

# KBC Forum 2023

## WDM-Netzwerke “weiter” gedacht

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# Smartoptics in short

MAIN OFFICES IN  
NORWAY, SWEDEN AND USA



GLOBAL REACH: OWN SALES AND  
+100 BUSINESS PARTNERS



>100 EMPLOYEES  
IN 7 COUNTRIES

R&D LOCATED IN  
SCANDINAVIA



PARTNERING WITH LEADING  
TECHNOLOGY SOLUTION PROVIDERS



INHOUSE SUPPORT BY OUR  
OWN ENGINEERS



FOUNDED  
IN 2006



28% AVERAGE YEARLY GROWTH  
THE LAST FIVE YEARS



TRADING AT EURONEXT  
GROWTH, OSLO

## Challenger of challengers.....

# Smartoptics – Where we sit...

smartoptics



MANAGEMENT

MULTI VENDOR

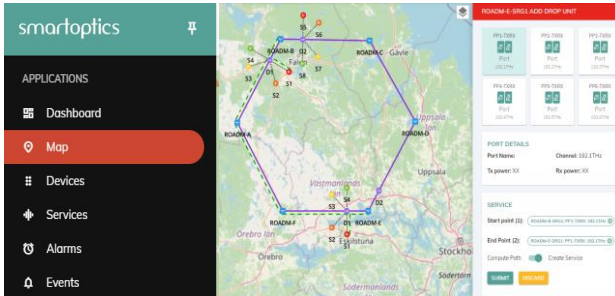
FCAPS

INVENTORY

netFLEX

## SoSmart

Domain control and network planning



CONTROLLER

PLANNING

MANAGEMENT

## DCP-M



DCI

AUTOMATION

16 TBIT/S

METRO



## DCP-F

Versatile line-system toolbox



METRO

FLEXIBILITY

19.2 TBIT/S

EDGE



## DCP-R

Ultimate network flexibility and control



METRO

FLEXIBILITY

16 TBIT/S

REGIONAL

SDN



## DCP-2

L1 Transponders and Muxponders

LOW SPEED

LOW COST 100G

LOW COST 400G

CWDM / DWDM / OADM

Transceivers

DCP-1610

DCP-108

DCP-110

DCP-404

DCP-1203

100M up to 400G



ENCRIPTION

netFLEX is a SW product and registered trademark of LightRiver Technologies INC. Smartoptics products are integrated in netFLEX by Lightriver. Smartoptics and LightRiver may partner in certain projects, but are independent entities.

ORCHESTRATION

OPEN LINE SYSTEMS

L1 TRANSPORT

**Major inventions, that will change “everything” if combined correctly....**



- Open Line systems “reloaded”**
- Pluggable coherent Transceivers “refined”**
- Cost efficient and open ROADMs**

The image features two fiber optic cables. One cable enters from the top left, and the other enters from the bottom right. Their ends are positioned towards the center, where they appear to glow with a bright blue light. The background is a dark blue field filled with out-of-focus, circular bokeh light spots in various shades of blue. The text 'Open Line Systems' is centered in the lower half of the image.

# Open Line Systems

# Open Line System architectures for different use cases

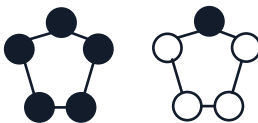


P-t-P / DCI OLS



AUTOMATION

DCI

Metro / Edge OLS



FLEXIBILITY



CONTROL

DCI

METRO

EDGE

Regional / Metro OLS



FLEXIBILITY

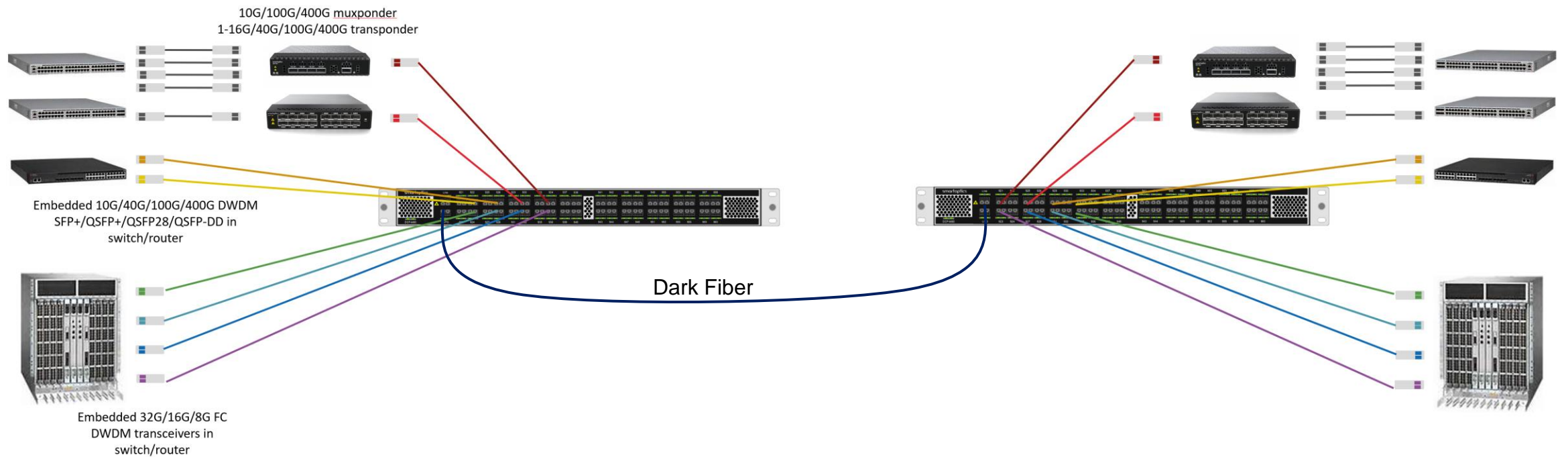
CONTROL

METRO

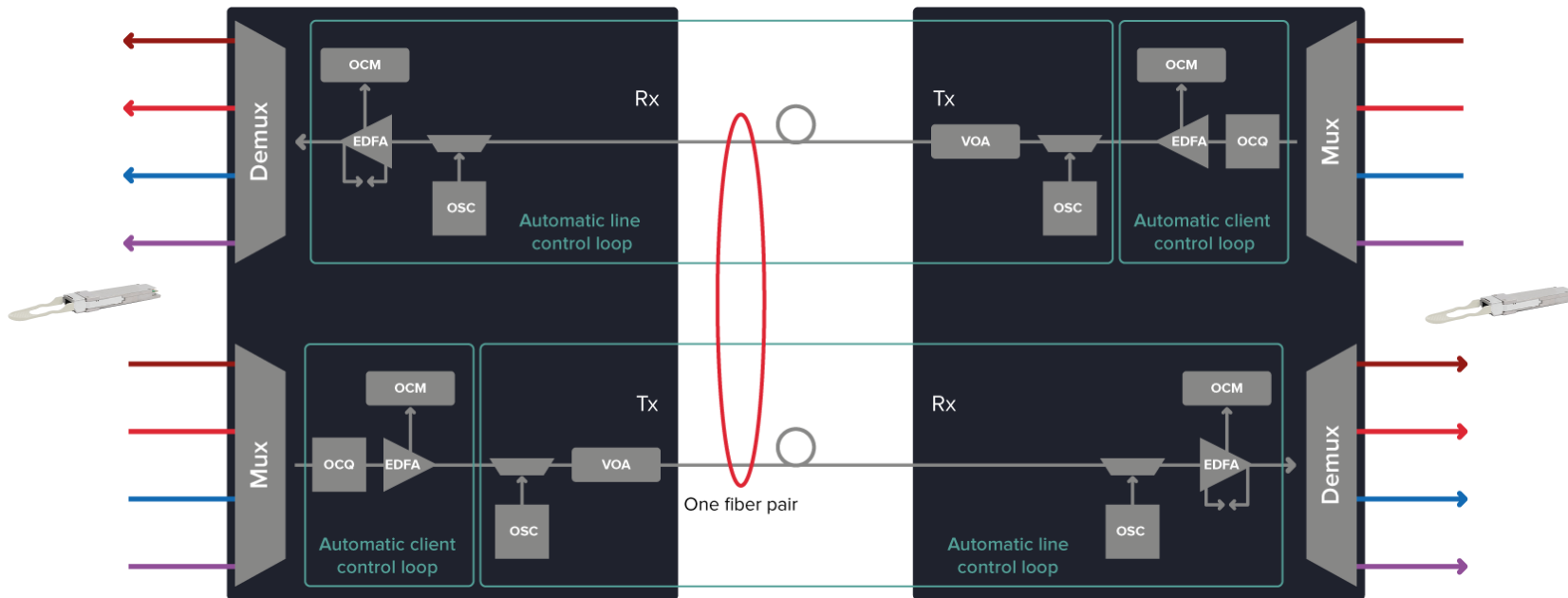
REGIONAL



# Smartoptics Open Line System philosophy



# How it works



OCM : Optical Channel Monitoring  
OCQ : Optical Equalizer  
OSC : Optical Service Channel  
VOA : Variable Optical Attenuator

## Client control loop

- Automatic protocol detection
- Automatic power level measurement
- Automatic power level regulation

## Line control loop


- Automatic measure of fiber length
- Automatic setting of dispersion compensation
- Automatic power level regulation
- **“zero touch” provisioning**



# ROADM based OLS

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The image features two fiber optic cables. One cable enters from the top left, and another enters from the bottom right. Their ends are exposed, showing multiple glass fibers. The top cable's fibers have a faint purple glow, while the bottom cable's fibers have a red glow. The background is dark with a pattern of out-of-focus blue light spots, creating a bokeh effect.

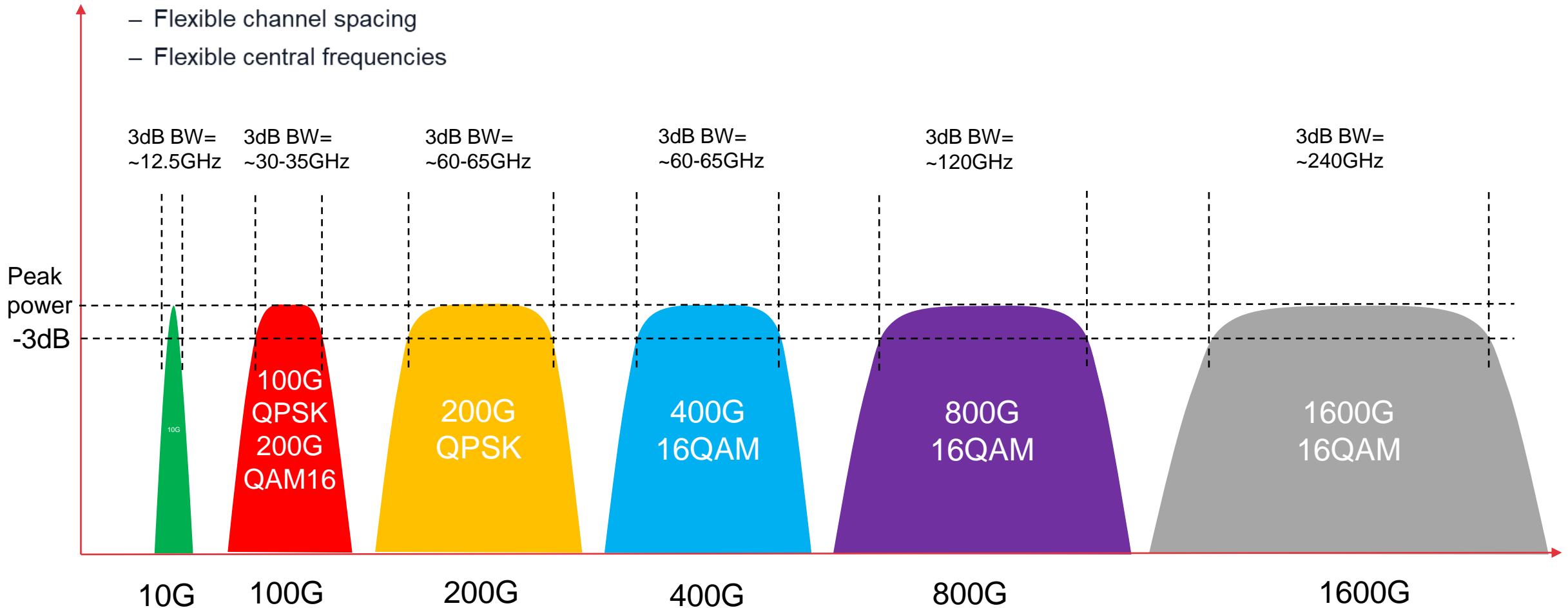
ROADM is a mature  
technology ! Why do  
we believe that this will  
be a market with  
strong growths ?

# Well...

- Metro and Access market segments are opening up. Current deployment mainly in Core and Metro-Core
- Old ROADM deployments need to be upgraded/replaced:
  - Old 50 GHz fixed grid systems does not support new traffic formats
  - **FlexGrid** required to boost performance beyond 400G
- Cost advantages of openness and disaggregation (Open API:s)
- New Generation of ROADM hardware extremely cost efficient
- ROADM Networks are highly automated with “almost no” need for manual operations. They come with excellent planning tools
- Embedded optics will replace transponder based DWDM Systems over time

# Why “FlexGrid” ?

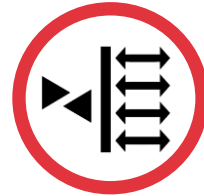
- Flexgrid is needed to allow for
  - Flexible bandwidth
  - Flexible channel spacing
  - Flexible central frequencies



# ROADM based OLS - high level feature requirements

## True Open Line System

No license or hidden fees

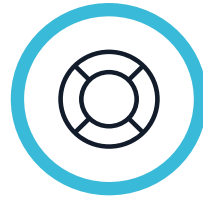


## All Major Formats

Support for all major modulation formats

## OpenROADM

OpenROADM API Compliant

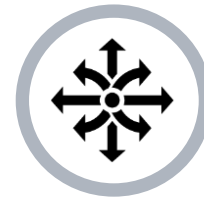


## Flexgrid prepared

Future proof

## High Level of Automation

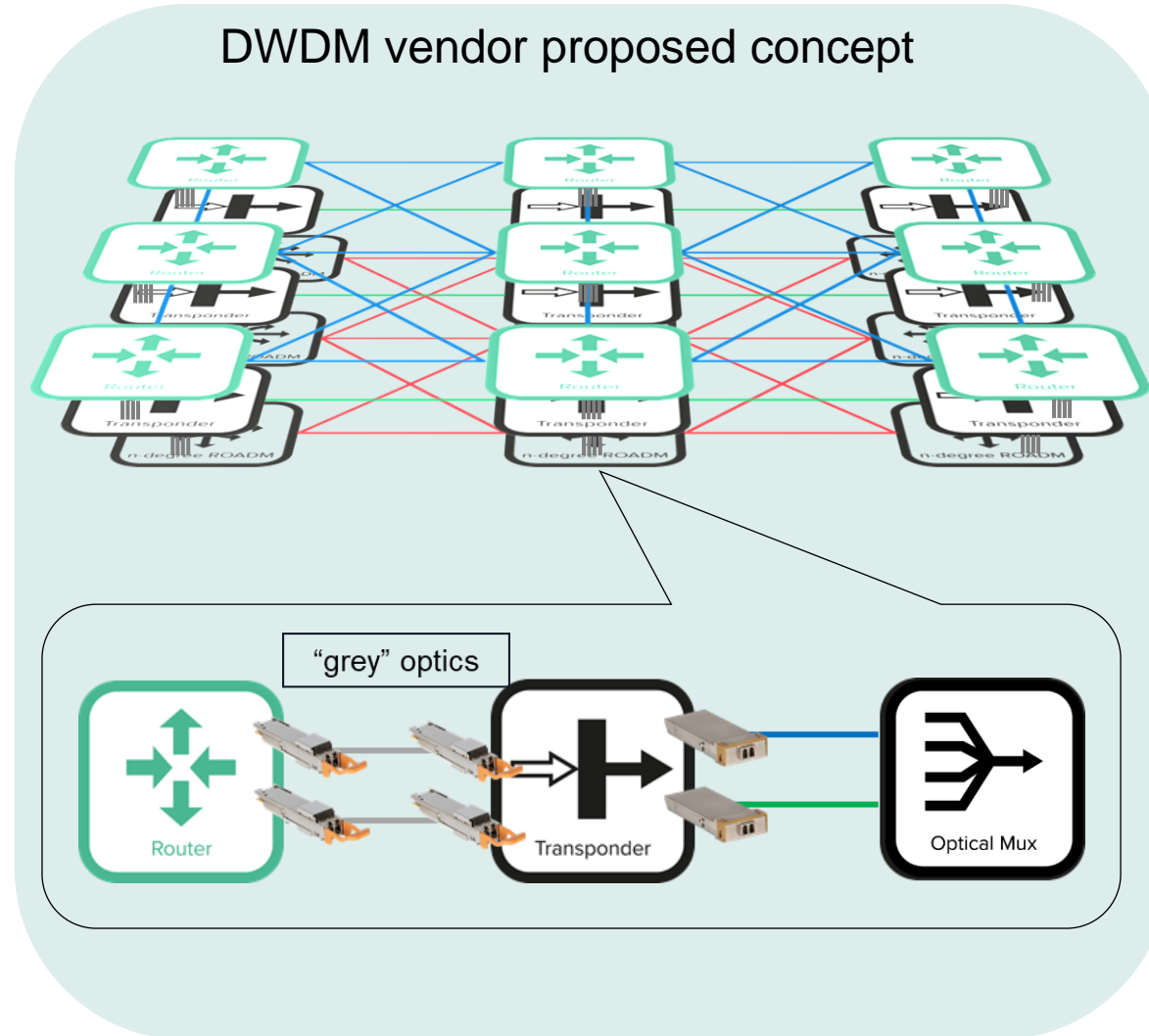
Automatic fibre distance measurement  
Automatic modulation format detection



## Any Network Topology

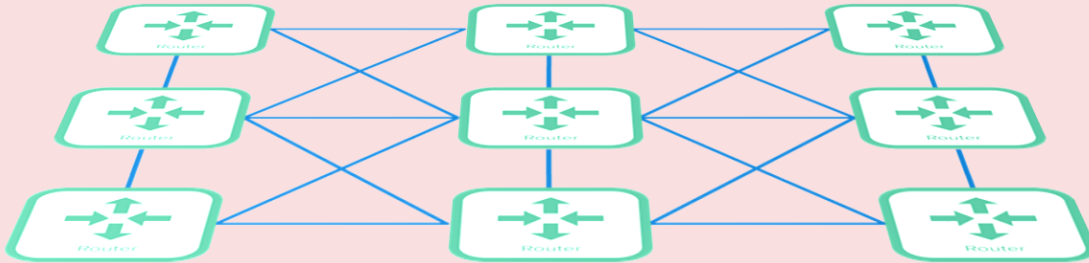
Optimized for chain, ring and meshed applications

# Conventional Building Concept ( dead end ? )

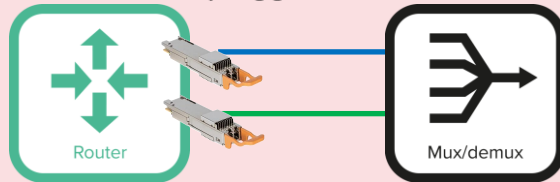


# Modern network concept using IP over DWDM

IP over DWDM concept  
(passive) DWDM layer: P2P

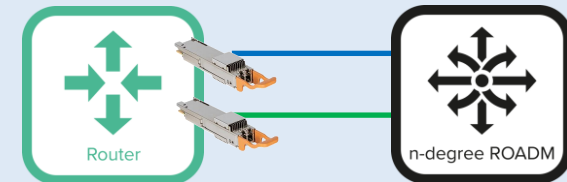
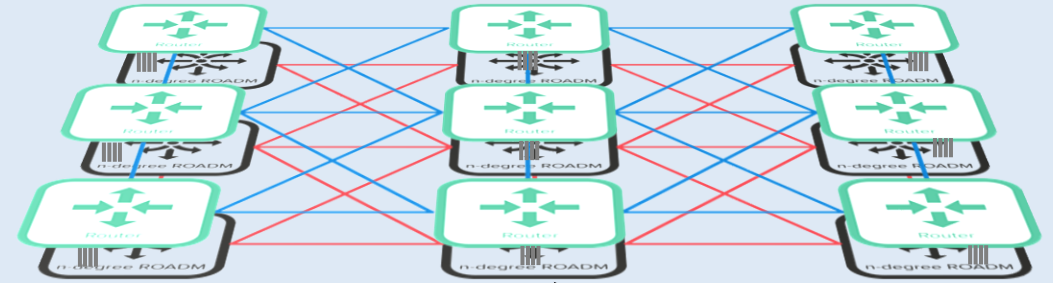


Coherent pluggables



Traffic engineering on Layer 3

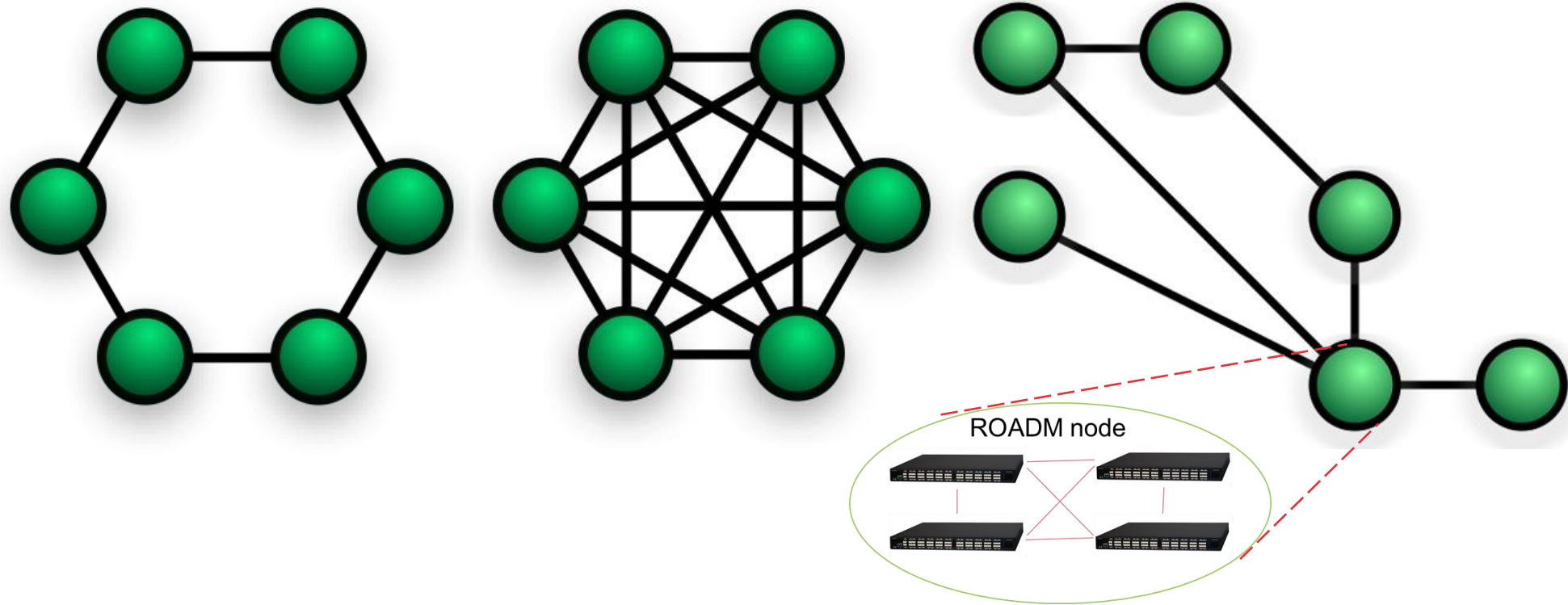
IP over DWDM concept  
with ROADM



Wavelength routing + Layer 3 traffic engineering



# Network applications



With ROADM technology it is possible to build almost any type of network topology

# Coherent Pluggable Optics

# Innovations around Coherent Pluggable Optics

- **High Tx power 400G QSFP-DD**
- In accordance with OpenZR+ but with 0 dBm output power
- Supported is already existing ROADM based networks
- Support for 200G 16QAM to work in 50GHz networks



- OTN and Encryption support in **400G QSFP-DD**
- OpenROADM compliant
- Layer-1 encryption
- In-band management via GCC



- Improved Optical Performance
- Probabilistic shaping
- Sub-carrier technology
- Additional modulation formats
- Additional line rates
- **100G QSFP28 coherent DWDM “soon”**
- 800G pluggable coherent DWDM modules mid next year
- 1,6T during 2025

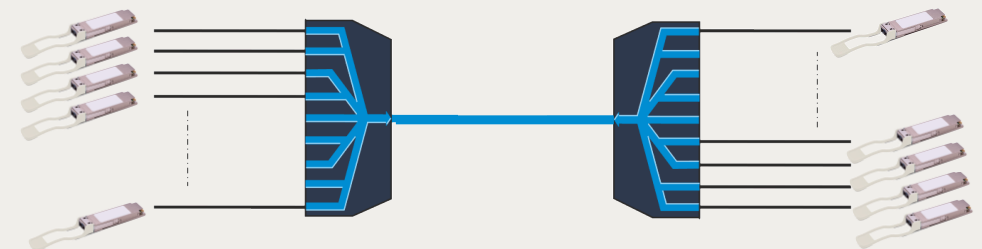


# 100G Coherent QSFP28



QSFP28 Transceiver

- Power budget: 22dB (Tx= -8dBm, ( 0dBm later) Rx= -30dBm)
- Host interface: CAUI-4 or OTL4.4
- 100Gbps DP-DQPSK (25Gbaud)
- Full C-band tuneable
- Up to 80km unamplified, 120km amplified
- Optional extended reach up to 300km amplified
- SC-FEC or RS(255,239)
- Power dissipation <5.0W (C-temp) <5.5W (I-temp)



# High Tx power 400G QSFP-DD



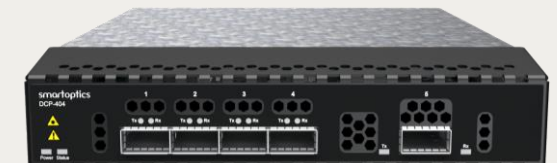
QSFP-DD Transceiver



In accordance with OpenZR+ but with higher output power to support already existing ROADM based networks.

- C-band tunable
- Supports OpenZR+ application modes
- 0dBm Tx output power (vs. -10dBm for regular ZR+)
- 20dB optical power budget @400G
- 400G/16QAM, 300G/8QAM, 200G/QPSK-8QAM/16QAM, 100G/QPSK
- Supported by Smartoptics DCP-404 Muxponder

Target release: Q2 2023



DCP-404



# 400G QSFP-DD with Encryption



QSFP-DD Transceiver

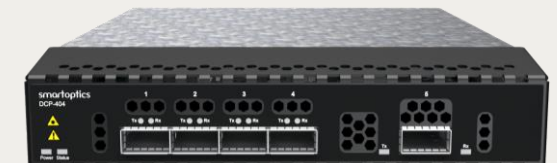


In accordance with OpenZR+ and OpenROADM

- C-band tunable
- Supports OpenZR+ and OpenROADM application modes
- 0dBm Tx output power
- 20dB optical power budget @400G
- 400G/16QAM, 300G/8QAM, 200G/QPSK-8QAM/16QAM, 100G/QPSK
- *AES256 encryption for all line rates in OpenROADM modes*
- Supported by Smartoptics DCP-404 Muxponder

Target release: Q4 2023

SmartConnect



DCP-404





The background of the slide is a dark blue field filled with a complex, glowing network of white and light blue lines and dots. These lines and dots form a web-like structure that resembles a fiber optic network or a data connection map. The lines vary in thickness and brightness, creating a sense of depth and connectivity. The dots, which act as nodes, are also of varying sizes and brightness, some appearing as small white specks and others as larger, more prominent blue or white spheres. The overall effect is a high-tech, futuristic aesthetic that suggests themes of communication, data, and technology.

# Optical Transceivers

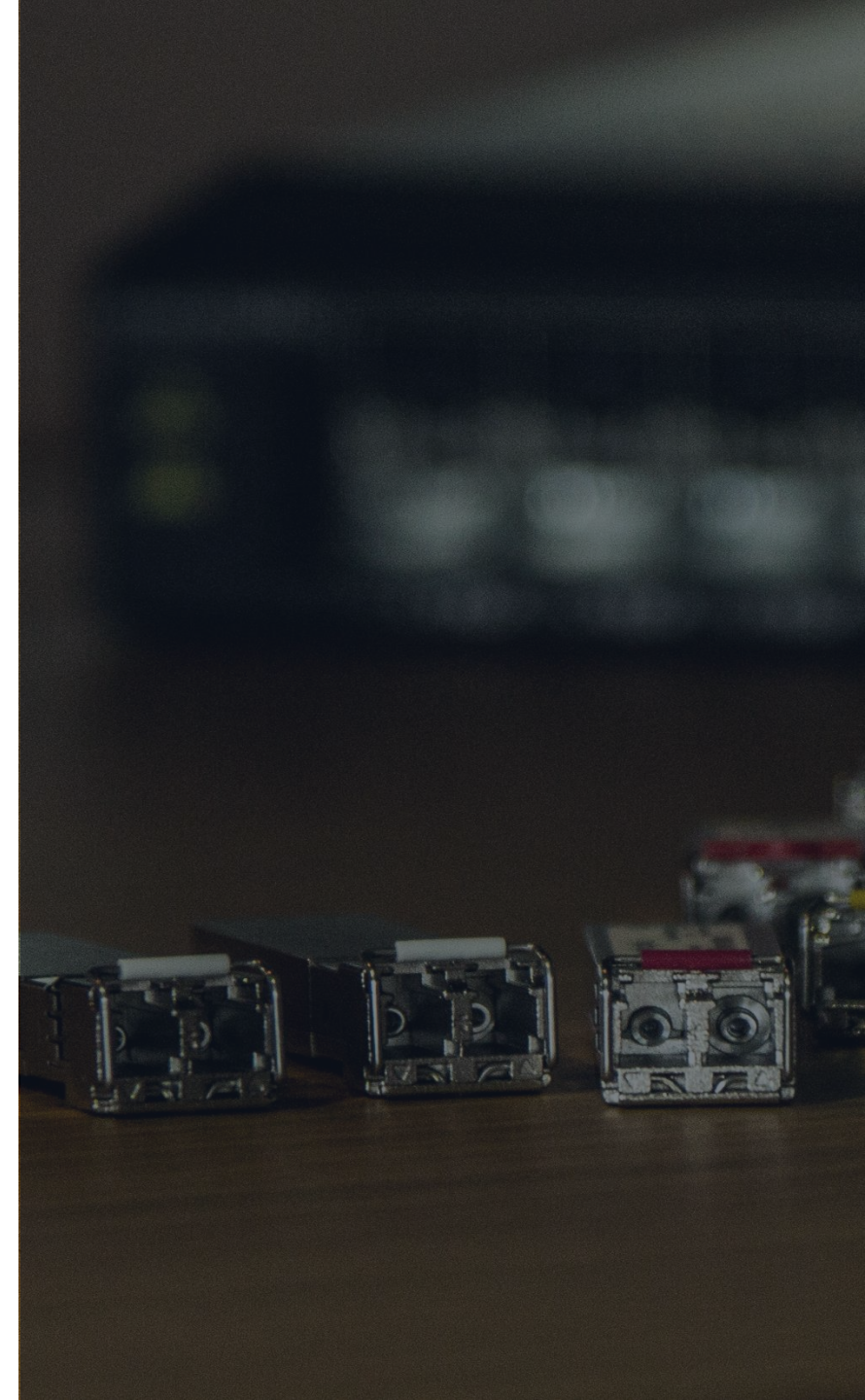
The past, the present.....



# Optical Transceivers

10G	40G	100G	400G
<b>XFP</b> <ul style="list-style-type: none"><li>• Grey, SR, LR, ER, ZR</li><li>• CWDM, DWDM</li><li>• Tunable</li></ul> 	<b>QSFP</b> <ul style="list-style-type: none"><li>• SR4, LR4</li><li>• PAM4 DWDM</li></ul> 	<b>CFP, CFP2, CFP4</b> <ul style="list-style-type: none"><li>• SR4, LR4, ER4</li><li>• ER4-DWDM</li><li>• Coherent DWDM</li></ul> 	<b>OSFP</b> <ul style="list-style-type: none"><li>• Coherent DWDM 400G ZR and ZR+</li></ul>
<b>SFP</b> <ul style="list-style-type: none"><li>• Grey, SR, LR, ER, ZR</li><li>• CWDM, DWDM</li><li>• Tunable</li></ul> 	<b>CFP</b> <ul style="list-style-type: none"><li>• 40G Base</li><li>• SR4, LR4, LR4-40</li></ul>	<b>QSFP28</b> <ul style="list-style-type: none"><li>• SR4, LR4, ER4</li><li>• PSM4, CWDM4</li><li>• PAM4 DWDM</li></ul>	<b>QSFPDD</b> <ul style="list-style-type: none"><li>• Coherent DWDM 400G ZR and ZR+</li></ul>

- All form factors
- Speeds from 1G to 400G
- Grey wavelengths
- CWDM and DWDM Fixed and Tunable



The background of the slide is a dark blue field filled with a complex, glowing network of light blue lines and dots. These lines and dots form a web-like structure that resembles a fiber optic network or a data connection map. The lines vary in brightness and thickness, creating a sense of depth and connectivity. The dots, which represent nodes in the network, are also glowing and are distributed throughout the frame, with a higher concentration in the upper left area.

# Optical Transceivers

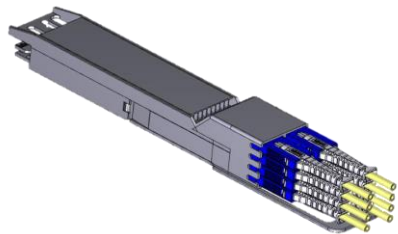
The future and beyond....

# 800G : Battle of the form-factors

## OSFP (Octal Small Form-Factor Pluggable)

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- Enables speed up to 800G
  - 8x100G electrical lanes
- Compared to QSFP-DD800
  - Physically larger form-factor
  - Improved heat sink, better thermal cooling properties
  - A “brand new” form-factor
    - No backwards compatibility with current form-factors (w/o converter)



## QSFP-DD800 (Quad Small Form-Factor Pluggable – Double Density-800G)

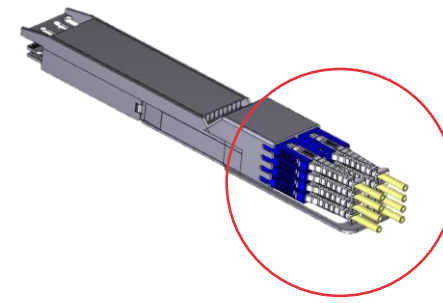
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- Enables speed up to 800G
  - 8x100G electrical lanes
- Compared to OSFP
  - Physically smaller form-factor, increased port density
  - Less surface area than OSFP, gets warmer
  - Provides interface provides backwards compatibility with the QSFP form factor

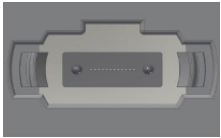




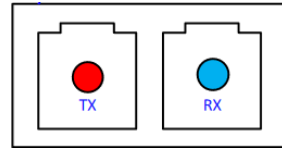
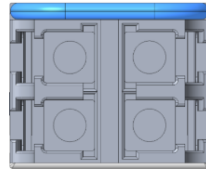
# 800G : Battle of connectors



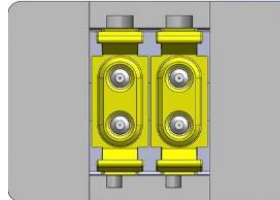
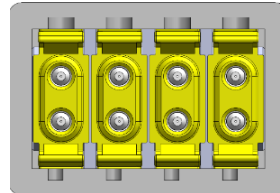
MPO-x



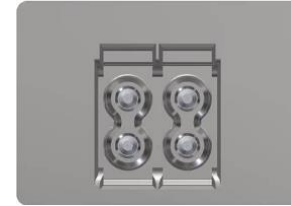
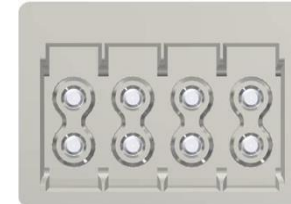
Dual LC



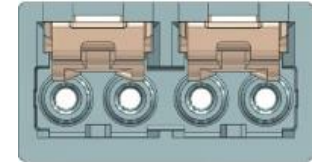
SN connectors



MDC connectors



CS connectors



Why so many? Depends...



...und natürlich gibt es das auch billiger, aber ;-)

27

