Royalty Rates And Licensing Strategies For Essential Patents On 5G Telecommunication Standards: What To Expect[1]

By Eric Stasik and David L. Cohen

In 2010, *les Nouvelles* published an article that discussed a number of publicly declared royalty rates for LTE (4G).[2] A decade later, 5G is the new star walking down the red carpet. This fifth-generation (5G) mobile communications technology provides not only a new Radio Interface Technology (RIT) called New Radio (NR), but also a next-generation core-network.

What is 5G?

5G, like its predecessors 4G and 3G, was developed by 3GPP to satisfy the performance requirements issued by the International Telecommunications Union (ITU) under the IMT program for broadband mobile systems. IMT-2020 for the development of 5G standards anticipates increases in data traffic between 10 and 100 times current levels through 2030, while the number of connected devices is projected to reach 50 billion any time from 2025 onwards. IMT-2020 technologies must support *"a huge amount of data much faster, reliably connect an extremely large number of devices, and process very high volumes of data with minimal delay."*[3] In practice IMT-2020 means new radio interface technologies (RITs), new frequency spectrum (allocated in bands used by previous standards and in newly available bands, including millimeter wave bands from 24 GHz to 52.6 GHz), as well as a new core network and backhaul, and brand-new features in mobile communications such as Ultra-Reliable Low Latency Communication (URLLC) that will facilitate factory automation, autonomous driving, smart grids, real-time VR, remote robotic surgery, and many other things yet unimagined, all on a massive scale. 5G departs from the current mobile architecture of devices connected through a network to the cloud and shifts, distributes, and decentralizes intelligence to the wireless edge. Edge computing is another revolutionary aspect of 5G. In short, there is no one single technology component that defines 5G.

It would seem likely that there will also be more than one 5G standard.[4] For comparison, there were six technologies that satisfied IMT-2000 (3G) and two technologies that satisfied IMT-Advanced (4G) criteria and specifications.[5] If there end up being multiple versions of 5G, it may complicate attempts to predict royalty structures. While we plan on reviewing some of the ambiguities that have emerged in the 5G licensing ecosystem in a future article, this article will focus on 3GPP 5G standards that have been the most widely used on a global basis.

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3GPP Release 15 and Release 16

3GPP has moreover split its 5G New Radio standard into two releases: Release 15, which corresponds to NR Phase 1, and Release 16, which corresponds to NR Phase 2. In NR Phase 1, there are common elements between LTE and NR, such as both using orthogonal frequency division multiplexing (OFDM).[6] Release 16, expected to have been completed in June 2020, will be the next major release and will include many new features such as Multimedia Priority Service, Vehicle-to-Everything (V2X) application layer services, 5G satellite access, Local Area Network support in 5G, wireless and wireline convergence for 5G, terminal positioning and location, and communication in vertical domains, to name

1. The authors gratefully appreciate input from Jim Harlan of InterDigital.

2. Stasik, Eric. "Royalty Rates and Licensing Strategies For Essential Patents on LTE(4G) Telecommunication Standards," *les Nouvelles*, Sep. 2010, pp. 114-119.

3. ITU, 5G-Fifth Generation of mobile technologies. *https://www.itu.int/en/mediacentre/backgrounders/Pages/5G-fifth-generation-of-mobile-technologies.aspx*.

4. 5G is one of six candidate standards developed for the IMT-2020 program that also includes RIT (Radio Interface Technology) proposals from China, Korea, ETSI and the DECT FORUM, India's TSDSI, and Nufront, a Chinese technology company.

5. Approved 3G standards are IMT-2000 CDMA Direct Spread, IMT-2000 CDMA Multi-Carrier, IMT-2000 CDMA TDD, IMT-2000 TDMA Single-Carrier, IMT-2000 FDMA/TDMA, and IMT OFDMA TDD WMAN. Approved 4G standards are LTE-Advanced and WirelessMAN-Advanced. *https://www.itu.int/en/ITU-R/Documents/ITU-R-FAQ-IMT.pdf.*

6. *https://spectrum.ieee.org/telecom/wireless/3gpp-release-15-overview.*

only some. Release 16 will bring the initial full 3GPP 5G system to its completion for IMT-2020.[7]

When it comes to the licensing of 5G SEPs, the storyline remains essentially the same as in previous 3GPP standards: lots of essential patents and many different patent holders, but there is a new twist on the side of implementation. IMT-2020 anticipates *"a seamlessly connected society, that brings together people, along with things, data, applications, transport systems, and cities in a smart networked communications environment."*[8] 5G will bring with it new business models, new applications, and new use cases, some of which will challenge the economics behind the long-standing practice of SEP holders granting whole-portfolio SEP licenses to handset and infrastructure manufacturers.[9] As former Ericsson CIPO Gustav Brismark recently remarked: "Each use case can be viewed as a separate industry vertical or sector of the overall 5G market with its own prerequisites, resulting in a need to price differentiate the associated royalties, rather than having one fixed price."[10]

What to Expect for Mobile Handsets—more of the Same

Early indications from a few key contributors suggest however that when it comes to licensing handsets and infrastructure, that practice of granting whole-portfolio SEP licenses to end-user devices will continue. Announced royalty rates for 5G handsets would seem to be similar to what was experienced for 4G. One could surmise, however, that the intent was to move the discussion away from a per-unit percent royalty applied to not only a handset but also a component or chip thereof, to a fixed dollar amount applied only to the handset.

In the following paragraphs we will compare some recent announcements on 5G royalty rates with previous, similar announcements on 4G royalty rates. Before going further, it is very important to emphasize that "announced" (or "program" or "rack" or "declared" or "headline") royalty rates may be (and usually are) quite different than the "actual" royalty rate resulting from the outcome of a bi-lateral negotiation. However, licensors having made a public announcement and absent other potentially relevant business factors, a potential licensee should expect that the announced rates will strongly correlate to a licensor's opening offer in a licensing negotiation. That is all that should be assumed from these announcements. Additionally, for companies with little or no commercial bargaining power (such as the ability to buy in bulk, the ability to offer a cross-license, etc.), it is probably reasonable for the purposes of initially estimating a bill of materials for SEP licensees to anticipate little difference between the announced and actual royalty rates.

Ericsson

In 2009, Ericsson joined a number of other 3GPP SEP holders in publicly announcing royalty rates for 4G/LTE. Ericsson's 2009 press release (no longer available online, but available from the author upon request) explained:

> *"Ericsson expects to hold a relative patent strength of 20-25 percent of all standard essential IPR. Ericsson believes the market will drive all players to act in accordance with these principles and to a reasonable maximum aggregate royalty level of 6-8 percent for handsets. Ericsson's fair royalty rate for LTE is therefore expected to be around 1.5 percent for handsets."*

Keeping with this tradition, in March of 2017 Ericsson announced its licensing terms for 5G/NR in 3GPP Release 15:

> *"Ericsson is prepared to grant licenses to its portfolio of essential cellular patents [with coverage for multimode mobile handsets that fully conform to 3GPP's forthcoming 5G/NR Release 15 technology] subject to reciprocity by the license seeker, at a fair and reasonable royalty rate of $5 per 5G/NR multimode compliant handset."* Ericsson also explained that it *"has decided to voluntarily allow for even lower royalty rates on a case-by-case basis"* and that *"in exceptional circumstances, Ericsson is prepared to allow for rates as low as, but not lower than, a floor of $2.5 per 5G/NR multimode compliant handset."*[11]

At first glance, the change from calculating royalties as a percentage of the ASP (average selling price) of end-user devices (as was done for LTE) to a royalty assessed as fixed price per unit appears significant. The mathematics are a bit more revealing: Ericsson's $5 per unit royalty rate is equivalent to a royalty of 1.5 percent on a handset ASP of approximately $330. Given current forecasts of an ASP for all smartphones under $300, **Ericsson's 5G/NR royalty rate is likely**

7. *https://www.3gpp.org/release-16.*

8. ITU, ITU towards "IMT For 2020 And Beyond." *https://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2020/Pages/default.aspx.*

9. Blecker, Marvin, Sanchez, Tom, and Stasik, Eric. "An Experience-Based Look At The Licensing Practices That Drive The Cellular Communications Industry: Whole Portfolio/Whole Device Licensing," *les Nouvelles*, Dec. 2016, pp. 231-243.

10. Brismark, Gustav. "Why Price Differentiation Is Key To Setting Patent Royalty Rates For 5G," *Intellectual Asset Magazine*, 3 Feb 2020.

11. Ericsson's FRAND licensing terms for 5G/NR Release 15, *https://www.ericsson.com/assets/local/patents/doc/frand-licensing-terms-for-5g-nr-in-3gpp-release-15.pdf.*

to be on average the same or slightly higher than Ericsson's royalty rate for 4G/LTE.

Ericsson's introduction of a "floor of $2.5…per 5G/NR handset" translates into a royalty of 1.5 percent on an ASP of approximately $165. This is again consistent with Ericsson's royalty rates for 4G/LTE—although by insisting that the royalty cannot go lower than $2.5—**end-user devices with an ASP under $165 might be expected by Ericsson to pay a somewhat higher royalty for 5G/NR than for 4G/LTE.**

On the other end of the price spectrum, Ericsson's $5 per unit royalty for 5G/NR handsets could be seen as something of a bargain compared to 4G/LTE. Smartphones with an ASP over $330 will pay a lower royalty rate for 5G/NR than for 4G/LTE. **At the very top end of the market**—such as Apple's iPhone that last reported an ASP of $766 in 2018[12]—**Ericsson's $5 per unit royalty for 5G/NR is less than half of what Ericsson announced for a license to its portfolio of 4G/LTE patents.** Given projections that 5G phone sales are expected to reach one billion units by 2025,[13] Ericsson's floor promises a healthy revenue stream despite the high-end discounts.

Also noteworthy are the facts that Ericsson's 5G/NR FRAND offer is 1) conditioned *"on reciprocity by the license seeker"*; 2) a whole SEP portfolio offer; and 3) only available to "mobile handsets that fully conform" to 3GPP specifications. This indicates that Ericsson will continue with the durable and sensible practice of offering 3GPP SEP portfolio licenses to end-user devices and will not be making licenses available to chipset manufacturers.

Nokia

Like Ericsson, Nokia also announced its royalty rates for 4G(LTE) in 2009. Nokia said that its *"rate for devices that deploy LTE as the only wireless communication standard to be in a range of 1.5 percent from the sales price of an end-user device."*

With regard to multi-mode devices, Nokia added:

> *When multiple wireless standards are used in the same end product, Nokia will follow similar principles in setting the royalty rate for Nokia patents essential to other standards. To avoid unfavorable effects of royalty stacking, Nokia will not charge royalties higher than 2.0 percent from the sales price of an end-user device for IPR that is essential to wireless communication standards irrespective of the number of wireless standards deployed in such a device.*

Along with Nokia, the then joint-venture Nokia-Siemens Networks issued a separate policy anticipating *"an LTE royalty rate for end-use terminal devices will be in the region of 0.8 percent of the selling price."*

For 5G/NR, Nokia announced (succinctly) in August 2018 that:

> *"Nokia expects that for mobile phones which implement the 5G New Radio standard, the licensing rate for the Nokia 5G SEP portfolio will be capped at €3 per device."* [14]

Using a currency exchange rate of 1.10 USD/EUR, Nokia's cap of €3 corresponds to $3.30 which corresponds to a percentage royalty of exactly 1 percent on a handset ASP of $330.[15] Given current forecasts of an ASP for all smartphones under $300, **Nokia's 5G royalty rate is likely to be slightly higher than Nokia-Siemens Networks announced royalty rate for LTE and almost half the royalty announced by the former mobile phone business of Nokia for LTE(4G).**

Qualcomm

In 2008, Qualcomm published its anticipated royalty rates for LTE (4G):

> *"Qualcomm expects that it will charge royalties for a license under its standards essential LTE patents and/or standards essential WiMax patents for complete, end user subscriber devices that implement LTE and/or WiMax standards, but do not implement any 3G CDMA standards, of approximately 3.25 percent of the wholesale selling price of each such device, subject to reciprocity and other standard terms and conditions."* [16]

With regard to multi-mode devices including 4G LTE:

> *"Qualcomm expects that it will not charge a royalty rate on such multi-mode devices for use of both Qualcomm's standards essential LTE and/or WiMax patents and standards essential 3G CDMA patents that is greater than Qualcomm's standard 3G CDMA royalty rate, subject to certain standard terms and conditions."*

12. Sales Data from Apple Corp's U.S. SEC Form 10-K for the fiscal year ended September 29, 2018 reported iPhone net sales of $166,699 (millions) on unit sales of 217,722 (thousands) corresponding to an ASP of $765.65.

13. *https://news.strategyanalytics.com/press-release/devices/strategy-analytics-5g-phone-sales-will-soar-2020.*

14. Nokia licensing rate expectations for 5G/NR mobile phones. *https://www.nokia.com/about-us/news/releases/2018/08/21/nokia-licensing-rate-expectations-for-5gnr-mobile-phones/.*

15. We do not see in the announcement that this offer is conditioned on reciprocity, but one might reasonably assume that it is.

16. Qualcomm LTE/WiMax PATENT LICENSING STATEMENT (December 2008) (available from the authors upon request).

Qualcomm's "standard 3G CDMA" royalty rate is the royalty rate associated with Qualcomm's CDMA patent portfolio (CDMA in this sense refers to the commercial standards CDMAOne and CDMA2000 and variants). It was noted by the court in *FTC v. Qualcomm* that *"Qualcomm charges a 5 percent running royalty on handset sales for a license to Qualcomm's CDMA patent portfolio, which includes CDMA SEPs and non-SEPs."* [17]

Table 1. InterDigital Royalty Rates

Cellular Technology	Rate	ASP Floor	ASP Cap
3G	0.40%	USD$40.00	USD$100.00
4G	0.50%	USD$50.00	USD$200.00
5G	0.60%	USD$60.00	USD$200.00

(Source: InterDigital https://www.interdigital.com/rate-disclosure)

In November 2017 Qualcomm published its *"5G NR Royalty Terms Statement"* that contained largely the same terms and conditions as for LTE.[18]

> *Under Qualcomm's licensing program for cellular essential patents, the following royalty terms will apply on a worldwide basis to a license for Original Equipment Manufacturer (OEM) branded mobile handsets that implement the 5G NR standard, up to and including release 15 of the 3GPP specifications:*
>
> - *An effective running royalty rate of 2.275 percent of the selling price of branded single-mode 5G handsets; and*
> - *An effective running royalty rate of 3.25 percent of the selling price of branded multi-mode (3G/4G/5G) handsets.*
>
> *In addition, Qualcomm will continue to offer licenses for OEM branded mobile handsets that include both Qualcomm's cellular standard essential patents as well as those patents not essential to the standard, a total portfolio of over 130,000 patents and pending applications worldwide at royalty rates of 4 percent of the selling price for branded single-mode handsets and 5 percent of the selling price for branded multi-mode handsets.*

Given that a single mode SEP-only license for LTE was 3.25 percent and the single mode SEP-only license for 5G is announced to be 2.275 percent, Qualcomm's royalty for 5G-NR is just about a full 1 percent lower than its standard rate for LTE. Even though 3G networks are beginning to be turned off, support for 3G and 4G will likely be a feature of 5G smartphones for some time into the future, so as a practical matter, the royalty rate for 5G smartphones will be the same as paid for 4G smartphones (*i.e.*, 3.25 percent.). Licensees that want to obtain a license to SEPs and non-SEPs can expect in most cases to begin negotiation from the same 5 percent of the selling price of a branded handset Qualcomm offered for 4G devices.

InterDigital

While the prior companies provided ex ante rate disclosures prior to the 5G NR freeze date in late 2018, InterDigital published its ex post 5G NR rates in early 2020. To our knowledge, unlike Ericsson and Nokia, InterDigital never published its royalty rates for LTE. That is, until very recently when InterDigital published on its website *"the base rates … currently offer[ed] for a license to various cellular technologies."*[19] See Table 1.

The *"cellular rates are not cumulative"* so a multimode 5G device that also supports 4G and 3G would only pay the rate *"related to the most advanced technology present on the device."*[20]

Note that these base rates are the rates before negotiation. As InterDitigal explains: *"Additional discounts apply for term of Agreement, product volumes, payment timing and structure, special market considerations."*[21]

For a multimode 5G handset, InterDigital's per unit royalty (before negotiation) would range from $0.36 to $1.20, the highest rate is thus well below Ericsson's floor of $2.50 and Nokia's cap of €3.00.

On its face, InterDigital's rates do not appear to be conditioned on reciprocity, so they are difficult to compare one-to-one with those of Ericsson whose rates are conditioned upon reciprocity. Digging a little deeper, however, if you are to review the IPR Information Statement and Licensing Declarations filed with ETSI,[22] it is clear that both Ericsson and InterDigital indicate that such irrevocable undertakings are subject to reciprocity.

17. Findings of Fact and Conclusions of Law, *FTC v. Qualcomm*, Case No. 17-CV-00220-LHK, U.S. District Court Northern District of California, San Jose Division, page 7, at line 21.

18. Qualcomm 5G NR Royalty Terms Statement. *https://www.qualcomm.com/documents/qualcomm-5g-nr-royalty-terms-statement.*

19. InterDigital Launches New Phase of Transparency Effort. *https://www.interdigital.com/rate-disclosure.*

20. *Ibid*.

21. *Ibid*.

22. *https://ipr.etsi.org.*

Table 2. Summary Of Announced Licensing Terms And Conditions For 4G And 5G Standards

SEP Holder	Announced Handset Royalty Rates			
	4G	4G Multimode	5G Only	5G Multimode
Ericsson	1.5% Subject To Reciprocity		5G Multimode $2.50 To $5.00 Subject To Reciprocity	
Nokia	1.5% Subject To Reciprocity	2.0% Subject To Reciprocity	Capped At €3 Per Device (Assumed Subject To Reciprocity But Not Mentioned)	
Nokia- Siemens	0.8%		N/A	
InterDigital	0.5% ASP Floor $50 ASP Cap $200		0.6% ASP Floor $60 ASP Cap $200	
Qualcomm	3.25%	5.00%	2.275%	3.25%
	Capped At $400			

InterDigital's 5G royalty rate is likely to be sightly hgher than the rates InterDigital applied to 4G. See Table 2.

Beyond Mobile Phones

5G and the incipient Internet of Things (IoT) will very likely release a lot of different equipment sold at such a scale that it makes sense to apply to them licensing models similar to that for 3G and 4G mobile phones. For example, the European Commission anticipates that 5G will allow for 1,000,000 connected devices per square kilometer, which will require an increase in smaller cells to deliver the required connectivity.[23] It is probable that nearly every consumer facing product—from IT, to home security, to entertainment products, to clothing, to white goods, to automotive, and telecom—as well as many business-to-business products, whether logistics and inventory management equipment, agricultural equipment, or medical equipment—will incorporate wireless functionality and thus be subject to cellular and wireless patent licensing. Moreover, to allow for connectivity on the scale required for 5G to work, it is also likely that the nature of the wireless infrastructure market will change such that it too may become more susceptible to mobile-handset type or other types of licensing.

In their 5G announcement, Nokia explained that their "licensing approach reflects the value that Nokia inventions bring to end-user devices, and we follow recognized industry licensing practices for wireless communication SEPs. Beyond mobile phones, Nokia believes that there will be an unprecedented variety of end-user devices that will use Nokia innovation. For other categories of devices, Nokia will determine its licensing rates separately and seeks to engage in constructive dialogue with relevant industry participants to define the licensing models best suited for those industries."[24]

While some economists and legal scholars contemplate royalty rates at some theoretical and impractical "incremental value,"[25] the commercial licensing market looks at the real-world value patented inventions bring to end-user devices and services. As licensing moves beyond the comfortable and familiar world of mobile handsets and end-user devices, it will be necessary for licensors and licensees to find licensing models that will foster continued innovation across a heterogeneous and diverse 5G ecosystem.

It will not be easy; in reaction to this massive, potential licensing market, many traditional net licensees have separately and through various industry groups been engaged in major lobbying efforts to influence SEP licensing in 5G.[26] It is to the new developments in 5G licensing that we hope to turn to in an upcoming paper. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=3658472*

23. Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions 5G for Europe: An Action Plan {SWD (2016) 306 final *https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-588-EN-F1-1.PDF.*

24. *https://www.nokia.com/about-us/news/releases/2018/08/21/nokia-licensing-rate-expectations-for-5gnr-mobile-phones/.*

25. Biddle, *et al.* (editors) "Patent Remedies and Complex Products," *Cambridge University Press*, 2019, p. 19.

26. The App Association *https://actonline.org*
Intellectual Property 2 Innovate *http://ip2innovate.eu.*
The App Developers Alliance *https://appdevelopersalliance.org.*
The Fair Standards Alliance *https://fair-standards.org.*
Computer and Communications Industry Association *https://www.ccianet.org.*
The Information Technology Industry Council *https://www.itic.org.*