Who is leading the 5G patent race for edge computing?

Executive Summary

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May 2021

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https://www.managingip.com/article/b1rznbcc4dsk23/who-is-leading-the-5g-patent-race-for-edge-computing

Edge Computing and the 5G standard

In the future, half of the world's data volume will no longer be generated by or between people but by vehicles, sensors, or other various types of networked devices, according to some predictions. Not only the number of devices but also the volume of data continues to increase dramatically. Telecom equipment supplier Ericsson estimates that global data traffic will increase fivefold to 136 exabytes per month within the next five years, compared to today. The expectation is that a typical end user will generate up to 1.5 gigabytes of data per day, and a vehicle with up to 4 terabytes even several times that amount.

The 3GPP (3rd Generation Partnership Project), the organization responsible for cellular standards development, already had these new requirements in mind when it defined the fifth-generation mobile network 5G. At its core, 5G was about offering significantly higher data rates (100 times higher than 4G/LTE), enabling latency times in the millisecond range, and providing significantly higher availability and reliability of the network. However, the significant increase in the number of end devices, the explosion in the volumes of data exchanged, and the need for minimum latency times are placing new demands which 5G technology alone may not meet. The concept of edge computing provides a solution. The idea behind it is simple: bring the cloud with its computing capacity closer to the users and thus achieve runtimes of less than 10 milliseconds but without losing the advantages of the cloud. In simpler terms, edge computing means running fewer processes in the cloud and moving those processes to local devices, such as on a user's smartphone, computer, an internet of things device, or an edge server. Bringing computation to the network's edge minimizes the amount of long-distance communication that must happen between client and server. The processing of vehicle data in the context of autonomous driving is often cited as a relevant use case for edge computing. Vehicles stand still for an average of 96% of their lifetime – here, the load-balancing advantage of edge computing becomes very clear: you do not necessarily have to install expensive components in every vehicle, but instead shift the logic to an edge computing device that can serve a large number of vehicles.

The potential for weight and cost reduction through edge computing devices can be illustrated, for example, by the complex image processing and video analysis of camera drones. And one can expand the application scenarios infinitely: from the implementation of blockchain logic in production, logistics and supply chains to the complex calculation of augmented and virtual

reality models, for example for plant technicians during installation or maintenance work, to the real-time control of production plants, and so on.

Patent leadership for edge computing and 5G

While the edge computing concept may reduce the volume of communication between device and the cloud, edge computing is still heavily dependent on connectivity standards such as 5G or Wi-Fi. Connectivity standards are often subject to thousands of patents and in some cases these patents claim inventions that read on the standardized technology. Such patents are referred to as standard essential patents (SEPs). Companies that define and specify technologies such as 5G or Wi-Fi and that own essential patents for such technologies will be among the technology leaders in a soon fully connected world. To get a better understanding of the landscape of patents, SEPs and standards contributions for edge computing technologies, the IPlytics Platform databases were used to analyze edge computing-related patent to understand which companies develop the latest standards that enable edge computing and which companies hold essential assets on edge computing technologies.

Table 1 shows the top 30 companies most active in patent filing, SEP declaration and standards development. The list of technology leaders shows some companies that do not yet participate in standards development, and thus also do not declare SEPs, but are still among the companies with most edge computing patent filings, such as SAS Institute (US), IBM (US), Pure Storage (US) and Microsoft (US). These companies are typically active in the cloud business (IBM and Microsoft), or data and software sectors (SAS Institute and Pure Storage). Chip, handset and network manufacturers such as Huawei (China), Intel (US), Nokia (Finland), Apple (US), Samsung Electronics (Korea) and Ericsson (Sweden) heavily contribute to standards development while at the same time own large patent portfolios some of which are declared as standard essential. Also, many of the telecommunications carrier companies can be found in the list of top patent owners and standards developers, such as Verizon (US), AT&T (US), China Mobile (China), Deutsche Telekom (Germany) and Orange (France

Table 1: Number of patents filed (pending and granted), number of SEP families declared and number of standards contributions that describe edge computing technologies, by current assignee/standards developer (IPlytics Platform, April 2021)

Current Assignee / Standards Developer	Patent Count	SEP Declaration Count	Standards Contributions Count
Huawei (CN)	821	138	862
Intel (US)	686	42	488
Nokia (FN)	576	87	439
SAS Institute (US)	426	0	0
Apple (US)	386	72	41
Samsung Electronics (KR)	287	16	536
Verizon (US)	196	0	50
Microsoft (US)	188	0	0
Cisco (US)	168	0	39
Ericsson (SE)	163	6	374
LG Electronics (KR)	160	33	144
NEC (JP)	158	3	55
Pure Storage (US)	155	0	0
IBM (US)	125	0	0
Siemens (DE)	120	0	30
Sony (JP)	119	0	66
AT&T (US)	99	0	130
ZTE (CN)	96	4	193
QUALCOMM (US)	68	6	256
Tencent (CN)	64	0	117
Convida Wireless (US)	60	0	88
CATT Datang Mobile (CN)	55	2	0
China Mobile (CN)	54	0	206
Deutsche Telekom (DE)	47	0	64
InterDigital (US)	46	2	77
SoftBank (JP)	46	0	4
Orange (FR)	41	0	60
HP Enterprise (US)	39	0	19
ETRI (KR)	37	1	29
Fraunhofer (DE)	35	11	17
Robert Bosch (DE)	34	0	10
Sharp (JP)	30	2	0

Edge computing and SEP Licensing

Licensing fees for SEPs in mobile standards (i.e., 4G, 5G or Wi-Fi) can easily amount to hundreds of millions of dollars per year, and the integration of patented and standardized connectivity standards poses serious economic risks for implementers. Future technologies that enable connectivity will increasingly rely on patented technology standards such as 4G, 5G, Wi-Fi and many more. Even if SEPs are licensed in, standards implementers should bear in mind the dynamic market of changing SEP ownership where patent assertion entities often acquire SEP portfolios to assert extensive royalty payments. As the number of declared SEPs is constantly rising, IP professionals working for standards-implementing companies should consider royalty costs and appropriate security payments in advance.

While the telecoms industry and large SEP-owning companies are experts in standards development and worldwide SEP filing and licensing, other sectors such as auto, consumer electronics, industrial manufacturing, energy, medical-healthcare and many more have little knowledge of connectivity standards that are subject to SEPs. IP professionals in these sectors will need to gain more expertise around patents and standards to understand that by making use of technology advances around connectivity such as edge computing, they will need to implement patented standards and thus at some point will have to pay royalties for SEPs. Furthermore, standards development is not only about developing the core technology layer of communication but also about developing application layers to enable technologies such as edge computing. For example, the 5GAA (5G Automotive Association), a global cross-industry organization, was created to connect the telecoms industry and vehicle manufacturers to develop end-to-end solutions for future mobility and transportation services making use of 5G. In this regard, experts across all industries where connectivity matters will need to consider participation in standards consortia such as 3GPP, IEEE and others to have a seat at the table where future technology decisions are made.

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