SLTE Emulation

How to test wet plant with no dry plant?

Submarine Cable Network Architecture

Dry Plant Vendor B

SLTE
PFE
TLTE (OTN,WDM)

Wet Plant Vendor A

Dry Plant Vendor C

SLTE
PFE
TLTE (OTN,WDM)

SLTE: Submarine Line terminal Equipment
PFE: Power Feed Equipment
TLTE: Terrestrial Line Terminal Equipment

Submarine Repeaters

Cable Landing Station

Cable Landing Station
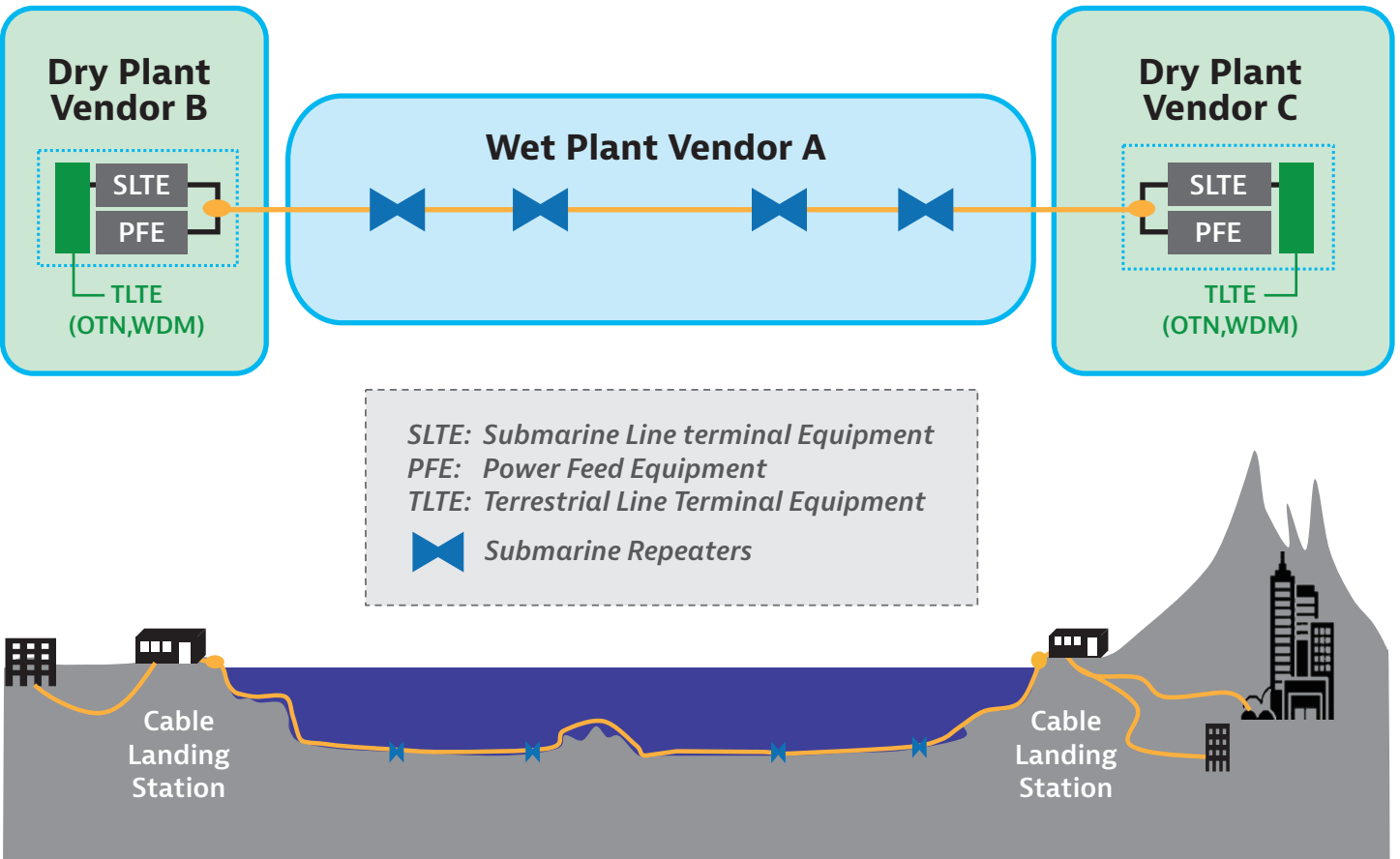
A Guiding Collaboration

Subsea Open Cables:
A Practical Perspective on
the Guidelines and Gotchas

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Open Submarine Cables

Open Cables

· Disaggregation of Wet-Plant and SLTE

| Dry Plant SLTE ➡ Vendor A | Wet Plant Submarine cable + amp. ➡ Vendor B | Dry Plant SLTE ➡ Vendor A |

Opportunity

· Open Cables enable independent vendor selection for wet and dry technology
· SLTE technology cycles are faster (5 Y) than a Submarine cable build (~25 Y)
· Open Cables allow the use of preferred SLTE technologies and vendors

Challenge

· Verification of wet-plant without presence of SLTE

Solutions

· SLTE simulator to test wet-plant performance under different conditions
· Use of new performance metrics to qualify wet-plant (independent from SLTE)
· Use of OSNR and G-OSNR is discussed in the industry

How to Qualify Wetplant when no SLTE is Present?

Many scenarios:

- Qualify a pre-staged link prior to loading on a ship

- Monitor basic parameters of the link while it is being laid

- I want to sell spare/dark fibers – what performance do I guarantee?
- I want to lease a dark fibers – how do I know if it works?
- I need to re-verify a link after a repair has been made – how do I know about quality of repair?

Technical challenges:

- Power at the amplifiers is not representative
  ➡ management system may not enable the link

- The wet plant is designed to operate with specific channel plans and spectral densities.
  Amplifier performance (OSNR, Gain-tilt etc.) will not be accurate if a different load is present.

- It is not practical to have a full SLTE system for certification of dark fiber

Three steps to SLTE Emulation

1. Create a cost effective and representative DWDM comb
2. Manage comb to insert active test channel
3. Adjust (degrade) OSNR to probe end of life specification

Additional options to create more complex spectral patterns to emulate mixed data-rate systems

Options to Accelerate Development

Optical Manufacturing Test Platform
2020 Lighwave Innovation Award Winner

Integrated Touchscreen

Rackmount

Standard Benchtop

Industry Leading Modules | MAP Series LightDIRECT

VIAVI Solutions

Sources & Amplifiers

EP, SLED Sources

ITU Tunable Laser

C, L, O Band Amplifiers

C, L, Band ASE Broadband Sources

Switching & Routing

Passive Utility

Switching 8x8, 16x16

Switching [1x2], [2x2], and [1x4] to [1x64]

Power, Loss and Spectral Measurement

C-band Coherent OSA

Basic & High performance OPM
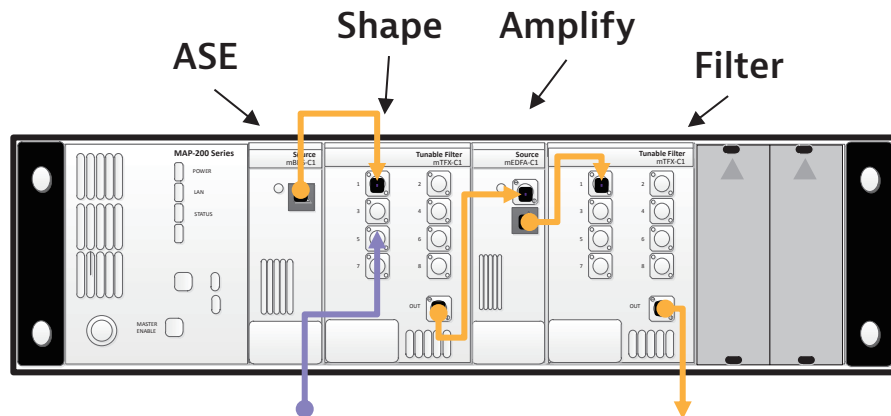
Signal Conditioning

Attenuation & Power control

Pol. Scrambler & Controller
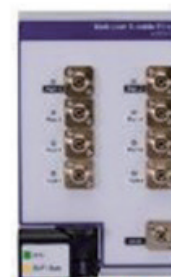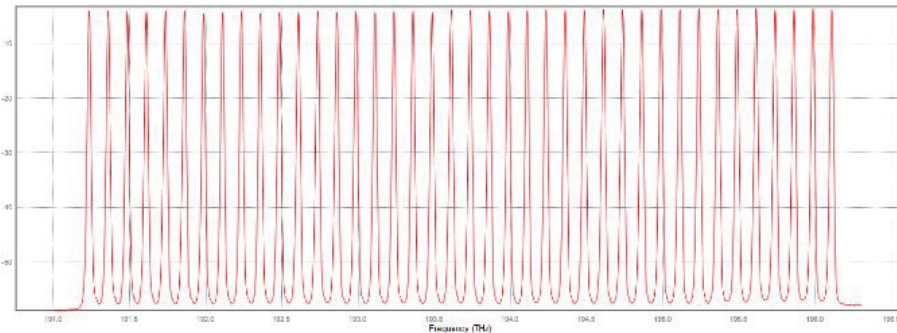
C&L Spectrum Manager & Tunable Filter

Solution: Source Grids for System Loading

ASE Shape Amplify Filter

Ports 2-8 can be used to multiplex live signals into the system
· Probe tone
· Live data channels

To System under test

Real example spectrum

1. Channels: 40 (set by TFX)
2. Spacing: 125 GHz (set by TFX)
3. Total Integrated Power: 17.5 dBm (OPM measured)
4. Channel Power: >1.4 dBm (calculation from OPM data)
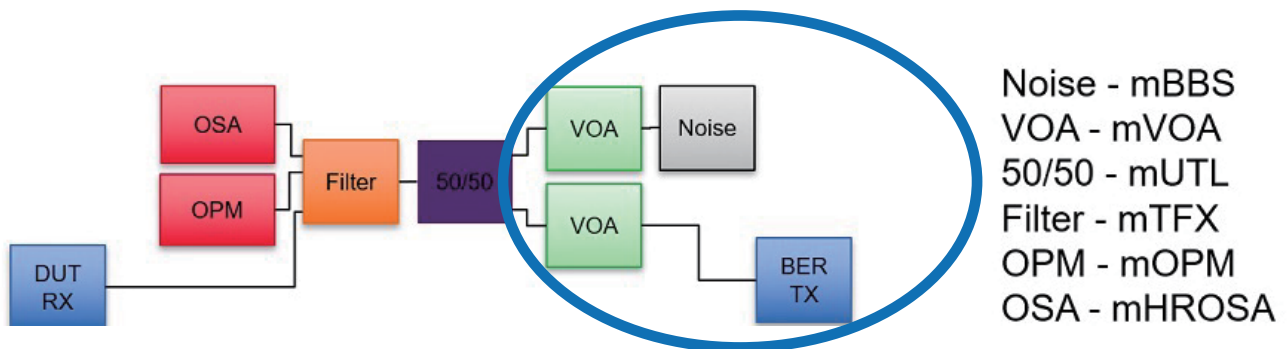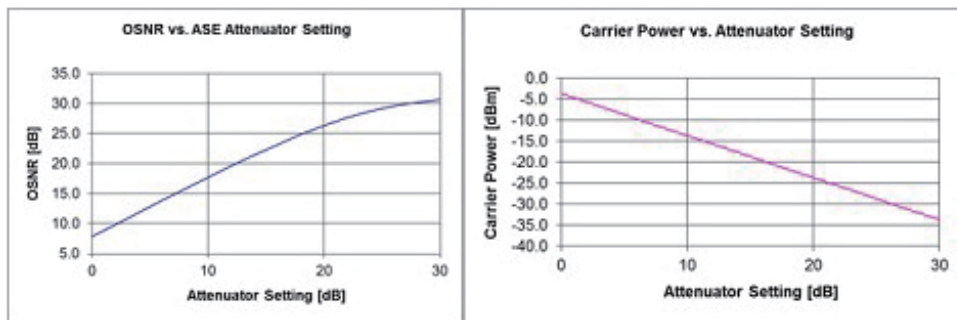5. OSNR (0.1dB NBW):   >50 dB (OSA measured)

> • **Use mTFX to shape and amplify a noise source to create any grid plan**
> • **Allow a single "live" data channel to be inserted**

Inserting
a Reference Signal

ASE   Shape   Amplify

Input Noise

Amplify

External
Reference
Transmitter

Insert a test channel

Low pass   High pass

Comb
filter

Compound filter
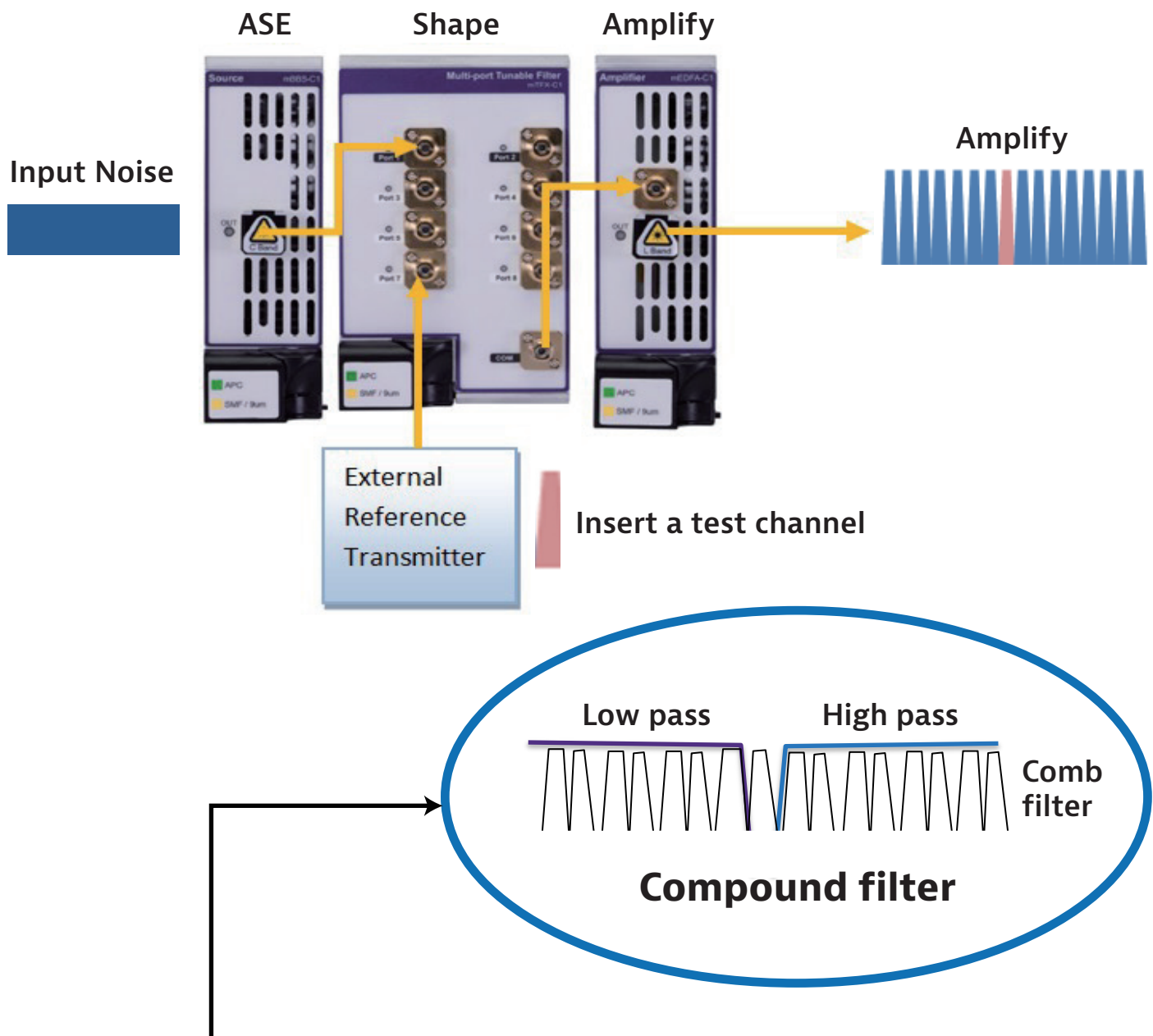
Complex filter shapes with muxing capability

Adding
a programmable OSNR

OSNR vs. ASE Attenuator Setting

Carrier Power vs. Attenuator Setting

Noise - mBBS
VOA - mVOA
50/50 - mUTL
Filter - mTFX
OPM - mOPM
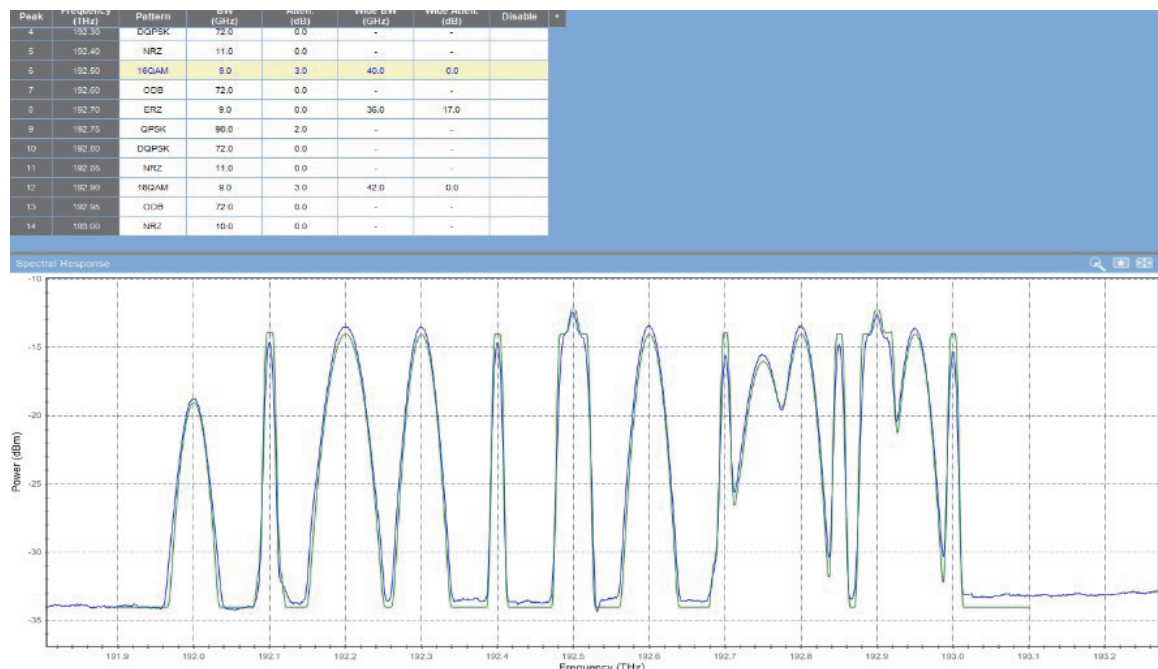OSA - mHROSA

**These systems can be combined with
a programable OSNR Source to stress an active channel**

Complex Loading Example

The mTFX can be used to create extremely complicated loading system

Leverage the full power of the mTFX to create arbitrary filter functions to emulate in-band OSNR and spectral density from different modulate rates and formats

Summary

· Leverage MAP-300 to create dynamic, flexible and cost effective SLTE emulator

· Versions deployed at all wet plant manufacturers – even on cabling ship

· Emulate intended operation conditions or range of condition with simple software interface

· Ensure wet plant amplifiers are running optimally to verify OSNR/GOSNR and gain tilt

· Allow live test channel insertion for Q-measurement and live system soak tests

· Create even more advanced loading schemes to emulate mixed signal operations

· Certify the wet-plant as part of commercial terms