



smartoptics
It's really simple!

SAN
Distance Extension Solutions

Company Introduction

SmartOptics designs and markets all types of fibre optical transmission products. Headquartered in Oslo, Norway, we serve Storage, Data and Telecom Networks worldwide with a unique and cost effective portfolio of optical transmission components & Systems.

Customers are turning to SmartOptics because we have a product portfolio which allows them to build the most cost effective and reliable transmission networks possible. Whilst our customers are experts in their fields, they still appreciate the valuable knowledge and experience that SmartOptics offers for optical transmission solutions.

Optical transmission projects have historically been prohibitively expensive and complicated, but Smartoptics products allow solutions which are simple to design and easy to install.

The T-Series consists of a comprehensive range of active and passive WDM solutions to suit all network requirements in an incredibly compact form factor resulting in low space and power requirements.

SmartOptics products now make optical networking, especially 4G, 8G and 10G connectivity, simple and affordable.

Product portfolio:

C/DWDM transmission systems

- 32 x 10Gbps DWDM
- 128 x 1G Ethernet connections
- 32 x 4G Fibre Channel connections
- 16 x 8G Fibre Channel connections
- down to 2 Mbps

Passive WDM network solutions

- C/DWDM Mux/Demux and OADM units
- 19" or 23" rack mountable
- CWDM and DWDM for indoor and outdoor environments

Optical & electrical transceivers

- all bit rates
- all distances
- all form factors

Storage Networking

- 32 x 4G Fibre Channel DWDM
- 16 x 4G Fibre Channel CWDM
- 16 x 8G Fibre Channel CWDM

Terje Hallan, CEO



Economics of CWDM or DWDM Fibre Channel Environments

Introduction

Coarse Wavelength Division Multiplexing (CWDM) and Dense Wavelength Division Multiplexing (DWDM) are established optical transport technology for extending transmission distances whilst simultaneously reducing fiber count. The technology is now fully available for 4.25 & 8.5 Gb/s applications such as Fibre Channel (FC) or FICON.

This whitepaper investigates the economical impact of C/DWDM transport technology in 4G environments. Both Capital & Operational expenditure, (Capex & Opex) are investigated and summarized.

Market Overview

The 4G and 8G FC standard boosts the performance of storage-area networks (SANs) by doubling speed while maintaining backward-compatibility.

In addition, 4G/8G storage hardware is available at a cost comparable to 2G products. When implementing a 4G environment it is important that all components support 4G, including the optical transmission equipment; it is also important that FC SAN capacity is increased without increasing costs.

Many end users are running their FC infrastructure over individual fibers, at 2G transmission speed. So not only are they losing half the available throughput, but wasting money on multiple fibers.

Optical transceivers (usually small form-factor pluggable, SFPs) provide the interface between Fibre Channel systems and the optical fibers of the SAN. SmartOptics offers a complete portfolio of 4G and 8G SFPs. Starting from 850 nm and 1310 nm SFPs for intra-office connections up to 100 km CWDM or DWDM SFPs for SAN extension applications.

SmartOptics was the first vendor to ship 4G and 8G CWDM SFP transceivers resulting in numerous mission critical installations and has driven the evolution of SAN's to another level.

C/DWDM Technology

C/DWDM multiplies fiber capacity by multiplexing optical light signals of different wavelengths on to a single optical fiber. The technology is well standardized according to ITU G.695 and G.694 and widely used in datacom and telecom applications.

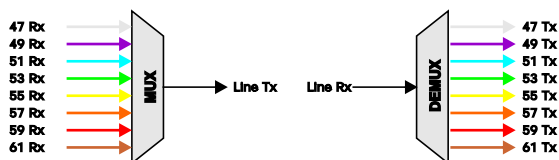


Figure 1: Illustration of CWDM function with 8 channels.

Due to the physical nature of light, C/DWDM wavelengths are completely independent from each other and data streams with different line-rates and protocols can be transported on a single fiber or fiber pair. This enables IP data (1G or 10G Ethernet) and storage data (8G/4G/2G/1G Fibre Channel) to be transported over a single fiber infrastructure without complex protocol conversion technologies.

Two components are necessary to build a CWDM system:

- Optical C/DWDM Multiplexer Units (Mux/Demux) which combine and split light signals of C/DWDM wavelengths
- CWDM transceivers, which generate light signals at specific CWDM wavelengths.

SmartOptics' CWDM solutions for distance extension in Fibre Channel/FICON environments

In SAN distance extension, C/DWDM is used to reduce the number of required WAN fibers. The illustration below shows a SAN extension in a Brocade environment between a primary site and a secondary site. In a) the implementation requires several WAN fibers to achieve the required capacity.

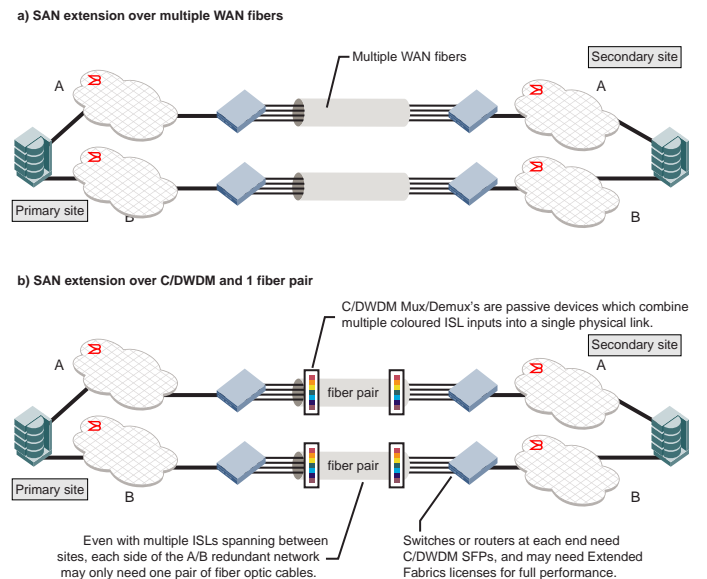


Figure 2: SAN extension with (a) multiple fibers and (b) C/DWDM.

In b) C/DWDM is used to optically multiplex several ISL signals onto a single fiber pair. C/DWDM SFPs are plugged directly into the E-ports/ISLs from the Fibre Channel switch to generate ISL signals of specific C/DWDM wavelength. The C/DWDM Multiplexer (Mux) combines these wavelength signals onto a fiber pair; the C/DWDM Demultiplexer (Demux) splits these wavelengths into several fiber on the receiver site. The number of required WAN fibers is reduced by the number of wavelength used.

SmartOptics' embedded 4G CWDM solution

In the embedded solution the SO-SFP-4GFC-L50-Cxx (50 km CWDM SFP) or the SO-SFP-4GFC-L80-Cxx (80 km CWDM SFP) is connected directly into the Fibre Channel switch. The SFPs are quad-rate and support 4G, 2G and 1G Fibre Channel as well as Gigabit Ethernet. They are connected to the client ports of the Mux/Demux unit; the combined output of the Mux/Demux is connected to the WAN fiber. Finally, the WDM Fibre Channel ports should be configured as E-ports and an adequate number of BB-credits need to be assigned, as in a non-WDM set-up.

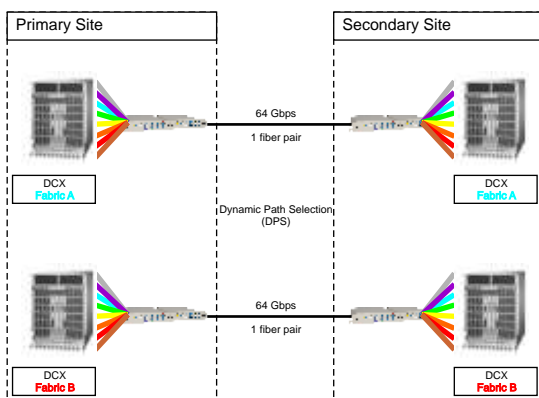


Figure 3: Typical SAN extension with embedded SmartOptics CWDM SFPs and T-3009 Mux/Demux units.

As a matter of fact, there is no additional signal delay contributed by embedded CWDM and existing rules for BB-credit allocation or channel trunking are valid. A further advantage of the embedded CWDM approach is very high reliability and simplicity. Adding new capacity is now only a matter of adding new CWDM SFPs instead of leasing more fiber or ordering new equipment and it can be done in hours instead of days, weeks or months. SmartOptics demonstrated with Brocade Communications the first 8x 4 Gb/s Fibre channel trunk over 80 km of fiber resulting in a total transmission capacity of 32 Gb/s. Today 16 CWDM wavelength and 80 DWDM wavelength are available for 4 Gbps and 8 Gbps applications.

Embedded C/DWDM offers lowest Total Cost of Ownership in SANs

Most enterprises already invest in C/DWDM technology for SAN applications. C/DWDM offers the lowest total cost of ownership; a straight forward way to increase capacity and all with incredible flexibility.

Today, IT Managers have to choose between three different approaches to interconnect their data-centers:

- 1) Multiple fibers
- 2) Stand-alone C/DWDM system and one fiber pair
- 3) Embedded C/DWDM solution and one fiber pair

Further technologies like FCIP, FCoSDH, or FCoSONET exist to bridge longer transmission distances and are not considered in this brochure. SmartOptics can supply both embedded and stand-alone WDM solutions as well as solutions using a single fiber.

The economical considerations are illustrated in figure 4 below. A 4G CWDM environment is used as an example. The approach using multiple fibers offers lower investment costs in optics, but results in the highest operational costs. When fiber connection fees are charged, CWDM approach is also lower in cost from day one.

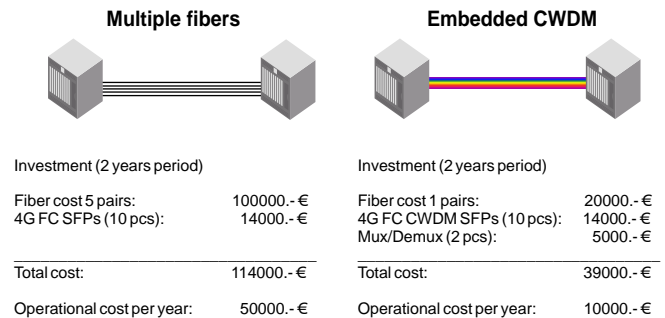


Figure 4: Economics of 4G CWDM vs multiple fiber solutions.

The reduction in operational costs is directly proportional to the number of C/DWDM wavelengths used by the C/DWDM system. Operational fiber leasing costs are reduced by 87% when using 8 wavelengths, 94% when using 16 wavelengths and 98% when using 32 wavelengths.

Return on Investment (ROI)

Figure 5 shows the total cost of ownership for an approach with multiple fibers compared to a CWDM solution. The time for ROI is usually only a few months due to the small extra investments in equipment and large cost savings on the fiber leasing costs.

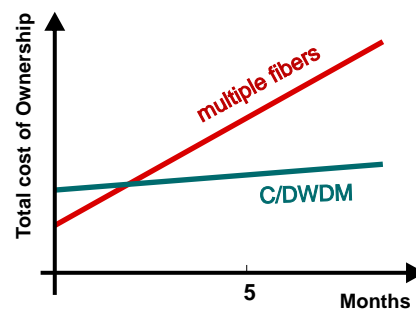


Figure 5: ROI of C/DWDM vs. multiple fibers solutions.

Summary

Smartoptics C/DWDM solutions enable IT Managers to further optimize their network in respect of costs, complexity and reliability resulting in improved performance and higher capacity. Embedded C/DWDM is very flexible and guarantees interoperability resulting in a future-proof concept. Operational costs for fiber leasing are lowered by up to 98% when using embedded C/DWDM technology.

Featured Products

Fibre Channel transceiver family

The SO-SFP-4GFC transceiver family are small form factor pluggable modules for bi-directional serial optical data communications such as 4x/2x/1x Fibre Channel and 1000BASE Ethernet. The modules are hot pluggable and digital diagnostic functions are available enabling optical power level monitoring.



FEATURES

- Brocade Data Center Ready
- 8.5 Gbps, 4.25 Gb/s, 2,125 Gb/s & 1.0625 Gb/s Fibre Channel
- 1000BASE Ethernet
- Up to 100 km transmission at CWDM
- Hot-Pluggable SFP footprint LC Optical Transceiver
- Small Form-Factor Pluggable (SFP) MSA compatible
- 18 CWDM wavelengths (): 1271 nm to 1611 nm
- 32 DWDM wavelengths ()
- SFF-8472 Digital Diagnostic Function
- Color coded latches

CWDM

SO-SFP-8GFC-40D-Cxx	8/4/2 Gbps Fibre Channel/FICON, SM, DDM, CWDM, 18dB, 40km
SO-SFP-4GFC-50D-Cxx	4/2/1 Gbps Fibre Channel/FICON, SM, DDM, CWDM, 18dB, 50km
SO-SFP-4GFC-80D-Cxx	4/2/1 Gbps Fibre Channel/FICON, SM, DDM, CWDM, 28dB, 80km

DWDM

SO-SFP-4GFC-80D-Dxxxx	4/2/1 Gbps Fibre Channel/FICON, SM, DDM, DWDM, 30dB, 80km
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SmartOptic's SFP are approved by Brocade and listed on the DCR matrix for the following Brocade products: 200E, 4100, 4900, 5000, 7500, 48000, 48000/FR4-18i/FC4-48/FC4-16IP/FA4-18, 300, 5100, 5300, DCX/DCX-4S

Many OEM partners from Brocade, as EMC, IBM, HDS, HP, SUN ... , follow the DCR matrix and support SmartOptics SFP's.

Optical Multiplexer and Demultiplexer

The T-3008 and T-3009 Mux/Demux Units are ideal for adding more capacity to an existing fiber network. By multiplexing 8 wavelengths, the capacity of the fiber will be increased significantly. The T-3009 has an upgrade port (1310 nm) enabling an additional 8 CWDM channels for further network upgrade.



FEATURES

- Fully compliant to ITU G.695 and G.694.2
- 19" rack mountable 1U height
- Color coded ports for easy set-up
- Laser shutter on line side for dirt and laser safety
- Easy fiber handling
- Duplex LC connector interface

CWDM T-Series

T-3008-LC	8 channel, CWDM Mux/Demux, IL Link=3.5dB, LC
T-3009-LC	8+1 channel CWDM Mux/Demux, IL Link=4.0dB, LC, 1310nm upg port
T-3016-LC	8 channel, CWDM extension Mux/Demux, IL Link=3.5dB, LC

DWDM T-Series

T-3809	8 channel, DWDM Mux/Demux, 100GHz 925~932, IL=4.5dB LC
T-3808	8 channel + upg port, DWDM Mux/Demux, 100GHz 934~941, IL=5.5dB, LC
T-3832	32 channel DWDM Mux/Demux, 100GHz 921~959, SO channel plan, IL=7.2dB, LC

Customer Feedback:

Our philosophy at SmartOptics is that business should be simple. We are proud to be working with some of the biggest names in the storage world: -

“Just a quick update message to let you know that the CWDM is installed and working within T-Systems. It was a very smooth and quick installation and within hours we had increased their cross site capacity from 96Gb/s using 24 dark fibres to 192Gb/s using just 4 dark fibres. This solution is far more cost effective than the 2Gb/s solution previously used and other alternative “active” DWDM systems. Now that Brocade have changed their approach to third party SFP usage, and locked out all other third party SFP vendors except for SmartOptics, SmartOptics can potentially be an important supplier for our Brocade applications where distance extensions are required. We already have other possibilities for your equipment which we hope to close soon.”

HP, UK

“I had the CWDM up and running within minutes, I really can't believe how simple this is. A typical configuration to extend the fabric is to implement a single SAN over distances to provide geographic separation of server and storage. Normally we would do this with a DWDM system, but we used the SmartOptics embedded CWDM solution and are delighted with the results.”

SUN Microsystems, UK

“The SmartOptics Product line is the perfect companion to our own portfolio. We are seeing more and more 4Gbps opportunities and by working with SmartOptics we have been able to satisfy these requirements over long distances using Embedded CWDM solutions. By having a long distance 4Gbps solution, it also means that our customers can now use their switches at the full line rate for which they were originally intended and maximise their investment.”

Acal, UK

“We were amazed at just how simple the SmartOptics system is and also how reliable the solution is as well. Normally we spend a lot of time configuring DWDM channels but with the SmartOptics solution we just plugged the optics in to our switches and we were up and running within minutes. Another reason why we chose the SmartOptics solution was the reliability of the system. There is a completely passive solution so the reliability figures are amazing compared to what we have been used to, and therefore we do not have to worry about expensive Service contracts and software licences.

Integrated Network Solutions, Norway

