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Making Data Centers Fit for the Future

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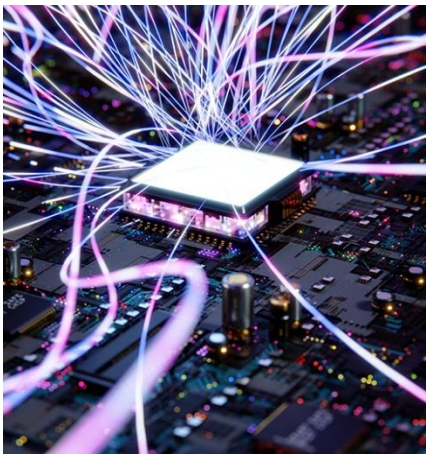

Data center operators face new challenges with technologies such as 5G, IoT, and artificial intelligence, while prioritizing and implementing environmentally sustainable solutions. These include rapidly growing volumes of data from a wide variety of sources and real-time analysis of AI algorithms or predictive maintenance. High-speed fiber optic cabling and intelligent edge concepts help to flexibly meet these challenges. Additional challenges include an increase in energy being used by data centers and the need for a more sustainable way of doing business while implementing modern technologies moving forward.

For some time now, the data center landscape has been undergoing change. The trend toward cloud computing has meant that more enterprise data centers are being abandoned. Instead, companies are shifting workloads to the cloud or relying entirely on cloud-first strategies.

Meanwhile, the demands on enterprise data centers, as well as the large data centers of cloud providers, are constantly increasing. Such requirements can no longer be met without high-performance, structured, and real-time capable fiber optic networks. Therefore, the Ethernet standard 400GBASE for transfer rates of 400 Gbps was standardized exclusively for fiber optic cables. The standardization of 800G is currently in progress. With the higher demand for speed, parallelization technologies are coming to the fore: The serial "lane speed" of singlemode transceivers for 800G is currently 100 Gbps. Up to 800 Gbps is therefore not possible without parallelization. In addition, the rest of the passive data cabling infrastructure must keep up.

The future belongs to singlemode fibers

Another limiting factor is the length limitation of the common protocols for multimode fibers to a maximum of one hundred meters. Driven by the mega data centers of the major cloud

providers, the trend is currently moving toward singlemode fibers that also support future data rates and ranges. The singlemode transceivers, which are still significantly more expensive, could be priced in line over the next few years. Their silicon photonics technology enables cost-effective production.

With the flux in hyperscale and cloud data center operators purchasing singlemode fibers, the cost of the infrastructure has dramatically decreased. Hyperscalers are deploying 400 to 800 Gbps channels and large enterprise data centers are upgrading to 100 and 400 Gbps. Overall, the increased demand in singlemode fibers has decreased the high cost of the infrastructure.

Data volumes are increasing

Sensors, edge devices and wearables in the IoT are generating increasingly large data streams. In traditional data center environments, the massive volume of data often results in delayed response times. Information is often accessed from different sources, including mobile sources, which are geographically too far away from the central nodes to ensure sufficient latency. In the Industry 4.0 environment, data acquisition and analysis are therefore increasingly performed directly in edge computing: the data from machines and sensors remains (in a data security-compatible manner) in the factory, while server containers and micro data centers on site are now part of everyday life. Only the information that is necessary for business processes is filtered and transferred to the cloud from the considerable data volumes.

The trend is toward the edge

This development towards the edge will continue in automated and autonomous driving. The path via the cloud data center is often too long and time-consuming. Instead, the vehicle will become increasingly important as an edge device and for computing capacity in the road infrastructure—consider, for example, intelligent traffic lights.

In preparation, a lot of compute power is migrating out of the data center and establishing itself locally at the point of origin of the data. High-speed Ethernet connections enable latency to be minimized and data to be processed in real time in the intelligent factory. Data cabling specialists help with the complex integration of edge solutions in company-specific scenarios. Challenging environments also require particularly robustly designed connectors. Part of holistic fiber optic cabling solutions can therefore also include lens connectors that enable fiber optic use even under harsh, dirt-loaded industrial conditions with varying temperatures or vibrations.

5G speed must also last in the data center

In both Industry 4.0 and autonomous driving, the spread of the new 5G wireless standard could provide a boost in the next few years. For the first time, the low latency of a few milliseconds at 5G is suitable even for hard real-time applications. The specified latency of 5G also has an impact in the data center because the latency must be maintained even after entering the data center. This is only possible, however, with modern hardware and appropriately designed fiber optic

cables. While small-cell mobile antennas outside the data center transmit the data, fiber optics must lead to the data center, which in turn uses a fast fiber optic cabling system.

AI further increases data volume

The increasing focus on data analytics for big data and artificial intelligence (AI) algorithms is also impacting data center infrastructure. Especially for AI applications around image recognition from photo and video streams, the storage and computing requirements are considerable. As the trend is toward clustered computing performance and increasingly powerful hardware, supercomputers are on the rise. For fast communication between servers in computer networks, high-performance data cabling is crucial. The better and more widespread AI algorithms become, the more the demand for computing power increases.

Adaptable to future technologies

Although data cabling accounts for only around two to four percent of the costs for new data centers, availability stands or falls with the quality of data transmission. Experience over the last three decades shows that around half of all data center failures are caused by the inadequate quality of the connection technology. The higher the demands on the data center, the more important application-neutral and future-oriented data cabling becomes, which can cope with higher speeds and can be flexibly adapted to future protocols and connectors.

As in the past, data cabling will continue to be based on the transceivers. Experience has shown that it is worthwhile here to orient oneself to the Multi Source Agreement (MSA) working groups in Silicon Valley. As the next singlemode stage on the "Terrabit Mountain" illustrated in the Ethernet Roadmap, 800G-DR8 and 800G-PSM8 are rated as promising variants of the coming 800G applications.

Security remains a decisive topic

The topic of security also remains a challenge to which data center operators must find answers. Bending-resistant fiber optics in particular are proving to be more resistant to eavesdropping technology based on bending coupling. To exclude cyberattacks or espionage, however, continuous performance monitoring of the networks is necessary in addition to comprehensive encryption. Security-as-a-service (also known as managed security) can provide relief. In this case, complex monitoring and prevention tasks are outsourced and the security knowledge in the SOC (Security Operations Center) of a specialized provider is accessed.

Environment, Social, and Governance (ESG)

ESG has gained extreme traction in 2021, and for good reason. Data centers account for approximately 2 percent of the total U.S. electricity use, and as the use of information technology grows, data center energy use will also grow. Data centers have been implementing renewable energy solutions utilizing modern technologies, but renewable energy alone can’t solve data

centers' impact on the environment. This is where ESG comes into play, allowing data center companies to get a holistic view of their company and understand the impact they have on the environment, their constituents, and the surrounding communities. More companies are taking accountability for the impact of their data centers by adopting ESG initiatives and creating streamlined roadmaps to dramatically reduce their carbon footprint. Data center companies are recognizing that technology providers, small and large, must take action toward a low-carbon future. Companies must target sustainability, seek innovative ways to reduce emissions, and influence renewable generation at every level.