

# Impact of channel count of PMD Clause 154 on black link design and volume manufacturing

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# References in this Contribution

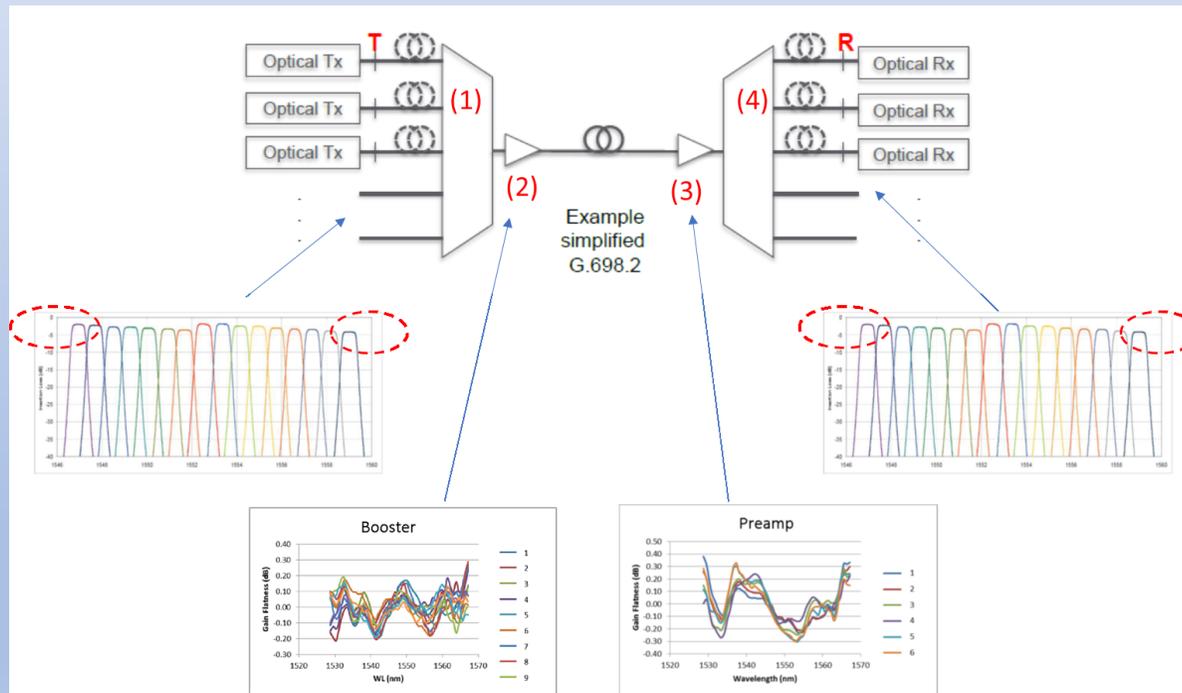
- “ Black Link Channel edge impairments and channel plan impacts for WDM Links”  
[http://www.ieee802.org/3/cn/public/18\\_11/deandrea\\_3cn\\_01c\\_1118.pdf](http://www.ieee802.org/3/cn/public/18_11/deandrea_3cn_01c_1118.pdf)
- Baseline considerations for 100G and 400G DWDM objectives”  
[http://grouper.ieee.org/groups//802/3/ct/public/19\\_03/stassar\\_3ct\\_01\\_0319.pdf](http://grouper.ieee.org/groups//802/3/ct/public/19_03/stassar_3ct_01_0319.pdf)
- “802.3ct wavelength grid considerations”  
[http://www.ieee802.org/3/ct/public/19\\_07/deandrea\\_3ct\\_01\\_0719.pdf](http://www.ieee802.org/3/ct/public/19_07/deandrea_3ct_01_0719.pdf)

# Contribution Investigation:

- Impact of channel count on EDFA power and design
- Optical Mux and DeMux manufacturing and impact
- Recommendation on PMD Channel count and start/stop frequency

# Black Link Model

- Main components
  - Optical Amplifier, Booster and Pre Amplifier
  - Passive Add/Drop (Mux and DeMux) Optical Filter



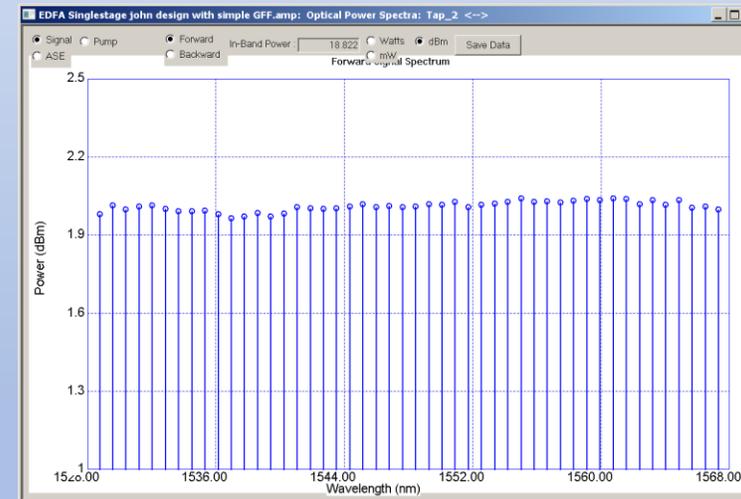
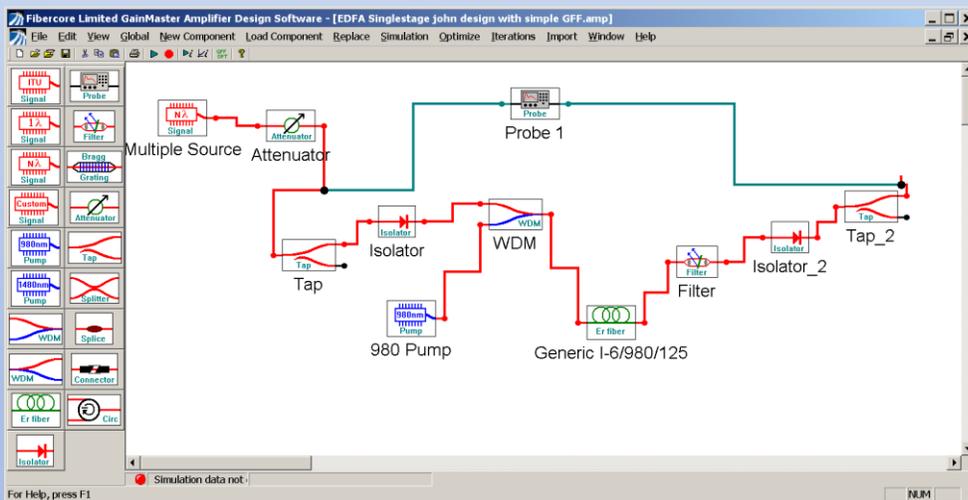
# EDFA Components

- Optical Isolators
  - PDL, to 0.2 db
  - WDL (flatness across band) to +/-0.2
- Optical Taps
  - PDL to 0.1 db
  - WDL to +/-0.2
- Pump Add Filter, 980/1550
  - PDL to 0.1 db
  - WDL to +/-0.1
- Erbium Fiber
  - Gain Medium, OSNR
  - Noise Figure
- Gain flattening filter
  - PDL to 0.1db
  - WDL (flatness across band) to +/-0.1

# EDFA Pump power Influence from channel count

- Assume EDFA design per channel power of +2 dbm:

Channel Count	P mW	P dBm	Pump Power@+2 dbm/ch
48	76.08	18.81	360
49	77.66	18.90	360.4
50	79.25	18.99	360.8



- Little impact on EDFA cost due to pump power increase

# Passive Add and Drop Filters (Mux and DeMux)

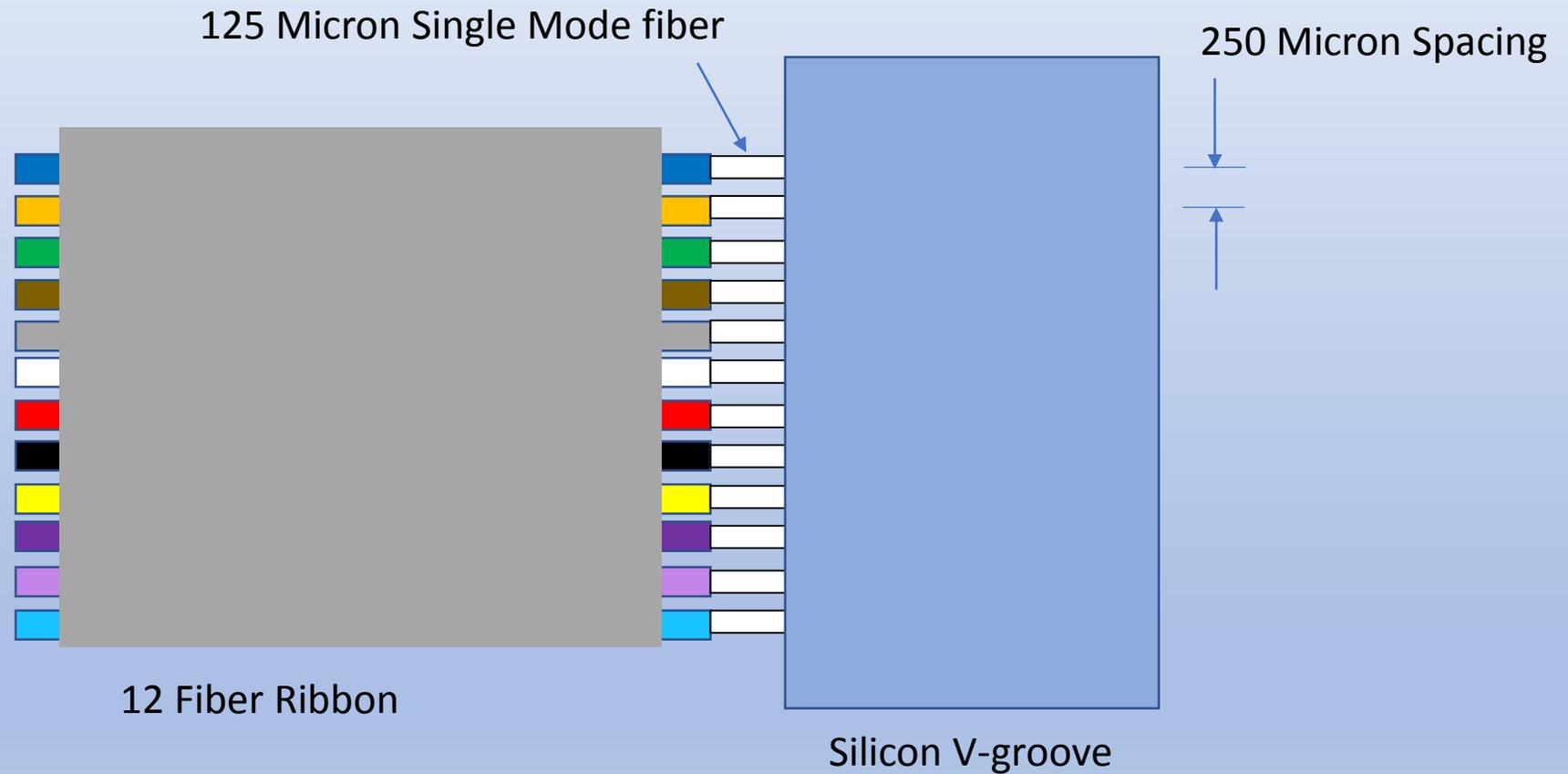
- Passive AWG filters are monolithic chips and fabricated to cover very wide frequency ranges
- They are typically fabricated as wide as possible for channel count to cover as many market applications as possible
- Coupling to these chips is typically V-groove silicon benches
- The V-grooves are built with ribbon fibers available from multiple high volume manufacturers of glass fibers
- Ribbon fibers have standardized to 8 and 12 channel counts and have been deployed in large mass volume, see Verizon, 2017 of 17 million fiber-km:

**“Verizon to buy \$300 million of fiber-optic cable from Prysmian,**

<https://www.lightwaveonline.com/fttx/cables-enclosures/article/16674010/verizon-to-buy-300-million-of-fiber-optic-cable-from-prysmian>

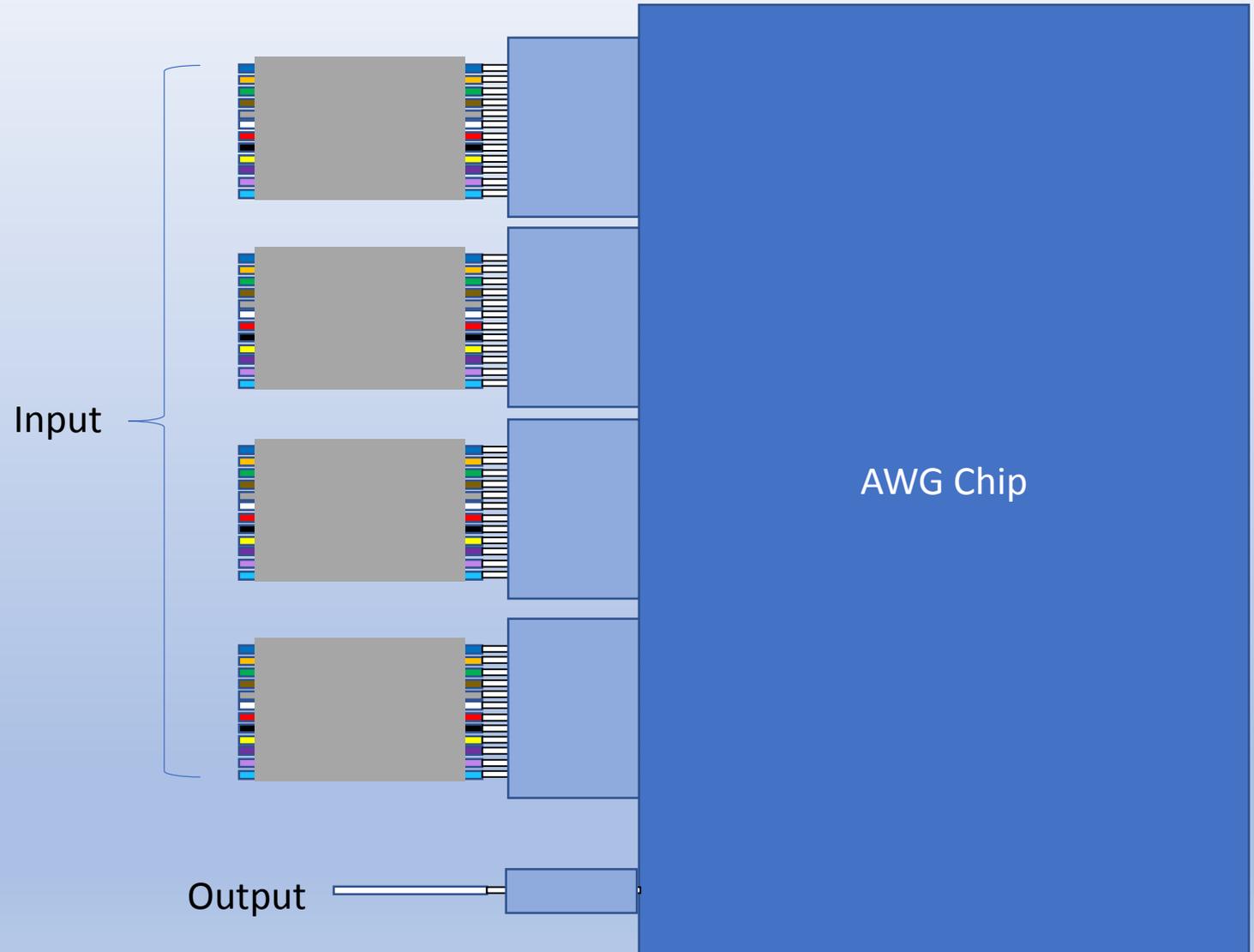
# Fiber Ribbon Assemblies

- Main components
  - Fiber Ribbon
  - Silicon V-Groove
  - Epoxy Attach



# AWG Mux and DeMux Coupling

- AWG Chip:
  - Channels designed with 250 micron spacing
  - Fiber Ribbon spacing aligned with chip in blocks of 12
  - Epoxy attach for 48 channels, 4 x12 ribbon assemblies



# Summary and Recommendation

- There relatively little impact of channel count on EDFA design when comparing 48, 49 or 50 channels
- There is an impact in going from 48 to 49 or 50 channels due to volume production with ribbon fibers in the AWG coupling
- Recommend IEEE P802.3ct committee adopt 48 channels as the channel count for PMD Clause 148, 100GBASE-ZR
- Recommend IEEE P802.3ct committee adopt OIF 48 channel range:
  - Start Frequency: 191.4 THz
  - Stop Frequency: 196.1 THz