2017 saw aggregated CIS industry revenue of $13.9B. We now forecast a 9.4% compound annual growth rate (CAGR) for the next five years. Year-on-year (YoY) growth hit a peak at 20% due to the exceptional increase in image sensor value, across almost all markets, but primarily in the mobile sector. The market has benefited from the operational recovery of leading CIS player Sony, which captured 42% market share. The CIS industry is able to grow at the speed of the global semiconductor industry, which also had a record year, mainly due to DRAM revenue growth. CIS have become a key segment of the broader semiconductor industry, featuring in the strategy of most key players, and particularly the newly-crowned industry leader Samsung. Mobile, security and automotive markets are all in the middle of booming expansion, mostly benefiting ON Semiconductor and Omnivision. These markets are boosting most players that are able to keep up with technology and capacity development through capital expenditure. The opportunities are all across the board, with new players able to climb the rankings, such as STMicroelectronics and Smartsense. Technology advancement and the switch from imaging to sensing is fostering innovation at multiple levels: pixel, chip, wafer, all the way to the system. CIS sensors are also at the forefront of AI development. We can foresee new techniques and new applications all ready to keep up the market growth momentum.

This report is aimed at giving the best possible snapshot of the current status of the CIS industry in order to proactively benefit from the next wave of innovations.

IMAGE SENSOR PROLIFERATION IS BENEFITING BOTH VOLUME AND REVENUE GENERATION

The key takeaway from 2017 has been the rapid deployment of dual camera approaches in the mobile sector. The market has quickly adopted dual cameras on the rear of the phones, serving photography either to improve resolution and low light performance or to provide optical zoom capabilities. Dual camera approaches have also been deployed on the front side, mostly serving biometric face or iris recognition, but also 3D sensing in the Apple iPhone X. Competition and differentiation between mobile device manufacturers is deeply linked to CIS implementation. CIS has therefore benefited from ever-increasing dollar content per smartphone.
Security is now one of the most active markets, tightly connected to Chinese involvement in the industry. Hikvision and Dahua are the two new leading OEM manufacturers, having capitalized very quickly on internet protocol (IP) camera technology, cloud computing and artificial intelligence. The number of cameras per security system isn’t limited by human monitoring any more, which is a paradigm shift for surveillance. In automotive the same is occurring, as rear back-up cameras have become mandatory in the US. Also, the move toward ever-increasing numbers of cameras per car, either to serve front Advanced Driver Assistance System (ADAS) collision avoidance or 360° parking assist cameras, is worldwide. The number of cameras increases at the same time as quality increases, which has a multiplier effect on revenue generation. The CIS industry sector is clearly in the middle of a golden age.

Sony is the unchallenged industry leader market and technology-wise. It benefited from the operational recovery of the Kuamoto foundry after the major earthquake of 2016. This helped Sony’s market share increase, on top of the CIS market’s rapid growth. Samsung is also maintaining its growth, and is now able to match most of Sony’s technology advancements in 3D stacking. This mostly serves Samsung’s handset division, but it’s increasingly supporting Chinese OEMs in a constrained environment for high-end Mobile CIS. Omnivision seems to have completed its transition toward continental China, with HLMC now producing one third of its products, and is capturing good revenue in automotive. The next logical step would be to expand its early successes in the near-infrared (NIR) Global Shutter device designed into the Intel Realsense products, which unfortunately suffered from shrinking computing business. STMicroelectronics stole the show at the end of 2017 by capturing the slot in the newly released iPhone X with an innovative NIR Global shutter based on a silicon-on-insulator (SOI) substrate. ON Semiconductor has become the key player in automotive despite growing competition from Sony and Samsung. Growth in its Industrial division helped mitigate decreasing volumes of action and drone camera products. On the CIS foundry side, HLMC has benefited from the production transfer from Omnivision and TPSCo similarly from ON Semiconductor. Hynix is apparently locked in a conundrum prioritizing DRAM over CIS. SMIC similarly has to invest in the next generation technology and is in transition. Probably the last key aspect of this year’s status of CIS is China’s positive progress. Having built a consistent ecosystem incorporating CIS foundries, CIS vendors and high growth system manufacturers, China CIS ecosystem will become more important in the future.
COMPANIES CITED IN THE REPORT (non exhaustive list)
Almalence, Ambarella, Apple, Ams, Arm, Axis, Basler, Bosch, Brigates, BYD, Caeleste, Canon,
Clairpixel, Cmosis, Cognex, Continental, Core Photonics, CSEM, Dahua, DB Hitek, DXO Mark,
Espros Photonics, Evg, Excelitas Technologies, Fairchild Imaging, Flir, Forza Silicon, Fotonic, Foxconn,
Fraunhofer, Fujitsu, Fujifilm, GalaxyCore, Given Imaging, GoPro, Gpixsel, Grass Valley, Hamamatsu,
Hassellblad, Himax Imaging, HikVision, Honeywell, Hoya, HTC, Huawei, Image Lab, IMEC, Infineon,
Invisage, Kingpak, Konica Minolta, Lattice, Leap Motion, Leica, Lenovo, LG, Luxima, Magna, Manitis,
Vision, Medigus, Melexis, Microsoft, Mobileye, Movidius, New Imaging Technologies, Nikon,
NXp, Nvida, Olympus, Omnivision, Omron, ON Semiconductor, Panasonic, PerkinElmer, Philips,
Pixart, PixelPlus, Pelco, PMD Technologies, Pyxalis, Raytrix, Rosnes, Red, Samsung, Sanei Hytech,
Sharp, Silicon Optronics, Sirona, SK Hynix, SMIC, Siemens, Smartsens, Socionext, Soitec, Sony,
STMicroelectronics, SuperPix, Teledyne, Teradyne, Trixell, TSMC, TowerJazz, TPSCo, UMC, Valeo,
Videantis, Vimagic, WLCS, XiaoMi, X-Fab, Xintec, Xperi, ZTE, and more ...

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

Glossary 2
Table of content 3
Report objectives 6
Methodology 8
Companies cited 13
Executive summary 14
Introduction 33

MARKET & TECHNOLOGY REPORT

Report objectives 6
> 2017 CIS laptop PC market revenue breakdown
> 2017 CIS tablet market revenue breakdown
> 2017 CIS photography market revenue breakdown
> 2017 CIS mobile market revenue breakdown
> CIS foundries - geographic mapping
CMOS image sensor - ecosystem
CMOS image sensor - competitive landscape
CMOS image sensor – M&A historical timeline

Market Forecast 46
> 2017 CIS revenue breakdown, by market
> CIS volume shipment forecast 2011 - 2023
> CIS revenue forecast 2011 - 2023
> CIS average selling price forecast 2011 - 2023
> CIS wafer production forecast 2011 - 2023

Ecosystem 60
> 2017 M&A activity in CIS
> CMOS image sensor – M&A historical timeline
> CMOS image sensor - competitive landscape
> CMOS image sensor - ecosystem
> CIS players - geographic mapping
> CIS foundries - geographic mapping

Players and rankings 72
> 2017 CIS revenue rankings, by player
> 2017 CIS production rankings, by foundry
> 2017 CIS player activity breakdown
> 2017 CIS mobile market revenue breakdown, by player
> 2017 CIS photography market revenue breakdown, by player
> 2017 CIS tablet market revenue breakdown, by player
> 2017 CIS laptop PC market revenue breakdown, by player
> 2017 CIS medical X-ray market revenue breakdown, by player

Other consumer market trends 117
> Consumer electronics volume forecast
> Consumer electronics revenue forecast
> Who can afford a smartphone?
> Revenue comparison
> Mobile market forecast, by phone type
> Mobile market forecast, by player
> Market drivers
> Mobile resolution mix - forecast
> Dual camera rollout scenario
> 3D camera applications
> Mobile market trends

Automotive market trends 132
> Light-vehicle volume forecast
> Automotive imaging trends
> Automotive camera volume forecast
> Robotic vehicle trends

High End market trends 153
> Medical CIS volume forecast
> Medical CIS trends
> Security and surveillance volume forecast
> Machine vision volume forecast

Technology trends 168
> Pixel/Resolution/Optical Format
> From FSI to BSI to stacked BSI
> Hybrid stack/Multi-stack
> 3D imaging and sensing
> Technology by players

Conclusion 207
Company profile 211

RELATED REPORTS
Benefit from our Bundle & Annual Subscription offers and access our analyses at the best available price and with great advantages

• Camera Module Industry Market and Technology Trends 2017
• STMicroelectronics’ Near Infrared Camera Sensor in the Apple iPhone X
• VCSELs - Technology, Industry and Market Trends
• Machine Vision for Industry and Automation
Find all our reports on www.i-micronews.com

MARKET & TECHNOLOGY REPORT

Yole Développement

Pierre Cambou is a lead analyst for Imaging since 2014. He is part of the Photonics, Sensing and Display team. He has been part of the imaging industry since 1999 by holding several positions at Thomson TCS, which became Atmel Grenoble in 2001 and e2v Semiconductors in 2006 (now Teledyne e2v). In 2012 he founded Vence Innovation (now Ilrny) to bring to market an infrared sensor technology for smart environments and interactions. Pierre holds an MSc from UTC Compiègne and Virginia Tech and graduated from GEM MBA in 2011.

Jean-Luc Jaffard has made invaluable contributions to imaging activity at STMicroelectronics, working at the forefront of this business’s emergence and impressive growth. At STMicroelectronics’ Imaging Division, Jean-Luc was appointed Research Development and Innovation Director, managing a large multidisciplinary/multicultural team. Soon after, he was promoted to Deputy General Manager and Advanced Technology Director, in charge of identifying and developing breakthrough imaging technologies and transforming them into innovative, profitable products. In 2010 he was appointed STMicroelectronics’ Intellectual Property Business Unit Director, and in January 2014 he created Red Belt Conseil’s Technology and Innovation branch.
ORDER FORM
Status of the CMOS Image Sensor industry 2018

BILL TO
Name (Mr/Ms/Dr/Pr):
Job Title:
Company:
Address:
City:
State:
Postcode/Zip:
Country:
*VAT ID Number for EU members:
Tel:
Email:
Date:

PAYMENT

BY CREDIT CARD

Name of the Card Holder:
Credit Card Number:
Card Verification Value (3 digits except Amex: 4 digits):
Expiration date:

BY BANK TRANSFER
BANK INFO: HSBC, 1 place de la Bourse, F-69002 Lyon, France,
Bank code: 30056, Branch code: 00170
Account No: 0170 200 1565 87,
SWIFT or BIC code: CCFRFRPP,
IBAN: FR76 3005 6001 7001 7020 0156 587

RETURN ORDER BY
• FAX: +33 (0)472 83 01 83
• MAIL: YOLE DÉVELOPPEMENT, Le Quartz,
  75 Cours Emile Zola, 69100 Villeurbanne/Lyon - France

SALES CONTACTS
• Western US & Canada - Steve Laferriere:
  +1 310 600-8267 – laferriere@yole.fr
• Eastern US & Canada - Troy Blanchette:
  +1 704 859 0453 – troy.blanchette@yole.fr
• Europe & RoW - Lizzie Levenez:
  +49 15 123 544 182 – levenez@yole.fr
• Japan & Rest of Asia - Takashi Onozawa:
  +81 34405-9204 – onozawa@yole.fr
• Greater China - Mavis Wang:
  +886 979 336 809 – wang@yole.fr
• Specific inquiries: +33 472 830 180 – info@yole.fr

PRODUCT ORDER - Ref YD18035
Please enter my order for above named report:
☐ One user license*: Euro 5,990
☐ Multi user license: Euro 6,490
- The report will be ready for delivery from September 28, 2018
- For price in dollars, please use the day’s exchange rate. All reports are
delivered electronically at payment reception. For French customers,
add 20% for VAT

I hereby accept Yole Développement’s Terms and Conditions of Sale(1)
Signature:

*One user license means only one person at the company can use the report.

SHIPPING CONTACT
First Name: ____________________________  Last Name: ____________________________
Email: ____________________________ Phone: ____________________________

ABOUT YOLE DEVELOPPEMENT
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
• Market data & research, marketing analysis
• Technology analysis
• Strategy consulting
• Reverse engineering & costing
• Patent analysis
• Design and characterization of innovative optical systems
• Financial services (due diligence, M&A with our partner)
More information on www.yole.fr

MEDIA & EVENTS
• i-Micronews.com website & related @Micronews e-newsletter
• Communication & webcast services
• Events: TechDays, forums...
More information on www.i-micronews.com

REPORTS
• Market & technology reports
• Patent investigation and patent infringement risk analysis
• Teardowns & reverse costing analysis
• Cost simulation tool
More information on www.i-micronews.com/reports

CONTACTS
For more information about :
• Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)
• Reports: David Jouard (jouard@yole.fr) Yole Group of Companies
• Press Relations & Corporate Communication: Sandrine Leroy (leroy@yole.fr)

(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: September 13, 2018
Definitions: “Acceptance”: Action by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by signing the purchase order which mentions “I hereby accept Yole 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 interest.

“Contracting Parties” or “Parties”: The Seller on the one hand and the Buyer on the other hand.

“Intellectual Property Rights” (“IPR”) means any right granted under patent law, database rights, Copyright, designs, topographical data bases, trademarks, registered models, designs, copyrights, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights of the Seller. Notwithstanding the fact that they have been registered or not and including any pending registration of one of the above mentioned rights.

“License”?: For the reports and databases, 3 different licenses are proposed. The buyer has to choose one license:

• User license: one person at the company can use the report.
• Multi-user license: the report can be used by unlimited users within the company. Subsidiaries and Joint-Ventures are not included.
• Corporate license: purchased under “Annual Subscription” report, the license can be used by unlimited users within the company. Joint-Ventures are not included.

“Products”: Depending on the purchase order, reports or databases on MEMS, CSC, Optics/MOEMS, Nano, bio… to the Buyer provided that it is informed of the defective products as far as the supplies allow and without prejudice.

1. SCOPE
1.1 The Contracting Parties undertake to observe the following general conditions as agreed by the Buyer and the Seller.

1.2 The Seller reserves the right to modify these terms and conditions at any time without notice.

2. OCCASION OF THE PRODUCTS
2.1 Products shall be sold “Free on Board”:

• within 15 months from the order for Products already released; or
• within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 Subscribers to a “Subscription” report are entitled to receive the report in question by email or to the Buyer’s address. In the absence of any confirmation in writing, orders shall be deemed to have been accepted.

3. MAILING OF THE PRODUCTS
3.1 Products shall be shipped “Free on Board”:

3.1.1 Orders are deemed to be accepted only upon written confirmation by the Buyer or a responsible officer of the Buyer within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

3.2 The products ordered shall be sent to the Buyer without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information as required under article 2.3 shall remain at the Buyer’s risk.

3.3 Payments due by the Buyer shall be sent by cheque payable to Yole Développement, credit card or by electronic transfer to the following account numbers:

• HSBC, 1 place de la Bourse 69002 Lyon France

4. PRICE, INVOICING AND PAYMENT
4.1 The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the information to the Seller, even in case of delayed delivery. In such case only, the Seller will have the right to invoice the Buyer provided that it is informed of the defective products as far as the supplies allow and without prejudice.

4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable damages and losses that may be borne by the Seller, following this decision.

4.3 The deadlines that the Seller is asked to state for the mailing of the Products are not guaranteed for a maximum of two months starting from the date of mailing, the Buyer shall indemnify the Seller for any delay that may be borne by the Seller, following this decision.

4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

4.5 The deadlines that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification does not affect the lead time, the late delivery liability of the Seller provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged by the Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, lost or spoiled products, etc. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 4.4 above.

4.7 The deadlines that the Seller is asked to state for the mailing of the Products are guaranteed for non delays and are not retractable. At the Seller's will, the Buyer may cancel the order or require the removal of all non-conformity. The application of these Terms and Conditions shall be settled by the French Commercial Courts of Lyon, which shall have exclusive jurisdiction upon such issues.

5. GOVERNING LAW AND JURISDICTION
5.1 The Seller does not make any warranties, express or implied, including, without limitation, those of saleability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take all the necessary precautions, the User agrees not to be free from errors.

6. PROTECTION OF THE SELLER’S IPR
6.1 All the IPR attached to the Products are and remain the property of the Seller. The Buyer agrees to respect the intellectual property laws of France and international copyright law 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. 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:

• Information storage and retrieval systems;
• Recordings and re-transmitters over any network (including and not limited to audio network);
• Use in any timesharing, service bureau, bulletin board or similar arrangement or public display;
• Printing or any other printing or online service (including bulletin boards or the Internet);
• Licensing, leasing, selling, offering for sale or assigning the Product;
• Derivative Works;

6.3 The Buyer shall be solely responsible for the Seller of all infringements of this obligation, whether this infringement comes from its employees or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This will be the recipient of each new report in PDF format. This person shall also be responsible for receiving and acknowledging any changes of fact the that the Products are not disseminated out of the company.

6.5 In the context of annual subscriptions, the person of contact shall be defined who will be responsible for any request of the Product or any other difficulty which is beyond the control, and not the fault of the Buyer.

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 consequential losses to the Seller.

7.2 In the event of breach by one Party under these conditions or the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of notice (30) days, should the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

8. MISCELLANEOUS
8.1 All the provisions of these Terms and Conditions are for the benefit of the Seller and its agents and agents. Each of them is entitled to assert and enforce those provisions against the Buyer.

8.2 The Buyer should communicate with the Seller, in accordance with these Terms and Conditions.