53GBaud links: updated receiver status (in reply to Piers's comment ID #46).

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P802.3cd ad hoc

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Background

100GBASE-DR specifications have been aligned with 802.3bs 400GBASE-DR4, to allow break-out solution.

These slides provide summary of 53GBaud RX technology status:

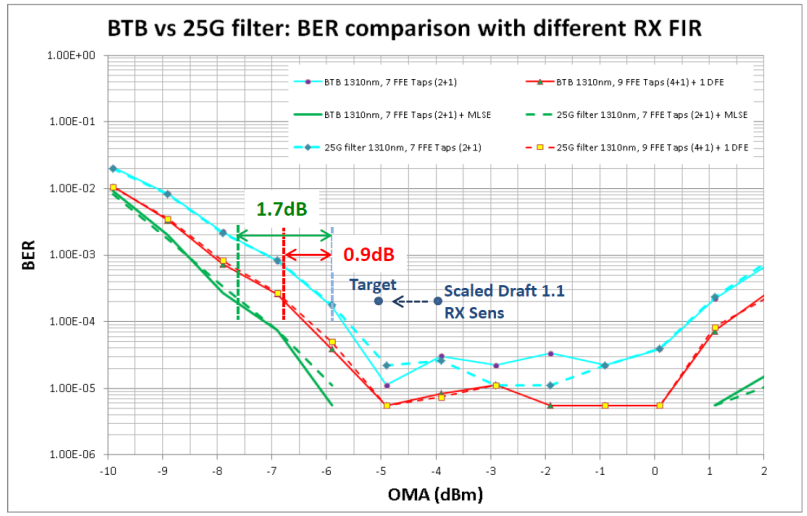
- In reply (in favour) to Piers's comment ID #46 against draft 1.3.
- Showing that the predicted RX improvement of mazzini_02a_1215_smf.pdf (slides 8-9) happened, so the proposed TX relaxation (slide 11) is valid.

This would allow to:

- Further reduce module's power consumption, thanks to laser power reduction (traverso_3bs_01a_1115.pdf).
- Move RX input power range away from TIA overload region.

Evolution of 53GBaud RX sensitivity results.

25GHz (RX filter) – results summary



25GHz BW filter used, to simulate more restricted BW components.

There's almost no penalty (0.1dB).

Measured 56Gbaud RX sensitivity, OMA

Condition	7 FFE	9 FFE	21 FFE	7 FFE / 1 DFE	9 FFE / 1 DFE	MLSE
BTB	-10.6	-11	-11.5	-11.2	-11.5	-12.3
25G Filter	-10.5				-11.4	-12.2

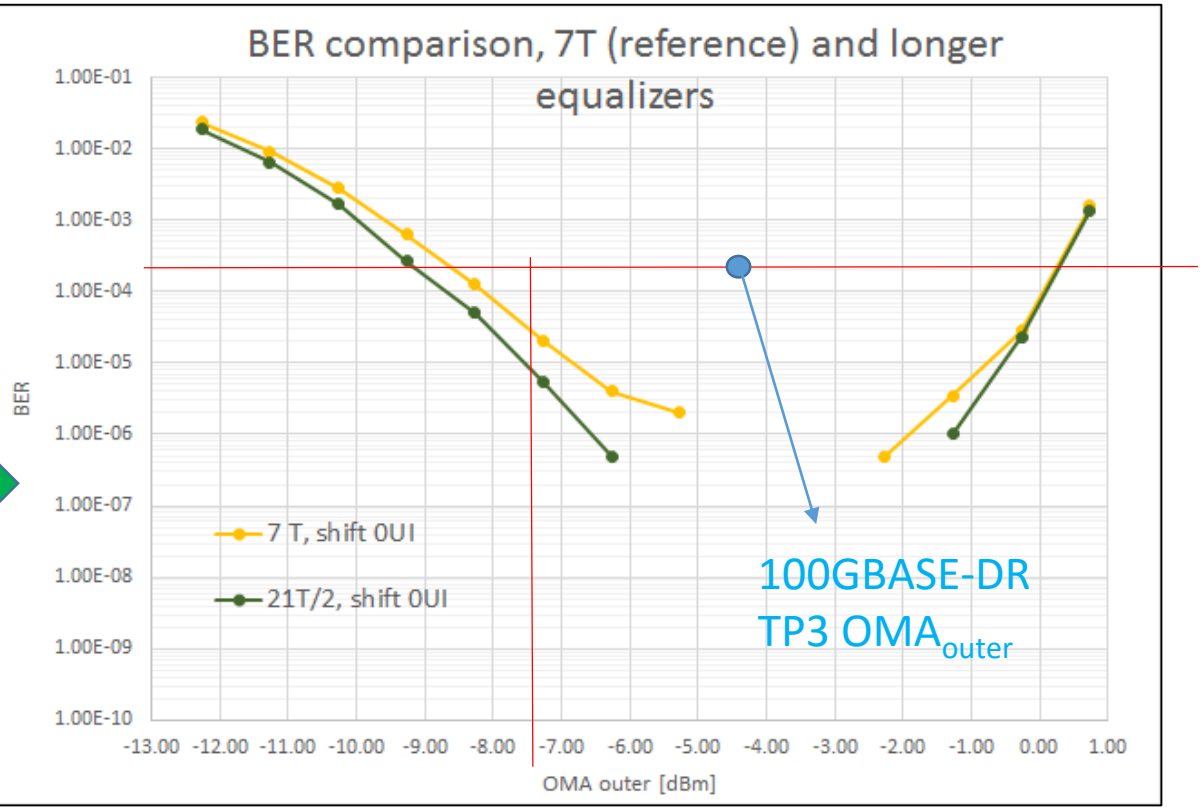
Calculated 53.125GBaud RX sensitivity, OMA

Condition	7 FFE	9 FFE	21 FFE	7 FFE / 1 DFE	9 FFE / 1 DFE	MLSE
BTB	-11.1	-11.5	-12	-11.7	-12	-12.8
25G Filter	-11				-11.9	-12.7

From resultsm -13dBm (-8.3dBm outer) is achievable (4dB margin w/respect current sensitivity specs).

mazzini_02a_1215_smf.pdf.

15 December 2015 8



Experimental results on different parts confirm that < -8.3dBm OMA_{outer} was the correct forecast.
We can consider above right curve as reference sensitivity value for different RX assemblies, with respect a reference receiver of 'normalized' parameters such:

- Bandwidth (25GHz)
- Responsivities (0.6 A/W)
- Equalizer (7T FFE taps)

(note: as per today, we have no permission to share detailed results from most companies).

802.3cd Draft 1.3 - 100GBASE-DR TX/RX OMA characteristics.

Table 140–6—100GBASE-DR transmit characteristics

Description	Value	Unit
Signaling rate (range)	53.125 ± 100 ppm	GBd
Modulation format	PAM4	—
Wavelength (range)	1304.5 to 1317.5	nm
Side-mode suppression ratio (SMSR), (min)	30	dB
Average launch power (max)	4	dBm
Average launch power[a] (min)	–2.4	dBm
Outer Optical Modulation Amplitude (OMA_{outer}) (max)	4.2	dBm
Outer Optical Modulation Amplitude (OMA_{outer}) (min)[b]	–0.3	dBm

Table 140–7—100GBASE-DR receive characteristics

Description	Value	Unit
Signaling rate (range)	53.125 ± 100 ppm	GBd
Modulation format	PAM4	—
Wavelengths (range)	1304.5 to 1317.5	nm
Damage threshold[a]	6.5	dBm
Average receive power (max)	4	dBm
Average receive power[b] (min)	–5.4	dBm
Receive power (OMA_{outer}) (max)	4.2	dBm
Receiver reflectance (max)	–26	dB
Receiver sensitivity (OMA_{outer})[c] (max)	–4.4	dBm

Considering previous slide, there are ~4dB margins at TP3 for 100GBASE-DR, which appears even too safe, still considering:

- 1dB ageing
- 1dB voltage/temperature corners
- ~1dB statistics

There’s room to relax by 1dB TX OMA reduction (<= -1.3 dBm) by tightening RX sensitivity, still keeping a safe optical margin for development (close to 3dB).

Comments

- 53GBaud RX technology is keep growing.
  - Forecasted sensitivity results given in mazzini_02a_1215_smf.pdf are confirmed over several parts, that can be summarized into a ‘reference receiver’ with slide’s 3 characteristics.
  - Further sensitivity improvements (at least 3-4dB) are expected from Ge/Si APD (huang_01_0615_smf), this should also help over to target longer (up to 10kms) reaches with similar 100GBASE-DR TX OMA.
  - Further bandwidth/roll-off enhancements are expected.
  - DSP RX equalizers are >> 7T so expected to consolidate margins.
  - Need to quantify penaltes on 4-channels solutions (400GBASEs).

- Since higher power modules imply either direct and non-direct costs to our customers (design complexity on line cards for heat management, power increase, etc...), as industry, we still have the opportunity to consider TX relaxation at least for 53GBaud links for data center applications.

THANK YOU

Comment ID #46

Cl **140** *SC* **140** *P* **300** *L* **1** # 46

Dawe, Piers Mellanox

Comment Type **TR** *Comment Status* **X**

This is a "cutting edge" proposal.

SuggestedRemedy

Show technical and economic feasibility for these draft numbers, or change them (e.g. if better receiver sensitivity is possible).

Proposed Response *Response Status* **O**