

5G: take it or leave it?¹

5G is reaching the mass market. Is it an opportunity for RF front-end legacy players? Will the Chinese companies be part of this dynamic?

OUTLINE:

- Market forecasts:
Yole Développement (Yole) expects the RF² front-end market to grow to more than US\$21 billion toward 2026, with a 8,3% CAGR³₂₀₂₁₋₂₀₂₆.
The biggest growth regards AiP⁴ module with a 75,5% CAGR₂₀₁₉₋₂₀₂₆.
The most attractive segment in 2026 will be the PA⁵ module with almost US\$10 billion.
The number of 5G phone will more than double in 2021 compared to 2020.
- Technology trends:
The mmWave⁶ version of 5G have significantly progressed in 2020.
Tight capacity has made OEM⁷ priorities their phone launches and, in some cases, even delay the launch date.
The competition has again intensified, leading to some evolution in the market share at OEM level.
- Supply chain:
Skyworks, Murata, Qorvo, Broadcom, and Qualcomm are the market leaders.
Qualcomm took advantage of the 5G transition and strongly increased its share in the RF front-end market.
A strong will for technological independence is pushing Chinese OEMs, investors and public authorities to massively invest in local companies

*“A sharp transition toward 5G is ongoing in mobile devices.” asserts **Cédric Malaquin, Technology & Market Analyst, RF Devices & Technology at Yole Développement (Yole)**. He adds: “The number of 5G phones will more than double in 2021 compared to 2020.*

¹ Extracted from:

Cellular RF Front-End Technologies for Mobile Handset 2021 report, Yole Développement
RF Front-End Module Comparison 2021 – Vol. 2 – Focus on 5G Chipset report, System Plus Consulting
Smartphone Design Win Quarterly Monitor, System Plus Consulting

² RF: Radio Frequency

³ CAGR: Compound Annual Growth Rate

⁴ AiP: Antenna in Package

⁵ PA: Power Amplifier

⁶ mmWave: millimeter Wavelength

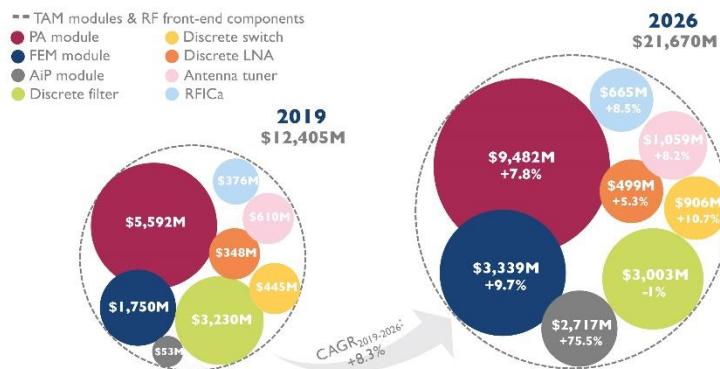
⁷ OEM: Original Equipment Manufacturer

This is a significantly faster penetration rate than the LTE⁸ standard 10 years ago. And 5G is leading to an unprecedented increase in content of RF devices, while previous radio standards still need to be supported”.

As a result, hundreds of RF components must be fitted into handheld format devices. This is now impacting mid-tier and entry-level phones, not only flagships. 5G features implemented in handsets focus on improving download speed and make the uplink more robust. In addition, there is an entirely new radio path created at mmWave frequencies, though this only applies to flagships right now.

2019-2026 RF front-end market forecast by type of component

(Source: Cellular RF Front-End Technologies for Mobile Handset 2021 report, Yole Développement, 2021)



The cellphone industry has entered a transition toward 5G.

First use cases of the technology have matured and MNO⁹ are proposing new services to the consumer. MNOs are strongly motivated to invest more resources and to demonstrate 5G’s added value to the consumers, as 5G is not the first thing they are thinking about. In addition, MNOs have developed advantageous commercial 5G packages, particularly in China, adding some more motivation to consumers to upgrade.

In this context, 5G has strongly penetrated the smartphone market in 2020 and is expected to further grow as the network is expanding in China, in Europe and in the USA.

A 5G phone is relatively more complex than a 4G phone at the RF front-end level. Therefore, it’s worth analyzing the technical trends and anticipating future changes to understand this complex market better. Indeed, as for every new air standard, 5G represents a significant opportunity for industry players to differentiate, innovate and win the market in the end. Released today, the [Cellular RF Front-End Technologies for Mobile Handset 2021 report](#) gives Yole’s analysts view on the RF front-end market evolution and its associated ecosystem.

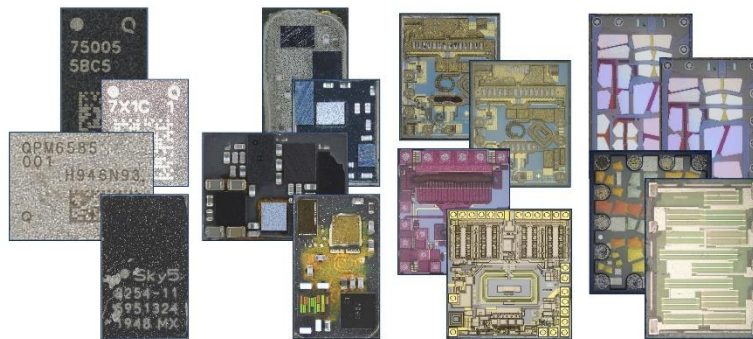
⁸ LTE: Long-Term Evolution

⁹ MNO: Mobile Network Operators

In addition, the reverse engineering and costing company, [System Plus Consulting](#), offers in-depth semiconductor technologies analysis, including RF solutions in its [Smartphone Design Win Quarterly Monitor](#). Read the dedicated article [here](#). Also, the company proposes a technical and cost overview of the evolution of RF front-end module technologies integrated in 5G mmWave and Sub-6 GHz Phones in 2020 in the [RF Front-End Module Comparison 2021 – Vol. 2 – Focus on 5G Chipset report](#).

RF front-end modules comparison: B4I/n4I PAMiD from Qorvo, Qualcomm and Skyworks

(Source: RF Front-End Module Comparison 2021 – Vol. 2 – Focus on 5G Chipset report, System Plus Consulting)



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As seen in the [Cellular RF Front-End Technologies for Mobile Handset 2021](#) report, Yole’s RF’s team estimates the RF content as US\$5-US\$8 higher in a 5G phone compared to a 4G version and an additional US\$10 for a mmWave version.

As a result, the RF front-end market is booming. It should reach US\$17 billion by the end of 2021, up from US\$14 billion in calendar year 2020. From there, RF front-end market growth should slow. ASP¹⁰ erosion will be stronger when 5G is mainstream and competition grows further. Overall, analysts expect an 8.3% CAGR between 2019, the year of 5G’s introduction, and 2026, leading to a US\$21 billion RF front-end market.

The introduction of 5G adds complexity to phones along with RF content. Building 5G phones using discrete components while keeping an acceptable form factor is a challenge, driving more integration.

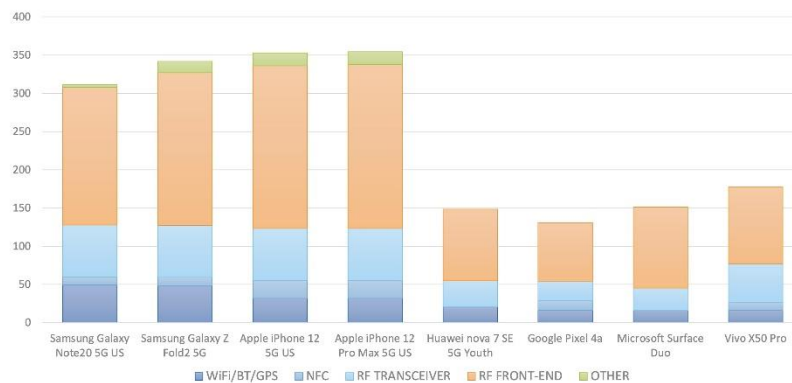
“The RF front-end market leaders all have flexible module offerings adapting to multiple market requirements. Besides that, some also have custom-built modules for the flagships” affirms **Mohammed Tmimi, PhD., RF Technologies and related markets analyst at Yole:** *“As a result, Skyworks, Murata, Qualcomm, Qorvo and Broadcom together share 85% of the RF front-end market. Skyworks is the market leader”.*

¹⁰ ASP: Average Selling Price

Qualcomm has the strongest growth. According to **Stéphane Elisabeth, Senior Technology and Cost Analyst at System Plus Consulting**: “At the end of 2019, Qualcomm had a smaller market share than the others supplier. This change in 2020, with OEMs like Samsung. The share of Qualcomm almost double at the beginning of the year. Yet, the situation changes at the end of 2019 with the release of the Apple phones. Indeed, the iPhone series doesn’t integrate a lot of Qualcomm’s component in its design. The goal of Apple is to avoid the use of Qualcomm completely in the future.”

Smartphone design wins, Q1 2021 - Focus on RF die area, in mm²

(Source: Smartphone Design Wins Quarterly Monitor, Q1 2021, System Plus Consulting)



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However, a variety of companies coming from China are emerging and experiencing double digit growth in the RF front-end space. Most started in the discrete business with standalone LNAs¹¹ or switches, which enabled them to accumulate know-how and establish trust with OEMs.

The next step for these fabless Chinese companies is to bring integrated modules to the market. This has been supported by more investments in China over the past two years. It’s likely that not all will succeed, but we can expect more cooperation and consolidation over the next few years.

A major difficulty for success will be the access to wafer capacity. There is not a shortage of RF components per se, more like tightness in the industry. This is pushing long term supply agreements that only big players can afford.

All year long, Yole Group of Companies, including *Yole Développement* and *System Plus Consulting* publishes numerous reports and monitors. In addition, experts realize various key presentations and organize key conferences.

¹¹ LNA: Low Noise Amplifiers



In this regard, do not miss the right technical choices for a reliable smartphone supply chain – Webcast on June 29th presented by Romain Fraux, CEO of System Plus Consulting and Jim Mielke, VP Consumer Teardowns, Department Director at System Plus Consulting. Register [here!](#)

In addition, Antoine Bonnabel, Technology & Market Analyst, RF devices and Technology at Yole will participate to “5G brings private networks to life but will have to compete with the edge computing approach” during IoT & 5G World – organized by EETimes. Make sure to be aware of the latest news coming from the industry and get an overview of our activities, including interviews with leading companies and more on [i-Micronews](#). Stay tuned!

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About our analysts

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.

Mohammed Tmimi, PhD., is a Technology and Market Analyst for the RF devices & Technologies Group at Yole Développement (Yole). Prior to Yole, Mohammed was engaged in developing a novel approach for RF/mmW high-speed serial links for high-performance chips at STMicroelectronics' Crolles R&D site in France as part of his Ph.D. During his Ph.D., he also worked on mmW design in advanced FD-SOI nodes and proposed an original interconnect technique for 2.5D/3D packaging. Mohammed now holds a patent on these serial links and has published two scientific papers. Mohammed graduated from INP Grenoble (France) with a master's in microelectronics and an electronics engineering degree from ENSAO (Morocco). He was awarded his Ph.D. in Nano Electronics and Nano Technologies from the University of Grenoble Alpes, France.

Stéphane Elisabeth, PhD is Senior Technology and Cost Analyst at System Plus Consulting, part of Yole Développement (Yole). Stéphane regularly works on numerous reverse engineering and costing reports while also managing custom projects in the RF electronics and advanced packaging fields. His mission at System Plus Consulting is to provide an in-depth understanding of the technologies selected by the leading semiconductor companies as well as the ecosystem around a device. In this context, Stéphane is leading a strategic watch to identify the latest innovative devices and collaborates closely with System Plus Consulting's laboratory to analyze devices or components. His aim is to reveal the link between functionality and the technical choice made by the device maker. Based on the identification of each process step and process flow, our analysts can then provide an accurate evaluation of the manufacturing cost. His significant industrial and technical knowledge allows him also to update internal simulation tools developed by System Plus Consulting's experts. In addition, Stéphane supports the development of RF electronics activities through key customer projects, including presentation of their results. Prior to this collaboration with System Plus Consulting, Stéphane worked on projects in partnership with THALES for the development of innovative hybrid RF circuits. He also regularly publishes articles and interviews within key RF electronics and packaging magazines. Stéphane holds an engineering degree in electronics and numerical technology (Université de Nantes, France) as well as a PhD. in Materials for Microelectronics (Université de Nantes, France).

Romain Fraux is the CEO of System Plus Consulting of Yole Développement. System Plus Consulting focuses on Reverse Costing analysis of electronics, from semiconductor devices to electronic systems. Supporting industrial companies in their development, Romain and his team are offering a complete range of services, costing tools and reports. They deliver in-depth production cost studies and estimate objective selling price of a product, all based on a detailed physical analysis of each component in System Plus Consulting laboratory. Romain has been working for System Plus Consulting for more than 15 years and was previously the company's CTO. He holds a bachelor's degree in Electrical Engineering from Heriot-Watt University of Edinburgh (Scotland), a master's degree in Microelectronics from the University of Nantes (France), and a Master of Business Administration.

Audrey Lahrach serves as a Technology & Cost Analyst, MEMS, Sensors & Display at System Plus Consulting, part of Yole Développement. With significant expertise in the field of MEMS & sensors, including inertial, pressure and gas, as well as in the field of display technologies, Audrey produces reverse engineering & costing analyses while also running custom projects. Her mission is performed in collaboration with the laboratory team, and together they define the objectives of the analyses and determine the methodologies to reveal the structure of the devices and all materials required for their development and production. Audrey's aim is to determine and

understand the technology choices made by the leading sensing companies, from the materials to the device itself. In addition, Audrey runs a technology watch daily to identify innovative MEMS & sensors and related semiconductor manufacturing processes. Her objective is to gain a comprehensive understanding of the evolution of semiconductor technologies and identify the strategy of the leading manufacturers. Thanks to her previous experience with CMOS image sensors and camera manufacturing, Audrey is also involved in the development of System Plus Consulting's imaging activities. Utilizing her knowledge in a combination of MEMS, sensing and imaging, Audrey is overseeing the development of a new System Plus Consulting product, the Smartphone Monitor. Audrey attends international trade shows & conferences to meet the MEMS & sensing companies, from component manufacturers to equipment manufacturers, and to identify the latest innovations. Audrey has taken part in online events to present key results of her teardowns and cost analyses. She has also published some articles in the press. Audrey holds a master's degree in Microelectronics from the University of Nantes (France).

About the reports and monitor

Cellular RF Front-End Technologies for Mobile Handset 2021

5G reaching the mass market is an opportunity and threat for RF front-end legacy players, and is unifying Chinese companies. – Performed by Yole Développement

Companies cited:

Active Semi, AGC, Airoha, Akoustis, Anhui YUNTA Electronic, Apple, ASE, Asus, AT&T, AwinIC,AXT, Broadcom, CanaanTek, Cavendish Kinetics, China Mobile, China Telecom, China Unicom, ChipBetter, CoolPad, Corning, Cypress Semiconductor, DB-HiTek, Dowa, EE, Elisa, Epic MEMS, Ericsson, Etisalat, EtraSemi, Ferfics, Freiberger, GlobalFoundries, Global Wafer, Google, HH Grace, HiSilicon, HMD Global, Honor, HTC, Huawei, Huntersun-MEMS, Infineon, Intel, IQE, Jio, JRC, KDDI, KT, Kyocera, and more...

RF Front-End Module Comparison 2021 – Vol. 2 – Focus on 5G Chipset

Technical and cost overview of the evolution of radio frequency front-end module technologies integrated in 5G mmWave and Sub-6 GHz Phones. – Performed by System Plus Consulting

Smartphone Design Win Quarterly Monitor

The first-ever smartphone technology monitor covering the latest components, packaging, and silicon chip choices of smartphone makers. – Performed by System Plus Consulting

Related reports:

- [5G's Impact on RF Front-End for Telecom Infrastructure 2021](#)
- [5G Packaging Trends for Smartphones 2021](#)
- [Apple iPhone 12 series mmWave 5G Chipset and Antenna](#)

About Yole Développement

Founded in 1998, Yole Développement (Yole) 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... [More](#)

About System Plus Consulting

System Plus Consulting specializes in the cost analysis of electronics, from semiconductor devices to electronic systems. Created more than 20 years ago, System Plus Consulting has developed a complete range of services, costing tools and reports to deliver in-depth production cost studies and estimate the objective selling price of a product... [More](#)

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