HAMAMATSU

PHOTON IS OUR BUSINESS

Creating Connections

Creating and sharing high-speed data has become the cornerstone of our society. The reach and impact of optical communication are yet to be fully understood. However, many challenges face photonics technology in optical communications. This technology relies on transmitting light signals over long distances where signal loss can occur due to effects like scattering, absorption, and dispersion. Minimizing signal loss is crucial to maintaining signal integrity and achieving high speed, particularly for long-distance communication.

With the increasing demand for high-speed data transmission, there is a constant need to expand the bandwidth capacity. Photonics technology has the challenge of increasing bandwidth while maintaining signal quality. Power consumption is also key to ensuring energy-efficient optical communication systems, particularly in data centers.

Integrating various optical components and functionalities into a compact device is key to improving the efficiency and scalability of optical communication systems. Photonic technology needs to realize high levels of integration and miniaturization, with high performance and high reliability.

Remarkable data transmission speed

From the early days of telegraphs to the introduction of LED and multimode fiber, the capacity and transmission distances of data have greatly improved. More specifically, optical communication through fiber optic technology has undergone significant advancements over the years. The development of optical amplifiers and DWDM (Dense wavelength-division multiplexing) systems further enhanced the capability of fiber communication, allowing for the transport of multiple wavelengths over long distances. Presently, experimental systems have successively transmitted data of 1,840Tbps (Terabits per second) over a single 37-core, 7.9-km-long fibre[1], making fiber optic cables the backbone of long-distance and regional networks.

Today, fiber-optic communication, linked to photonics technology, has revolutionized the way we transmit data over short and long distances, and it is used across many fields. Fiber-optic communication products include **transmitter photo ICs**, integrating light emitters and driver circuits, as well as **receiver photo ICs**, integrating light sensors and signal processing circuits, capable of achieving high data transmission speed. Optical transceivers, integrating the transmitter and receiver features, enable higher-speed data communication, while also incorporating optical connectors suitable for a wide range of optical fibers.

Hamamatsu Photonics recently developed an **optical transceiver** capable of achieving fiber-optic communications at a significantly higher data transmission speed than before, now reaching 1.25 Gbps (gigabits per second). It provides standard-compliant optical connectors that attach to the preferred optical fibers, depending on the application. For short-distance board-to-board communication within the equipment, it is usable with inexpensive POF (plastic optical fibers) achieving highspeed data communication at a low cost. Moreover, when used in conjunction with HPCF (hard plastic clad fibers) or large-diameter glass optical fibers, it extends the data transmission distance up to 100 meters, making it ideal for establishing networks or facilitating communication between devices and equipment.

The Hamamatsu optical transceiver P16671-01AS is capable of serial data communication at data rate of 150 Mbps to 1.25 Gbps.

Underwater communication

Underwater optical communication has other challenges for photonics, including mitigating the effects of attenuation and scattering, and the need for a robust and reliable solution due to the underwater environment. In response to this, high-speed response **PMT (photomultiplier tube) modules** featuring

Hamamatsu photosensor modules H14447, H14990-100-02 and photomultiplier tube module H14600-100 for underwater optical communications.

high gain, and a large effective diameter for better light collection, are ideal for high-speed underwater optical communications.

Measuring data

There exist ultra high-speed detectors called **streak cameras** which capture light emission phenomena occurring in extremely short time periods. Used for a variety of applications, these have proven to be useful for optical communications since they can measure the dispersion in time occurring in optical fiber. For example, a laser diode with a wavelength of 1.5 µm generates many pluses, creating different wavelengths at the same time[2]. The speed of each optical pulse transmitted through the optical fiber varies depending on its wavelength. Thus, when the output light undergoes time-resolved spectroscopy after being transmitted a long distance, the differences in arrival time depending on each wavelength of a pulse can be measured. This is practical to gather the necessary information when manufacturing optical fibers.

Hamamatsu Photonics remains committed to pushing the boundaries of transmission speed, continuously expanding its product lineup, and meeting evolving market demands. Its dedication to innovation in fiber-optic communication and photonics technology ensures that the world will continue to benefit from faster and more reliable data transmission in various industries.

References:

[1] Petabit-per-second data transmission using a chip-scale microcomb ring resonator source | Nature Photonics
https://www.nature.com/articles/s41566-022-01082-z.epdf

[2] https://www.hamamatsu.com/content/dam/hamamatsu-photonics/sites/documents/99_SALES_LIBRARY/sys/SHSS0006E_STREAK.pdf