

# Antenna for 5G and 5G-related Applications

## Patent Landscape Analysis - April 2019

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.



### REPORT OUTLINE

- Antenna for 5G and 5G-related applications
- Patent landscape analysis
- April 2019
- Ref.: KM19004
- PDF > 120 slides
- Excel file > 3,600 patents
- €6,490 for a multi-user license

### REPORT'S KEY FEATURES:

- **IP trends**, including time-evolution of published patents, and countries of patent filings
- Ranking of **main patent assignees**
- **Patent analysis for main applications** (handsets, infrastructures & networks, vehicles) **and technologies** (MIMO, beamforming, antenna array, mm-wave, monopole antenna, dipole antenna, microstrip antenna, etc.)
- **Key patents**
- **Key players' IP position**, and **relative strength** of their patent portfolios
- Key players' **IP profile**: Samsung Electronics, Oppo Mobile, Huawei, and Intel
- **Excel database** containing all patents analyzed in this report, including technology and application segmentations

### RELATED REPORTS

- [Acoustic Wave Filters IP Landscape 2017 \(Knowmade\)](#)
- [RF Front-End Modules for Cellphones - Patent Landscape 2017 \(Knowmade\)](#)
- [5G's Impact on RF Front-End Module and Connectivity for Cellphones 2018 \(Yole Développement\)](#)
- [Internet of Things RF Protocols and their Impact on the Electronics Industry – 2018 \(Yole Développement\)](#)
- [RF Front-End Module Comparison - 2018 \(System Plus Consulting\)](#)
- [Qorvo QPF4006 39GHz GaN MMIC Front-End Module – 2018 \(System Plus Consulting\)](#)

### A young but already highly-competitive IP domain

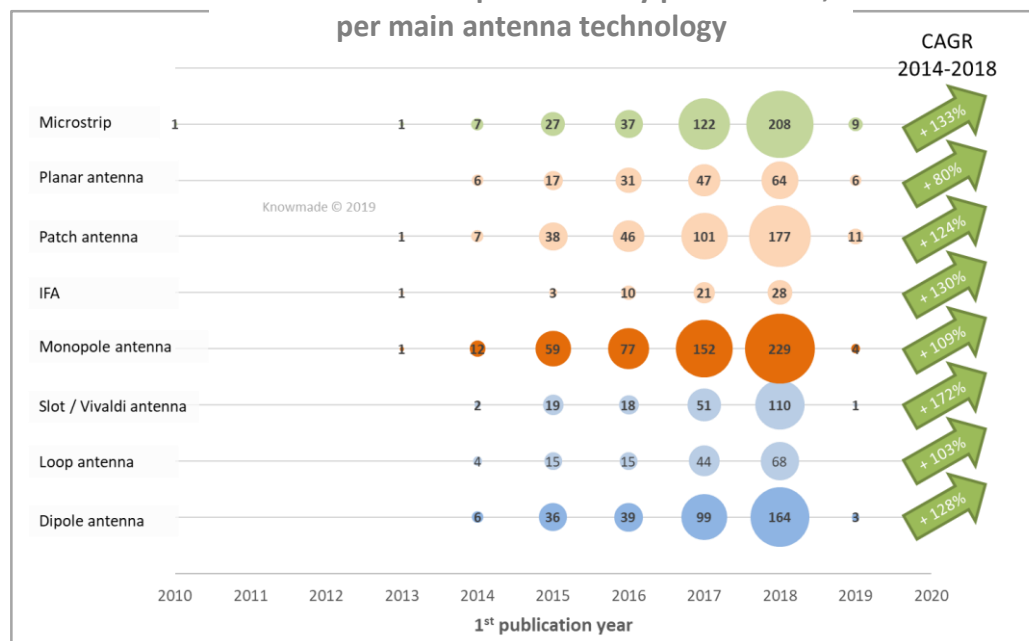
**5G (5<sup>th</sup>-generation) wireless communication**, expected to hit the market by 2020, is the next mobile technology standard - delivering high data rate, low latency communications, and massive device connectivity.

**5G** is a broad market, and its deployment requires the development of many technology blocks. Indeed, **5G will affect global telecommunication services** such as mobile phones, IoT (internet of things), vehicles, and more. Along with mobile devices, 5G and 5G-related networks require the deployment of new infrastructures supporting specific protocols and operation modes, such as **multi-input multi-output (MIMO)**, **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. 5G players must explore new frequency spectrums and more - especially the **millimeter wave frequencies** (from 20 GHz - 300 GHz). Among all RF components now in development for **5G applications** (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. 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.

Today, the **IP landscape related to antenna for 5G** is still unsettled. With more than 75% of patent applications still pending, **much will change in the coming years**. Indeed, after an initial period of domestic patent applications, the main IP and market players - i.e. **Samsung, Intel, Ericsson, and Huawei** - have begun extending their portfolios worldwide. Samsung and Intel appear to be the two leaders currently best-positioned to limit their main competitors' patenting activity and freedom-to-operate.

Time-evolution of patent family publications, per main antenna technology



### Analysis per 5G application type

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.

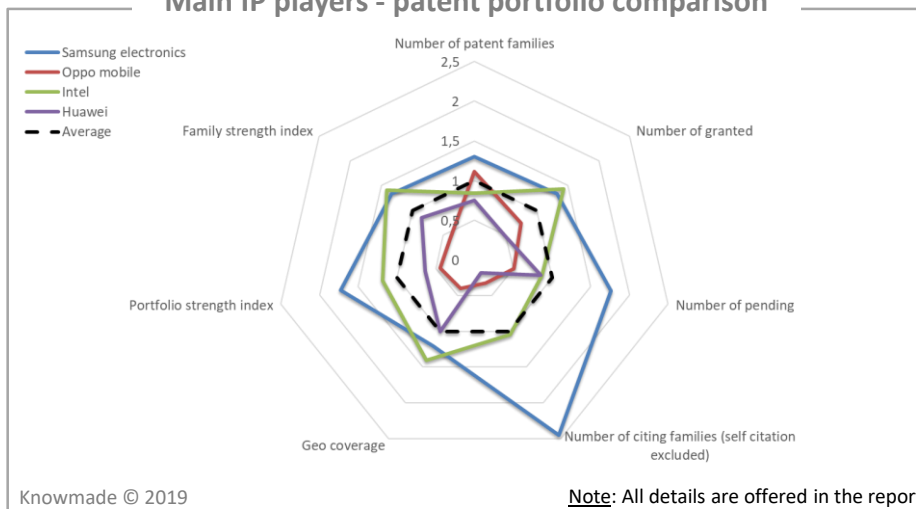
### Main IP players, per application



### Analysis per antenna type

We have observed **significant IP activity** related to **monopole** and **microstrip** antenna. This IP dynamic confirms the growing interest in low-profile, small-size, low-cost antenna, which are oft-used in **handsets**. Furthermore, our report details recent developments and trends that attest to the growing interest in **patch antennas**, which appear to be the **preferred solution** for addressing 5G's technical challenges. Indeed, the main IP and market players (**Apple, Samsung, Huawei, etc.**) have commenced development of IP activity related to patch-antenna array.

### Main IP players - patent portfolio comparison



### Comparison of patent portfolios held by main IP players

This report provides a detailed comparison of the four main IP players: **Samsung, Intel, Huawei, and Oppo Mobile**. Each one's **strength and weaknesses** are highlighted, and information is provided about their **recent and future technology developments**. Also included is a detailed description and analysis of their **key patents**.

### Report's main assets

- Understanding the key players' patented technologies and current IP strategies**  
More than **620 patent applicants** are involved in the **antenna for 5G patent landscape**. This report reveals the **key players' IP position** through a detailed analysis of their patent portfolios. Knowmade also provides an understanding of these players' **patented technologies** and their **IP strategy**, and explores their **capability to limit other firms' patenting activity and freedom-to-operate**.
- Analyzing IP players' position on promising applications and developed technologies**  
This report also supplies an understanding of **IP players' positions on promising applications**. The **main IP players and key patents** are presented for each segment, in concert with an **understanding of the current technical challenges addressed in these patents**.
- Identifying and understanding key patents related to antenna for 5G**  
A thorough **analysis of key patents (seminal, blocking) related to antenna for 5G** is included in this report. Furthermore, for each segment a selection of seminal, blocking, and most-promising patents is furnished.
- Available Excel patent database**  
Our report integrates an **Excel database containing the >3,600 patents** analyzed in this study. This pivotal patent database **allows for multi-criteria searches** and includes patent publication numbers, hyperlinks to the original documents, priority date, title, abstract, patent assignees, patent's current legal status, and technological/application segments.

**Companies mentioned in this report** (non-exhaustive list)

SAMSUNG ELECTRONICS, OPPO MOBILE, INTEL, AAC TECHNOLOGIES, HUAWEI TECHNOLOGIES, SHENZHEN SUNWAY COMMUNICATION, AT&T, LG, GUANGDONG TONGYU COMMUNICATION, SOUTH CHINA UNIVERSITY OF TECHNOLOGY, ERICSSON, XIDIAN UNIVERSITY, XIAMEN UNIVERSITY, TAN KAH KEE COLLEGE, CHIUN MAI COMMUNICATION SYSTEMS, SOUTHEAST UNIVERSITY NANJING, NOKIA, COMBA TELECOM SYSTEMS, UNIVERSITY OF ELECTRONIC SCIENCE & TECHNOLOGY OF CHINA, KUANG CHI INSTITUTE OF ADVANCED TECHNOLOGY, SHANGHAI AMPHENOL AIRWAVE COMMUNICATION ELECTRONICS, MURATA MANUFACTURING, QUALCOMM, KUNSHAN RUIXIANG XUNTONG COMMUNICATION TECHNOLOGY CO, SONY, ELECTRONICS & TELECOMMUNICATIONS RESEARCH INSTITUTE, ZTE, CHINA JILIANG UNIVERSITY, HUIZHOU SPEED WIRELESS TECHNOLOGY, VIVO MOBILE COMMUNICATION, and more.

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**AUTHORS****Dr. Paul Leclaire**

Paul 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 as a Consultant for an innovation strategy consulting firm.

**Contact:** paul.leclaire@knowmade.fr

**Dr. Nicolas Baron**

Nicolas is CEO and co-Founder of Knowmade. He manages the company's development and strategic direction, and personally leads the Semiconductor department. He holds a PhD in Physics from the University of Nice Sophia-Antipolis (France) and a master's degree in Intellectual Property Strategies and Innovation from the IEEPI (Strasbourg, France).

**Contact:** nicolas.baron@knowmade.fr

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Ref.: KM19004

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