**Understanding DWDM and ROADM Networks**

**Crosstalk (XT)**
- Crosstalk occurs when fiber and separate wavelengths. A proportion of optical power intended for a use channel is coupled in an adjacent or different channel.
- Effects: generation of additional noise affecting optical signal noise ratios (OSNR), leading to bit errors.
- Solutions: use appropriate optical channel spacing, for example 0 nm, 10 nm.

**Four Wave Mixing (FWM)**
- This interference phenomenon produces unwanted signals from three photons (where a fourth is automatically induced) a fourth from three waves mixing a lead. FWM is problematic in systems using dispersion shifted fibers (DSF). Wavelength-tuning at the same speed as the constant time over long periods increases the effect of FWM.
- Effects: power transfer to new signal frequencies (states), channel crosstalk and bit errors.
- Solutions: use appropriate optical channel spacing.

**Chromatic Dispersion (CD)**
- CD — the phenomena of the different wavelengths of an optical pulse traveling at different velocities due to fiber imperfections. Time difference is called Differential Group Delay (DGD).
- Effects: decrease of peak power, pulse broadening, and bit errors.
- Solutions: use of fibers with lower chromatic dispersion.

**Polarization Mode Dispersion (PMD)**
- PMD — the effect of the different polarization modes (fast axis, slow axis) of a signal statistically traveling at different velocities due to fiber imperfections. Time difference is called Differential Group Delay (DGD).
- Effects: decrease of peak power, pulse broadening, and bit errors.
- Solutions: careful fiber laying (stress), use of new fibers with low PMD values, exact fiber geometry.

**Optical Transport Networks**

**Effect of CD, DGD and FWM**
- Optical power transfer to new signal frequencies (states), channel crosstalk and bit errors.

**Span Loss and Dispersion Management of a Link**
- Optical amplifier with integrated dispersion compensation (OCD) is distributed along the link to recover the optical power and overcome the positive dispersion of the fiber. Each amplifier will reduce the optical signal to noise ratio (OSNR) due to the ASE noise amplified spontaneous emission (ASE).
- OSNR = Optical signal power / Optical noise power.

**ROADM Types**

**Efficiency**
- Amplifier: Amplified Spontaneous Emission of an optical amplifier
- CD: Chromatic Dispersion
- OAM: Optical Amplifier Module (incl. dispersion compensation)
- DGD: Dispersion Group Delay
- N: Number of DWDM bands
- C: C-band
- L: L-band
- MUX: Optical Multiplexer
- DEMUX: Optical Demultiplexer
- FWM: Four Wave Mixing
- ROADM: Recombinable Optical Add-Drop Multiplexer
- WSS: Wavelength Selective Switch
- WXC: Wavelength Cross Connect
- WDM: Dense Wavelength Division Multiplexing
- OAR: Optical Amplifier Module
- T: T-band
- S: S-band
- DB: Duo Binary
- R: Return to Zero
- O: Original band
- C: Conventional band
- N: Original channel spacing
- N+1: New channel spacing
- +: Optical Add-Drop Switch
- –: Optical Add-Drop Switch
- +: Optical Add-Drop Switch
- –: Optical Add-Drop Switch
- B: Band
- T: Time
- C: Channels
- W: Wavelength

**40G Modulation Techniques**
- New modulation techniques are used in high-speed 40G networks to do dispersion limitations.
- NRZ formats are used for over long distances. 40G formats are used for short distances.
- A modulation of the phase between transmission between the two channels affects the eye pattern.

**To learn more, visit jdsu.com/fibertest**

We wrote the book on Fiber Optic Testing. Visit us online for your free copy.