Exploring the Feasibility of Longer Reach

An Overview of Tradeoffs

Vipul Bhatt, II-VI

Jose Castro, Panduit

Lance Thompson, II-VI

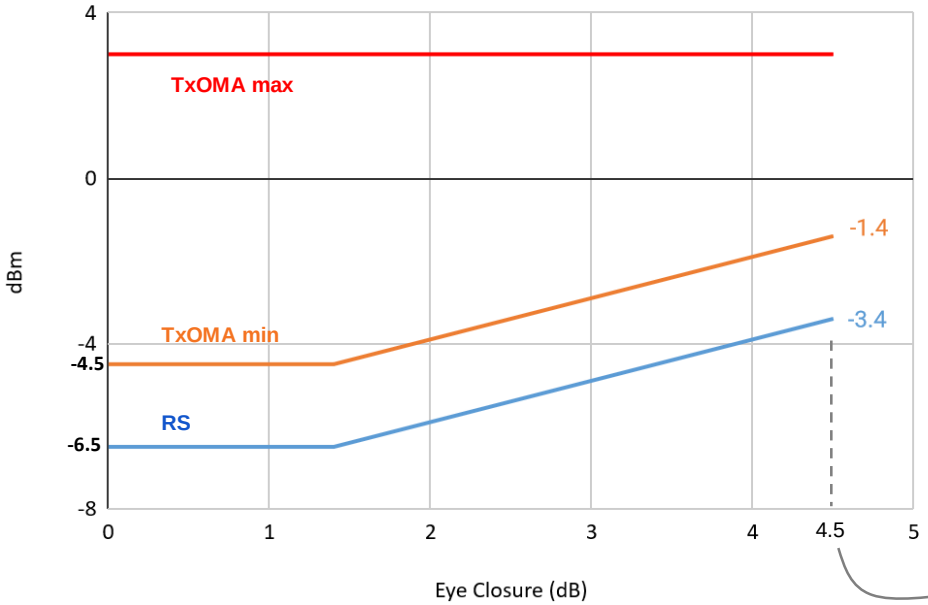
IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group
May 2020

OMA Budget: How to Move from 50G to 100G

Starting Point: 50G-SR Specs, Clause 138

TxOMA min: Move up by 2 dB (to follow RxOMA curve)

RS: Move up by 2 dB (smaller area of photodiode, 2x noise power)

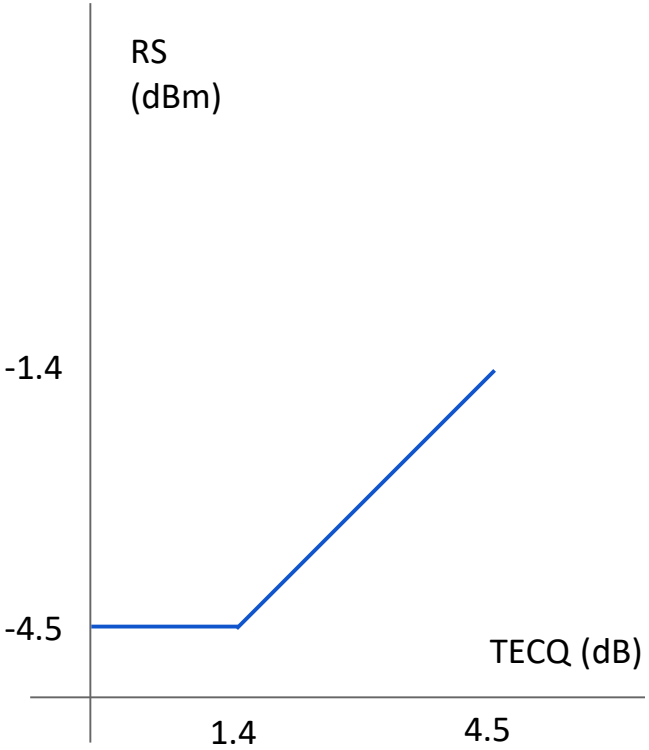


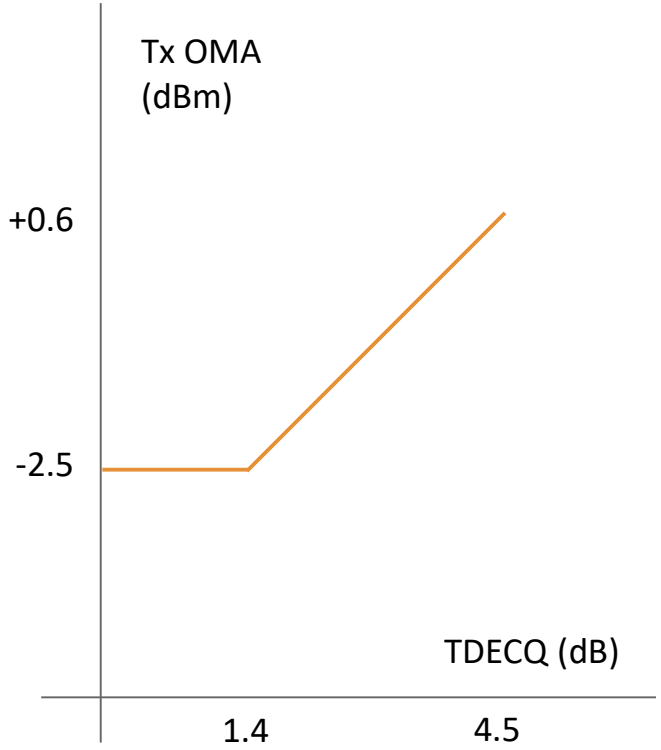
TxOMA max: Don't move this up too much (yields, RIN)

1.9 dB channel insertion loss + 0.1 dB. Maintain.

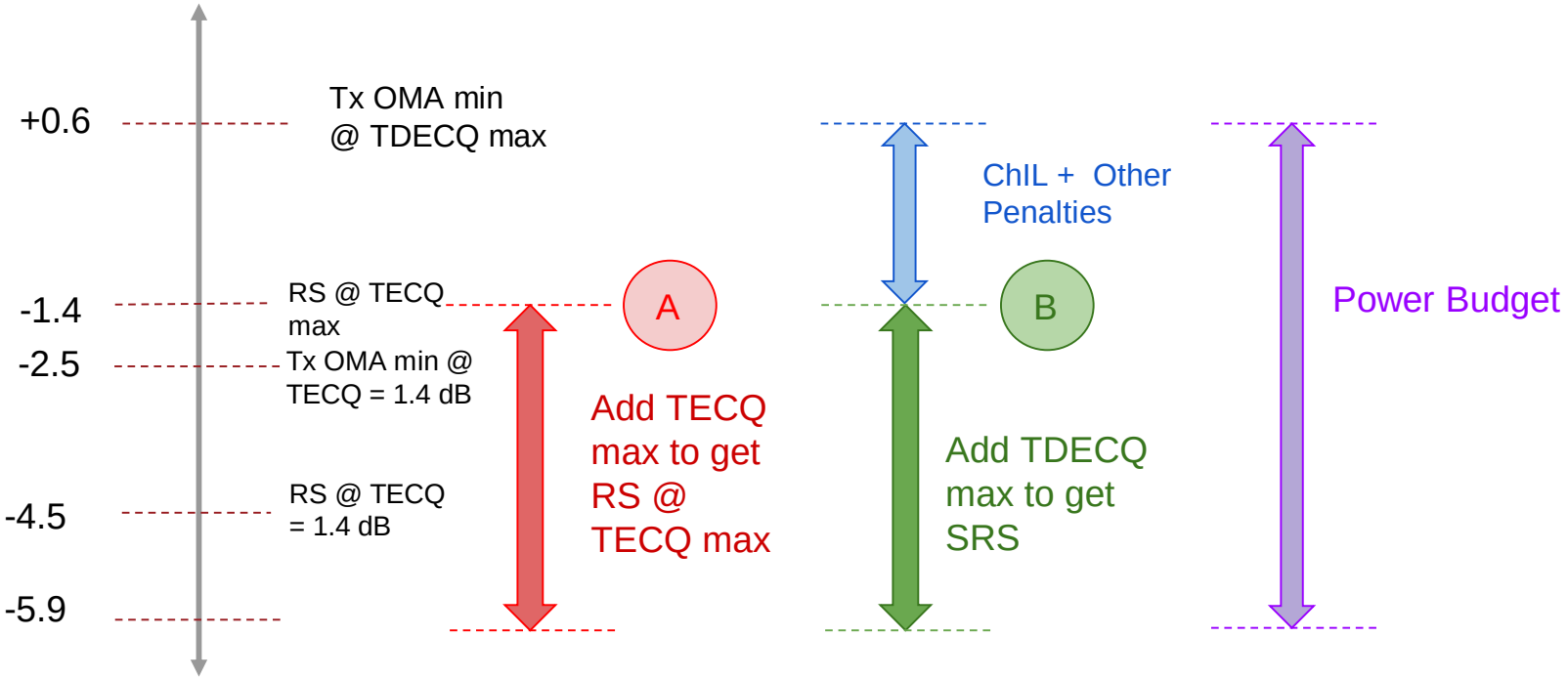
TDECQ max, TECQ max. Already high. Maintain!

Strawman 100G OMA Budget

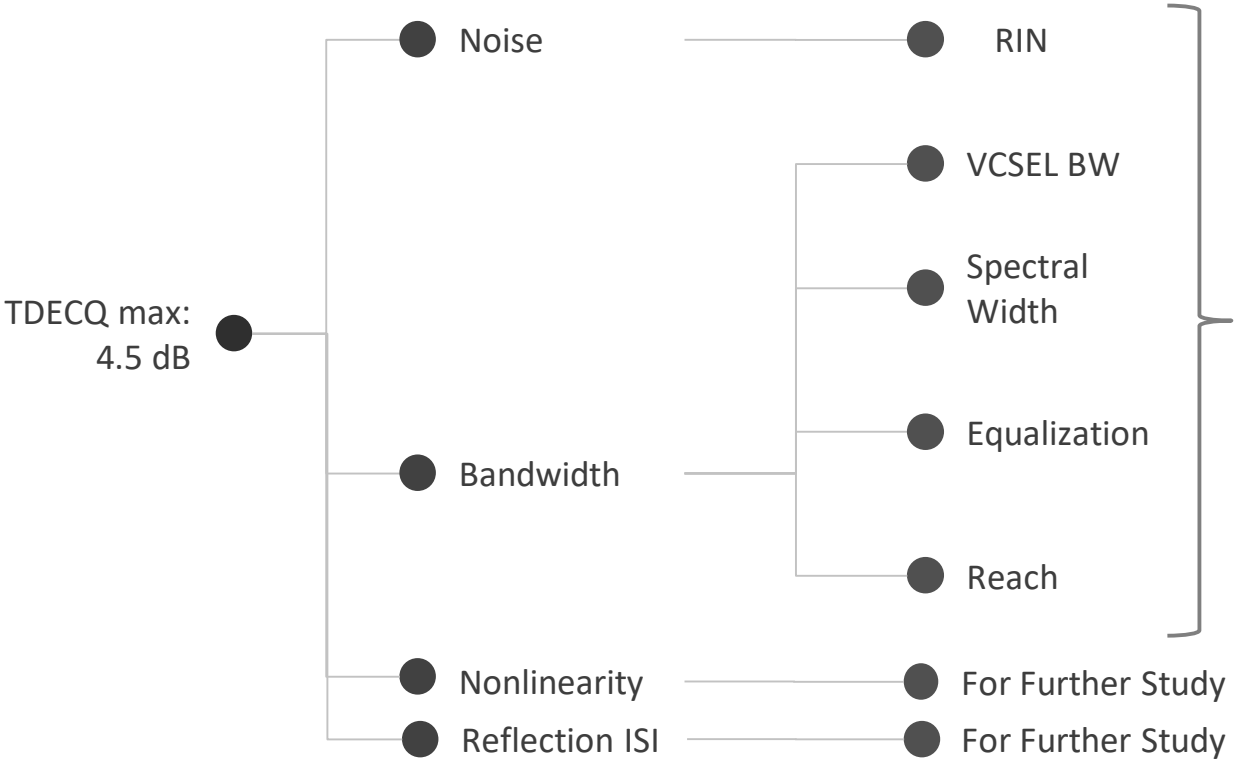




Strawman 100G OMA Budget



Eye Closure Factors

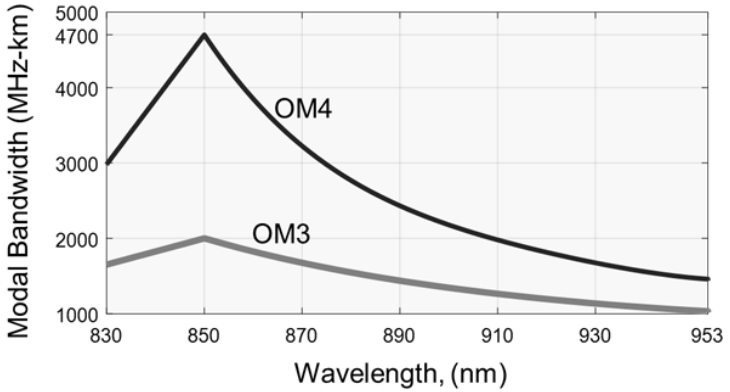


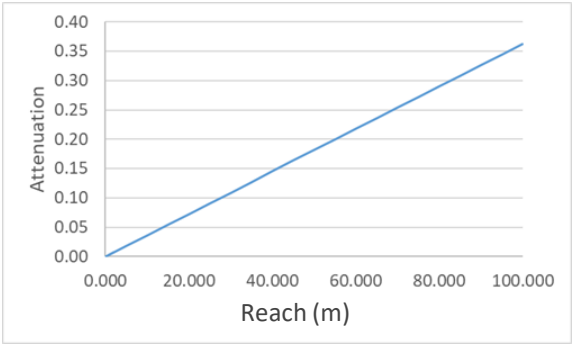
We focus on 5 major factors that affect TDECQ. To get a directional sense, we can plot TDECQ (or penalties, for convenience) as a function of any one variable by holding the other four constant.

Model Inputs

Inputs, assumptions:

Tx OMA: +0.6 dBm
Q: 3.49
Signaling Rate: 53.125 GBaud
Wavelength: 844 nm
ER min: 3 dB
RIN12OMA: Varied around -131 dB/Hz (3 dB more aggressive than 400G-SR4.2)
Effective DJ: 0.1 UI
MPN k (OMA): 0.1
ChIL: Fiber attenuation + 1.5 dB for connectors
Additional penalty: 0.1 dB
Rx Bandwidth: 26.56 GHz
Tx impulse response: Gaussian



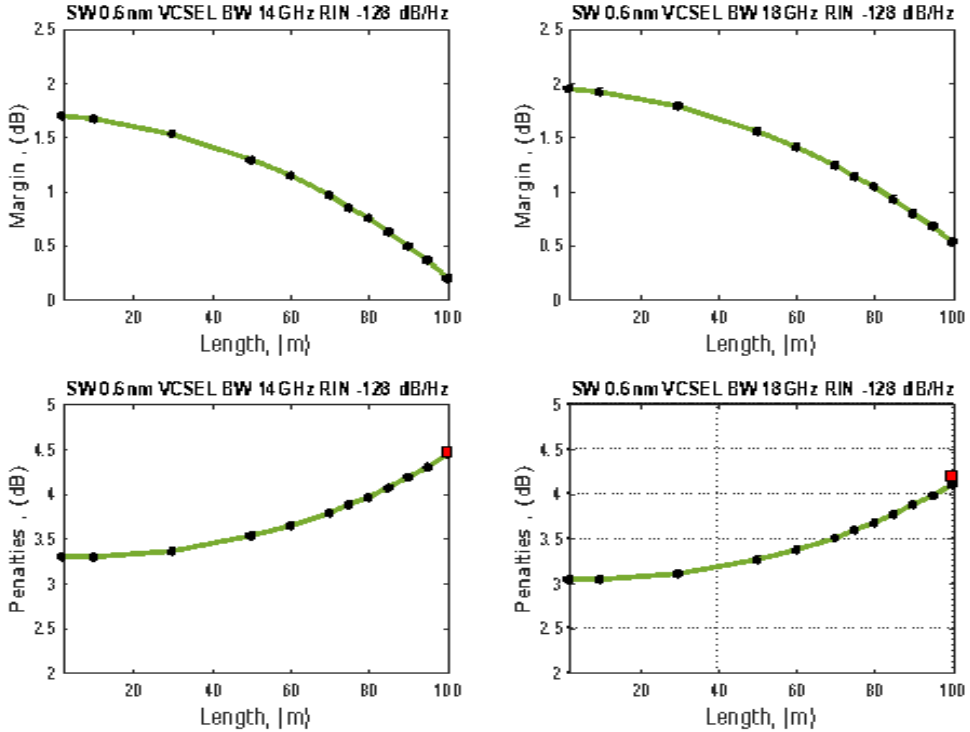


Caveat

"All models are wrong, but some models are useful." – George E. P. Box

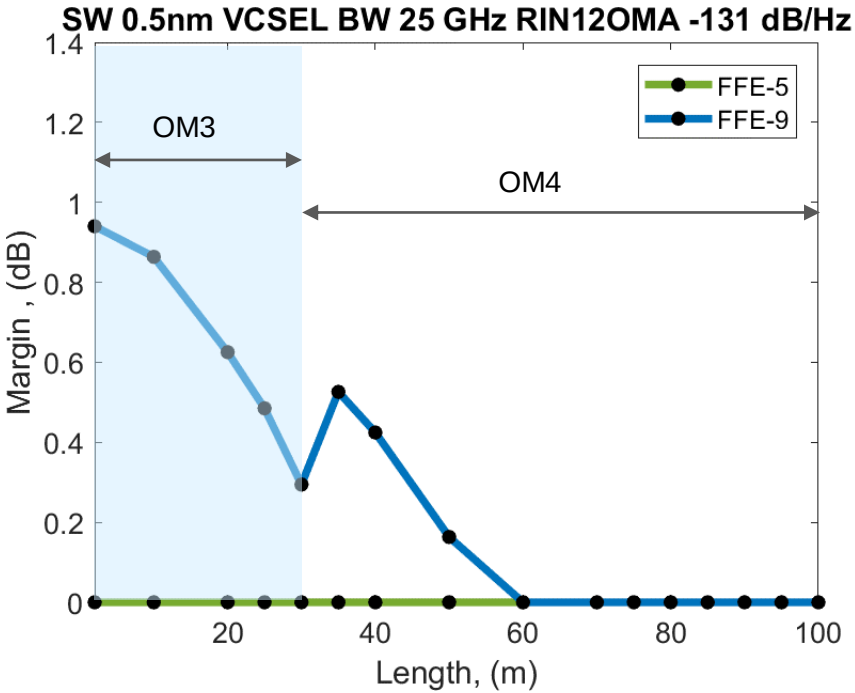
The work presented here is based on modeling and analysis that is still work in progress. It has not been correlated with measurements. Our purpose is to present a directional sense of tradeoffs.

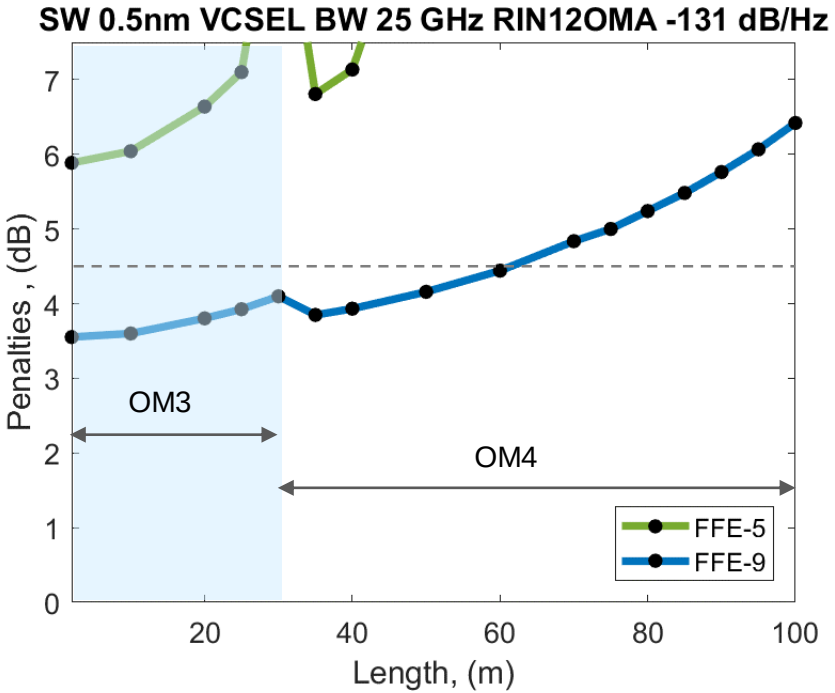
The Model Was Validated Against 50G-SR Specs



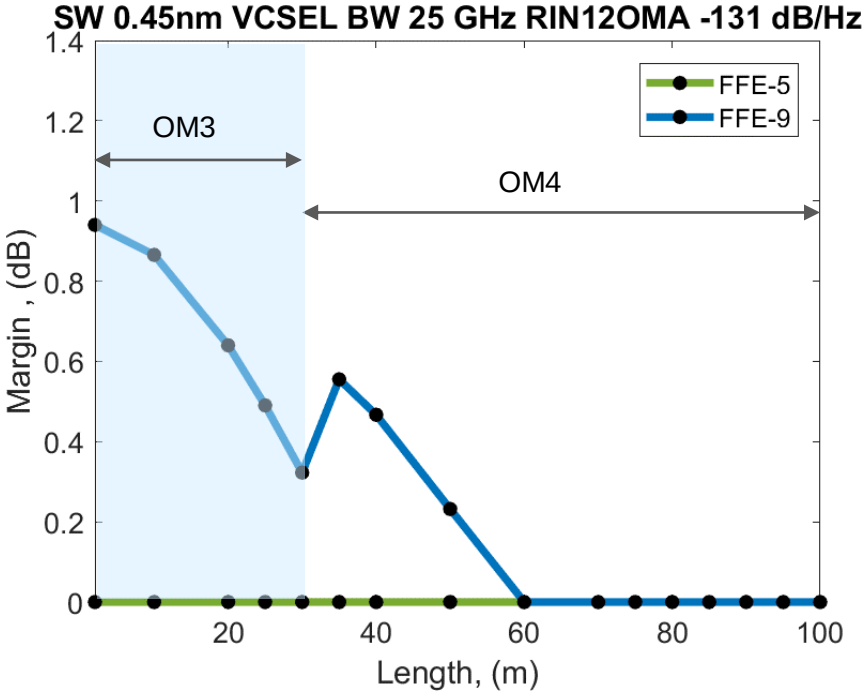
Computed TDECQ (red squares) matches well with IEEE specs

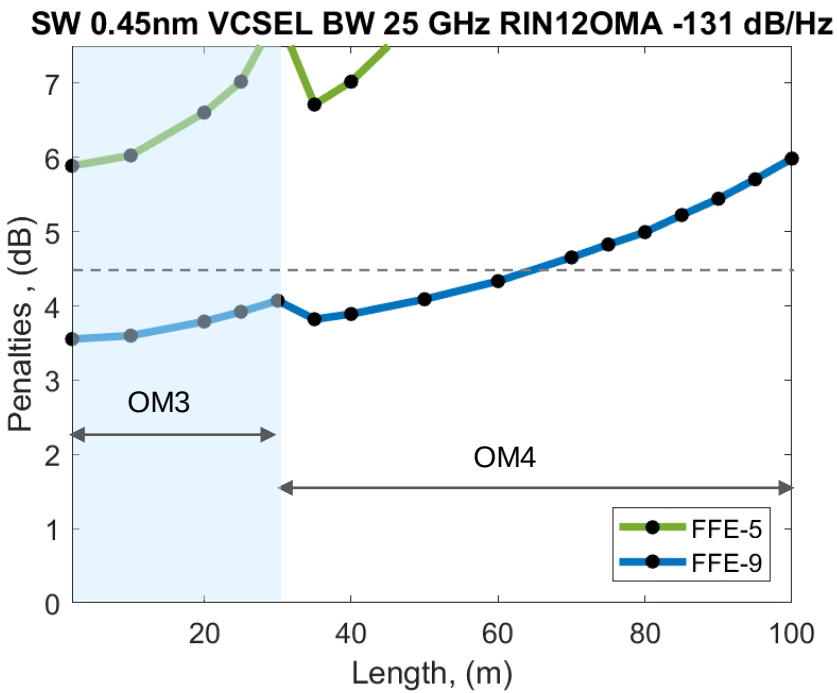
More Equalizer Taps Are Very Helpful





Reducing Spectral Width to 0.45 nm is Marginally Helpful



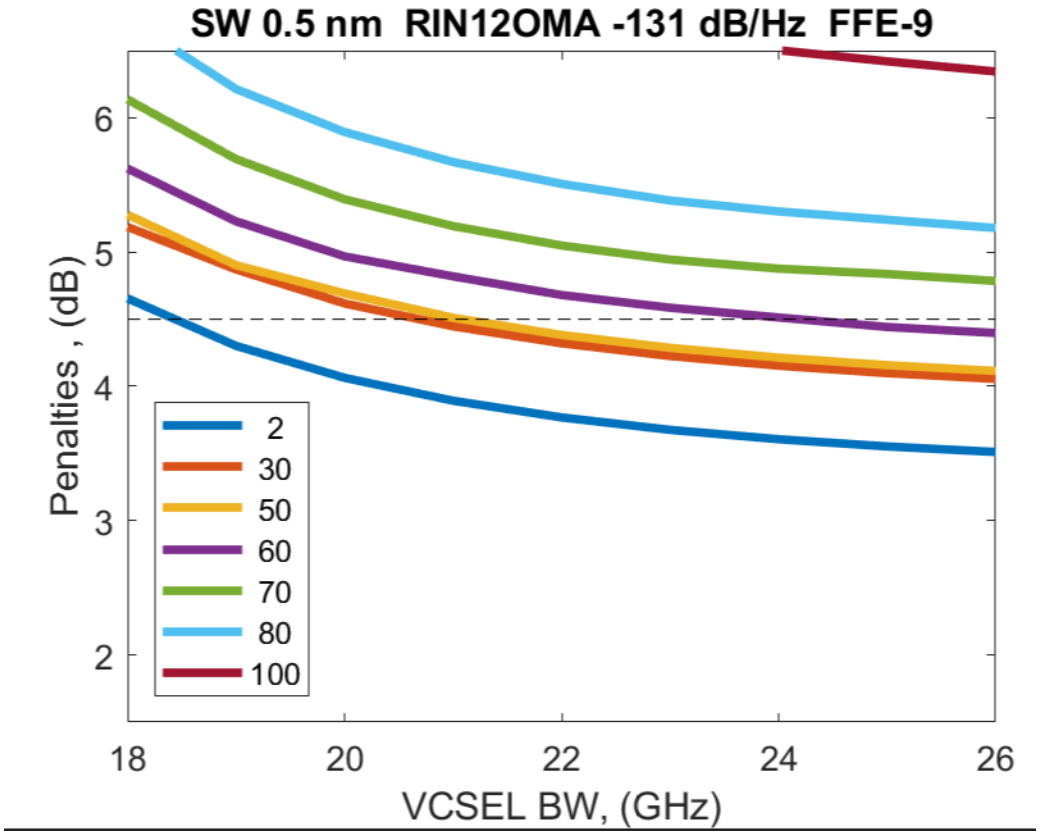


Effect of VCSEL Bandwidth (at 0.5 nm Spectral Width)

More VCSEL bandwidth helps

But offers diminishing marginal benefits at the high end

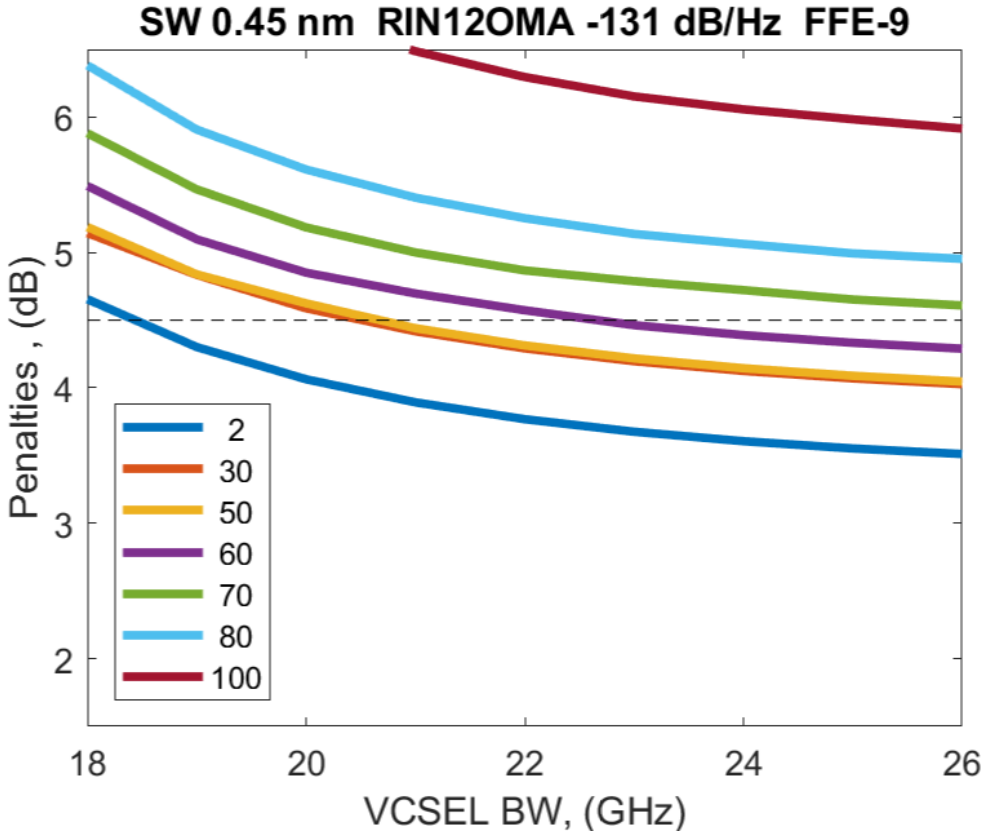
Penalties for 30 m OM3 and 50 m OM4 are essentially the same



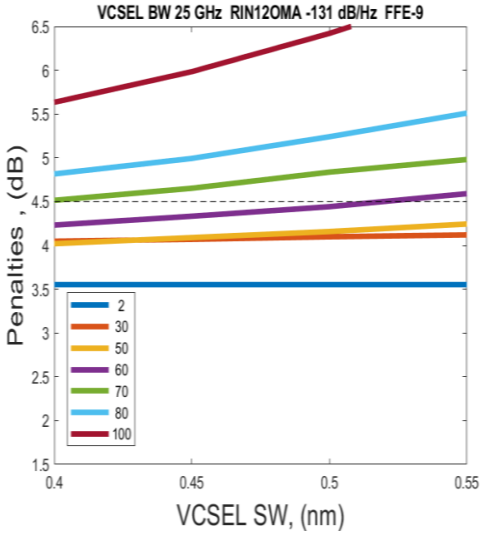
Effect of VCSEL Bandwidth (at 0.45 nm Spectral Width)

Reduced spectral width helps a little

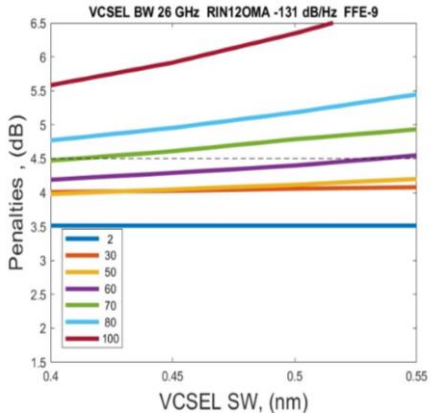
It brings us closer to the 70 meters line (green), but not quite



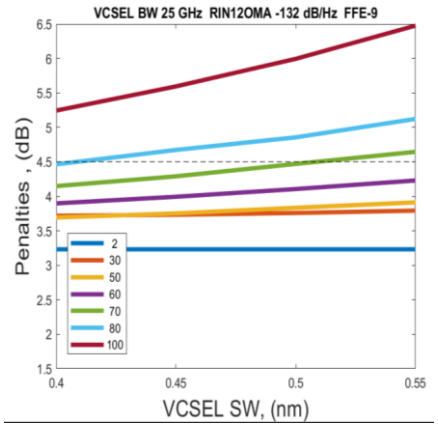
RIN is a Bigger Lever than VCSEL Bandwidth



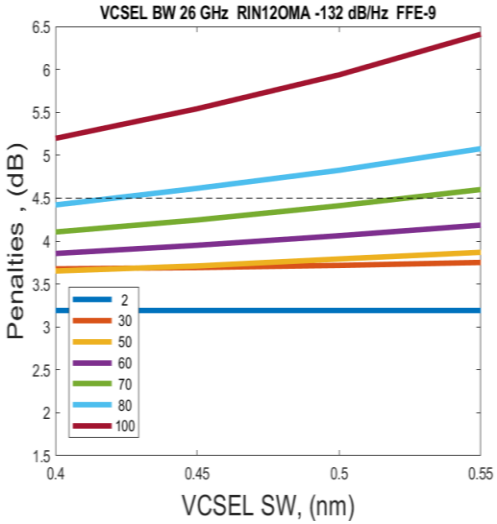
Improve Bandwidth



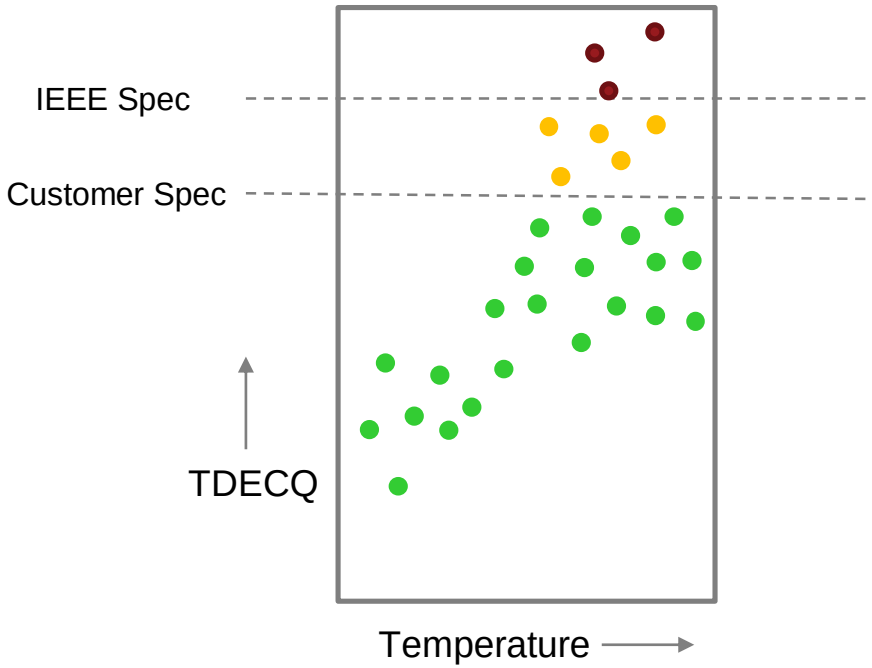
Improve RIN

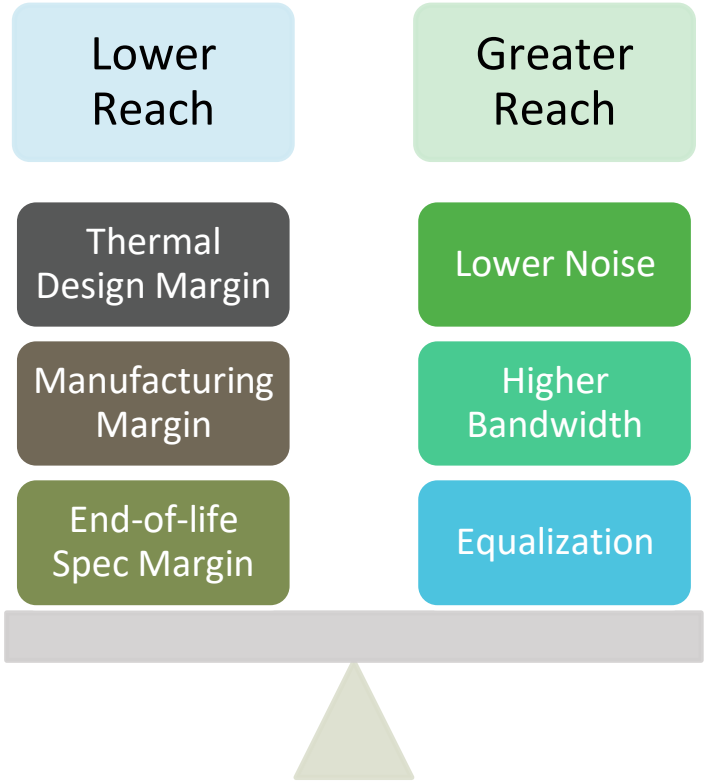


Improve Both



Successful Products Need Design Margin





Concluding Remarks

1. To support a reach greater than 50 meters, Equalization and RIN are big levers worth exercising
2. Improvements in VCSEL bandwidth and spectral width help, but with diminishing marginal benefits
3. Penalties for 30 meters on OM3 and 50 meters on OM4 are comparable
4. We must add margin, and we must support target specs with measurements
5. Supporting a reach greater than ~70 meters will require improvement in component specs beyond what was presented today
6. Discussion