Addressing TDECQ -VRx

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IEEE P802.3db 100 Gb/s, 200 Gb/s, and 400 Gb/s Short Reach Fiber Task Force

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802.3db TBDs

- Supporting lower cost Transmit & Receive specifications: TDECQ for VRx specifications
  - TDECQ / SECQ & Impact of BT filter
  - Review of Measured Results
- Discussion

Table 167–7—Transmit characteristics

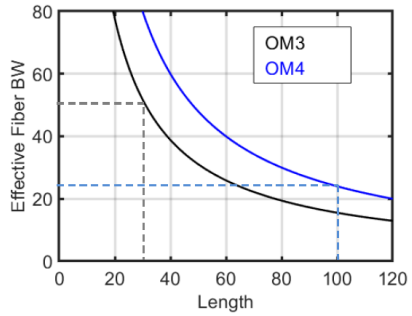
Description	100GBASE-VR 200GBASE-VR2 400GBASE-VR4	100GBASE-SR 200GBASE-SR2 400GBASE-SR4	Unit
Signaling rate, each lane (range)	53.125 ± 100 ppm		GBd
Modulation format	PAM4		—
Center wavelength (range)	TBD	844 to 863	nm
RMS spectral width[a] (max)	0.65	0.6	nm
Average launch power, each lane (max)	4		dBm
Average launch power, each lane (min)[b]	–5		dBm
Outer Optical Modulation Amplitude (OMA_{outer}), each lane (max)	3.5		dBm
Outer Optical Modulation Amplitude (OMA_{outer}), each lane (min)[b,c]	–3		dBm
Transmitter excursion, each lane (max)	2		dBm
Overshoot/undershoot	TBD	TBD	%
Launch power in OMA_{outer} minus TDECQ (min)[b]	TBD	–4.4	dBm
Transmitter eye closure for PAM4 (TECQ), each lane (max)	TBD	4.4	dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane (max)	TBD	4.4	dB
Average launch power of OFF transmitter, each lane (max)	–30		dBm
Extinction ratio, each lane (min)	2.5		dB
Transmitter transition time, each lane (max)	17		ps
$RIN_{12}OMA$ (max)	–131		dB/Hz
Optical return loss tolerance (max)	12		dB
Encircled flux[d]	≥ 86% at 19 μm ≤ 30% at 4.5 μm		—

Impact of BT filter and TDECQ

- See ieee802.org/3/cd/public/July17/king_3cd_01a_0717.pdf
  - In this case, measurement methodology reduced the TDECQ BT filter bandwidth from 0.75*Baud rate to 0.5*Baud rate
  - Reduction in BT filter bandwidth increased the TDECQ budget by 0.9dB
- In 802.3db, two different BT filters are used due to difference in reach
  - Assuming similar 850nm wavelength range, we can summarize the equivalent BT filter value:

VRx	SRx
21GHz	15GHz

Effective Fiber BW



Effective fiber bandwidth calculated by adding modal and chromatic dispersion bandwidth in quadrature[1,2,3] at wavelength of 863 nm and RMS spectral width of 0.6 nm.

30m OM3	52 GHz
100m OM4	24 GHz

1. Expressions for modal bandwidth from kolesar_3cm_01_1118.pdf.
2. Chromatic dispersion parameters U0 = 1316 nm and S0 = 0.10275 ps/(nm²·km) for OM3 and OM4, abbott_3db_adhoc_01_080620.pdf.
3. Reference king_3cm_adhoc_01_062818.pdf.

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Two Link Length PMDs

Parameter	PMD1	PMD2	Units	Notes
MMF	OM3	OM4	—	1
Link length	30	100	m	2
Fiber attenuation	0.1	0.3	dB	
Reference equalizer BT filter Uw = 0.6 nm Uw = 0.5 nm	 21.9 22.2	 14.7 15.7	 GHz GHz	3

⇦ For testing transmitter compliance

Notes

1. Equivalent OM3 and OM4 lengths can be defined for the two links. Lower cost OM3 chosen for the short link, and higher modal bandwidth OM4 for long reach.
2. The 100m length maintains the reach of MMF links. Technical feasibility of a 100m OM4 link presented in ingham_3db_adhoc_01a_062520.pdf.
3. Calculated at 863 nm and RMS spectral width Uw with fiber chromatic dispersion parameters U0 = 1316 nm and S0 = 0.10275 ps/(nm²·km). Reference equalizer BT filter bandwidth is a best fit to the combined fiber modal and chromatic dispersion modeled as a Gaussian LPF, and receiver modeled as a 4th order Bessel-Thompson filter with BW of 26.5625 GHz.

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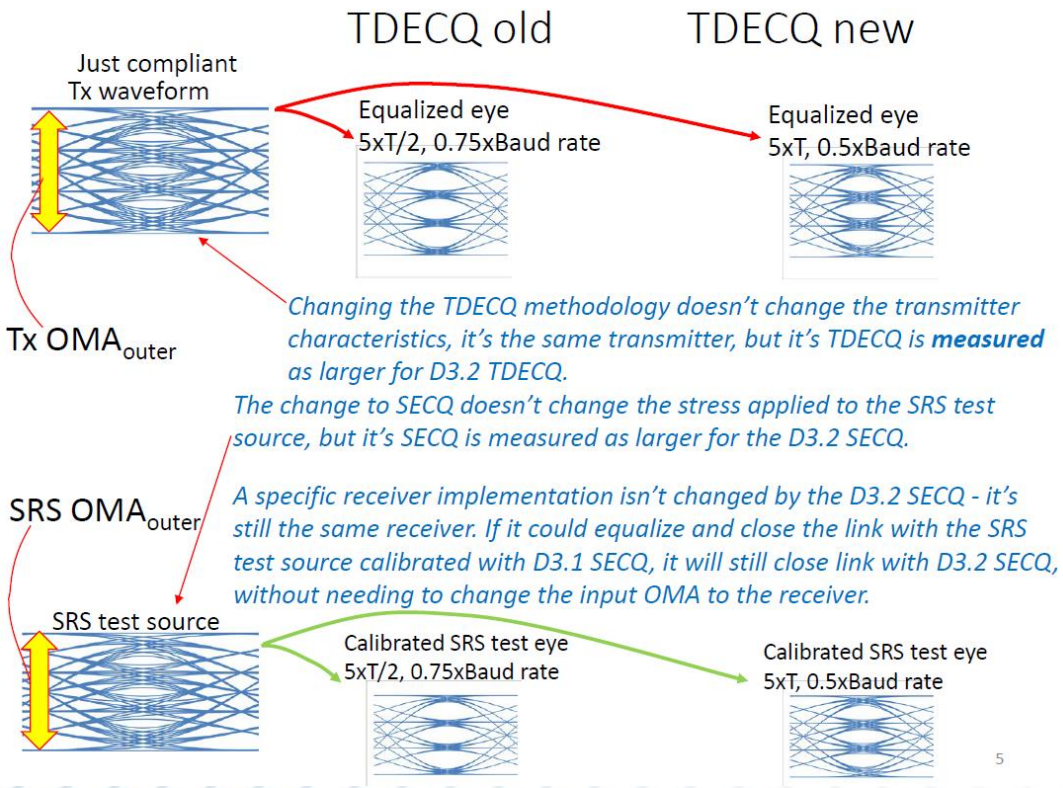
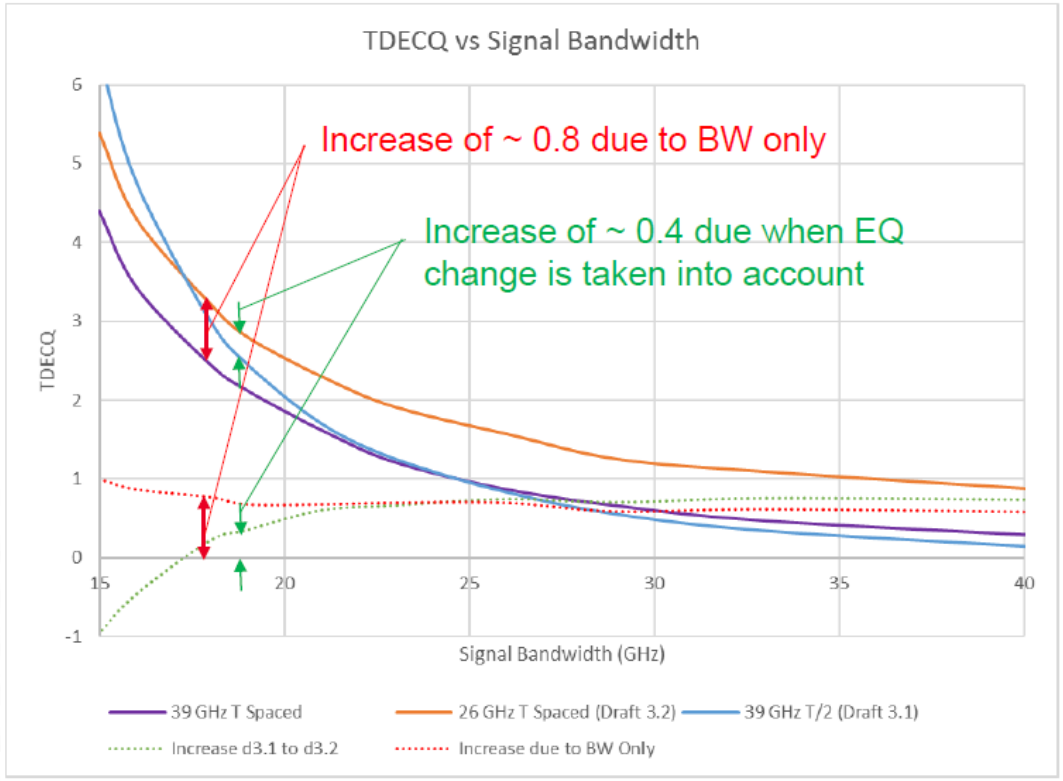
Equivalent TDECQ

- For a given transmitter and 9-tap FFE reference Rx,
  - TDECQ of 4.4dB when measured with 15GHz BW is the equivalent to a lower TDECQ if the BT filter is changed to 21GHz



king_3cd_01a_0717 (reference receiver BW change)



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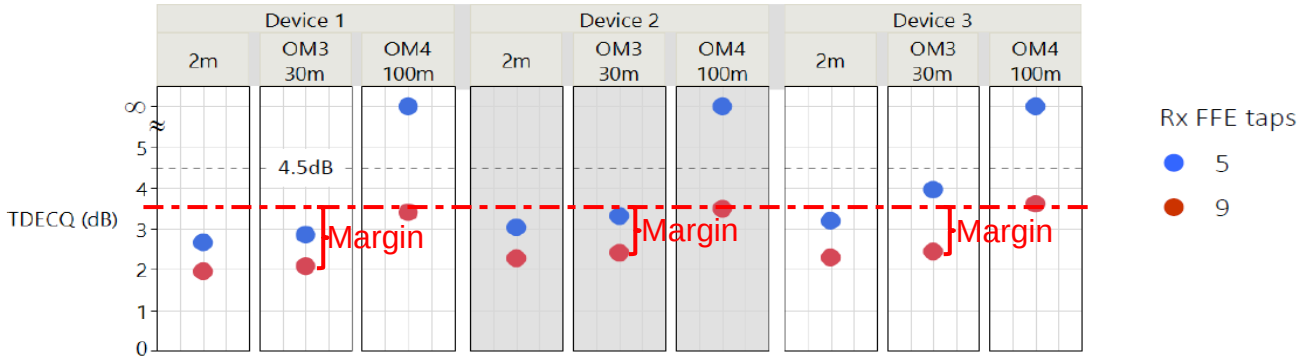
3.4dB TDECQ for 50m Application

- 3.4dB TDECQ has the potential to balance margin between transmitter and receiver increasing implementation flexibility
  - Note SMF specification is 3.4dB with 26GHz BT filter and 5-tap FFE

TDECQ vs Rx FFE taps



- 30 m OM3 link: 5-tap Rx FFE is sufficient for TDECQ within 4.5 dB
- 100 m OM4 link: TDECQ within 4.5 dB with a 9-tap Rx FFE, but not measurable with a 5-tap Rx FFE

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Proposal for 50m TDECQ

- Balancing lower cost 50m implementations, 3.4dB is proposed TDECQ limit for the 50m objective
  - Additional TDECQ margin for lower cost VCSELs / transmitters relative to the 100m (15GHz BT filter) target when compared to 50m (21GHz BT filter) target
  - 3.4dB SECQ helps ensure lower cost receivers
    - TDECQ (with 9-taps + 21GHz BT filter) similar to the SMF TDECQ leveraged in 802.3cu (3.4dB with 5-tap and 26GHz BT filter) allowing for commonality for down stream component requirements