CAUI-4 Consensus Building, Specification Discussion

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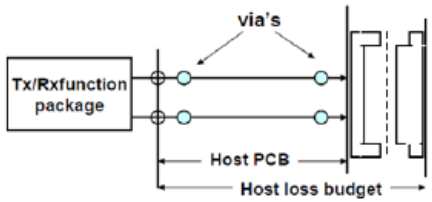
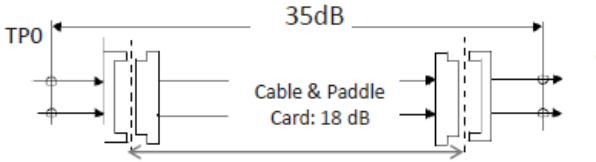
Consensus Building Summary

- 3+ consensus calls held to discuss chip-module CAUI-4 host budget:
- Foundation for calls:
  - latchman_01_0312 budget interoperable with VSR and CR4
  - ghiasi_02a_0712 raised the potential of increasing the chip-module and chip-chip budget for longer reaches
- Conclusion of the consensus calls was to maintain the host budget outlined in latchman_01_0312 for chip-module to ensure interoperability with passive cables

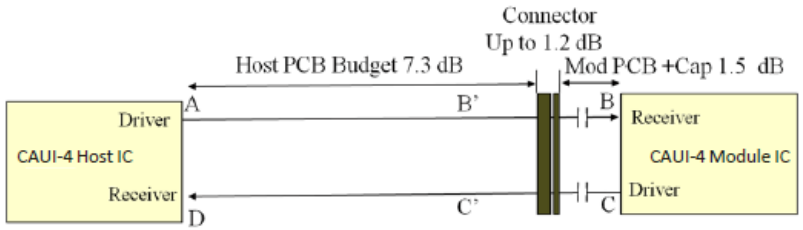
•Host Loss Budget: 8.5dB at 12.89GHz

•includes PCB loss, two sets of vias and mated connector





CR4 Budget: 5 m cable assembly link budget example with 8.5 dB host loss: 35 dB @12.89 GHz (FEC Required)



CAUI Budget

Additional Topics

- The consensus building calls included discussion on
  - Chip – Chip CAUI budget
    - Strong interest in a higher link budget (relative to chip to module)
  - Asymmetric link budget potential
    - CAUI-4 module interface plugged into CR4 host for example
    - Potential to provide informative guidance on asymmetric chip-module link budgets

CAUI-4 Chip - Module Spec Discussion

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CAUI-4 Chip-module host transmitter considerations

- Comparing CR4 with VSR
  - 802.3bj D1.1 TP2 vs VSR 7.2, TP1a
  - Similar specification methodology

	CR4 (D1.1, TP2)	VSR (7.2, TP1a)	CAUI-4 Potential
Signaling rate, per lane	25.78125+/-100ppm	19.6 – 28.05	25.78125+/-100ppm
Unit Interval	38.787879ps	35.65ps - 51ps	38.787879ps
Differential peak-to-peak output voltage (max) with Tx disabled	35mV		TBD
Common Mode Voltage Limits	1.9V	-0.3V (min) to 2.8V (max)	TBD
Differential output return loss (min)	TBD	SDD22 < -11dB for 0.05<f<fb/7 SDD22 < -6.0 + 9.2*log(2f/fb) dB for fb/7<f<fb	TBD
Common-mode AC output voltage (max,rms)	30mV	17.5mV	TBD
Amplitude peak-to-peak (max)	1200mV	900mV	TBD

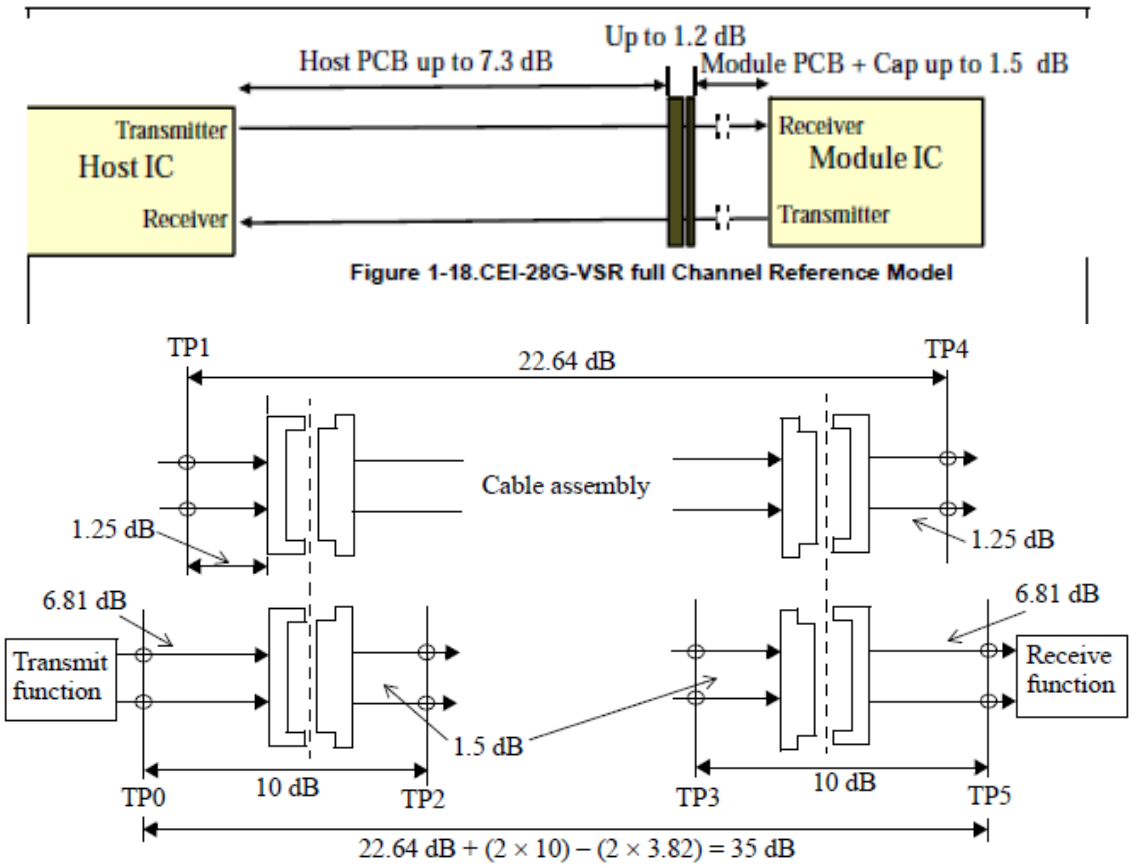
CAUI-4 Chip-module host transmitter considerations

- Different methodologies used to specify jitter, Tx waveform
  - Need to agree on methodology before setting numbers

	CR4 (D1.1, TP2)	VSR (7.2, TP1a)	CAUI-4 Potential
Transmitter steady state voltage	0.34 (min) - 0.6V (max)		
Linear fit pulse (min)	0.52 x Transmitter steady state voltage		
Transmitted wave form Max RMS normalized error (linear fit), “e” abs coefficient step size (min.) abs coefficient step size (max.) Pre-cursor full-scale range (min.) Post-cursor full-scale range (min.)	 0.037 0.0083 0.05 1.54 4		
Far end transmit output noise (max)	TBD		
Output jitter (max)	Effective RJ: 0.15UI Even-odd jitter: 0.035UI TJ excluding DDJ: 0.28UI	0.54UIpp @ 0^{-15} Measured using CTLE	TBD
Amplitude peak-to-peak (min)		600mV (TP0a)	TBD
Differential termination mismatch (max)		10%	TBD
Common to differential mode conversion (max)		SDC22 < -25 + 20*(f/fb) dB for 0.05<f<fb/2 SDC22 < -15 dB for fb/2<f<fb	TBD
Transition time (min, 20/80%)		10ps	TBD
Eye height at 10^{-15} probability (min)		100mV Measured using CTLE	TBD

CAUI-4 chip-module channel considerations

- Good agreement between 802.3bj D1.1 and VSR



CAUI-4 Chip-module module receiver considerations

	VSR (7.2, TP1)	CAUI-4
Bit Error Ratio	10^{-15} or better per lane	10^{-12} or better
Signaling rate, per lane	19.6 – 28.05	25.78125+/-100ppm
Unit Interval	35.65ps - 51ps	38.787879ps
Overload differential voltage (min)	900mVppd	TBD
Differential termination mismatch (max)	10%	TBD
Differential input return loss (max)	SDD11 < -11dB for 0.05<f<fb/7 SDD11 < -6.0 + 9.2*log(2f/fb) dB for fb/7<f<fb	TBD
Common to differential mode conversion (max)	SDC11 < -25 + 20*(f/fb) dB for 0.05<f<fb/2 SDC11 < -15 dB for fb/2<f<fb	TBD
Stress receiver test (min)	See Section 1.3.10.2.1	TBD

CAUI-4 Chip-module module transmitter considerations

- Use similar specification methodology as host transmitter

	VSR (7.2, TP4a)	CAUI-4 Potential
Signaling rate, per lane	19.6 – 28.05	25.78125+/-100ppm
Unit Interval	35.65ps - 51ps	38.787879ps
Differential voltage peak-to-peak (max)	900mV	TBD
Common-mode noise (rms, max)	17.5mV	TBD
Differential termination mismatch (max)	10%	
Differential output return loss (max)	SDD22 < -11dB for 0.05<f<fb/7 SDD22 < -6.0 + 9.2*log(2f/fb) dB for fb/7<f<fb	TBD
Common mode to differential conversion return loss (max)	SDC22 < -25 + 20*(f/fb) dB for 0.05<f<fb/2 SDC22 < -15 dB for fb/2<f<fb	TBD
Transition time 20/80 (min)	9.5ps	TBD
Vertical eye closure (max)	6.5dB	TBD
Eye width at 10^{-15} probability (min)	0.57UI	TBD
Eye hight at 10^{-15} probability (min)	240mV	TBD

CAUI-4 Chip-module host receiver considerations

	CR4(1.1 TP3)	VSR (7.2, TP4a)	CAUI-4
Bit Error Ratio	10^{-12} or better	10^{-15} or better per lane	10^{-12} or better
Signaling rate, per lane	25.78125+/-100ppm	19.6 – 28.05	25.78125+/-100ppm
Unit Interval	38.787879ps	35.65ps - 51ps	38.787879ps
Differential peak-to-peak input amplitude tolerance / overload differential voltage pk-pk	1200mVppd (max)	900mVppd (min)	TBD
Differential input return loss (min) / Differential return loss (max)	12-1.24(f)^0.5, 0.01≤ f ≤ 10.31 6.3-13log10(f/13.75), 10.31≤ f ≤ 25	SDD11 < -11dB for 0.05<f<fb/7 SDD11 < -6.0 + 9.2*log(2f/fb) dB for fb/7<f<fb	TBD
Differential to common mode input return loss (min) / Common mode to differential conversion loss (min)	10, 0.01≤ f ≤ 25 GHz	SDC11 < -25 + 20*(f/fb) dB for 0.05<f<fb/2 SDC11 < -15 dB for fb/2<f<fb	TBD
Stress receiver test (min)	See 92.8.4.2	See Section 1.3.10.2.1	TBD
Differential termination mismatch (max)		10%	TBD
Common mode voltage		-0.3 V (min) to 2.8V (max)	TBD

CAUI-4 Chip – Chip Spec Discussion

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Chip-Chip Considerations

- Target: low power, simple chip-chip specification to allow communication over TBD loss with one connector
  - Similar to Annex 83A in 802.3ba
    - 25cm or ~10 inches over PCB
    - If we apply 1.7dB loss / inch we get 17dB + Connector (~1dB)
      - Meg6_HighSR-Narrow (kochuparambil_01_0112)
  - Compare to OIF SR / MR
    - SR: 15.4dB
    - MR: ~20dB
- Potential differences with KR4:
  - Lower loss budget supports lower power, smaller receiver design
  - Reduced latency & complexity
    - No FEC
    - No in-band transmitter training
      - Adaptive Rx (SFP+)
      - Assume “system management”