**CMOS IMAGE SENSOR SERVICE - IMAGING RESEARCH**

Quarterly Market Monitor - 2019

As camera quantity and die size increase per end-device, a 10.1% year-on-year growth rate is expected for 2019.

**WHAT ABOUT THE CMOS IMAGE SENSOR SERVICE - IMAGING RESEARCH?**

A full package:
The CMOS Image Sensor Quarterly Market Monitor includes the following deliverables:

- Excel database with quarterly update on historical and forecast data
- PDF slide deck with graphs and comments/analysis covering expected evolutions
- Direct access to a Yole Développement analysts for one year, providing an opportunity for on-demand Q&A and discussions regarding trends, analyses, forecasts, and breaking news

**Frequency:**
Receive every quarter the updated Market Monitor documents

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**CMOS IMAGE SENSOR (CIS) HAS BECOME A KEY SEGMENT IN SEMICONDUCTOR INDUSTRY**

CIS is an analog variant of the CMOS process commonly used for memory and logic circuits, and has become a key segment in semiconductor, reaching $15.5B in 2018 and exceeding 3% of total semiconductor sales. This segment has seen Sony become a significant semiconductor player, alongside other CIS players such as Samsung, OVT, and ON Semiconductor. Innovative approaches like wafer stacking technologies have emerged specifically for CIS, and have become key developments for the semiconductor market in general. In the context of a fierce rivalry in the technology sector, imaging has become a key focal point of OEMs and the entire semiconductor supply chain.

**IMAGE SENSOR ATTACHMENT RATES ARE INCREASING, THANKS TO MOBILE PHOTOGRAPHY**

In 2007, smartphones began disrupting the imaging market and its corresponding technology. Just five years later, the production peak for digital still-cameras was reached, and phones became the primary imaging device for consumers. New use-cases linked to social media began fuelling the need for high-quality rear (world-facing) cameras for photography, quickly followed by front (selfie) cameras for videos and top-grade photography. 2015 - 2017 saw additional cameras attached, either to extend the zoom capability on the rear or to provide 3D biometric interaction on the front. In 2019, 3D rear cameras are pushing the trend further to the back, improving the photographic experience and making inroads into augmented reality (AR) applications.

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**CIS market dynamics**

(Yole Développement, June 2019)
In 2019, the overall attachment rate for CIS cameras per phone is moving towards in average of 2.5 units per phone, and the growth rate for CIS attachment will rise from 6.5% to 7.8% from 2019 - 2021. Amidst stagnant smartphone volume, CIS attachment rate is a central, successful strategy for main smartphone OEMs like Apple, Huawei, and Samsung.

Alongside mobile, which is the main application market (representing 70% of all CIS sales), security and automotive are experiencing double-digit growth and have grown into billion-dollar CIS segments. Again, the attachment rate per end-system is the key metric to monitor.

The CIS market’s future promises to be as dynamic as its past. Yole Développement’s quarterly monitor will answer the pressing questions facing this industry, including:

• Will the three primary CIS (Sony, Samsung, and OVT) continue to manage supply and drive industry revenue to even higher levels?

• Will the 3D sensing trend help STMicroelectronics and Infineon join the leading pack?

• Will China’s entrance in the CIS market disrupt the current market balance?

• What demand segments will emerge to compensate for the diminishing computing and consumer categories?

• How much farther will the CIS roadmap extend? Is there a future beyond hybrid stacking?

• How will AI and machine learning impact CIS demand and the technology roadmap?

• Will autonomous vehicles meaningfully impact the CIS market? If so, when?

• Will CIS capital expenditures continue their recent upward trend, or will capital intensity climb too high and threaten supplier stability?

With its CIS quarterly market monitor, Yole Développement provides opinions and answers to all of these questions on a quarterly basis.

WHAT DO THE UPCOMING QUARTERS HOLD?

2019 looks slightly different than 2018. With a low Q1, the CIS market faces a slowly eroding ASP since most players can now match Sony’s proposition. Nevertheless, the market remains...
Benefit from our Bundle & Annual Subscription offers and access our analyses at the best available price and with great advantages.

The CIS Quarterly Market Monitor contains all of the data related to CIS revenue per quarter, CIS shipments, near and long-term revenue, market share per quarter, capex per company, and market demand/supply forecasts, as well as a complete analysis and details of the demand side, with a deep dive into mobile, consumer, computing, automotive, medical, security, defense & aerospace, and industrial. For the top players (Sony, Samsung, OVT, ON Semiconductor, Panasonic, Canon, SK Hynix, and others), the CIS Quarterly Market Monitor furnishes a detailed analysis of capex, shipments, and wafer production per technology (process mix), along with the expected impact of CIS technology changes. The following deliverables are included:

- Excel database with all historical and forecast data
- PDF slide-deck with graphs and comments/analysis regarding expected evolutions
- Direct access to a Yole Développement analyst for one year, providing an opportunity for on-demand Q&A and discussions regarding trends, analyses, forecasts, and breaking news.

The monitor content will evolve according to the feedback received from our customers.

### COMPANIES MONITORED IN THE PRODUCT
Canon, OVT, ON Semiconductor, Panasonic, Samsung, SK Hynix, Sony, STMicroelectronics

### TABLE OF CONTENTS (complete content on i-Micronews.com)

**CIS market overview**
- Per technology (VIS, NIR)
- Shipments by technology node (XX nm)
- Shipments by technology (FSI x BSI x Stack BSI x Multi-Stack)

**Supply**
- Industry wafer production (CIS wafer production, per foundry - Long/near term - VIS and NIR)
- Industry wafer capacity estimation

**Player**
- Sony – Revenues per quarter and per application, capacity, fab.
- Samsung – Market mix
- OVT – Market mix
- ON Semiconductor – Market mix
- STMicroelectronics – Market mix
- Panasonic – Market mix
- Canon – Market mix
- SK Hynix – Market mix
- Others – Market mix

**CIS market segment share**
- Mobile market
- Consumer market
- Automotive market
- Medical market
- Security market
- Industry market
- Aerospace & Defense market

**CIS technology**
- CIS wafer demand, per segment

### KEY FEATURES OF THE MONITOR
- Quarterly update of the data
- Market forecast through 2024 in $US, units, and wafers
- Market share (Sony, Samsung, OVT, ON Semiconductor, STMicroelectronics, Panasonic, Canon, SK Hynix) from 2015 to present: by revenue ($US), segment ($US), technology (wafer), and foundry (wafer)
- Demand forecast through 2024 by category (i.e. mobile, consumer, security, auto), in revenue ($US) and units
- Supply forecast through 2024: by supplier for wafer production (wpm, by fab), technology mix (% of wafers), and process node (% of wafers)

### AUTHORS
**Pierre Cambou** has been part of the imaging industry since 1999. He first took several positions at Thomson TCS, which became Atmel Grenoble in 2001 and e2v Semiconductors in 2006. In 2012 Pierre founded Vence Innovation, later renamed Irlux, to bring to market an infrared sensor technology for smart environments and interactions. He has an Engineering degree from Université de Technologie de Compiegne and a Master of Science from Virginia Tech. Pierre also graduated with an MBA from Grenoble Ecole de Management. In 2014 he joined Yole Développement as Imaging Activity Leader.

Chenmeijing Liang works as a Technology & Market Analyst within the Photonics, Sensing & Display Division at Yole Développement (Yole). As part of the Imaging team, Chenmeijing contributes daily to analyses of CIS markets, related technologies and market strategies of the leading semiconductor companies, as well as the quarterly monitor. Prior to Yole, she was engaged in the development of R&D projects: Chenmeijing was a member of Group PSA R&D department where she worked on Vehicle 3D Holography Imaging projects. In addition, she assisted with various technical and commercial projects. Chenmeijing Liang holds a master’s degree in the field of Applied Physics and Optical engineering from Paris-Saclay University and University Pierre and Marie Curie (UPMC) (Paris, France).
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(1) Our Terms and Conditions of Sale are available at www.yole.fr/Terms_and_Conditions_of_Sale.aspx
The present document is valid 24 months after its publishing date: June 27, 2019

ABOUT YOLE DÉVELOPPEMENT
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.

CONSULTING AND ANALYSIS
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• Patent analysis
• Design and characterization of innovative optical systems
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Definitions: “Acceptance”: Action by which the Buyer accepts the terms and conditions of sale in its entirety. It is done by signing the purchase order which mentions “I hereby accept Yole Développement’s Terms and Conditions of Sale.”

“Buyer”: Any business user (i.e. any person acting in the course of its business activities, for its business needs) entering into the following general conditions to the exclusion of consumers acting in their personal interests.

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“Intellectual Property Rights” (“IPR”) means any rights held by the Seller in its Products, including any patents, trademarks, registered designs, models, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights or similar in any part of the world, notwithstanding the fact that they have been registered or not, or including any pending registration of one of the above mentioned rights.

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“Correspondence”: Correspondence becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by the Buyer after signing the purchase order which mentions “I hereby accept Yole Développement’s Terms and Conditions of Sale.”

“Acceptance”: Action by which the Buyer accepts the terms and conditions of sale in its entirety. It is done by signing the purchase order which mentions “I hereby accept Yole Développement’s Terms and Conditions of Sale.”

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2. MAILING OF THE PRODUCTS

2.1 Products are sent by email to the Buyer:
- Within a few days from the order for Products already released and paid;
- Within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best efforts to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 The Seller shall by no means be responsible for any delay in receiving the Product, including any delay resulting from the event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.

2.3 The Buyer agrees to be solely upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 The mailing is operated through electronic means either by email via the sales department or automatically online via an email/password. If the Product’s electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

2.6 No return of Products shall be accepted without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information shall, as provided for in article 2.5, remain at the Buyer’s risk.

3. PRICE, INVOICING AND PAYMENT

3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are to be exclusive of Value Added Tax. The re-price are re-evaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.

3.2 Payments due by the Buyer shall be sent by cheque payable to Yole Développement, credit card or by electronic transfer to the following account:
- IBAN: FR76 3005 6001 7001 7020 0156 587
- BIC or SWIFT code: CCFRFRPP
- Branch code: 00170
- Bank code: 30056
- Address: 1 Rue Bourge 69002 Lyon France

3.3 IBAN: FR76 3005 6001 7001 7020 0156 587
- Address: 1 Rue Bourge 69002 Lyon France
- Bank code: 30056

3.4 If such deadlines are not met, it shall not lead to any guaranteed. If such deadlines are not met, it shall not lead to any cancellation of the orders, except for non-acceptable difficulties which are beyond the control, and not the fault of the Seller.

5. FORCE MAJEURE

5.1 The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labour difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the Seller’s control or power of the Seller.

6. PROTECTION OF THE SELLER’S IPR

6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international laws, regulations and conventions.

6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company (only in the country of the primary user). The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as: • Internal storage systems; • Recordings and re-transmitting over any network (including any local area network); • Using in any time-sharing, service bureau, bulletin board or similar arrangement or public display; • Posting any Product to any other online service (including bulletin boards or the Internet); • Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 If the Buyer would like to use data coming from the Products for purposes, press articles and financial reports, the Buyer needs to contact Yole Développement’s Public Relations Director (info@yole.fr) to get an official authorization and verify data up to date. In this case the Seller will make sure to provide up-to-date data under a suitable public format.

6.4 The Buyer shall be solely responsible towards the Seller of all infringements of the obligation, whether this infringement comes from employees or from third parties. In case the Buyer produces Products and shall personally care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.5 The Buyer shall define in its company a contact point for the needs of the contract. This person will be the recipient of each new report. This person shall also be responsible for receipt of the copyrights and will guaranty that the Products are not distributed by any other company, external consultants, the joint venture done with a third party, and so on and on.

6.6 Please note that whether in Bundles or Annual Subscription, all unsolicited reports will be cancelled and lost after the 12 month period.

6.7 As a matter of fact the investor of a company, external consultants, the joint venture done with a third party, and so on and on, cannot access the report and should pay a full license price.

7. TERMINATION

7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequent loss that may be borne by the Seller, following this decision.

7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of 60 days from the date of mailing, the Buyer shall have the right to terminate all the pending orders, without being liable for any compensation.

8. MISCELLANEUS

8.1 All provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer. Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party. The Seller may, from time to time, update these Terms and Conditions. Such update will be deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

9. GOVERNING LAW AND JURISDICTION

9.1 Any dispute arising out of or linked to these Terms and Conditions or to any transaction relating to the Products shall be settled by the French Commercial Courts of Lyon, which shall have exclusive jurisdiction upon such issues.

9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.