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Robust and Flexible Wavelength Division Multiplexed Optical Access Networks

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Motivation

Future wavelength division multiplexed (WDM) access networks should be as flexible as possible. One **flexibility** is port wavelength-agnosticism at the optical network unit (ONU) interface, achieved via tunable laser. At the same time such systems needs to be **robust** against crosstalk impairments during tuning process.

Flexible WDM System

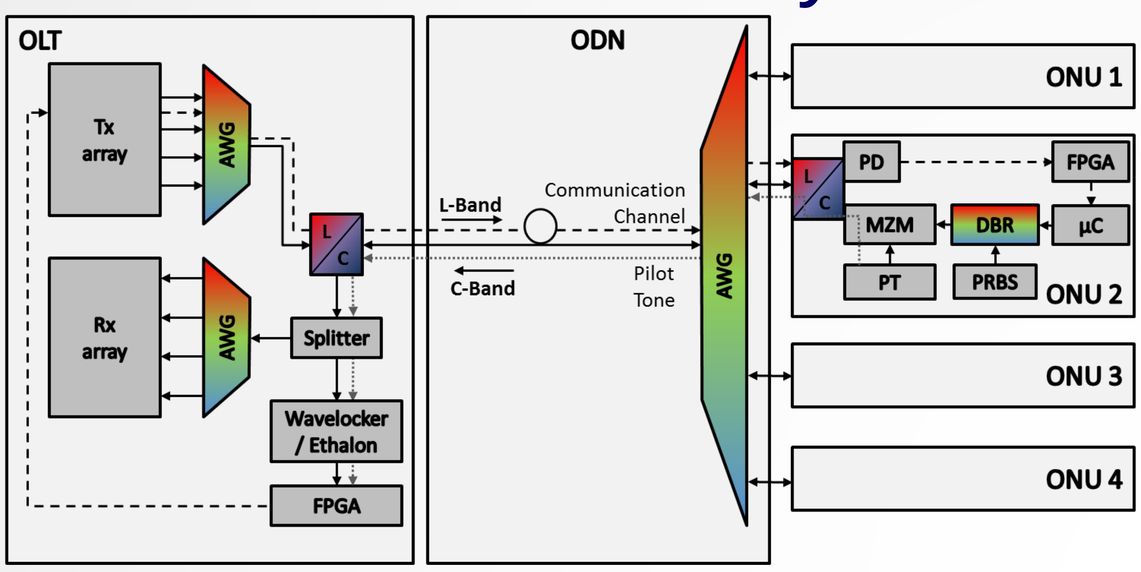

Figure 1: Port-agnostic WDM system. OLT: optical line terminal, AWG: arrayed waveguide grating, FPGA: field programmable gate array, ODN: optical distribution network, ONU: optical network unit, PD: photodiode, DBR: distributed Bragg resonator, MZM: Mach-Zehnder-Modulator, PT: pilot tone

Filter characteristic and crosstalk impairments

Crosstalk impact is determined by the signal-to-interferer ratio (SIR).

- 80km differential path length ~ differential loss of 22dB
- Emission power difference ~ 4dB
- Filter isolation coherent ~ 30dB
- Filter isolation at half channel spacing ~ 12dB

Worst case coherent crosstalk: SIR = 4dB (parallel polarsition)
Worst case inter-channel crosstalk: SIR = -14dB

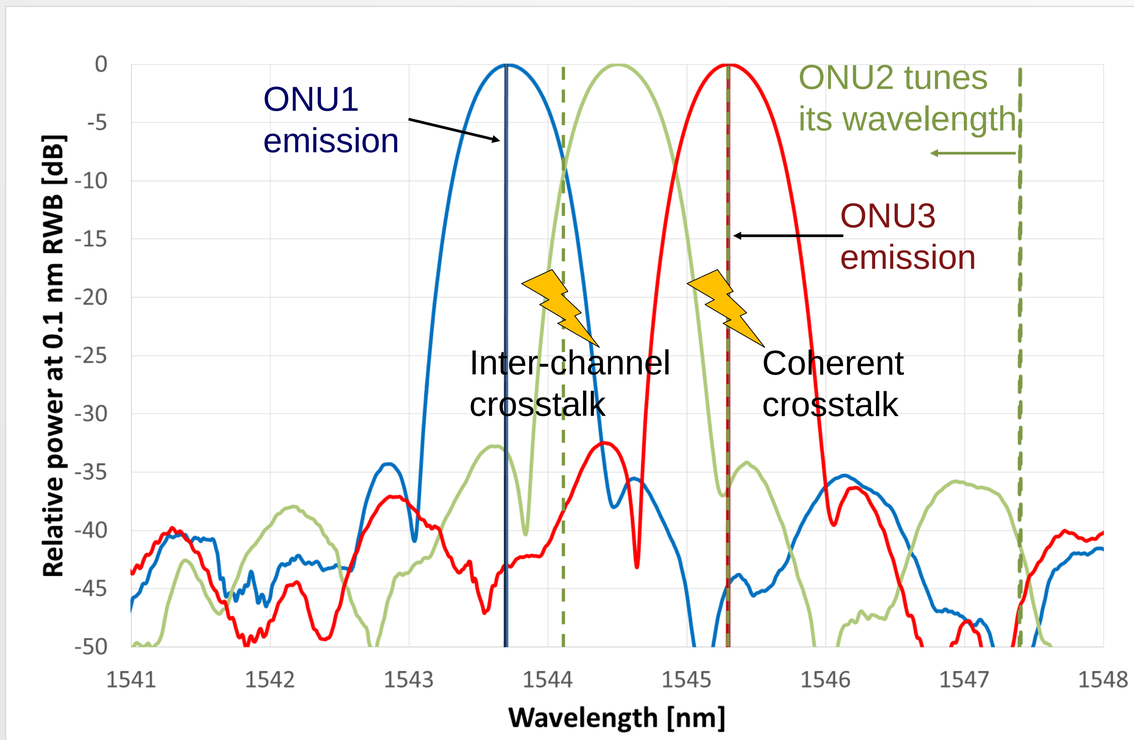

Figure 2: Filter isolation for inter-channel and coherent crosstalk

Measurement setup

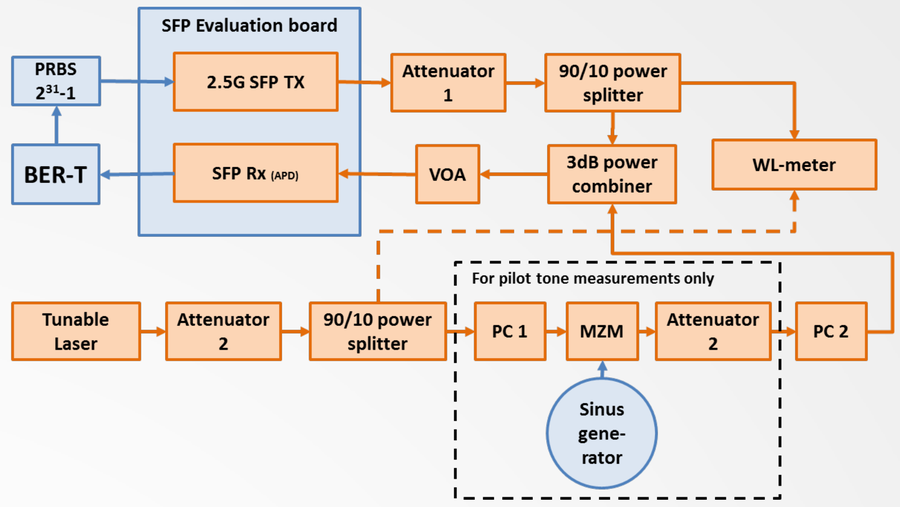

Figure 3: Measurement setup for coherent and incoherent crosstalk evaluation with and without pilot tone modulation. BER-T: bit error rate tester, SFP: small form factor pluggable, PC: polarization controller, MZM: Mach-Zehnder modulator, WL-Meter: Wavelength meter

Impact of crosstalk

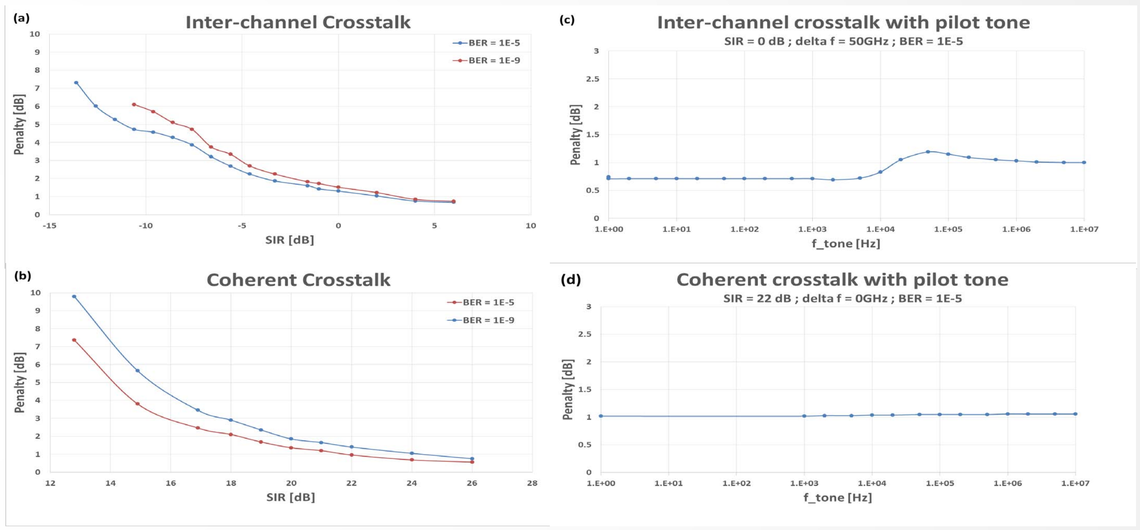

Figure 4: Penalty of different crosstalk impairments (a) Inter-channel crosstalk; (b) Coherent crosstalk; (c) inter-channel crosstalk with pilot tone modulation on interferer; (d) coherent crosstalk with pilot tone modulation

Crosstalk mitigation for robust WDM systems

- Limiting differential path loss
- Limiting transmitter launch-power window
- Polarization control (scrambling)
- Power down during tuning
- Filter channel isolation

Conclusion

Crosstalk can have a heavy impact on wavelength-agnostic WDM systems. Differential reach between ONUs determines mainly the BER performance of WDM system. Pilot tone modulation has almost no influence on BER performance. Crosstalk mitigation by reducing the differential reach to 40 km (11 dB differential loss) in combination with reduced launch power during tuning seems promising.

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