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40G & 100G Overview

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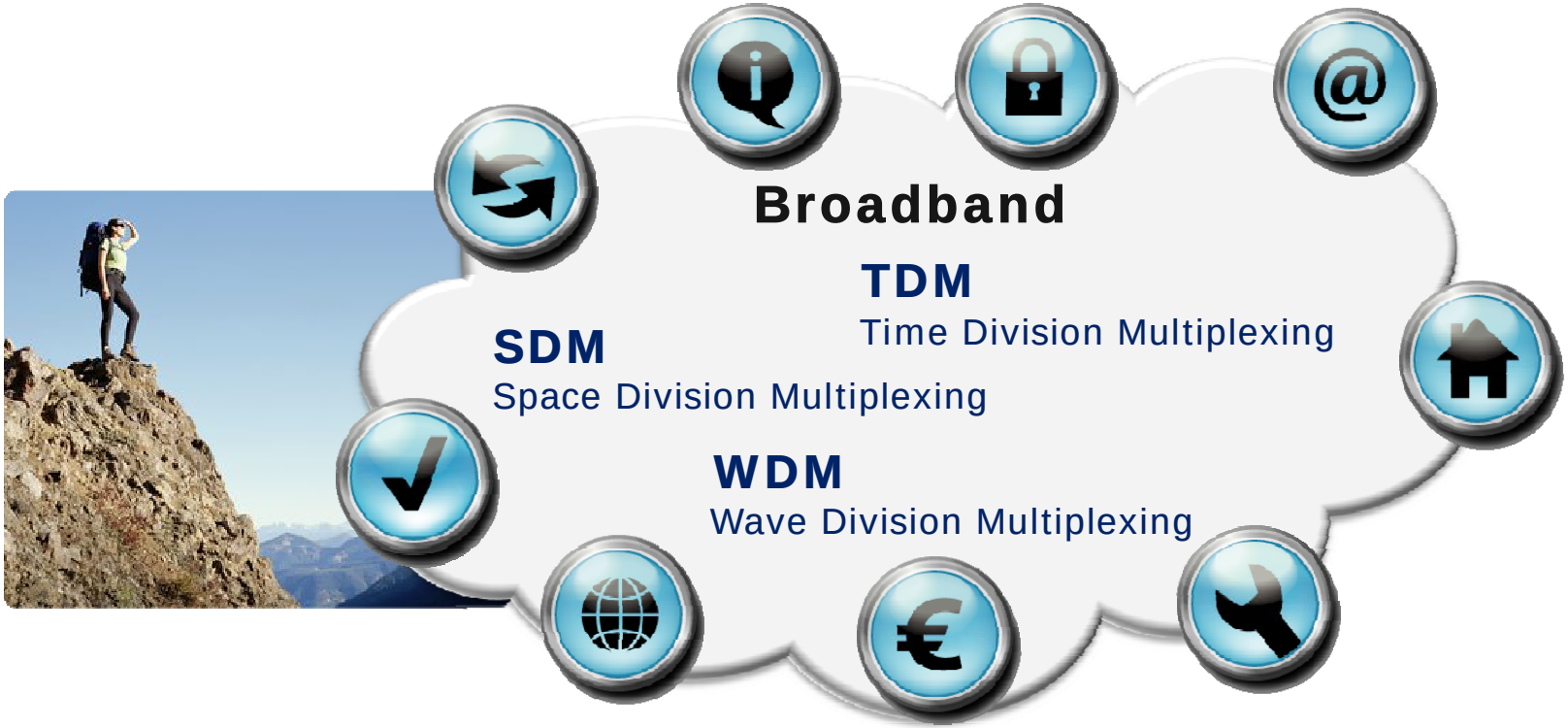
More Bandwidth with a Twist of QoS



The major drivers for 10G and now 40G deployments were the need to:

- ❑ Connect Core routers
- ❑ High capacity demanding users communities like radio astronomers and high-energy physicist
- ❑ Better economics versus yesterdays high end transmission capacity
- ❑ Network capacity exhaust

These have been the dominant cited factors most often given when moving towards high transmission speeds.

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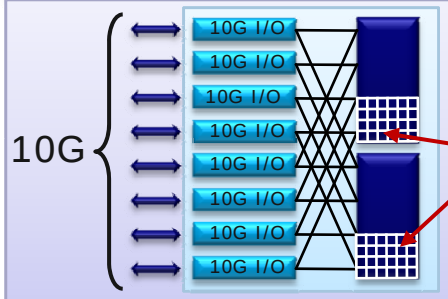
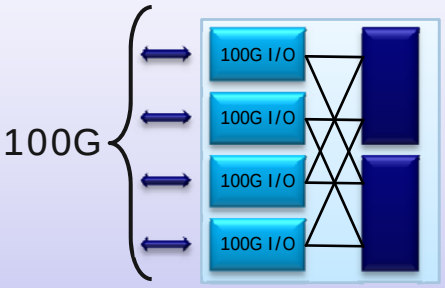
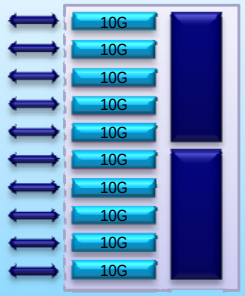
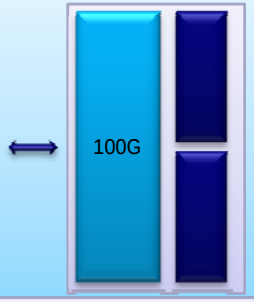
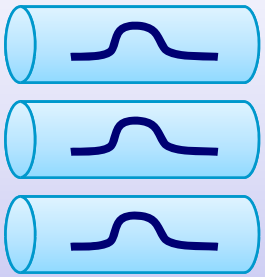
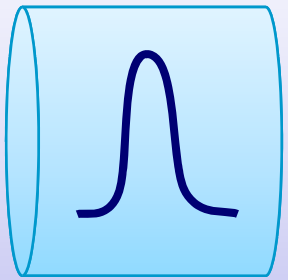
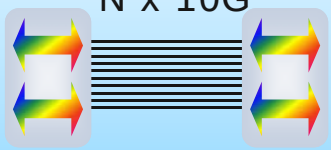
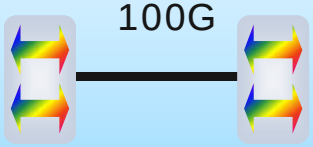
Benefits of 100G Networking

10G interfaces	100G interfaces
 On high-end core routers - Fabric capacity is poorly utilized with lower speed I/O.	 Better utilization of fabric bandwidth due to improved access into the fabric.
 On high-end core routers: 10 x 10G interfaces subscribe 100G of bandwidth.	 The price of 100G interface on router will be much lower than 10 x 10G for the same capacity.
 Small capacity wavelengths limit bandwidth bursts or increases the need for Link Aggregation Groups.	 A high capacity wavelength is better able to accommodate peak bandwidth limiting the need for Link Aggregation Groups.
 Large wavelength count consumes the DWDM grid resulting in a higher network complexity and cost.	 Efficient use of DWDM grid. No parallel wavelengths means lower OAM cost and fewer managed entities.

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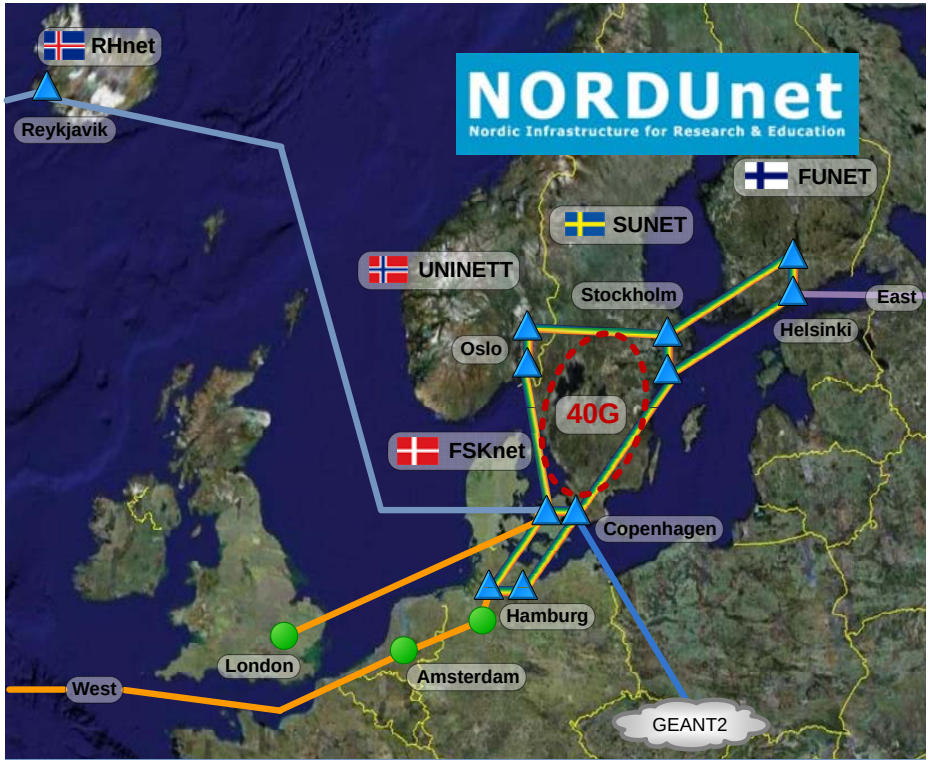
40G Status Q1 2009

40G is commercially available and has a service window until 2011.

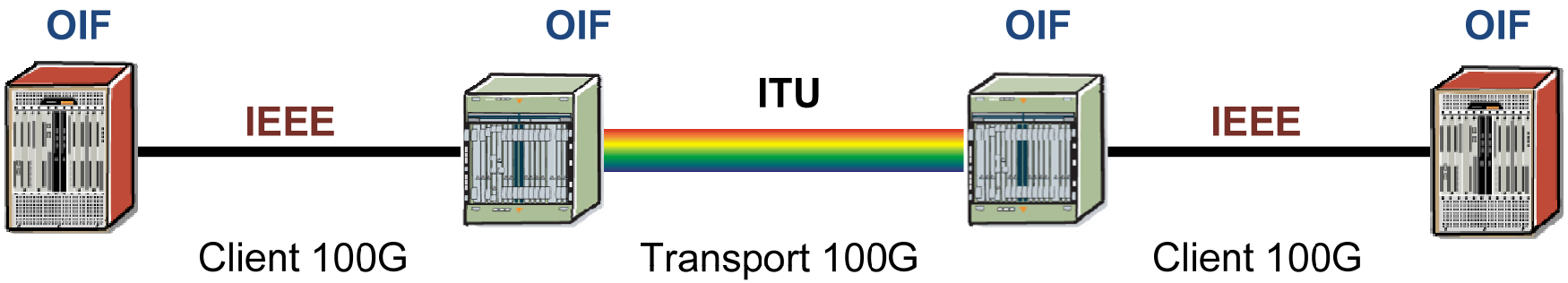
40G is widely deployed



- 40G Client i/o standardized
- 40G Transport i/o autonomous
- Small cost reduction bit/bit compared to 10G

100G Main Standardisation Org.

Component and equipment suppliers, network operators and standards bodies like IEEE, the International Telecommunications Union (ITU) and Optical Internetworking Forum (OIF) have joined forces to create a healthy 100G ecosystem.



ITU

IEEE

OIF OPTICAL INTERNETWORKING FORUM

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40G and 100G Client Interface

IEEE P802.3.ba draft standard covering the following areas:

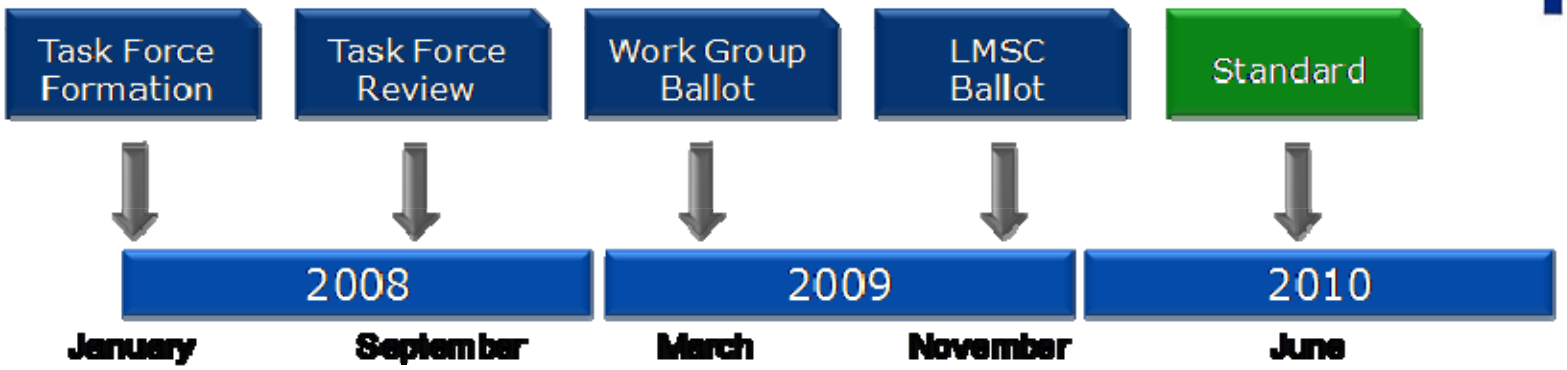
- Support full-duplex operation only
- Preserve the 802.3 Ethernet frame format utilizing the 802.3 MAC
- Preserve max. and min. frame size of current 802.3 standard
- Support a BER better than or equal to 10^{-12} at the MAC/Physical Layer
- Provide appropriate support for Optical Transport Network
- Support MAC data rates of 40G and 100G

Distance/Medium	40 GbE	100 GbE
1 m Backplane	40GBASE-KR4	
10 m Copper	40GBASE-CR4	100GBASE-CR10
100 m MMF	40GBASE-SR4	100GBASE-SR10
10 km SMF	40GBASE-LR4	100GBASE-LR10
40 km SMF		100GBASE-ER10

Physical Layer specifications

IEEE

LAN/MAN Standards Committee (LMSC)



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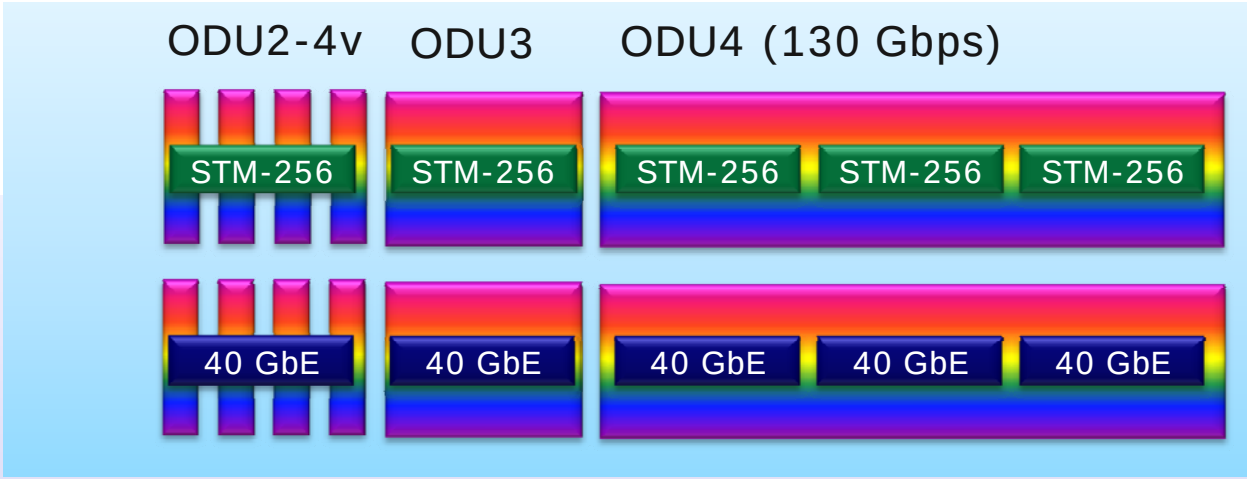
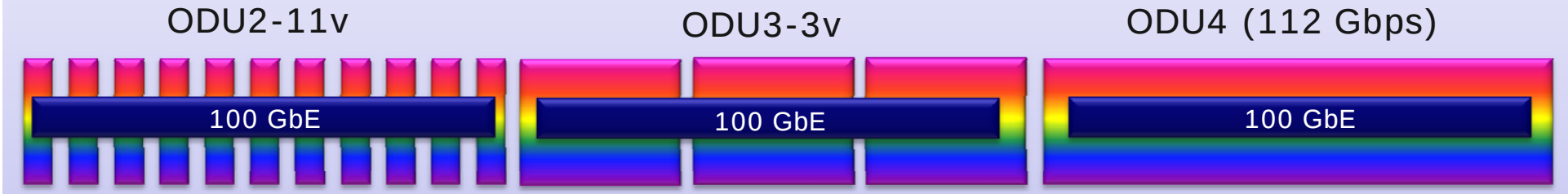
100G Transport Interface

G.709 OTN
OTU-4

OTU-4 is rate optimized for transporting 100 GbE - approximately 112 Gbps





Expected performances for the 100G Transport

- Transparent reach greater than 1.000 km
- Channel spacing equal 50 GHz
- Channel count equal to the extended C-band
- Compatible with existing installed DWDM base
  - Smooth integration into 50 GHz systems
- Compatible with existing 10G & 40G channels

Standard awaits IEEE P802.3ba standard – OUT-4 expected finalized summer 2010

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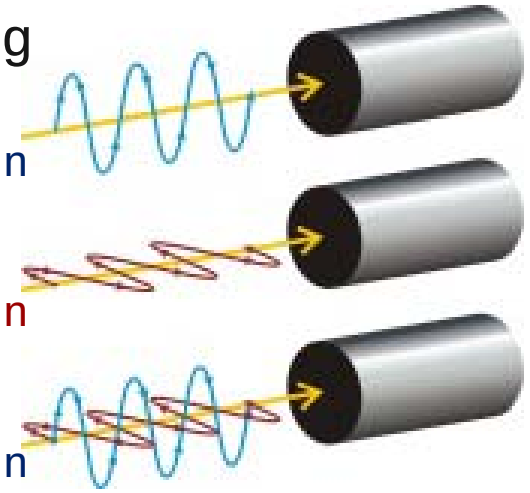
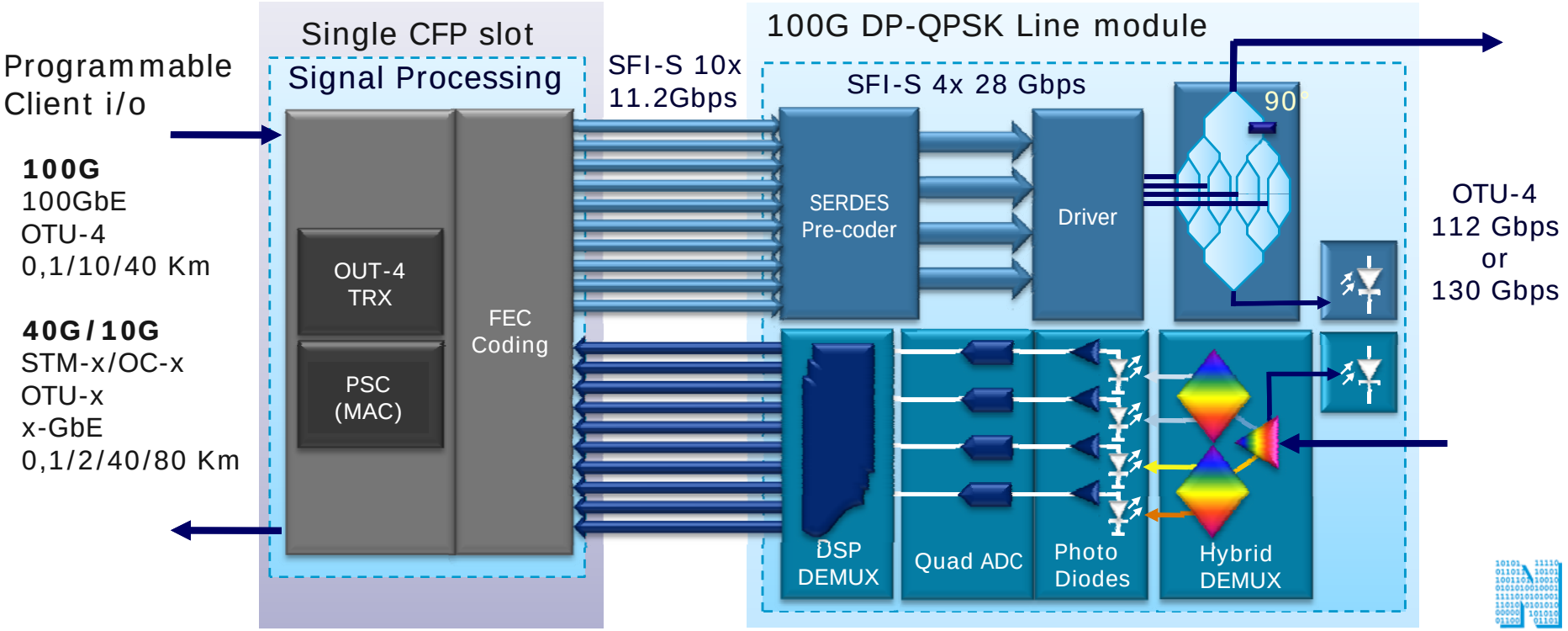
100G Optical Interworking

Dual-Polarization - Quadrature Phase Shift Keying

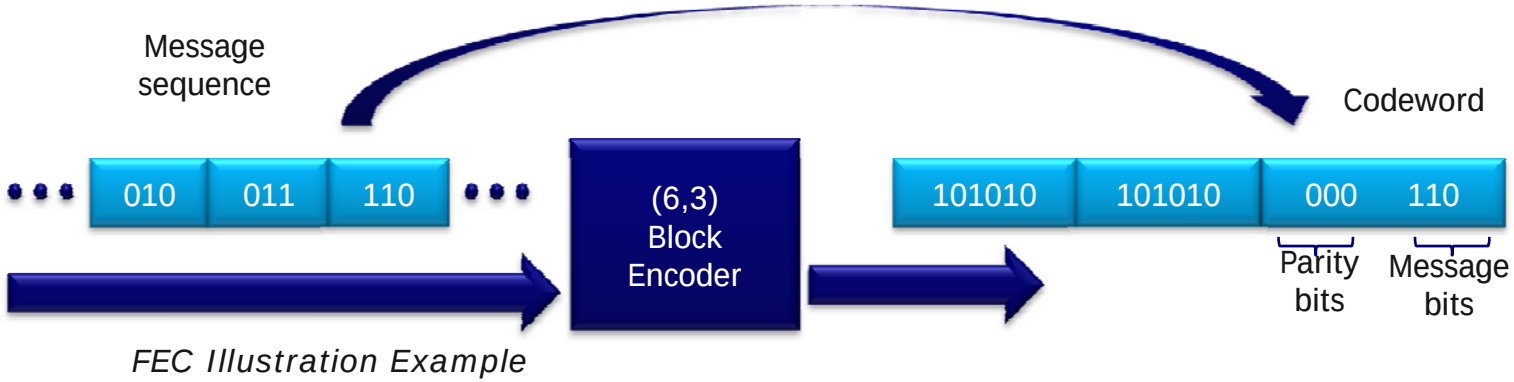
Consensus within the Industry - identified DP-QPSK modulation with a coherent receiver as the chosen 100G modulation technique for integrated photonic components.





100G Optical Interworking Cont.

Forward Error Correction for 100G DP-QPSK



FEC Illustration Example

The OIF members have defined a common basis for a FEC schema.

OIF has defined that full DWDM inter-operability is outside their current work scope.

OIF OPTICAL INTERNETWORKING FORUM

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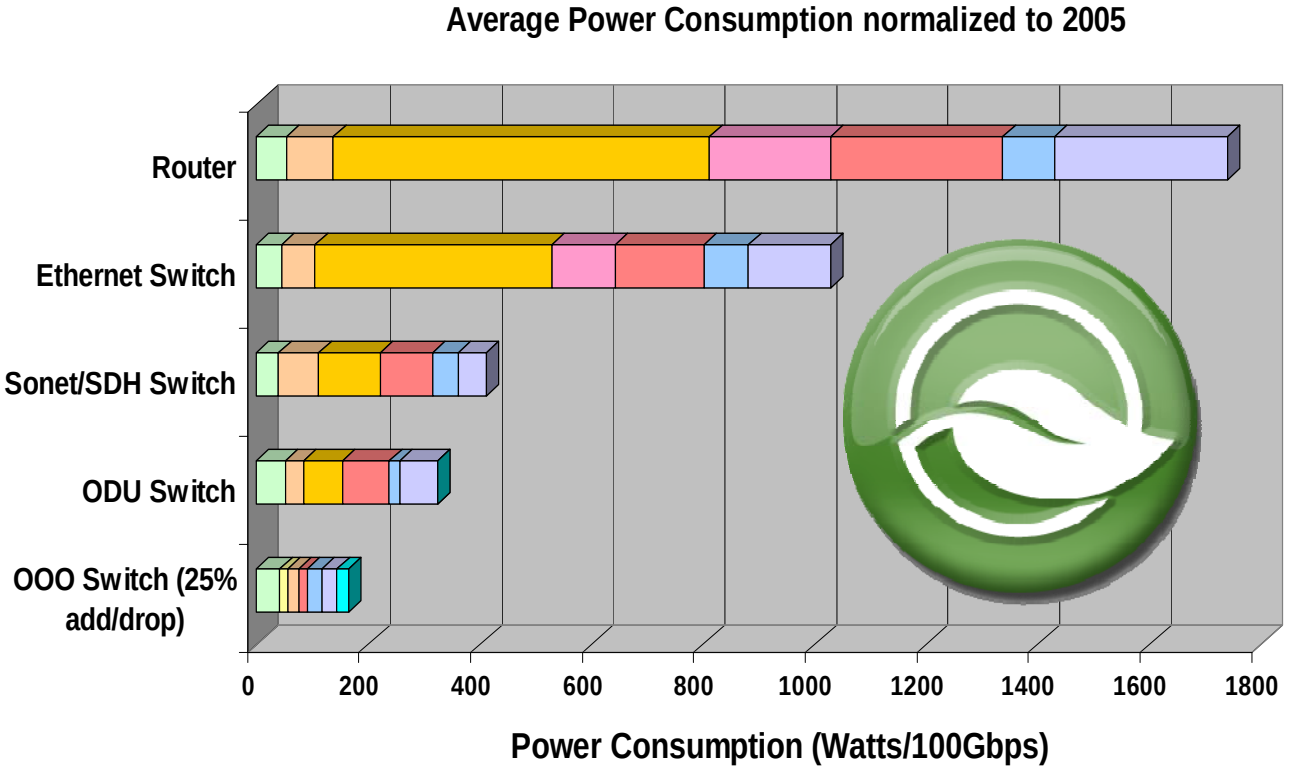
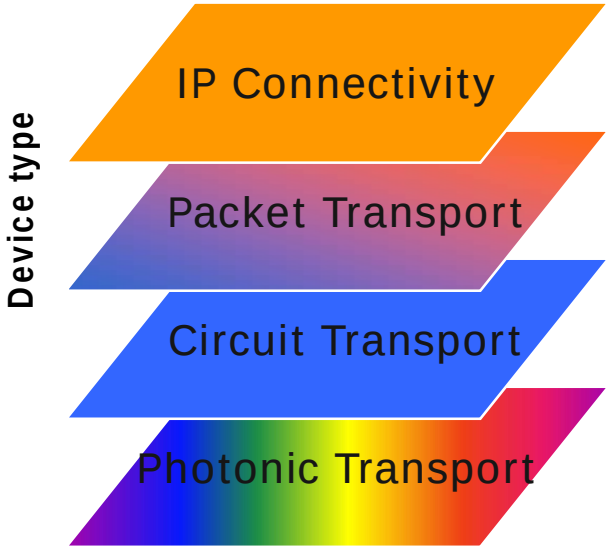
Carbon Dioxide Footprint Reduction





Source: Alcatel·Lucent

2009 figures are roughly 1KW/100Gbps for Routers & 500W/100Gbps for Switches

Power efficiency is a strong motivator to push functionality to lower layers due to direct power costs and indirect MTBF.

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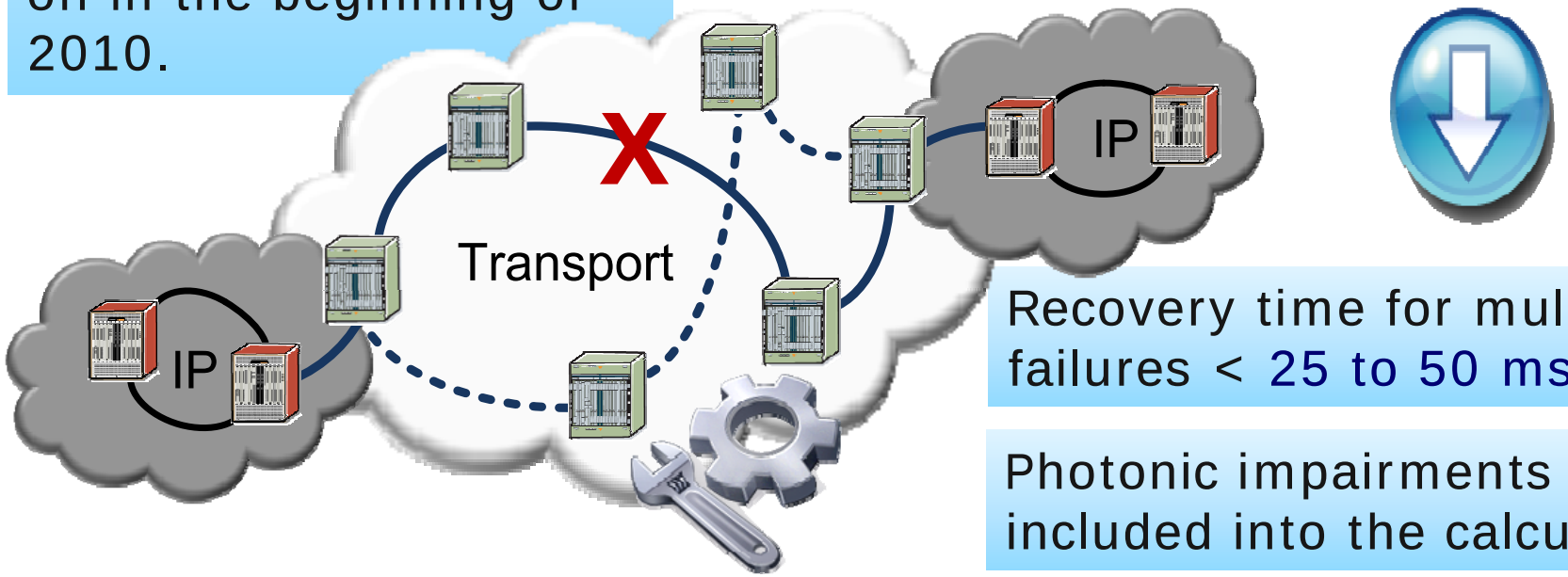
Re-emerged Protection Schema

GMPLS has become one of the key Control Plan Management Protocols which have found its way to the photonic area and is expected to take off in the beginning of 2010.

This will lead to emerging photonic functionality like:

- Network and Resource Discovery
- Dynamic Provisioning
- Distributed Automatic Restoration



Recovery time for multiple failures < 25 to 50 msec.

Photonic impairments are included into the calculation

Protection for external IP failures can consequently be moved down to the less costly photonic layer.

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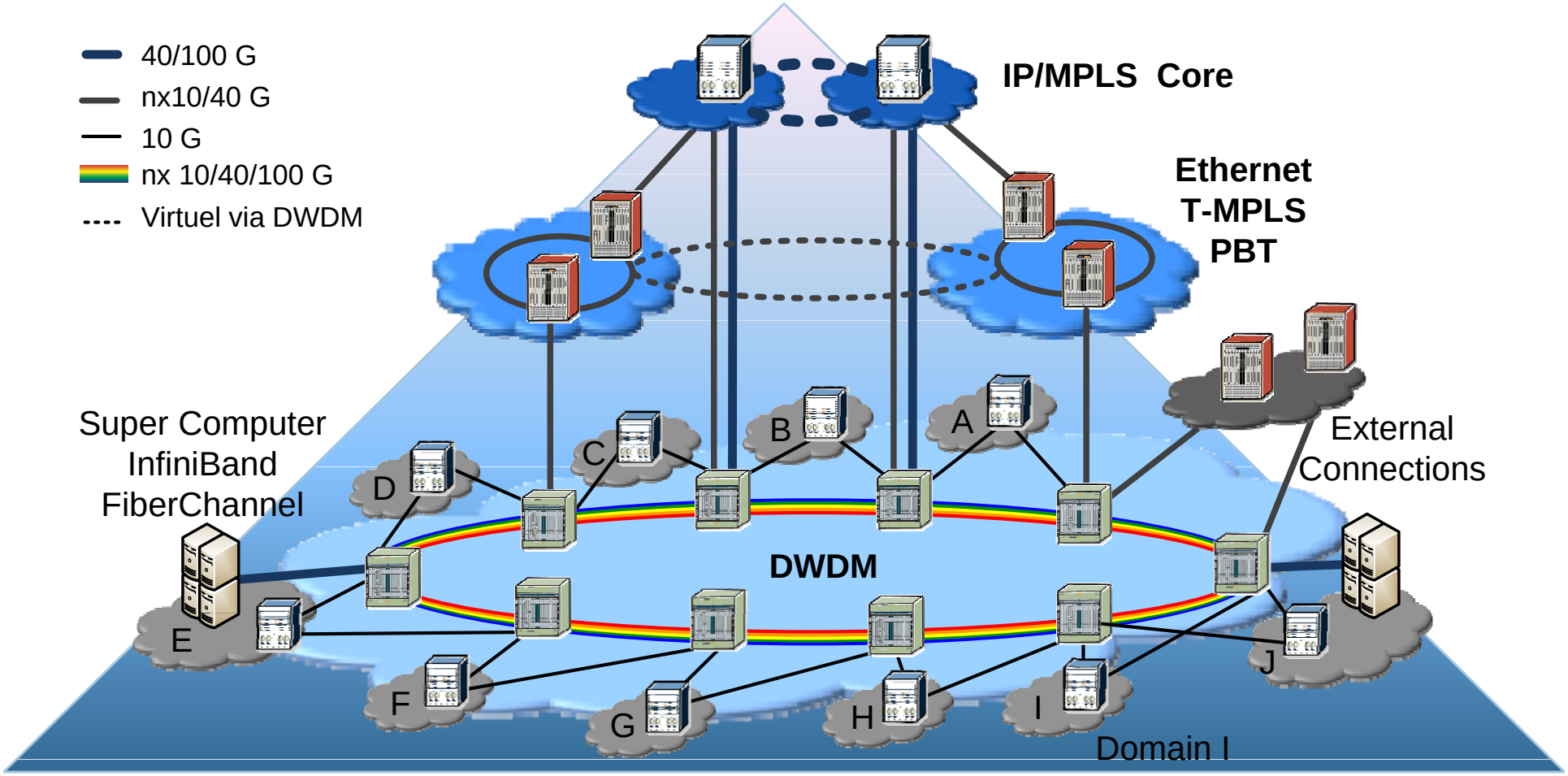
100G Fitting into NGN Architecture

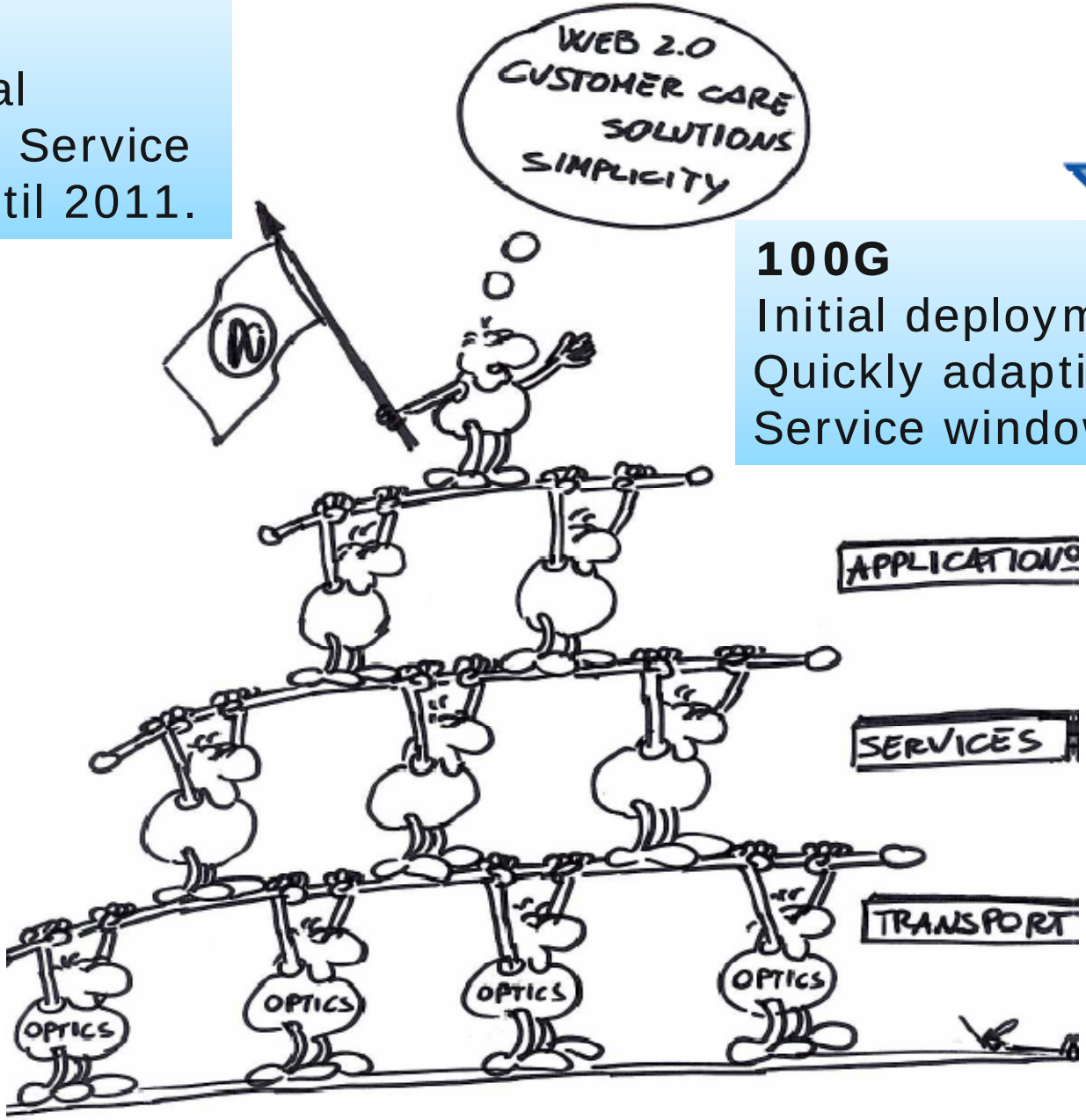


Sustainable environmental impact due to less power intensive electronic devices.

Switch where you can, route where you must.

Summery

40G
Commercial available – Service window until 2011.



100G
Initial deployment 2010.
Quickly adaption – Service window until 2016

Thank you

Questions...

Presentation an report can be found at: wiki.nordu.net

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Report – Directory “Document Repository”