CHANNEL OPERATING MARGIN (COM) PROPOSAL FOR CDAUI-8

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CONTRIBUTORS & SUPPORTERS

CONTRIBUTORS

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OVERVIEW

- **Demonstrate a DFE-LESS Receive Architecture for Channel Compliance**
- **Why DFE-LESS?**
  - DFE less - No Error-Propagation and related MTTFPA Concerns
  - Lower Power, Simpler implementation
- **Methodology:**
  - Use the public-domain Simulation Tool (COM) and Channels
  - Establish a base-line to match previously published results
    - DFE based implementation: healey_3bs_01_0315
  - Obtain Simulation results with DFE-less Channel Compliance configuration
- **Proposed Configuration:**
  - No DFE, 2nd Post-cursor in the TX, Modified CTLE, and a 2nd Low-frequency CTLE

CHANNELS

- http://www.ieee802.org/3/bs/public/14_07/mellitz_3bs_01_0714.pdf (11-July-14)
  - Rich Mellitz, Intel
  - Chip-to-Chip (w/ mezzanine) channels
  - Channels 1 to 7
  - IL: 7, 9, 11, 15, 17, 2 x19dB @13.28GHz
  - XT: 4FEXT, 3NEXT

- http://ieee802.org/3/bs/public/channel/TEC/shanbhag_02_0914.pdf (30-Sep-14)
  - Megha Shanbhag, Nathan Tracy, TE Connectivity
  - Medium reach/Chip-to-chip channel using a single connector (Armor)
  - IL: 19.1dB @13.28GHz
  - XT: 7FEXT, 0 NEXT

BASELINE

- **Start with CAUI-4 COM configuration (as in healey_3bs_01_0315)**
- **Set the number of signal levels L = 4, DER_0 = 1E-06, and fb = 26.5625Gb**
- **Set Add = 0.02UI and SNR_TX = 31dB**
- **Increase CTLE range (-15 to 0 in steps of 1) and set DFE tap range = [1 0.2 0.2 0.2 0.2]**
- **Reduce R_LM to 0.92**
- **Package model:**
  - 'Designed Package' used in healey_3bs_01_0315 provides approx. 2dB improvement
  - In this case, we tweaked the package parameters to obtain improvement in the same ball park
    - Rd = 50 Ohms, Cp = 1.15e-04 nF, and Cd = 1.5e-04 nF

BASELINE

- **Channel operating margin (COM) for the baseline configuration**

Test Case	1	2	3	4	5	6	7	8
Insertion Loss (dB) at fb/2	19.2	14.34	7.22	18.93	17.24	11.14	9.24	18.75
healey_3bs_01_0315 (final pass)	1.16	2.22	2.41	1.09	0.65	2.04	2.09	2.2
Baseline for this implementation	-0.03	0.96	1.52	0.23	-0.02	1.25	1.19	1.73

- **The resulting baseline is on average about 1dB worse**
- **Package parameters can be tweaked further to improve the baseline to obtain a closer match. But feasibility needs further investigation.**

GO DFE-LESS & ADD 2ND POST-CURSOR

- **Take away the DFE (set Nb = 0), Set DER0 = 1.3E-04 (No Fear of Error Propagation)**
  - 1.3E-04 represents 4 links cascaded

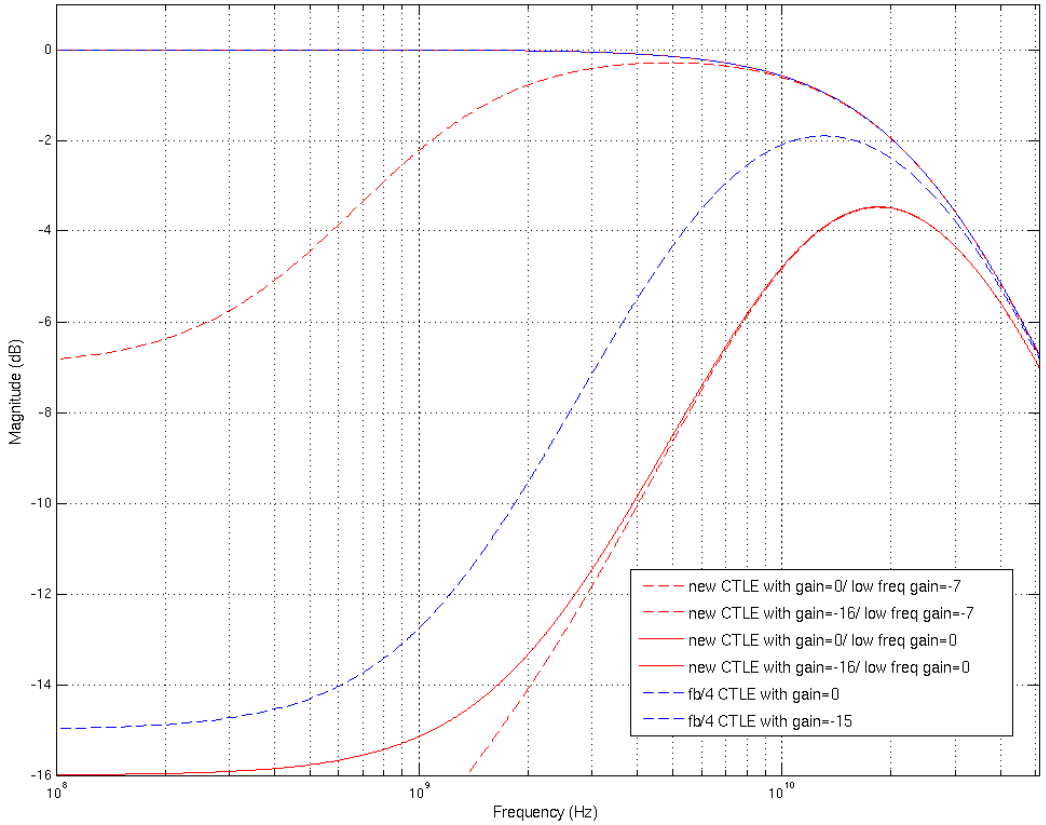
Test Case	1	2	3	4	5	6	7	8
healey_3bs_01_0315 (final pass)	1.16	2.22	2.41	1.09	0.65	2.04	2.09	2.2
This implementation	-2.31	0.2	2.79	-2.58	-1.50	1.58	1.9	-0.68

- **Add 2nd post-cursor to TX-FIR:**

Test Case	1	2	3	4	5	6	7	8
This implementation	-1.43	1.53	3.32	-1.54	-0.12	2.49	2.47	0.89

CTLE AND OTHER TX MODIFICATIONS

- **Increase CTLE b/w to fb/2**
- **A 2nd pole-zero pair is introduced at 1G (CTLE-LOW)**
  - Configuration is similar to the main CTLE
  - DC gain range set to [-7:0] dB
- **Relax SNR_TX to 29dB**
- **Increase level-mismatch Ratio to 0.95**



RESULTS

Test Case	1	2	3	4	5	6	7	8
Insertion Loss (dB)	19.2	14.34	7.22	18.93	17.24	11.14	9.24	18.75
healey_3bs_01_0315	1.16	2.22	2.41	1.09	0.65	2.04	2.09	2.2
Baseline with DFE	-0.03	0.96	1.52	0.23	-0.02	1.25	1.19	1.73
Set Nb=0 (no DFE) & DER0 =1.3E-04	-2.31	0.2	2.79	-2.58	-1.50	1.58	1.9	-0.68
Add 2nd post cursor in TX-FFE	-1.43	1.53	3.32	-1.54	-0.12	2.49	2.47	0.89
Modified CTLE +TX_SNR and R_LM adjust.	0.473	2.15	3.34	0.74	1.03	2.95	2.96	3.15

- **The final results are comparable to Implementation with DFE**

CONCLUSIONS

- **Proposed a feasible DFE-less receive architecture:**
  - No Error-propagation/MTTFPA Concerns
  - Simpler implementation/Lower Power
- **COM values greater than 2dB possible on several Channels**
- **Required enhancements needed to COM to accommodate the proposed architecture are extensions of existing features**
- **Package Models have a significant impact on overall link performance**