-text-messaging.html>.

³⁵² Filip A. Leitao, Sergio S. Freire & Solange Rito Lima, *SMS Over LTE: Interoperability Between Legacy and Next Generation Networks*, at 1 (2010), available at <http://www.scribd.com/doc/93806098/SMS-to-LTE>; Mark Milian, *Why Text Messages Are Limited to 160 Characters*, L.A. TIMES (May 3, 2009), <http://latimesblogs.latimes.com/technology/2009/05/invented-text-messaging.html>.

³⁵³ *Technical Realization of the Short Message Service (SMS)*, 3GPP, <http://www.3gpp.org/ftp/Specs/html-info/23040.htm> (last visited Feb. 21, 2014); *Short Message Service*, 3GPP2, http://www.3gpp2.org/public_html/specs/CS0015-0.pdf (last visited Feb. 21, 2014); *3GPP2 Specifications*, 3GPP2, http://www.3gpp2.org/Public_html/specs/cref.cfm (last visited Feb. 21, 2014); see also Filip A. Leitao, Sergio S. Freire & Solange Rito Lima, *SMS Over LTE: Interoperability Between Legacy and Next Generation Networks*, at 1 (2010), available at <http://www.scribd.com/doc/93806098/SMS-to-LTE>.

³⁵⁴ Jeff Roberts, *New York Times Tangles with Patent Trolls*, TIME MAGAZINE (Aug. 31, 2012), available at <http://business.time.com/2012/08/31/new-york-times-tangles-with-patent-trolls/>.

³⁵⁵ Lisa Shuchman, *Judge Sides with NY Times Over SMS ‘Patent Troll’*, CORPORATE COUNSEL (Aug. 16, 2013), http://www.law.com/corporatecounsel/PubArticleCC.jsp?id=1202615701941&Judge_Sides_with_NY_Times_Over_SMS_Patent_Troll.

³⁵⁶ Loek Essers, *Motorola Android Phones Infringe on Microsoft SMS patent, German Court Rules*, COMPUTER WORLD (Apr. 25, 2013), http://www.computerworld.com/s/article/9238679/Motorola_Android_phones_infringe_on_Microsoft_SMS_patent_German_court_rules.

³⁵⁷ Gwenaël Le Bodic, MULTIMEDIA MESSAGING SERVICE: AN ENGINEERING APPROACH TO MMS xiii (2003).

³⁵⁸ *About OMA*, OMA, <http://openmobilealliance.org/about-oma/> (last visited Feb. 21, 2014).

³⁵⁹ *Open Mobile Alliance IPR Procedural Guidelines For OMA Members*, OMA (Feb. 2, 2004), http://openmobilealliance.org/wp-content/uploads/2013/01/Member_IPRGuidelines_v53006.pdf (last visited Feb. 21, 2014).

We have identified one damages award for MMS technology. In June 2013, Summit 6 secured a \$15 million dollar verdict against Samsung for its patent on formatting photographs for transfer over MMS (discussed above in Non-Standards Based Camera and Video).³⁶⁰

A number of other infringement suits relating to MMS technology are pending. Comcast brought suit against Sprint in February 2012 for MMS-related patents.³⁶¹ Likewise, non-practicing entities Intellectual Ventures, Intellect Wireless Inc., and Novo Transforma Technologies have filed infringement suits related to MMS technology.³⁶²

E-mail

Basic e-mail standards are available on a royalty-free basis.³⁶³ The specifications for each standard are issued by the Internet Engineering Task Force (IETF) as a Request for Comments (RFC), which is the “basic publication series for IETF.”³⁶⁴ The three basic e-mail standards are:

- Simple Mail Transfer Protocol (SMTP) – a standard for transferring e-mail reliably and efficiently across IP networks,³⁶⁵ with the specification provided in RFC 5321;³⁶⁶
- Internet Message Access Protocol (IMAP) – a standard that “allows clients to access and manipulate messages on a server in the same way that users would normally read, store, copy, and delete messages on a local mailbox”;³⁶⁷ the specification is RFC 3501;³⁶⁸ and
- Post Office Protocol (POP) – a standard for retrieving e-mail by “keep[ing] track of . . . users’ mailboxes, receiv[ing] messages from the SMTP delivery infrastructure, allow[ing] downloading of messages addressed to its user, and hold[ing] on to the

³⁶⁰ Jess Davis, *Samsung Hit With \$15M Jury Verdict For Phone Photo Patent*, LAW360 (Apr. 8, 2013), <http://www.law360.com/articles/430841>.

³⁶¹ Complaint, *Comcast Cable Commc’ns v. Sprint Commc’ns Co.*, No. 2:12-cv-00859 (E.D. Pa. Feb. 17, 2012), ECF No. 1.

³⁶² See, e.g., *Novo Transforma Techs. LLC v. NTCH Inc. D/B/A Clear Talk*, No. 13-cv-745 (D. Del. filed Apr. 26, 2013); *Intellect Wireless, Inc. v. HTC Corp.*, No. 09-cv-2945 (N.D. Ill. filed May 14, 2009); Complaint, *Intellectual Ventures I LLC v. AT&T Mobility LLC*, No. 12-cv-193 (D. Del. Feb. 16, 2012), ECF No. 1.

³⁶³ Jonathan Zittrain, *Normative Principles for Evaluation Free and Proprietary Software*, 71 U. CHI. L. REV. 265, 280-281 (2004) (SMTP); Fernando Piera, *IPR Protection of Computer Programs and Computer Software in the Global Market*, 12-SUM CURRENTS: INT’L TRADE L.J. 15, 20 (2003) (SMTP); Sunil Abraham, *Report on Open Standards for GISW 2008*, in GLOBAL INFORMATION SOCIETY WATCH 2008 ACCESS TO INFRASTRUCTURE 20, 20-21 (2008), available at https://www.apc.org/en/system/files/GISW2008_EN.pdf (POP3 and IMAP).

³⁶⁴ IETC, *International Property Rights in IETC Technology*, RFC 3979 at 2 (Mar. 2005), <http://www.ietf.org/rfc/rfc3979.txt>.

³⁶⁵ Peter Loshin, ESSENTIAL EMAIL STANDARDS: RFCs AND PROTOCOLS MADE PRACTICAL 144 (1999).

³⁶⁶ IETC, *Simple Mail Transfer Protocol*, RFC 5321 (Oct. 2008), <http://tools.ietf.org/html/rfc5321>.

³⁶⁷ Loshin, *supra* note 365, at 185.

³⁶⁸ IETC, *Internet Message Access Protocol – version 4rev1*, RFC 3501 (Mar. 2003), <http://tools.ietf.org/html/rfc3501>.

messages until users tell it to delete them”;³⁶⁹ the specification for POP3, the most recent version, is RFC 1939.³⁷⁰

Internet Protocols

No royalty is typically required for the standards on which internet browser communications protocols operate because of the longstanding “royalty-free tradition of basic Internet and Web technology, which allows anybody to offer services or develop improvements without asking or paying for permission.”³⁷¹ This process for developing standards “considers the requirements and contributions of the entire user community, and is designed to ensure that the standard can be used freely and that its use or implementation infringes on no patents.”³⁷² Of course, browsers themselves may entail a cost, such as if the smartphone supplier implemented Windows and its Explorer browser. Moreover, even if the smartphone maker developed its own browser, there are patents that may be asserted. We have attempted to address those assertions above in “Other Pre-Installed Software.”

The dominant software standards organization for creating internet and browser protocols is the World Wide Web Consortium (W3C), an “international community” of tech companies, universities, and government agencies that develops standards based on community consensus.³⁷³ Although W3C members pay dues, any member of the public may participate in the development of standards.³⁷⁴ W3C’s royalty-free policy is intended to promote “the widest adoption of Web standards.”³⁷⁵ If the licensing status of a technology developed outside of W3C “become[s] a barrier to implementation of the technology according to the W3C Royalty-Free (RF) Licensing Requirements,” W3C “may choose not to publish” a recommendation document for the technology, or it could launch a Patent Advisory Group (PAG).³⁷⁶ A PAG’s mission under such a scenario is to “resolve the conflict” of a patent “that may be essential” to a specification but is not available royalty-free.³⁷⁷

W3C’s royalty-free standards include:

³⁶⁹ Loshin, *supra* note 365, at 172.

³⁷⁰ IETC, *Post Office Protocol – Version 3, RFC 1939* (May 1996), <http://tools.ietf.org/html/rfc1939>.

³⁷¹ Brian Kahin, *Open Standards and the Royalty Problem*, OPENSOURCE.COM (Jan. 20, 2011), <http://opensource.com/law/11/1/open-standards-and-royalty-problem>.

³⁷² President’s Council of Advisors on Science and Technology, *Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology*, at 16 (Dec. 2010), <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-nitrd-report-2010.pdf>.

³⁷³ W3C, *Facts About W3C*, <http://www.w3.org/Consortium/facts.html> (last visited Feb. 21, 2014).

³⁷⁴ *Id.*

³⁷⁵ W3C, *W3C Patent Policy* (Feb. 5, 2004), <http://www.w3.org/Consortium/Patent-Policy-20040205/>.

³⁷⁶ W3C, *Frequently Asked Questions (FAQ) about the W3C Patent Policy* (question 32) (last modified July 19, 2012), <http://www.w3.org/2003/12/22-pp-faq.html#outside-normative-ref>.

³⁷⁷ *W3C Patent Policy, 7.1: PAG Formation* (Feb. 5, 2004), <http://www.w3.org/Consortium/Patent-Policy-20040205/#sec-PAG-formation>; *see also Procedures for Launching and Operating a Patent Advisory Group (PAG)* (last revised Jan. 8, 2008), <http://www.w3.org/2007/04/patent-exception-management>.

- Uniform Resource Locator (URL) – a “single naming scheme” used “to give access to any resource on the Web in a uniform way”;³⁷⁸
- Hypertext Markup Language (HTML) – the “publishing language of the World Wide Web”;³⁷⁹
- Hypertext Transfer Protocol (HTTP) – created in conjunction with the Internet Engineering Task Force (IETF),³⁸⁰ it is used to transfer data across the World Wide Web;³⁸¹
- Cascading Style Sheet (CSS) – a “mechanism for adding style (*e.g.*, fonts, colors, spacing) to Web documents”;³⁸²
- Extensible Markup Language (XML) – “a simple text-based format for representing structured information” such as “documents, data, configuration, books, transactions, [and] invoices”;³⁸³ and
- Java Script – scripting language developed by Ecma International, with many of the Application Programming Interfaces (APIs) developed by W3C.³⁸⁴

Finally, two significant internet standards created and provided on a royalty-free basis by the IETF are the Transmission Control Protocol (TCP) and the Internet Protocol (IP).³⁸⁵ TCP and IP standards are used to send data across the internet.³⁸⁶

³⁷⁸ W3C, *HTML and URLs*, <http://www.w3.org/TR/WD-html40-970708/htmlweb.html> (last visited Feb. 21, 2014); *see also* W3C, *URL: W3C Working Draft* (May 24, 2012), <http://www.w3.org/TR/2012/WD-url-20120524/>.

³⁷⁹ W3C, *HTML*, <http://www.w3.org/html/> (last visited Feb. 21, 2014); *see also* Kahin, *supra* note 371.

³⁸⁰ W3C, *HTTP Activity Statement*, <http://www.w3.org/Protocols/Activity> (last visited Feb. 21, 2014).

³⁸¹ W3C, *HTML and URLs*, <http://www.w3.org/TR/WD-html40-970708/htmlweb.html> (last visited Feb. 21, 2014); *see also* W3C, *HTTP – Hypertext Transfer Protocol*, <http://www.w3.org/Protocols/> (last visited Feb. 21, 2014).

³⁸² W3C, *Cascading Style Sheets Home Page*, <http://www.w3.org/Style/CSS/> (last visited Feb. 21, 2014).

³⁸³ W3C, *XML Essentials*, <http://www.w3.org/standards/xml/core> (last visited Feb. 21, 2014); *see also* W3C, *Extensible Markup Language*, <http://www.w3.org/XML/> (last visited Feb. 21, 2014).

³⁸⁴ W3C, *JavaScript Web APIs*, <http://www.w3.org/standards/webdesign/script> (last visited Feb. 21, 2014).

³⁸⁵ Tim Berners-Lee, *Long Live the Web: A Call for Continued Open Standards and Neutrality*, SCIENTIFIC AMERICAN (Nov. 22, 2010), <http://www.scientificamerican.com/article.cfm?id=long-live-the-web&print=yes>.

³⁸⁶ *See* Information Sciences Institute, *Transmission Control Protocol, RFC 793* (Sept. 1981), <http://www.ietf.org/rfc/rfc0793.txt>; Information Sciences Institute, *Internet Protocol, RFC 971* (Sept. 1981), <http://www.ietf.org/rfc/rfc791.txt>.

Networking Software (i.e., sharing on local networks)

UPnP

Universal Plug and Play (UPnP) is an open, Internet-based communication standard that allows devices on a network automatically to communicate with each other.³⁸⁷ UPnP was developed by Microsoft and Microsoft donated it to the UPnP Forum.³⁸⁸

UPnP can be implemented royalty-free for general members of the UPnP Forum with no annual membership fees.³⁸⁹

Digital Media Sharing

The Digital Living Network Alliance (DLNA) promulgates standards to allow devices to share content (photos, music, videos) in a home network—e.g., playing a video from a smartphone on a television. The fees to certify a product with DLNA include membership fees between \$10,000 and \$150,000 annually, and certification fees between \$1,000 to \$15,000 annually. Therefore, a company could pay between \$11,000 and \$165,000 annually to the DLNA.

In 2003, Sony started DLNA to define media sharing standards.³⁹⁰ Currently, more than 250 companies are members and DLNA has certified more than 20,000 device models, including mobile phones.³⁹¹ DLNA has three types of device classes: home network devices, mobile handheld devices, and home infrastructure devices.³⁹² The DLNA Guidelines identify IP protocols that enable communication between devices, allowing the devices to find and recognize each other, and share digital content.³⁹³ Guidelines for interoperability provide

³⁸⁷ *About UPnP Forum*, UPnP, <http://upnp.org/about/what-is-upnp/> (last visited Feb. 21, 2014).

³⁸⁸ Madeleine Bath, *What Could UPnP Possible Mean to Building Systems?* (Dec. 2003), <http://www.automatedbuildings.com/news/dec03/articles/bath/bath.htm> (last visited Feb. 21, 2014).

³⁸⁹ Harish Naidu, *Evolution of the Device Ecosystem*, MICROSOFT CORP., <http://upnp.org/events/documents/02-01KeynoteDeviceEcosystemHarishN.ppt> (last visited Feb. 21, 2014); *Become a Member*, UPnP, <http://upnp.org/membership/> (last visited Feb. 21, 2014). For companies that want additional benefits (e.g., access to official UPnP test tool and ability to test devices for certification, special assistance, and license to the UPnP certification mark), the annual membership fee for Implementer Members is \$5,000. There is also an additional \$15,000 annual fee for Steering Committee membership, which includes additional benefits such as overseeing the governance and operation of the UPnP Forum. *Id.*

³⁹⁰ *DLNA Setup & FAQ*, Sony, http://esupport.sony.com/US/p/support-info.pl?info_id=884 (last visited Feb. 21, 2014).

³⁹¹ *The Value of the Certification Program*, DLNA, <http://www.dlna.org/dlna-for-industry/digital-living> (last visited Feb. 21, 2014).

³⁹² See Dan Grabham, *DLNA: What It Is and What You Need to Know*, TECHRADAR (Mar. 22, 2012), <http://www.techradar.com/us/news/digital-home/home-networking/dlna-what-it-is-and-what-you-need-to-know-1079015>.

³⁹³ *Digita DLNA Technical Overview*, DLNA, <http://www.dlna.org/dlna-for-industry/digital-living/how-it-works> (last visited Feb. 21, 2014).

vendors with information to build interoperable networked platforms and devices.³⁹⁴ Guidelines are free to members and, for non-members, can be bought for \$500 for internal evaluation purposes only.³⁹⁵

The use of DLNA in smartphones is not commonplace but it is offered in some, such as Sony's Xperia and certain Samsung models. Sony, for example, describes the use of DLNA in the Xperia as follows: "Show time? Connect the Xperia J DLNA Android phone to your TV or Tablet via Wi-Fi and DLNA and give people the bigger picture."³⁹⁶ Apple has not joined DLNA and instead adopted its own proprietary standard, Airplay.³⁹⁷

To certify a product, the company has to be a DLNA member, ensure that the device has the necessary certification prerequisites according to DLNA Guidelines, and submit the device to DLNA's certification system.³⁹⁸ There are two classes of certifications for base devices. Class 1 is \$15,000 and includes certification for an unlimited number of derivatives³⁹⁹ for one year from the original date of certification.⁴⁰⁰ Class 2 is \$1,000 and includes certification for up to 40 derivatives for one year from the original date of certification.⁴⁰¹ Additional derivatives in Class 2 are purchased for \$25 each.⁴⁰²

In order to be a DLNA member, a company has to sign a membership agreement and pay fees according to membership level and service on the Board of Directors.⁴⁰³ The table below identifies the membership levels for the DLNA, along with the applicable fees.⁴⁰⁴

³⁹⁴ *Id.*

³⁹⁵ *Id.*

³⁹⁶ *Sony Xperia J*, <http://www.sonymobile.com/us/products/phones/xperia-j/> (last visited Feb. 21, 2014); *see also, e.g., Samsung Galaxy S*, <http://www.samsung.com/au/smartphone/galaxys/index.html> (last visited Feb. 21, 2014).

³⁹⁷ *See* Grabham, *supra* note 392.

³⁹⁸ *DLNA Certification and Logo Program*, DLNA, <http://www.dlna.org/dlna-for-industry/certification> (last visited Feb. 21, 2014).

³⁹⁹ A derivative is a "revision, new model, or product configuration which meets the same level of conformance with the DLNA Guidelines as the DLNA Certified Product which it is based on." Digital Living Network Alliance Certification Process, DLNA (July 14, 2006), [ftp://ftp.im.must.edu.tw/download/wtlin/960906/\[Standard\]%20Digital%20Living%20Network%20Alliance/Certification%20and%20Logo%20Program/DLNA_Certification_Process_v1_04.pdf](ftp://ftp.im.must.edu.tw/download/wtlin/960906/[Standard]%20Digital%20Living%20Network%20Alliance/Certification%20and%20Logo%20Program/DLNA_Certification_Process_v1_04.pdf).

⁴⁰⁰ *Id.*

⁴⁰¹ *Id.*

⁴⁰² *Id.*

⁴⁰³ *See DLNA Contributor Membership Process*, DLNA, <http://www.dlna.org/dlna-for-industry/become-a-member/inquire-about-industry-membership/thank-you> (last visited Feb. 21, 2014).

⁴⁰⁴ *Digital Living Network Alliance Summary of Member Fees*, DLNA (last revised June 12, 2012), http://www.dlna.org/docs/dlna-contributor-membership-documents/dlna_exhibit-d_summary-of-fees_revised-6-12-12.pdf.

Membership Level	Initial Fee	Annual Renewal Fee
Contributor Membership	\$10,000	\$10,000
Promoter Membership	\$50,000	\$50,000
Additional Fee for Board of Directors Membership	\$50,000	\$50,000

Input / Output: USB

USB 2.0⁴⁰⁵ and 3.0⁴⁰⁶—the current USB standards in today’s smartphones—are royalty-free for “Adopters” of the USB standard.⁴⁰⁷

Universal Serial Bus (USB) is a “standard for connecting external and internal devices to a computer” by using a single standardized interface socket.⁴⁰⁸ USB technology was developed by Intel, which introduced the original USB 1.0 specification in 1996.⁴⁰⁹ In 1995, Intel formed the USB Implementation Forum (USB-IF) with other industry players in order to support and accelerate USB adoption.⁴¹⁰ For companies wanting to join the USB-IF, there is an annual membership fee of \$4,000, and membership includes benefits such as participation in USB-IF’s Compliance Program.⁴¹¹ Currently, the USB-IF has more than 800 member companies.⁴¹²

⁴⁰⁵ See USB 2.0 Document Index, UNIVERSAL SERIAL BUS, http://www.usb.org/developers/docs/usb20_docs/#usb20adopters (last visited on Feb. 21, 2014) (“The USB 2.0 Adopters Agreement allows a signing company to participate in a reciprocal, royalty-free licensing arrangement for compliant products.”).

⁴⁰⁶ USB 3.1 Specification, UNIVERSAL SERIAL BUS, <http://www.usb.org/developers/docs> (last visited on Feb. 21, 2014) (“The USB 3.0 Adopters Agreement allows a signing company to participate in a reciprocal, royalty-free licensing arrangement for compliant products.”).

⁴⁰⁷ See Jerry Ascierio, *Intel Won’t Charge Royalties for USB 2.0 Host Spec*, EE TIMES, Dec. 21, 2000, http://www.eetimes.com/document.asp?doc_id=1142701; David S. Jones, *FireWire v. USB: Apple and Intel Play Hardball*, PC STATS (May 20, 2002), www.pcstats.com/articleview.cfm?articleid=1104&page=2.

⁴⁰⁸ See *Intel and USB: Helping Make It Easier to Connect Devices to PCs 1*, INTEL, <http://www.intel.com/content/dam/www/public/us/en/documents/case-studies/usb-standards-case-study.pdf>.

⁴⁰⁹ *Id.* at 2.

⁴¹⁰ *Id.* at 2. Intel also states that it has “[h]elped develop an open industry specification with a royalty-free intellectual property (IP) licensing obligation.” *Id.*

⁴¹¹ See *Members*, UNIVERSAL SERIAL BUS, https://www.usb.org/members_landing (last visited Feb. 21, 2014).

⁴¹² *Id.*

Intel, along with Compaq, Hewlett Packard, Lucent, Microsoft, NEC, and Phillips led the development of USB 2.0.⁴¹³ In April 2000, USB 2.0 (High Speed USB) was approved and it provided enhanced performance.⁴¹⁴ Next, in November 2008, USB 3.0 (SuperSuper USB) was released.⁴¹⁵ USB 3.0 has faster data transfer speeds and improved power management.⁴¹⁶ In addition, USB 3.0 is backwards compatible with USB 1.0 and 2.0 devices.⁴¹⁷

In order to access the royalty-free USB 2.0 and 3.0 technologies, companies have to sign a USB Adopters Agreement.⁴¹⁸ Under the USB 2.0 Adopters Agreement, companies that sign are “(i) are obligated to license on a royalty-free and non-discriminatory basis, certain IP that would be necessarily infringed by products compliant with the final USB 2.0 interface specification or its adopted supplements; and (ii) will receive a license of the same scope from the USB 2.0 Promoters and other companies that have signed Adopters Agreements.”⁴¹⁹ Similarly, under the USB 3.0 Adopters Agreement “a signing company [] participate[s] in a reciprocal, royalty-free licensing arrangement for compliant products.”⁴²⁰

A newer technology, Wireless USB 1.1, is offered on “reasonable and non-discriminatory terms.”⁴²¹ Wireless USB technology was created by the Wireless USB Promoter Group: Agere Systems, Hewlett Packard, Intel, Microsoft, NEC Electronics, Philips, and Samsung. It was also aided by over 100 contributing companies.⁴²² While the hope is to expand Certified Wireless USB to smartphones,⁴²³ it appears that smartphones have not yet integrated the Wireless USB standard. However, Samsung,⁴²⁴ Alereon,⁴²⁵ and Wisair⁴²⁶ have announced that they are selling

⁴¹³ *A Technical Introduction to USB 2.0*, UNIVERSAL SERIAL BUS, http://www.usb.org/developers/usb20/developers/whitepapers/usb_20g.pdf.

⁴¹⁴ *See Intel and USB*, *supra* note 408 at 2.

⁴¹⁵ *See id.* at 3. In order to accelerate the introduction of USB 3.0, Intel developed and licensed royalty-free an extensible host controller interface specification, which provides a “standardized method for USB 3.0 controllers to communicate with the USB 3.0 software stack.” *Id.* at 4.

⁴¹⁶ *See id.* at 3.

⁴¹⁷ *See id.*

⁴¹⁸ *See Members*, UNIVERSAL SERIAL BUS, https://www.usb.org/members_landing (last visited Feb. 21, 2014).

⁴¹⁹ *Hi-Speed USB Development Tools*, UNIVERSAL SERIAL BUS, <http://www.usb.org/developers/usb20> (last visited Feb. 21, 2014) (emphasis added).

⁴²⁰ *USB 3.1 Specification*, UNIVERSAL SERIAL BUS, <http://www.usb.org/developers/docs> (last visited Feb. 21, 2014) (emphasis added).

⁴²¹ *Wireless USB Adopters Agreement*, Universal Serial Bus, http://www.usb.org/developers/wusb/WUSB_Adopters_Agreement_Final_020411.pdf (last visited Feb. 21, 2014).

⁴²² *Introducing Certified Wireless USB from the USB-IF*, UNIVERSAL SERIAL BUS, http://www.usb.org/developers/wusb/About_WUSB_FINAL5.pdf (last visited Feb. 21, 2014).

⁴²³ *See id.*

⁴²⁴ *Samsung’s New High-Performance Wireless USB SOC Solution Brings Short-Range Wireless Communications to CE Products*, SAMSUNG (Feb. 11, 2009), <http://www.samsung.com/global/business/semiconductor/news-events/press-releases/detail?newsId=4126>.

⁴²⁵ *Alereon Announces First Wireless USB Chipset Solution* (Jan. 8, 2007), <http://www.alereon.com/press-room/alereon-press-releases/148-alereon-announces-first-wireless-usb-chipset-solution>.

Wireless USB chips that could be used in the mobile phone market. We have not yet identified any publicly available royalty information for Wireless USB 1.1 and there does not appear to be any current litigation on this technology.

User Interface

The user interface (UI) category includes patents that relate to the smartphone user interface, including the touch screen hardware and software. The category of user interface—*e.g.*, Apple’s touch to zoom feature—incorporates aesthetic and functional features that are product-differentiating. For product-differentiating features, it is possible for innovators to avoid infringement by developing their own distinct features (which could distinguish their own products). The range of design freedom is greater for these technologies than the standardized and “commercially necessary” technology described above. A truly distinctive and innovative user interface—as distinct from a copied or derivative design—may result in minimal or no royalty exposure.

The estimated cost of the hardware associated with the user interface is \$27 to \$34 per unit, consisting of a display (\$18-20), a touch panel (\$7-11), and a touch controller (\$2-3).⁴²⁷

In 2012, Apple asserted three utility patents against Samsung related to user interface aspects of the operating system. These patents were:

- U.S. Patent No. 7,844,915 (’915 patent) entitled “Application programming interfaces for scrolling operations” relates to gesture control on a touch screen. The patent covers a method by which a device differentiates between a one-fingered gesture (employed for scrolling) and a two-finger gesture (employed, for example, in pinch-to-zoom).
- U.S. Patent No. 7,864,163 (’163 patent) is entitled “Portable electronic device, method, and graphical user interface for displaying structured electronic documents.” It covers a UI graphical method that zooms in on and substantially centers a portion of an electronic document in response to a user’s double-tap on a touch screen.
- U.S. Patent No. 7,469,381 (’381 patent) is entitled “List scrolling and document translation, scaling, and rotation on a touch-screen display.” This patent is the so-called “rubber banding” patent that covers a UI graphical feature that creates the illusion of the screen “bouncing back” when the user scrolls to the bottom of an electronic document.

⁴²⁶ *Wisair to Bring Wireless USB Functionality to Mobile Devices with New Embedded Solution* (Mar. 25, 2008), <http://www.prnewswire.com/news-releases/wisair-to-bring-wireless-usb-functionality-to-mobile-devices-with-new-embedded-solution-57097507.html>

⁴²⁷ Nomura Securities 2012 Smartphone Guide (citing Gartner data), *available at* http://images.businessweek.com/bloomberg/pdfs/nomura_smartphone_poster_2012.pdf (last visited Feb. 20 2014) (citing estimates that a smartphone display would be \$18-20 per unit; the average cost of a touch panel would be \$7-11 per unit; and, the average cost of a touch controller would be \$2-3 per unit, for a total hardware cost ranging between \$27 and \$34 per unit).

The jury found infringement of these three patents and awarded over a billion dollars in damages—but this award also included damages for infringement of design patents and trade dress dilution. After a retrial on certain damages issues—at which a second jury awarded Apple \$290 million—the total damages from the original trial and retrial (including design patents, trade dress, and utility patents) were over \$900 million.

In August 2012, OSRAM and Samsung Electronics Co., Ltd. settled patent suits brought in the U.S. (including before the International Trade Commission), Germany and South Korea.⁴²⁸ In the ITC, Osram asserted nine patents and Samsung asserted eight patents, all related to LED patent portfolios. The settlement included a cross-license agreement to the parties respective LED patent portfolios. The parties have also signed a separate memorandum of understanding to explore the possibilities of jointly developing future LED-based products. Financial terms of the settlement were not disclosed. Additionally, several cases involving camera and video-related technology were recently filed and are pending.⁴²⁹

Outer Design

The outer design category includes design patents, trademarks, and trade dress (registered and unregistered) that relate to the physical appearance of the smartphone and the visual appearance of the smartphone's software. This category also includes functional physical attributes such as buttons, switches, and antennae. We have not located estimates of the cost of the shell and casing of a smartphone.

As of March 2013, nine of the top twenty design patent holders in the United States were smartphone manufacturers or tied to the smartphone industry, but there is sparse public information regarding royalties or licenses for the physical appearance of smartphones.⁴³⁰ There has also been relatively little litigation in this area, the most notable case being the 2012 *Apple v. Samsung* trial. The design patents at issue in that case covered the shape and appearance of, e.g., the device and the screen for various Apple iPhones, iPod touches, and iPads.⁴³¹ It should be noted that the public evidence in the *Apple v. Samsung* trial—including documents comparing the iPhone to Samsung's products and including explicit directives on how to copy Apple features—made it an exceptional case.

Unlike in cases involving utility patents, an infringer's profits are a permissible remedy in cases involving design patents or dilution of registered and unregistered trade dresses.⁴³²

⁴²⁸ *Osram and Samsung Reach Global Settlement Over LED Patent Suits*, OSRAM (Aug. 17, 2012), http://www.osram.com/osram_com/press/press-releases/_business_financial_press/2012/osram_samsung/index.jsp.

⁴²⁹ *Microsoft Corp. v. Motorola, Inc.*, No. 10-cv-1823-JLR (W.D. Wash. filed Nov. 9, 2010); *EON Corp. IP Holdings LLC v. FLO TV Inc. et al.*, No. 10-cv-00812 (D. Del. filed Sept. 23, 2010); *Black Hills Media, LLC v. Samsung Elecs. Co. Ltd. et al.*, No. 13-cv-00379 (E.D. Tex. filed May 6, 2013).

⁴³⁰ See *USPTO Design Patents Report*, Part B, (last modified March 28, 2013), available at http://www.uspto.gov/web/offices/ac/ido/oeip/taf/design.htm#PartA1_1 (listing Samsung, Sony, Microsoft, Hon Hai, LG, Motorola, Nokia, Sharp and Apple as leading design patent holders).

⁴³¹ See U.S. Patent Nos. D618,677, D593,087 and D504,889.

⁴³² See 15 U.S.C. § 1117.

Similarly, damages for design patents need not be apportioned and a patent owner may recover an infringer's total profits for design patent infringement.⁴³³ Thus, in *Apple*, the jury awarded a verdict of hundreds of millions of dollars, including for infringer's profits, for the design patents and trade dress. As noted above, after a retrial on certain damages issues, the total damages from the original trial and retrial (including design patents, trade dress, and utility patents) were nearly \$1 billion. Post-trial and appellate proceedings are ongoing.

Again, this category of patents is aimed at non-standardized, product-differentiating designs. As a consequence, suppliers have the discretion to steer clear of particular intellectual property. Careful and truly original design—rather than copying or other derivative designs—could mean that a smartphone supplier could likely avoid paying royalties on design patents.

Conclusion

The available data on royalties for smartphone technology varies in clarity and robustness. For some technologies, such as cellular and Wi-Fi, there has been significant public disclosure of rates through company announcements and/or litigation. For many other areas, the available information is less clear cut and amounts either to a small number of data points about damages and/or royalties or even only an assessment of the amount of litigation involving the technology. We have not attempted to derive estimates of the potential royalties for many of the technologies that have been addressed.

But even with these gaps in the data—and the limitations of the available data, as described at the outset—the magnitude of the potential royalty burdens on a smartphone become apparent. Totaling the figures described above for particular components or technologies leads to potential royalties of \$121 to \$124 (for smartphones using either Microsoft Windows Phone or Android or some other open source operating system), as shown below:

Technology	Potential Royalty Demands
Cellular Baseband Chip (Standardized)	\$54
Wi-Fi/802.11	\$50
AAC	\$0.20
MP3	\$0.95
H.264	\$10.60
Operating system software (Microsoft or Android)	\$5-8
Total (approx.)	\$121-124

⁴³³ See *Apple, Inc. v. Samsung Elecs. Co., Ltd.*, 926 F. Supp. 2d 1100, 1111 (N.D. Cal. Mar. 1, 2013) (“This argument is clearly foreclosed by Federal Circuit precedent. As explained in *Nike Inc. v. Wal-Mart Stores, Inc.*, 138 F.3d 1437, 1442–43 (Fed.Cir.1998), Congress specifically drafted the design patent remedy provisions to remove an apportionment requirement that the Supreme Court had imposed. Thus, there is simply no apportionment requirement for infringer's profits in design patent infringement under [35 U.S.C.] § 289.”).

Indeed, the royalty data shows that the potential royalties demands on a smartphone could equal or even exceed the cost of the device's components.⁴³⁴ To be sure, for the reasons described above, many of the so-called "headline" rates on which these royalty figures are based may not withstand negotiation or litigation, but they have nonetheless been sought (and received) from some licensees. With the addition of royalties for the components/technologies for which we did not have sufficient data to include royalty figures, the total potential royalties would increase. Without access to the actual royalty figures paid by smartphone suppliers it is impossible to know for certain their magnitude. But our research demonstrates that they are likely significant. Indeed, the available data suggest that the smartphone royalty stack may be one important reason why selling smartphones is currently a profitable endeavor for only a small number of suppliers.

Further, the available data demonstrate a need for licensees to advocate and courts to rigorously apply methodologies for calculating royalties that focus on the actual value of a claimed invention put in context of the myriad other technologies in a smartphone and the components in which the technologies are implemented. Our research shows a common thread where many of the largest royalty demands rely on the methodology of seeking a royalty based on a percentage of the sales price of the entire smartphone, as opposed to the modest price of the component in which the accused functionality is implemented. That methodology often stems from licensing practices that conflict with the Federal Circuit's more recent apportionment jurisprudence and it is increasingly being rejected by the courts.

The need for apportionment and rigorous valuation of claimed inventions when calculating royalties is especially acute for standardized technologies, where a patent holder may have just a small slice of the declared essential patents for a particular standard and where that standard may be just one of many supported by the device. Indeed, when courts have rigorously applied methodologies that account for royalty stacking concerns and make a meaningful assessment of the value of the patented technology to the accused devices, the results have been royalties that appear far more economically sustainable for device suppliers. That is the case in both the *Innovatio* and *Microsoft v. Motorola* decisions, where the court set RAND royalties at a fraction of what the patent holders had sought. Data such as that presented herein may further crystallize the need for such nuanced analyses of rate-setting.

⁴³⁴ As noted above, *see supra* p. 3, the estimated cost of all components in a smartphone—not including software—is \$120-140.