

Smartphone Revolution

Technology patenting and licensing fosters innovation, market entry, and exceptional growth.

By Keith Mallinson



IT IS REMARKABLE HOW DRAMATICALLY AND RAPIDLY THE FORTUNES of so many mobile-handset vendors have turned with the advance of smartphones. Their marketplace was transformed by Apple's iPhone starting in 2007 and a succession of Android-based smartphone newcomers since 2008. This has greatly expanded the size of the handset market, with global revenues doubling in the last six years, as consumers substitute more expensive smartphones for their feature phones and basic phones. Yet, the changes have devastated most of the leading incumbent handset vendors.

Former leaders Nokia, Ericsson, and Motorola have exited by divesting their handset divisions, and BlackBerry has struggled to survive following its precipitous market share decline, as business models and competitive cost structures have changed. Samsung Electronics is the only incumbent that has really flourished, while LG Electronics has also advanced, and HTC has wavered.

Low barriers to market entry, with open availability of standardized technology platforms, including 3G HSPA, 4G LTE, and operating software such as Android, are enabling many new market entrants in a highly competitive handset market, including smartphones. It is therefore inevitable that many of these will never become profitable, regardless of patent royalty rates.

While exaggerated estimates for allegedly excessive mobile standard-essential patent (SEP) royalties prevail, the actual payments remain below 5% (US\$19 billion) of the US\$377 billion in annual smartphone sales (Morgan Stanley). However, these royalty charges are vital to fund ongoing research and development (R&D), which is now predominantly undertaken by companies that no longer manufacture handsets.

STRATEGIC STRENGTHS BECAME LIABILITIES

Seemingly strong brands, product distribution, patent ownership, vertical and horizontal integration with semiconductor chips, network equipment, and manufacturing have been insufficient to ensure survival, let alone success. Those companies exiting the handset market once had these attributes in spades. For example, Nokia had it all, with close to 50% market share in smartphones and, as illustrated in Figure 1, 40% in mobile phones in general until 2007. It ranked highly in global consumer brand ratings, dominating distribution in Europe and many nations worldwide. A cumulative US\$60 billion spent on R&D [1] funded one of the strongest patent portfolios in the industry, and Nokia was able to exploit various synergies with its network-equipment division and in-house baseband modem development capabilities.

The business models and the basis for success in smartphones and mobile phones have been revolutionized. Costly supporting and complementary operations quickly became major burdens when incumbents were wrong-footed in the market and lost the cash flows required to support them while also needing to do things differently. Instead, low costs and a much greater reliance on technologies from other manufacturers are the keys to success for most of the many recent market entrants.

The newcomers are exploiting technology platforms that are open, widely available, and cheap to adopt. Apple is something of an exception, having created much of its own ecosystem, but it is also entirely dependent on others for radio technologies and manufacturing. Samsung uniquely remains highly integrated but also employs outside technology, including Android and Qualcomm's baseband chips in many cases.

WHAT MADE THE SMARTPHONE REVOLUTION POSSIBLE AND REWARDING

Smartphones, or at least the precursor to what we regard as such today, have existed for more than a decade, with the release of Nokia's Communicators at the dawn of the new millennium and the first cellular BlackBerry in 2002. But these were only niche devices, and network service constraints severely limited their utility beyond messaging. A combination of many technological advances has since made modern smartphones the enormous success they are today. These include much faster networks (today, 4G LTE is 1,000-times faster than 2G GPRS, which was introduced around 2000); fast and yet low-powered application, graphic, and digital signal processors; greatly improved display technology; revolutionary improvements in operating systems and user interfaces; better battery performance; and an extending ecosystem with app stores and mobile-oriented content.

The smartphone market-entry barriers are now relatively low, with standardized and openly available technology platforms. Smartphone vendors can capitalize on extensive published standards, market-leading merchant (i.e., off-the-shelf) chips and reference designs provided by these suppliers, and contract manufacturing. Consequently, several relatively new players are rapidly growing their market shares, as shown in Figure 2. The addressable markets have grown to include hundreds of operators and several billion consumers. The average selling prices, at

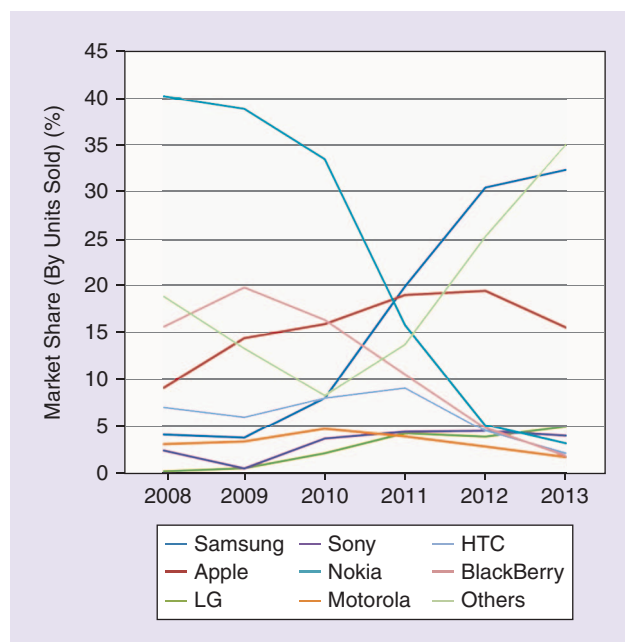


FIGURE 1. How the “mighty” have fallen in the smartphone marketplace. (Image courtesy of WiseHarbor.)

around US\$275 for smartphones versus US\$175 for handsets, in general, generate substantial revenues, while strong downward pricing trends are maximizing smartphone penetration growth.

Handsome rewards, including profits, are available to those market leaders that can build large market shares and a sustainable edge. According to Credit Suisse, handset manufacturer operating profits since 2007 have tripled to US\$51 billion on US\$326 billion revenues in 2013. Reportedly, these are

overwhelmingly shared between Apple and Samsung, with others making small profits or suffering losses.

TECHNOLOGY LICENSING IN SMARTPHONES

Much of the costly R&D and standardization work required to create the technology platforms smartphone manufacturers employ is still being borne by network-equipment vendors like the formerly diversified handset leaders mentioned previously. They are increasingly dependent on technology licensing to help fund ongoing R&D. Similarly, specialized technology vendors such as Qualcomm and InterDigital have business models that are largely dependent on licensing fees. Microsoft also generates income this way, licensing its patents to Android device makers. In addition, Google, which provides the Android smartphone platform and its Play app store, generates income from these in various other ways, including mobile search advertising charges.

There is an enormous intellectual property (IP) legacy covering different standard-essential technologies in smartphones. As discussed, former market leaders such as Nokia, Research-in-Motion (now BlackBerry), Ericsson, Siemens, and Motorola all have extensive patent portfolios covering standard-essential technologies. Smartphone market entrants Apple, Samsung, and Google, providing Android and its Play ecosystem to many others, entered owning little or nothing in the way of standard-essential patented technologies but with complementary IP assets.

The film *Wilmer Hale* [2] argues unconvincingly that aggregate patent-licensing fees, including SEPs and non-SEPs, are excessive at around US\$120 per US\$400 smartphone. It

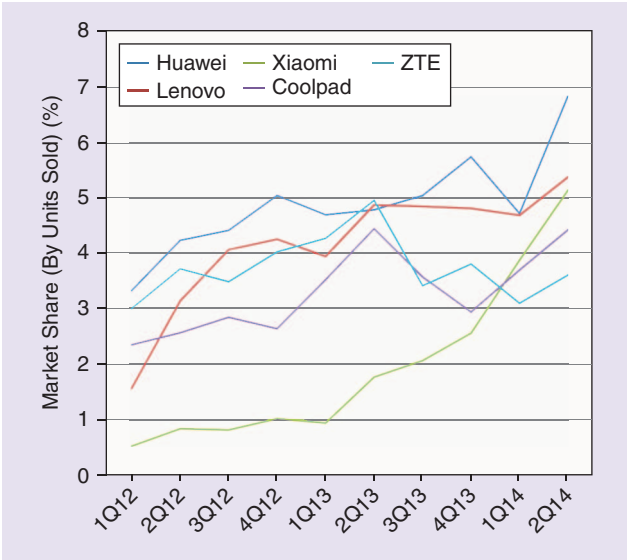


FIGURE 2. With low barriers to entry, new challengers in the smartphone market are growing rapidly. (Image courtesy of WiseHarbor.)

Table 1. An example list of technologies that need to be IP-licensed with smartphones.			
Layer	Functions	Implementation	Notable IP Owners
Cellular and other wireless	Modem protocols, including GSM, CDMA, HSPA, LTE, Wi-Fi, Bluetooth, NFC, and GPS	Dedicated silicon baseband processors running microcode or software-defined radios on more general-purpose processors	Ericsson, Nokia, Qualcomm, InterDigital, Motorola/Google, Samsung, and LG (the list of claimants is growing)
Multimedia	Speech vocoders, video recording/playing codecs, and graphics engines	Dedicated silicon graphics-processing units with hardware acceleration or software acceleration	Various information and communications technology companies—patent-pool administrator MPEG LA lists 33 licensors for the AVC/H.264 video standard
Operating system platform and user interface	The device’s management system and human interface	Software on general-purpose applications processors with voice recognition, text-to-speech, and innovative hardware such as touch-screen controllers	Google (Android*), Apple iOS, Windows Phone (Microsoft), BlackBerry, and WebOS—Microsoft also licenses its patents infringed in use of Android
Applications	Various	Software that is typically obtained in the aftermarket	Numerous—Rovio’s Angry Birds was a popular game
Physical design	Aesthetic style and ergonomics	Hardware form factor and layout	Handset manufacturers (typically not licensed to third parties); Apple is asserting its design IP
System design	Apps stores, content delivery, service management, and billing	External to device, including network, service provisioning, and third-party content providers	Various, including Apple, Google, and mobile operators
*Open-source software has nominally somewhat common ownership. However, it can be under significant control of its leading sponsor(s) while being fragmented with vendor-specific implementations (e.g., with Kindle Fire).			

concludes that “few suppliers are meeting the basic goal of selling devices for more than the costs incurred in supplying them,” implying that this is due to the alleged “royalty stack,” and stating that “those costs may be undermining industry profitability—and, in turn, diminishing incentives to invest and compete.”

Smartphones are complex devices that include a wide range of IP. Table 1 lists some of the technologies required to build a smartphone. (Table 1 closely resembles the table I created for my article “Valuing IP in Smartphones and LTE,” *IP Finance*, <http://ipfinance.blogspot.co.uk/2011/11/valuing-ip-in-smartphones-and-lte.html>.)

In light of this, it seems that a prospective device manufacturer might need to license and pay royalties for a large range of technologies from many companies to have the right to assemble and offer a smartphone for sale. However, the extent of licensing and the amounts actually paid in royalties are nowhere near what is indicated previously.

THE EXAMPLE OF 4G LTE

Let us consider the royalty-stack assessments in [2] with requirements to incorporate 4G technologies in a smartphone. Table 2 is taken from [2] and illustrates the publicly announced rates demanded from a range of vendors to license their respective LTE-related IP. It would seem that the cost to ensure “freedom to operate” in LTE is around US\$54.30 per device. This amounts to a royalty rate in excess of 13.5%.

PILING ON OTHER CHARGES

In comparison to basic mobile phones and even feature phones, smartphones include many technologies in addition to those for cellular communications. There is a great deal of detail on this in [2], and much of it is drawn from publicly available announcements of licensing rates from major technology vendors. A summary of this, provided in Table 3, is also drawn from material provided in [2]. The claim is that the royalty demand could potentially be greater than US\$120 on a US\$400 device. That is more than 30% of the device sales price, despite the omission of many of the technologies shown in Table 1.

These bottom-line figures beg two fundamental questions: are royalty charges at these levels reasonable, and do these figures accurately represent what is actually being paid? My analysis in this article mainly focuses on answering the second question by showing that these figures are massively overstated. But before that, I have a few comments in response to the first question.

The costs of many other kinds of products and services are predominantly or overwhelmingly in IP charges. Prime examples include books, movies, recorded music, and patented drugs. As consumer electronic product-manufacturing costs decline and as the technology-development, software-content, and associated costs increase, there is no reason why there should be any limit to the percentage of costs in IP versus tangible costs or total product prices. In fact, it is quite reasonable for IP to be a substantial proportion of costs in smartphones, given the enormous developments in and utility of the technology platforms. These can so readily be employed by product companies—and with little up-front cost.

Table 2. The publicly announced licensing rates for 4G/LTE technology (from [2]).

Company	Announced LTE Rate	Royalty (US\$400 Device)
Qualcomm	3.25% of device	US\$13.00
Motorola	2.25% of device	US\$9.00
Alcatel-Lucent	Up to 2% of device	US\$8.00
Huawei	1.5% of device	US\$6.00
Ericsson	1.5% of device	US\$6.00
Nokia	1.5% of device	US\$6.00
Nortel	1% of device	US\$4.00
ZTE	1% of device	US\$4.00
Siemens	0.8% of device	US\$3.20
Via licensing	Based on device volumes	<US\$2.10
Sisvel patent pool	€0.99 per device	US\$1.30
Vodafone	Free	US\$0.00
Total		US\$54.30

Table 3. The publicly announced licensing rates for several key mobile device technologies (from [2]).

Technology	Potential Royalty Demand
Cellular Baseband IC (with LTE/4G)	US\$54.00
Wi-Fi (802.11)	US\$50.00
AAC (audio playback)	US\$0.20
MP3 (audio compression)	US\$0.95
MPEG (H264/265)	US\$10.60
Operating system (Microsoft or Android)	US\$5.00–US\$8.00
Total	US\$121.00–US\$124.00

The main reason why the aforementioned royalty-stack totals massively overstate what is actually happening is that they do not reflect the significant factors that determine how much is actually paid.

- ▼ There is a very substantial reduction or an elimination of royalty charges in cross-licensing among patent owners. Neglecting to reflect this is double-counting costs. Companies spend money on R&D so they can use the technology themselves and to barter the same IP to reduce or eliminate IP charges at no additional cost.
- ▼ Headline royalty rates are asking prices that are also commonly discounted for various other reasons in patent-licensing negotiations. For example, prospective licensees are commonly able

Table 4. The total sales and R&D investments for leading cellular-technology companies.

	2008	2009	2010	2011	2012	2013
Total sales (US\$ million)	399,917	353,836	401,722	510,840	559,173	582,011
R&D (US\$ million)	27,990	27,854	30,829	37,922	39,970	41,927
R&D/sales	7.0%	7.9%	7.7%	7.4%	7.1%	7.2%

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

to negotiate reductions for bundles of patents including multiple technologies, by identifying weak patents, and by agreeing to pay rather than infringe or provoke litigation.

- ▼ Many patent owners do not actively seek licenses and do not have licensing programs. They own patents for defensive purposes in the event they are sued.
- ▼ Many manufacturers remain unlicensed for much of the patented technology they use.

So instead of these inflated totals, how much are smartphone manufacturers actually paying, and what is the justification for these charges?

MARKET CHANGES SINCE 2007

There have been dramatic structural changes in the mobile-communications-technology supply since the introduction of the iPhone in 2007. With the demise of vertical integration, those who are developing standard-essential technologies for 4G and 5G networks need to monetize these efforts through patent licensing as well as through product sales, which are dwindling or have collapsed in many cases. A key question is how departing handset vendors are asserting their significant patented investments in 4G and 5G technologies. Let us explore this further by looking back at how mobile-device technology is used to generate revenues and where we stand today.

NETTING-OFF

Once upon a time, new mobile-communications technologies such as 2G GSM were developed by small clutches of vertically integrated players. Mobile-technology pioneers, including Alcatel, Ericsson, Nokia, Nortel, Motorola, Qualcomm, and Siemens, all manufactured handsets as well as network equipment. Some of these companies also produced communications chips. These all-encompassing approaches are known as *vertical integration* and *horizontal integration*. Companies were technological jacks-of-all-trades.

Business models were predominantly oriented toward generating income from device and other product sales. The technology-development costs and risks of failure (e.g., with the demise of the rival U.S. 2G TDMA standard) were compensated for through product sales and in cross-licensing among the major players, for little or no cash royalty payments, to obtain access to all the SEP technologies required to make and sell products.

VERTICAL DISINTEGRATION

Over the last decade or so, virtually all of the diversified mobile-technology manufacturers have exited the handset market. From among the previously mentioned brand names, Alcatel, Motorola, and Nokia live on in handsets, but ownership is now removed from the original parent companies. The demise of some of these manufacturers in the face of new market entrant challengers was tracked in [3]. Some of them have also ceased sales of other mobile products, including network equipment and chips.

Consequently, these parent corporations have lost their ability to obtain a financial return on their mobile-technology R&D investments directly through the sales of handsets, which is by far the largest product market in the mobile sector. Global market revenues in 2013 were US\$377 billion for handsets, according to Morgan Stanley; US\$61 billion for network equipment, including radio, IP, and transport and core equipment, according to Ericsson; and around US\$20 billion in baseband modem chips (which are mostly embodied in handset products). Nevertheless, the pace of technology development is continuing relentlessly in standard-essential technologies and in mobile technologies in general.

R&D SPENDING CONTINUES TO INCREASE

Despite so many major mobile-technology vendors no longer selling handsets, mobile R&D spending, of approximately US\$42 billion in 2013, has grown 50% since 2008, as indicated in Table 4. The figures include 12 large technology companies with a predominant or exclusive focus on mobile communications, including several of those named previously. Some of them are quite diversified and do not break out their wireless and mobile R&D expenditures in public disclosures, so the figures include some R&D related to other technologies and product markets. However, the total excludes many companies that also invest significantly in cellular R&D, so I believe the table provides a fair and consistent, though approximate, representation of total R&D investments and their growth by the mobile-technology industry as a whole.

NEW BUSINESS MODELS

Value can best be derived from standard-essential and other patented technologies through the manufacture and sale of one's own products but also through cross-licensing to protect one's own product sales from infringement claims and through licensing for receipt of cash royalty payments.

Licensing value, through cross-licensing or in cash, tends to correlate positively or proportionally with product sales revenues. Significantly for Alcatel-Lucent, Ericsson, and Nokia, the mobile-network-equipment market, in which they are all still major players, has only around one-sixth the market value of that for handsets. This means the value potential for royalty-generating licenses or royalty-mitigating cross-licenses is also correspondingly lower there for the mobile SEPs, which tend to apply to both networks and devices.

Therefore, to maintain R&D investment levels or increase them, technology developers are increasingly dependent on licensing others' handsets and other devices for cash royalties to recoup returns on their costly and risky R&D.

Qualcomm has been able to focus on developing its patent licensing while substantially growing its R&D. It needs to do so because R&D spending (e.g., US\$5 billion in 2013) exceeds the profit it makes on its chip sales. It led the way in licensing; the company was the majority developer of CDMA technologies in the 1990s. Qualcomm's exit from network equipment and handset businesses around the turn of the millennium eliminated its need to patent-protect those operations through cross-licensing. Qualcomm's licensing revenues of US\$7.9 billion in 2013 are equivalent to a royalty rate yield of 1.77% of the previously indicated total global handset revenues.

The opportunity to grow licensing income with SEPs and non-SEPs (also referred to as implementation patents) was presented as a significant strategic objective by Ericsson and Nokia at their Capital Markets Days in Stockholm and London toward the end of 2014. Ericsson's 2013 licensing income was around US\$1.6 billion, which corresponds to a royalty rate of 0.42% on the same basis as for Qualcomm. The corresponding figures for Nokia were US\$650 million and 0.17%, respectively.

Nokia, in particular, has a history of handset patent-licensing agreements that sought to minimize or eliminate royalty outpayments through cross-licensing rather than to maximize royalty income. The company needs to unravel previous arrangements and substitute sales-volume-dependent agreements for legacy sales-volume-independent agreements. These were highly beneficial while handset market shares were up to around 40% last decade. These companies are also including nonmobile SEPs and non-SEPs in some of their licensing. Ericsson, Nokia, and others still need cross-licensing to provide freedom to operate in the design, manufacture, sale, and use of network equipment.

LOW BARRIERS WITH MODEST ROYALTIES PAID

The mobile-device business—including smartphones, feature phones, tablets, and Internet of Things connectivity—has relatively low barriers to market entry through the freely available 3rd Generation Partnership Project (3GPP) standards, including 3G HSPA and 4G LTE. That is why there have been so many new handset original equipment manufacturers—with the most notable successes including Apple since 2007 and Xiaomi since 2011—seizing substantial market shares in recent years. Ease of market entry is also exemplified by many new and fast-growing handset vendors in various developing nations. *The Financial Times* recently reported that local brands are commanding sub-

stantial smartphone market shares, e.g., almost 60% in the Philippines and almost one-third of sales in Vietnam [4].

Ericsson, Nokia, and Qualcomm are widely regarded as holding, in total, a substantial proportion, and quite likely the majority, of SEPs reading on 3GPP standards. The basis for this includes company disclosures of patents that are considered possibly essential to 3GPP standards [5], third-party assessments of patent essentiality in 3GPP standards [6], [7], and other assessments of patent strength [8]. On this foundation, and the fact that Qualcomm has a better-developed patent-licensing program than any other company, aggregate mobile SEP royalties across all handsets worldwide are most likely to be no more than a mid-single-digit percentage. Conservatively, an estimate of 5% is more than double the total of 2.36% in royalty rates I have calculated for Ericsson, Nokia, and Qualcomm. Other significant SEP holders account for only relatively small licensing revenues. For example, InterDigital Communications, with a business model entirely focused on patent licensing, reported US\$264 million in patent-licensing revenues in 2013. That corresponds to a comparable royalty rate of 0.07%.

Smartphone designers also seek to include features that are subject to nonmobile SEPs and that might be subject to non-SEPs. But the latter are more easily ignored or worked around with alternative technologies, and some features might be omitted if this is not possible. In the case of SEPs, it is generally not possible to implement the standard, or part of it, without infringing.

A NEW AND VIBRANT ECOSYSTEM

On the basis of financially audited royalty incomes from leading licensors, my estimate that total mobile SEP royalties amount to less than a mid-single-digit percentage of handset revenues is in marked contrast to the aggregate royalty rate estimates of others [2]. Elsewhere [9], [10], I have published a more detailed rebuttal of the assessment that the smartphone royalty stack could amount to US\$120 on an average US\$400 smartphone, including SEPs and non-SEPs. That defective estimate would correspond to a 30% royalty rate, or around US\$100 billion per year in total royalties.

This is more than five times my practical estimate of less than US\$19 billion, which includes all mobile SEPs, many noncellular SEPs, and many non-SEPs also thrown into the licensing bundles. This figure is less than half the mobile industry's R&D spending in 2013 (see Table 3) and represents an aggregate licensing rate of less than 5% per device.

Royalties paid on noncellular SEPs (e.g., H.264 video and 802.11 Wi-Fi) and non-SEPs amount to no more than additional single-digit billions of dollars. It has been disclosed that Samsung, with a 2013 smartphone revenue share of 34%, paid Microsoft an annual US\$1 billion in licensing fees to implement Android. This is exceptional and accounts for a significant proportion of all non-SEP royalties paid.

MARKET AND TECHNOLOGY LICENSING REALITIES

By every measure, the patent system and the risk-reward balance it strikes—spurring innovation, market entry, and competition while not overburdening licensees—is evidently working very well with respect to the following.

- ▼ *Subscriber and network traffic growth:* This is outstanding, with 7 billion mobile connections worldwide, billions of people now using smartphones with mobile broadband, and data usage doubling every year.
- ▼ *Increasing product and service performance:* Innovations include faster baseband modems, applications and multimedia processors, higher screen pixel densities, additional sensors, improved operating system software, and a flourishing apps ecosystem.
- ▼ *Market entry and competition:* Successful new entrants in recent years include Apple and Xiaomi. Market shares have shifted enormously, with supplier concentration decreasing significantly to low levels.
- ▼ *Price reductions:* If royalty stacking was a problem, average smartphone prices would not be falling, but the authors of [2] admit prices are falling significantly by stating that by mid-2013, “the average price of a smartphone fell to US\$375 from US\$450 at the beginning of 2012.” This is despite the fact that functionality and performance for the “average” handset increases substantially every year. Quality-adjusted prices are therefore declining even more dramatically.

The market is flourishing, while patent fees have only modest financial impact:

- ▼ According to Credit Suisse, handset-manufacturer operating profits since 2007 have tripled to US\$51 billion on US\$326 billion revenues in 2013.
- ▼ The methods of determining charges follow well-established principles and benchmarks in bilateral negotiation; cross-licensing agreements frequently reduce licensing fees to nominal values; and the small proportion of instances where there are licensing disputes in litigation are settled by the courts.
- ▼ Negotiated and court-adjudicated rates in many significant IP cases are typically much lower than demanded rates, yet demanded figures are often used by IP attorneys and some commentators to portray licensing revenues and costs as excessive.

POSITIVE OUTCOMES OVERALL

Licensing fees fund technology developments and innovations that enable large and growing revenues and profits in handsets, network equipment, and mobile operator services. Licensing fees contributed to the US\$42 billion in cellular-sector R&D spending in 2013 by various companies.

This investment is risky: fees help compensate for extensive work in standard-setting organizations where most new technology submissions are rejected and some standards (e.g., WiMAX) subsequently fail in the marketplace. Cumulative R&D, as enabled by licensing fees, was vital input to generating revenues of US\$377 billion for handsets in 2013.

While smartphone manufacturer profits, of US\$51 billion in 2013 are currently concentrated with the established leaders, Apple and Samsung, the aspiring market entrants, including Huawei, Xiaomi, and others, fight to acquire larger market shares. Profits are more evenly distributed among cellular network equipment suppliers, including market leader Ericsson, with recent strong profit growth for Huawei and ZTE. For mobile operators worldwide, the average earnings before interest, tax, depreciation,

and amortization divided by revenue (EBITDA) margin is a healthy 33%, according to GSMA Wireless Intelligence. This enables ongoing annual capital expenditures by mobile operators, most significantly including 3G HSPA and 4G LTE technology upgrades and expansions.

The clear conclusion is that this is a healthy and growing marketplace with profits justifying continuing investment in technology development. Instead of diminishing incentives to invest, patent-licensing fees facilitate development and open exploitation of ever-improving technology platforms with abundant competition in the downstream market for devices including smartphones. With such low barriers for market entry and many competitors as a result, it is inevitable that many handset manufacturers are unprofitable, regardless of royalty rates. It is the intensity in downstream competition that undermines profits—not royalties that many companies are not even paying!

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