

Who is leading the 5G patent race?

A patent landscape analysis on declared SEPs
and standards contributions

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1. The next industrial revolution and 5G patents

With more and more companies declaring ownership of standard essential patents (SEPs) for 5G standards, it is crucial to keep up with the filing numbers of the patent leaders in connectivity.

The next industrial revolution will see increasing technological convergence as connectivity technologies are gradually integrated into mechanical products. For example, while the importance of connectivity modules in cars may currently be small, experts believe that the connected vehicles of the future will shift consumer focus from the automobile itself to the broader issue of transportation. We will also see the increasing importance of 5G technology in other industries where smart factories, smart homes, smart meters and even smart medical devices will rely on 5G connectivity.

Soon most industries where connectivity matters will heavily depend on standardised and often patented standards, which are developed in open, consensus-based, standards-development organisations (SDOs). Understanding the 5G patent landscape is therefore crucial for any IP professionals across industry verticals as SEPs are infringed when implementing 5G standardised technology. SEP owners will request royalties for SEPs and recent patent litigation in the auto industry shows both how lucrative the SEP licensing market is and how the smart phone wars have been shifting to the auto industry, with a potential to spill over into other industries (e.g., home appliances, manufacturing, and energy).

2. The 5G patent landscape

To identify 5G patents, the IPlytics Platform integrates all European Telecommunications Standards Institute (ETSI) declared patents and matches these to the 3GPP standards database. The 5G landscape in this report is counted based on the following criteria:

- The analysis considers all patent declarations published at ETSI up to February 1st 2021.
- Patent declarations were classified as relevant to 5G if the technical specifications of the declaration were marked as 5G technology by the 3GPP standards data.
- All specifications marked as 5G technology are considered. This includes specifications marked for several standard generations (eg, 4G and 5G or 3G and 5G).
- Patent declarations were also marked as 5G if the project description of the declaration contained information for standard projects describing 'New Radio' or '5G'.
- Since patent applications and patents across standard generations can be essential, patent declarations previously declared for 2G, 3G or 4G and declared again for 5G were also considered.
- All counts and shares are based on the INPADOC extended patent family definition.
- Patent ownership changes were considered up to February 1st 2021, as well as corporate tree information to aggregate counts to the ultimate parent company and the current owner. Companies such as Motorola (US) a wholly owned subsidiary of Lenovo (CN) or Sharp (JP) a wholly owned subsidiary of Foxconn (CN), were listed separately.

Table 1 illustrates the top patent owners of 5G declared patent families. The first column counts 5G portfolio shares, considering granted patents as well as pending applications at all worldwide patent offices. Here, Huawei leads with

a share of more than 15.39%, followed by Qualcomm with 11.24%, ZTE with 9.81%, Samsung with 9.67% and Nokia with 9.01%.

Table 1. Top 5G patent declaring companies (IPlytics Platform, February 2021)

Current Assignee	Share of 5G families	Share of 5G granted and active families	Share of 5G EP/US granted/active families	Share of 5G EP/US granted/active families not declared to earlier generations
Huawei (CN)	15.39%	15.38%	13.96%	17.57%
Qualcomm (US)	11.24%	12.91%	14.93%	16.36%
ZTE (CN)	9.81%	5.64%	3.44%	2.54%
Samsung Electronics (KR)	9.67%	13.28%	15.10%	14.72%
Nokia (FN)	9.01%	13.23%	15.29%	11.85%
LG Electronics (KR)	7.01%	8.7%	10.3%	11.48%
Ericsson (SE)	4.35%	4.59%	5.25%	3.79%
Sharp (JP)	3.65%	4.62%	4.66%	5.50%
Oppo (CN)	3.47%	0.95%	0.64%	1%
CATT Datang Mobile (CN)	3.44%	0.85%	0.46%	0.68%
Apple (US)	3.21%	1.46%	1.66%	2.15%
NTT Docomo (JP)	3.18%	1.98%	2.25%	1.9%
Xiaomi (CN)	2.77%	0.51%	0.23%	0.32%
Intel (US)	2.37%	0.58%	0.32%	0.4%
Vivo (CN)	2.23%	0.89%	0.08%	0.07%
InterDigital (US)	1.43%	1.6%	1.79%	0.42%
Lenovo (CN)	0.9%	0.32%	0.38%	0.40%
Motorola Mobility (US)	0.78%	0.72%	0.59%	0.84%
NEC (JP)	0.71%	0.79%	0.8%	0.52%
MediaTek (TW)	0.70%	1.19%	1.42%	1.79%
Shanghai Langbo (CN)	0.65%	0.81%	0.14%	0.22%

The second column counts patent families where at least one patent has been granted, while Column 3 shows 5G patent families where at least one patent has been granted at the USPTO or EPO. Finally, the fourth column presents EPO/USPTO-granted patent families that have never been declared to any previous standard generation (i.e., 2G, 3G or 4G). The shares and counts change depending on the filtering reported in the different columns. Nokia with 15.29%, for example, has the largest EPO/USPTO-granted 5G family portfolio, followed by Samsung with 15.10%. Qualcomm and Huawei have the highest shares when only considering patent families that have not been declared to previous generations.

Overall, the numbers show that the top 10 companies own more than 80% of all granted 5G patent families, while the top 20 own more than 93% of all 5G granted patent families. These numbers confirm that there are only a few major large 5G patent owners, but looking at overall 5G declarations, the IPlytics Platform database identified more than 100 independent companies, which have declared ownership of at least one 5G patent.

The 5G patent family statistics presented in Table 1 are not based on verified SEP families. Neither ETSI nor the declaring companies have published independent assessments of the essentiality or validity of the declared 5G patent families. Thus, the 5G patent families presented are only alleged potentially essential. Many well-known SEP studies estimate that between 20% and 30% of all declared patents are essential. However, the essentiality rate differs across patent portfolios. To consider the essentiality rate differences across 5G portfolios, IPlytics created a random sample data set of 1,000 5G-declared patent families (EPO/USPTO granted).

The 1,000 randomly selected 5G patent families represent a balanced sample of 5G declarations across different company portfolios, different IPC/CPC classifications, different grant years, and families declared to standards from different 3GPP groups and releases.

Table 2: 5G patent ownership shares multiplied by essentiality rate

Current assignee	Share of 5G EP or US granted and active families multiplied by essentiality rate of 1,000 expert mapped patents
Huawei (CN)	8.38%
Qualcomm (US)	10.75%
ZTE (CN)	2.33%
Samsung Electronics (KR)	18.52%
Nokia (FN)	11.44%
LG Electronics (KR)	6.63%
Ericsson (SE)	4.89%
Sharp (JP)	5.86%
Oppo (CN)	n/a
CATT Datang Mobile (CN)	n/a
Apple (US)	3.49%
NTT Docomo (JP)	2.67%
Xiaomi (CN)	n/a
Intel (US)	0.18%
Vivo (CN)	n/a
IST (US)	n/a
InterDigital (US)	5.11%
Lenovo (CN)	3.00%
Motorola Mobility (US)	n/a
NEC (JP)	0.91%
MediaTek (TW)	5.00%
Shanghai Langbo (CN)	n/a

The sample of the 1,000 randomly selected 5G families were manually mapped to the corresponding 5G technical specifications by cellular technology experts and US/EP patent attorneys. Here IPlytics uses a ‘four eyes’ approach first having a cellular technology expert map patent claims to technical specification sections for on average 6 hours per patent family and then secondly having a patent attorney double check the expert’s work for an additional 3 hours per patent family. The essentiality rates were applied to all company portfolios of 5G EP or US granted and active families (presented in table 2). If the patent portfolio states “n/a” there was not enough sample data available to multiply the essentiality rate to the declared EP/US granted patent portfolio.

The selection of patents followed a statistical sampling method also used in political polling methods, which ensures no selection bias and provides a balanced sample across the major 5G portfolios to identify:

- true positive values, which represent patents fully mapped to a standard specification (verified SEPs).
- true negative values, which represent patents that could not be mapped to any standard specification (verified non-SEPs).

Table 2 illustrates EP or US granted 5G ownership shares when applying the essentiality rate filter taken from the manually mapped examples. Here, Samsung leads 5G patent ownership, followed by Nokia and Qualcomm.

3. The 5G standard contribution landscape

Beyond 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 cast their votes on the standard.

Table 3. Top companies submitting technical contributions for 5G standards (IPlytics Platform, February 2021)

Organisation / Entity	Share of 5G Technical 3GPP Contributions	Share of 5G Approved Technical 3GPP Contributions
Huawei (CN)	17.58%	22.94%
Ericsson (SE)	14.47%	18.04%
Nokia (FN)	10.00%	14.28%
Samsung Electronics (KR)	6.70%	5.52%
Qualcomm (US)	6.65%	6.92%
ZTE (CN)	6.02%	5.53%
Intel (US)	4.84%	4.69%
CATT Datang Mobile (CN)	4.05%	3.14%
LG Electronics (KR)	3.89%	3.14%
NTT Docomo (JP)	3.05%	4.06%
MediaTek (TW)	2.32%	1.39%
Vivo (CN)	1.97%	0.85%
OPPO (CN)	1.92%	1.01%
InterDigital (US)	1.76%	1.64%
China Mobile (CN)	1.66%	3.21%
AT&T (US)	1.33%	1.75%
Lenovo (CN)	1.21%	1.40%
Motorola (US)	1.19%	1.36%
Apple Inc. (US)	1.07%	0.71%
Deutsche Telekom (DE)	0.99%	1.79%
NEC (JP)	0.97%	1.08%

Using the IPlytics Platform's database of 3GPP standards contributions, Table 2 shows the top companies that have submitted 5G-relevant contributions. The first column counts 5G standard contributions that are considered to be technical contributions, excluding editorial modifications and formal corrections, among others.

The second column counts all technical 5G contributions that the 3GPP has approved and accepted. The numbers show that Huawei, Ericsson and Nokia are by far the strongest standards developers, followed by Samsung, Qualcomm and ZTE. Considering only approved and accepted contributions in Column 2, the top three standard developing companies have collectively submitted more than 55% of all approved and agreed 5G contributions.

4. Outlook

The licensing of 5G SEPs looks set to become a major issue not only for the handset industry, but also for any manufacturing sector where connectivity will matter. 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 - patent directors should consider royalty costs and appropriate security payments in advance.
- Patent directors should not only consider information retrieved from patent data, but also monitor and consider patent declaration data, claim charts, patent pool data as well as standardisation data such as technical contributions to understand the landscape of 5G patent holders.
- Senior patent managers should bear in mind the dynamic market of SEPs, where patent assertion entities often acquire patent portfolios to assert extensive royalty payments.



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