Tools to Investigate MPDV Component Characteristics

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Thanks to the MPDV Gen I Team!

Motivation

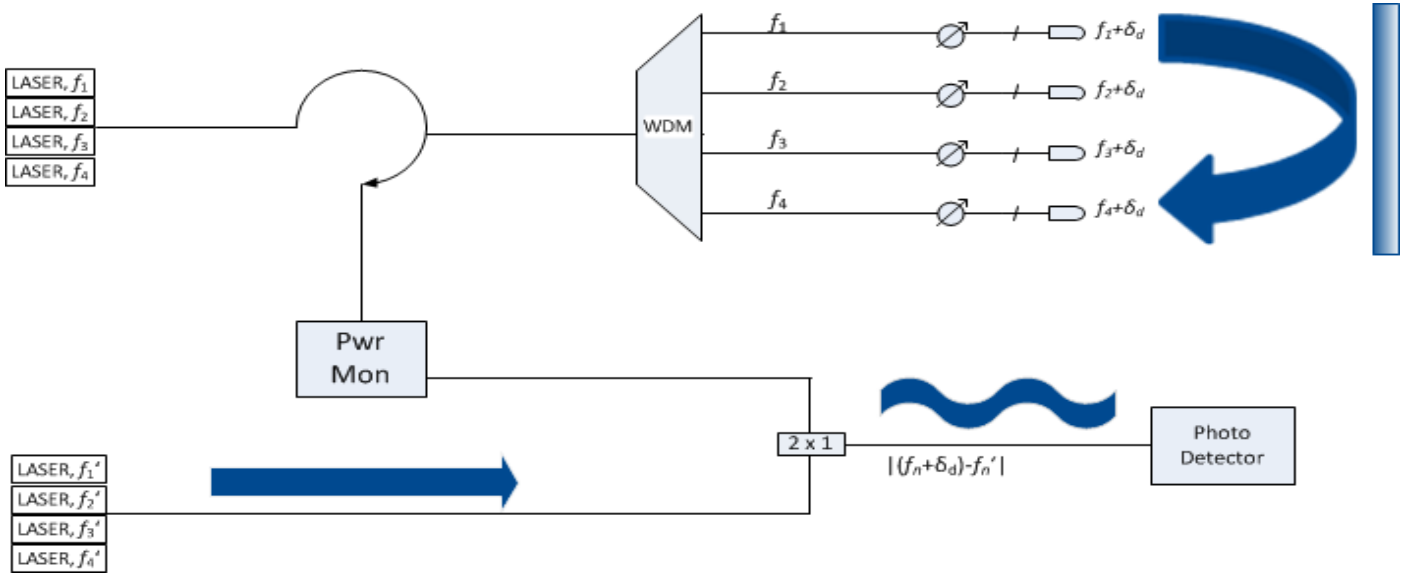
- 128 channel system
  - Each 32 channel chassis contains 278 components
  - 4 systems = 1112 components!
  - Statistics will and does catch up

- Similarities with telecommunication systems

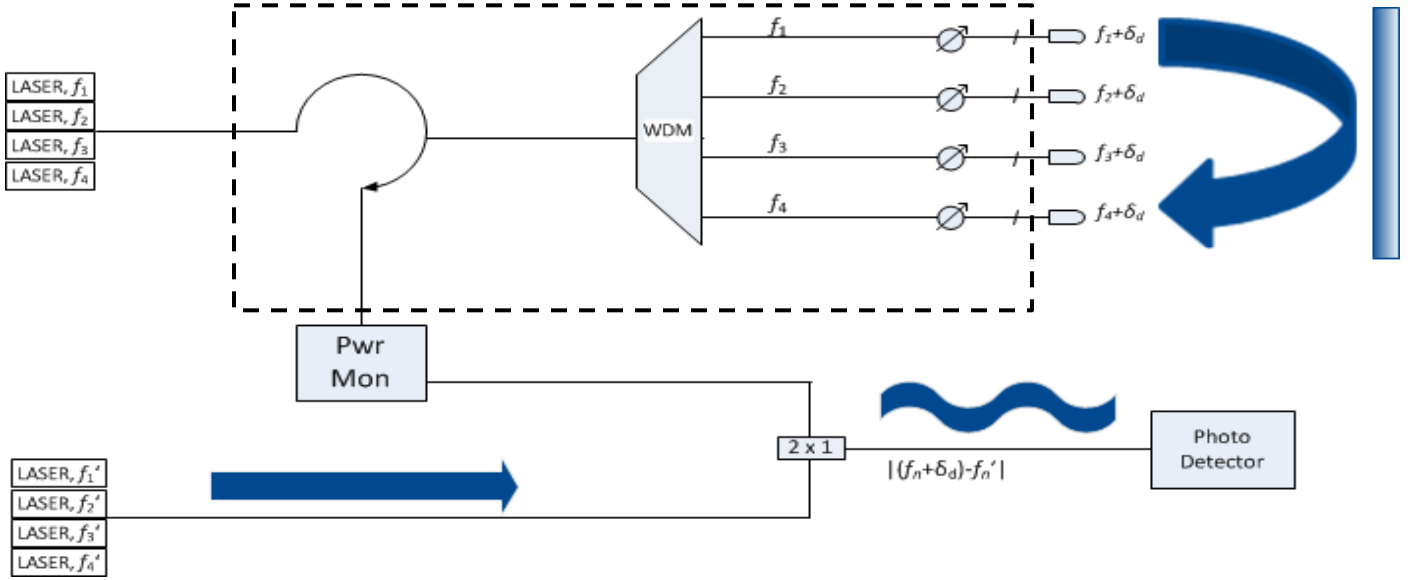
Insertion Loss	Coherence
Back reflectance	Frequency Dependence

- Explain what's in the "black box" of our test equipment

Simplified Schematic of MPDV Channel

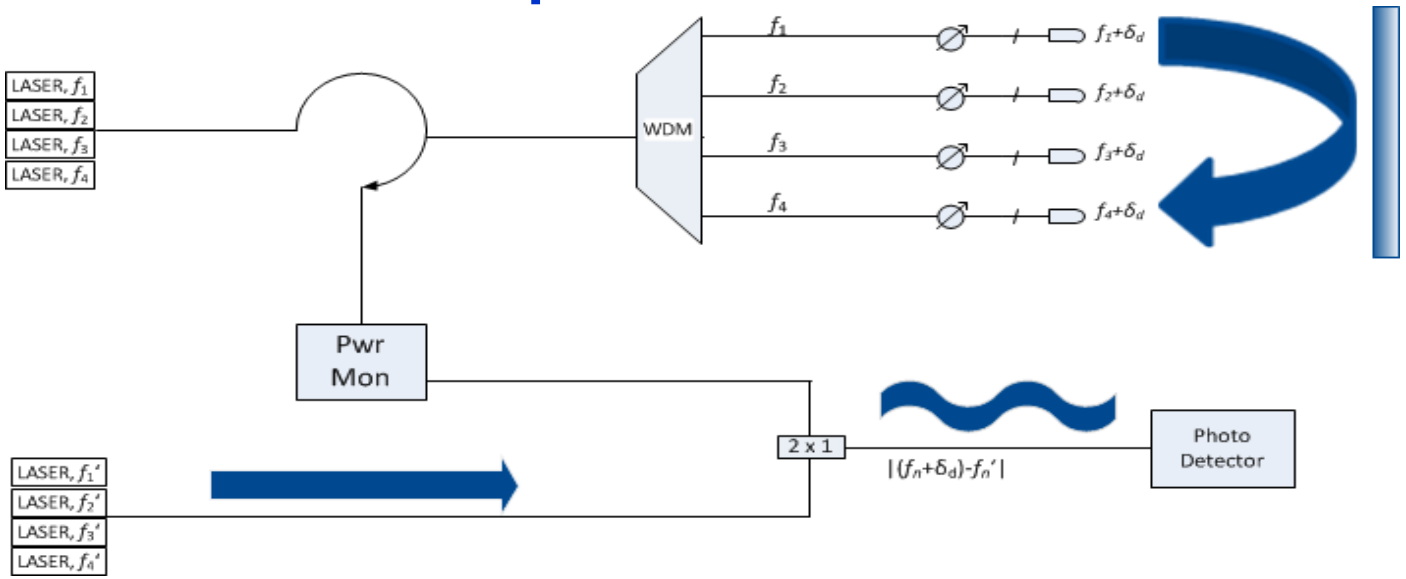


Simplified Schematic of a MPDV Channel



- Grouped passive components into modules
- Fusion spliced components to reduce insertion losses and back reflections.
- Signal is passed two ways.
- QA tests required before splicing signal path
- Summed individual losses and compared with combined losses of along path

Requirements for Components Tested



Circulators

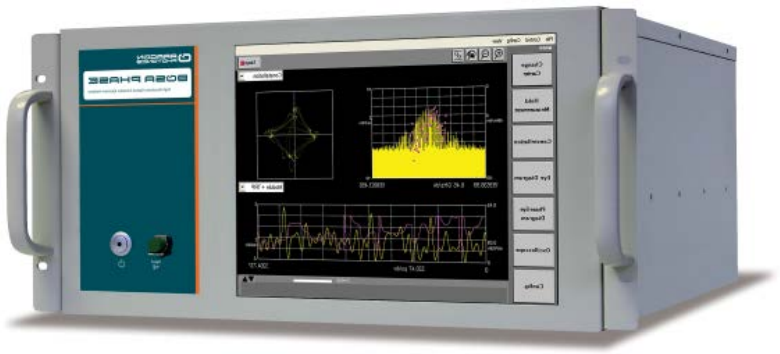
Power levels <50 dBm (cut off of in-line EigenLight)

Dense Wavelength Division Multiplexer

Passbands of 200GHz

Minimize back reflections to <40 dBm

BOSA PHASE® Complex OSA by Aragon Photonics



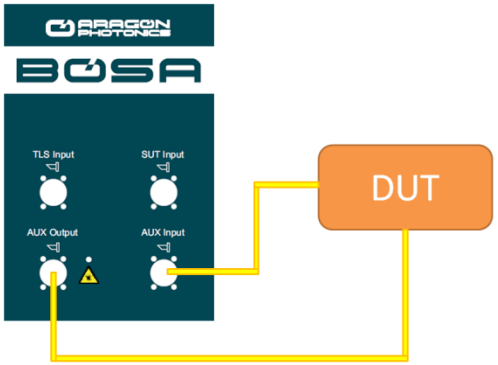
Specifications:

Resolution (@3dB) :	80fm / 10MHz
Dynamic Range:	>80dB
	>40dB @ ±0.3pm

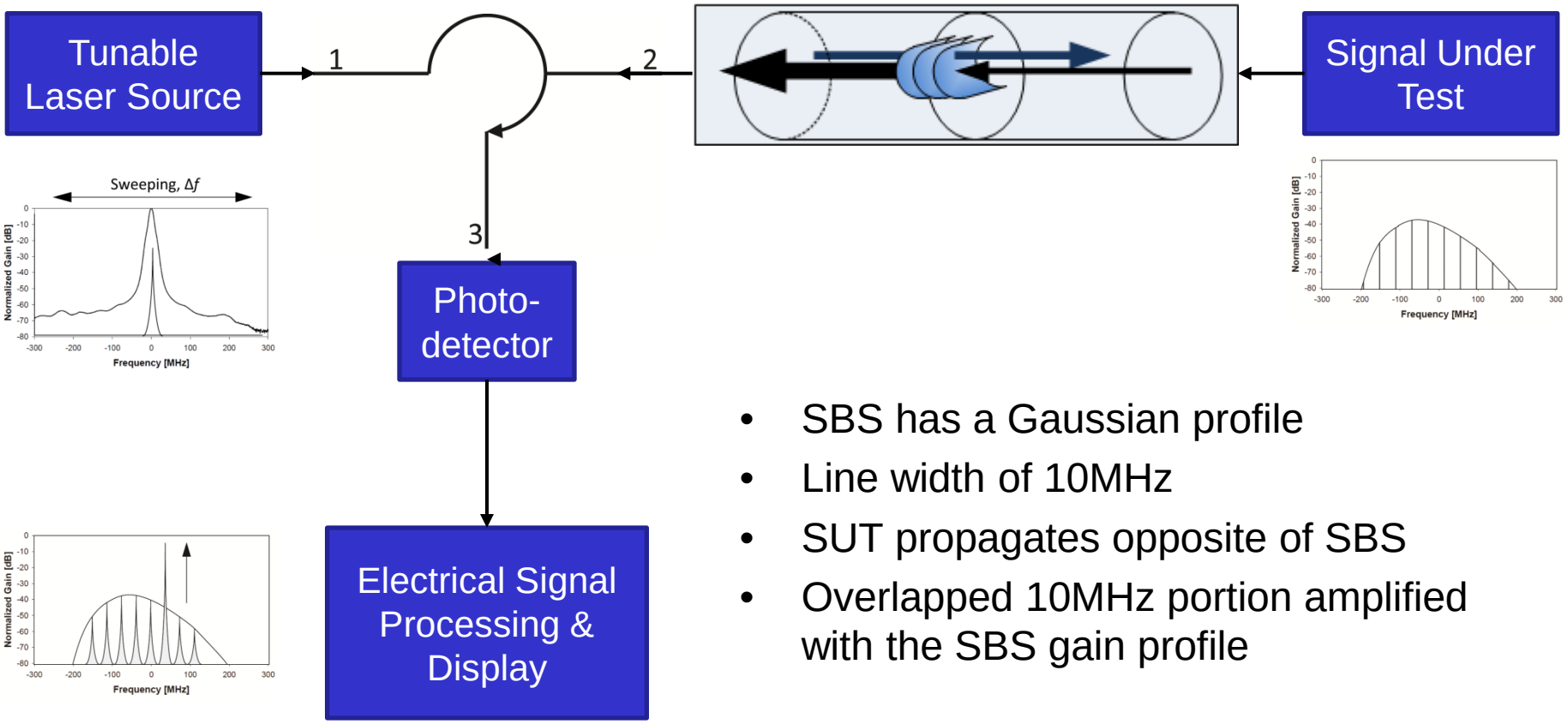
Option 210: External Tunable Laser

Wavelength Range:	1515-1565nm
Accuracy:	±1.5pm
Output Power:	4-8 dBM
Linewidth:	<1MHz

Option 220: Component Analyzer Application

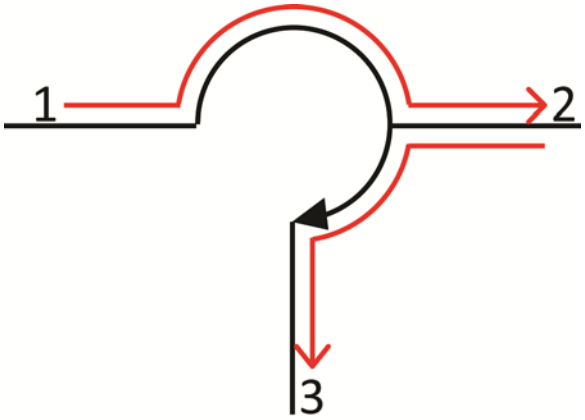


BOSA Measurement Technique

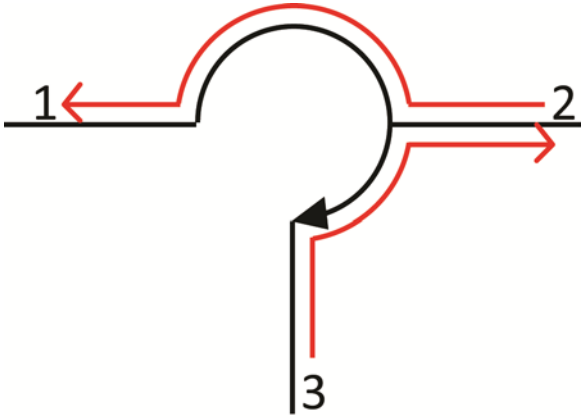


- SBS has a Gaussian profile
- Line width of 10MHz
- SUT propagates opposite of SBS
- Overlapped 10MHz portion amplified with the SBS gain profile

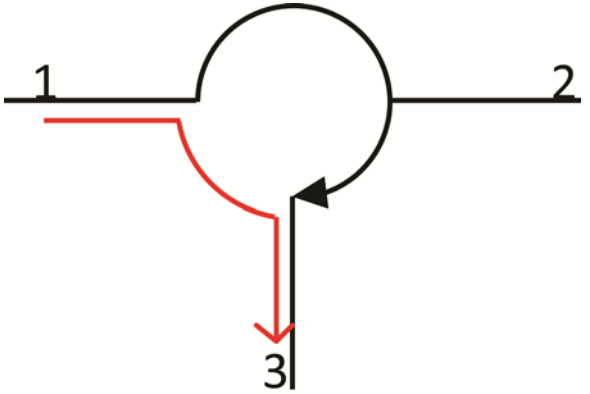
Optical Spectrum Analyzer: Circulator Leakage



Insertion Loss(~0.8dB)

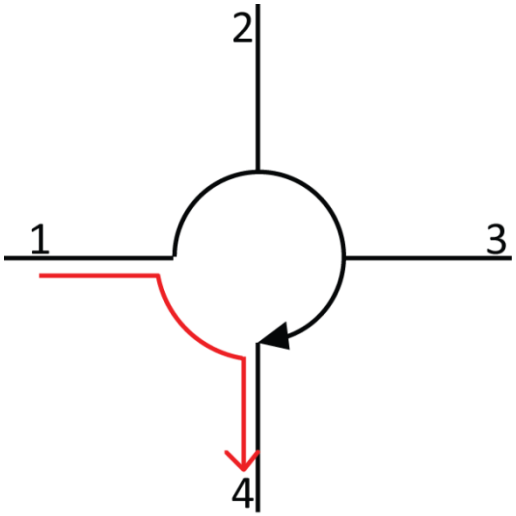


Isolation(~40dB)



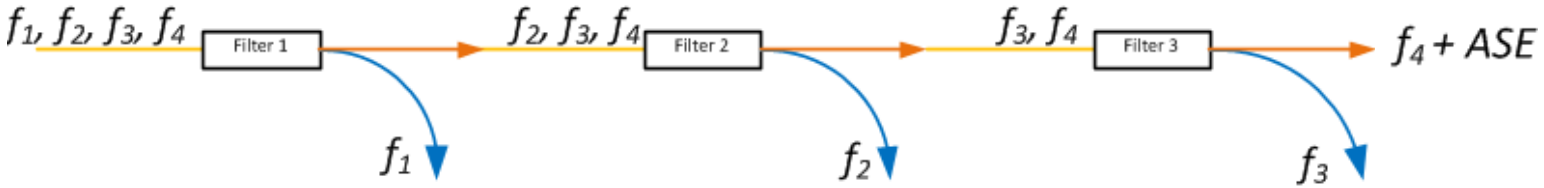
Directivity(~50dB)

OSA sensitivity -70dBm



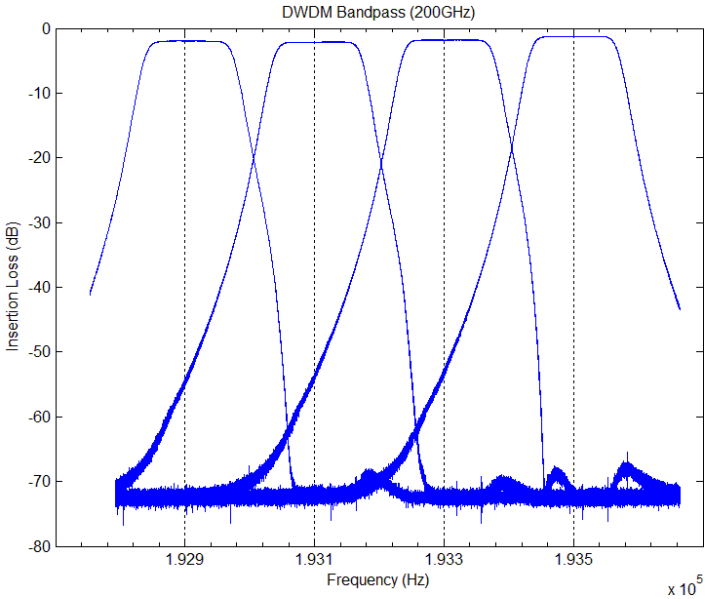
Future work: Look to 4-port circulators for better directivity.

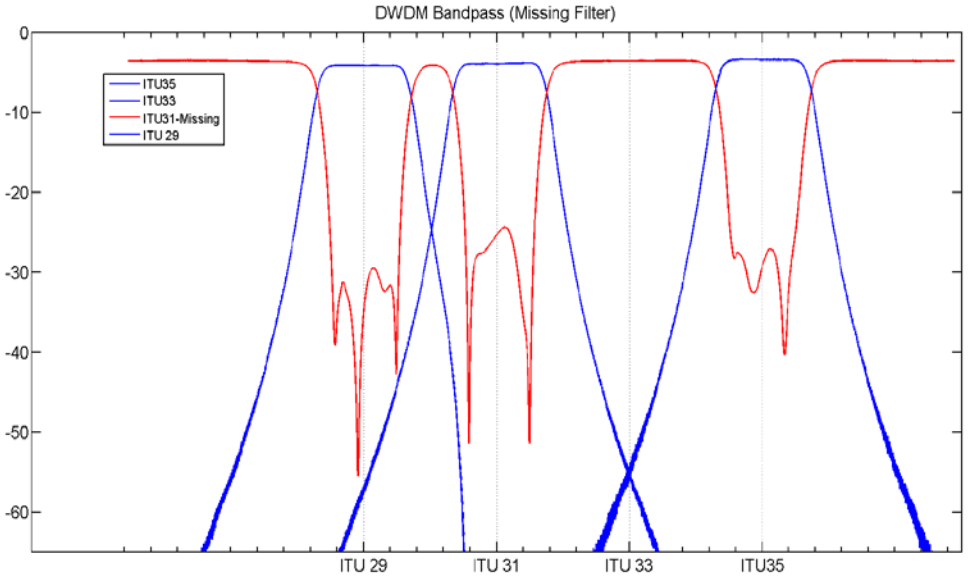
Optical Spectrum Analyzer: DWDM



Important Parameters:

- Channel Gain
- Channel Noise figure
- All filters Present





Missing Filter!

ITU33 is routed to ITU 31 rejection leg (output + ASE)

Spectral holes due to previous filtering

Optical Backscatter Reflectometer by Luna Technologies®

Specifications:

- -130 dB sensitivity
- 70 dB dynamic range
- High spatial resolution

$$\delta x = \frac{\lambda_0^2}{(2n\Delta\lambda)}$$

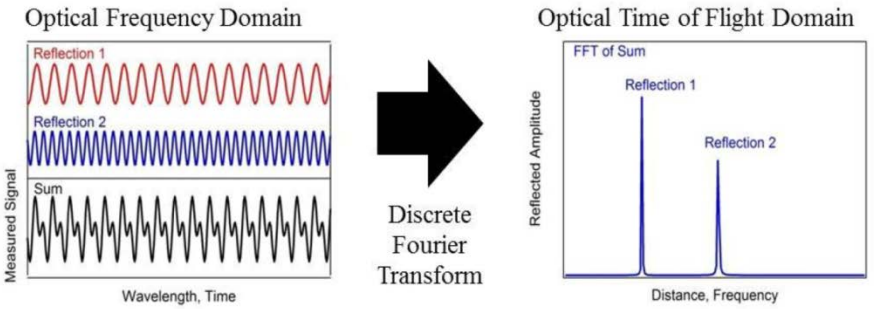
Highest Resolution (μm)	Max Scan Length
10	30
20	70
1000	2000*

*Upgrade option: Extended Range Measurements

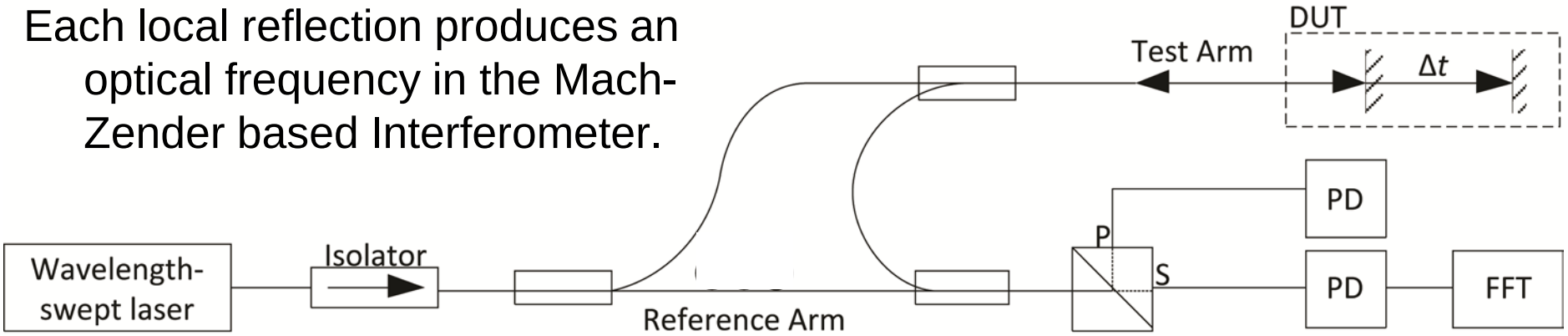
OBR 4600 Measurement Technique

Swept-wavelength coherent interferometry

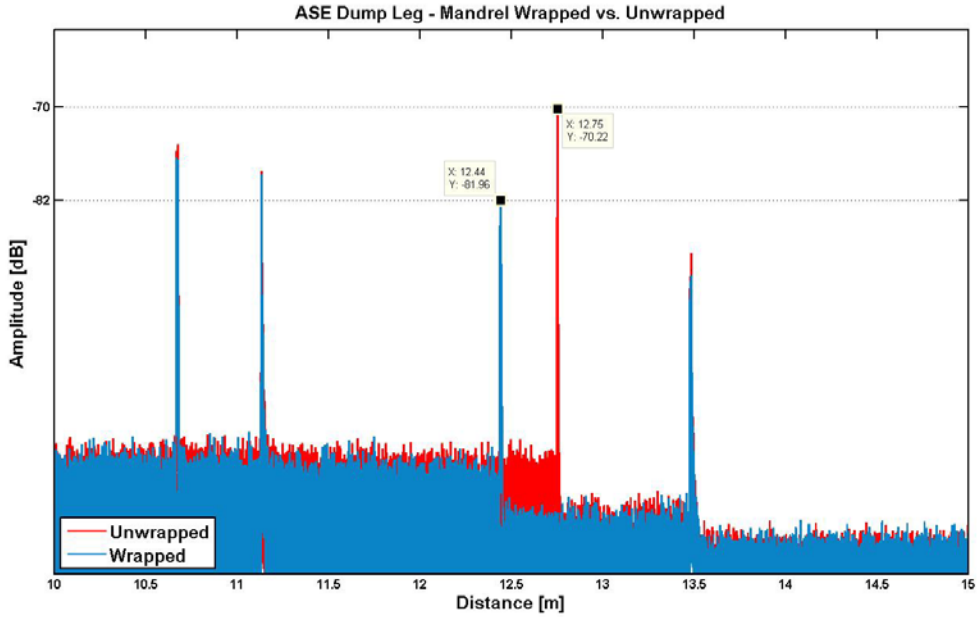
A visual representation of DFT from optical frequency domain to the optical time of flight.



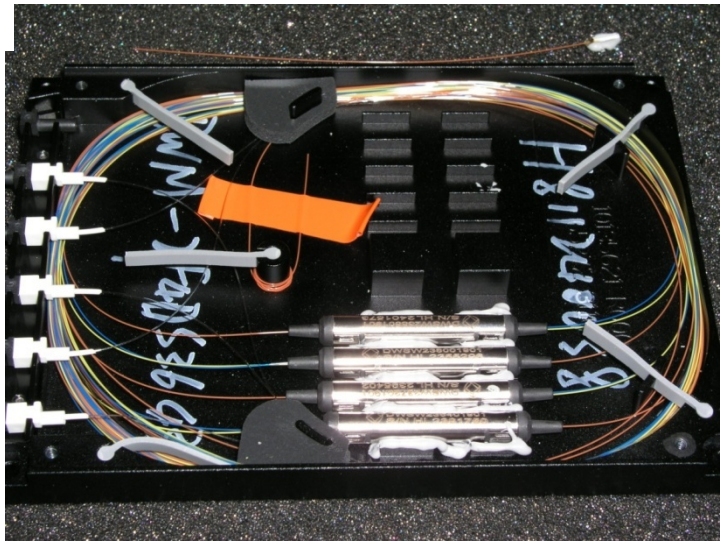
Each local reflection produces an optical frequency in the Mach-Zender based Interferometer.



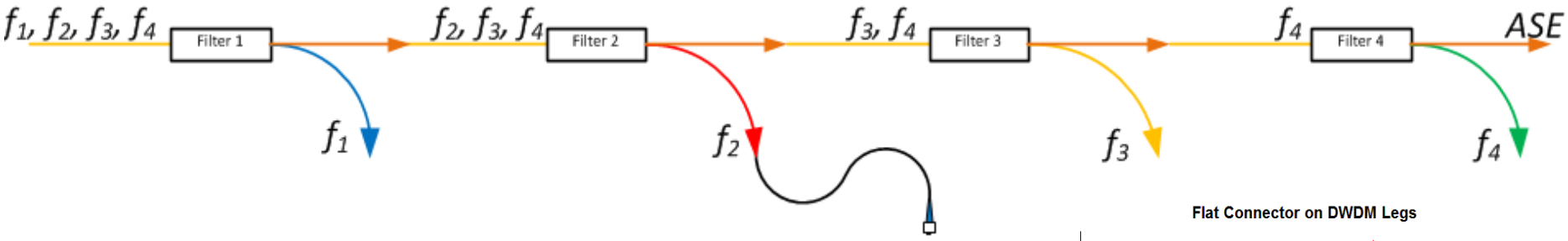
Decision – Mandrel Wrap ASE Dump Leg of DWDM



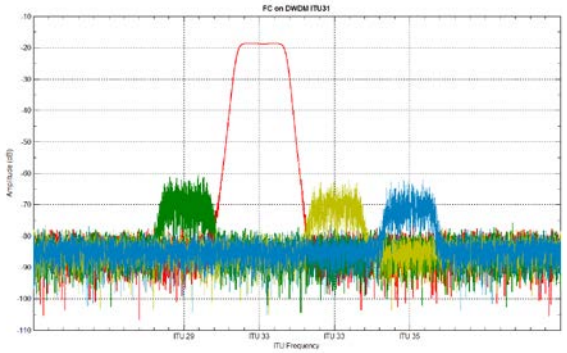
- Decreases back reflectance by ~10dB
- Requires small bend radius to reduce BR
- Weigh the risk of mandrel wrap

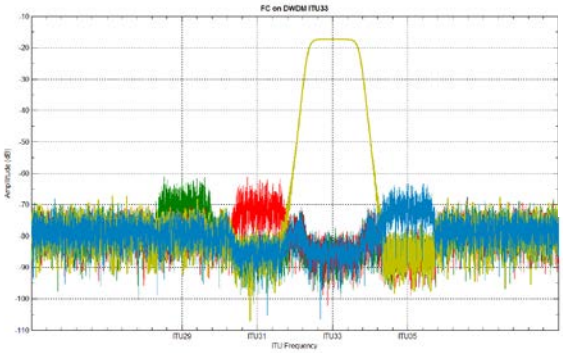


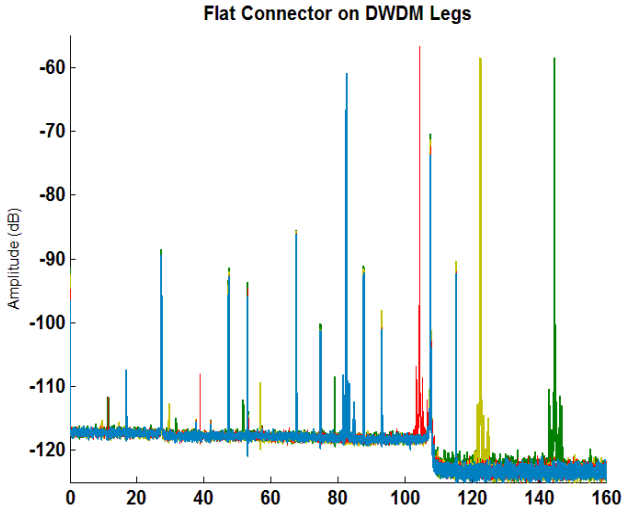
Indentifying Paths in Multiplexed System



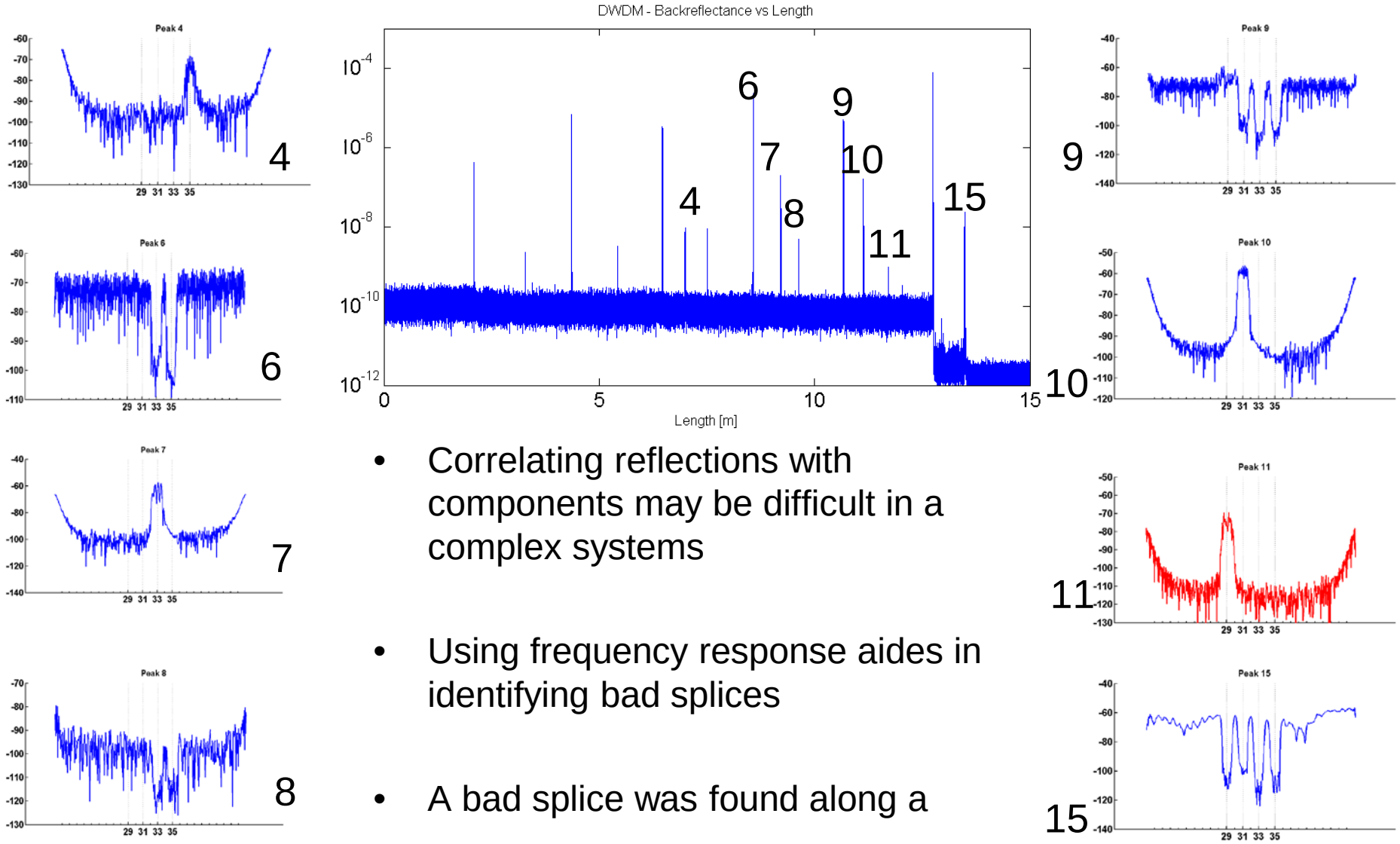
- Filters are operate in series
- Signal paths run in parallel
- Able to differentiate by frequency response





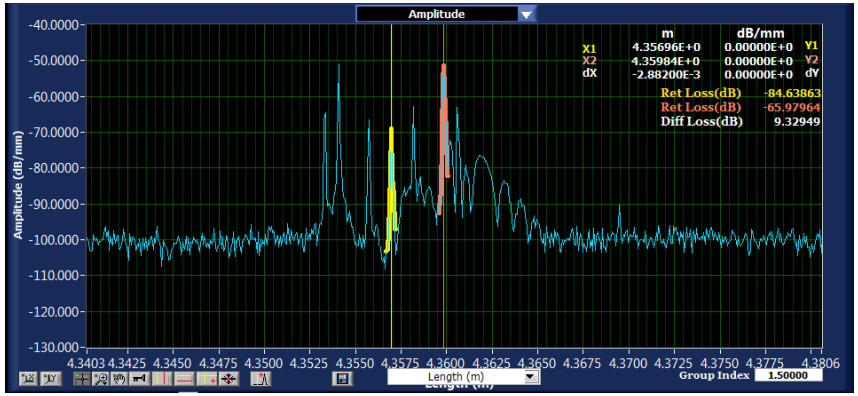


Finding faults in DWDM



- Correlating reflections with components may be difficult in a complex systems
- Using frequency response aides in identifying bad splices
- A bad splice was found along a

OFDR to Investigate Components

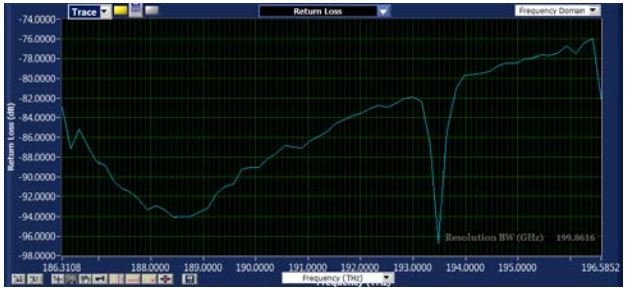


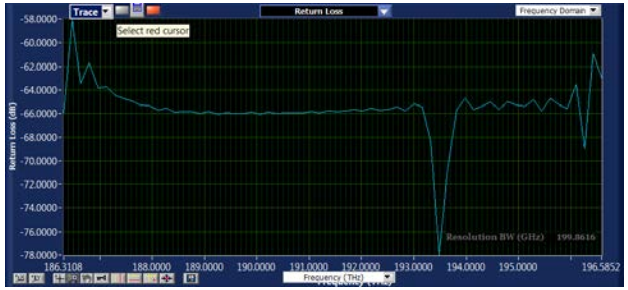
Amplitude vs Length

High spatial resolution allows sub-component interrogation

Spectral response provides a more complete picture

ITU35 filter

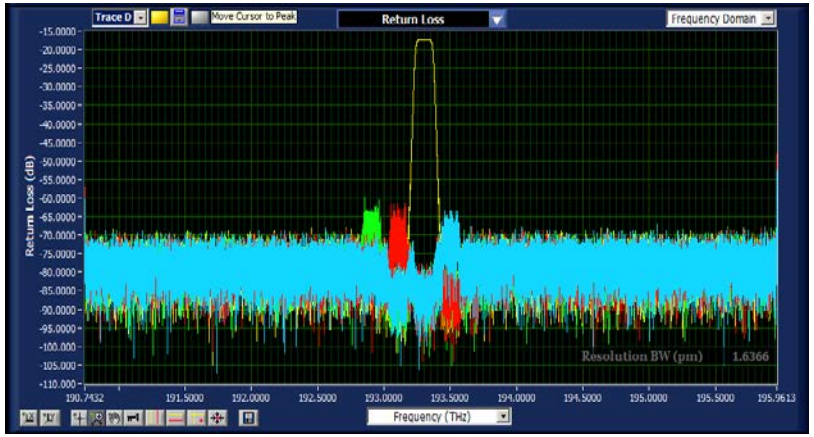


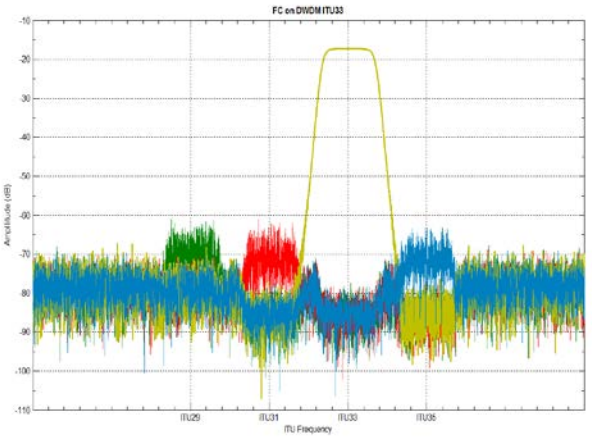


Return Loss vs. Frequency

Native Files versus .TXT Files

- BOSA PHASE and LUNA OBR4600 have the option to save files in either .bdr or .obr files
  - Binary data files
  - Need to know file structure beforehand (ie header lines, date stamp
  - Smaller size
  - More information
  - Manipulate data in another program (MATLAB, Igor)





Conclusions

- QA measurements of components before assembly is worth the time!
- Supplement time domain checks with frequency domain measurements to help troubleshoot
- Looked at BOSA PHASE and LUNA OBR4600
- Writing GUI to

On Going / Future Work

- Noise measurements (ASE-ASE, ASE-Signal, ASE
- Characterize Lasers (Temperature, Current)
- Characterize EDFA (
- Photo-detector Response