smartoptics

The Smartoptics guide to simpler, more flexible 100G DWDM connectivity

Using open line networking to get data center traffic solutions that work

Corporate data centers face the growing need for data networking capacity over longer distances. While traditional WDM solutions are designed for telecom carriers, making them overspecified and too expensive for most companies, open line networking offers an alternative.

A solution brief from Smartoptics

The challenge of 100G data centre connectivity

For most corporate data centers, the key concern is managing connections within the data center itself, since that's where most of the traffic stays. For this environment, it's possible to connect 100G traffic together in a relatively simple way, using standard transceiver and cable assemblies, within the equipment rack or spanning opposite sides of the data center floor. This is sufficient for most scenarios, when there is no need to worry about transferring data between data centers or between towns or cities.

However, in many corporate scenarios, there is a requirement to replicate traffic between geographically separated data centers over long distances. The most common reason for this is a growing emphasis on security, which would bring a need to have remote data backups. This requirement doesn't represent the bulk of the traffic, but the consideration – even for the small amount of traffic involved – is extremely important.

Traditional data traffic solutions have been designed by and for telco-grade networks and large service providers, but it's no longer sufficient for these types of organizations to set the agenda for corporate data centers.

This guide covers some of the factors involved in defining data center needs and traffic requirements. It outlines how to simplify connectivity using open line networking.

When transceivers are not enough

The most straightforward way to connect 100G traffic is using standard transceivers. There is a wide range of 100G options suitable for this in CFP and QSFP28 form factors. To offer cost-optimized solutions for connecting switches together in a rack or data center, Ethernet switch vendors strive to maximize the density of optical transceiver ports on their equipment. In this way they can offer maximum channel count and lowest cost per bit traffic.

This is typically achieved by choosing the smallest form factor transceivers available: the QSFP28 transceiver is the smallest module, and has the lowest power consumption of transceivers that can handle 100G traffic. It's also notable that the QSFP28 has the same physical size as the QSFP+ commonly used for 40G traffic. This means that switch vendors can increase the traffic throughput by a factor 2.5 without the need to redesign the front panel of their switches.

For data handling and transfer that stays within the rack and the data center, the QSFP28 offers the perfect fit. IIt only becomes a problem when 100G traffic needs to be transported over long distances, as in the case of providing data center connectivity between different geographical locations. The small and cost-effective QSFP28 transceiver can't handle connections over distances between data centers. There have been recent releases of transceivers with DWDM capabilities, most significantly the QSFP PAM4, but be effective this device requires amplification even for very short distances. For distances over 5-6km it also needs dispersion compensation to handle data traffic up to 80km. Switch vendors who support the QSFP form factor offer low-powered, high-capacity solutions that work efficiently within data centers, but that are not sufficient for moving data over longer distances.

For data handling and transfer that stays within the rack and the data center, the QSFP28 offers the perfect fit. The problem arises when 100G traffic needs to be transported over long distances.

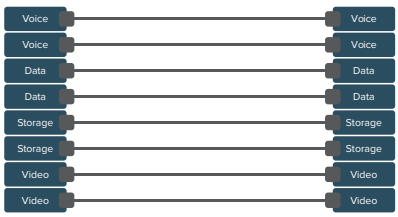
At the other end of the range, coherent CFP/CFP2 transceivers support metro and long haul DWDM applications. The problem is that these are, in many cases, too large to be used in an Ethernet switch. They use a significant amount of power, more than most switch vendors can handle. Adding CFP transceivers even to address the limited long-distance needs can significantly reduce port counts, and increase power usage, making the 100G switches poor performers in cost-effectiveness.

What's needed is a solution that will allow a switch to transport 100G traffic over longer distances. For telco-grade networking, the traditional way to do this has been to introduce a media converter in the form of a transponder. The transponder takes the output from the switch, via an SR4/LR4 transceiver, and converts it to a longer distance wavelength division multiplexing (WDM) signal. This makes it possible for the DWDM signal to be transmitted over long distances or as part of a DWDM network.

Inter-data center connectivity through DWDM networking

Dense Wavelength Division Multiplexing, DWDM, has long been the technology of choice for transporting large amounts of data between sites in telco operator environments. It increases bandwidth by multiplexing different channels, allowing different data streams to be sent simultaneously over a single optical fiber network. In this way, DWDM networks maximize the usefulness of fiber and help optimize network investments.

If individual services are connected over their own fiber the number of fibers required is equal to the number of services required. In theory, this is not problematic, but fiber is expensive to own, so this can be an expensive way of connecting traffic between sites. With DWDM networking, a multiplexer is used to combine the various traffic outputs from the switches and routers to a single output. This means that the outputs connect to the line fiber, offering the benefit that only one dark fiber needs to be used, instead of one individual fiber per service.



Individual fibers required per channel

WDM multiple services transported together on one optical fiber

Using this approach, up to 80 simultaneous wavelength channels can be connected over a dark fiber with DWDM. Traffic channels that are transparent to speed and protocol, such as Ethernet, storage, voice, or data services can be combined with no restrictions.

Another advantage of using DWDM to transport multiple channels over a dark fiber network is that DWDM signals are stronger than standard SR4/LR4 signals, so they can travel further. It's also possible to amplify and repeat DWDM signals, which means that traffic can be transported over even greater distances in excess of 1000km.

These are some of the reasons that DWDM is the choice for carriers and service providers. Traffic can be transported across long distances without bringing power consumption issues to the switches and routers. But when it comes to corporate data centers, this solution introduces a number of limitations.

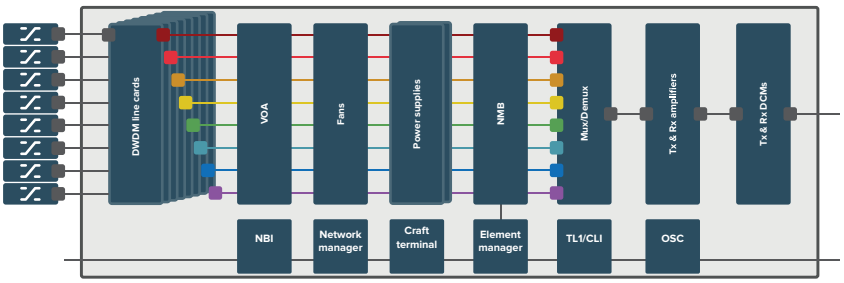
Dense Wavelength Division Multiplexing, DWDM, has long been the technology of choice for transporting large amounts of data between sites in telco operator environments. It increases bandwidth by multiplexing different channels and helps optimize network investments.

The limitations of telco-grade DWDM networking

Telco-designed solutions are large, cumbersome, and expensive, and typically require telecom networking expertise to operate and maintain. For corporate data centers who want the benefits of DWDM, these solutions are limited in flexibility and not appropriate for their needs.

Telco-designed systems are too complex for corporate data centers

In addition to the required multiplexers and transceivers, a complete transponder solution for carriers and service providers also offers various other functions. These include functions for amplifying the signal, signal conditioning, dispersion compensation, and network management, all of which are important to the kind of system a carrier or service provider needs. For each of these, there is a card that fits into a 19" chassis system, which brings a need for large real estate requirements, along with a requirement for additional telecom transmission knowledge to operate and manage them. The result is a fairly cumbersome, even clumsy, vertically integrated chassis based system.



19" fixed DWDM telco system with vertical plug in cards

This type of complete solution meets the demands of telecom carriers, but for corporate data centers, these systems are far overspecified. In most cases, corporate data centers have relatively simple traffic demands, which means they require neither the capacities nor the advanced feature sets offered by traditional WDM solutions. From an enterprise point of view, these are unnecessarily complicated to design, install, and configure, as well as being expensive to own and maintain. Even though corporate data centers do have DWDM needs, this is normally only for the small percentage of connections that interconnect sites over longer distances.

Distributed data centers need distributed DWDM networking

In addition to being overly complex and costly for corporate data centers, the vertically integrated telco solutions introduce another challenge for enterprise use.

In a data center, switching equipment and racks are often distributed across the floor or building. Consequently, the user does not have the luxury of having all the DWDM signals from these switches conveniently close together in one particular rack, all cabled to a central DWDM chassis system.

With the Ethernet equipment located throughout the data center, the ideal scenario is one where the DWDM networking equipment for transporting traffic between data centers is also distributed throughout the building. But because of the size and configuration of the vertically integrated DWDM racks, it's not possible to distribute these throughout the data center. This means that all traffic from the switching equipment distributed throughout the data center floor that requires access to the DWDM system must be cabled back to this central DWDM system. This makes the cabling both costly and very messy.

As switching equipment and racks are often distributed across the floor or building, the ideal scenario is one where the DWDM networking equipment for transporting traffic between data centers is also distributed throughout the building.

Symmetrical solutions limit the flexibility

A third reason why enterprise organizations tend to avoid these types of telco-grade DWDM solutions is that they are typically restricted to symmetrical network architectures, meaning that the same equipment is required at each site when connecting together switches or sites. If there is a chassis system with traffic cards at one site, the same chassis and traffic cards are required at the other sites. Solutions with different networking equipment are, therefore, not supported with this type of equipment.

But data centers often need flexibility. For example, in the case of an ISP offering LAN extension services, an asymmetrical solution would make most sense. Here, a transponder at the customer site gives the operator control and visibility, while at the operator's site, an embedded DWDM signal based on standard DWDM transceivers, gives the lowest-cost approach. Installing full range of transponder equipment at both ends only results in an over-complicated system that is far more expensive than is needed.

The open networking model – high-density switching and low-cost DWDM

Today's companies and organizations want freedom to build custom networks for their specific requirements. This means building solutions that fit corporate data centers, not carrier telecom networks. They want to reap the rewards of breakthroughs in DWDM and transceiver technology.

The Open Compute (www.opencompute.org) community argues that the solutions designed by and for traditional telecoms are holding organizations back. The vertically integrated approach favored by carriers doesn't cater to the range of needs of data center networking outside of the telecom-grade scenario. The open networking model for data centers is driven by the opportunity to make a variety of options work well together in ways that can address individual needs at various scales.

In an open system, users have the freedom to select connections that suit their traffic and demands best, allowing them to build world-class networks that are fit for their specific needs. For most, this is a mixture of transponders or DWDM interfaces embedded directly in to their switches and routers. These open compute systems are a far cry from the monolithic, vertically integrated telco DWDM systems that require symmetric transponder solutions, extremely large capital and operating budgets, and highly specialized expertise.

What most organizations actually need are solutions that allow best-in-breed 100G switches and routers to be used with maximum port count, lowest power consumption and lowest cost per bit. What that looks like in terms of data center design depends on the traffic and storage needs of the organization. For those occasions where the traffic from these switches and routers needs to be connected over longer distances or a DWDM network, they need something that is cost-effective and as simple as possible to install and operate. Ideally, datacom applications would no longer have to use cumbersome telco-grade solutions.

> *In an open system, users have the freedom to select connections that suit their traffic demands, allowing them to build networks that are fit for their specific needs.*

The Smartoptics way to 100G DWDM connectivity

To meet the needs of today's corporate data centers and enable them to take full benefit of the breakthroughs in DWDM and transceiver technology, Smartoptics has designed the M-Series and DCP platforms. These are platforms that can overcome the difficulties with 100G cabling and limitations of QSFP28 transceivers, without heavy upfront and ongoing operating costs. They also make it easy and cost-effective to decentralize the otherwise rigid chassis-based systems, and allow distributed DWDM throughout a data center. This allows companies to draw on the principles and benefits of the more flexible open line networking techniques from the Open Compute community, and build networks dedicated to their specific needs.

No longer are the telcos setting the data center networking agenda. The Smartoptics range of products, platforms and solutions helps enable organizations to design, build, operate and maintain data centers that meet their evolving traffic needs.

Traditional Telco systems

- Complex and expensive
- Inflexible networking
- Vertical chassis systems
- Optimized for telecom market
- Symetrical networking limits use of embedded DWDM

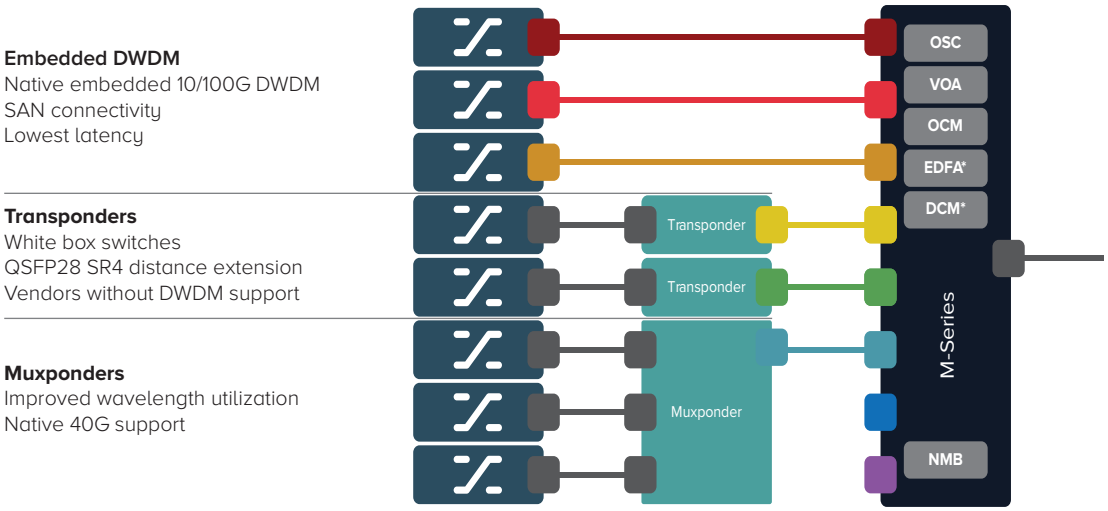
Smartoptics products and platforms

- Simple and flexible
- Cost-effective networking with lower TCO
- Intelligent DWDM multiplexer
- Optimized for datacom market
- Ideal for open networking solutions, and use of embedded DWDM extends embedded approach

M-Series: intelligent DWDM multiplexing for open line networking

The Smartoptics M-Series platform is designed specifically for open line networking. There is a convenient 1U DWDM multiplexer for creating "virtual fibers". It works with any combination of transponders, muxponders and embedded DWDM transceivers.

M-Series combines the simplicity of a passive multiplexer with features traditionally only available in complex telco DWDM systems. It has integrated channel monitoring, amplification and signal conditioning and easily handles all of today's data protocols up to 100Gbps per channel. It also makes more flexible networking possible, enabling the functionality to be distributed across the data center and between campuses.



M-Series handles any combination of embedded DWDM transceivers and transponders for maximum flexibility

DCP: Open transponder networking for distributed data centers

The Smartoptics DCP portfolio is an open and flexible family of 100G modular transponder and muxponder products, designed for datacom connectivity where the requirement is to transfer data between sites over a dark fiber network. The DCP platform is designed on open line networking architecture principles, which means it's not locked down to a central chassis system. With the DCP platform, low-powered transponders and muxponders can be placed next to the switches or routers whose traffic they need to transport, allowing them to be locally managed. This leads to a distributed and decentralized DWDM architecture in the data center that mirrors the layout of the switches and routers. It also means that cabling is minimized to these DWDM nodes is minimized, so that it's far simpler and more efficient. The overall result is DWDM networking with an unprecedented flexibility, without the cost and complexity of a telco grade data center.

The versatility of open networking models

The combination of the M-Series and the DCP family of products introduces completely new opportunities for building solutions that meet the needs for 100G networking within and between data center locations. These platforms enable organizations to enjoy the benefits of all the latest DWDM breakthroughs, while drawing on the advantages of flexible open networking architectures.

The benefits of a decentralized DWDM architecture include:

- **Flexible DWDM node distribution:** DWDM nodes are no longer limited to a central chassis in the same rack as the equipment needed for traffic transport. They can be distributed throughout the data center, close to the switches and routers whose traffic they need to transport.
- **Smaller footprints:** Individual low power DWDM modules have smaller footprints and take up less physical space in the data center
- **Mid-span meet architecture:** This approach enables the mixing and matching of signal types in an asymmetric way, such as a transponder at site A and an embedded DWDM signal at site B.

Flexible networking solutions to suit all networking tasks

Truly innovative organizations need effective, efficient systems that can grow and change with them. Today, the requirement for transporting data traffic between sites is primarily for security, and although it's a small percentage of traffic, it is a very important part of the traffic consideration. To achieve this, many organizations are still relying on complex and expensive platforms designed primarily for telecom operators.

Thanks to the Open Compute Project, it's now possible to break free of the agenda set by carriers, and design flexible, scalable data center networking fit for the innovative, fast-moving datacom industry.

The Smartoptics portfolio is built on the principles of open line networking. It is designed to keep networking as simple, open, and cost-efficient as possible. Using the M-Series, the DCP platform, and open transceivers – in any combination -- it's possible to handle all of the network tasks that a corporate data center has. This model allows organizations to build data centers that are free from the constraints of the historical telecoms networks, and can be easily scaled and adapted as organizational needs change.

Smartoptics harnesses the latest and best of open line networking, delivering solutions for all application types, reducing costs, maximizing flexibility, and enabling the ultimate performance for a corporate data center.

About Smartoptics

Smartoptics provides innovative optical networking solutions and devices for the new era of open networking. Our customer base includes thousands of enterprises, governments, cloud providers, Internet exchanges as well as cable and telecom operators.

We have an open networking approach in everything we do which allows our customers to break unwanted vendor lock-in, remain flexible and minimize costs. Our solutions are used in metro and regional network applications that increasingly rely on data center services and specifications.

Smartoptics is a Scandinavian company founded in 2006. We partner with leading technology and network solution providers such as Brocade, Cisco, HPE and Dell EMC and have a global reach through more than 100 business partners.

smartoptics

Ryensvingen 7
NO-0680 Oslo
Norway
+47 21 41 74 00

info@smartopics.com
smartoptics.com

so-OLN-R 4.1