

# **Who is leading the 5G patent race?**

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September 2022

Licensing of 5G SEPs promises to become a highly lucrative market, making the 5G patent race more competitive than ever before – although the latest 5G patent data shows the question of who is currently winning it remains unclear.

## 5G and global competition across industries and countries

As the world continues to grapple with the unprecedented challenges of the covid-19 pandemic, the development of 5G continues unabated. While the 5G standard has been developed since 2015 (Figure 1), its adoption is only beginning. Global wireless 5G adoption has finally reached the rapid acceleration phase, having exceeded half a billion connections by the end of 2021 and is forecast to reach 1.3 billion by the end of 2022. The 2021 Ericsson Mobility Report forecasts 5G subscriptions to reach 4.4 billion globally by the end of 2027, accounting for approximately 49% of total global mobile subscriptions. But the question remains: will 5G be a game changer in the smartphone industry?

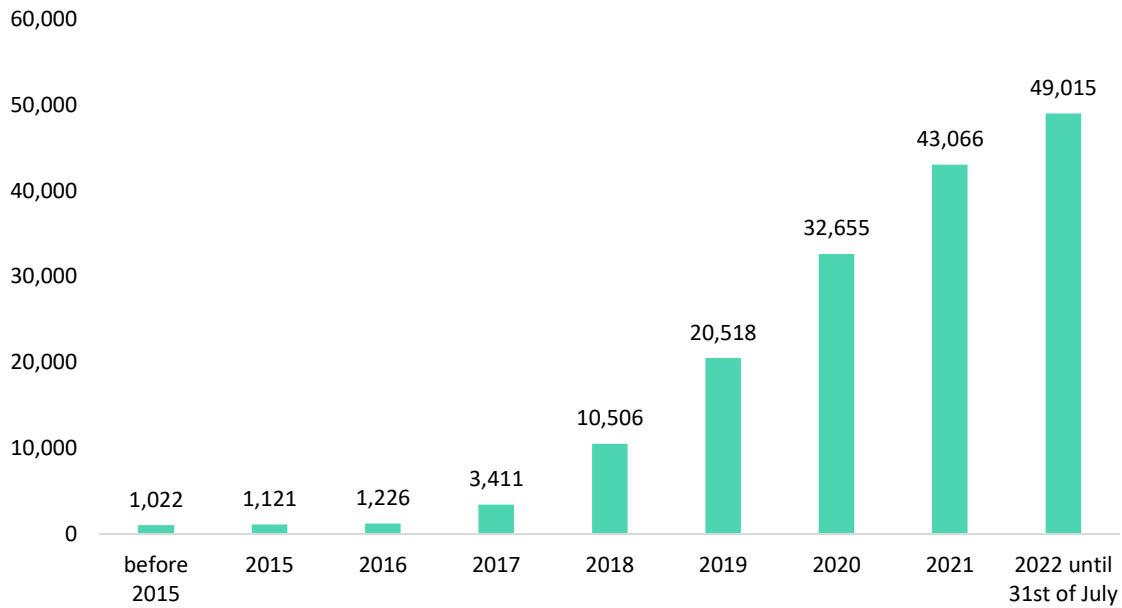
In April IAM's Jacob Schindler [discussed](#) the hypothesis that: "5G and the low latency (removal of delays) it offers will principally benefit businesses rather than consumers – at least for the time being". Following this, the full potential of 5G will likely be only exploited in use cases such as autonomous driving, IoT, virtual reality or industrial automation, for which low latency, increased network stability and increased bandwidth, as well as lower energy consumption, will be critical. If that is the case, will the advances of 5G justify a significant increase in SEP royalties for smartphones? Publicly communicated headline rates for 5G smartphone devices announced by the major licensors represent "a substantial increase in royalties over what they received for 4G", according to an [Ankura study published by IAM last year](#). Using IPlytics data, Ankura argues that "these rises are not explained by an increased share of patent holding". But is patent counting enough to understand the value of 5G? Current SEP litigation (*Ericsson v Apple*; *Nokia v Oppo and Vivo*; *InterDigital v Oppo*, among others) has been triggered by the present cycle of upgrading SEP licensing deals from 3G/4G to 3G/4G/5G and the questions of how much additional value 5G brings. However, the discussion about SEP value is only one challenge. Licensing of 5G SEPs takes place globally, while litigation is local. The rise of [so-called anti-suit injunctions](#) shows that international courts are

competing to set global FRAND rates. Regulators (including the current [EU Commission communications](#)) in different countries compete to set rules for leadership in technology standards innovation and products alongside the related SEP licensing ecosystem, thus influencing the global technology equilibrium. In this context, a balanced framework for SEP licensing on FRAND terms is more important than ever, while competition for 5G leadership goes beyond companies as it is relevant to entire economies. This poses the question: who is leading the 5G patent race?

## The 5G patent race

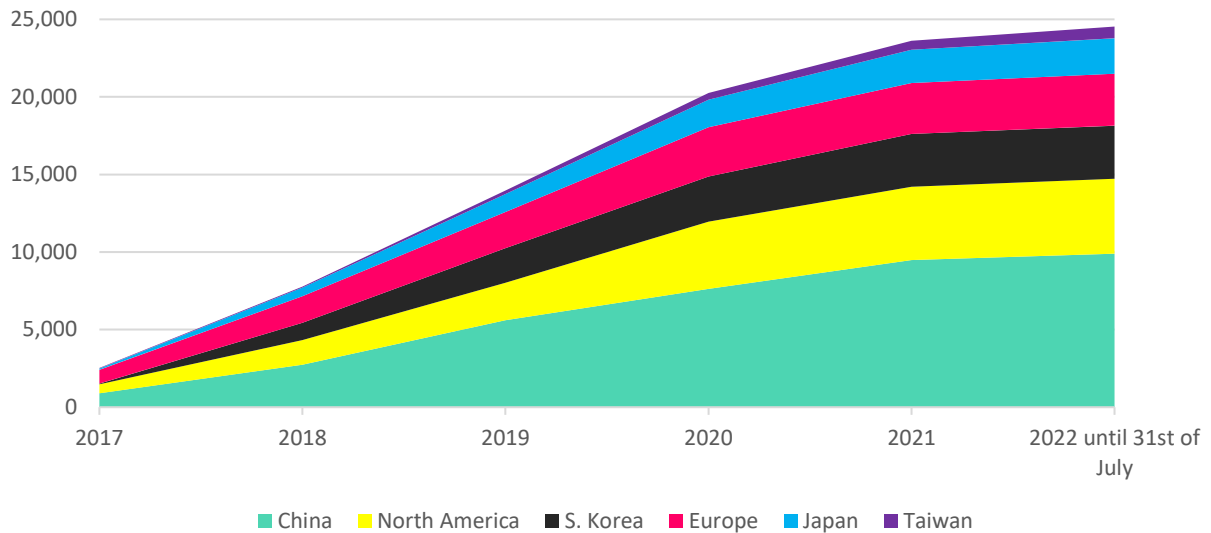
A recent [report by the USPTO](#) argues that “no company or country leads in 5G patenting”. Utilizing IPlytics data from May 2021, the report examined both global 5G patent families and triadic patent families in which a patent or application is filed at each of the USPTO, EPO and the Japan Patent Office. Indeed, it is very difficult to crown a winner, especially when the underlying data is based on 5G patents that were self-declared and not checked for essentiality or validity. However, the 5G patent race is more competitive than ever because the licensing of 5G SEPs is set to become one of the most highly lucrative markets, not only when it comes to receiving royalties from SEPs but also in retaining leadership of increasingly competitive industrial value chains. IPlytics data shows that, of the SEP holders that have self-declared at least 10 patent families over the past decade, the number of unique patent owners has risen from 99 in 2010 to 261 in 2021 (by factor 2.6x). The uptick in the number of SEP holders is largely driven by market entrants from China, Taiwan and South Korea, which develop smartphones, network devices, computer chips or semiconductor technology. Figure 1 shows that until the 31<sup>st</sup> of July 2022, almost 50,000 active and granted patent families were declared for 5G following a rapid increase in only four years.

**Figure 1:** Cumulative Number of declared active 5G patent families (pending and granted), by year of first declaration (IPlytics Platform, 2022).



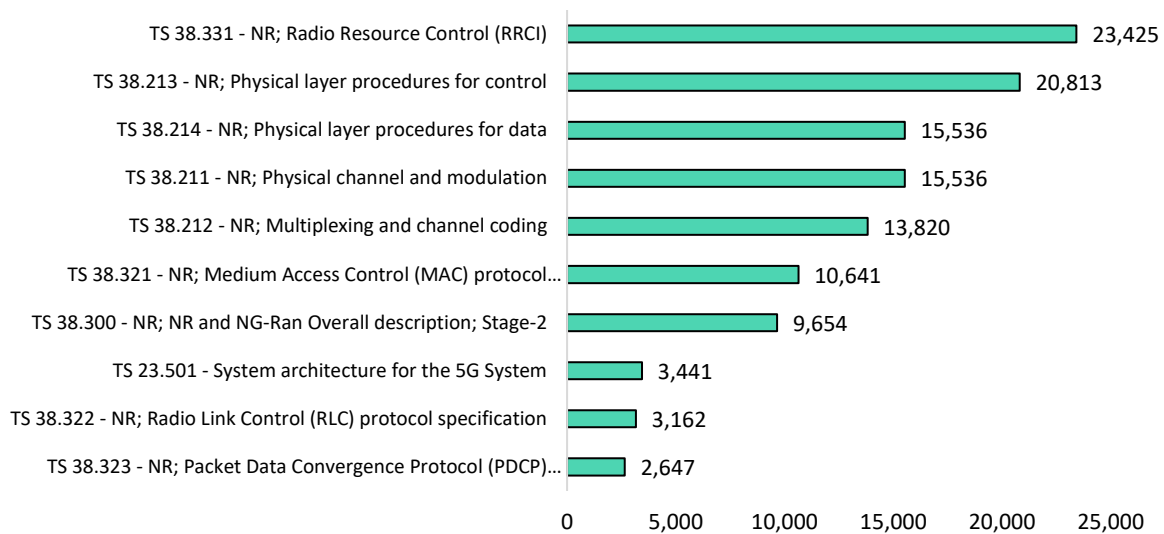
Although it may be difficult to answer the question about who wins the 5G race, we can observe a shift in the cellular industry. While 4G technology development was mostly dominated by US and European companies, Chinese and South Korean companies have led in 5G development with the highest number of active and granted (US or European) 5G self-declared patent families. Figure 2 shows that Chinese organizations (as the headquarters of the current assignee) are leading, even though the 5G patent numbers in Figure 2 only consider European or US-granted patent families.

**Figure 2:** Cumulative number of declared 5G US or EP granted patent families by headquarter of current patent owner (IPlytics Platform, 2022).



However, not all self-declared patents are essential and valid, also SEPs vary by value – with some covering core technologies of the standard and others only claiming inventions on minor improvements to the standard. 5G is a complex technology standard with over 1,200 technical specifications. Depending on the use of 5G for machine-to-machine communication or to enable advance driving systems, for example, not all specifications may be adopted to comply with 5G. It is often argued that therefore maybe not all 5G patents are relevant. Figure 3 shows the number of 5G patent families declared to specific technical specifications. Considering that the figure is based on a total of 49,015 worldwide 5G filed patent families (pending and granted), most patent declarations focus on the top 10 core technical specifications (TS). 5G declarations to the top 10 TS represent about 86% of all declared 5G patent families.

**Figure 3** Number of declared 5G patent families (pending and granted), by technical specification (IPlytics Platform, 2022)



## Who are the 5G leaders?

Many reports have been published about 5G SEP leadership claiming to crown a 5G patent race winner. There has also been considerable criticism about how to count and determine 5G patent ownership. While there are multiple approaches to identifying 5G SEPs, it is crucial to be transparent about how patents are counted and what source data is considered. Most 5G patent reports published in the past make use of publicly available data for self-declared patents hosted by the European Telecommunications Standards Institute (ETSI). However, reports often do not share these raw numbers, which makes it impossible to reproduce the analysis and confirm the accuracy of the data. ETSI hosts a database of declared patents, where standard-setting companies can submit lists of patents that they believe to be potentially essential to 5G.

In this report, we make use of self-declared 5G patents that have been submitted (declaration date) and published (upload date) at ETSI up to July 31<sup>st</sup>, 2022, using the following approach:

- We count 5G declarations for patent families based on the extended INPADOC family definition.

- The analysis includes patents granted at the EPO or the USPTO but excludes expired and lapsed patents up to July 31<sup>st</sup>, 2022.
- We count patent families according to the current patent assignee and aggregate counts according to the highest parent company using the latest corporate tree data. Patent ownership changes are considered up to July 31<sup>st</sup>, 2022.
- We make use of the 3GPP technical specification (TS) database to map ETSI-declared TS numbers to the 5G technology generation.

Table 1 illustrates the top 30 5G patent declaring companies by year of declaration. The counts are cumulative and thus allow to track the 5G patent portfolio size for the past 8 years. In the first three years of 5G standards development between 2015-2017 Nokia and Qualcomm were the first to declare larger patent portfolios followed by Huawei and Ericsson who were leading in 2017. From 2016 to 2017 as well as from 2017 to 2018 the total number of declared granted 5G patent families tripled each year while the marginal increase went down after that. Still the number of 5G declarations is and has been constantly increasing over the years. As of July 31<sup>st</sup>, 2022, Huawei has declared most patents granted either at the EPO or USPTO, followed by Qualcomm, Samsung, LG, Nokia Ericsson and ZTE. The top 10 5G patent owners together own about 84% of all declared and granted 5G patent families.

It should be noted that the listed companies in table 1 are not requested to provide any evidence that the self-declared patents are essential, nor are they required to provide any updates to declarations. Furthermore, ETSI does not conduct an essentiality check of the self-declared patents. A recent IPlytics analysis shows that the share of fully mappable patents, that is, patents where all claim elements were found in the 5G standard specification and a claim chart was made to justify that the patent is essential, differs strongly across the self-declared 5G patent portfolios and ranges from 5G portfolios with an essentiality rate of only 6% to 5G portfolios with an essentiality rate of 30% and an average between 10-15%.

**Table 1:** Top 30 declaring companies as to cumulative number of declared 5G patent families (granted in either EPO or USPTO) per year

Current Assignee	2015	2016	2017	2018	2019	2020	2021	2022
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Huawei (CN)	71	77	822	1,430	2,270	3,736	3,857	3,886
QUALCOMM (US)	116	130	156	1,024	1,507	3,192	3,368	3,471
Samsung Electronics (KR)	22	22	37	1,096	2,150	2,758	3,225	3,228
LG (CN)	19	20	37	769	1,727	1,862	2,889	2,914
Nokia (FI)	158	172	195	954	1,208	1,963	1,988	2,002
Ericsson (SW)	35	46	693	755	1,126	1,210	1,307	1,355
OPPO(CN)	0	0	0	223	451	552	936	1,020
Sharp (JP)	0	0	11	439	554	850	892	897
ZTE (CN)	20	22	24	197	557	578	721	801
NTT DOCOMO(JP)	20	23	28	33	426	562	617	630
Apple (US)	24	41	185	253	362	453	527	535
CATT Datang Mobile (CN)	5	0	5	123	338	359	437	437
MediaTek (TW)	0	0	0	16	29	219	336	400
InterDigital (US)	51	54	82	91	296	321	357	363
NEC (JP)	18	21	26	34	86	154	211	280
Xiaomi (CN)	0	0	0	0	10	140	140	256
Sony (JP)	4	0	8	27	30	43	193	232
HTC (TW)	23	25	25	38	92	92	92	204
Fg Innovation (CN)	0	0	0	0	131	170	185	199
ETRI (KR)	3	0	11	22	60	150	179	179
Vivo (CN)	0	0	2	0	81	93	140	163
BlackBerry (CA)	60	65	72	99	129	158	160	160
ASUSTeK Computer (TW)	0	0	0	8	106	117	147	153
Panasonic (JP)	6	0	7	11	36	117	133	133
Lenovo (CN)	5	0	5	5	33	84	127	127
Google (US)	43	43	43	49	50	54	106	114
Fujitsu (JP)	0	0	5	13	37	53	86	108
Intel (US)	0	0	45	54	76	92	104	104
Shanghai Langbo (CN)	0	0	0	0	0	57	59	92
Motorola Mobility (US)	0	0	0	3	11	63	91	92



The ranking of Table 1 must consider these essentiality rate differences to make accurate assumptions about the 5G leadership situation. Table 1 is the starting point to identify the strongest 5G patent owners. Semantic claim section comparisons and AI based essentiality determination approaches further support SEP portfolio determination to get closer to understand what is really standard essential and what is not.

## Outlook and the new SEP battlefields

The recent [SEP lawsuit against Ford in Munich](#), resulting in the latter no longer being permitted to sell its cars with LTE-enabled communication tools in Germany, is the tip of the iceberg in the current automotive battlefield of SEP litigation. SEP licensing beyond the smartphone world reveals new challenges and disagreement between SEP holders, licensors and standards implementers, in this case the auto industry, for example regarding where SEPs should be licensed in the value chain, what should be considered a FRAND rate and what should be deemed excessive. While current litigation in the auto industry concerns 3G and 4G SEPs, the question of how much value 5G brings to a vehicle is more difficult to answer when advanced driving systems heavily rely on 5G-enabled connectivity and increasing litigation is anticipated. But adoption of 5G in other industries is expected in the future, as the number of IoT applications that will make use of 5G is endless. One thing is certain: the majority of SEP holders will actively monetise and enforce their SEP portfolios covering 5G standards in this fast-moving, high-investment environment. However, SEP owners as well as standard implementers are faced with the challenge of managing operational and financial risks and cost exposures, while striving to maximise value.

The licensing of 5G SEPs looks set to become a major issue, not only for the handset industry, but for any manufacturing sector that involves connectivity. Senior patent directors, licensing executives or legal counsel should bear the following in mind:

- Future technologies that enable connectivity will increasingly rely on patented technology standards, such as 5G.
- The quantity of 5G SEP declarations as well as the number of SEP owners has constantly increased. Licensees must consider royalty costs and appropriate security payments in advance.

- Patent directors and licensing executives ought not only to consider information retrieved from patent data, but also monitor and study patent declaration data, SEP claims and standards section comparisons alongside, for example, technical contributions to understand the landscape of 5G patent holders.
- The essentiality rate differs across self-declared patent portfolios. SEP determination is crucial to make accurate assumptions about 5G leadership. Further refinement and analysis are needed to identify essentiality rates.
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