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Silicon Photonics Market- Global Industry Size, Share, Trends, Opportunities, and Forecast, 2018-2028 Segmented By Component (Lasers, Modulators, PICs, Photodetectors, and Ultra-low-loss Waveguides), By Application (Data Center, Telecommunication, Consumer Electronics, Healthcare, Automotive, and Others), By Waveguide (400-1,500 NM, 1,310-1,550 NM, and 900-7000 NM), By Product (Transceivers, Variable Optical Attenuators, Switches, Cables, and Sensors), By Material (Silicon or Silicon Based Alloys, Indium Phosphide, and Others), By Region and Competition

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Abstracts

Silicon photonics market is expected to grow during the forecast period due to the rapid developments in the 5G industry, combined with the surge in demand for cloud-based services, which provide a plethora of opportunities to companies that offer products in the silicon photonics market. Over the years, major players have shown interest in the silicon photonics technology. Intel Corporation, Cisco Systems, Inc., IBM Corporation, and Juniper Networks, Inc., among other players, have invested heavily to assert their dominance in the growing silicon photonics market. However, even with such enormous growth, the silicon photonics market is facing many challenges, including problems in adopting different communication systems, risk of thermal effects, and lack of commercialization in the telecommunication sector.

The emerging technology that transmits data inside computer chips via optical beams is called silicon photonics. There is a significant opportunity in the future since silicon

photonics. Due to this, can transfer more data while using less power and without any signal loss.

Global Silicon Photonics Market: Drivers & Trends

Increasing Demand for 5G Communication:

Silicon photonics technology is expected to change the telecommunication industry completely. Until now, data was transmitted in the form of electrical signals through copper wiring. However, the emergence of technologies, such as 5G communication that enables faster data speeds, and the maximum throughput that copper allows for can potentially act as a bottleneck on computing speeds. Hence, with silicon photonics, more patterned silicon will be used to transmit data-carrying laser signals and carry the potential to allow more data to be moved around faster while also consuming less power. Moreover, silicon photonics can be easily manufactured at the same mass scale as current silicon-based technologies. Moreover, companies such as, Intel Corporation are intensifying their portfolio of 100G silicon photonics transceivers to be used for 5G and IoT applications.

Silicon photonic technologies are primarily used in optical communication systems and networks due to their favoring features such as bandwidth, immunity to electromagnetic fields, and compatibility with optical fiber and flexibility. The fabrication of photonic devices through complementary metal-oxide semiconductor (CMOS) compatible processes has paved a new path for low cost and reduced footprint circuits, making optical technologies available for numerous network segments and new applications. 5G rebuilds the 4G baseband unit (BBU), radio remote unit (RRU) and antenna into the centralized unit (CU). On the other hand, the distributed unit (DU) and active antenna unit (AAU) ensure that the network will incorporate fronthaul, midhaul, and backhaul. These changes have increased the demands for optical transceivers to meet the high bandwidth and distance requirements associated with critical links in the 5G network architecture.

The rising number of smart phones and other connected devices has increased the data traffic, as these devices transfer large amount data across a network at a given point of time, further creating the demand for 5G from end consumers. As per Telefonaktiebolaget LM Ericsson, a leading network solution provider, the monthly global mobile data traffic is expected to exceed 100 ExaBytes (EB) by the end of 2023. Furthermore, the need for high-speed network solutions from healthcare, consumer electronics, and automotive sectors has created an immense opportunity for 5G service

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providers. Hence, the increasing demand for 5G infrastructure is going to positively impact the growth of silicon photonics market.

High Speed Data Transmission Through Silicon Photonics:

The telecom industry has embraced fiber-optic technology as an improved solution to meet the surging demand for higher speeds and large-capacity data transmission over the electrical copper wires. At present, a huge amount of data is transmitted and received over long-haul fibers, which has led to the replacement of high power-consuming electrical switches that require optical-electrical-optical conversions and cause signal loss. This has led to the emergence of photonic switches to improve transmission quality and link a single transmission to tens and sometimes thousands of servers.

Moreover, silicon-based photonic switches use advanced CMOS technology to garner huge attraction from researchers as a powerful platform because of their low cost and high capacity. Moreover, traditional copper cabling is stifling datacenter evolution and high-performance computing (HPC) because of its slow data transfer capacity. Moreover, it is deemed inadequate for HPC applications, data centers, or efficiently managing growing data volumes. On the other hand, in the case of silicon photonics, data is transmitted among computer chips by optical rays, which can transmit large amounts of data in shorter time than electrical conductors. With the increasing advancements in silicon photonics technology, it is anticipated that it can realize data transfer speed at 1 tbps in a cost-effective manner.

Companies such as Intel Corporation, IBM Corporation, and Cisco Systems, Inc. consider silicon photonics as a promising technology that can reshape how datacenter systems exchange data and create leaner rack equipment. Therefore, these companies are investing in technology. IBM Corporation has invested in its silicon nano-photonics technology, which uses light instead of electrical signals to transfer data, enabling huge volumes of data to be transferred swiftly between computer chips in servers, large data centers, and supercomputers via pulses of light. With the integration of silicon photonics chips, it has become easier to transfer large chunks of data (>100 GB) from long distances because of the strong signal strength. Currently, silicon photonics technology is used extensively in regions such as North America and Europe. Furthermore, as the demand for higher bandwidth increases in applications such as data centers, the industry would be shifting toward vertical integration to drive the manufacturing process. In addition, it is expected that optoelectronics product development is going to witness an increased number of research activities in the coming years.

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Rising Deployment of Data Centers: Data centers have witnessed a crucial role in the ingestion, computation, storage, and management of information. However, many data centers are clunky, inefficient, and outdated. Hence, to keep them running, data center operators are upgrading them to fit the ever-changing world. Additionally, in 2021, Cisco Systems, Inc. claimed that traffic within data centers will increase three times, with a high amount of share attributed in hyperscale facilities such as those developed by leading players including Google, Amazon, Facebook, Apple, and Microsoft. Hyperscale data centers can be expanded to virtually any desirable size due to their architecture. These centers require high-speed connections to move lump-sum data between their basic building blocks, such as the individual servers and their supporting equipment.

The state-of-the-art transmission rates in data centers are mostly of 100 Gb/s. However, the industry is currently aiming to deploy a speed of around 400 Gb/s. This speed is also anticipated to increase going forward. The growing speed signifies the fact that silicon photonics solutions would be able to proceed deeper into the communications structure easily. Moreover, the largest volume demand for PICs is for data center interconnects (or DCIs) in data and telecom networks, with new applications coming, such as 5G wireless technology, automotive or medical sensors. Indium phosphide (InP) is the most used, but silicon photonics is growing at a faster rate. Silicon photonics technology is being adopted in system-to-system connections in various data centers. The technology is further expected to move between the sections on the chips within the servers as well.

Global Silicon Photonics Market: Challenges

Complex Design Platforms and Fabrication Processes:

Silicon photonics is rapidly gaining maturity in high bandwidth optical communication, with applications in datacom, access networks, and I/O for bandwidth-intensive electronics along with emerging applications in spectroscopy and sensing. The integration of photonics and electronics is needed to get the most optimum performance out of the photonics, such as side-by-side, stacked, or on the same chip. However, the combination of photonics and electronics can create a range of new problems on the design side, such as codesign and co-simulation of complex photonic and electronic circuits, verification algorithms that can handle photonic circuits, and tolerance to variability.

There are still major challenges in the fabrication processes, design platforms, and

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specific device design for system-level applications. The fundamental value proposition of silicon photonics is that it can leverage mature fabrication processes using lower resolution CMOS processing compared to current state-of-the-art microelectronic chips. However, the existing fabrication techniques for high-quality electronic devices do not necessarily realize high-quality optical devices in large volumes. Monolithic integration of CMOS with photonics in silicon photonic devices is strongly dependent on the design rules of the specific fabrication processes, leading to devices that currently must be post-processed to achieve high yield.

Packaging Issues with Silicon Photonics Devices:

Packaging plays a significant role in system-level implementations of silicon photonics devices. Cost-effective, robust packaging is required for silicon photonic devices to be marketable. For silicon photonics to be a viable platform, there is a requirement for the automation of packaging. Significant problems in packaging are high-volume optical connections, thermal stability, and proper packaging of electronic components. Most commercial silicon photonics devices are transceivers. Grating couplers typically provide optical connections, as they are less sensitive to misalignment, as compared to edge-coupling. However, grating couplers are wavelength-selective, making their use for large spectral-bandwidth solutions difficult.

Thermal stability is also a significant issue in the packaging of silicon photonic devices. Some of these devices use large thermally induced changes in the refractive index. The devices must be packaged such that external temperature fluctuations do not alter the operation of the device. Moreover, the physical properties of silicon photonics, which lead to this excess thermal generation, is two-photon absorption, a process in which an electron-hole pair is excited with the help of a pair of photons. This process, however, generates unwanted heat and light. Due to thermal heat generation, silicon photonics technology is considered a non-ecofriendly technology, as thermal pollution increases the surrounding temperature significantly. Therefore, packaging with thermal electric coolers (TEC) is becoming more common. However, these components add to the overall power and cost of the device.

Market Segments

The global silicon photonics market is segmented into component, application, waveguide, product, material, and region. Based on component, the market is segmented into lasers, modulators, PICs, photodetectors, ultra-low-loss waveguides. Based on application, the market is segmented into data centers, telecommunication,

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consumer electronics, healthcare, automotive, and others. Based on waveguide, the market is segmented into 400-1,500 NM, 1,310-1,550 NM, 900-7000 NM. Based on product, the market is segmented into transceivers, variable optical attenuators, switches, cables, sensors. Based on material, the market is segmented into silicon or silicon-based alloys, indium phosphide, and others. Based on region, the market is segmented into North America, Asia-Pacific, Europe, South America, and Middle East & Africa.

Market Players

Major market players in the global silicon photonics market are Intel Corporation, Luxtera Inc. (Subsidiary of Cisco Systems, Inc.), Acacia Communications, Inc., Infinera Corporation, IBM Corporation, Finisar Corporation, STMicroelectronics N.V., Fujitsu Ltd., OneChip Photonics Inc., and NeoPhotonics Corporation

Report Scope:

In this report, global silicon photonics market has been segmented into following categories, in addition to the industry trends which have also been detailed below:

Silicon Photonics Market, By Component:

Lasers

Modulators

PICs

Photodetectors

Ultra-low-loss Waveguides

Silicon Photonics Market, By Application:

Data Center

Telecommunication

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Consumer Electronics

Healthcare

Automotive

Others

Silicon Photonics Market, By Waveguide:

400-1,500 NM

1,310-1,550 NM

900-7000 NM

Silicon Photonics Market, By Product:

Transceivers

Variable Optical Attenuators

Switches

Cables

Sensors

Silicon Photonics Market, By Material:

Silicon or Silicon Based Alloys

Indium Phosphide

Others

Silicon Photonics Market, By Region:

North America

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- United States
- Canada
- Mexico

Europe

- Germany
- Italy
- Spain
- United Kingdom
- France

Asia pacific

- China
- India
- Japan
- Singapore
- South Korea

Middle East & Africa

- South Africa
- Saudi Arabia
- UAE

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South America

Brazil

Argentina

Colombia

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in global silicon photonics market.

Available Customizations:

Global silicon photonics market with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

Detailed analysis and profiling of additional market players (up to five).

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11. MARKET DYNAMICS

12. MARKET TRENDS AND DEVELOPMENTS

13. COMPETITIVE LANDSCAPE

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