How Optical Filters Enable Data Centers' Ubiquitous AI Demands

Peter Hook, Yongbao Xin, and Daniel Ulba, Iridian Spectral Technologies

Artificial intelligence (AI) touches all aspects of our lives. In a general sense, 77% of everyday devices in use feature some form of AI, and 9 out of 10 organizations support AI for a competitive advantage.[1] This expansive usage makes AI the main driver of growth in data center capacity demand.[2] However, existing data center infrastructure must be improved to handle that demand, which is also created by:

- **Gigabit Ethernet Growth:** The growth of 10 Gigabit Ethernet (GE), 25 GE and 40 GE network adapters
- **Cloud IT:** A single request can trigger multiple data exchanges between servers in one data center, as well as servers in different data centers.
- **New Storage Technology:** Flash memory, solid-state drive (SSD) storage, and software-defined storage enhance the attractiveness of cloud storage.
- **Continuous Data Availability and Mobility:** Distributing virtual computing and storage resources across many physical devices
- **Dynamic Allocation of Resources:** Dynamic allocation of server, storage, and network resources for resource sharing

In addition to performance improvements, data center upgrades focus on economy of space and energy usage, as well as temperature management and component sustainability. Optical filters designed and manufactured by Iridian Spectral Technologies fulfill all these goals while offering cost efficiency.

How Do Optical Filters Upgrade Data Centers?

Per the International Energy Agency's special report *Energy and AI*,[3] electricity demand from data centers worldwide is expected to more than double by 2030 to around 945 terawatt-hours (TWh) — "slightly more than the entire electricity consumption of Japan today." Iridian can support the need to rebuild AI-enabling infrastructure with its optical filters that operate passively, versus alternative solutions utilizing active components that draw energy. Passive optical filters also tend to be more reliable and less temperature sensitive than active components.

Moreover, data center demand for connectivity speed and data volume is likely to be four times its current level by 2030. Through the application of optical filters, data center customers are seeking to push the boundaries of maximum performance. Iridian Spectral is in the top tier of optical filter providers because our capability is born out of advanced off-the-shelf technologies, rather than off-the-shelf products. This enables us to quickly design and create components that fulfill even the most challenging customer specifications.

To serve AI applications, data needs to be accessed and transferred constantly to and from data centers, as well as between stacks within the data centers. This requirement places an enormous burden on the interconnects between servers in the data center — components that can number in the hundreds of thousands for even a single data center.

The Power Of Fit-For-Purpose Datacom Filters

Iridian has a wealth of experience in designing and manufacturing optical filters for both long-distance signal transportation (telecom filters) and for short-range data center interconnects (datacom filters). The technologies and some of the goals are similar despite vastly different applications. For example, increasing signal speed and volume is key to both application sets, but datacom filters may require unique form factors, size, or temperature management capabilities to optimize filter and data center functionality.

As Iridian has noted before, "Optical interconnect bandwidth enhancement using single mode fiber (SMF), multimode fiber (MMF), coherent digital optical transmission, dense wavelength division multiplexing (DWDM), multiple spatial modes, increased data rates, and other techniques will come into use as each of the optical data center interconnects start to require data transfer rates approaching those of the long-haul fiber connections."

In addition to deep experience and broad capability, Iridian helps its customers to proceed quickly from prototyping to high-volume production. Particularly in telecom, we are renowned for quick project development turnaround. For example, a longtime customer — a laser production company — has been using Iridian's etalon filters to support internal communications within its data center.

Thousands of send and receive tunable laser assemblies (TLAs) rely on the silicon (Si) etalon filters to provide controlled free-spectral range (FSR) and tunability to enable selection of specific wavelength peaks, fostering the highest possible communication rate. Historically, data center communications have been limited to the C-band (1530-1565nm), but that range is expanding out of necessity. Iridian's wavelength division multiplexing (WDM) filters can separate or combine up to four different signals in the O-band (1260-1360nm), the C-band, and the L-band (1565-1625nm); our broad bandpass filters can transmit the entire O, C, or L-band.

Datacom filters often have similar optical functionality and requirements as traditional telecom filters. However, the optical design, filter size and thickness may be customized to meet the unique requirements of these ultra-compact products. Additionally, all Iridian datacom filters adhere to Telcordia 1221 environmental testing.

Iridian also reduced the size of the filter modules used by that customer by a factor of between 30% and 50%. This means the customer can pack more filter modules into a smaller space, taking up less room in the server racks and consuming less power overall. Just like Iridian's hybrid gain flattening filters for telecom, our optical datacom filters can be stacked within a single module, reducing the form factor by combining the functions of two different filters into one unit.

Beyond reduced power consumption, less heat sensitivity, and smaller sizes, our optical filter customers increasingly prioritize signal fidelity specifications in their requests. There is a need for reduced transmittance ripple and higher reflection isolation in particular.

Are Inadequate Filters Slowing You Down?

Whether you have precise components and specifications in mind to bolster the performance of your data center or you simply are exploring potential options, Iridian Spectral Technologies is the premier source for optical filters. We can help customers recognize their technical requirements and spec filters to meet those needs, regardless of where discussions begin. Starting with rapid prototyping for system testing, we quickly move to large-volume production once the optimal components are identified, consistently manufacturing each one with high quality and performance at a competitive cost. To learn more, visit https://www.iridian.ca.

Resources

- *An Overview of Optical Interconnect Technology*
- *Optical Interconnects | Optical Filters | Solutions*
- *https://youtu.be/dMc5a7bG770*

References

1. *Webster, Mark. "149 AI Statistics: The Present & Future of AI at Your Fingertips." AuthorityHacker, Update Nov. 15, 2024. https://www.authorityhacker.com/ai-statistics/*
2. *Srivathsan, Bhargs et al. "AI power: Expanding data center capacity to meet growing demand." McKinsey & Company, Oct. 29, 2024. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/ai-power-expanding-data-center-capacity-to-meet-growing-demand*
3. *IEA (2025), Energy and AI, IEA, Paris https://www.iea.org/reports/energy-and-ai, Licence: CC BY 4.0*

IRIDIAN
SPECTRAL TECHNOLOGIES

About Iridian Spectral Technologies

Iridian Spectral Technologies is a world leader in designing and manufacturing custom optical filter solutions. Iridian uses advanced, proprietary thin-film design deposition and manufacturing technology to deliver durable, high-performance optical filters for use in applications including telecommunications and data centers, Raman and fluorescence spectroscopy, mid-IR gas sensing, satellite-based imaging, communications, and many more.