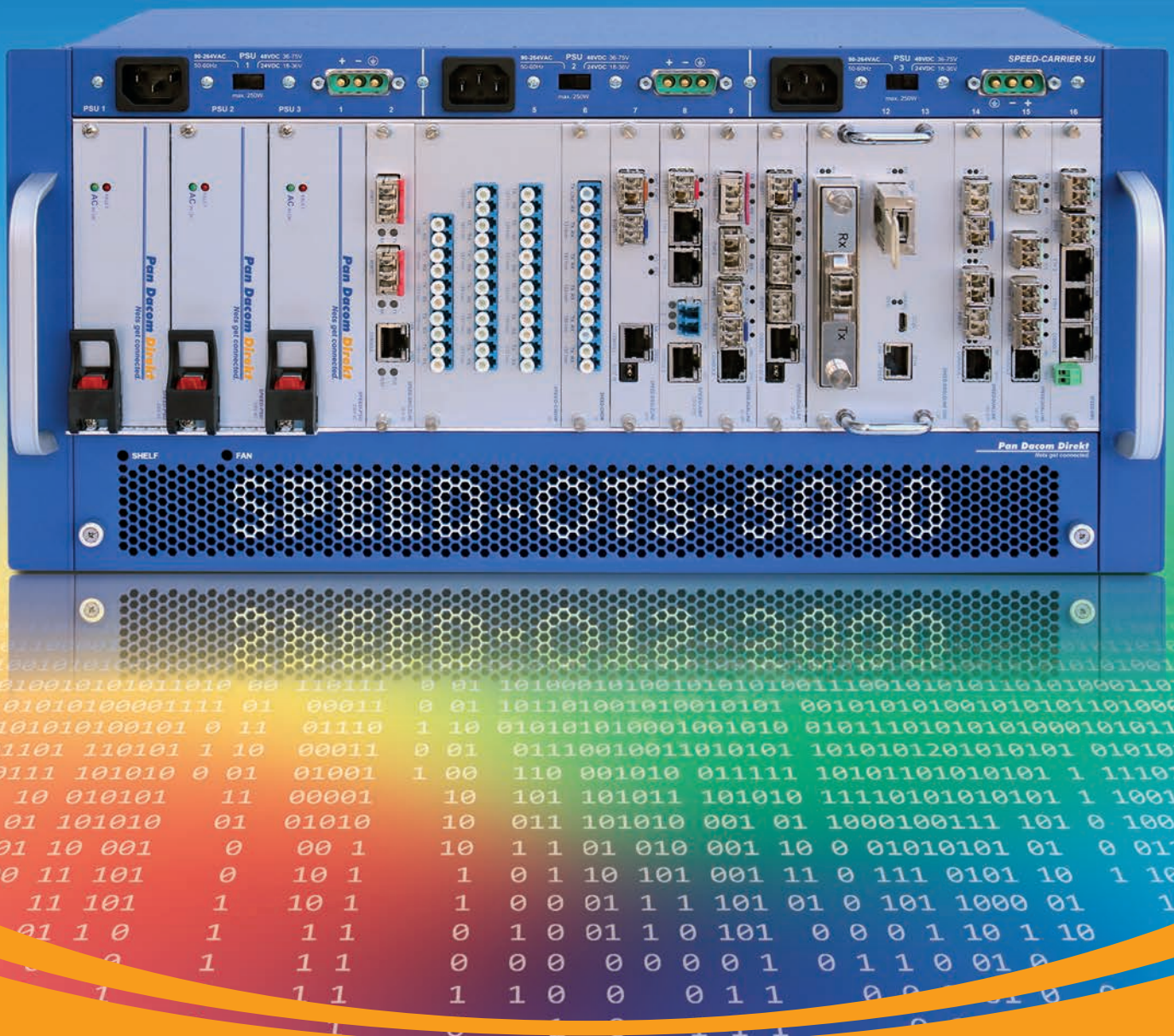


SPEED-OTS-5000

WDM System Overview



simply the best optical networking

“SPEED-OTS-5000” Hybrid WDM System – A System for All Your Needs

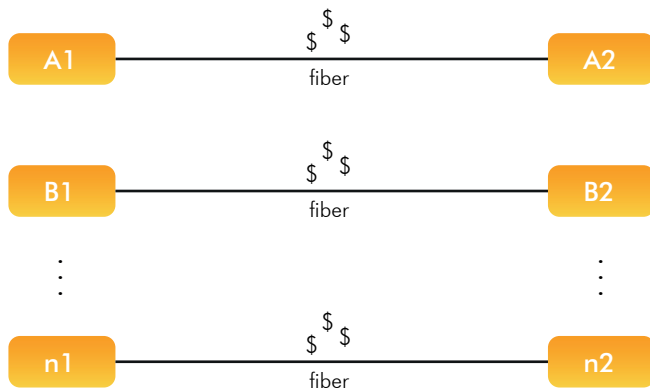
SPEED UP Your Network

By using WDM technologies, fiber optic capacities can be elegantly and cost-efficiently multiplied. The **SPEED-OTS-5000 System** grows flexibly along

the network requirements – from simple $n \times E1$ system up to redundant multi 10 Gigabit nodes.

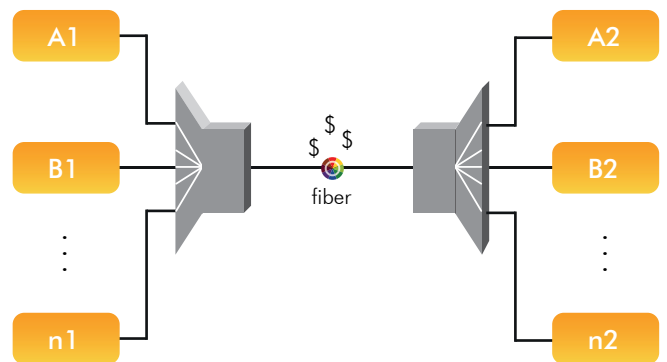
Without WDM

One Application over one fiber

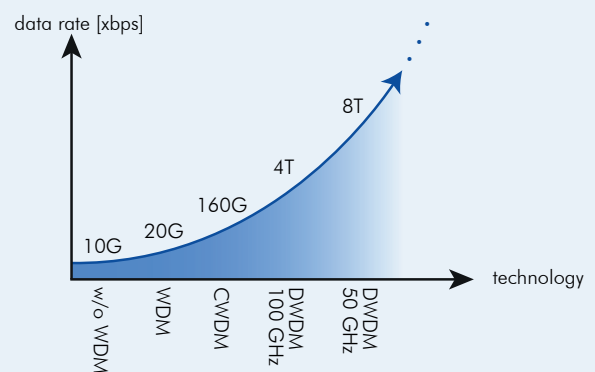


With WDM

Up to 96 independent Applications over one fiber



Capacity of one Fiber Using the SPEED-OTS-5000 System



Fast Installation – Fast Return on Investment (ROI)

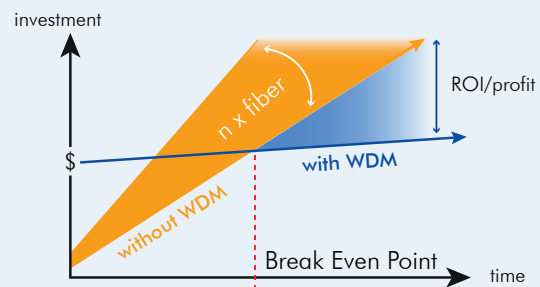
SPEED UP Your Cashflow

Pan Dacom Direkt has especially considered regional and campus-like network infrastructures with various interfaces for its product development in

addition to the classic WDM applications. Here the **SPEED-OTS-5000 System** offers an outstanding flexibility and cost efficiency.

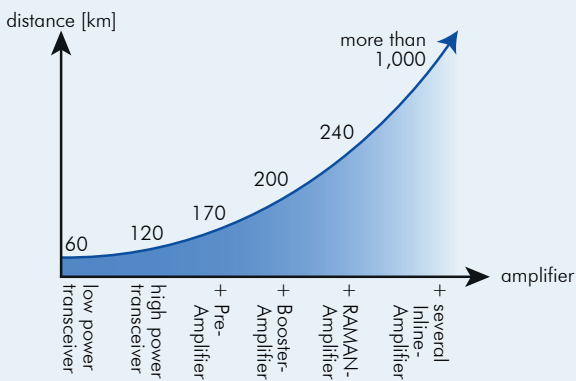
- ✓ **Save costs** by reducing the quantity of rented fibers
- ✓ **Increase capacity** of installed fibers up to 1.200 Gbps
- ✓ **Keep data streams independent** – transparency for protocols
- ✓ **Be flexible** and grow as required
- ✓ 100% traffic separation and up to **96 wavelengths via 1 fiber pair**

Once Only Investment – Fast Return on Investment (ROI)

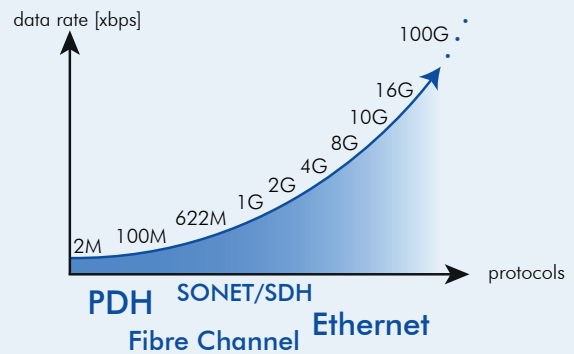


Without WDM = Rent for n x fiber pairs
With WDM = Investment + rent for 1 fiber pair

Distance Range of the SPEED-OTS-5000 System



Supported Data Rate per WDM Channel



We as Pan Dacom Direkt GmbH are an **ISO-9001** certified corporation and are designing and manufacturing all our active “Optical Transport Systems” (OTS) exclusively in Germany. Our products and systems are complying with the highest quality standards “**Made in Germany**”.

» SPEED-OTS-5000 «

Overview About the Features

Efficient Usage

- » Add further channels on demand
- » Scalable solution with CWDM, DWDM and BWDM
- » 100% protocol transparent
- » Up to 96 channels via one pair of fiber
- » Transmission of 100 Mbps up to 16 Gbps via 1 wavelength
- » Total capacity of 1.2 Tbps via one pair of fiber
- » With a guaranteed future for 100 Gbps connections

Supported Protocols

- » 100BaseTX/FX and 1000BaseTX/FX
- » 10 Gbps Ethernet and 40 Gbps Ethernet
- » E1 / E3
- » STM-1/4/16/64
- » SD-SDI, ED-SDI, HD-SDI, Dual-Link HD-SDI, 3G-SDI
- » Audio: MADI protocol
- » ESCON
- » 1/2/4/8 Gbps Fibre Channel
- » 16 Gbps Fibre Channel
- » Infiniband
- » 40 Gbps Ethernet SR4
- » 100 Gbps Ethernet SR10

Flexible Power Supply

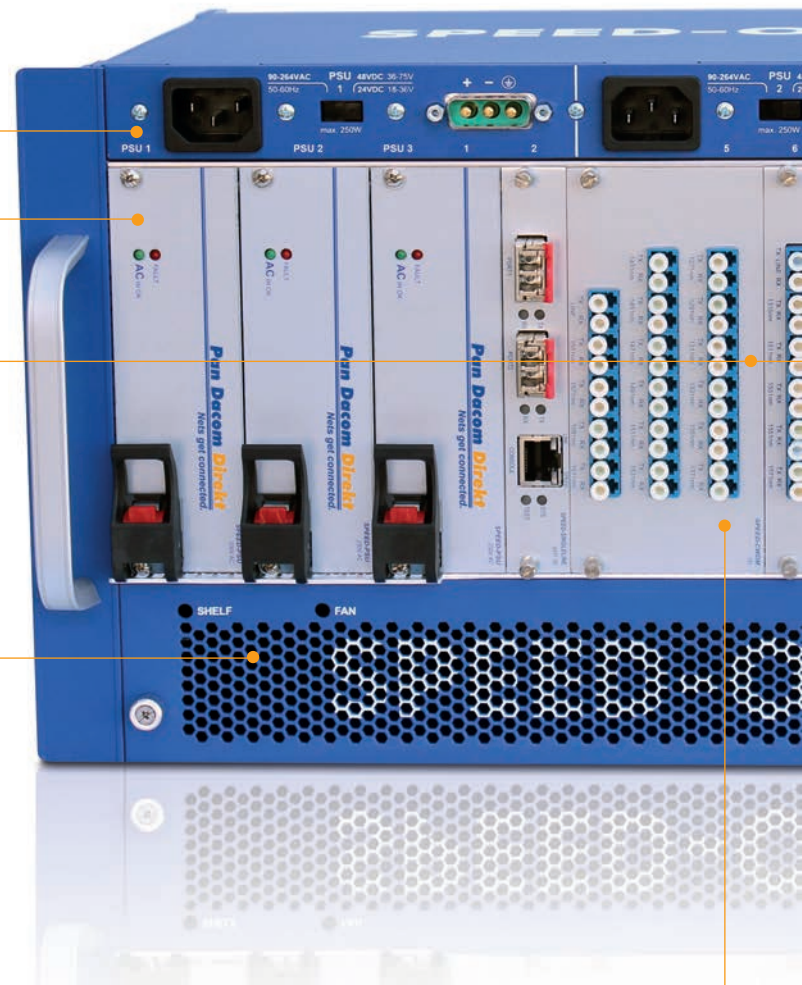
- » Redundant and fail-safe:
115 / 230 V AC, 48 V DC, optional 24 V DC
- » Up to three power supplies per chassis
- » Redundant mixed operation
(230 V AC / 48 V DC / 24 V DC)
- » Stand-by and load-sharing operation

Active and Passive Modules

- » CWDM, DWDM, OADM and BWDM
- » EDFA and RAMAN amplifiers
- » Transponder cards from 100 Mbps up to 16 Gbps
- » Dispersion compensation modules (DCM)

Intelligent Cooling System

- » Individually controlled and redundant fans regulated by integrated temperature sensors
- » This method enormously extends the durability and ensures a long lasting and uninterruptible cooling



Hot-Swap & Front Access

- » All system components are hot-swappable and replaceable on-site without impacting the running data communication
- » Front access for convenient installation and hardware extension during operation
- » In case of module changes automatic storage of configuration data for safe and efficient handling

Low Power Consumption

- » Only 84 watt e.g. 32 x 1 GbE
- » Only 194 watt e.g. 30 x 10 GbE

Individual Expandable According to All Your Requirements



Management

- » SNMPv1, v2c or v3 management
- » User-friendly and intuitive web interface (HTTP/HTTPS)
- » RADIUS user authentication
- » SSHv2 incl. SCP or telnet access
- » Port-based alarm lock (time controlled alarm activation)
- » Configuration storage and software update of all slots via NMS module
- » Integrated NMS aggregation switch equipped with 4 x Fast Ethernet for SNMP and Web-NMS
- » Remote in-band NMS via WDM uplink
- » NMS of 3rd Party network equipment connectable via Fast Ethernet port
- » IPv6 compatible
- » Unlikely event of breakdown of NMS card has no influence on the data traffic

Chassis

- » Depth only 23.5 cm
- » Optional ETSI installation kit
- » 1U and 5U chassis available
- » Optional polarity protection

High Port Density

- » Up to 512 Gbps capacity with 5U chassis
- » No additional space for air conditioning required
- » 16 slots for high- & low-speed modules as well as management module

100G ready 

GREEN IT 

tunable DWDM 

Certified by:



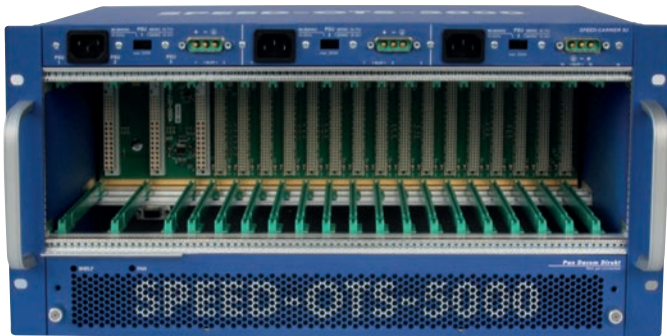
Brocade Data Center Ready



» SPEED-OTS-5000 «



Chassis



19" Chassis, 16 Slots, 5U SPEED-CARRIER 5U

Robust 5HE chassis for the flexible use of modular SPEED-system cards

- » 19" Chassis
- » Only 5U height
- » Dimensions: (HxWxD): 200 x 483 x 235 mm
- » 16 (15) slots for SPEED-system cards
- » Up to three power supplies can be used per rack
- » Modulare and redundant 230 V AC / 48 V DC / 24 V DC power supply
- » Active on-demand cooling system



Brocade
Data Center
Ready



19" Chassis, 4 Slots, 1U SPEED-CARRIER 1U

Compact 1HE chassis for active and passive SPEED-system cards

- » 19" Chassis
- » Only 1U height
- » Dimensions: (HxWxD): 44.45 x 483 x 260 mm
- » 4 Slots for SPEED-system cards
- » Redundant 230 V AC / 48 V DC power supply
- » Mixed operation possible (230 V / 48 V)



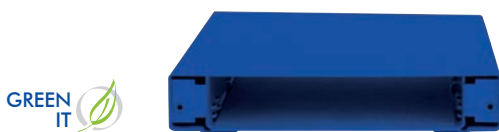
Brocade
Data Center
Ready



19" Chassis, 6 Slots, 1U SPEED-CARRIER 1U Mounting Rack

19" Chassis for up to 6 passive SPEED-system cards

- » 19" Chassis
- » Only 1U Height
- » Dimensions (HxWxD): 44.45 x 483 x 175 mm
- » 6 slots for passive SPEED-system cards



Standalone Housing, 1 Slot SPEED-STANDALONE

Standalone housing with external power supply for one SPEED-system cards

- » Standalone housing
- » Dimensions (HxWxD): 25 x 131 x 206 mm
- » 1 slot for SPEED-system cards
- » Power supply via external adapter

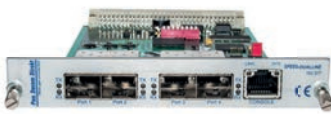


Individual Expandable According to All Your Requirements

Active SPEED-System Cards

2-Channel Transponder Card for 4/8/10/16 Gbps

SPEED-DUALLINE 16G SFP+

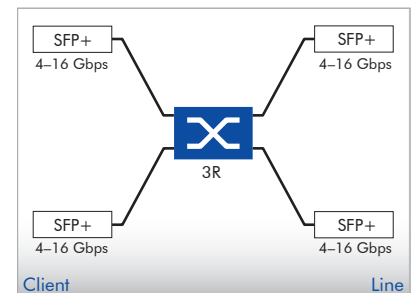


NEW **16 GFC DWDM**

Brocade Data Center Ready

Compact 16 Gbps Fibre Channel transponder card for wavelength conversion with 3R signal regeneration and 1+1 protection.

- » 4x SFP+ Ports
- » Supported data rates: 4 Gbps bis 16 Gbps
- » Supported protocols: 10 GbE, 4/8/10/16 GFC und STM-64
- » 1+1 protection
- » 3R signal regeneration for longer distances
- » Occupies 1 slot in the SPEED-OTS-5000 system
- » Support of tunable DWDM SFP+ transceiver (Software Release 6.0)



2-Channel Transponder Card for 2/4/8 Gbps Fibre Channel

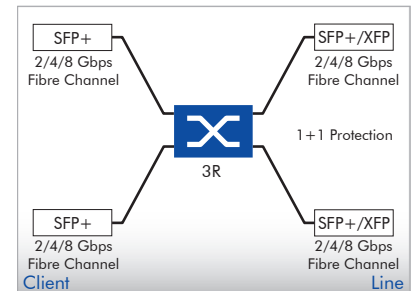
SPEED-DUALLINE FC XFP & FC SFP+



Brocade Data Center Ready

Compact 8 Gbps Fibre Channel transponder card for wavelength conversion with 3R signal regeneration and 1+1 protection.

- » XFP variant with 2 x XFP and 2 x SFP+ slots
- » SFP+ variant with 4 x SFP+ slots
- » Supported data rates and protocol: 2/4 and 8 Gbps Fibre Channel
- » 1+1 protection
- » 3R signal regeneration up to 8 Gbps
- » Support of tunable DWDM XFP transceivers
- » Occupies 1 slot in the SPEED-OTS-5000 system
- » Support of tunable DWDM SFP+ transceiver (Software Release 6.0)



2-Channel Transponder Card for 10.3 Gbps Ethernet (OTU-2 Converter)

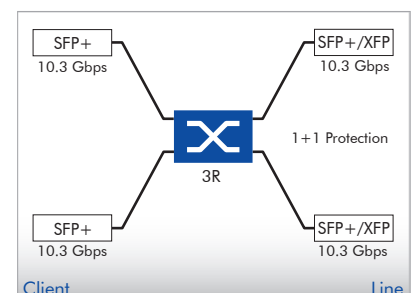
SPEED-DUALLINE 10G XFP & 10G SFP+



100G ready

Compact 10.3 Gbps transponder card for wavelength conversion with 3R signal regeneration and 1+1 protection.

- » XFP variant with 2 x XFP and 2 x SFP+ slots
- » SFP+ variant with 4 x SFP+ slots
- » Supported data rate: 10.3 Gbps Ethernet LAN
- » 1+1 protection
- » 3R signal regeneration for longer distances
- » Support of tunable DWDM XFP transceivers
- » Optional 10 G Ethernet to OTU-2 converter
- » Optional 10 Gbps-FEC support
- » Occupies 1 slot in the SPEED-OTS-5000 system
- » Support of tunable DWDM SFP+ transceiver (Software Release 6.0)



» SPEED-OTS-5000 «



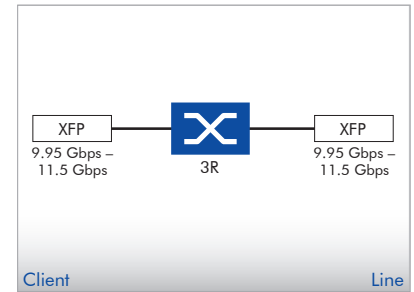
Active SPEED-System Cards

1-Channel Transponder Card for 9.95 to 11.5 Gbps with 3R (Protocol Transparent OTU-2 Converter)

SPEED-SINGLELINE XFP 3R

Compact 10 Gbps transponder card for wavelength conversion and 3R signal regeneration.

- » 2x XFP slots (10 Gbps)
- » Supported data rates: 9.95 Gbps to 11.5 Gbps,
- » Protocol transparent (IP, SDH, Storage, etc.)
- » 3R signal regeneration for 10 Gbps
- » Support of tunable DWDM XFP transceivers
- » Optional as 10G Ethernet to OTU-2 converter
- » Optional with 10G FEC support
- » Occupies 1 slot in SPEED-OTS-5000 system

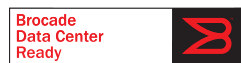
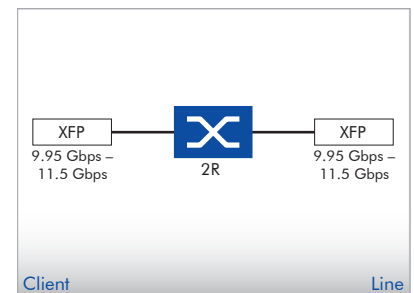


1-Channel Transponder Card for 9.95 to 11.5 Gbps with 2R

SPEED-SINGLELINE XFP

Very compact and cost-optimized 10 Gigabit transponder card for wavelength conversion.

- » 2x XFP slots (10 Gbps)
- » Supported data rates: 9.95 Gbps to 11.5 Gbps
- » Protocol transparent (IP, SDH, Storage, etc.)
- » Support of tunable DWDM XFP transceivers
- » Optional as 10G Ethernet to OTU-2 converter
- » Optional with 10 Gbps FEC support
- » Occupies 1 slot in SPEED-OTS-5000 system

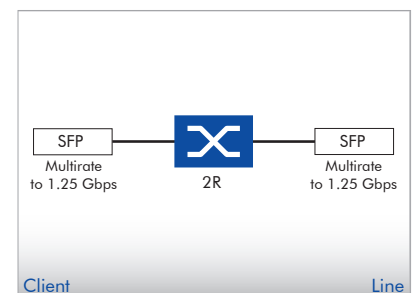


1-Channel Transponder Card for 10 Mbps to 1.25 Gbps Multirate

SPEED-SINGLELINE SFP

Cost optimized multirate transponder card for single channel wavelength conversion, or media conversion.

- » Supported data rate: 10 Mbps to 1.25 Gbps
- » Protocol transparent (IP, SDH, Storage, etc.)
- » Ideal usage as a stand-alone converter
- » Occupies 1 slot in SPEED-OTS-5000 system



Active Modules for Efficient WDM Networks

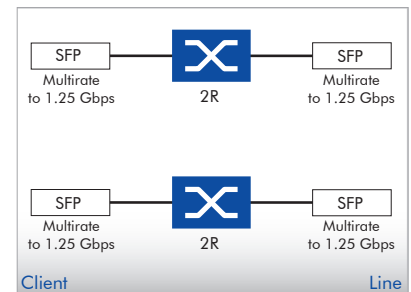
2-Channel Transponder Card for 10 Mbps to 1.25 Gbps Multirate

SPEED-DUALLINE SFP



Cost optimized multirate transponder card for dual channel wavelength conversion, or media conversion.

- » Supported data rate: 10 Mbps to 1.25 Gbps
- » Protocol transparent (IP, SDH, Storage, etc.)
- » Ideal usage as a stand-alone converter
- » Occupies 1 slot in SPEED- OTS-5000 chassis



2-Channel Transponder Card for up to 2.97 Gbps Multirate

SPEED-DUALLINE SFP 3R

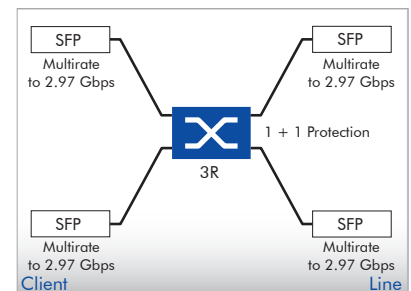


Brocade
Data Center
Ready



Compact multirate transponder card for wavelength conversion of two WDM applications, with 3R signal regeneration and protection functionality.

- » 4 x SFP slots
- » Supported data rate: 10 Mbps to 2.97 Gbps
- » Protocol transparent:
 - » Ethernet, SDH, Fibre Channel, ATM etc.
 - » Video: SD-SDI, ED-SDI, HD-SDI, Dual-Link HD-SDI, 3G-SDI
 - » Audio: MADI protocol
- » Cross connect, 1+1 protection
- » 3R signal regeneration up to 2.97 Gbps
- » Configurable <50 ms protection switching (manually, automatically)
- » Max. 9 W power consumption (incl. SFP transceivers)
- » Occupies 1 slot in SPEED-OTS-5000 system



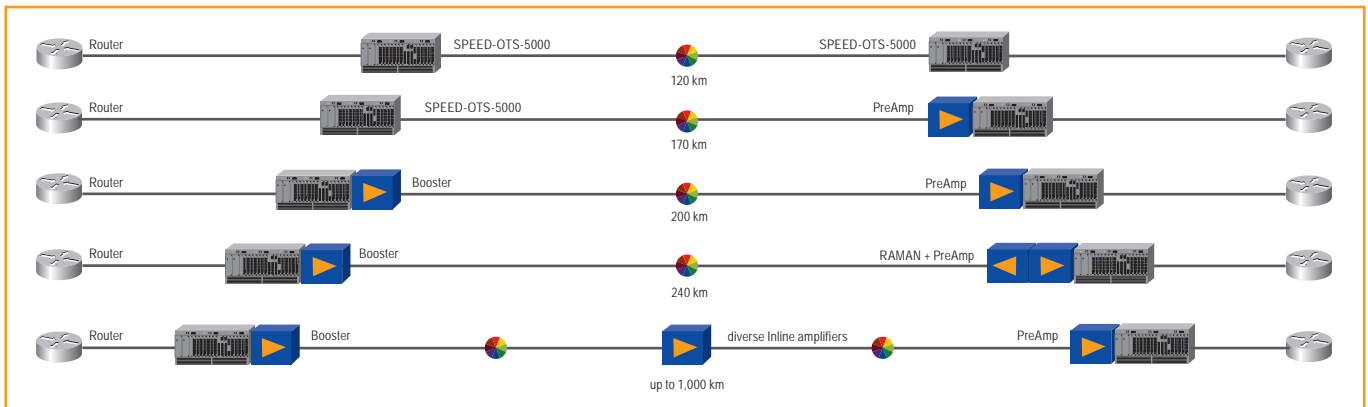
» SPEED-OTS-5000 «



Point-to-Point Transmission Over Long Distances

The use of optical amplifiers in point-to-point connections enables the transmission of DWDM signals over long distances. For this purpose **four different types of amplifiers** are available. The **Booster** (power amplifier) is used at the beginning of the transmission link. Thus a signal with high power is available. The **Pre-amplifier** is designed to increase a low signal value at the end of the transmission path to a level that is detectable by the receiving

transceiver. By using an **Inline amplifier** a signal is amplified several time during transmission. Therefore very long distances can be accomplished. With the help of a **RAMAN amplifier** point-to-point connection of up to 240 km are possible, this is a big advantage in the event that an interim location does not exist. In comparison to an EDFA amplifier, a RAMAN amplifier provides a better OSNR performance.

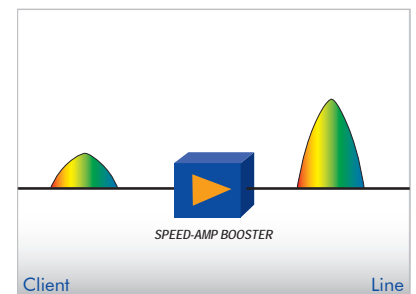


Optical EDFA Amplifier SPEED-AMP BOOSTER



Optical EDFA booster for all DWDM signals up to 100 Gbps in order to increase transmission distance up to 200 km without "inline" location.

- » Typically used at the beginning of the transmission link
- » Protocol transparent from 100 Mbps up to 100 Gbps
- » Suitable for all DWDM channels in C-band
- » Support of 50 GHz and 100 GHz grid
- » Laser protection class 1M
- » Optional with OSC channel for management information
- » Occupies 2 slots in the SPEED-OTS-5000 system

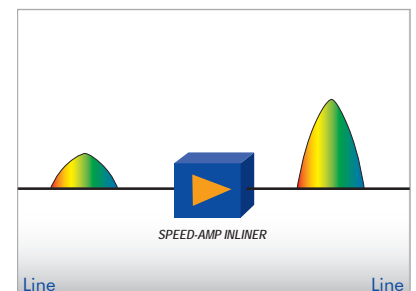


SPEED-AMP INLINER



Optical EDFA Inline amplifier in order to increase all DWDM signals up to 100 Gbps at an "inline" location.

- » Typically used in between of the transmission link
- » Protocol transparent from 100 Mbps up to 100 Gbps
- » Suitable for all DWDM channels in the C-band
- » Support of 50 GHz and 100 GHz grid
- » Laser protection class 1M
- » Optional with OSC channel for management information
- » Occupies 2 slots in the SPEED-OTS-5000 system



Optical EDFA and RAMAN Amplifiers

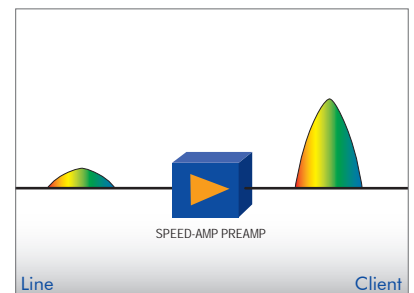
Optical EDFA Amplifier

SPEED-AMP PREAMP



Optical preamplifier for better receive quality of strongly attenuated DWDM signals of up to 100 Gbps.

- » Typically used at the end of the transmission link
- » Protocol transparent from 100 Mbps up to 100 Gbps
- » Suitable for all DWDM channels in C-Band
- » Support of 50 GHz and 100 GHz grid
- » Laser protection class 1M
- » Optional with OSC channel for inband management information
- » Occupies 1 slot in the SPEED-OTS-5000 system



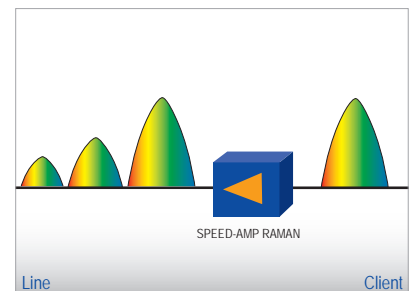
Optical RAMAN Amplifier

SPEED-AMP RAMAN



Optical RAMAN amplifier in order to increase signals during transmission by reverse pumping of signal power into the fiber optic cable.

- » Typically used at the end or at the beginning of the transmission link
- » Protocol transparent from 100 Mbps up to 100 Gbps
- » Used as a forward or reverse amplifier
- » Support of 50 GHz and 100 GHz grid
- » Laser protection class 1M
- » With OSC channel for inband management information
- » Improving the OSNR performance
- » 2 slots in SPEED-OTS-5000 system



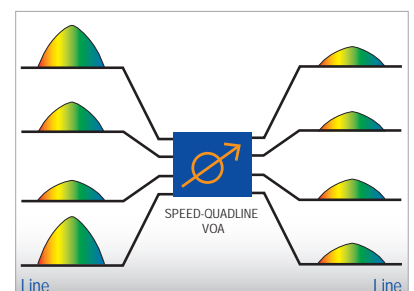
4-Channel VOA Card with Power Monitoring

SPEED-QUADLINE VOA



Compact 4-channel variable optical attenuation (VOA) card for optical network power management.

- » 4x VOA SFP ports for individual attenuation of each WDM channel
- » Fully protocol and wavelength transparent
- » TAP monitor for power monitor and power control of each channel
- » Attenuation range of 0 dB up to 25 dB
- » Occupies 1 slot in the SPEED-OTS-5000 system
- » To be announced shortly



» SPEED-OTS-5000 «



Passive SPEED-System Cards

WDM – Wavelength Division Multiplexing

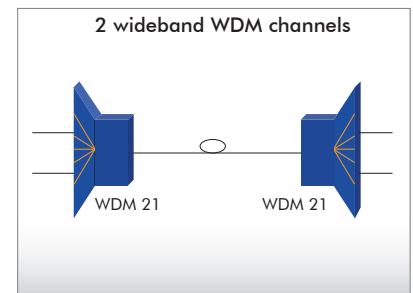
Cost-optimized SPEED-WDM solution to transmit **two applications** via one pair of fiber.



SPEED-WDM 21

2-channel WDM, suitable for parallel transmission of two applications.

- » Wavelengths:
 - Wideband 1260 to 1457 nm
 - Wideband 1464 to 1620 nm
- » Occupies 1 slot in SPEED-OTS-5000 system



CWDM – Coarse Wavelength Division Multiplexing

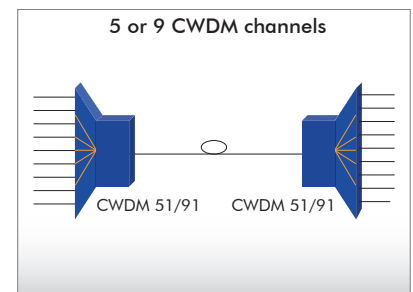
By using SPEED-CWDM solution, five or nine applications can be transmitted over one pair of fiber. For future scalability extension, eight additional channels can be taken into operation without interruption of running services. This solution can be used in order to transmit up to **16 applications** over one pair of fiber.



SPEED-CWDM 51 & 91

5- and 9-channel CWDM, extremely compact for parallel transmission of up to nine applications.

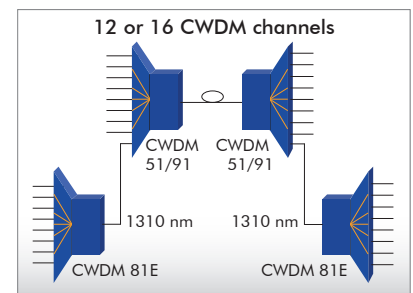
- » 1310 nm wideband for future extensions
- » Wavelengths:
 - Wideband 1310 nm (1271 to 1451, 1471, 1491nm), 1511, 1531, 1551, 1571, 1591, 1611 nm
- » Occupy 1 or 2 slot(s) in the SPEED-OTS-5000 system



SPEED-CWDM 81E

8-channel CWDM extension, optimal for capacity enhancement of 2-channel WDM or 5-/9-channel CWDM installations by additional eight channels.

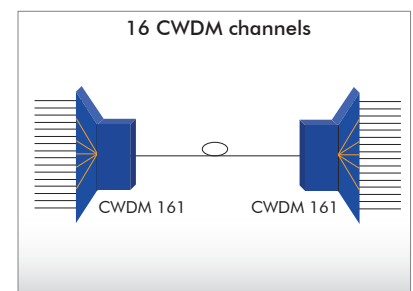
- » Wavelengths:
 - 1271, 1291, 1311, 1331, 1351, 1371, 1431 and 1451 nm
- » Occupies 2 slots in the SPEED-OTS-5000 system



SPEED-CWDM 161

16-channel CWDM, extremely compact for the parallel transmission of 16 applications over 1 pair of fiber.

- » Wavelengths:
 - 1271, 1291, 1311, 1331, 1351, 1371, 1431, 1451, 1471, 1491, 1511, 1531, 1551, 1571, 1591 and 1611 nm
- » Occupies 3 slots in the SPEED-OTS-5000 system



Passive Modules for Efficient WDM Networks

DWDM – Dense Wavelength Division Multiplexing

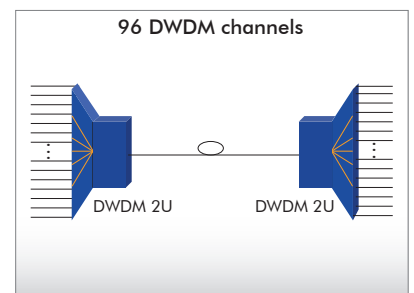
By using the SPEED-DWDM 1U / 2U solution, up to **96 applications** can be transmitted via one pair of fiber.



SPEED-DWDM 2U 13/59.5

96-channel 50 GHz DWDM multiplexer in only 2U 19" rack size.

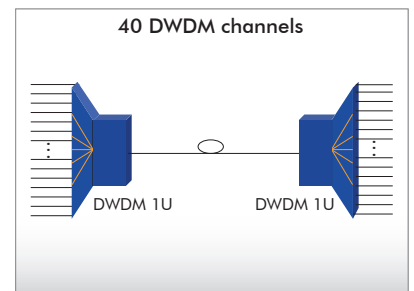
- » 19" housing with 96 DWDM channels
- » 2U rack size
- » 50 GHz and 100 GHz DWDM available
- » Integrated 3% monitoring port for external OSA measurement devices



SPEED-DWDM 1U 20/59 & 19/58.5

40-channel 100 GHz DWDM multiplexer in only 1U 19" rack size.

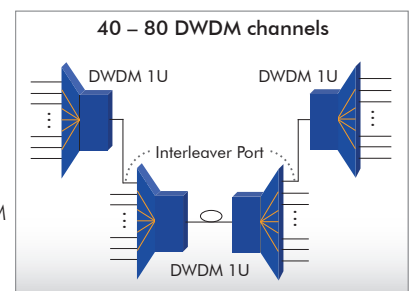
- » 19" housing with 40 DWDM channels
- » 1U rack size
- » Standard 100 GHz DWDM transceivers for SPEED-DWDM 1U 20/59
- » 50 GHz channel and tunable DWDM transceivers for SPEED-DWDM 1U 19/58.5



SPEED-DWDM 1U 20/59I & 19/58.5I

40-channel 100 GHz DWDM multiplexer with integrated interleaver port in order to expand to additional 40 DWDM channels.

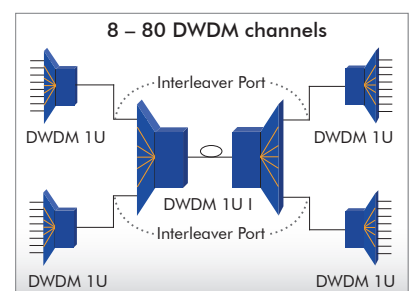
- » 19" housing with 40 DWDM channels with 100 GHz grid
- » Integrated interleaver port in order to expand to 80 DWDM channels without interruption of running applications
- » 50 GHz and 100 GHz DWDM transceivers available



SPEED-DWDM 1U I

Interleaver device for extension of up to 80 DWDM channels.

- » Interleaver for 50 GHz DWDM channels
- » Supported ITU-T channel numbers from 16 up to 59
- » Interleaver port for SPEED-DWDM 1U and SPEED-DWDM 81E



» SPEED-OTS-5000 «



Passive Optical Multiplexer

DWDM – Dense Wavelength Division Multiplexing

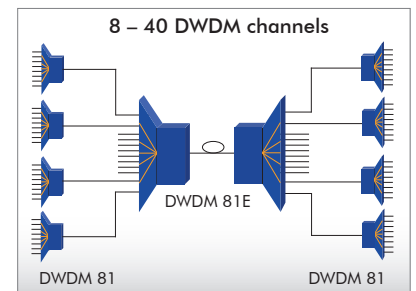
An 8-channel DWDM system can be extended by 8 further DWDM channels per DWDM module for up to **40 channels** without traffic interruption.



SPEED-DWDM 81E

8-channel DWDM multiplexer with four extension ports for uninterrupted expansion up to 40 DWDM channels.

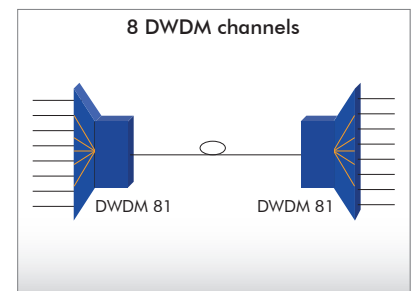
- » Wavelength acc. to ITU-T 100 GHz grid
- » 8 DWDM channels, channel 34 to 41
- » 4 extension ports:
 - » Channel 16 to 23
 - » Channel 43 to 50
 - » Channel 25 to 32
 - » Channel 52 to 59
- » Occupies 2 slots in SPEED-OTS-5000 system (+ 2 further slots for each 8-channel DWDM multiplexer)



SPEED-DWDM 81 XX/XX

8-channel DWDM aggregation, ideal for the pre-concentration of up to eight applications for the use of SPEED-DWDM 81E.

- » Wavelengths:
 - » 16/23: channel 16 to 23
 - » 34/41: channel 34 to 41
 - » 25/32: channel 25 to 32
 - » 43/50: channel 43 to 50
 - » 30/37: channel 30 to 37
 - » 52/59: channel 52 to 59
- » Further wavelengths on request
- » Occupies 2 slots in the SPEED-OTS-5000 system



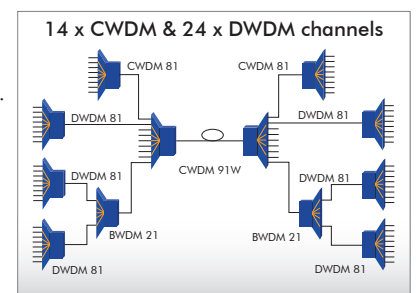
CWDM/DWDM Hybrid

With the SPEED-CWDM/DWDM hybrid solution a CWDM system can be extended by additional channels for a total capacity of 108 channels without interruption of running services.



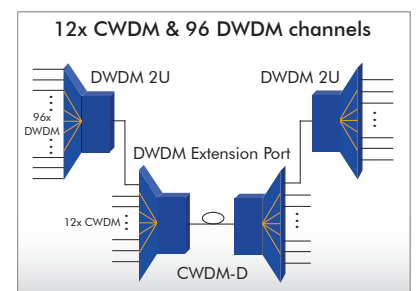
SPEED-CWDM/DWDM Hybrid

- » Uninterruptible cascading of CWDM and DWDM for up to 38 channels
- » Occupies 1 or 2 slot(s) in the SPEED-OTS-5000 system



SPEED-CWDM-D

- » 12 channel CWDM with one extension part for up to 96 DWDM channels
- » Uninterruptible cascading of CWDM and DWDM for up to 108 channels
- » Uninterruptible cascading of CWDM and DWDM for up to 108 channels
- » CWDM: 1271, 1291, 1311, 1331, 1351, 1371, 1431, 1451, 1491, 1511, 1591 and 1611
- » Occupies 3 slots in the SPEED-OTS-5000 system



Passive Modules for Efficient WDM Networks

SPEED-BWDM Band Filter

With SPEED-BWDM band filters complete wavelength ranges can be connected with low attenuation.



SPEED-BWDM 21 & 51

2- and 5-channel band multiplexer for a low attenuated connection of complete DWDM ranges.

- » 2-channel band filter for the channels:
 - » 25 to 32 and 34 to 41, or 43 to 50 and 52 to 59
- » 5-channel band filter for channels:
 - » 16 to 23, 25 to 32, 34 to 41, 43 to 50, 52 to 59
- » Low loss switching of 8-channel DWDM bands at inline locations
- » Occupies 1 slot in the SPEED-OTS-5000 system



SPEED-DWDM R/B

- » 2-channel band multiplexer for the channels:
 - » 20 to 38, 41 to 59
- » Occupies 1 slot in the SPEED-OTS-5000 system

Add&Drop Multiplexer (CWDM/DWDM/BWDM)



SPEED-Add&Drop Singleside

1 to 3-channel Add&Drop WDM multiplexers minimum attenuation loss through extraction of wavelengths. Transmission in one direction only.

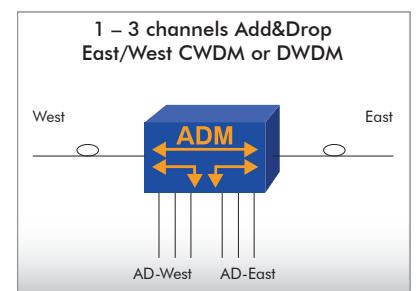
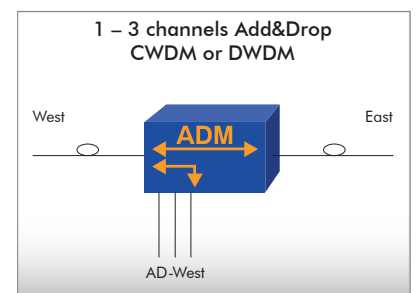
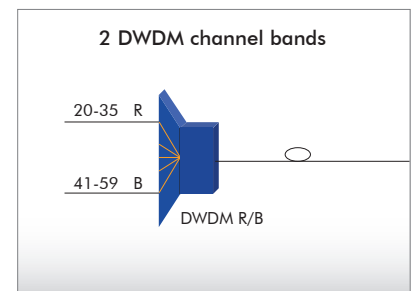
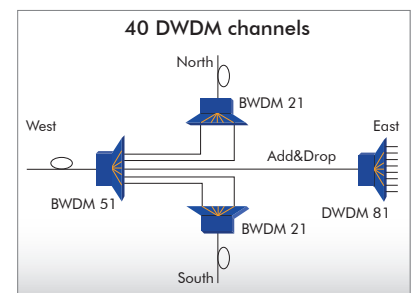
- » Optimized for installation of bus topologies
- » CWDM, DWDM and BWDM multiplexers available
- » With 1, 2 or 3 Add&Drop channels
- » Channels selectable
- » Occupies 1 slot in the SPEED-OTS-5000 system



SPEED-Add&Drop Dualside

1 to 3-channel Add&Drop WDM multiplexer, minimum attenuation loss through extraction of wavelengths. Transmission in both directions possible.

- » Ideal for installation of ring topologies
- » CWDM and DWDM multiplexers available
- » With 1, 2 or 3 Add&Drop channels
- » Channels selectable
- » Occupies 1 slot in SPEED-OTS-5000 system



» SPEED-OTS-5000 «



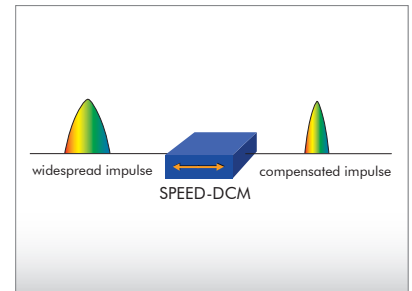
Further Passive SPEED-System Modules



SPEED-DCM

Dispersion compensation module for distances of up to 200 km.

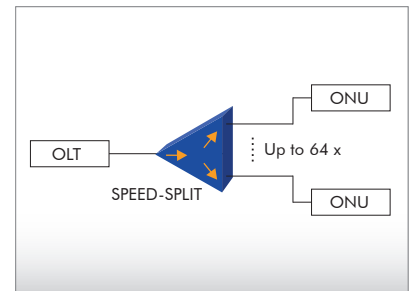
- » Individual compensation level from 20 km to 200 km
- » Suitable for 10 Gbps and for data rates up to 40 Gbps
- » 1 or 2 DCM modules per cord available
- » Occupies 1 slot in the SPEED- OTS-5000 chassis



SPEED-SPLIT

Optical splitter for FTTx networks supporting division ratio of 1:2 up to 1:64.

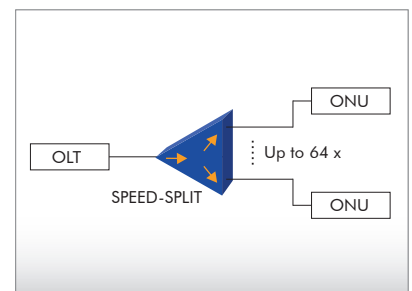
- » Available as a module for insertion into SPEED- OTS-5000 chassis or in a 19" housing
- » Customized support of split ratio available on request
- » Occupies 1or 2 slot(s) in the SPEED-OTS-5000 system



SPEED-COUPLER

Multipurpose power splitter e.g. for monitoring systems or OSA measurements in CWDM/DWDM networks.

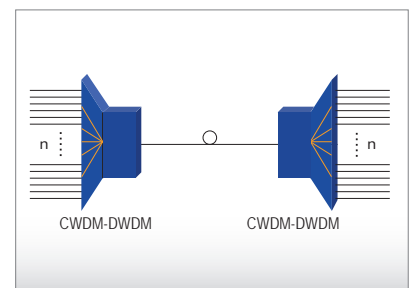
- » Individual splitting of power available e.g. 10% for monitoring and 90% for signal transmission (or: 20/80, 30/70, 40/60, 50/50)
- » Occupies 1 slot in the SPEED-OTS-5000 system



SPEED-CWDM/DWDM

Customized production of SPEED multiplexer:

- » Customized number of channels
- » Customized housing
- » Customized wavelength
- » Customized connectors
- » Customized combination of CWDM, DWDM and Add&Drop multiplexer



Further Equipment for High Flexibility

Pluggable Optical Transceiver Modules

SFP, SFP+ and XFP

The SPEED system supports SFP, SFP+ and XFP on each optical pluggable transceiver link. With this pluggable solution network providers have the highest flexibility and best cost control in case of optic replacements.

Most of the transceivers support performance monitoring with integrated diagnostic monitoring interface (DMI). So the system provides best transparency of current temperature, data rate, wavelength as well as thresholds and alarm levels.

Comprehensive Portfolio of Different Transceivers – Many Types at Stock or with Shortest Delivery Time

Type:	GBIC, SFP, SFP+, XFP, X2, CFP, CXP, QSFP
Protocol:	Fast Ethernet, 1 Gbps Ethernet, 10 Gbps Ethernet, 40 G, 100 G, E1, E3, STM-1/4/16/64, 1/2/4/8/10 GFC, divers multirate types
Wavelength copper:	Copper, 850 nm, 1310 nm, 1550 nm, Single fiber (bidi), DWDM (50 GHz), DWDM (100 GHz), 8 channel tunable, full-tunable
Distance:	550 m, 2/10/40/80/100/120/140/160/180 km
Power Budget:	<10/14/ 23/25/28/32/37/39/>39 dB
Miscellaneous:	Digital Monitoring Interface (DMI), Forward Error Correction (FEC), Industrial Temperature (I)

Tunable DWDM Transceiver

- » For 102 DWDM channels over one fiber pair
- » XFP and SFP+
- » 50 GHz fixed and tunable version
- » Tunables are ideal spare parts
- » Available for 10 Gbps as well as 8 Gbps



System Transceiver with MPU

- » Micro Processor Unit (MPU)
- » E1/E3/STM-1 over IP functions inside a SFP module
- » Extended reach of Copper Fast Ethernet lines up to 550 m in a SFP
- » Update simple switches with Ethernet OAM functions by using a SFP adapter

3rd Party Compatible Transceivers for Nearly all Switch Vendors, such as:

- | | | | |
|-----------------------------|-------------------------------------|-----------------------|-------------|
| » Cisco Systems | » HP | » QLogic certified | » ADVA |
| » Nortel Networks | » Extreme Networks | » Marconi | » Arista |
| » Juniper Networks | » Legacy Foundry Networks Equipment | » Alcatel Lucent | » Transmode |
| » 3COM | » Avaya | » D-Link | » etc. |
| » Enterasys Secure Networks | » Huawei | » Riverstone Networks | |
| » Brocade certified | | » Linksys | |

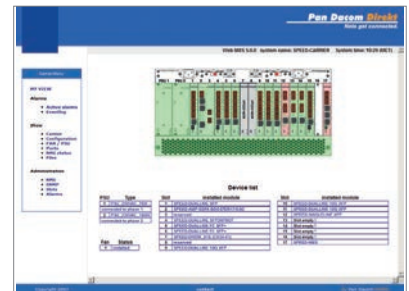
» SPEED-OTS-5000 «



Comprehensive Management System

SPEED-Network Management Card

Management module for central monitoring and configuration of all SPEED-system card



- » SNMPv1, v2c or v3 management
- » Syslog
- » User-friendly and intuitive web interface (HTTP/HTTPS)
- » RADIUS user authentication
- » SSHv2 (incl. SCP) or telnet access
- » Port based alarm lock (time controlled alarm activation)
- » Configuration storage and software update of all slots via NMS card
- » Automatic configuration update after replacement of a module



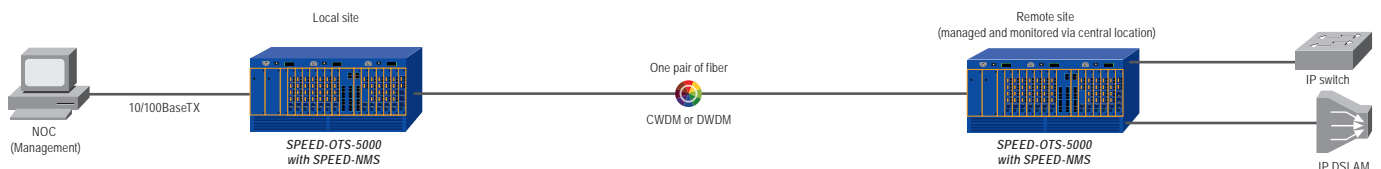
Monitoring and Configuration of the SPEED-OTS-5000 System

The SPEED-NMS module is the central management hub of the SPEED-OTS-5000. Configuration and monitoring of integrated modules are performed by a graphical HTML-based interface (Web GUI), SNMP or Command Line Interface.

Using the corresponding Pan Dacom Direkt MIB table the SPEED-OTS-5000 can be integrated into existing SNMP based management systems. With extensive monitoring features (such as transceivers RX-/TX-level, temperature etc.) the system status can be analyzed. Constantly SNMP traps are sent for each status change. Furthermore the SPEED-NMS card supports an intuitive web interface which encrypts all data transfers (HTTPS).

This enables an easy configuration and provides a consolidated overview of the entire system. For quick troubleshooting all slots and ports are color-coded within the web interface according to their status. In addition an „Active Alarms List“ is available which shows an overview of all the critical states. All alarms are stored in an alarm history file. Individual port labels enable a fast assignment of errors to a client or service. Physical access to the SPEED-NMS card is provided by a RS232 interface or an integrated 4-port Ethernet switch supporting two 10/100BaseTX and two SFP ports.

Remote Management



A connection to the remote site can be established via an in band channel of an amplifier, a TDM card or using an own CWDM or DWDM wavelength for the management information. With the integrated Ethernet switch additional network units can be managed by Ethernet at a location where a SPEED-OTS-5000 is installed. In this case, the Ethernet management port of a network unit can be connected directly to a switch port of the

SPEED-NMS card. So management information and additional data are transmitted using a dedicated wavelength. No additional transponder module is needed. In the case that a module has to be replaced on site, the whole configuration of this module is redundantly saved on the NMS card and will automatically be updated on the new module. So there is no on site configurations needed.

Management Module for Monitoring and Configuration

Active Monitoring by Thresholds (Performance Monitoring) and Reports

Compliance with SLAs or critical conditions can be detected in advance using an active monitoring. This provides a granular view of the network to its provider.

Trap Receiver with Configurable Priority of Alarms, Alarm Correlation and Alarm Escalation

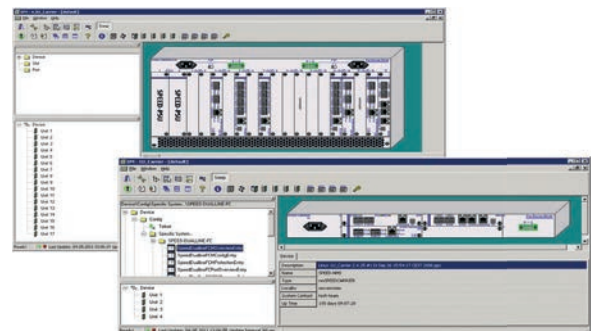
Incoming alarms are classified by event-filters assigning priority and escalating them accordingly (e.g. SMS, e-mail or forwarding of alarms to higher-level NMS systems). Secondary error messages are suppressed so trouble shooting will be simplified. Only critical alarms are displayed. All alarms must be confirmed by the user.

Technical or Service View for Quick Customer Identification

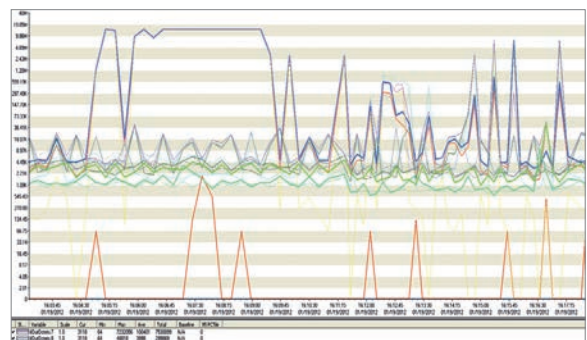
With this solution other SNMP-based network components can be monitored. Using only one Element Manager saves CAPEX and OPEX.

Further Features:

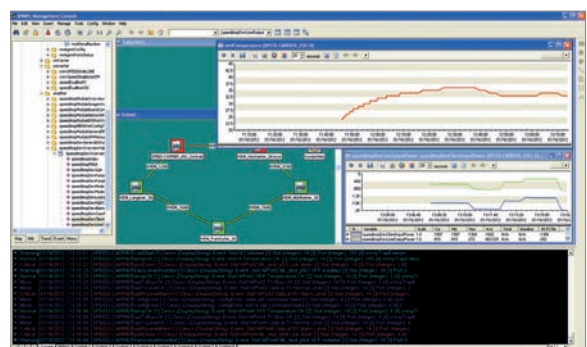
- » SNMPv1, v2 or v3
- » Graphical view of system status by using different color-coding
- » Define different user profiles with individual value set
- » Active alarms, alarm history and customized alarm filters
- » MAP/Submap views (Topology views)
- » Root Cause Analyse
- » Periodic status monitoring



Graphical view of system and status monitoring



Performance monitoring and threshold control



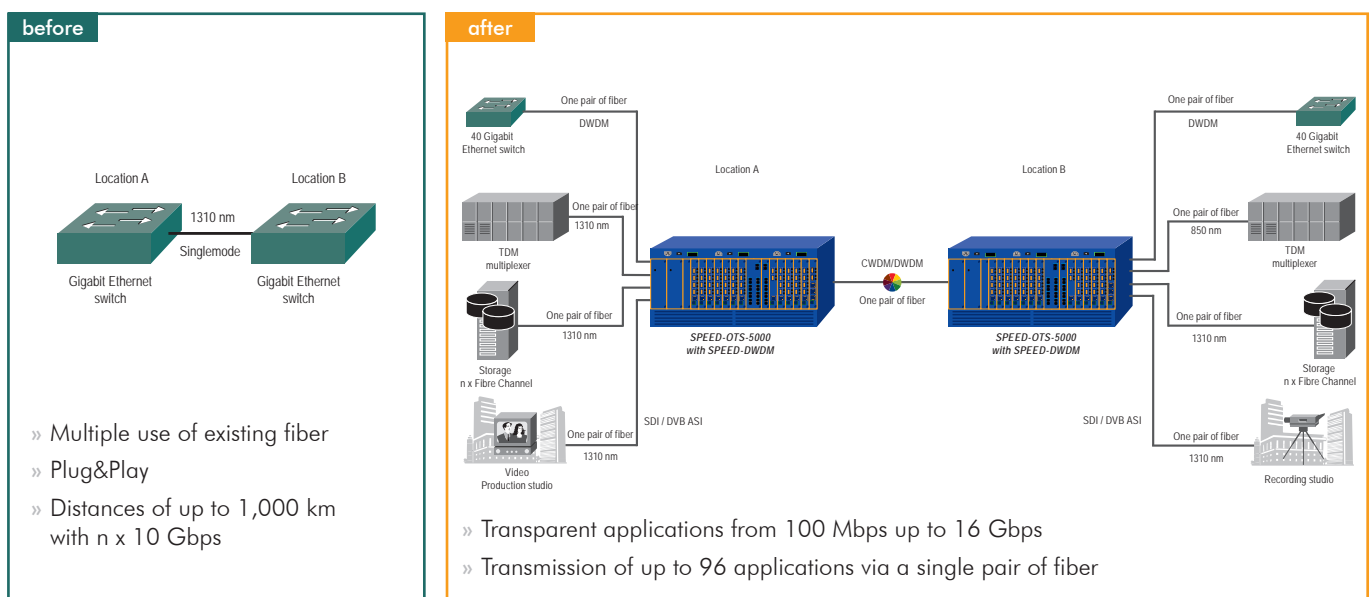
Graphical view of net topology with statistical analysis

» SPEED-OTS-5000 «

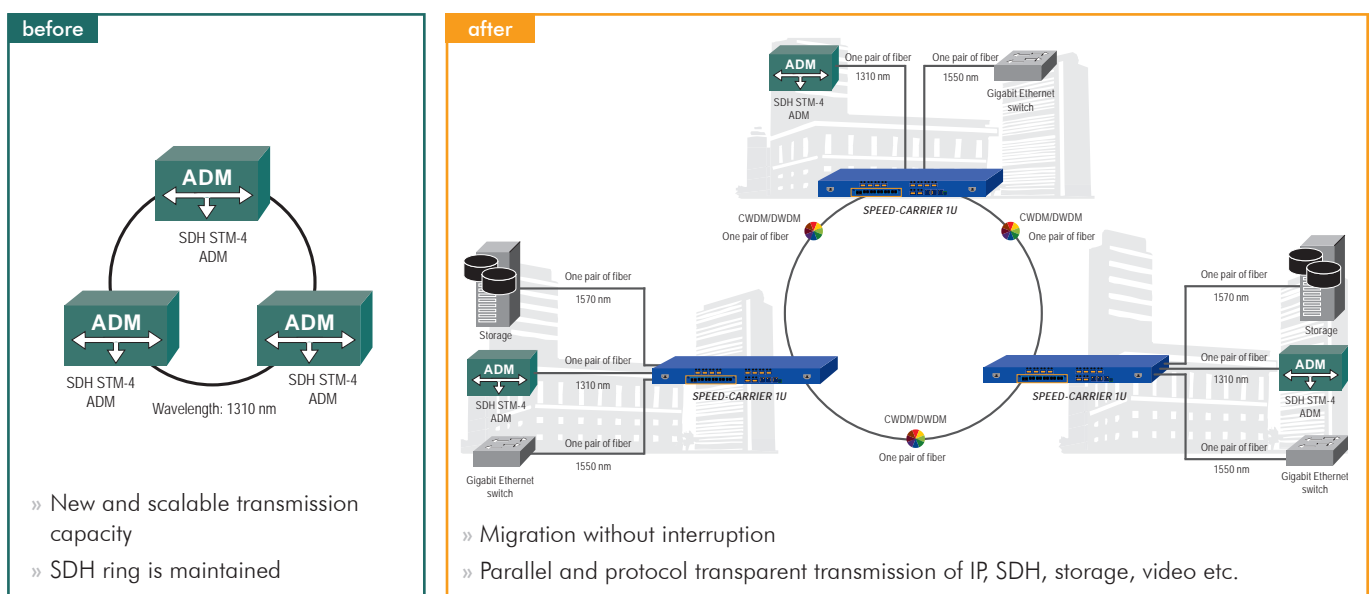


Typical Applications

Capacity Expansion of Optical Networks in Point-to-Point Applications

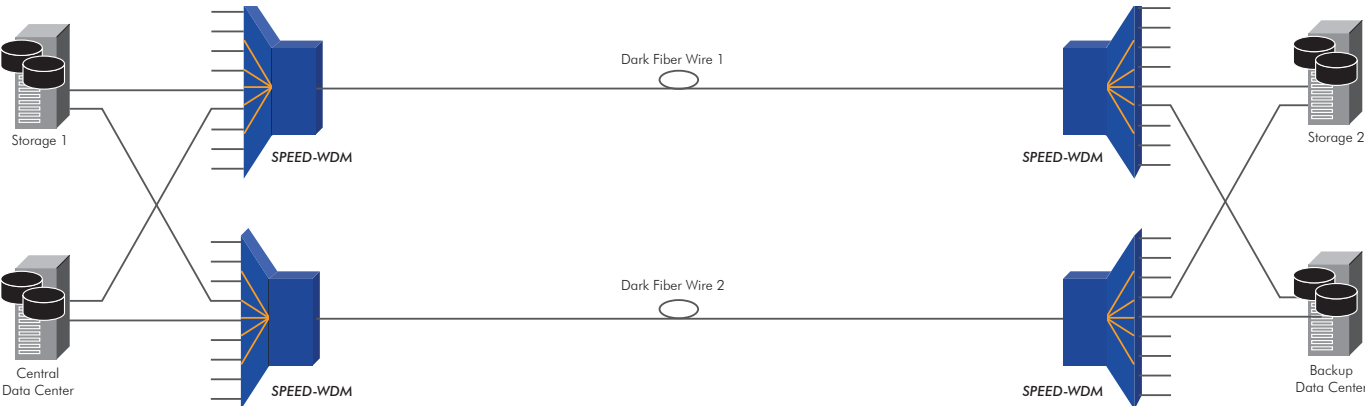


Cost-Saving Alternative to SDH Upgrade with High Scalability



Typical Applications for WDM Systems

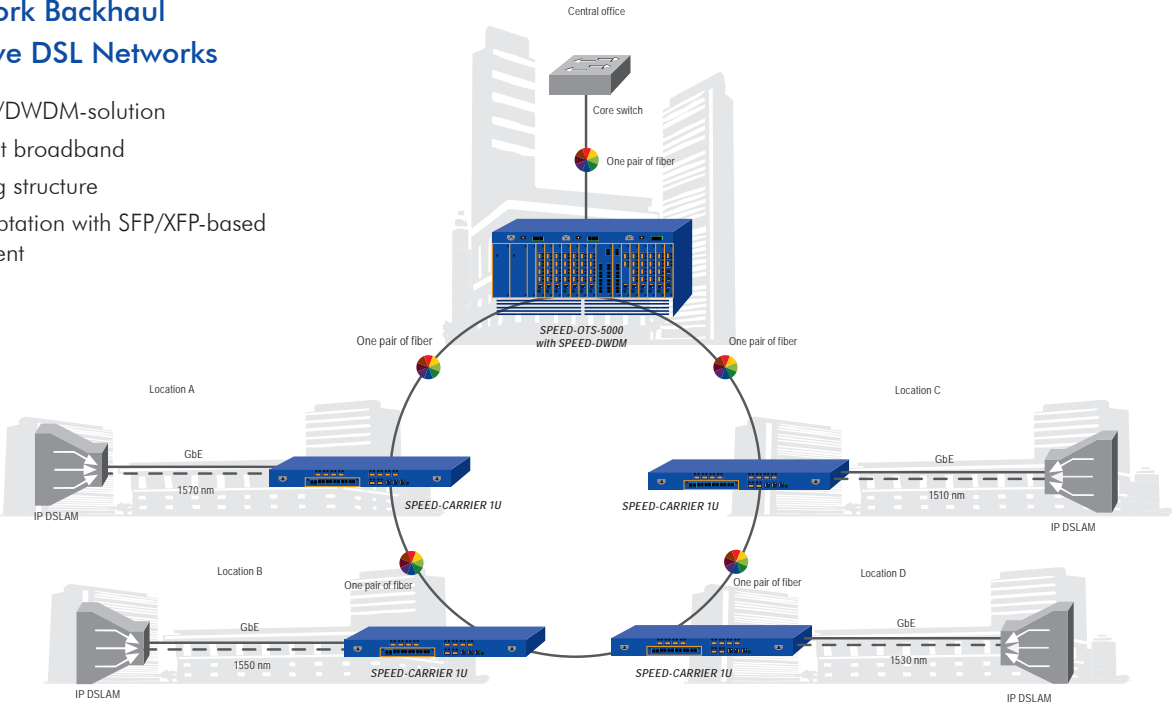
Storage Backup – Secure Data Center Connections



- » Ideal for backup scenarios
- » Short switching time < 50 ms
- » In-band remote-management
- » Configurable switching behavior
- » Manual switchover of individual wavelengths for maintenance
- » Brocade certified system

Optical Network Backhaul for Competitive DSL Networks

- » Purely passive C/DWDM-solution
- » Ideal for low-cost broadband
- » Protection by ring structure
- » Wavelength adaptation with SFP/XFP-based network equipment



» SPEED-OTS-5000 «



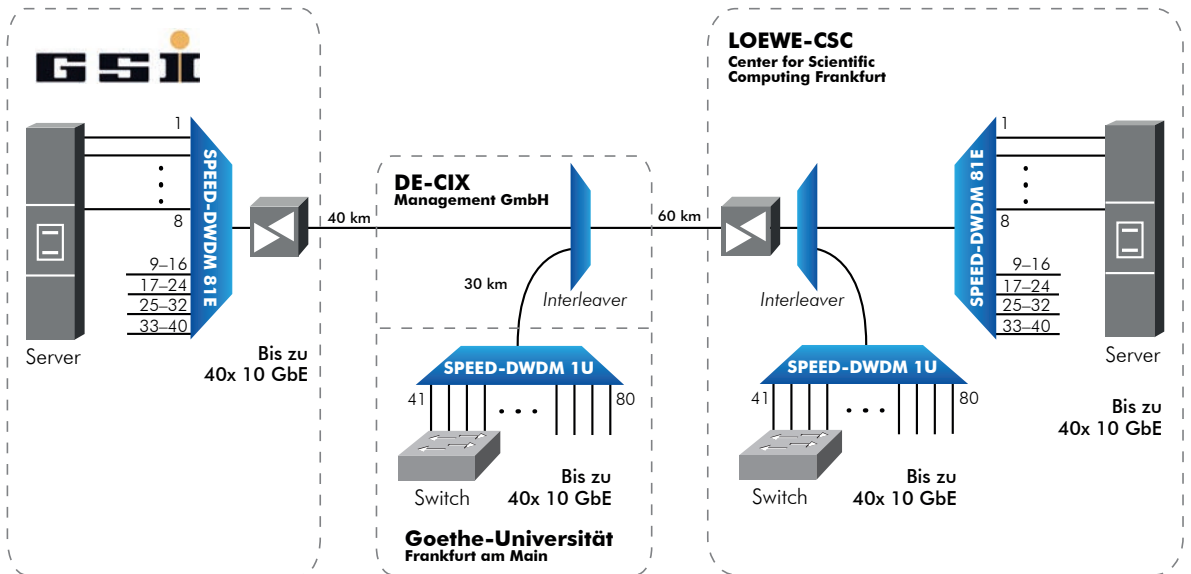
Pan Dacom Direkt References



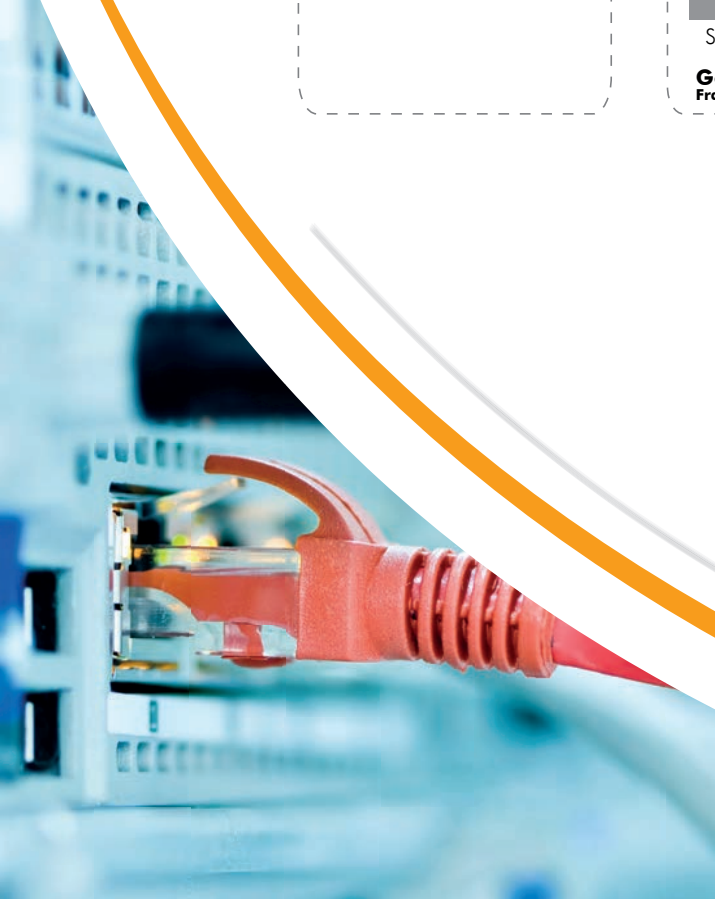
GSI GmbH
Helmholtzzentrum
für Schwerionenforschung



Nationwide Inter Networking of Universities



» "The close collaboration and the excellent realization has been prevailing for the success of the project"



Reference Projects

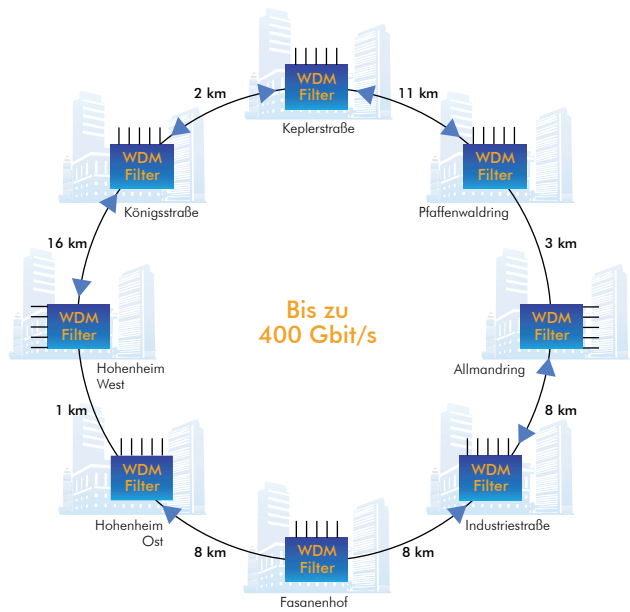


BelWü
Baden-Württemberg
extended LAN



High Bandwidth Inter Networking of Research Centers

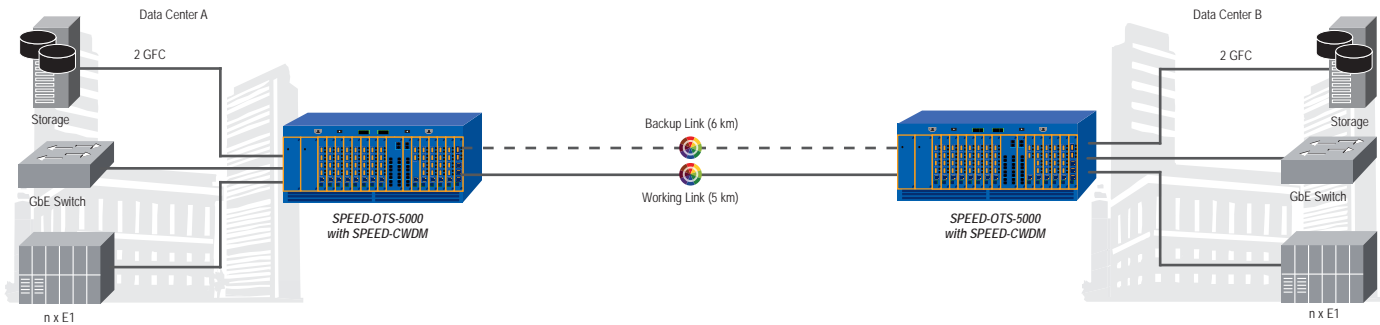
“Due to the unique band filter concept of the Pan Dacom Direkt SPEED-OTS-5000 series a dedicated band allocation per user is possible. This allows a clear separation of responsibility and liability and guarantees an easy to handle network operation. The fast and simple installation of the complete network which has been realized by the Pan Dacom Direkt Service Team in less than 5 days has really been impressive.”



UniCredit Banka of Slovenija d.d., an internationally operating bank with its headquarter in Ljubljana



Redundant Connection of Two Data Centers with Multipurpose Applications (Gigabit Ethernet, 2 Gigabit Fibre Channel and E1) Using an Existing Fiber Optic Link.



“The aim was to use a cost-effective and easy-to-manage solution to connect both data centers by reducing the link costs. We decided to install the Pan Dacom Direkt solution, due to its compact design, easy-to-use platform and low cost structure.”

» SPEED-OTS-5000 «



Pan Dacom Direkt References

DER TELEKOMMUNIKATIONSPARTNER

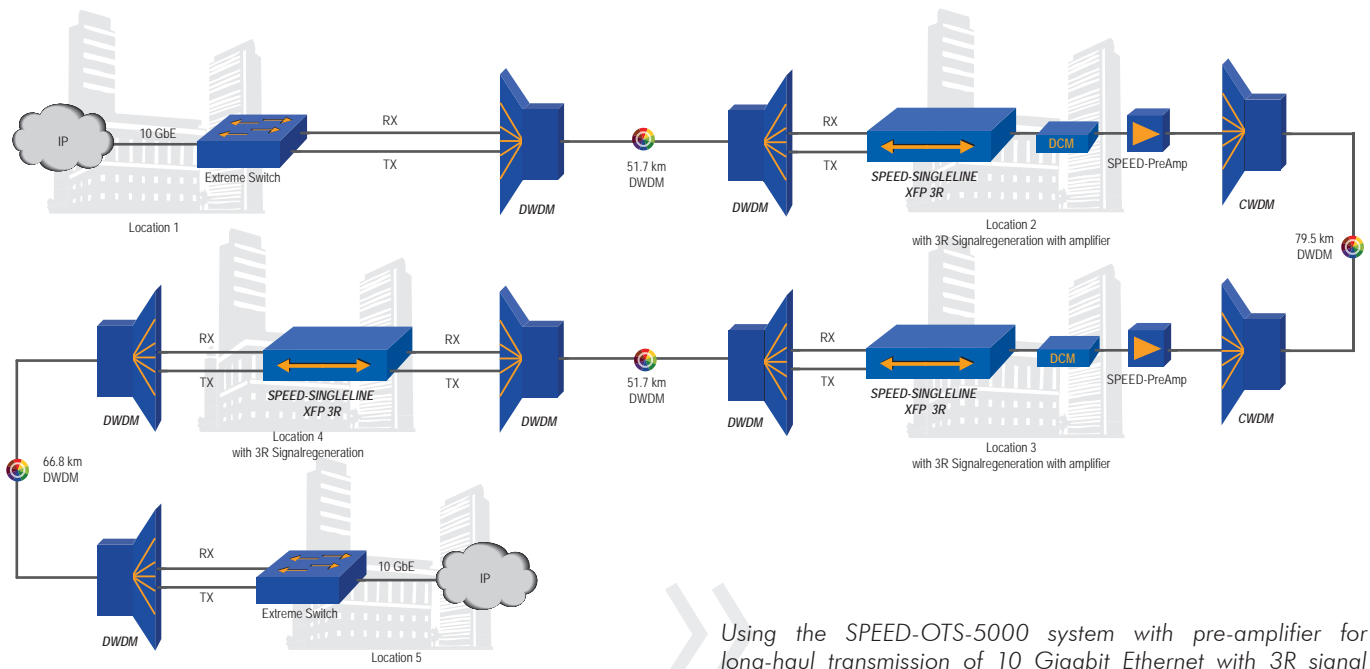


OÖ.FERN GAS

Service GmbH

Ein Unternehmen der OÖ. Ferngas AG

Long-Haul Transmission of 10 Gigabit Ethernet over 250 km with Inline Amplifiers and 3R Signal-Regeneration



Using the SPEED-OTS-5000 system with pre-amplifier for long-haul transmission of 10 Gigabit Ethernet with 3R signal regeneration via a bidi CWDM/DWDM hybrid system.

Reference Projects



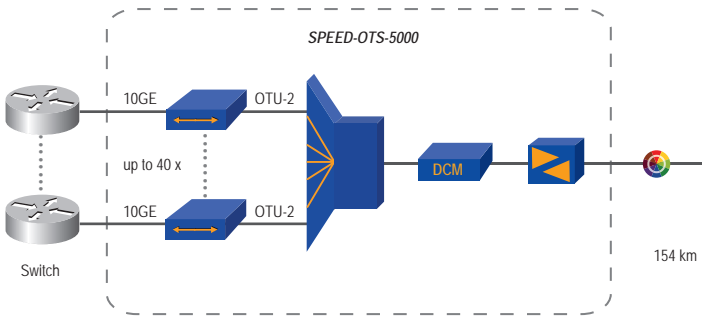
ITandTel
Elektrizitätswerk Wels AG
Business IT-Lösungen



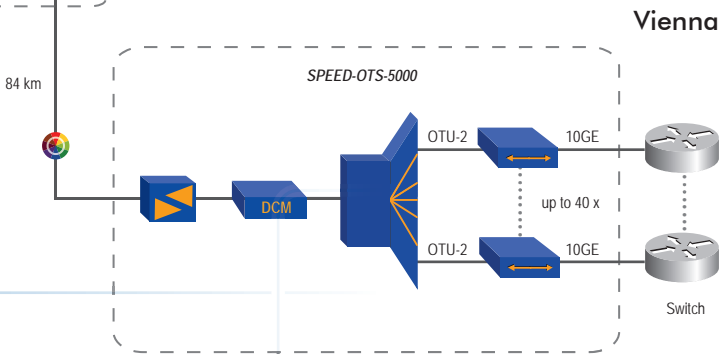
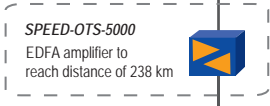
Componet Handels GmbH
IT Distribution & Support 

“Pay as You Grow” WDM Concept from Linz to Vienna – Scalability up to 40 DWDM Channels without Traffic Interruption

Linz



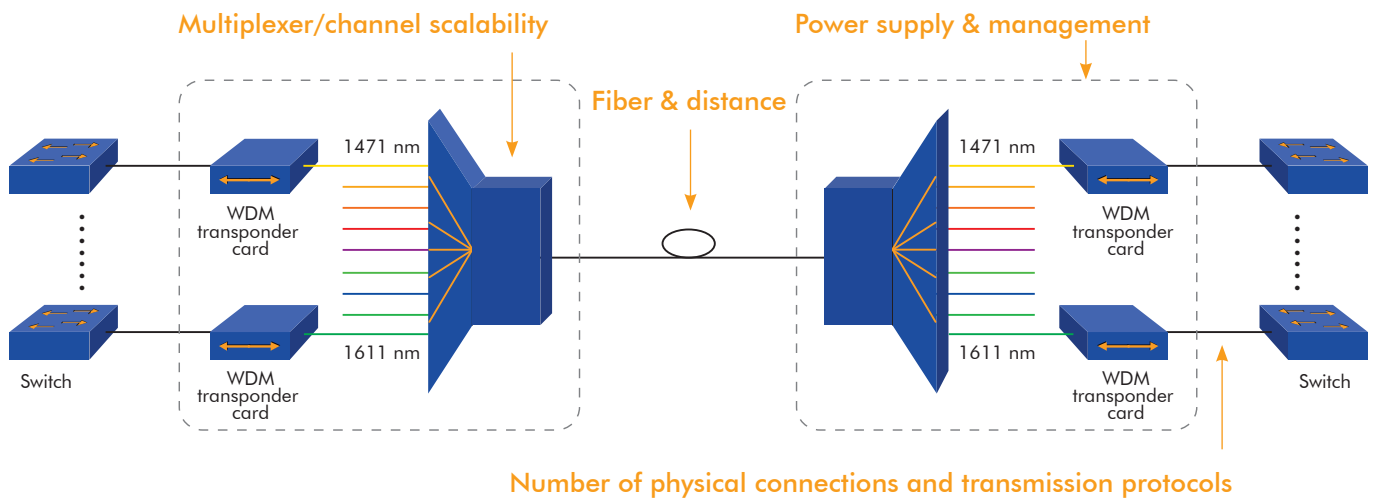
- » High capacity connection over 238 km with only one inline amplifier location
- » FEC (Forward Error Correction) to reach long distances without signal regeneration
- » DCM (Dispersion Compensation Module) to compensate the different delay of optical wavelength spectrums



» “The SPEED-OTS-5000 system convinced us because of its scalable solution with an optimized price-performance ratio and the reliable support by the German manufacturer with direct contacts to R&D and an ultra fast response.”

» SPEED-OTS-5000 «

Typically Required Information for a WDM Project Design



Checklist

- ✓ **Multiplexer/channel scalability**
 - » Number of channels in step 1 (e.g. 8 channels)
 - » Number of channels plan for future (e.g. 40 channels)
- ✓ **Fiber & distance**
 - » Distance (e.g. 15 km)
 - » Type of fibre (e.g. G.655, G.652)
 - » Fiber attenuation (e.g. 25 dB)
 - » Possibility of optical inline amplification and/or signal regeneration
- ✓ **Power supply & management**
 - » PSU side A/B (e.g. 24 V DC, 48 V DC, 230 V AC)
 - » PSU redundancy (if required)
 - » Remote management (yes or no)



✓ Number of physical connections and transmission protocols (start node A, end node B)

Ethernet	Fibre Channel	PDH/SDH	OTN	Infiniband	Video	Audio
» Fast Ethernet	» 1/2/4 GFC	» E1	» OTU-1 (2 Gbps)	» 2,5 Gbps	» SD-SDI	» MADI
» Gigabit Ethernet	» 2/4/8 GFC	» E3	» OTU-2 (10 Gbps)	» 5 Gbps	» ED-SDI	
» 10 Gigabit Ethernet	» 4/8/16 GFC	» STM-1/4/16	» OTU-3 (40 Gbps)	» 10 Gbps	» HD-SDI	
» 40 Gigabit Ethernet	» 8/16/32 GFC	» STM-64	» OTU-4 (100 Gbps)	» 40 Gbps	» Dual-Link HD-SDI	
» 100 Gigabit Ethernet		» STM-256			» 3G-SDI	

✓ Connection to client devices e.g. switches, routers ...

Please indicate 850 nm multi-mode or 1310 nm single-mode or copper connection

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Telefax: +49 (0) 6103/83 4 83 - 444

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Pan Dacom Direkt

Nets get connected.

Pan Dacom Direkt is vendor of transmission technology and access solutions, conveniently located in Dreieich near Frankfurt, easily accessible by car, train or airplane.

Founded in 2002 as spin-off from network pioneer Pan Dacom Networking AG we are successfully designing, delivering and implementing optical transmission technology to our widespread German and international partner base since more than 10 years. A major part of our business is the development and manufacturing of our CWDM and DWDM SPEED-OTS-5000 Series – which is a very flexible and cost effective solution for the implementation of optical networks.

With WDM technology network providers can easily increase the capacity of existing optical links. Furthermore they can save

the quantity of rented fibers by using one fiber for up to 96 applications. The SPEED-OTS-5000 Series is completely transparent and offers an easy way to upgrade networks within a few days. The system enables "Pay-as-you-grow" scalability from low data streams up to terabit transmissions today.

The SPEED-OTS-5000 Series is developed and manufactured in Germany. With our high level of technical expertise and experience we find compelling solutions for our customers which are individually customized based on off-the-shelf products as well as specially developed solutions. Our team of deeply committed and highly motivated experts is looking forward to working together with you!

Your **Pan Dacom Direkt** Team

