



FOR IMMEDIATE RELEASE:

Apple's strategy towards 3D sensing is pushing VCSEL industry

Extracted from: VCSEL - Technology, Industry and Market Trends report, Yole Développement, July 2018

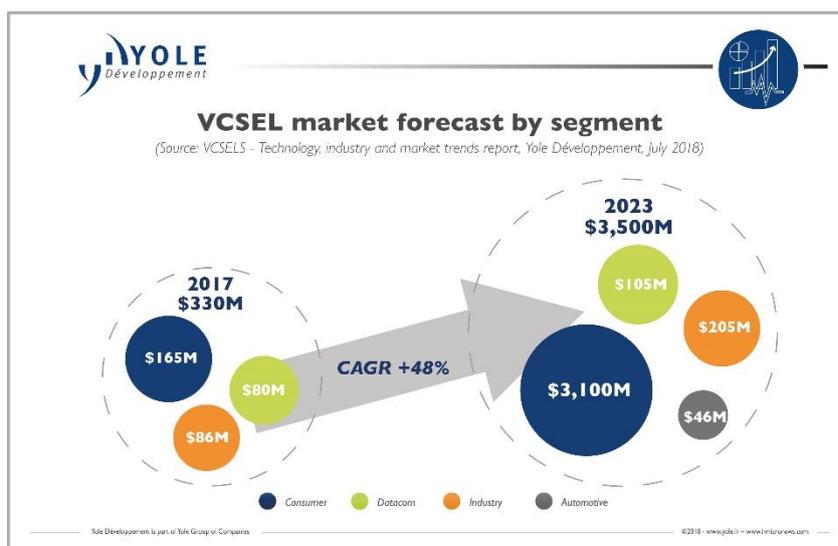
LYON, France – July 26, 2018: The VCSEL¹ industry took a strategic turn last year with the release of the latest iPhone. Indeed the leading smartphones manufacturer, Apple revealed to the entire world a new smartphone with innovative 3D sensing function based on VCSEL technology. Apple's technical choice directly impacted the VCSEL industry and [Yole Développement \(Yole\)](#) announces today impressive market figures in its new technology and market report, [VCSEL - Technology, Industry and Market Trends](#): more than 3.3 billion units in 2023 with a 31% CAGR² between 2017 and 2023. This explosion is changing the future of all players of the VCSELS supply chain including: OEMs³, integrators, device manufacturers, epi houses, foundries, equipment and material suppliers.

[VCSEL - Technology, Industry and Market Trends report](#) performed by Yole, presents an in-depth analysis of the VCSEL industry with its supply chain and competitive landscape. It exposes a comprehensive review of the main VCSEL applications including in-depth analysis of the consumer and automotive landscapes with 3D sensing, LiDAR and gas sensing. Under this report, Yole details VCSEL device market size,

broken down by application and segment, and the related MOCVD⁴ reactor market. In addition, Yole's analysts bring to light a significant overview of the VCSEL IP⁵ landscape.

VCSEL manufacturing processes, associated challenges, recent trends and player positioning are also well analyzed.

3D sensing – and more – in smartphones will drive the VCSEL market for the next five years, announces the



¹ VCSEL : Vertical Cavity Surface Emitting Lasers

² CAGR : Compound Annual Growth Rate

³ OEM : Original Equipment Manufacturer

⁴ MOCVD: Metalorganic Chemical Vapor Deposition

⁵ IP: Intellectual Property

market research and strategy consulting company. Make sure to get an up-to-date picture today of this explosive market.

Data communications was the first industrial application to start integrating VCSELs. Their sweet spot has been in short-distance data communication due to their low power consumption and competitive price compared to EELs⁶. Driven by the development of datacenters, the VCSEL market and production boomed in the 2000s with the internet's popularity, and then grew steadily. Some new applications for VCSEL emerged, like laser printers and optical mice, but weren't strong growth drivers.

Only in 2014, almost 20 years since the first use of the technology in datacom, VCSELs started to make their way into high volume consumer smartphones. But this coupling with sensors for proximity sensing and autofocus functions was only the beginning of the VCSEL success story.

"In 2017 Apple released the iPhone X, with a 3D sensing function based on this technology," explains **Pierrick Boulay, Technology & Market Analyst at Yole**. And he explains: *"The iPhone X integrates three different VCSEL dies for the proximity sensor and the Face ID module, and made the VCSEL market explode in 2017, propelling overall revenue to about US\$330 million."*

Good iPhone X sales have now triggered the interest of other smartphone brands in this breakthrough 3D sensing function. Less than one year after the release of Apple's flagship, its competitors are now following the same trend and starting to integrate 3D sensing technologies. Xiaomi and Oppo were the quickest on the draw, with the Xiaomi Mi8 and the Oppo Find X models presented in the second quarter of 2018. Other leading smartphone players like Huawei, Vivo or Samsung are also expected to integrate VCSELs into their flagship models by 2019. In this context, the explosion of VCSEL demand initiated in 2017 will persist for the next five years, potentially multiplying the business opportunity more than tenfold. During that time, the technology might also find some new growth drivers into some other high volume applications such as automotive Light Detection and Ranging (LiDAR) or gas sensors.

"This trend will likely cause rapid evolution in the VCSEL industry in coming years in the form of investment, new entrants and M&A", comments **Pars Mukish, Business Unit Manager SSL⁸ & Display activities at Yole**.

VCSEL market volume is expected to grow from 652 million units in 2017 to more than 3.3 billion units in 2023. This booming trend is likely to trigger interest in VCSEL technology at many industry levels, including OEMs, integrators, device manufacturers, epi houses,

⁶ EEL : Edge Emitting Lasers

⁷ M&A : Mergers and Acquisitions

⁸ SSL : Solid-State Lighting

foundries, equipment and material suppliers. To be able to follow this booming demand, more than 100 MOCVD reactors will be needed, which is likely to please companies that supply this equipment, such as Aixtron, Veeco and Taiyo Nippon Sanso.

Yole expects therefore strong investment and proliferation in the VCSEL industry with the entry of several new players, mostly from the LED industry, whose technology is similar.

Since 2016, Yole analysts' have already seen some M&A, like ams' acquisition of Princeton Optronics and Osram's deal for Vixar and investment in manufacturing expansion or supply chain reinforcement, like Apple investing US\$390 million in Finisar. Yole expects the bulk of these investments to occur in the coming years.

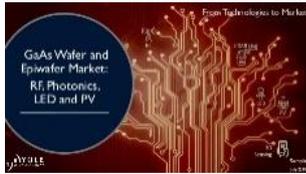
And once VCSEL hype reaches its peak, Yole also expects a necessary consolidation phase with more M&A occurring at all level of the supply chain and to support different strategies:

- Vertical integration - from system to module and/or from module to component
- Application diversification - from datacom to sensing
- Business diversification - from LED or EEL devices to VCSELs

Yole proposes today a deep understanding of the whole 3D sensing supply chain for smartphone's application. The strategy consulting & market research company proposes today a comprehensive collection of reports from substrate to system, including device. Yole's analysts expand their investigations and reveal their vision with dedicated reports:

- Substrate: [GaAs Wafer & Epiwafer Market: RF, Photonics, LED and PV applications](#)
- Component: [VCSELs - Technology, Industry and Market Trends](#)
- System: [3D Imaging & Sensing 2018](#)

These reports are presented on i-micronews.com, [reports section](#).

ABOUT THE REPORTS:**VCSELS - TECHNOLOGY, INDUSTRY AND MARKET TRENDS**

3D sensing – and more – in smartphones will drive the VCSEL market for the next five years - Produced Yole Développement (Yole).

Companies cited in the report: Accelink, Aixtron, Alight, ams, Anadigics, Apple, Arima Lasers Corporation, Asus, Audi, Avago, AWSC, Beam Express, Blackmore, Bosch, Broadcom, Cable solutions, Canon, Changelight, Continental, Device Innovation, Egismos Technology Corporation, Emcore, Epistar, Epiworks, Excelitas, Finetech, Finisar, FLIR, Foxconn, Fuji Xerox, Fujitsu, Global Communication Semiconductor, Google, Hamamatsu, Hella, Heptagon, Himax, HLJ, Honeywell, Honor, HTC, Huawei, Ibeo, iHealth, II-VI, Infineon, Infinera, Inneos, Innoluce, Innoviz, Intel, IntelliEpi, IQE, JDSU, Journal of semiconductors, Kaiam, Koito, Landmark Opto, Lasermate, Lasertel, Laytec, LeddarTech... [Full list](#)

Authors:

Pierrick Boulay and Pars Mukish, all part of the Photonics, Sensing & Display division at Yole Développement (Yole) co-authored the VCSEL - Technology, Industry and Market Trends report:

Trends report:

- **Pierrick Boulay** works as Market and Technology Analyst in the fields of LED, OLED and Lighting Systems to carry out technical, economic and marketing analysis. He has experience in both LED lighting (general lighting, automotive lighting...) and OLED lighting. In the past, he has mostly worked in R&D department for LED lighting applications. Pierrick holds a master degree in Electronics (ESEO - France) Pars Mukish holds a master degree in Materials Science & Polymers (ITECH - France) and a master degree in Innovation & Technology Management (EM Lyon - France). Since 2015, Pars has taken on responsibility for developing SSL and Display activities as Business Unit Manager at Yole. Previously, he has worked as Marketing Analyst and Techno-Economic Analyst for several years at the CEA (French Research Center).
- **Pars Mukish** holds a master degree in Materials Science & Polymers (ITECH - France) and a master degree in Innovation & Technology Management (EM Lyon - France). Since 2015, Pars has taken on responsibility for developing SSL and Display activities as Business Unit Manager at Yole. Previously, he has worked as Marketing Analyst and Techno-Economic Analyst for several years at the CEA (French Research Center).

As well as:

GAAS WAFER AND EPIWAFER MARKET: RF, PHOTONICS, LED AND PV APPLICATIONS

Photonics applications are driving the GaAs wafer and epiwafer market into a new era. – Produced Yole Développement (Yole).

Companies cited in the report... [Full list](#)

Authors: Dr. Hong Lin and Dr. Ezgi Dogmus, all part of the Power & Wireless division at Yole Développement (Yole) co-authored the GaAs wafer & Epiwafer market report

**3D IMAGING & SENSING 2018**

The iPhone X initiated a trend. What happens next? – Produced Yole Développement (Yole).

Companies cited in the report... [Full list](#)

Authors: Pierre Cambou and Dr. Guillaume Girardin are part of the Photonics, Sensing & Display division at Yole Développement (Yole) co-authored the 3D Imaging & Sensing report.

**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 covering MEMS & Sensors - Imaging - Medical Technologies - Compound Semiconductors - RF Electronics - Solid State Lighting - Displays - Photonics - Power Electronics - Batteries & Energy Management - Advanced Packaging - Semiconductor Manufacturing - Software & Computing and more...

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. . For more information, visit www.yole.fr and follow Yole on [LinkedIn](#) and [Twitter](#).

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