

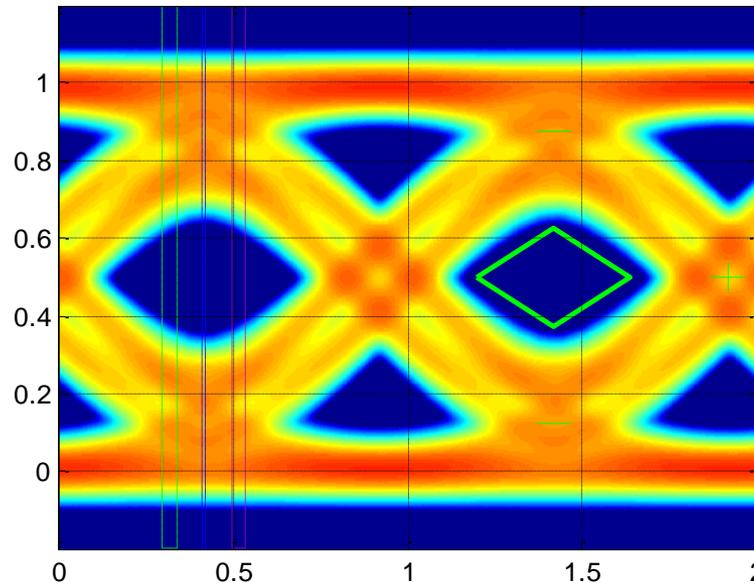
Stressed eye simulations for 100GBASE-SR4

Piers Dawe
Mellanox Technologies

Introduction

- The stressed eye generator is fairly involved and could be difficult to implement and tune
- Its parameters need to be consistent with worst case transmitters and channels
- Need a definition that will lead to consistent tests
- This presentation investigates the stressed eye generator by simulation

Simulated worst case received signal

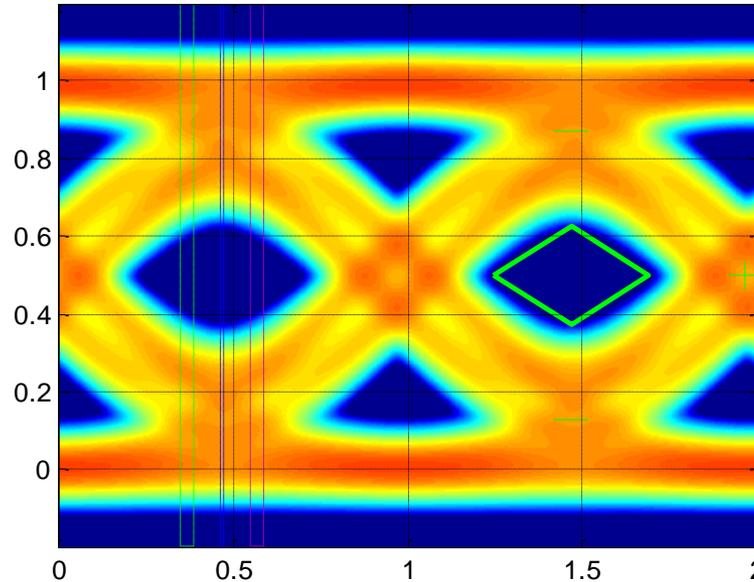


*This should
be our target*

*SEC is much
less than 4.9
dB*

- Parameters as link model, ideal reference receiver
- SEC = 3.9 dB Target ? dB
- J2 between 0.37 and 0.40 UI Target ? UI
- J4 between 0.49 and 0.53 UI Target ? UI
- J4-J2 = 0.12 to 0.13 UI (target) ? UI
- More high probability jitter, less tails, than SRS Eye shape is like the mask

Simulation of TDEC analysis of worst case transmitted signal



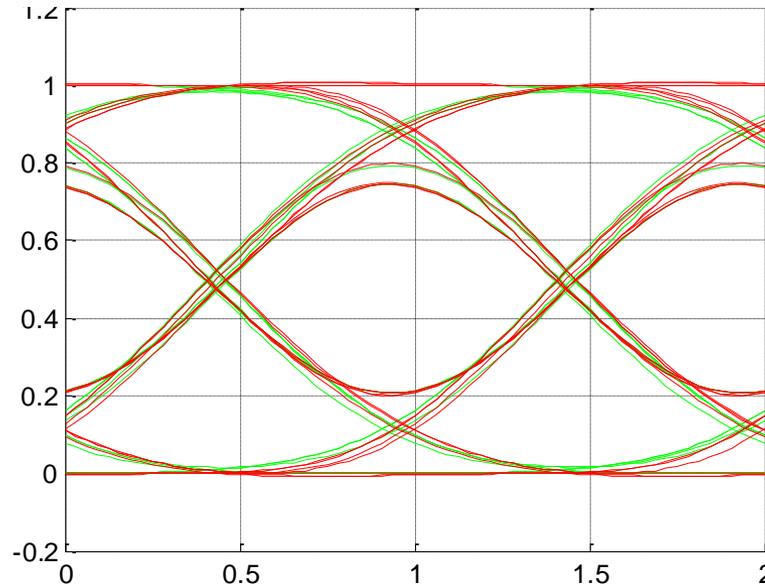
This is NOT our target

In this case, TDEC is more pessimistic than link model

Even so, TDEC is much less than 4.9 dB

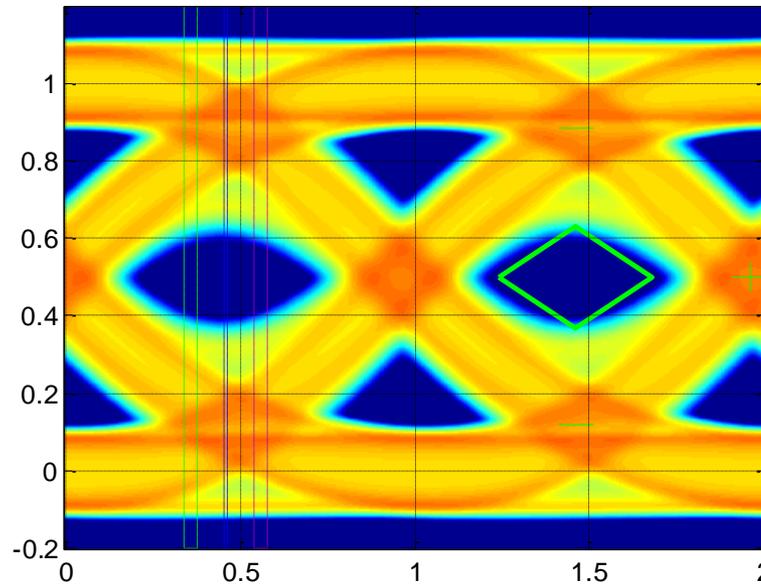
- Tx parameters as link model, 12.6 GHz filter and estimated MPN and MN as TDEC algorithm (In this case, TDEC estimates more MPN than model)
- TDEC = 4.4 dB Target ? dB
- J2 between 0.40 and 0.44 UI Target ? UI
- J4 between 0.54 and 0.59 UI Target ? UI
- J4-J2 = 0.14 to 0.15 UI (target) ? UI
- More high probability jitter than SRS Eye shape is more like the mask

Checking the SRS filter



- Green: Gaussian laser and fibre models, Bessel-Thomson observation filter
- Red: Bessel-Thomson SRS filter, Bessel-Thomson observation filter
- Very good agreement

Simulated D3.2 stressed eye

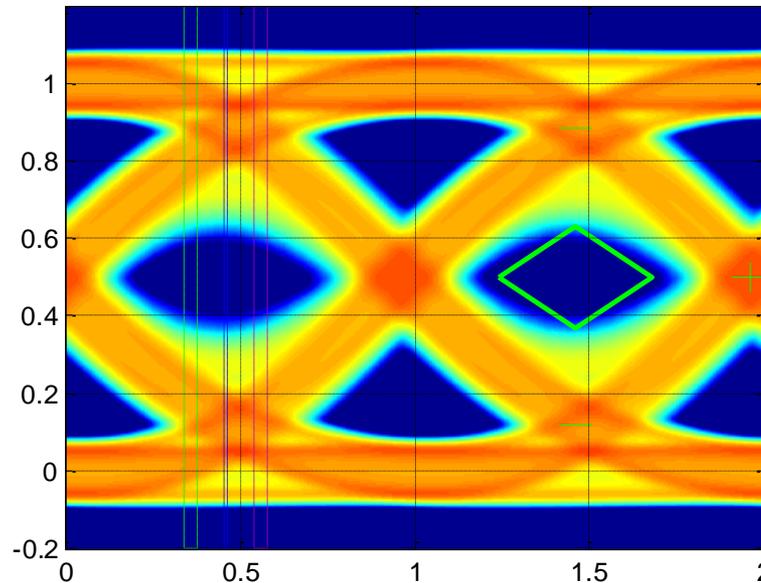


Exceeds the
0.1 UI
shrinkage
limit from
SI1

*Would a slower 2nd
filter allow less
shrinkage and less
Gaussian tails?*

- Trying to meet D3.2 spec with ideal BT4 filters and wideband Gaussian noise (Second low pass filter gives 2.1 dB SEC, the minimum allowed by D3.2)
- SEC = 4.9 dB Target 4.9 dB
- J2 between 0.37 and 0.41 UI Target 0.39 UI
- J4 between 0.53 and 0.59 UI Target 0.53 UI
- J4-J2 = 0.16 to 0.18 UI (target) 0.14 UI
- Too much Gaussian tails. Eye is very shallow compared with mask

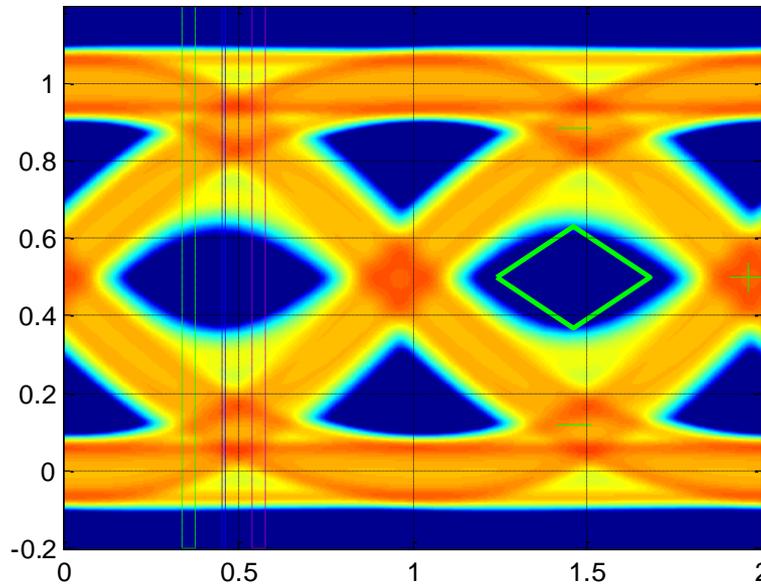
Another simulated D3.2 stressed eye



Exceeds the
0.1 UI
shrinkage
limit from
SI1

- Trying to meet D3.2 spec with ideal BT4 filters and **low frequency** Gaussian noise
- SEC = 4.9 dB Target 4.9 dB
- J2 between 0.33 and 0.37 UI Target 0.39 UI
- J4 between 0.52 and 0.60 UI Target 0.53 UI
- J4-J2 = 0.19 to 0.23 UI (target) 0.14 UI
- **Even more** Gaussian tails. Eye is very shallow compared with mask

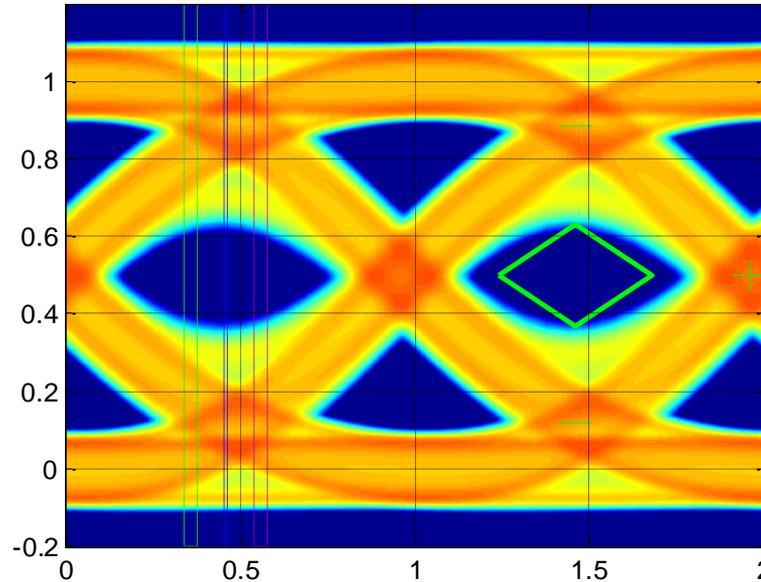
Simulated improved stressed eye



Exceeds the
0.1 UI
shrinkage
limit from
SI1

- Target 4.3 dB with ideal BT4 filters and wideband Gaussian noise
- SEC = 4.3 dB Target 4.3 dB
- J2 between 0.33 and 0.36 UI Target 0.39 UI
- J4 between 0.48 and 0.52 UI Target 0.53 UI
- J4-J2 = 0.15 to 0.16 UI (target) 0.14 UI
- Too much Gaussian tails. Eye is still shallow compared with mask

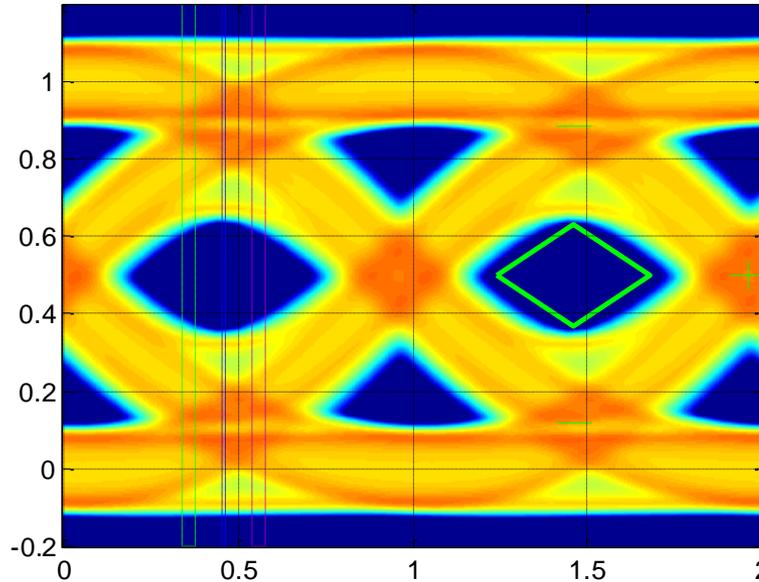
Simulated improved stressed eye 2



More than
0.1 UI
shrinkage
from SI2

- Target 4.3 dB with ideal BT4 filters and slow Gaussian noise
- SEC = 4.33 dB Target 4.3 dB
- J2 between 0.31 and 0.34 UI Target 0.39 UI
- J4 between 0.44 and 0.47 UI Target 0.53 UI
- J4-J2 = 0.13 to 0.14 UI (target) 0.14 UI
- Gaussian tails OK? Eye is still shallow compared with mask

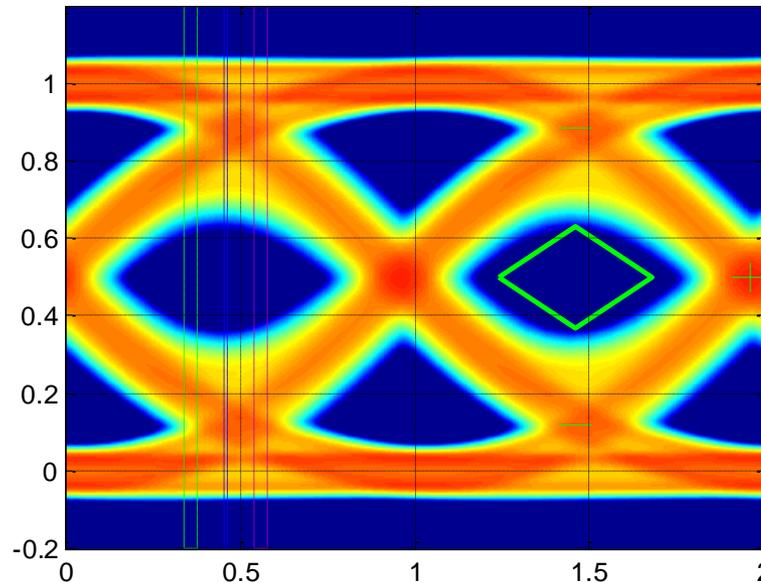
Simulated improved stressed eye 3



- Target 4.3 dB with ideal BT4 filters and Gaussian jitter
 - SEC = 4.3 dB
 - J2 between 0.37 and 0.40 UI
 - J4 between 0.51 and 0.53 UI
 - J4-J2 = 0.13 to 0.14 UI
 - Gaussian tails OK.
- Target 4.3 dB
Target 0.39 UI
Target 0.53 UI
(target) 0.14 UI
Eye is still shallow compared with mask

*More
convenient
than
Gaussian
noise*

Simulated stressed eye with 0.1 UI PWS from each SI



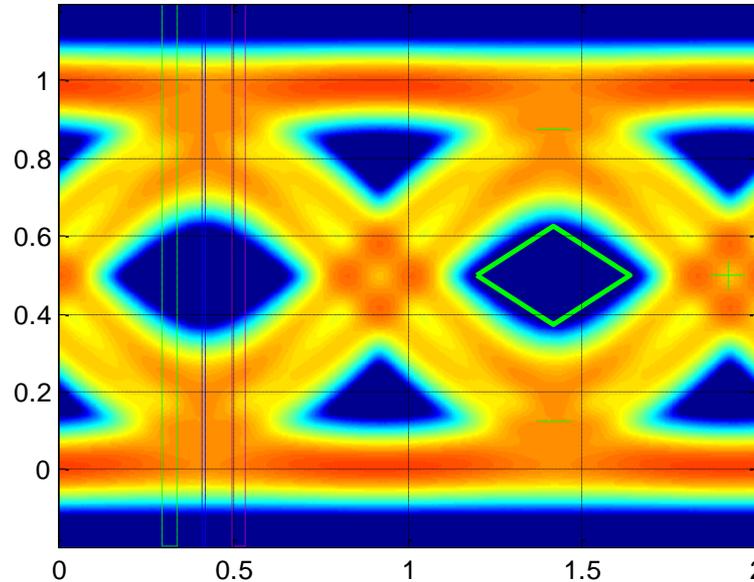
*Pulse shrinkage
limit should apply
to both SI1 and SI2*

*0.1 UI limit needs
to be increased*

- Ideal BT4 filters and **wideband Gaussian noise**
- Each sinusoidal interferer separately gives 0.1 UI PWS
- SEC = **3.8 dB**
- J2 between 0.30 and 0.33 UI Target 0.39 UI
- J4 between 0.47 and 0.53 UI Target 0.53 UI
- J4-J2 = 0.17 to 0.20 UI (target) 0.14 UI
- **Gaussian tails much too big.** Eye is still shallow compared with mask

Backup

Simulation of \sim TDEC analysis of worst case received signal



SEC "+ M" is still much less than 4.9 dB

- Deterministic parameters and RIN as link model, estimated MPN and MN as TDEC algorithm (In this case, TDEC estimates more MPN than model)
- SEC "+ M" = 4.3 dB Target ? dB
- J2 between 0.40 and 0.43 UI Target ? UI
- J4 between 0.53 and 0.59 UI Target ? UI
- J4-J2 = 0.13 to 0.16 UI (target) ? UI
- More high probability jitter than SRS Eye shape is more like the mask