

3D imaging and sensing: now it is rear 3D sensing turn to be the leading growing application¹

OUTLINES:

- 3D rear sensing in mobile has diversified its application use cases.
- After Apple's technology choice, Android phone makers take another path by using ToF² for 3D sensing applications.
- ToF is changing the value of the 3D sensing module.
- ams and Lumentum won the first round of 3D: what is the impact on the supply chain?

“At Yole Développement (Yole), we expect the global 3D imaging and sensing market to expand from US\$5.0 billion in 2019 to US\$15.0 billion in 2025, at a 20% CAGR³” affirms **Pierre Cambou, Principal Analyst, Imaging.**

With the introduction of the iPhone X in September 2017, Apple set the technology and use-case standard for 3D sensing in the consumer space. Two years later, Android phone makers have taken a different approach, using ToF cameras instead of Structured Light and are placing them on the rear of the phone.

Richard Liu, Technology & Market Analyst in the Photonics, Sensing & Display division at Yole and based in Shenzhen, China, adds: *“Compare to structured light, ToF modules only needs a VCSEL⁴ and a diffuser on the emitter, which is less complex. ToF sensors have now improved a lot thanks to the BSI⁵ technique. They have also gained a cost advantage within a maturing ecosystem. This is the main reason why ToF has won the favor of Android phone makers”.*

The market research and strategy consulting releases today its annual imaging technology & market analysis, 3D Imaging and Sensing. This report marks another step forward in the understanding of the industry and its evolution. Under this new report, Yole's imaging team is offering an up-to-date study of the industry with detailed market forecasts and trends, scenarios for mobile front & rear 3D cameras, updated rear 3D camera applications, deep analysis of the ecosystem, technology cost breakdown and more...

¹ Extracted from: 3D Imaging and Sensing, Yole Développement 2020

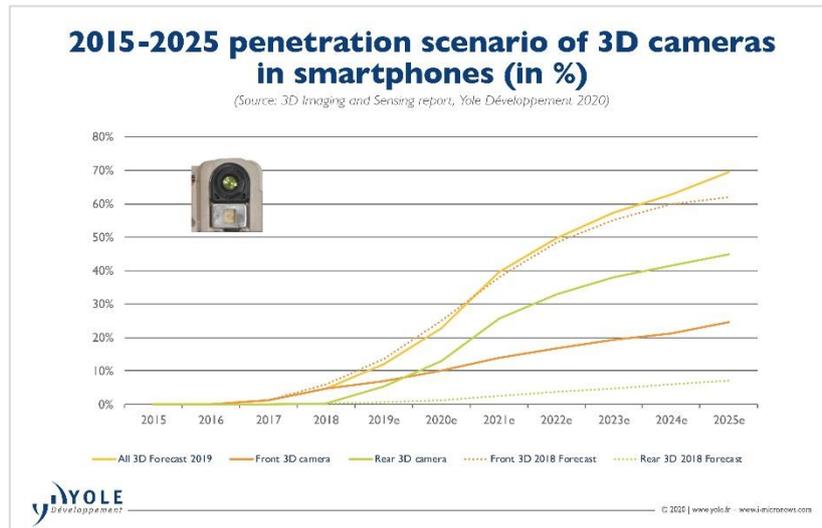
² ToF : Time-of-Flight

³ CAGR : Compound Annual Growth Rate

⁴ VCSEL : Vertical Cavity Surface Emitting Laser

⁵ BSI : Back Side Illumination

Without doubt, 3D sensing main trend is the switch adoption from the front to the rear of phones and the ToF camera mass adoption. According to Yole’s 3D imaging & sensing report, rear attachment will surpass front attachment, penetration rate reaching about 42% in 2025.



3D rear sensing in mobile should diversify its application use cases. First used for photography, to enhance bokeh and zoom capabilities, it will expand into AR⁶ and gaming. Beyond smartphones, ToF camera modules have a broad application market in front of them, including intelligent driving, robots, smart homes, smart TVs, smart security and VR⁷/AR. Currently, the application of ToF sensing technology in these fields is still in its infancy. The significance of the 3D sensing market means the transition from imaging to sensing is happening now. AI⁸-powered devices and robotics are gaining a better understanding of their surroundings, and developing a new level of interaction with humans. Stereo cameras for ADAS⁹ are a highly anticipated application of 3D imaging and sensing technology.

“The most important component in this application, LiDAR¹⁰, is now focused on by a large number of suppliers”, explains Richard Liu from Yole. “There are a wide range of LiDAR technologies to choose from, making the field as a very competitive one.”

In addition to automotive ADAS, and industrial AGVs¹¹ in the logistics industry, as well as face recognition and face payments in commercial sectors have been very successful. As such, 3D sensing technology is moving towards ubiquity. Technology providers of global shutter image

⁶ AR : Augmented Reality

⁷ VR : Virtual Reality

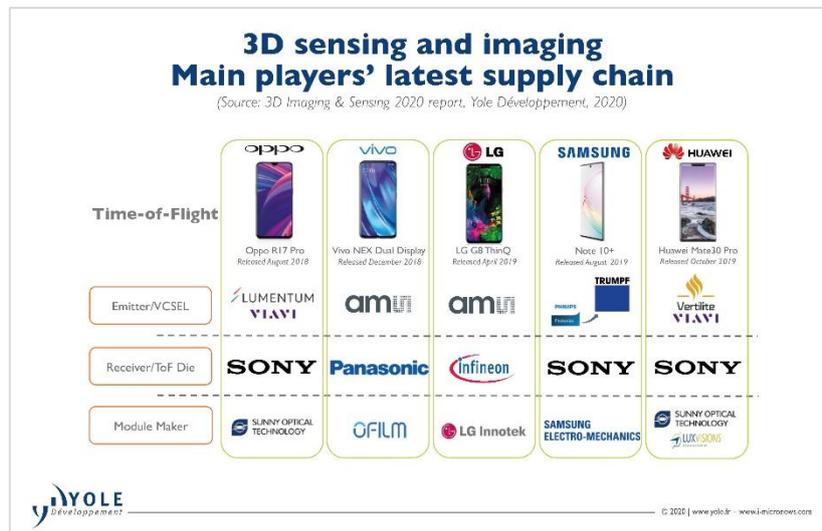
⁸ AI : Artificial Intelligence

⁹ ADAS : Advanced Driver Assistance Systems

¹⁰ LiDAR : Light Detection and Ranging

¹¹ AGV : Automatic Guided Vehicles

sensors, VCSELs, injection-molded and glass optics, DOEs¹², and semiconductor packaging are all benefiting.



So what is the impact of ToF's adoption on the supply chain?

“The mobile 3D sensing supply chain is changing rapidly,” analyses Pierre Cambou. “As structured light technology was introduced in iPhones in 2017, companies like Lumentum, ams and ST Microelectronics won this first round. Later, Princeton Optronics (ams) and Finisar were prepared to gain VCSEL market access, so the market did quickly become more competitive”.

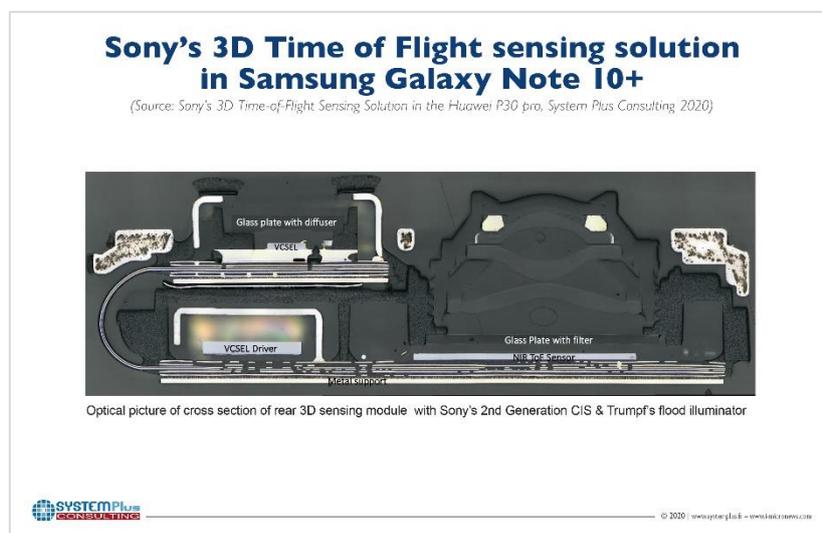
In 2019, Finisar was acquired by Il-VI, which helps consolidate an existing industrial business. During this period, there were several other big mergers, such as Philips Photonics being acquired by Trumpf and ams swallowing OSRAM. Trumpf and ams are both actively moving into the Android camp's 3D camera supply chain, providing VCSELs to Samsung and Huawei respectively.

In China, another player is entering the 3D sensing ecosystem: The VCSEL output beam of the flood emitter for ToF requires no coding and is therefore easier to produce. This helped a Chinese supplier called Vertilite to join the market. They have already won orders from Huawei for 3D sensing in 2019. This move was also driven by the policy of China cultivating local supply chains in the middle of the US-China trade conflict.

ToF arrays are key components for mobile rear 3D sensing. ToF camera technology was first applied to the Phab2 Pro smart phone in 2016, which was using pmd and Infineon's TOF array. A year before that, Sony bought SoftKinetic, a Belgian gesture-recognition company with its well-known DepthSense ToF sensing system. This move brought Sony from a zero market share position in 3D sensing receiver chips to 45% by the time ToF camera

¹² DOE : Diffractive Optical Elements

modules took off in 2019. With its strong technology and supply capabilities, Sony is expected continue maintaining its leadership position in ToF. But as there has always been competition in this area of CIS¹³ chip manufacturing, competition will increase. pmd with partner Infineon Technologies recently announced a matching chip. Yole’s analysts expect CIS giant Samsung and STMicroelectronics to bring to market their own indirect ToF array sensors in 2020. Samsung already adopted ToF technology notably in its Galaxy Note 10+. It has been deeply analyzed by System Plus Consulting, sister company of Yole in the reverse engineering & costing report, [Samsung Galaxy Note 10+ 3D Time of Flight Depth Sensing Camera Module](#).



Generally speaking, the competition remains very intense among a small group of CIS players. In the medium term Yole expects more opportunities for M&A¹⁴ as automotive LiDAR applications may come into play. There are a large number of highly competitive emerging companies. There are also a few Chinese startups, such as Hesai Technology, RoboSense, and LeiShen Intelligence. The underlying semiconductor products are the same: CIS chips, VCSEL, MEMS, wafer-level optical elements.

The market research and strategy consulting Yole is following the CIS industry, on a quarterly basis with its [Quarterly Market Monitor](#). Each quarter, Yole’s imaging team analyzes the latest news coming from the industry and financial reports. Analysts also debate with leading imaging players to get a deep understanding of their activities. Market forecast in US\$, units, and wafers, market shares evolution (Sony, Samsung, OmniVision, ON Semiconductor, STMicroelectronics, Panasonic, Canon, SK Hynix) and more are detailed in Yole’s quarterly market monitor.

¹³ CIS : CMOS Image Sensor

¹⁴ M&A : Mergers & acquisitions

Definitely, the ecosystem is not expected to stand still in 2020. Stay tuned on [i-Micronews](#) to discover the detailed description of the 3D Imaging & Sensing report, CIS Quarterly Market Monitor, as well as other imaging reports.



All year long, Yole Group of Companies, including [System Plus Consulting](#) and Yole Développement, publishes numerous reports covering the Imaging & Sensing industry: more on [i-Micronews](#). In this regard, Pierre Cambou and Richard Liu wrote a dedicated [3D Sensing and imaging article](#). Yole Group's teams announces an impressive 2020 agenda dedicated to imaging & sensing technologies and markets. Make sure to save the date right now!

- [3D Imaging and Sensing: From Enhanced Photography to an Enabling Technology for AR and VR – Webinar, online event on January 19](#)
- [Embedded World 2020 \(February 25, Nuremberg, Germany\)](#)
- ... etc

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About our analysts

Pierre Cambou MSc, MBA, is a Principal analyst in the Photonic and Display Division at Yole Développement (Yole).

Pierre's mission is dedicated to imaging related activities by providing market & technology analyses along with strategy consulting services to semiconductor companies. He is responsible for the CIS Quarterly Market Monitor while he has authored more than 15 Yole Market & Technology reports.

He has been deeply involved in the design of early mobile camera modules and the introduction of 3D semiconductor approaches to CMOS Image Sensors (CIS).

Known as an expert in the imaging industry, he is regularly interviewed and quoted by leading international media. Pierre has an Engineering degree from Université de Technologie de Compiègne (France) and a Master of Science from Virginia Tech. (VA, USA), Pierre also graduated with an MBA from Grenoble Ecole de Management (France).

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 reports.

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).

Richard Liu, is a Technology and Market Analyst in the Photonics, Sensing & Display division at Yole Développement, part of Yole Group of Companies. Based in Shenzhen (China), Richard is dedicated on imaging activity (Monitors) as well as the development of technology & market reports.

Prior to Yole, Richard was engaged in camera module design on image sensor, AF/OIS at Onsemi, before this, he worked as a customer-application-technologist in Micron/Aptina Imaging. Richard has over 12 years post graduate experience in both of imaging semiconductor and camera module industry, he has the successful track record in developing projects for the tier one smart phone and module makers, which brought him wide industry connection in the CMOS image sensor supply chain and ecosystem.

Richard graduated from Wuhan University (China) and holds an Electronics Engineering Degree.

Audrey Lahrach is in charge of costing analyses for IC, LCD & OLED Displays and Sensor Devices. She holds a Master degree in Microelectronics from the University of Nantes.

Taha Ayari, PhD, is involved in analyzing compound semiconductor devices with dedicated technical, costing and pricing analysis. He has a deep knowledge in epitaxy techniques, materials characterizations as well as devices microfabrication. He participated in numerous international conferences and has authored or co-authored several papers. Taha holds a MSc and a PhD in Electrical and Computer Engineering from Georgia Institute of technology (Atlanta, USA).

Véronique Le Troadec, has joined System Plus Consulting as a laboratory engineer. Coming from Atmel Nantes, she has extensive knowledge in failure analysis of components and in deprocessing of integrated circuits.

About the report & monitor

3D Imaging & Sensing 2020

While a second wave of 3D sensing technology integration has been initiated by Android phones, could Time-of-Flight be the decisive technology for future consumer applications? – Performed by Yole Développement

CIS Quarterly Market Monitor

As camera quantity and die size increase per end-device, a 10.1% year-on-year growth rate is expected for 2019 – Performed by Yole Développement

Samsung Galaxy Note 10+ 3D Time of Flight Depth Sensing Camera Module

Deep analysis of the rear 3D sensing module with Sony's 2nd Generation CIS. – Performed by System Plus Consulting.

And related reports:

- [Status of the Camera Module Industry 2019 – Focus on Wafer Level Optics](#)
- [LiDAR for Automotive and Industrial Applications 2019](#)
- [VCSELs – Market and Technology Trends 2019](#)
- [CMOS Image Sensor Service – Imaging Research - Monitor](#)
- [Status of the CMOS Image Sensor Industry 2018](#)

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, & technology trends to grow their business... [More](#)

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