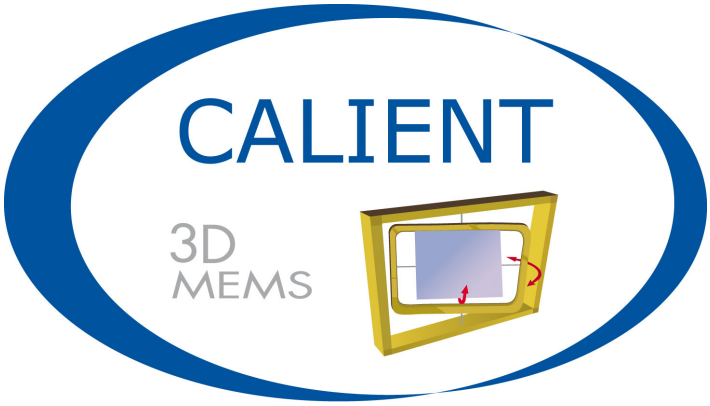

Move the light, not the fiber

Cloud computing has moved our business world into the age of the “mega”data center. These are huge facilities with literally hundreds of thousands of square feet of computing real estate. In these huge data centers the physical and virtual resources and the data flows are becoming extremely complex, almost too complex for humans to negotiate. Network intelligence to analyze and optimize the flows in these large networks is becoming necessary. To this end, photonic switching enables a fully-automated, dynamically reconfigurable, highly-scalable physical layer which can respond to reconfiguration requests on demand.

Telecom Review met with Daniel Tardent, Director of Marketing for CALIENT Technologies, to get a perspective on the “new data centers” and how photonic switching is supporting their growth. CALIENT provides 3D MEMS systems that build service provider, cloud computing, content delivery and government networks. Their switches have demonstrated years of reliability, with eight years of successful continuous operation at large companies in diverse markets. With more than 80,000 optical terminations shipped, CALIENT has one of the largest installed bases of photonic switches worldwide.

CALIENT will be unveiling their new S-Series Photonic Switch family in March. This new product line builds on their existing 3D MEMS core technology with entirely modernized electronics, optics, and control systems. The new systems are smaller, lighter, and consume less than 20% of the power of previous switches making them ideal for deployment in power hungry datacenters.

The combination of the server growth together with the very complex computational tasks required in modern computing applications means that the needed bandwidth within the data center is increasing two to four times per year. Additionally up to 75% of that bandwidth is actually within the data center running east-west between clusters. Furthermore, the top-of-rack interfaces at the server aggregation layer are rapidly scaling to 40 Gbit/s, and 100 Gbit/s. These factors combine to place tremendous demands on the traditional aggregation layer connecting clusters that has limited ability to scale.

To address this problem new trends have emerged in datacenter architecture. The first trend is that the servers themselves are getting much more powerful. Multiple blade servers within each rack are common and multiple racks connecting up to top-of-rack switches are becoming the norm.

The second trend is that the traditional top-of-rack functionality is actually moving into the servers themselves. Third, and most importantly, the cluster aggregation layer is converging into the top-of-rack switches. Overall this represents a flattening and simplification of the network architecture. But in order to maximize this simplification, a connection infrastructure that is both low in latency and scalable is needed.

Photonic switching can provide the needed connection infrastructure. Deploying a photonic switching fabric enables a solution that allows every top-of-rack switch to connect directly to any other top-of-rack switch within its cluster or neighboring clusters. It also allows direct optical pass through from top-of-rack switches to the data center aggregation layer.

This results in simplification of the network and extremely high-performance low-latency connections between servers and switches. This is a powerful solution to the connectivity required to enable cloud computing networks. Furthermore, because this photonic switching layer is transparent to protocols and line speed, it future proofs the data center network by supporting scaling from 10 to 40 to 100 Gbit/s and potentially beyond without having to replace the network.

Why Photonic Switching Is Necessary

The question inevitably arises this could be done with large numbers of direct fiber connections

between top of rack switches and between top of racks and the data center aggregation layer. So why is photonic switching necessary?

Photonic switching supports complete automation of single-mode fiber management within the data center. This means that the entire physical network northbound from top of rack switches can be automated. Any connectivity changes can be made on-demand without a technician having to visit the site.

The racks and clusters within the data center can be reconfigured either on demand or cyclically to support real-time resource and bandwidth demands. Photonic switching allows the whole physical network within a large data center to be dynamically reconfigured based on a number of different factors.

These factors could include instantaneous demand, cyclical patterns throughout a day or a month, or potentially even predictive network traffic algorithms that can predict when specific resources need to be switched around within the data center.

This has not been possible in previous data center networks as all physical reconfiguration has required hands-on human intervention at the patch panel.

Example use cases include:

• Scheduled Maintenance – the ability to take racks and clusters out of service for maintenance while simultaneously bringing online backup maintenance racks.

• Adding Floating Resources – Racks of servers can be added to and removed from clusters to support application demands. These could be based on instantaneous demand or cyclical / time-of-day needs.

• Flow-Based Network Flattening – Any Top of Rack switch in any cluster can be directly

connected to any other Top of Rack in any other cluster to support application needs. This results in the lowest possible latency and the flattest network.

• Reallocation of Inter-Data Center bandwidth between clusters – Optical bandwidth exiting the Data Center can be reallocated internally between clusters to support instantaneous or time-of-day application demands. One example is the typical morning load on email applications where more bandwidth is required temporarily on clusters supporting these applications.

The dynamic reconfiguration capabilities of photonic switching also enable a range of disaster recovery responses that are not typically available in a manually switched physical network.

Fiber Monitoring

In addition to the benefits offered by photonic switching, the inbuilt optical power monitoring that CALIENT deploys in its switching systems to optimize path losses can also monitor the health of optical networks within and between the data centers. This supports a very rapid response to a number of failure scenarios including bad connectors, patch cords, and other network equipment failures.

Disaster Recovery

Photonic switching offers many switchover and recovery options in disaster recovery scenarios. For example, it allows the ability to recover from a storage, server, or edge router outage. These are typically situations that may be beyond the scope of a simple fiber optic failure and potentially require a coordinated recovery of multiple optical paths. The Photonic Switch provides an optical network fabric that can make coordinated changes across the data center or cloud network in the event of a failure situation.

Energy Efficiency Benefits

Data center power consumption is a major challenge, especially with the growth of huge mega data centers and their 10 Gbit/s, 40 Gbit/s, and 100 Gbit/s network interfaces. The power problem is twofold – the cost and reticulation of the power itself and, second, the management of the thermal energy dissipated within the buildings. The energy consumption of an all-optical switch versus a pure electrical switch or a hybrid optical electrical optical switch is at least in order of magnitude, different. This means that deploying a pure photonic switching fabric can result in significantly lower energy consumption within a large data center, and therefore, sizeable cost savings in power consumption.

Conclusion

Cloud-based video and rich media are driving rapid growth in data center server deployments and the networks they use to transport data. This phenomenon is apparent within the data centers themselves, and also in the networks between data centers which form the basis for cloud computing. Photonic switching offers significant benefits in all of these applications.

• It provides scalable and future-proof networking within and between data centers. The photonic switch network is inherently scalable from 10 Gbit/s to 40 or 100 Gbit/s and beyond

• It facilitates dynamic reconfiguration of data center resources to support maintenance, capacity increments, real time or cyclical demand spikes, reallocation of bandwidth for time of day loads, etc.

• It maximizes cloud performance by reallocating resources between data centers on demand or based on cyclical patterns.

• It offers reduced network power cost and thermal management problems due to the inherently low power consumption of pure photonic switching.

• It supports automated fiber management & monitoring, providing low-cost resources to assist data center operators with fault isolation and restoration within and between data centers.