
Basic DWDM Components

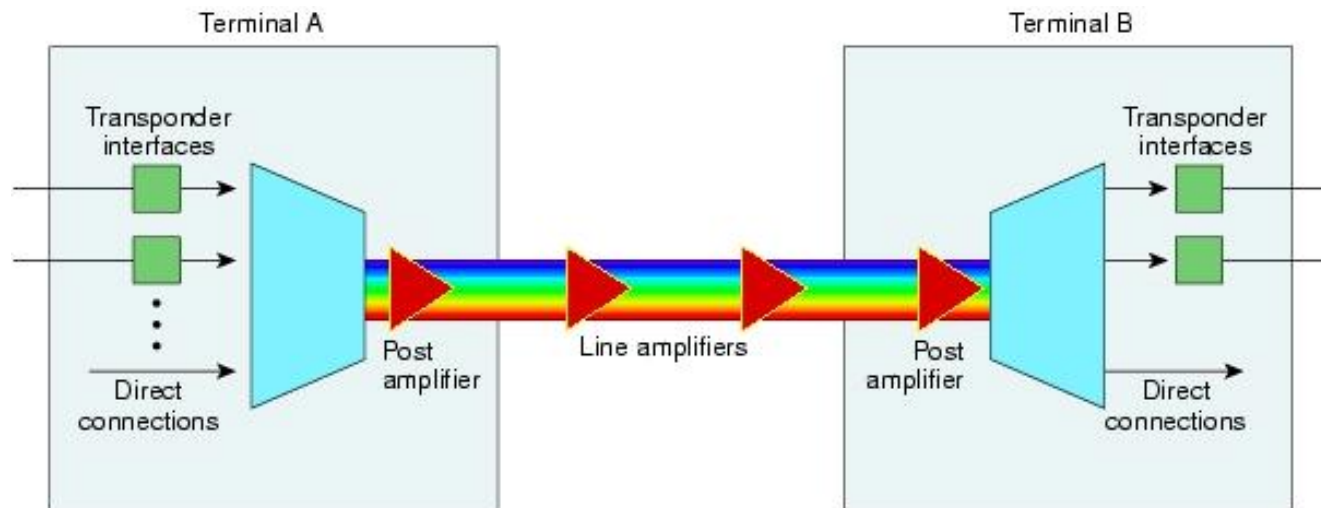
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Introduction

- A short definition of a WDM system, which both applies to Dense Wavelength-Division Multiplexing (DWDM), and Coarse Wavelength-Division Multiplexing (CWDM) is this:
 - In fiber-optic communications, wavelength-division multiplexing (WDM) is a technology which multiplexes multiple optical carrier signals on a single optical fiber by using different wavelengths (Lambda's) of laser light to carry different signals.



CWDM

- The main characteristic of the recent ITU CWDM standard is that the signals are not spaced appropriately for amplification by EDFAs.
 - This therefore limits the total CWDM optical span to somewhere near 60 km for a 2.5 Gb/s signal, which is suitable for use in metropolitan applications.
 - Systems from different vendors claim to span 80-120 km

DWDM

- Originally refers to optical signals multiplexed within the 1550-nm band so as to leverage the capabilities (and cost) of erbium doped fiber amplifiers (EDFAs), which are effective for wavelengths between approximately 1525 nm - 1565 nm (C band), and/or 1570 nm - 1610 nm (L band).
 - EDFAs can amplify any optical signal in their operating range, regardless of the modulated bit rate.
 - EDFAs therefore allow a single-channel optical link to be upgraded in bit rate by replacing only equipment at the ends of the link, while retaining the existing EDFA or series of EDFAs along a long haul route.

Choosing the right system

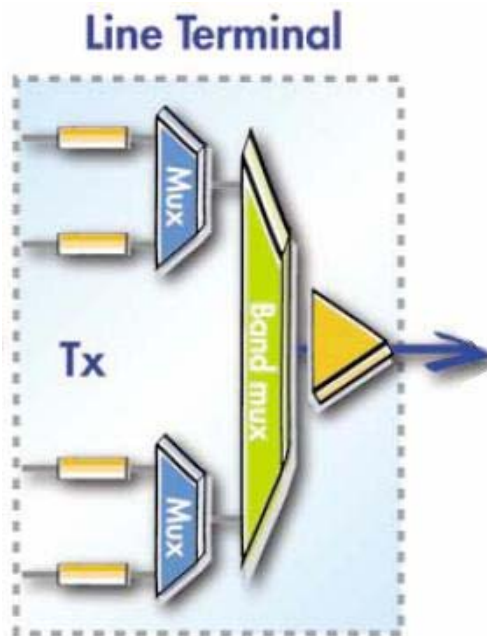
- When having to move traffic on spans stretching more than 800 km, it is obvious for many reasons to select the DWDM system over the CWDM or an SDH system for that matter.
- This leads us to taking a closer look at the basic building block inside the DWDM system.



The Alcatel LM1626 DWDM platform

The DWDM system, TS

- A DWDM terminal
 - The terminal multiplexer actually contains one wavelength converting transponder for each wavelength signal it will carry.

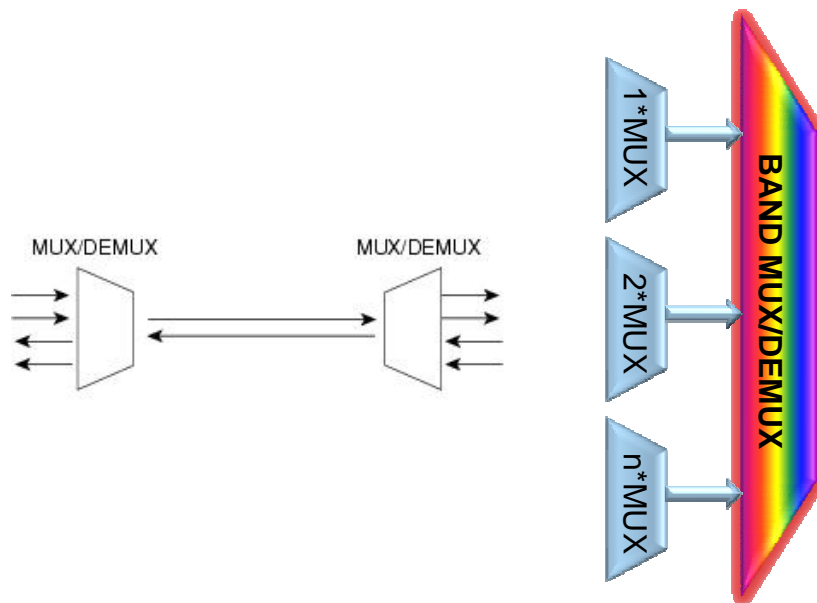


The terminal also contains other modules in the equipment such as the Optical Supervisory Channel (OSC), Automatic Laser Control (ALC), Line Amplifier (LOFA) and the Band Mux/Demux (BMDX), splitters and filters

- And of course other small parts such as PSU's and controller cards.

The DWDM system, MUX

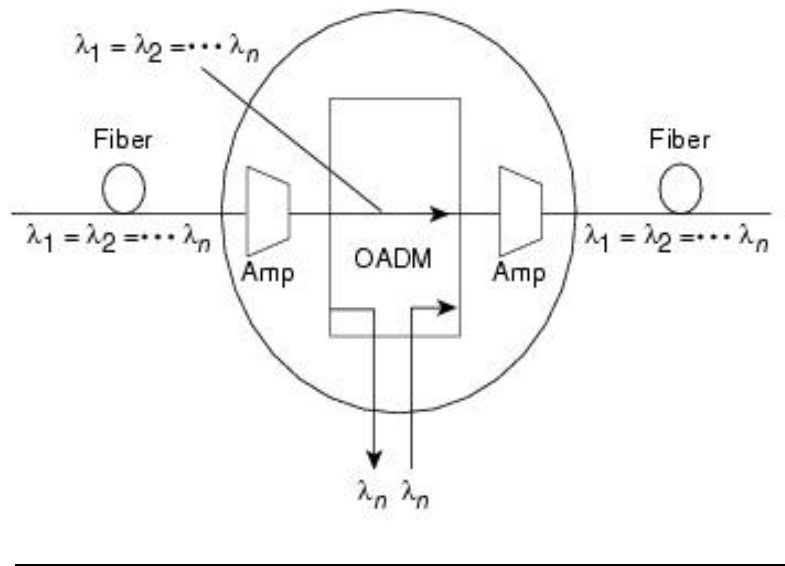
- DWDM terminal demultiplexer
 - The terminal demultiplexer breaks the multi-wavelength signal back into individual signals and outputs them on separate fibres for client-layer systems (such as SONET/SDH) to detect.



This shows both band MUX/DEMUX, and the smaller channel MUX/DEMUX, which multiplexes up to 8 channels at a time.

The DWDM system, OADM

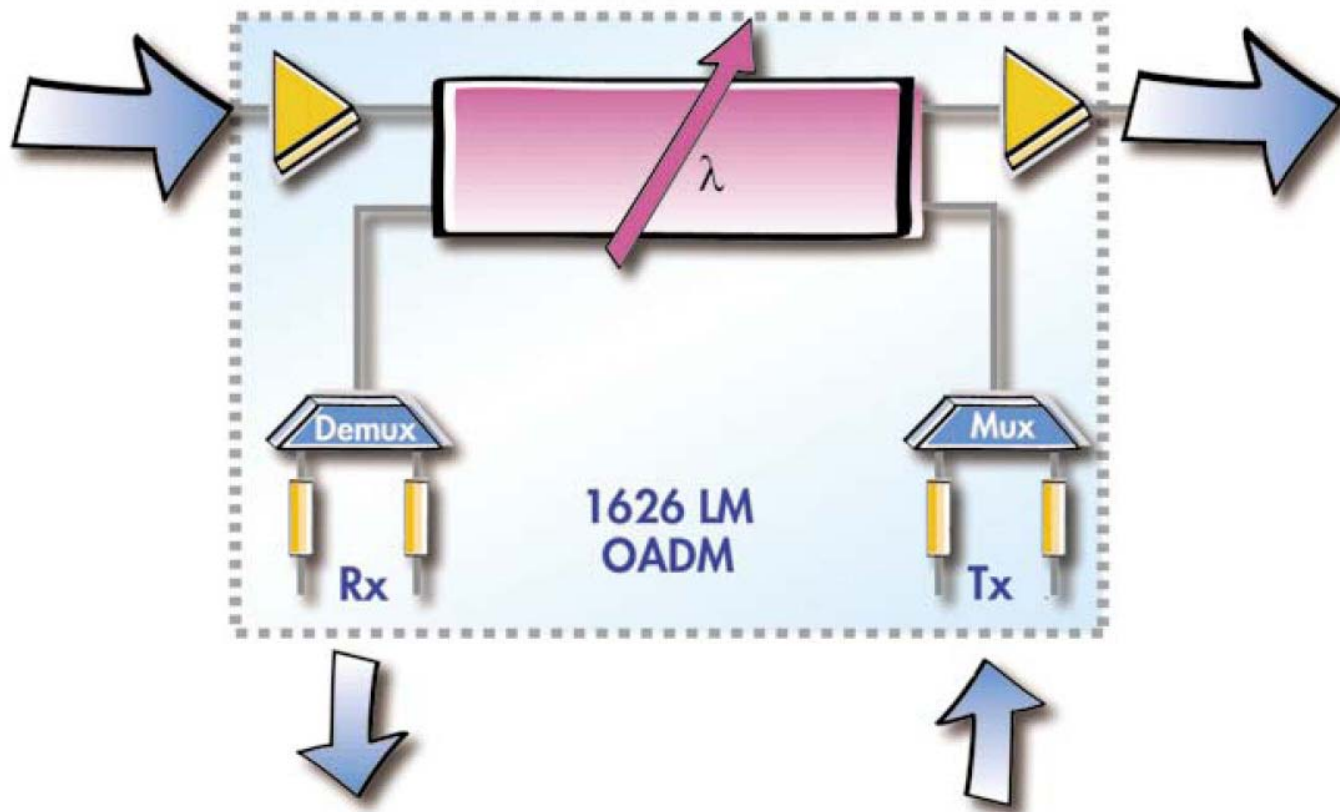
- Optical Add/drop multiplexer (OADM)
 - Between multiplexing and demultiplexing points in a DWDM system, there is an area in which multiple wavelengths exist.



It is often desirable to be able to remove or insert one or more wavelengths at some point along this span. An optical add/drop multiplexer (OADM) performs this function. Rather than combining or separating all wavelengths, the OADM can remove some while passing others on. OADMs are a key part of moving toward the goal of all-optical networks.

The DWDM system, R-OADM

- The R-OADM
 - The R-OADM is an extended version of the OADM so to speak.

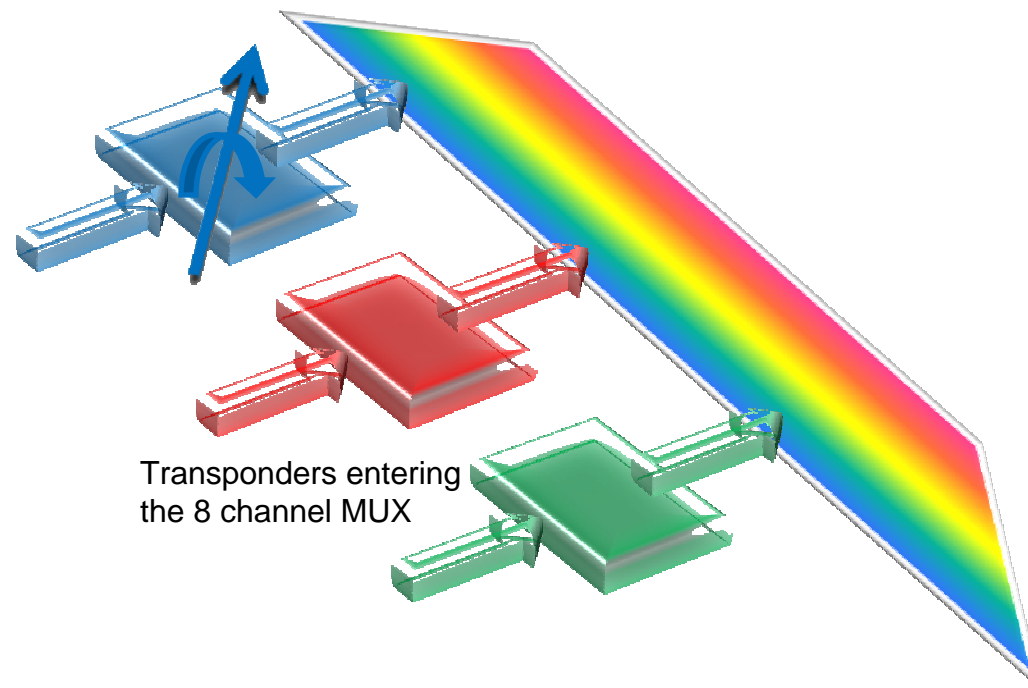


The DWDM system, OSC

- Optical Supervisory Channel (OSC)
 - The OSC carries information about the multi-wavelength optical signal as well as remote conditions at the optical terminal or EDFA site.
 - The “out-of-band” Optical Supervisory Channel (OSC) allows the supervision of all the NEs along the WDM path; moreover it gives some order-wires (data channel and voice channel) to the users.
 - Out-of-band, means the OSC is using a different band than the DWDM system is normally running in, which normally would be the U-band.
 - ITU standards suggest that the OSC should utilize an OC-3 signal structure, though some vendors have opted to use 100 Megabit Ethernet or another signal format.

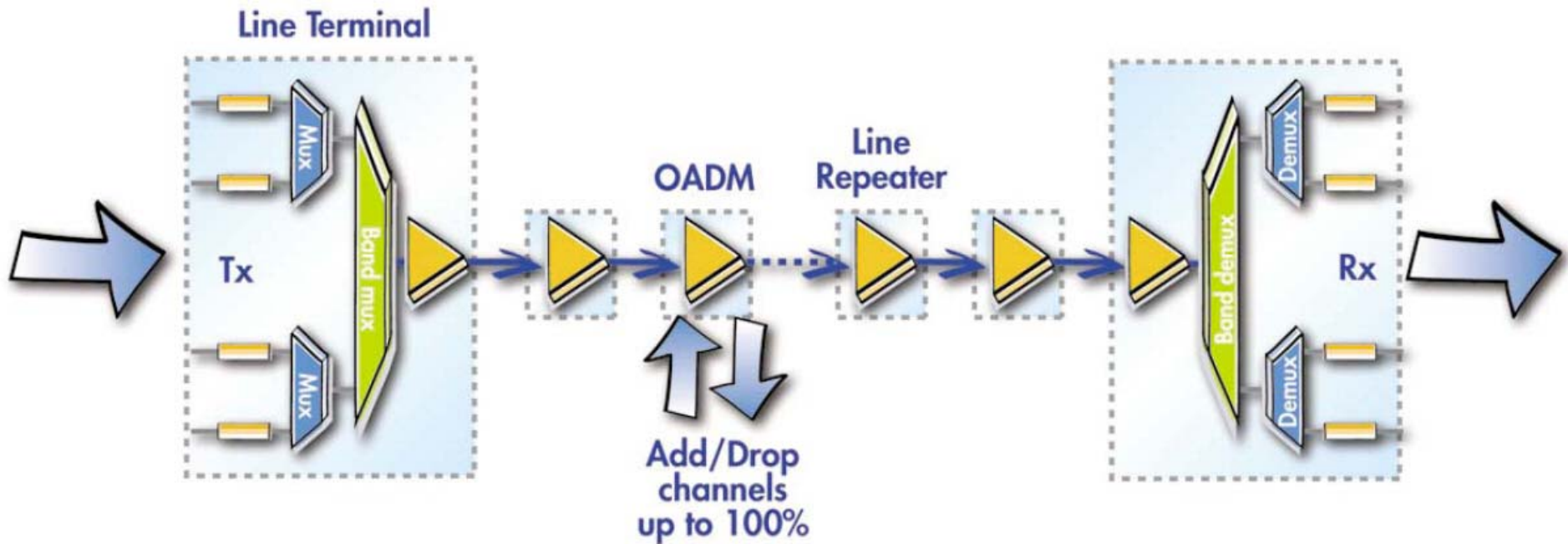
Transponder

- The transponder accepts input in the form of standard single-mode or multimode laser. The input can come from different physical media and different protocols and traffic types.



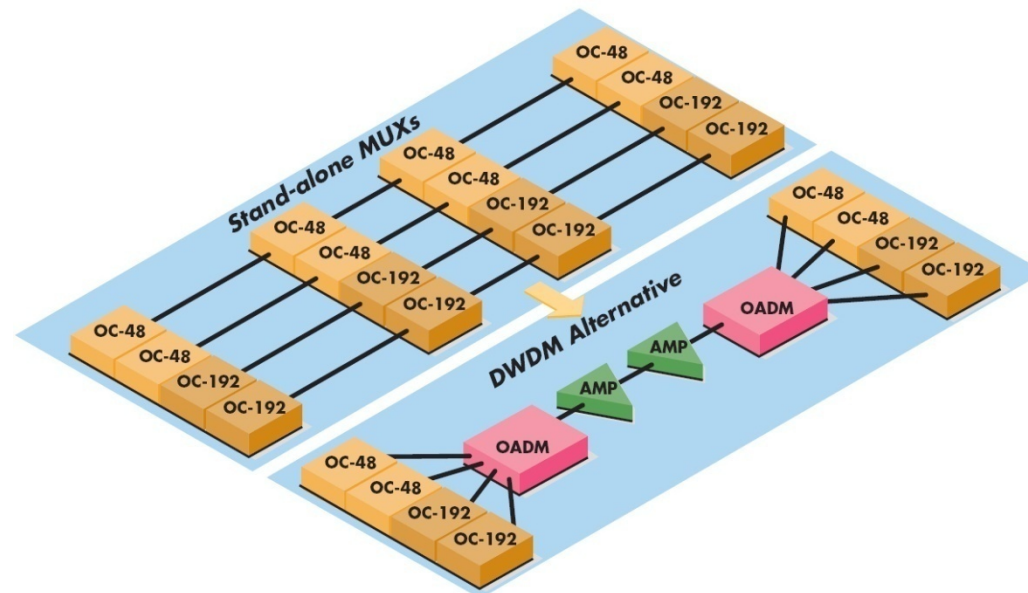
The DWDM system

- Which in the end builds up to a network like this one



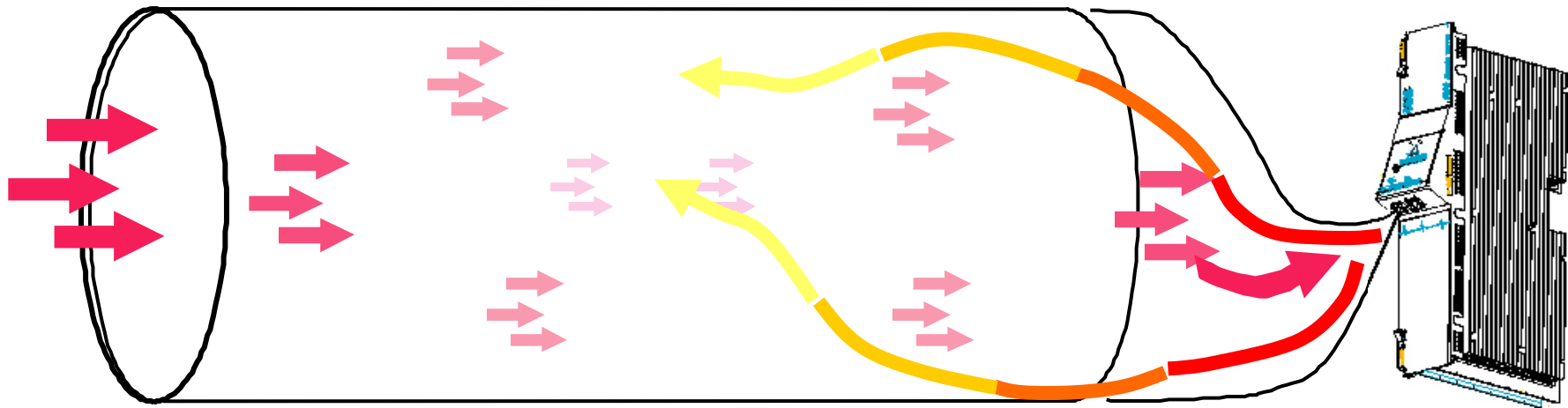
The past of systems

- The terms used in today's systems have changed, but the basic building blocks still remain.
- Naturally the techniques have been refined quite a bit since the beginning, but it still beats having many fibers and lots of equipment to run traffic on those fibers.



Today's DWDM system

- In order to go the extra distance, and carry more traffic, the DWDM system have been boosted with RAMAN amplifiers, CMD and PMD compensation units.
- The funny part of the RAMAN amplification is actually, that it builds on backscatter in the fiber, which is normally something you would try to avoid.



Future in DWDM

- So the big question is, does DWDM have any future in optical networking?
- It is believed that future DWDM systems can multiplex up to 15.000 or more channels on a single span.
- So the answer to that question must be, YES.

Questions

- Questions welcome

Thank you!