




Building DWDM
Without getting burnt

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Vocus



Agenda

- Gotchas – planning distances and PoPs
- Gotchas – optical fibres and connectors
- Gotchas - Optical roadmap to 40G & 100G optical links





Vendors 2

Requirement: Light up 150km fibre
between A and B

V 1,2,3: Must have 1 amplifier node roughly
near the middle.

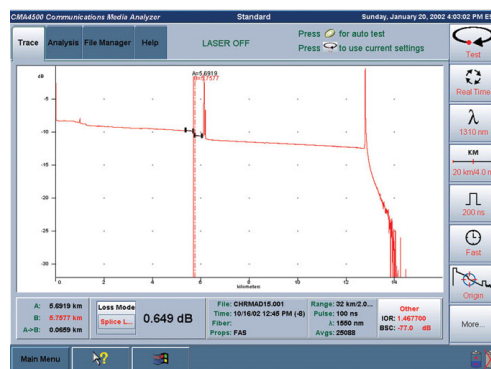
V4: Need 1 amplifier site in middle – can
design without central amplifier, but more
expensive

V5: Need 3 amplifier nodes(!)


Lesson 2: Don't assume tender response is
only design option



Know your fibre

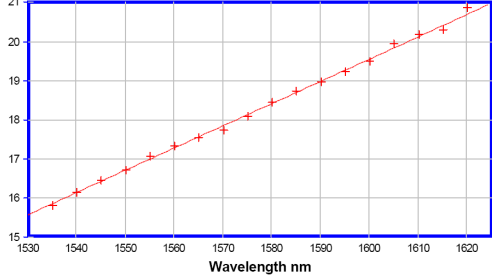


Easy to measure attenuation - OTDR

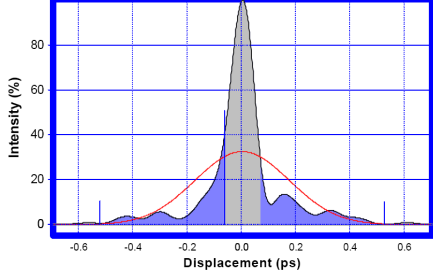


Know your fibre


SINGLE MODE CHROMATIC DISPERSION



PMD Plot



Lesson 3: More than 20km, also need Chromatic Dispersion and Polarisation Mode Dispersion for 10G and 40G operation




EDFA Amplifiers

- “Standard” longhaul 10G transponders ~ 4mW covers ~ 20dB fibre loss (~90km)

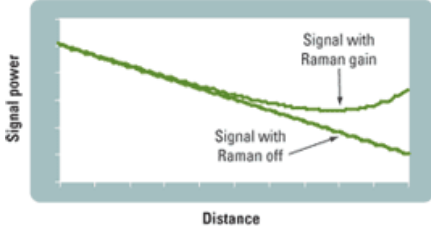
EDFA Amplifiers – Erbium Doped Fibre

- provide ~ 10dB – 30dB amplification
- add up to 120 km span
- Output power - up to 110 mW



Raman amplifiers

Raman amplification in transmission fiber
Single span with Raman



The graph plots Signal power on the y-axis against Distance on the x-axis. Two curves are shown: a solid line for 'Signal with Raman off' which shows a steady exponential decay, and a dashed line for 'Signal with Raman gain' which follows the solid line until a certain point, then levels off and slightly increases, indicating distributed amplification.

Use Raman scattering for distributed amplification

- High power “Pump” laser shining along fibre
- Contra-directional and/or co-directional
- Turns ~ 30km of fibre into distributed amplifier
- Output Power – **500mW to 1500mW!**



Choose Connectors Wisely



The grid displays 16 types of fiber optic connectors:

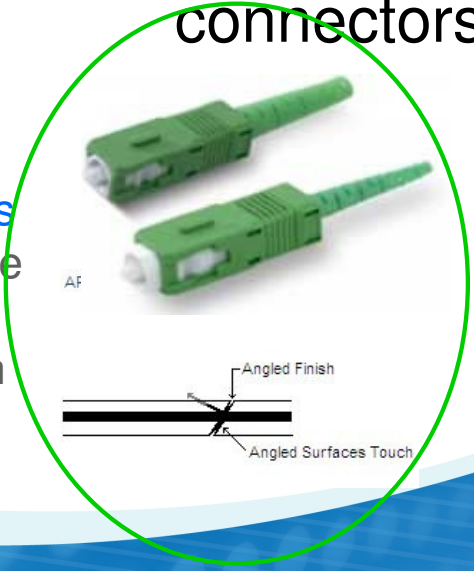
- F-SMA
- FDD/MMC
- ESCON
- T-ST
- T-SC
- T-SC-Duplex
- T-SC/APC-8°/9°
- MTRJ (male)
- MTRJ (female)
- LC
- LC-Duplex
- FC/PC
- FC/APC
- DIN
- E-2000
- E-2000/APC



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Flat vs Angled connectors

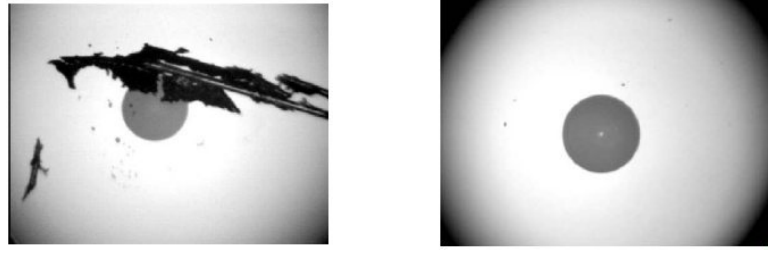
Lesson 4:
Standardise on angled connectors to prevent damage to high-power amplifiers through back-reflections



The diagram shows two green angled fiber optic connectors. Below them is a cross-sectional diagram of a fiber end face. The diagram shows two horizontal lines representing the fiber core and cladding. The top surface is labeled 'Angled Finish' and the bottom surface is labeled 'Angled Surfaces Touch'. The angle between the surfaces is indicated as 8 degrees. The label 'AF' is also present near the connectors.

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Keep it clean



The left image shows a fiber end face with a large amount of dark, irregular dirt and debris. The right image shows a clean, clear fiber end face with a single dark spot in the center.

Dirt causes excess attenuation – reliability problems

1550nm is Infrared – localised heating can cause pitting!

Lesson 6 – Clean before every connection



Finally...



Lesson 7:

Bend Radius Matters!



Thankyou

Questions?

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