

Apple is entering silicon photonics¹

Beyond communication, silicon photonics is penetrating consumer and automotive.

OUTLINE:

- **Market forecasts:**

Overall, the silicon photonics transceiver market will reach US\$4.6 billion in 2026, with a CAGR² of 25% between 2021 and 2026.

The total silicon photonic die market should go over US\$1 billion in 2026.

By 2035, the silicon photonic market could grow further with a large contribution of consumer healthcare.

Automotive and autonomous driving will benefit from silicon photonics sensing in the future.
- **Technology trends:**

The main application of silicon photonics is optical communication.

New applications have entered the market in 2020 such as immunoassays, FOG³...

Novel applications of silicon photonics are expected to reach the market in the coming five years...

Three main companies are preparing for CPO⁴: Cisco, Intel, and Broadcom.
- **Supply chain:**

Rockley Photonics as announced plans for biosensors in smart watches with Apple using silicon photonics.

The silicon photonics eco-system is getting larger with more fabs and foundries, more companies involved in packaging, modelization, PDK⁵s, and designs.

Three developments are evident in the silicon photonics industrial landscape: vertical integration, SPAC⁶, and emerging foundry services.

¹ Extracted from:

[Silicon Photonics 2021 report](#), Yole Développement

[Intel Silicon Photonic 100G CWDM4 QFSP28 Transceiver](#), System Plus Consulting, 2020

² CAGR: Compound Annual Growth Rate

³ FOG: Fiber Optical Gyroscopes

⁴ CPO: Co-Packaged Optics

⁵ PDK: Process Design Kit

⁶ SPAC: Special Purpose Acquisition Company

*“Since the 1998 release by Bookham of the first product using the silicon photonics platform, the main application for silicon photonics has been optical communication.” asserts **Alexis Debray, Ph.D., Senior Analyst at Yole Développement (Yole)**. He adds: “And after the 2008 release by Luxtera (now Cisco) of the first optical transceiver using silicon photonics, the silicon photonics optical transceiver market has grown to US\$581 million, with almost 5 million units shipped.”*

In this dynamic context, Yole and System Plus Consulting, both part of Yole Group of Companies, investigate disruptive photonics technologies and related markets in depth, to point out the latest innovations and underline the business opportunities.

- Released today, the Silicon Photonics 2021 report from Yole provides market data on silicon photonics dies, SOI wafers, and transceivers and describes the novel silicon photonics applications in consumer, automotive, and computing. It also presents a complete analysis of the silicon photonics market up to 2026 with revenues, volumes, and average selling prices segmented by applications and technologies.

This technology and market report has been developed in collaboration with **Jean-Louis Malinge**, strongly involved in this industry for a while. Jean-Louis Malinge and Yole collaborate for a long time to get a deep understanding of the silicon photonics technologies and identify related applications and market segments.

- In addition, the custom reverse costing analyses company, System Plus Consulting, presents the Intel Silicon Photonic 100G CWDM4 QFSP28 Transceiver, a special case study focused on Intel’s silicon photonic transceiver to illustrate latest innovations and technical choices made by the leading company. This report describes Intel’s potential in terms of packaging and photonics.

With both analyses, Yole and System Plus Consulting present a unique understanding of the silicon photonics industry.

Because silicon photonics is a platform, numerous applications are today possible, and many have been proposed by research centers and universities.

In 2020, two new applications reached the market. Genalyte, a California company established by one of the co-founders of Luxtera, released systems for immunoassays based on silicon photonics elements. Also, KVH released FOG based on silicon photonics, intended for robotic car navigation.

For **Eric Mounier PhD., Director of Market Research at Yole**: *“Novel applications for silicon photonics are poised to further penetrate the market. In March 2021, Aeva, another California-based company, went public with an initial valuation of US\$1.7 billion”.*

The company’s goal is to bring FMCW⁷ LiDAR to the market with silicon photonics to serve autonomous driving. Also in March 2021, the American company Rockley Photonics

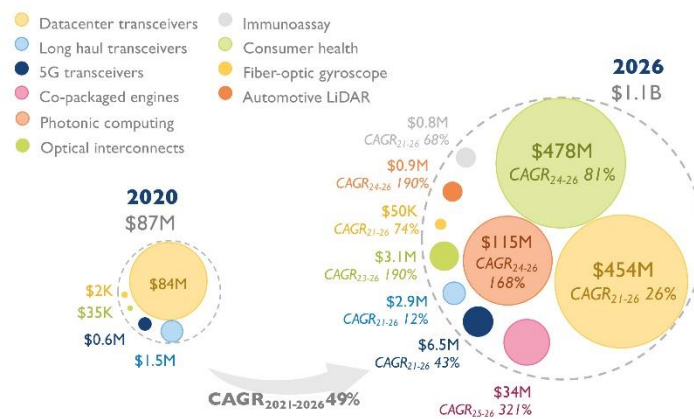
⁷ FMCW: Frequency Modulated Continuous Waves

announced its intention to go public in Q2 2021 at an initial valuation of US\$1.2 billion with an Apple-supported spectrophotometer project for smartwatches.

In addition to sensing for immunoassays, FOG, LiDAR, and consumer healthcare, other applications for silicon photonics include electronic noses, OCT⁸, and cardiovascular diagnostic devices. Computing could also benefit from silicon photonics through photonic computing and quantum computing, as well as optical interconnects in disaggregated datacenters, which will allow using light to connect the various elements of high-performance computing.

2020-2026 silicon photonics die forecast by application

(Source: Silicon Photonics 2021 report, Yole Développement, 2021)



Apple started working with Rockley Photonics in 2017 and has since become Rockley Photonics’ largest customer, with US\$70 million of NRE⁹ commitment to date. In 2019 and 2020, Rockley Photonics had two main customers that accounted for 100% (2020) and 99.6% of its revenue (2019). To date, Rockley Photonics has received US\$359 million in investments. Rockley Photonics seeks to develop and produce photonic modules (based on silicon photonics) that can measure numerous biological parameters such as blood oxygen levels, lactate, alcohol, and glucose, among others. The project is known as a “clinic-on-the-wrist” and relies on a miniaturized spectrophotometer. Universities have previously demonstrated such spectrophotometers, but industrialization to the level of the Apple Watch could be a tough challenge.

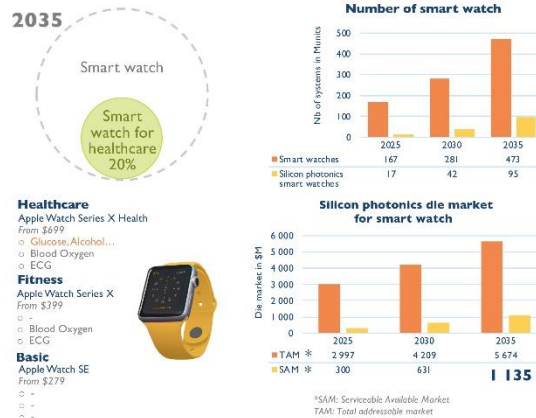
According to **Alexis Debray from Yole**: “With an estimated silicon photonics die price of US\$18, the module could be estimated at US\$45 and could fit a new, high-end US\$699 Apple Watch with healthcare functions. If the adoption rate of healthcare functions for smartwatches reaches 20% by 2035, the associated silicon photonics die market could reach US\$1.1 billion. By comparison, the 2020 silicon photonics die market for optical transceivers is estimated at US\$84 million”.

⁸ OCT: Optical Coherence Tomography

⁹ NRE: Non-Recurring Engineering

Long-term opportunities for silicon photonics in consumer healthcare

(Source: Silicon Photonics 2021 report, Yole Développement, 2021)



Intel, which is marketing servers, has 53% market share in silicon photonic transceivers for datacom in 2020¹⁰. Intel is one of the leading silicon photonics companies, without doubts. In this context, Yole's partner, System Plus Consulting, releases an exhaustive analysis of the [Intel Silicon Photonic 100G CWDM4 QFSP28 Transceiver](#).

For Sylvain Hallereau, PhD, Principal Technology & Cost Analyst at System Plus Consulting: "In just a few short years, Intel has already shipped more than 3M units of its 100G pluggable transceivers. And with its CWDM4 100G technology, Intel is the first in the world to offer a silicon photonic solution up to 10km. The 100G PSM4 and CWDM4 represent the first step, with Intel's 200G and 400G products expected to enter volume production in the second half of 2020."

All year long, Yole Group of Companies, including [System Plus Consulting](#) and [Yole Développement](#) publishes numerous reports and monitors. In addition, experts realize various key presentations and organize key conferences.



In this regard, do not miss the [Optical Transceivers & Silicon Photonics Forum 2021](#) on September 2nd in Shenzhen, China & online, presented by:

- Alexis Debray, Senior Analyst, Emerging Technologies, from Yole
- Martin Vallo, Technology & Market Analyst, Solid-State Lighting, from Yole
- Sylvain Hallereau, Principal Technology & Cost Analyst at System Plus Consulting
- Sven Otte, CEO of Sicoya

Further speakers will be confirmed soon. Register now on [i-Micronews!](#)

Make sure to be aware of the latest news coming from the industry and get an overview of our activities, including interviews with leading companies and more on [i-Micronews](#). Stay tuned!

¹⁰ Market share based on the market value, in US\$.



Press Release

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About our analysts

Alexis Debray, Ph.D., is a Senior Analyst at Yole Développement (Yole), dedicated to the production of technology & market reports and custom consulting projects in the fields of Photonics, Sensing, and Semiconductors. Before joining Yole, Alexis spent 17 years in Japan. He worked for 2 years developing expertise in MEMS technologies and then for 15 years at Canon Inc. as a research engineer, where he contributed to numerous developmental projects focused on MEMS devices, lingual prehension, and terahertz imaging devices. Alexis is the author of various scientific publications and patents. He graduated from ENSICAEN (France) and was awarded a Ph.D. in applied acoustics.

With more than 25+ years' experience within the semiconductor industry, **Eric Mounier PhD.** is Director of Market Research at Yole Développement (Yole). Eric provides daily in-depth insights into current and future semiconductor trends, markets and innovative technologies (such as Quantum computing, Si photonics, new sensing technologies, new type of sensors ...). Based on relevant methodological expertise and a strong technological background, he works closely with all the teams at Yole to point out disruptive technologies and analyze and present business opportunities through technology & market reports and custom consulting projects. With numerous internal workshops on technologies, methodologies, best practices and more, Yole's Fellow Analyst ensures the training of Yole's Technology & Market Analysts. In this position, Eric Mounier has spoken in numerous international conferences, presenting his vision of the semiconductor industry and latest technical innovations. He has also authored or co-authored more than 100 papers as well as more than 120 Yole's technology & market reports. Previously, Eric held R&D and Marketing positions at CEA Leti (France). Eric Mounier has a Ph.D. in Semiconductor Engineering and a degree in Optoelectronics from the National Polytechnic Institute of Grenoble (France).

Jean-Louis Malinge collaborates with Yole Développement (Yole) to investigate the silicon photonics technologies and market evolution. Jean-Louis is strongly involved in this industry for many years and as an expert, he is an accomplished business management executive with extensive experience as a General Manager and CEO in France and the United States. He serves on numerous Boards of Directors. Amongst his experiences, he has formulated successful strategies to position or reposition lot of businesses, led numerous acquisition projects, and managed the creation of a successful joint-venture in Asia. Jean-Louis' academic credentials include an Executive M.B.A. from MIT Sloan School in Boston, Massachusetts. He also holds an engineering degree from the Institut National des Sciences Appliquées (INSA Rennes, France).

Sylvain Hallereau is Principal Technology & Cost Analyst at System Plus Consulting, part of Yole Développement (Yole). Working in close collaboration with the laboratory teams, Sylvain produces reverse engineering & costing reports while also contributing to custom projects, especially focused on solid-state lighting components, sensors, biotechnology devices, and ICs. Together, they define the objectives of the analysis and the most relevant methodology to gain a detailed understanding of the structure of the device. Sylvain then analyzes the results to describe the technology choices made by the leading semiconductor companies and the related process flows and also calculates the cost structure. In parallel, based on his significant technical and industrial knowledge, Sylvain supports the development of the semiconductor device activities and the related team at System Plus Consulting. He also contributes to the strategies of this department. Sylvain daily runs a strategic watch within the semiconductor community. Through his investigations, his aim is to identify innovative components and new manufacturing processes. In this way, Sylvain supports System Plus Consulting with the setting up of new methodologies for analysis and the updating of advanced simulation tools, especially those developed internally by System Plus Consulting's experts. Sylvain regularly contributes to numerous media articles, using his technology and industry expertise to analyze and comment on the latest innovations. He holds a master's degree in Microelectronics from the University of Nantes (France).

About the reports

Silicon Photonics 2021

Beyond communication, silicon photonics is penetrating consumer and automotive – heading to \$1.1B in 2026. – Performed by Yole Développement

Companies cited:

Acacia, Accton, Aeva, AIO Core, Alibaba Cloud, Alpine Optoelectronics, Amazon, amf, ams, Analog Photonics, Anello, AOI, Aryballe, AT&T, Axalume, Ayar Labs, Bra-Ket Science, Broadcom, Broadex, Caliopa, CeliO, Ciena, Cisco, Cloudlight, Elenion, Ericsson, Facebook, Fiberhome, ficonTEC, Finisar, Fujitsu, Fujitsu Optical Components, Genalyte, GlobalFoundries, Google, Hengtong, HPE, Huawei, Hyperlight, IBM, II-VI, Infinera, InPhi, Intel, iPrionics, IQE, Iris Light Technologies, Juniper, Kaiam, KVH, Leoni, Lightelligence, Lightmatter, Lightwave Logic, Lumentum, Luminous, Lumiphase, Luxtera, MACOM, Microsoft, Molex, NEC, NeoPhotonics, Nokia, and many more...

Intel Silicon Photonic 100G CWDM4 QFSP28 Transceiver

A deep analysis of the world's first 100G CWDM silicon photonic transceiver, covering new technologies and the main differences from the Intel 100G PSM4. – Performed by System Plus Consulting

Related reports:

- [Optical Transceivers for Datacom & Telecom 2020](#)
- [LiDAR for Automotive and Industrial Applications 2020](#)
- [High-End Inertial Sensors for Defense, Aerospace and Industrial Applications 2020](#)
- [Quantum Technologies 2021](#)
- [II-VI/Finisar 100Gb CWDM4 Optical Transceiver](#)
- [Intel Silicon Photonic 100G PSM4 QFSP28 Transceiver](#)

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... [More](#)

About System Plus Consulting

System Plus Consulting specializes in the cost analysis of electronics, from semiconductor devices to electronic systems. Created more than 20 years ago, System Plus Consulting has developed a complete range of services, costing tools and reports to deliver in-depth production cost studies and estimate the objective selling price of a product... [More](#)

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