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"A NEW DATASET ON MOBILE PHONE PATENT LICENSE ROYALTIES"

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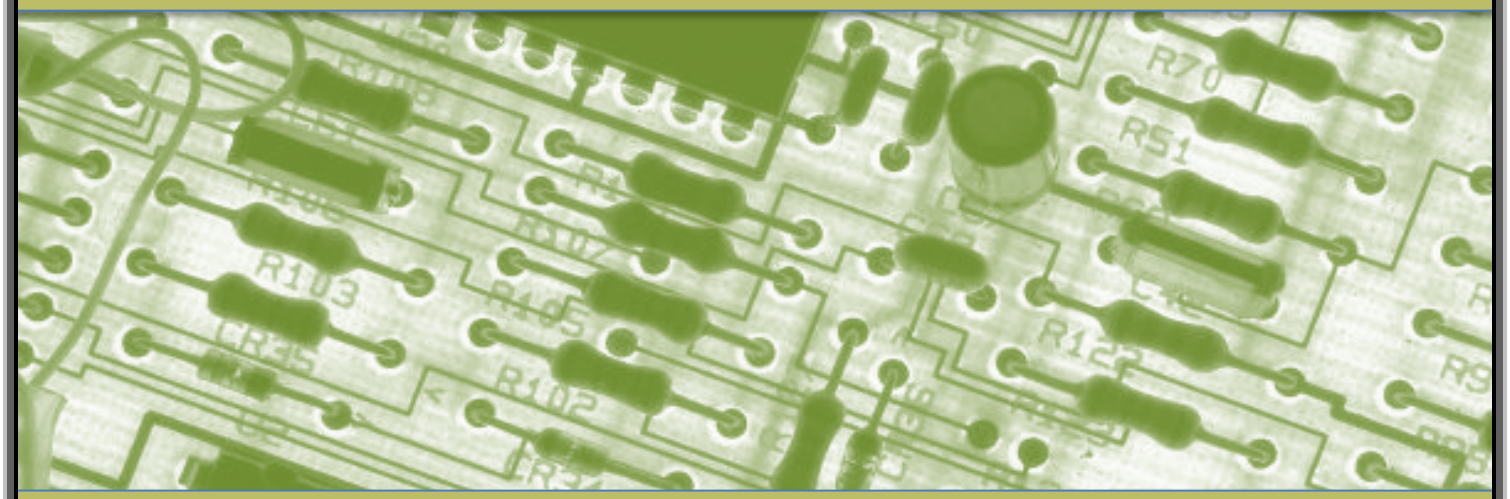

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A New Dataset on Mobile Phone Patent License Royalties[1]
September 2016 Update

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1. Introduction

Mobile phones integrate a wide array of technologies, from computing to consumer electronics to communications, and from semiconductors to hardware, software and services. This makes them a relevant target for a large and broad array of patents and licensors. In addition, mobile phones rely on technological standards to make them interoperable. A standard-compliant smartphone uses hundreds, if not thousands of standard essential patents (SEPs), which are owned by many different patent holders.[3]

[1] We thank Jonathan Barnett, Anne Layne-Farrar, Keith Mallinson, Jorge Padilla and others who wished to remain anonymous but provided important perspective and helpful comments. Jordan Horrillo provided excellent research assistance.

[2] ***Alexander Galetovic*** is Professor of Economics, Universidad de los Andes, Santiago, Chile. His current research focuses on standard essential patents, competition policy and antitrust. Galetovic has been a Research Scholar at the International Monetary Fund, a Tinker Visiting Professor at Stanford and a Rita-Ricardo National Fellow at the Hoover Institution. ***Stephen Haber*** is A.A. and Jeanne Welch Milligan Professor in the School of Humanities and Sciences, Professor of Political Science, Professor of History, Professor (by courtesy) of Economics, Senior Fellow of the Stanford Institute for Economic Policy Research, and Peter and Helen Bing Senior Fellow at the Hoover Institution, at Stanford University. Haber directs the Hoover Institution Working Group on Intellectual Property, Innovation, and Prosperity (Hoover IP2). Hoover IP2 succeeded the Hoover Project on Commercializing Innovation (PCI). To ensure academic freedom and independence, both PCI and IP2, along with all work associated with them, have only been supported by unrestricted gifts. Some major donors have included Microsoft, Pfizer, and Qualcomm. ***Lew Zaretzki*** is Managing Director, Hamilton IPV a Silicon Valley IP strategy consulting firm serving many of the world's finest technology companies and leading technology investors in matters of corporate strategy, IP strategy, M&A, and IP transactions.

[3] It is estimated that there are about 150.000 declared mobile SEPs worldwide (issued and applied for) in the so-called "4G stack," which includes LTE, WCDMA and GSM/ GPRS/ EDGE. Of these, about 20,000 are US patents. Galetovic and Gupta report that in 2013 there were 128 SEP holders. "Royalty Stacking and Standard Essential Patents: Theory and Evidence from the Mobile Wireless Industry," Hoover IP2 Working Paper 15012, 2016..

While some have claimed that dispersed ownership of SEPs leads to high cumulative royalty rates, the estimates that underpin these claims are based on the simple addition of published handset royalty rates.[4] There are a variety of reasons to be dubious of this method, not the least of which is that it conflates "rack rates" which might not be paid by anybody, with actual market transaction rates. Indeed, just as firms have incentives to declare all possible patents as essential, they also have incentives to post high royalty rates to license their portfolio, even if they never actually earn any licensing revenue from that portfolio.[5]

This note describes a new dataset to estimate the Average Cumulative Patent Royalty Yield paid in the mobile phone value chain— the sum total of patent royalty payments earned by licensors, divided by the total value of mobile phones shipped. We build upon earlier work by Mallinson that focused on mobile SEPs [6] but go beyond that

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One should note that it may have been in the interests of patent holders to declare all possible patents as "essential." One reason is that patentees risked legal penalties for not declaring a patent essential. Also, some firms may have acted on the perception that a large SEP portfolio bolstered their reputation and increased their leverage when negotiating royalties. Moreover, the ETSI IPR database, just lists declared essential patents, but neither ETSI nor anybody else audits those declarations. For these reasons, it is not clear how many of these patents are truly essential. Industry participants often estimate the rate of over-declaration at 50% or more. Others think that few SEPs would pass a legal test of essentiality.

[4] See, for example, Eric Stasik, "Royalty Rates and Licensing Strategies for Essential Patents on LTE (4G) Telecommunications Standards," Les Nouvelles, September 2010, pp. 114-119.

[5] At one point in time it became common for the major equipment vendors to publish a declared LTE royalty rate, usually with caveats that it could be adjusted in light of grant backs or for other reasons. For example, Nortel declared a 1% rate, but it appears to have never actually received any LTE licensing revenue.

[6] See Keith Mallinson, "Cumulative Mobile-SEP Royalty Payments No More than Around 5 percent of Mobile Handset Revenues," IP Finance, August 19, 2015. J. Gregory Sidak builds upon Mallinson as well, but takes a somewhat different theoretical approach, including payments in kind and estimates of the value of cross-licenses. Thus, it is a study of potential IP value, rather than the cumulative royalty yield. See J. Gregory Sidak, "What Aggregate Royalty Do Manufacturers of Mobile Phones Pay to License Standard-Essential Patents?" Criterion Journal on Innovation 1 (701). Following Mallinson, we use the term royalty "yield" rather than royalty "rate." "Rate"

work by: (i) analyzing patent royalties in the entire mobile phone value chain (i.,e, royalties on mobile SEPs, but also audio and video codecs, imaging, operating systems, semiconductors, and other components); (ii) comparing our results on patent royalties to other costs of mobile phone manufacture and to OEM profits; (iii) generating time series that permit researchers to analyze the stability of the Average Cumulative Patent Royalty Yield back to 2007. For some firms, our coverage goes back to 2000.

Our purpose is to provide as comprehensive and transparent a data source as is practically possible for use by other researchers, industry practitioners, and government officials. Thus, this note should be read as an adjunct to the Excel Workbook that we have posted to the web at: http://hooverip2.org/wp-content/uploads/New-Dataset-on-Mobile-Phone-Patent-License-Royalties.xlsx That workbook shows the underlying data and sources. It also explains the decisions we made in estimating or approximating values.

We do not take a position on whether the estimates of the royalty yield we present in this study are "too high," "too low," or "just right." That is an important debate, but it can only be joined on the basis of evidence.

2. Methods—"Follow the Money"

All methods of analysis are dependent upon an underlying theory, and underlying theories are created in order to answer particular questions of interest. Calculating the cumulative royalties paid (or earned) in the mobile phone value chain is not an exception to this

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refers to the actual royalty paid by a licensee, typically an OEM or EMs, to a licensor as a percentage of the licensee's sales. Yield is the sum total of patent royalty payments divided by the total value of mobile phones shipped, the latter of which might include the production of OEMs that evade patent licenses. Some researchers refer to royalty yield as the "royalty stack," a term we eschew because it is theory-laden and an oxymoron.

general rule. The basic question researchers are asking is how do royalties paid by firms in the mobile phone value chain affect production and decisions at the margin? That is, if royalty rates were X percent higher, by how much would output fall and prices increase? If they were X' lower, by how much would output rise and prices fall? Microeconomic theory provides a guide to the relevant facts necessary to answer this question; it tells us that we need to approximate paid per-unit royalties.[7]

In an ideal world for researchers, mobile phone Original Equipment Manufacturers (OEMs), Electronics Manufacturer Services (EMSs), Original Design Manufacturers (ODMs) and component manufacturers in the mobile phone value chain would report the identities of the IP holders from whom they license and the value of the payments to each of those licensors. It would then be possible to determine the "IP Bill of Materials (BoM)" paid by each firm in the in the mobile phone value chain. From there, one could calculate a weighted average BoM for every firm in the value chain, with the weights determined by their relative contribution to total mobile phone sales.

It is almost never the case that researchers can work with the ideal data, and the data on mobile phone patent licenses are not an exception to this rule. The fundamental problem is that licensees have very weak incentives to disclose their patent license royalty payments.

[7] One might claim that this approach to data ignores other economic costs borne by manufacturers. For example, we do not include the opportunity cost borne by a manufacturer that buys patents to prevent claims of infringement, or the opportunity cost borne by manufacturers who cross license their patents (in a cross licensing agreement firms may forego some or any royalty payment in exchange for access to another firm's portfolio), or the membership subscriptions paid to defensive aggregators of patents. Such expenditures will increase a firm's fixed costs. They will not, however, affect marginal costs of production, and thus not influence production and pricing decisions at the margin.

As a matter of accounting, however, payments by licensees must show up as revenues for licensors, and licensors have strong incentives to disclose their patent licensing revenues. For publicly-traded firms with licensing revenues that are a non-trivial component of their total revenues, those incentives are legal and regulatory; the sources of revenue must be disclosed to investors. Even licensors without legal and regulatory incentives to disclose their revenues, however, such as patent pools administered by firms that specialize in pool administration, have market-based incentives to disclose the identities of their licensees and their tiered royalty charges per unit, thereby allowing the royalty revenues of the pool to be approximated.

It is therefore possible to estimate the total cost of patent licenses in the mobile phone value chain by identifying the major licensors and retrieving the information necessary to estimate their licensing revenues. One can then divide the sum of these revenues across all licensors by the total value of mobile phones sold to obtain an average cumulative royalty yield. There are three numbers that one needs to know in order to estimate the Average Cumulative Royalty Yield: (i) the mobile phone patent licensing revenue earned by each licensor; (ii) the total number of mobile phones sold; (iii) the average selling (wholesale) price of a mobile phone (ASP).

2A. Estimating the Size of the Market

The number of phones sold and the ASP are easy to come by: a number of data analytics firms estimate these, and issue press releases that they then post to the web. Firms such as IC Insights, IDC, Gartner, and GFK produce these estimates. The estimates tend to be within a few percentage points of one another such that results would not be

sensitive to which source is used.[8] These same firms also produce estimates of the quantity and value of tablets. We do not include these in these calculations. If we would include tablets, it would increase the value of device sales, and thus drive down the Average Cumulative Royalty Yield.

These same entities also estimate device sales and prices by major OEMs, and provide this data in press releases, which they post to the web. These estimates also tend to be within a few percentage points of one another.[9] We use this data in order to estimate the revenues earned by patent pools, which tend to have tiered royalty schedules.

2B. Estimating Patent Licensing Revenue

Estimating patent licensing revenue is straightforward in principle, though it can be complicated in practice. Firms that earn significant revenues from patent licensing report those figures in financial reports (e.g. SEC forms 10k and 20-f for example). Private firms are not obligated to disclose such information about their operations. In these cases we estimate revenues based on information that firms make publically available. For example, successful patent pools typically disclose the identities of their licensors and licensees, the patents covered by the pool, and the fee schedule for licensees. Developing an estimate given this information is practical, although it often tends to overestimate royalties. However, that is consistent with our chosen bias and so we expect it.[10]

[8] For the data, see *Tab 1.8, Device Sales*, in the Excel workbook that accompanies this document.
[9] For the data, see *Tab 1.9, OEM Sales*, in the Excel workbook that accompanies this document.
[10] For the data, see *Tab 1.7, Revenues by Licensor,* in the Excel workbook that accompanies this document.

There are some public firms that earn patent licensing revenue in the mobile phone value chain but in amounts that are modest relative to their other revenue sources. They therefore do not break out this revenue as a reportable segment in their public filings. There are also private firms, and these are not obligated to disclose their revenue sources. When it is practicable, we estimate the revenues of both types of firms on the basis of information on their websites, reports in the trade and financial press, and interviews with industry practitioners.[11] When it is not practicable, we enumerate those firms.[12] We then do a sensitivity analysis in which we assign a series of plausible total revenues for these firms as a group (based on information from the trade press as well as interviews with industry practitioners) in order to see the degree to which their inclusion affects our results. [13] That sensitivity analysis finds that even an upper bound estimate of the combined mobile phone patent licensing revenues of these firms would not have a significant effect: even if the mobile phone patent licensing revenues for these firms as a group were $2 billion, the average cumulative royalty yield would only increase between 0.4 and 0.6 percentage points.

The core of our method, then, is to "follow the money." In following the money, we make no distinctions as to where a licensor is earning revenues in the mobile phone value chain, nor do we make distinctions among the different patented technologies in a mobile phone. We capture, for example, revenues earned from licenses taken by

[11] For the data, see *Tab 1.7, Revenues by Licensor,* in the Excel workbook that accompanies this document

[12] For the list of firms, see *Tab 6.0, Other Firms,* in the Excel workbook that accompanies this document.

[13] See, *Tab 1.6 Sensitivity,* in the Excel workbook that accompanies this document.

semiconductor and base band chip producers, as well as the OEMs and EMSs that assemble phones. We also capture revenues earned from licenses on patents that enable video, imaging, audio, and other functions, as well as the SEPs that enable mobility. We capture, as well, the revenues of a major software company that earns revenue from its patents that read on the most popular mobile phone operating system.

2C. Basic Principles of Data Collection

In following the money we are guided by four principles. First, to the degree possible, the estimates should be produced using publicly-available sources so that our results can be replicated and improved upon by other researchers. Indeed, we invite users of the data in the Excel workbook that accompanies this document to share information with us so that we can improve our estimates. Second, we endeavor to have as long a time series for each licensor as is practically possible. Third, decisions about how to treat data should bias in favor of obtaining a larger royalty yield. This implies that we err on the side of: (i) including licensors that license to a variety of industries, not just mobile phones, which means that we may be counting their revenues from those other products as patent royalties on mobile phones; (ii) attributing royalties to mobile phones that may have been paid on other mobile products, such as tablets; (iii) double counting, which means that we may be including both the royalty revenues declared by a licensor and the royalty revenues earned by a pool where the licensor is a member; (iv) biasing approximations upwards.[14]

[14] For example, in the case of Huawei, which is a relatively new licensor whose legal status as a privately owned collective means that it is not subject to the same kind of reporting requirements as U.S. or European firms, we liberally assume that its mobile phone royalty revenues are the

3. Data Quality

The quality of data varies across firms. We classify licensors according the accuracy of our estimates of their licensing data in four categories: Confirmed, Documented, Approximated, and Researched. Table 1 shows the licensors classified in each category.[15]

As as a general rule, the largest licensors are also the entities which disaggregate licensing revenues from other revenues, and for which we have a primary source document that was generated as a legal requirement. Qualcomm, Interdigital, Nokia, and Ericsson, are examples of these kinds of licensors. Given the high quality and accountability of their direct knowledge of their operations and their reporting under SEC auspices, we consider these figures "Confirmed." In 2015, this category accounted for 80.6 percent of total revenues.

Other licensors provide sufficient information in publicly available documents so as to allow us to estimate their licensing revenues. In some cases we have to disaggregate licensing revenues related to mobile phones from other licensing revenues based on information in footnotes to SEC 10k's. In other cases, we have licensing fee schedules and the identities of the licensees, and can estimate the licensing revenues per licensee. We denote these as "Documented." Entities in this category include the major patent pools such as MPEGLA MPEG4; MPEGLA AVC/H.264, and Via's AAC pool. It also includes Microsoft, which licenses its patents that read on the Android Operating System to OEMs.

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same as a well-established, U.S.-based technology company, Interdigital. In doing so, we assume that Huawei is earning, on its mobile phone patents alone, roughly 20 percent of all patent revenues earned by all Chinese companies in any line of economic activity.

[15] Also see *Tab 6.0, Others*, in the Excel workbook that accompanies this document.

There are some entities that are non-trivial mobile phone value chain licensors for which we have information about their total licensing revenues. We have to make assumptions, however, based on other data or interviews, about the percentage of their total licensing revenues that are from the mobile phone value chain. We denote these as "Approximated." They include Tessera, Wi-LAN, and Rambus.

Finally, there are some entities with little or no disclosure. Examination of the available data indicates that they have very modest, sometimes zero, revenues. We denote these as "Researched." The one exception to the generalization about size and data quality is Intellectual Ventures. In this case, we have estimated its total revenues from information on its own website over time (using the web-tools that allow researchers to look at archived webpages) and from information in the trade press about its financial performance. We have to approximate the percentage of this revenue from the mobile phone value chain on the basis of information on the firm's website about its patent portfolio, as well as interviews with industry practitioners.

In addition, there are firms that appear to earn some patent licensing royalties from the mobile phone value chain, but there is limited information in the public domain about the magnitudes. Some large, public companies (some of which are mobile phone OEMs) earn some patent licensing revenues, but their licensing activities are not significant enough to be a reportable segment in their financial statements. Some of these firms, or EMSs that produce for them, are also major sources of licensing revenue for other firms covered in this study. There are also small private companies that appear to earn some patent licensing royalties from the mobile phone value chain, but the publicly available

information about their revenues and operations is fragmentary. We call those "Other identified firms." The available evidence does not suggest any one of these firms—public or private—individually has licensing revenues significant enough that its addition would have a material effect on the overall magnitude of the cumulative royalty yield.

4. Results

We are able to estimate, with varying degrees of accuracy, the mobile phone patent licensing revenues of 32 licensors in the mobile phone value chain. We estimate that the 32 licensors as a group had cumulative royalties in 2015 of almost $14.3 billion (see Table 2).[16] Of these 32, 11 have licensing revenues of effectively zero. Licensing revenues of the remaining 21 firms run from a low of $2.4 million to a high of $8.2 billion in 2015.

One way to put these numbers into perspective is to ask how they compare to the value of mobile phone shipments. In 2015 original equipment manufacturers (OEMs) sold 1.97 billion mobile phones for $437 billion.[17] It follows that the ASP was $221.80, and that the average cumulative royalty per phone was $7.25. The Average Cumulative Royalty Yield is simply total patent royalties divided by the value of total phone shipments, or 3.3 percent.[18]

[16] For the data by licensor, see *Tab 1.7, Revenues by Licensor*, in the Excel workbook that accompanies this document.
[17] According to IDC. For the data, see *Tab 1.8, Device Sales*, in the Excel workbook that accompanies this document.
[18] For the calculations, see *Tab 1.3, Royalty Yield Summary*, in the Excel workbook that accompanies this document.

Another way to put these data into perspective is to ask how they compare to data from earlier years. Because we take a time-series approach, some of our firm-level revenue estimates go back to 2000. By 2007, we have data for 10 firms, and these accounted for 76 percent of all royalty revenues in 2015. By 2009, we have data on 15 firms, and these accounted for 92 percent of all royalty revenues in 2015. As Figure 1 shows, both of those series are remarkably stable. The 2009-15 series, for example, hovers at around 3 percent, falling only marginally during the last two years.[19]

Yet another way to put these data into perspective is to ask how they compare to estimates that other researchers have made about the other costs of production, such as semiconductors and base band processors, as well as OEM operating margins on mobile phones. Figure 2 presents that data. The results indicate that patent licensing is the smallest of the categories: slightly lower than the cost of base band processors, about one-sixth the cost of semiconductors, and about one-fourth of OEM operating margins.[20]

5. Sensitivity Analysis

These results do not seem to be sensitive to how one treats the data. For example, what if we assume that feature phones no longer yield patent licensing revenues, because they are now mostly produced and sold in jurisdictions that tend not to be strong enforcers of IP rights? What would happen if the cumulative royalties of $14.3 billion in 2015 would be spread across 1.424 billion smartphones with a total value of

[19] For the data, see *Tab 1.4, Royalty Yield Series,* in the Excel workbook that accompanies this document.

[20] For the data and sources, see *Tab 1.5, Economic Analysis*, in the Excel workbook that accompanies this document.

$424 billion instead of 1.97 billion smart and feature phones with a value of $437 billion. The Average Cumulative Royalty per smartphone would be $9.93. The Average Cumulative Royalty Yield would be 3.4 percent.[21]

What would happen if we imputed the royalties of firms that we know earn some licensing revenues, but that do not provide enough information for us to estimate those revenues on a firm-by-firm basis? As Table 3 shows, the results would be a modest increase in the Average Cumulative Royalty Yield.[22] For example, if we assume that these firms as a group earned $1 billion in licensing revenues in 2015, which would be a generous assumption, then the royalty yield on a smartphone would increase from 3.4 percent to come to 3.6 percent. If we make the extremely generous assumption that the combined royalties of these firms came to $2 billion in 2015, then the cumulative average royalty yield would still only be 3.8 percent.

What happens if we relax the assumption that every smartphone shipped in 2015 paid licensing royalties? What if it was the case that some OEMs evaded licenses, such that the $14.3 billion is actually spread across fewer than 1.4347 billion smartphones? As a first step, we find determine an upper-bound evasion rate, which we put at 30 percent.[23] We then calculate the Average Cumulative Royalty Yield assuming that only 70 percent of smartphones paid licensing royalties. Table 3 shows the results. Under the assumptions that: (i) all royalties are charged on smartphones (none on feature phones);

[21] See *Tab 1.3 Royalty Yield Summary*, in the Excel workbook that accompanies this document.
[22] See *Tab 1.6, Sensitivity*, in the Excel workbook that accompanies this document.
[23] For a discussion of how we estimated that upper-bound evasion rate, see the footnote in *Tab 1.6, Sensitivity*, in the Excel workbook that accompanies this document.

and (ii) that 30 percent of smartphone production evades royalties, the average cumulative royalty rate would grow from 3.4 percent to 4.8 percent.

What if we pushed harder still, and made three strong assumptions: all royalties are earned on smartphones; the evasion rate is 30 percent; and the royalties for firms in the "Other" un-enumerated category in 2015 was $2 billion? How high could we push the estimate of the Average Cumulative Royalty Yield? As Table 3 shows, the answer is 5.5 percent.

6. Concluding Remarks:

A crucial input to any academic inquiry, policy debate, or industry study is the facts, dispassionately gathered. Our purpose in creating the dataset we outline in this note is to do that. The information in this dataset is therefore not meant as a judgment of any sort upon the merits or effectiveness of any entity or its operations. We invite users of this dataset to share their ideas, suggestions, and corrections with us so that they may be potentially included in future versions. We would like to improve upon these estimates by making corrections when we have erred and to obtain superior data sources when they exist. We will be first to seek improvement in our next edition, and hope to benefit from the support of likeminded others. Perhaps with ongoing cooperation within the community over time we may all gain greater clarity as to the functioning of individual firms and the industry.

Table 1: Types of Licensors Classified by Type and Quality of Their Data

	Confirmed	Documented	Approximated	Researched	Other identified firms
Public corporation	***Qualcomm (2.1)*** ***Ericsson (2.2)*** ***Nokia (2.3) (incl. Alcatel-Lucent)***[1] ***Interdigital (2.4)*** **Parker Vision (3.9)** **Unwired Planet (3.10)**[2] **VirnetX (3.11)**	***Microsoft (2.5)***	**Philips (3.1)**[3] **Tessera (3.5)** **Rambus (3.6)** **Acacia Technologies (3.7)** **WiLAN (3.8)** **Marathon Patent Group (3.12)**	**AT&T 802.11 (3.2)** **AT&T MPEG4 (3.3)** **Broadcom (3.4)**	Apple (6.0) Blackberry (6.0) Google (6.0) Infineon (6.0) Samsung Electronics (6.0) Siemens (6.0) Technicolor (6.0) Texas Instruments (6.0) Vringo (6.0)
Private corporation			***Huawei (5.6)***	**SISVEL Wireless (5.1)** **IP Com (5.2)**[5] **PanOptis-Optis (5.3)**[2] **IP Bridge (5.4)** **Intellectual Ventures (5.5**)	Core Wireless/Conversant (6.0)[7] France Brevet (6.0)[8] ETRI (6.0)[9] ITRI (6.0)[10] Longitude Licensing (6.0)[11] Mobile Media Ideas (6.0) Rockstar (6.0) Round Rock (6.0) VoiceAge (6.0)
Patent pool		**Via Licensing AAC (4.1**) **MPEGLA MPEG4 (4.3)** **MPEGLA AVC H.264 (4.4**)	**Via Licensing LTE (4.2)**[4]	**SISVEL LTE (4.5)** **SISVEL WiFi (4.6)** **SIPROLab WCDMA (4.7)** **Vectis WiFi (4.8)**[6]	

(Tabs in the Workbook in parentheses.) **Licensors included in the Cumulative Royalty Yield estimate in boldface.** *Technology leaders in italics.*
Source: see tab *1.7 Revenues by Licensor,* in the Excel workbook that accompanies this document.

Notes to Table 1

(1) Nokia acquired Alcatel-Lucent in January 2016.
(2) PanOptis recently purchased Unwired Planet. Both license part of Ericssons's patent portfolio.
(3) Philips is a major licensor, but is more diversified with major trademark/ brand licensing operations, and also major digital A/V licensing which includes major pool participation. However, it has some mobile SEP licensing business.
(4) Google licenses its LTE patents through Via. Dolby owns Via Licensing.
(5) IP Com manages the former Bosch mobile patents.
(6) Vectis licenses some of Ericssons's WiFi patents.
(7) Core Wireless/Conversant licenses part of Nokia's patent portfolio.
(8) France Brevet is a French sovereign fund with a portfolio including near-field communication (NFC) patents.
(9) ETRI is a South Korean research institute.
(10) ITRI is a Taiwanese research institute.
(11) Longitude Licensing represents Sandisk and other major tech companies.

Table 2 Cumulative Royalty Yield Classified by Quality of Data (in 2015)

	Type 1 Public company	*Type 2 Private company*	*Type 3 Patent pools*	*Total*
Confirmed	$11,512,623,115 (81%)	-	-	$11,512,623,115 (81%)
Documented	$1,134,500,000 (8%)	-	$310,218,512 (2%)	$1,444,718,512 (10%)
Approximated	$604,358,781 (4%)	$432,488,000 (3%)	-	$1,036,846,781 (7%)
Researched	$124,752,491 (1%)	$68,400,000 (0%)	$86,982,900 (1%)	$280,135,391 (2%)
Total	$13,376,234,387 (94%)	$500,888,000 (4%)	$397,201,412 (3%)	$14,274,323,799 (100%)

Source: See tab *1.7 Revenues by Licensor*, in the Excel workbook that accompanies this document.

Table 3: A Sensitivity Analysis of the Average Cumulative Royalty Yield (2015)

% Unlicensed Phones	Effective Smartphones Royalties Charged by "Other" licensors as a group ($m)				
	$0	$500	$1.000	$ 1.500	$ 2.000
0%	3.4%	3.5%	3.6%	3.7%	3.8%
5%	3.5%	3.7%	3.8%	3.9%	4.0%
10%	3.7%	3.9%	4.0%	4.1%	4.3%
15%	4.0%	4.1%	4.2%	4.4%	4.5%
20%	4.2%	4.4%	4.5%	4.7%	4.8%
25%	4.5%	4.6%	4.8%	5.0%	5.1%
30%	4.8%	5.0%	5.1%	5.3%	5.5%

Source: see tab 1.6 *Sensitivity*.

Figure 1
Patent Royalties as % of Value of Mobile Phones (Smart and Feature) Shipped, 2007-2015

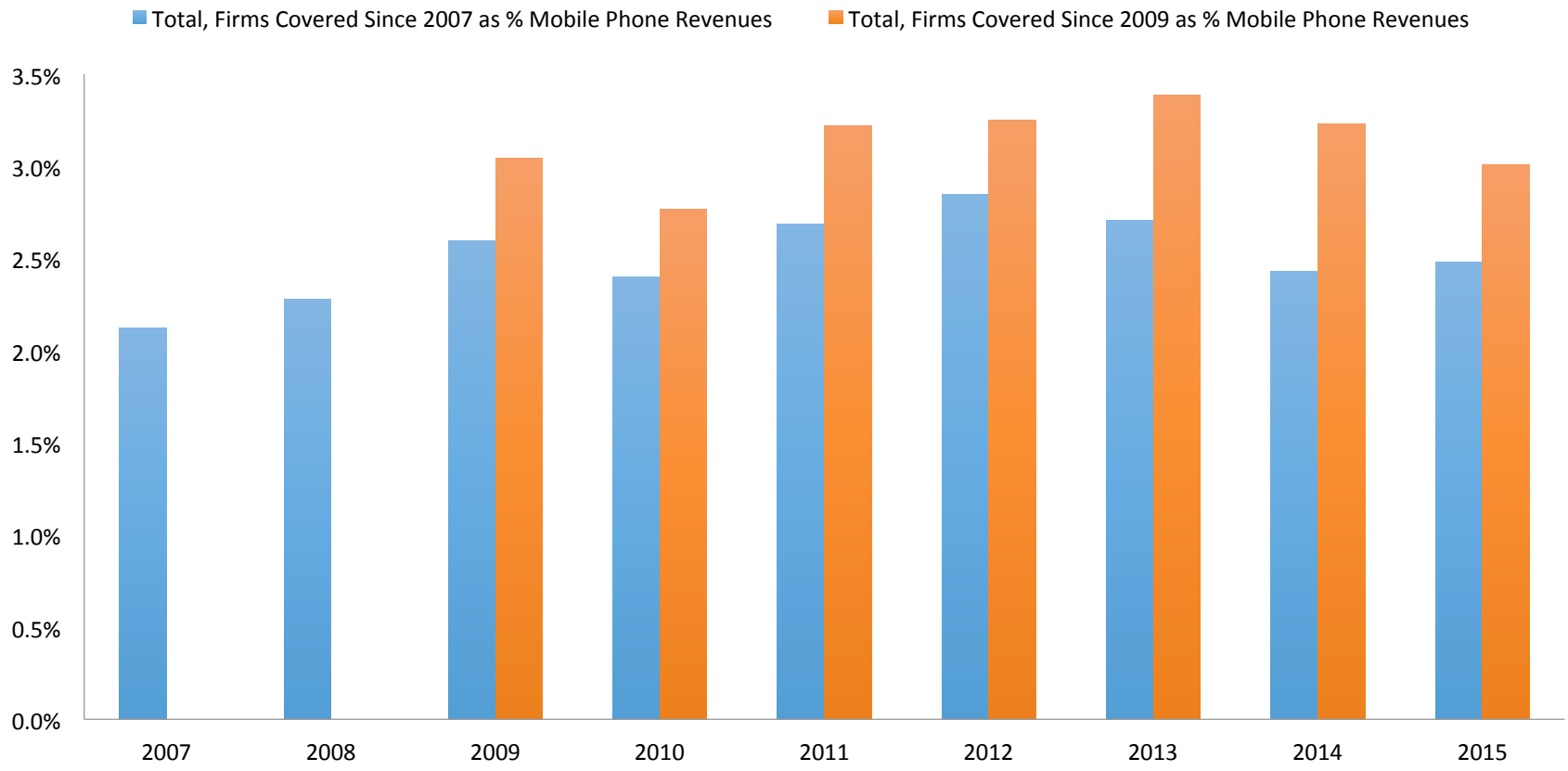

Figure 2: Mobile Phone Economics (2015)