Status of the CMOS image sensor industry
2016 report sample
Executive Summary
REPORT OBJECTIVES

Provide a clear understanding of applications and related technologies.

Ecosystem identification and analysis:

- Determination of the applications range
- Technical market segmentation
- Economic requirements by segment
- Key players per market and analysis
- Market size and market forecast in $M and Munits

Analysis and description of market and technologies involved:

- Major actors on a global basis
- Detailed applications per market segment
- Technology identification for different products and processes
- Competing technologies
- Main technical challenges
Yole’s market forecast model is based on the following elementary structured blocks:
WHAT IS TAKEN INTO ACCOUNT BY THE ANALYSIS?

From wafer to first packaged sensor

- Analysis at the component level
  - Wafer
  - Die
  - Sensors

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ABOUT THE AUTORS OF THIS REPORT

Biography & contact

**Pierre Cambou**
From 1999, Pierre Cambou has been part of the imaging industry. Pierre took several positions at Thomson TCS which became Atmel Grenoble in 2001 and e2v Semiconductors in 2006. In 2012 he founded a start-up called Vence Innovation (now Irlynx) in order to bring to market a disruptive infrared Man to Machine interaction technology. He has an Engineering degree from Université de Technologie de Compiègne and a Master of Science from Virginia Tech. More recently he graduated from Grenoble Ecole de Management’s MBA. He joined Yole Développement as Imaging Activity Leader in 2014.

Contact: cambou@yole.fr

**Jean-Luc Jaffard**
From 1966 Jean-Luc Jaffard paved the way of imaging activity at STMicroelectronics being at the forefront of the emergence and growth of this business. At STMicroelectronics Imaging Division he was successively appointed as Research Development and Innovation Director managing a large multidisciplinary and multicultural team and later on promoted to Deputy General Manager and Advanced Technology Director in charge of identifying and developing breakthrough Imaging Technologies and to transform them into innovative and profitable products. In 2010 he was appointed STMicroelectronics Intellectual Property Business Unit Director. In January 2014 he created the Technology and Innovation branch of Red Belt Conseil.
Body sample
WHAT WE GOT RIGHT WHAT WE GOT WRONG
Forecast over the years

We are raising our forecast for CMOS Image Sensors

 Mostly driven by smartphone camera crase and the renewal of applications in the consumer space, CIS market keeps its momentum while passing the $10B landmark

The main reason for this forecast increase is the early introduction of dual cameras in smartphones

Historical revenue forecast (in $M)

Our goal is to predict +/-10% in 5 years time
• When Yole Développement presented its first report in 2010, the imaging industry was at a turning point as CMOS image sensor revenues were breaking the 50% threshold in respect to CCD.

• Since last year, the industry has reached the $10B landmark and has become a key technology for major semiconductor companies such as Sony, Samsung, On Semi and now SK Hynix.

• Mobile remains the key application market for CIS, it is demanding in term of volume and performances therefore ASP are kept at a good level for the top notch technology. The industry has reached $10.3B in 2015 and with 10.4% CAGR forecasted for the 2015-2021 period, and will reach $18.8B in 2021.

• Currently the most dynamic CIS markets are mobile and automotive. New features and performance are needed to serve those markets.
Leveraging its technology leadership rooted in digital photography and applied to mobile markets and benefiting from resolution increases of mobile secondary camera, Sony grabbed both revenue and volume leadership in 2015.

SK Hynix confirmed it was able to supply this technologically demanding market as it proved itself an alternative to Galaxycore.

Sony is now taking the lead in volume.
CIS REVENUE BREAKDOWN (IN $M)

by market

<table>
<thead>
<tr>
<th>Market</th>
<th>2014</th>
<th>2015</th>
<th>CAGR 2015-2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
<td>$5,908</td>
<td>$6,665</td>
<td>12%</td>
</tr>
<tr>
<td>Consumer</td>
<td>$1,611</td>
<td>$1,401</td>
<td>1%</td>
</tr>
<tr>
<td>Computing</td>
<td>$1,187</td>
<td>$1,052</td>
<td>-3%</td>
</tr>
<tr>
<td>Automotive</td>
<td>$279</td>
<td>$537</td>
<td>23%</td>
</tr>
<tr>
<td>Medical</td>
<td>$29</td>
<td>$34</td>
<td>15%</td>
</tr>
<tr>
<td>Security</td>
<td>$140</td>
<td>$388</td>
<td>11%</td>
</tr>
<tr>
<td>Industrial/Space/Defence</td>
<td>$146</td>
<td>$271</td>
<td>10%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$9,300</td>
<td>$10,348</td>
<td>10.4%</td>
</tr>
</tbody>
</table>

2015 CIS Revenue breakdown by market

- Mobile: 64.4%
- Consumer: 13.5%
- Computing: 10.2%
- Automotive: 5.2%
- Medical: 3.8%
- Security: 3.8%
- Industrial/Space/Defence: 2.6%

2014
- CIS Revenue: $9,300M

2015
- CIS Revenue: $10,348M

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## CIS REVENUE RANKING (IN $M)

### by player

<table>
<thead>
<tr>
<th>Company</th>
<th>2014 (in $M)</th>
<th>2015 (in $M)</th>
<th>YoY Growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sony</td>
<td>$2,779</td>
<td>$3,645</td>
<td>31%</td>
</tr>
<tr>
<td>Samsung</td>
<td>$1,825</td>
<td>$1,930</td>
<td>6%</td>
</tr>
<tr>
<td>Omnivision</td>
<td>$1,378</td>
<td>$1,250</td>
<td>-9%</td>
</tr>
<tr>
<td>On Semi</td>
<td>$670</td>
<td>$810</td>
<td>21%</td>
</tr>
<tr>
<td>Canon</td>
<td>$482</td>
<td>$404</td>
<td>-16%</td>
</tr>
<tr>
<td>Toshiba</td>
<td>$360</td>
<td>$350</td>
<td>-3%</td>
</tr>
<tr>
<td>Panasonic</td>
<td>$244</td>
<td>$336</td>
<td>38%</td>
</tr>
<tr>
<td>SK Hynix</td>
<td>$200</td>
<td>$325</td>
<td>63%</td>
</tr>
<tr>
<td>Galaxycore</td>
<td>$325</td>
<td>$275</td>
<td>-15%</td>
</tr>
<tr>
<td>STMicro</td>
<td>$260</td>
<td>$200</td>
<td>-23%</td>
</tr>
<tr>
<td>Pixart</td>
<td>$166</td>
<td>$170</td>
<td>2%</td>
</tr>
<tr>
<td>Pixelplus</td>
<td>$114</td>
<td>$130</td>
<td>14%</td>
</tr>
<tr>
<td>Other</td>
<td>$498</td>
<td>$523</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$9,300</strong></td>
<td><strong>$10,348</strong></td>
<td></td>
</tr>
</tbody>
</table>

### 2015 CIS Revenue market share by player

- **Sony** 35%
- **Samsung** 19%
- **Omnivision** 12%
- **On Semi** 8%
- **Canon** 4%
- **Toshiba** 3%
- **Panasonic** 3%
- **SK Hynix** 3%
- **Galaxycore** 2%
- **Pixart** 2%
- **Pixelplus** 1%
- **STMicro** 2%
- **Other** 5%
- **Other** 5%

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MOBILE MARKET TREND

The mobile camera will become a multi sensor optronics interface

Technology is almost ready
Players are working on the killer applications

# of sensors

1 sensor
2 sensors
3 sensors
3+ sensors

Photography & video
Catching up with DSLR and video cameras

Embedded 3D computational
New embedded 3D imaging

Embedded 3D Interactive
The world becomes interactive

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MOBILE MARKET TREND

Dual camera rollout scenario

The question is no more if but when?

Breaking the 20% threshold means Apple or Samsung have integrated at least one dual camera.

- iPhone 7 & 7S with dual camera
  - Front or back?

- P9 (Rear 13+13Mp)
- G5 (Rear 16+8Mp)

- Samsung should follow accordingly

- Next HW updates for Apple

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CONSUMER MARKET TREND

Light field imaging has many intermediaries

Pandora’s box is open

Processing x Complexity

- Video/Movies - Videochat
- Enhanced videocall - Morphing

- Virtual Reality

3D/Sphere Video

Virtual world with interaction

Interactive World

Augmented/Mix Reality

Object Mapping

- Smart environment interaction

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USE OF MACHINE VISION TECHNOLOGY

Disruptive vision sensing technology is transforming all markets

Generation of images are less and less intended for human usage
Machines have great need of sensory input for autonomy & interaction
CIS sensors are a key part of this technology revolution

Robotics and Immersive technologies will transform the imaging landscape

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- **NEPCON Japan**
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- **Image Sensors**
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- **International Conference and Exhibition on Device Packaging**
  March 15-17, 2016 – Fountain Hills, USA

- **Lab-on-a-Chip European Congress**
  March 15-16, 2016 – Madrid, Spain

- **APEC**
  March 20-24, 2016 – Long Beach, USA

- **PCIM Europe**
  May 10-12, 2016 – Nuremberg, Germany

- **ECTC**
  May 31-June 3, 2016 – Las Vegas, USA

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  June 21-23, 2016 – San José, USA

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  July 12-15, 2016 – San Francisco, USA

- **LED Professional Symposium – LpS**
  September 20-23, 2016 – Bregenz, Austria

- **SEMICON Europa**
  October 25-27, 2016 – Grenoble, France

- **SEMICON Japan**
  December 14-16, 2016 – Tokyo, Japan

*Non exhaustive list
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June 20, 2016

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• Report Business: Fayçal Khamassi (khamassi@yole.fr)
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   Branch code: 0000
   Account no: 0170 200 1656 87
   BIC or SWIFT code: CCFRFRPP
   IBAN: FR76 3005 6001 700 7020 0165 87

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4.2. The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary damages resulting from the use of the Products or arising from a material breach of this agreement.

4.3. In no event shall the Seller be liable for:

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   b) any modification, interruption, deletion, defect, damage or failure to store any information or data of any kind.

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. All the Products sold by the Seller 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 is subject to the best effort of the Seller provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

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4.7. The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. The Seller reserves the right not to lead to any damages or cancellation of the orders, except for non acceptable delays exceeding 6 months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of the price of its first down payment to the exclusion of any further damages.

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5.1. The Seller shall not be liable for any delay in performance directly or indirectly caused by reason of acts of nature, flood, fire, accident, war, governmental intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other failures which are beyond the control, and not the fault of the Seller.

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

8.2. No waiver by either of 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 and the Buyer shall 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 or linked to these Terms and Conditions or to the interpretation or execution shall be subject to 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.

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

From Technologies to Market
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Yole Développement’s 30 analysts operate in the following areas:

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- MEMS & Sensors
- Compound Semi.
- LED
- Power Electronics
- Batteries / Energy Management
- Advanced Packaging
- MedTech
- Manufacturing

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- 3D Imaging & Sensing 2016**
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