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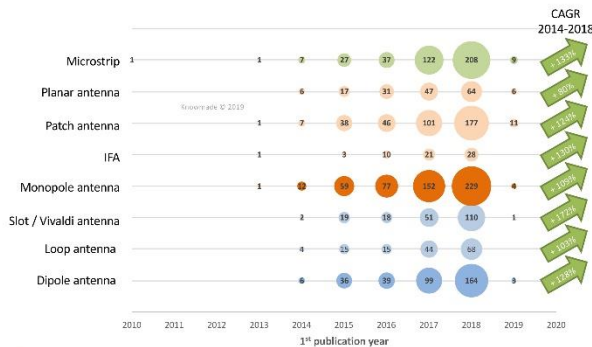
**Antennas for 5G: Samsung, Intel, Ericsson, and Huawei and more have begun extending their portfolios**

Extracted from: Antenna for 5G and 5G-related Applications – Patent Landscape Analysis, Knowmade, 2019 - 5G’s Impact on RF Front-End Module and Connectivity for Cell Phones report, Yole Développement, 2018

**LYON, France – May 16, 2019:** Today, the IP<sup>1</sup> landscape related to antenna for 5G is still unsettled, announces [Knowmade](#). With more than 75% of patent applications still pending, much will change in the coming years.

**Antenna for 5G & 5G-related applications: time evolution of patent family publications per main technology**

(Source: Antenna for 5G and 5G related Applications Patent Landscape, Knowmade, 2019)



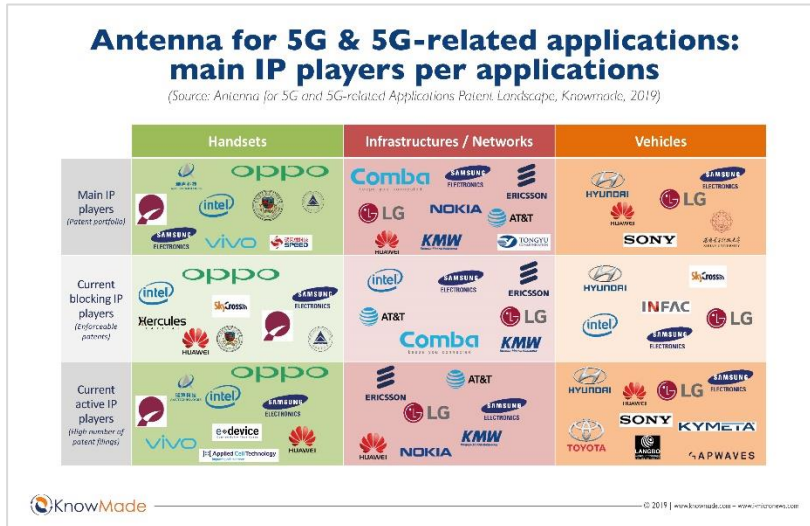
“After an initial period of domestic patent applications, the main IP and market players including Samsung, Intel, Ericsson, and Huawei, have begun extending their portfolios worldwide”, comments **Paul Leclaire, PhD. Patent & Technology Analyst at Knowmade**. “Samsung and Intel appear to be the two leaders currently best-positioned to limit their main competitors’ patenting activity and freedom-to-operate.”

With its new patent landscape analysis, [Antenna for 5G and 5G-related Applications](#), Knowmade proposes today a deep understanding the key players’ patented technologies and current IP strategies. According to Knowmade’s analysts, more than 620 patent applicants are involved in antennas’ development for 5G applications.

Under this dynamic context of development, this report is a real opportunity to get a deep understanding of the ecosystem and key players’ IP position through a detailed analysis of their patent portfolios. With this new analysis, Knowmade also explores capability of each player to limit other firms’ activities related to antenna for 5G. What will be the impact at the antennas’ level, in term of technology evolution and market trends? How will leading players manage 5G introduction? What are the current R&D efforts made by these companies? What is the status of the IP landscape? Knowmade, partner

<sup>1</sup> IP : Intellectual Property

of [Yole Développement \(Yole\)](#) proposes today a valuable and comprehensive overview of the antenna patent ecosystem.



5G wireless communication, expected to hit the market by 2020, is the next mobile technology standard. Therefore, 5G will totally redefine how RF front-end interacts in-between the network and the modem. Indeed, new RF sub-6 GHz, and mm-wave pose big challenges for industrials. However, with these challenges comes opportunity to disrupt the market's leadership...

“On the 5G sub-6 GHz side, the current front-end leaders including Broadcom, Qorvo, Skyworks, and Murata have already begun adapting to these changes,” explains **Cédric Malaquin, Technology & Market Analyst at Yole**. And he adds: “Skyworks has launched its 5G Front End platform, Sky5™ and Qorvo will integrate 5G content in its high end LTE platform, RF Fusion™. Qualcomm has pushed the 5G mmWave approach with the commercial release of dedicated compact antenna in package to be integrated in smartphone corner.”

“Qualcomm is the new entrant that brings with it an end-to-end solution from modem to antenna”, explains **Antoine Bonnabel, Technology & Market Analyst at Yole**. “Also, strategic investment in TDK Epcos’ filtering technology has become profitable. The first revenue was generated in the RF front-end segment during 2017. At Yole, we can expect further revenue to come in the near future. A first mobile phone, Sony’s XZ2 already adopted Qualcomm’s complete solution.”<sup>2</sup>...

Antoine is also engaged within the RF electronics activities at Yole and closely collaborates with Cédric to propose relevant technology & market analyses and presentations all year long.

Along with mobile devices, 5G and 5G-related networks require the deployment of new infrastructures supporting specific protocols and operation modes, such as MIMO<sup>3</sup>, massive MIMO, beamforming, beam steering, carrier aggregation, and others. In addition to increase the data rate and bandwidth, 5G devices must be compatible with many data types.

<sup>2</sup> Source : [5G's Impact on RF Front-End Module and Connectivity for Cell Phones report](#), Yole Développement, 2018

<sup>3</sup> MIMO : Multi-Input Multi-Output

5G players must explore new frequency spectrums and more – especially the millimeter wave frequencies, from 20 GHz to 300 GHz. Among all RF components now in development for 5G applications including filters, power amplifiers, RF front-end modules, etc... the antenna has become a very complex, invaluable segment of the 5G network.

*“It was only in 2014 that the term “5G” began appearing in patents. Since then, the number of 5G-related patent publications has seen a huge increase, with a growth rate of 113% from 2014 – 2018,”* explains **Paul Leclaire from Knowmade**. *“This strong acceleration is pushed mostly by Chinese IP players, which account for more than 56% of IP activity. In particular, we have noticed a large number of Chinese academic players, which is quite unusual in the telecom domain.”*

In this report, Knowmade has manually segmented the patent corpus in terms of applications. The analysis shows that after a dominant period by US and European IP players involved in the development of antenna for infrastructures and networks, the IP activity related to antenna for handsets has started accelerating. Pushed by the strong patenting activity of Chinese giants Oppo Mobile and Huawei, the IP segment related to handsets is strengthening and will continue growing in importance, thanks to the filing of a number of promising patents related to antenna for handset...



Knowmade and Yole Développement pursue their investigation and propose today a significant collection of RF electronics reports. The partners, both part of Yole Group of Companies combine their market, technical and patent expertise to perform complete analyses and support the leading semiconductor companies in their development. A detailed description of each report is available on [i-micronews.com](http://i-micronews.com), [RF Electronics section](#).

In addition, Yole Group of Companies will be exhibiting at [European MicroWave Week](#) (Paris, France, from Sept. 29 to Oct. 4 - Booth B577). Save the date right now to meet our experts!

**ABOUT THE REPORTS:**

- [Antenna for 5G and 5G-related Applications Patent Landscape](#)

Players worldwide are racing to develop and assert their next generation of antenna devices. On the cusp of the release of the first 5G devices, get an insider's view of players' IP activities and their related antenna technology developments. – Performed by Knowmade

- [5G's Impact on RF Front-End Module and Connectivity for Cell Phones 2018](#)

How is 5G enabling new business opportunities despite flat mobile growth? - **Produced by Yole Développement**

**Companies cited in the report:**

AIROHA, Akoustis, Alcatel, Alcatel-Lucent, Analog Devices Inc. (Hittite), Amazon, Amkor, Apple, ASE Group, ASUS, AT&T, BLU, Broadcom Ltd. (Avago echnologies, Javelin Semiconductor), Brocade, Cavendish Kinetics, Cisco, China Mobile, China Telecom, China Unicom, Coolpad, DelfMEMS, Ericsson, Fujitsu, GLOBALFOUNDRIES, Gartner, Gionee, and more ...

**About the authors:**

- **Nicolas Baron**, PhD. is CEO and co-Founder of Knowmade. He manages the company's development and strategic direction, and personally leads the Electronics & Telecom department. He holds a PhD in Physics from the University of Nice Sophia-Antipolis and a master's degree in Intellectual Property Strategies and Innovation from the European Institute for Enterprise and Intellectual Property (IEEPI Strasbourg), France.
- **Antoine Bonnabel** works as a Technology & Market Analyst for the Power & Wireless team of Yole Développement (Yole). He carries out technical, marketing and strategic analyses focused on RF devices, related technologies and markets.

Prior to Yole, Antoine was R&D Program Manager for DelfMEMS (FR), a company specializing in RF switches and supervised Intellectual Property and Business Intelligence activities of this company. In addition, he also has co-authored several market reports and is co-inventor of three patents in RF MEMS design.

Antoine holds a M.Sc. in Microelectronics from Grenoble Institute of Technologies (France) and a M.Sc. in Management from Grenoble Graduate School of Business (France).

- **Paul Leclaire**, PhD works for Knowmade in the fields of RF technologies, Wireless communications and MEMS sensors. He holds a PhD in Micro and Nanotechnology from the University of Lille (France), in partnership with IEMN in Villeneuve-d'Ascq and CRHEA-CNRS in Sophia-Antipolis (France). Paul previously worked in innovation strategy consulting firm as Consultant.
- As a Technology & Market Analyst, specialized in RF devices & technologies within the Power & Wireless division at Yole Développement (Yole), **Cédric Malaquin** is involved in the development of technology & market reports as well as the production of custom consulting projects.

Prior his mission at Yole, Cédric first served Soitec as a process integration engineer during 9 years, then as an electrical characterization engineer during 6 years. He deeply contributed to FDSOI and RFSOI products characterization. He has also authored or co-authored three patents and five international publications in the semiconductor field.

Cédric graduated from Polytech Lille in France with an engineering degree in microelectronics and material sciences.

**ABOUT YOLE GROUP OF COMPANIES**

Knowmade is a Technology Intelligence and IP Strategy consulting company specialized in analysis of patents and scientific information. The company supports the business development of R&D organizations, industrial companies, and investors by helping them to understand the competitive landscape, follow the technology trends, and find out opportunities and threats in terms of technology and patents. Knowmade is involved in compound semiconductors, power electronics, batteries, RF electronics & wireless communications, solid-state lighting &

display, photonics, MEMS sensors, memories, semiconductor manufacturing & packaging, medical devices, medical imaging, biotech/pharma, and agri-food.

Knowmade's experts provide prior art search, patent landscape analysis, scientific literature analysis, patent valuation, IP due diligence and freedom-to-operate analysis. In parallel the company proposes litigation/licensing support, technology scouting and IP/technology monitoring service. Knowmade's analysts combine their technical and patent expertise with powerful analytics tools and proprietary methodologies, delivering invaluable patent analyses and scientific reviews.

More info on <http://www.knowmade.com> and follow Knowmade on LinkedIn.



Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and image sensors, Compound Semiconductors, RF Electronics, Solid-state lighting, Displays, software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business. . For more information, visit [www.yole.fr](http://www.yole.fr) and follow Yole on [LinkedIn](#) and [Twitter](#).

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