

Who leads the 5G patent race November 2021?

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November 2021

5G and the next technological revolution

The next Industrial Revolution will not only affect the smartphone and computer world but will also have an impact on considerably more industrial verticals, including [automotive](#), [home appliances](#), [manufacturing](#), [energy](#) and healthcare. Estimates suggest that half of the worldwide data traffic of the next five years will no longer result from people's usage, but instead will be generated by vehicles, machines, meters, sensors, medical instruments, or various other types of networked devices without any human interaction. Standards such as 5G allow for the handling of extensive amounts of data to connect industrial machinery and robots, thus enabling remote control, monitoring and repair actions, as well as industrial automation. From smart grids to drone control, energy and utilities, companies will rely on standards to handle connectivity demands.

Hospitals and medical equipment manufacturers will use 5G to provide data to a variety of devices and fixed machines, as well as to make possible the application of remote surgery. Enhanced monitoring and automation are likely to assist industries as diverse as agriculture and finance, while online shops will increasingly turn to virtual reality experiences. 5G-based tracking will emerge in the logistics sector, while connected cars will rely on 5G-based driving assistance. Edge computing and the low latency of 5G will be used in the gaming business, as well as in general augmented and virtual reality applications. Over the next few years, as advanced 5G cellular technology replaces existing protocols, these developments will occur swiftly. The worldwide adoption of 5G technology is expected to contribute up to \$2 trillion to the global economy over the next 15 years.

While 5G will be widely adopted across industries beyond the smartphone world, 5G is subject to hundreds of thousands of SEPs that every 5G implementer will be required to use. Although the licensing of 4G and 5G is mostly understood in the smartphone world, with multiple SEP holders having already publicly declared 5G SEP rates for smartphones, the licensing of SEPs in industries such as the automotive sector, manufacturing, home appliances, energy or healthcare is still something of an unknown factor. It is expected that most patent holders will actively monetize and enforce their SEP portfolios covering connectivity standards in this fast-moving, high-investment environment. Negotiating and operating in a complex SEP environment will be a major challenge for 5G adopters. The SEP-related global royalty income in 2020 was estimated at \$20 billion, yet market researchers foresee a strong increase in the compound annual growth rate of royalty income over the upcoming years due to the wide implementation of 5G beyond smartphones. Experts, however, anticipate that the industry will not always align on FRAND rates for 5G SEPs, yielding numerous [SEP-related litigation in the years to come](#).

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. All 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 most reports do not share these raw numbers, which makes it impossible to 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 30 September 2021, using the following approach:

- We count 5G declarations for patent families based on the extended INPADOC family definition.
- The analysis includes both pending and granted patents but excludes expired and lapsed patents up to 30 September 2021.
- 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 30 September 2021.
- We make use of the 3GPP technical specification (TS) database to map ETSI-declared TS numbers to the 5G technology generation. Patents were also classified as 5G if the ETSI project description included “NR”, “New Radio” or “5G”.

Table 1 illustrates the top 30 patent owners of 5G self-declared patent families. The first column counts 5G portfolio shares and considers granted patents as well as pending applications at all worldwide patent offices. Huawei (CN) has declared the most patent families, followed by Qualcomm (US), Samsung (KR), ZTE (CN), LG (KR) and Nokia (FN). The second column counts patent families where at least one patent has been granted, while the third column counts 5G patent families where at least one patent has been granted at the IP5 offices (US, EP, CN, KR, JP) and the fourth column counts 5G patent families where at least one patent has been granted for EPO/USPTO. Here Huawei, LG, Samsung, and Qualcomm have the largest 5G portfolios.

Finally, the fifth column presents EPO/USPTO-granted patent families that have not been declared to earlier generations (2G, 3G or 4G) before 2016. Here, Huawei has the largest 5G portfolio, closely followed by Qualcomm and LG.

Table 1: Self-declared patents by the top 5G patent owners

Current Assignee	5G families	5G granted active families	5G IP5 granted active families	5G EPO/USPTO granted and active families	5G EPO/USPTO granted active families not declared to other generations
Huawei (CN)	13.52%	15.93%	16.08%	15.29%	18.10%
QUALCOMM (US)	9.97%	10.44%	10.52%	12.85%	13.24%
Samsung Electronics (KR)	9.94%	10.55%	10.60%	12.44%	11.33%
ZTE (CN)	9.83%	7.43%	7.48%	4.33%	4.08%
LG Electronics (KR)	9.04%	10.79%	10.96%	13.02%	14.09%
Nokia (FN)	8.34%	9.74%	9.75%	11.38%	9.18%
CATT Datang Mobile (CN)	5.03%	4.38%	4.34%	1.40%	1.76%
Ericsson (SE)	4.69%	4.66%	4.55%	5.41%	4.58%
Oppo (CN)	4.57%	4.10%	3.82%	3.01%	4.04%
Sharp (JP)	3.73%	3.80%	3.75%	3.83%	3.95%
Vivo (CN)	3.68%	2.46%	2.50%	0.20%	0.24%
NTT DOCOMO (JP)	3.59%	2.67%	2.60%	2.10%	1.87%
Xiaomi (CN)	1.70%	1.04%	1.04%	0.43%	0.53%
Apple (US)	1.70%	1.76%	1.74%	2.07%	2.18%
Intel (US)	1.47%	0.74%	0.68%	0.46%	0.47%
InterDigital (US)	1.37%	1.30%	1.28%	1.51%	0.51%
Lenovo (CN)	1.12%	0.37%	0.38%	0.46%	0.53%
FG Innovation (CN)	0.88%	0.51%	0.48%	0.57%	0.77%
MediaTek (TW)	0.81%	1.15%	1.15%	1.42%	1.60%
NEC (JP)	0.68%	0.83%	0.83%	0.84%	0.64%
ETRI (KR)	0.54%	0.59%	0.59%	0.66%	0.42%
Shanghai Langbo (CN)	0.53%	0.63%	0.64%	0.19%	0.26%
Motorola Mobility (US)	0.51%	0.58%	0.55%	0.44%	0.59%
Panasonic (JP)	0.43%	0.42%	0.39%	0.43%	0.25%
BlackBerry (CA)	0.43%	0.61%	0.61%	0.73%	0.53%
Fujitsu (JP)	0.42%	0.53%	0.47%	0.39%	0.32%
ASUSTeK (TW)	0.40%	0.45%	0.46%	0.49%	0.66%
KT (KR)	0.32%	0.28%	0.28%	0.27%	0.34%
Google (US)	0.32%	0.34%	0.34%	0.43%	0.13%
HTC (TW)	0.24%	0.34%	0.33%	0.41%	0.50%

Essentiality rates of self-declared patent portfolios

It should be noted that the above listed companies 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.

To better understand the essentiality rate of self-declared 5G patent families, IPlytics created a sample data set of 2,000 5G declared patent families (EP or US granted), mapped, and evaluated by independent subject matter experts and patent attorneys. The claim mapping followed a blind double-checking approach, where at least two experts mapped the patents to 5G specifications. During the first step of the process, a cellular technology expert had on average six hours to conduct the initial claim section mapping. Second, a US or EP patent attorney had on average three hours to double check and verify the first mapping result. Where there was disagreement, both experts arranged a call to discuss and conclude a final mapping status of fully mappable, partially mappable, or not mappable patents. In total, 18,000 hours were spent on the mapping of 2,000 5G-declared patent families that were randomly selected by a computer.

Statistical tests confirm the random nature of the sample of 2,000 5G patent families, meaning that it is thus representative of the whole population of self-declared 5G patents. Additional tests confirm that the top 20 5G patent owners are above the minimum sample size required to be representative. 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%. 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 while the 5G shares need further refinement to adjust 5G portfolios by the different essentiality rates that can be identified for example by evaluated 5G patent samples of independent subject matter experts. Also, [AI based essentiality determination](#) approaches further support SEP portfolio valuation to get closer to understand what is really standard essential and what is not.

5G leadership and standards contributions

Alongside the declared patent data analysis, the IPlytics Platform gathers information on standard-setting companies that are actively involved in 5G standards development. The 5G standard is specified in international 3GPP meetings where companies present and submit technical contributions, which all members then discuss and approve or reject. The principle of consensus decision making at the 3GPP means that considerable research and investment is required to create meaningful and convincing contributions that are approved by all members and are then incorporated into the final standard. Companies can only gain credibility by regularly participating in and developing the best standards specifications, a process which allows them to incorporate their own developed, and sometimes patented, technologies. 5G contribution data therefore facilitates assessment of the involvement and investment of companies in the development of 5G standards.

Using the [IPlytics Platform's database of 3GPP standards contributions](#), Table 2 displays the top 30 companies (classified by the same means as the 5G patent declarations in Table 1) that have submitted contributions to 5G specifications. The first column counts all 5G standard contributions, while the second column only considers technical contributions, excluding editorial modifications and formal corrections. The third column counts all technical 5G contributions that were approved within the 3GPP groups incorporated into the final 5G standard. Regarding the third column, Huawei has the highest number of approved contributions, followed by Ericsson (SE) and Nokia (FN). These three companies are by far the strongest contributing 5G standards developers, followed by Qualcomm, Samsung and ZTE (CN). Companies such as LG, CATT (CN), OPPO (CN), Sharp (JP) or Vivo (CN) have considerably low numbers of 5G contributions, while they rank among the top 10 5G patent-declaring companies.

Table 2. Technical contributions for 5G standards by the top standard developing companies

Organisation/Entity	5G 3GPP contributions	5G technical 3GPP contributions	5G approved technical 3GPP contributions
Huawei (CN)	21.64%	21.10%	23.18%
QUALCOMM (US)	6.94%	6.72%	6.44%
Samsung Electronics (KR)	5.72%	6.27%	6.00%
ZTE (CN)	5.67%	5.42%	5.37%
LG Electronics (KR)	2.39%	2.62%	2.41%
Nokia (FN)	12.89%	12.81%	14.61%
CATT Datang Mobile (CN)	3.14%	3.36%	2.72%
Oppo (CN)	1.29%	1.34%	1.10%
Sharp (JP)	0.29%	0.26%	0.21%
Vivo (CN)	1.28%	1.32%	1.19%
Ericsson (SE)	17.52%	16.01%	18.83%
NTT DOCOMO (JP)	2.23%	2.34%	2.76%
Apple (US)	1.10%	1.16%	1.02%
Xiaomi (CN)	0.30%	0.37%	0.30%
Intel (US)	3.83%	3.96%	3.71%
InterDigital (US)	1.31%	1.63%	1.59%
MediaTek (TW)	2.00%	1.61%	1.50%
Lenovo (CN)	1.23%	1.38%	1.40%
ETRI (KR)	0.45%	0.54%	0.46%
Shanghai Langbo (CN)	0.01%	0.01%	0.01%
Motorola Mobility (US)	1.20%	1.33%	1.34%
FG Innovation (CN)	0.00%	0.00%	0.00%
NEC (JP)	1.00%	1.02%	0.93%
Panasonic (JP)	0.07%	0.08%	0.00%
Fujitsu (JP)	0.11%	0.12%	0.02%
BlackBerry (CA)	0.49%	0.32%	0.24%
ASUSTeK (TW)	0.09%	0.11%	0.03%
Google (US)	0.16%	0.09%	0.05%
KT (KR)	0.22%	0.29%	0.18%
HTC (TW)	0.12%	0.10%	0.07%

The licensing of 5G SEPs looks set to become a major issue not only for the handset industry, but also for any manufacturing sector in which connectivity will be involved. Senior patent managers and patent directors should bear the following in mind about 5G patents:

- Future technologies that enable connectivity will increasingly rely on patented technology standards, such as 5G.
- The number of [5G SEPs is constantly rising](#). Therefore, patent directors should consider royalty costs and appropriate security payments in advance.
- Patent directors ought not only consider information retrieved from patent data, but also monitor and take into account patent declaration data, claim charts, and patent pool data, as well as standardization data including 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 the 5G leadership situation. Further refinement and analysis is needed to [identify essentiality rates](#).
- The dynamic market of SEPs means that patent assertion entities often acquire patent portfolios to assert extensive royalty payments.

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IPLYtics - The Gold Standard for SEPs and Standards



Empowering IP professionals to understand the complexity of patents and standards in the connected world.

IPLYtics is the first solution on the market to bring together comprehensive and highly indexed information on technical standards, declared SEPs, patent pools, global patents and standards contribution data. Using all these data points, IPLYtics produces an industry-leading analysis into the past, present and future of standards-essential technology. IPLYtics provides fast, intuitive access to patents and standards that can help empower the user to:

- align patent portfolio strategy to protect innovations;
- engage in continuous strategic portfolio development as it relates to SEP assets;
- understand the competitive landscape and strategies accordingly; and
- help in initiatives such as licensing, acquisitions and joining patent pools.

The next technology revolution will connect everything from different realms of technology, making it even more challenging to understand how technologies relate to connectivity standards. IP professionals must rethink – even revolutionize – how to approach both patent and standards data. To navigate the highly complex and ever-changing IP world, the only way to stay ahead of the competition is to gain business-ready, actionable insights quickly and use them for decision making across organizations. IPLYtics gives you those business-ready insights in a matter of seconds and serves them with intuitive visualizations so you can leverage them right away.

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