Channel compliant bandwidth mask considerations for 100 GHz spaced 100G and 400G links

Presenter: John DeAndrea

Affiliation: Finisar

Supporters

- Your name

Contents

- Prior work: “Coherent 100G and 400G PMD Layer WDM considerations”, deandrea_3cn_01c_1118.pdf
- Black Link Model, “Further considerations on objectives for PHYs running over point-to-point DWDM systems” stassar_b10k_01_0318.pdf
- Additional parameters for channel filters and impairments
- PMD compliant mask, 100G and 400G proposal
- Channel filter ripple mask
- Test Methods
- Wrap up and next steps

Our goal in P802.3ct

- We would like to get away from engineered links, and provide an P802.3ct specification for WDM links which can be tested and be interoperable with many transmitter and receiver implementations
- For the black link, our use case is 80 km, and 2 filters only
- The effects of the channel, based on the filters and components in the link, can be properly bounded with a compliant channel mask
- Eye masks have been successfully used in area's of IEEE 802.3, see 10GBASE-S/L/R, King_2_0711.pdf

On black link channel filters:

- ITU-T G.698.2 Figure 7-3 discusses the channel with regard to passband ripple
- For IEEE, an acceptable channel bandwidth mask can be realized for both the 100G and 400G options

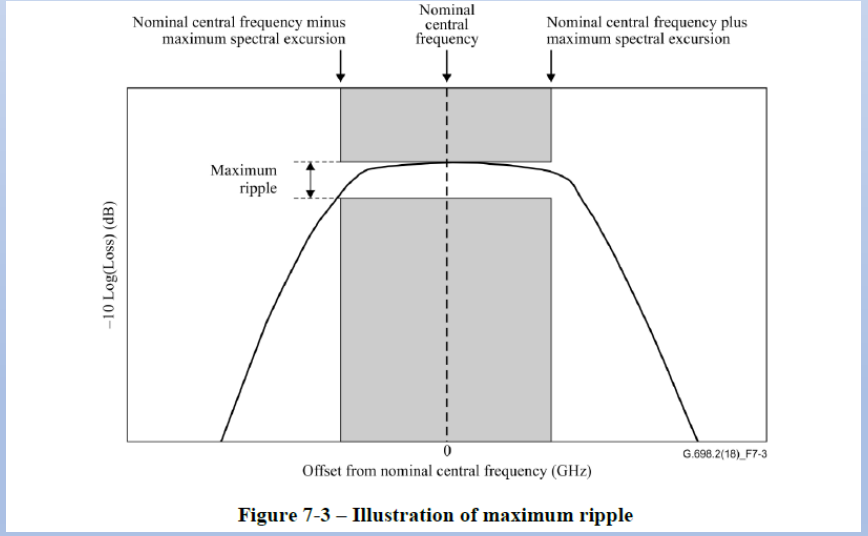


Figure 7-3

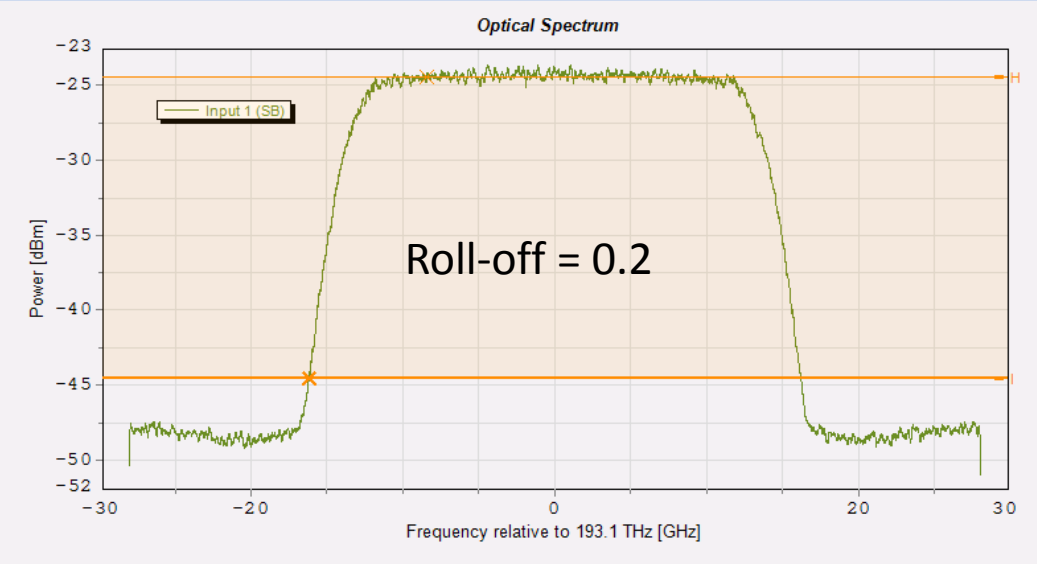
PMD cable plant channel bandwidth definitions

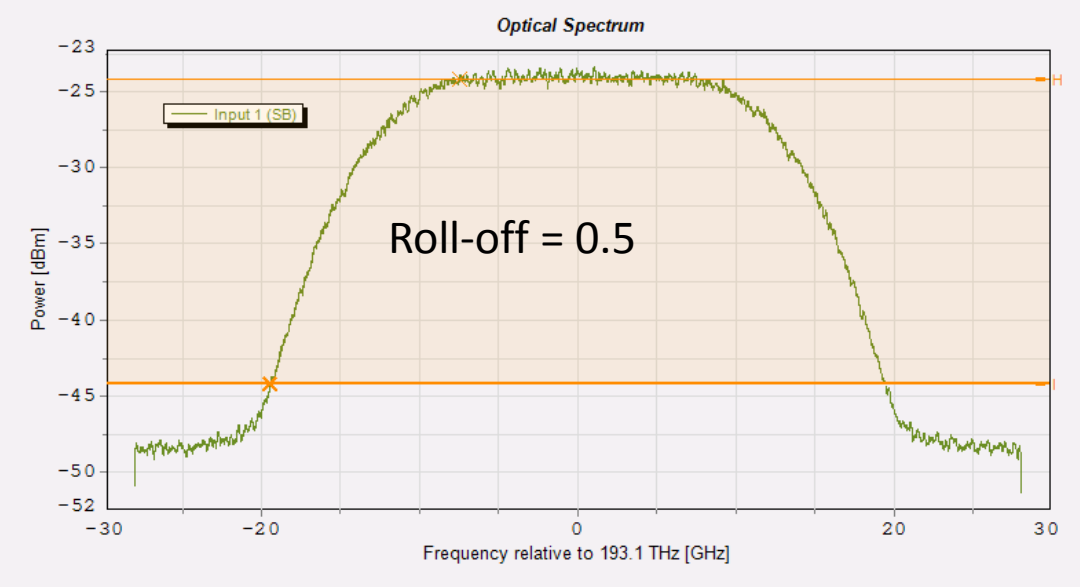
- Let's talk in IEEE terms, and add some additional definitions for compliant channel in terms of cascaded filters
  - 0.5 dB clear channel passband: This is the minimum bandwidth the channel must support to allow transmitter central frequency tolerance + modulation to propagate and allow transmission of a BER impairment of less than 0.x dB
  - 3 dB clear channel passband: This is the minimum bandwidth the channel must support to allow transmitter central frequency tolerance + modulation to propagate and allow transmission of a BER impairment of less than 0.x dB
  - 20 dB clear channel passband: This is the minimum bandwidth the channel must support to allow transmitter central frequency tolerance + modulation to propagate and allow transmission of a BER impairment of less than 0.x dB

100G coherent modulation bandwidth

QPSK	0.2 roll-off	0.5 roll-off
0.5 dB BW	10.2	8.0
3 dB BW	11.2	10.2
20 dB BW	13.7	16.5

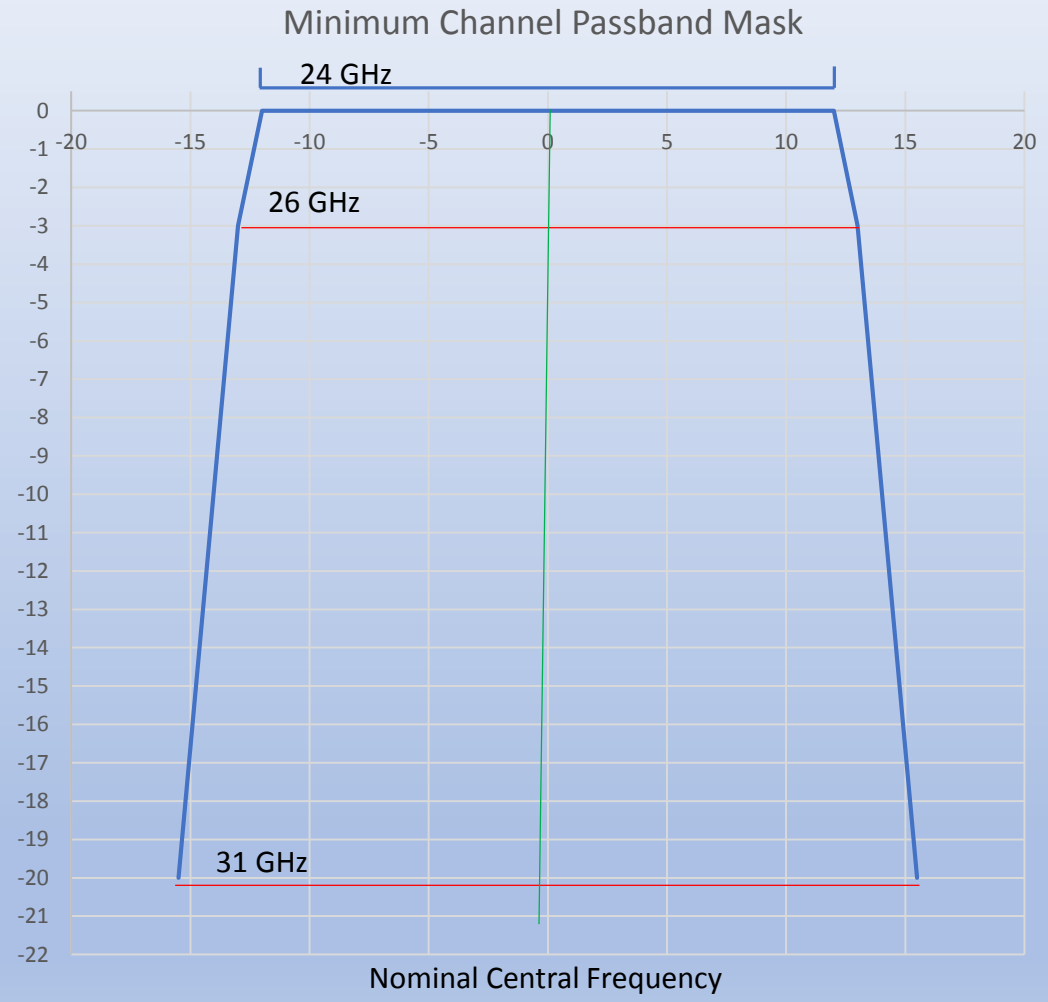
Modulation half BW





Note: Chart scaled for 25.78125 rate
ref: [deandrea_3cn_01c_1118.pdf]

100G Compliant channel passband characteristic



QPSK	0.2 roll-off	0.5 roll-off
0.5 dB BW	10.2	8.0
3 dB BW	11.2	10.2
20 dB BW	13.7	16.5

Modulation half bandwidth

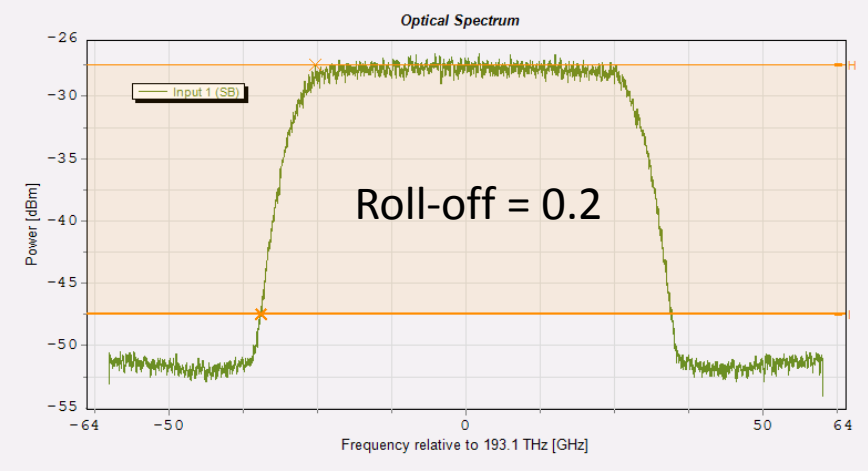
Channel	- side	+side
0.5 dB BW	12.0	12.0
3 dB BW	13.0	13.0
20 dB BW	15.5	15.5

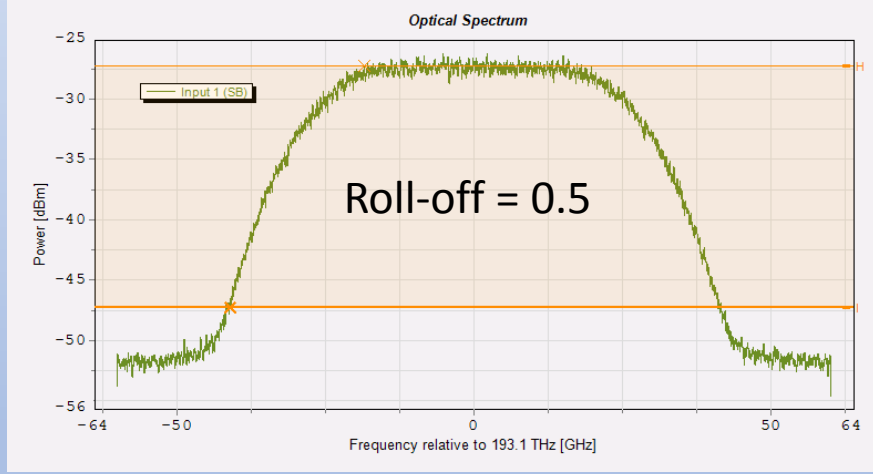
Minimum Filter half bandwidth
(Added Tx center accuracy)

400G coherent modulation bandwidth

16 QAM	0.2 roll-off	0.5 roll-off
0.5 dB BW	25.8	21.2
3 dB BW	27.4	23.7
20 dB BW	34.4	40.7

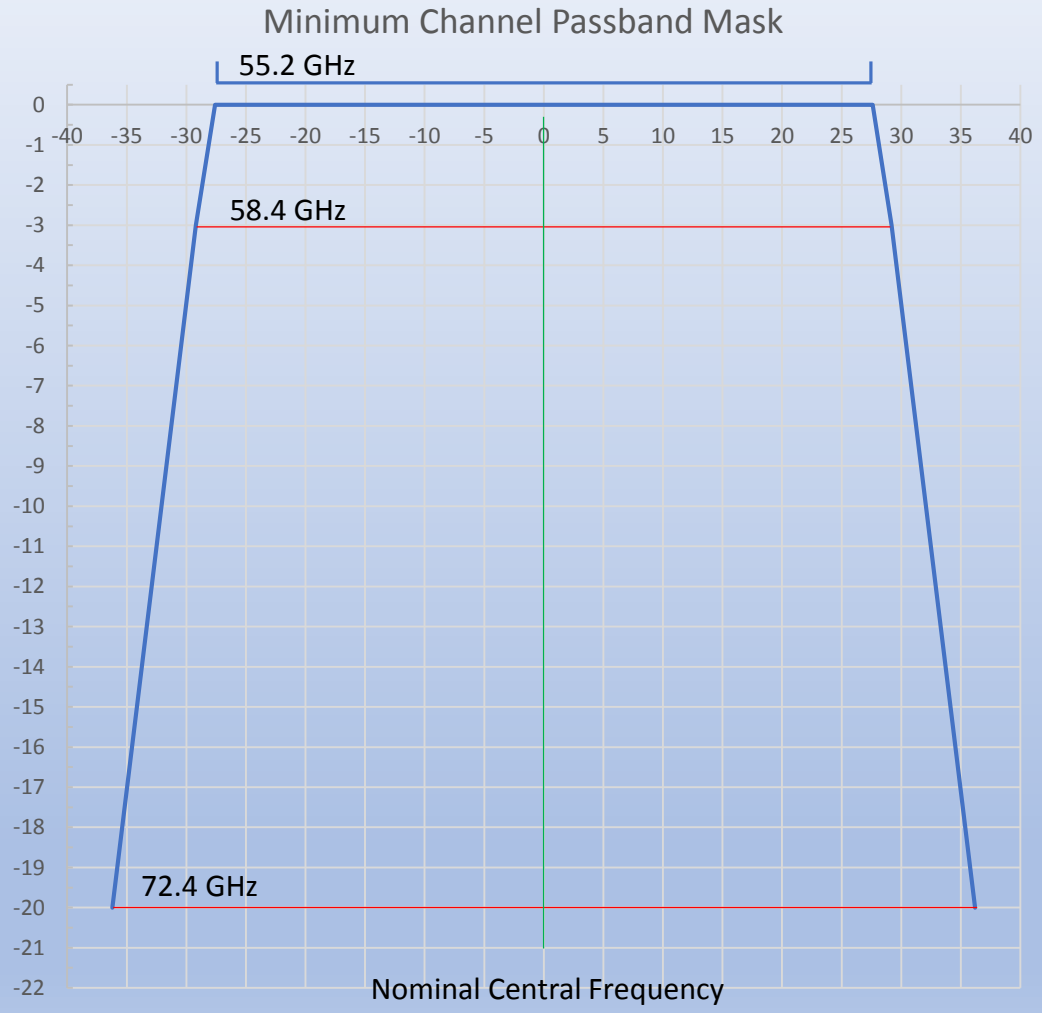
Modulation half bandwidth





Note: 59.84375 rate

400G Compliant channel passband characteristic



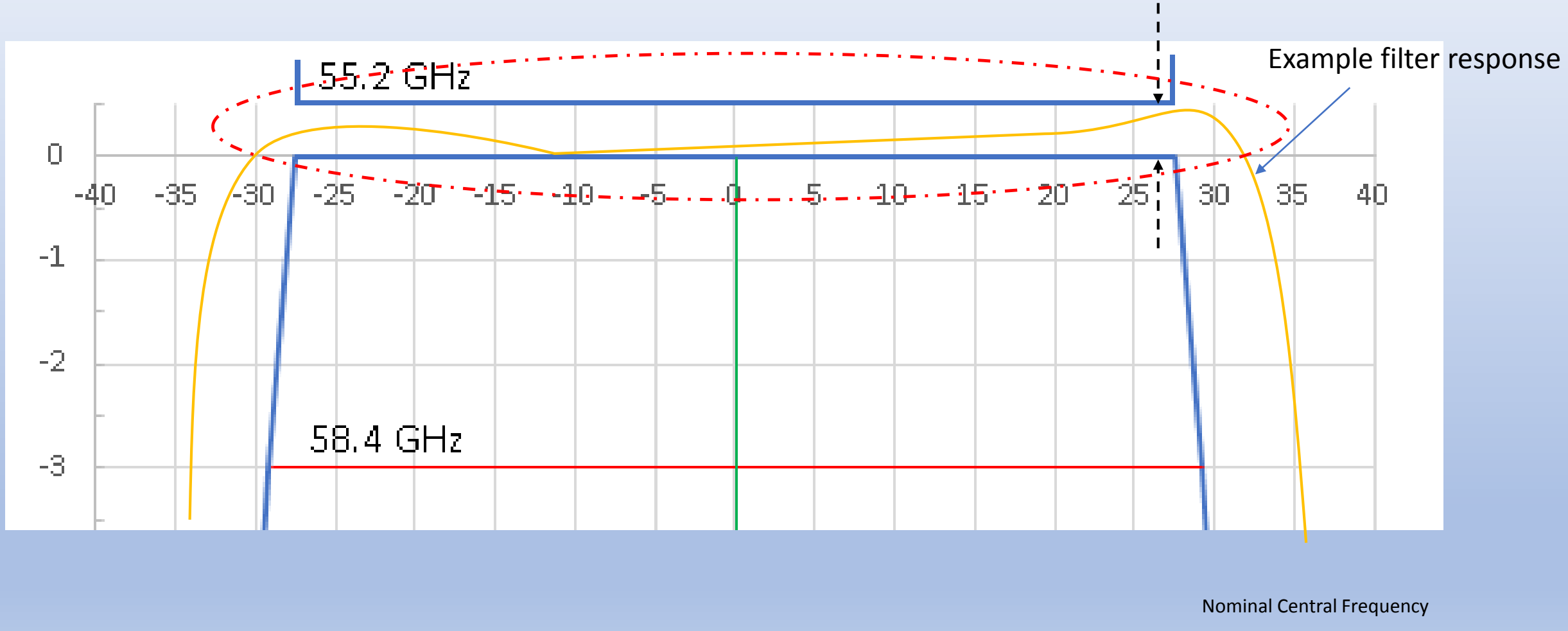
16 QAM	0.2 roll-off	0.5 roll-off
0.5 dB BW	25.8	21.2
3 dB BW	27.4	23.7
20 dB BW	34.4	40.7

Modulation half bandwidth

Channel	- side	+side
0.5 dB BW	27.6	27.6
3 dB BW	29.2	29.2
20 dB BW	36.2	36.2

Minimum Filter half bandwidth
(Added Tx center accuracy)

Channel ripple passband mask



PMD cable plant channel bandwidth test method 1

- Equipment
  - Amplified spontaneous emission power source (ASE)
    - Similar to an EDFA, but no signal amplification
    - Covering the transmitter channel range
    - This type of source emits all states of polarization
  - Coherent optical channel monitor(C-OCM)
    - This is similar to an optical spectrum analyzer
    - Differs in that it uses a coherent dual polarization detector
    - Correlates well to coherent receiver designs

PMD cable plant channel bandwidth test method 1

- Test Steps
  - ASE source is turned on and plugged into C-OCM
  - Full sweep is done and data points stored
  - ASE source plugged into the mux/cable plant
  - Scan done on far side demux
  - Full sweep scan subtracted from far side scan
  - Result is PMD cable plant filter response
- Pros: Fast and simple method
- Cons: No PDL data

PMD cable plant channel bandwidth test method 2

- Equipment
  - Swept wavelength tunable laser
  - Polarization controller
  - Power meter

PMD cable plant channel bandwidth test method 2

- Test Steps
  - Swept wavelength source set to step across PMD channel plan
  - Polarization controller synchronized with steps
  - Power meter synchronized to source and controller
  - Samples taken for full channel plan
- Pros: Channel bandwidth and polarization information
- Cons: Remote synchronization, PDL/PDG stability

Wrap up and next steps

- Presented and proposed a filter mask to IEEE P802.3ct for adoption in the channel PMD section of the specification
- Ask the working group to consider this for adoption to insure interoperable PMD transmitter, cable plant, and receiver designs
- Presented test methods for channel characterization for channel bandwidth and PDL/PDG
- Plan testing of mux/demux, amplifiers and 80 km fiber with proposed test methods

Last slide

- Thankyou!