

# Silicon photonics: datacom, yes, but not only...<sup>1</sup>

## OUTLINES:

- Silicon photonics market: Yole Développement points out a sustained growth.
- Silicon photonics technologies are not spread of by new potential applications.
- The market research & strategy consulting company announces an overall silicon photonics market reaching US\$3.9 billion in 2025.
- Competitive landscape:  
Silicon photonics is attracting new players, especially with co-packaged emerging technologies.  
Intel: more than 3 million units of its 100G pluggable transceivers shipped, in just a few short years.  
China is watching the European photonic ecosystem.
- Save the date right now: [Optical Transceivers & Silicon Photonics Forum 2020](#) on September 9 at IPM, in Shenzhen, China, alongside the 22nd CIOE.

In 2019, shipments of silicon photonic transceivers for datacenters reached almost 3.5 million units, for revenues worth US\$364 million. And the success story does not stop there... “Indeed, this is an impressive growth since most products appeared in 2016 and 2017,” reminds **Alexis Debray, PhD. Technology & Market Analyst at Yole Développement (Yole)**. And he explains: “Silicon photonic transceivers are reported to have better reliability and lower price than transceivers using legacy optics. And we see lot of new companies that are focusing their activities on the development of transceivers to penetrate the silicon photonics world for telecom/datacom applications.”

And this growth is expected to continue in coming years, explains Yole in its Silicon photonics report, 2020 edition, [Silicon Photonics Market & Technology 2020](#). So what does this story make so successful?

The main reason is focused on the global network traffic. Therefore, it doubles every three years thanks to applications in Cloud, video streaming, and IoT<sup>2</sup>. As a result, the silicon

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<sup>1</sup> Extracted from :

- [Intel Silicon Photonic 100G CWD4M4 QFSP28 Transceiver report](#), System Plus Consulting, 2020
- [Silicon Photonics Market & Technology 2020 report](#), Yole Développement, 2020

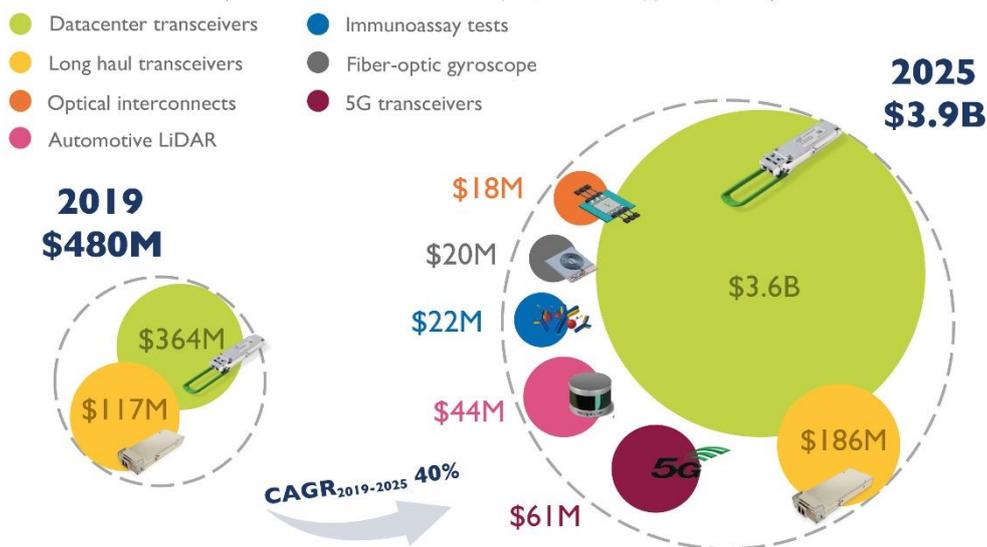
<sup>2</sup> IoT : Internet of Things

photonic transceiver market is directly impacted. Yole’s analysts expect this industry to be worth US\$3.6 billion in 2025 with 24 million units shipped.

In parallel, the development of silicon photonic transceivers as an industry with millions of units shipped has resulted in the emergence of an ecosystem with PDKs<sup>3</sup>, design rules, simulation software, testing equipment, and foundries. This ecosystem is enabling new companies to easily access this technology and enter new applications. Genalyte, a Californian company, releases immunoassays using silicon photonics this year. A first announcement has been done last week: read it on [i-Micronews](#). Fiber optic gyroscopes using silicon photonics were announced for this year by KVH. Electronic noses, LiDARs, and OCT<sup>4</sup>, all relying on silicon photonics, are under development and expected in coming years.

## Silicon photonic 2019-2025 market forecast by application

(Source: Silicon Photonics 2020 report, Yole Développement, 2020)



Yole and its partner [System Plus Consulting](#) deliver this year two significant analyses dedicated to the silicon photonics technologies and its industry.

System Plus Consulting proposes a special case study focused on Intel’s silicon photonic transceiver to illustrate latest innovations and technical choices made by the leading company: [Intel Silicon Photonic 100G CWDM4 QFSP28 Transceiver report](#).

Silicon Photonics report from Yole reveals a deep understanding of the technologies and market status including all technical issues. With market trends and figures, an overview per market segment, a detailed description of the competitive landscape and a relevant technology

<sup>3</sup> PDK : Process Design Kits

<sup>4</sup> OCT : Optical Computed Tomography

roadmap including new developments related to co-packaged technologies from Intel, Rockley, the market research and strategy consulting company proposes a valuable and comprehensive analysis of its annual silicon photonics report.

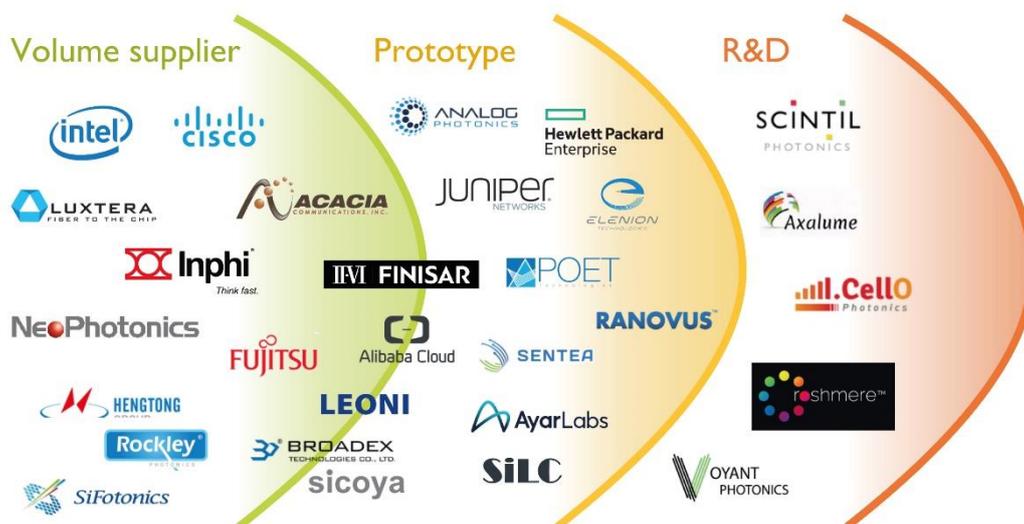
Yole and System Plus Consulting, in collaboration with Jean-Louis Malinge, a world-renowned telecommunication & photonics expert, investigate the silicon photonics industry for a while to deliver high added value analyses. Discover today the status of this industry.

Silicon photonics is a great technology for optical communications, allowing more reliable and cheaper products, and enabling the high data rate densities that will be needed in five years for switches. It has attracted important players in datacom infrastructure.

Cisco acquired Lightwire in 2012 for US\$217 million, and in 2019 it bought both Luxtera for US\$660 million and Acacia for US\$2.6 billion. Luxtera has 35% of the market share in silicon photonic transceivers for datacom, while Acacia is the main player for silicon photonic transceivers for long haul.

## Readiness of silicon photonic players

(Source: Silicon Photonics 2020 report, Yole Développement, 2020)



Intel, which is marketing servers, has 60% market share in silicon photonic transceivers for datacom. Intel is one of the leading Silicon photonics companies, without doubts. Indeed, in just a few short years, Intel has already shipped more than 3 million units of its 100G pluggable transceivers. “With its CWDM4 100G technology, Intel is the first in the world to offer a silicon photonic solution up to 10km for direct detection,” explains **Sylvain Hallereau, Senior Technology & Cost Analyst, System Plus Consulting**. “The 100G PSM4 and CWDM4

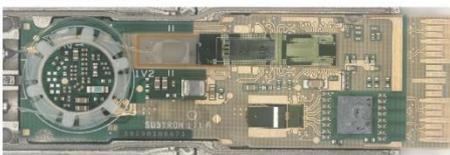
represent the first step, with Intel’s 200G and 400G products expected to enter volume production in the second half of 2020.”

Intel’s transceiver reuses a part of the PSM4 technology, but many other facets represent new approaches from the leading company.

## Intel silicon photonic 100G CWDM4 QFSP28 transceiver - Physical analysis

(Source: Intel Silicon Photonic 100G CWDM4 QFSP28 Transceiver report, System Plus Consulting, 2020)

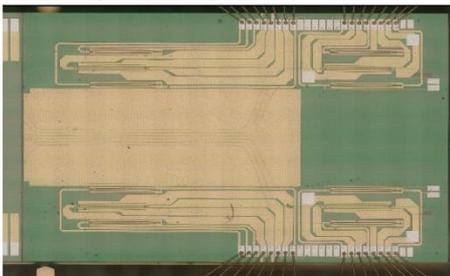
Optical connector PCB



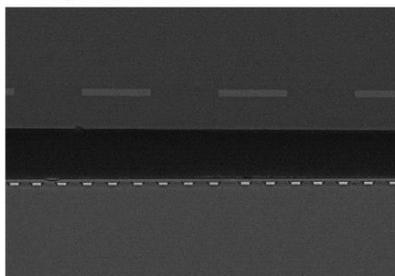
Silicon photonic die



InP laser integrated on silicon photonic die



Demultiplexer cross-section



The transceiver comes with two separated lines with several dies. The transmitter silicon photonic die integrates four InP<sup>5</sup> lasers for the four wavelengths, in a different configuration than the PSM4. On the same die, a Mach-Zehnder modulator is added to modulate the signal, but the CWDM MZI is more complex. Light extraction is performed by the edge of the die and not by a mirror. Other components have been added to the system in order to focus or isolate the signal. Data is processed by using a four-channel 25G optical CDR<sup>6</sup> component from MACOM.

The receiver function is performed by four germanium photodiode dies and a TIA<sup>7</sup> circuit. The Ge<sup>8</sup> photodiodes are manufactured on a dedicated SOI<sup>9</sup> substrate, and an optical demultiplexer is assembled between the SiGe<sup>10</sup> photodiodes and the fiber optic.

System Plus Consulting’s analysts describe and analyze Intel’s potential in terms of packaging and photonics. Within a very small form factor, Intel has successfully managed to integrate four lasers, a photonic driver, optical modules, CDR functionality, high-performance photo-

<sup>5</sup> InP : Indium Phosphide

<sup>6</sup> CDR : Clock and Data Recovery

<sup>7</sup> TIA : Trans Impedance Amplifier

<sup>8</sup> Ge : Germanium

<sup>9</sup> SOI : Silicon On Insulator

<sup>10</sup> SiGe : Silicon Germanium

diodes, two advanced substrates, and materials for optic. This report clearly points out the impressive technology developed by Intel by showing how the chipset configuration is implemented and describing in detail the transmitter and receiver line.

*“This tendency of vertical integration is continuing, and silicon photonics seems to be an opportunity for system companies to enter the transceiver market”, asserts **Eric Mounier, PhD. Fellow Analyst at Yole.** “This is the case for Juniper Networks, a leader in routers and switches, which acquired Aurion in 2016 for US\$165 million and which is preparing 400ZR silicon photonics transceivers. Fujitsu Optical Networks is proposing 400ZR silicon photonic transceivers. Nokia acquired Elenion in February 2020.”*

However, diversity is key for businesses to operate smoothly. Other companies like Inphi and NeoPhotonics are proposing silicon photonic transceivers with strong technologies. HPE is developing a platform for the development of silicon photonics with several partners. China also has strong ambitions for 5G and Cloud datacenters. Several Chinese companies are entering the silicon photonic market, usually with Western companies. Alibaba Cloud is collaborating with Elenion, Hengtong with Rockley Photonics, and Broadex with Sicoya. Silicon photonics has shipped millions of units of optical transceivers. It is expected to be a key technology for network switches in the next five years with CPO. The number of companies interested in silicon photonics is impressive. Silicon photonics has become an established industry and will enable new applications in coming years.



*All year long, System Plus Consulting and Yole Développement combine their expertise and deep understanding of the markets and disruptive technologies to publish numerous reports. In addition our experts realize various key presentations and organize key conferences.*

*Save the date right now: [Optical Transceivers & Silicon Photonics Forum 2020](#) on September 9 at IPM, in Shenzhen, China, alongside the 22nd CIOE.*

*This Forum is the first conference focused on optical transceivers and silicon photonics. Therefore, Yole is proud to collaborate with the China International Optoelectronic Expo (CIOE) to organize an all-new Executive Forum on Optical Transceivers and Silicon Photonics. This event will explore optical transceiver applications within the optical communication industry. Discover the program on [i-Micronews](#) and well as the overall 2020 program. Stay tuned!*

### Press contacts

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### About our Analysts

**Alexis Debray**, PhD is a Technology & Market Analyst, Optoelectronics at Yole Développement (Yole). As a member of the Photonics, Sensing & Display division, Alexis is today engaged in the development of technology & market reports as well as the production of custom consulting projects dedicated to the imaging industry. After spending 2 years at the University of Tokyo to develop an expertise focused on MEMS technologies, Alexis served as a research engineer at Canon Inc. During 15 years he contributed to numerous projects of development, focused on MEMS devices, lingual prehension, and terahertz imaging devices. Alexis is the author of various scientific publications and patents. He graduated from ENSICAEN and holds a PhD in applied acoustics.

**Sylvain Hallereau** has been Project Manager at System Plus Consulting since 2000. He is in charge of costing analyses for Integrated Circuits, Power semiconductors and LEDs. He has significant experience in the modeling of manufacturing costs for electronics components.

**Jean-Louis Malinge** is an accomplished business management executive with extensive experience as a General Manager and CEO in France and the United States. He also serves on numerous Boards of Directors. He has formulated successful strategies to position or reposition numerous businesses, has led numerous acquisition projects, and also managed the creation of a successful joint-venture in Asia.

Jean-Louis is currently a Venture Partner with Arch Venture Partners. Jean-Louis is currently Director with the board of EGIDE Group, POET Technologies and Cailabs. He is also Managing Director of YADAIS, a telecommunications and photonics consulting firm.

Jean-Louis was President and CEO of Kotura from 2004–2013, when Kotura was acquired by Mellanox. A global leader in silicon photonics, Kotura designs, manufactures, and markets CMOS optical components that are deployed throughout the communications network.

Formerly, Jean-Louis served as Vice President - Optical Networking Products for Corning, Inc. His other prior experience includes serving as Technology Director with Amphenol and Thompson CSF in France.

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 in Rennes, France.

With more than 25+ years of experience within the semiconductor industry, **Eric Mounier**, PhD. is Fellow Analyst at Yole Développement (Yole). Eric is daily providing deep insights into current and future semiconductor markets and innovative technologies such as Silicon photonics, MEMS, quantum computing and new type of sensors.

Based on a relevant methodology expertise and strong technological background, he is closely working with the overall teams at Yole to point out disruptive technologies and analyze business opportunities.

Eric Mounier has a Semiconductor Engineering Degree and a Ph.-D in Optoelectronics from the National Polytechnic Institute of Grenoble (France).

**Nicolas Radufe** is in charge of physical analysis at System Plus Consulting. He has a deep knowledge in chemical and physical analyses. He previously worked in microelectronics R&D for CEA/LETI in Grenoble and for STMicroelectronics in Crolles.

### About the reports

#### **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*

#### **Silicon Photonics Market & Technology 2020**

*Pluggable transceivers in high volume production. Co-packaged optics in line of sight. - Performed by Yole Développement*

### 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](#)



## Press Release

### About Yole Développement

Founded in 1998, Yole Développement (Yole) has grown to become group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services. 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](#)

**For more information and images, please visit [i-Micronews](#)**

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