TX DIFFERENTIAL PRECODER BENEFITS FOR CDAUI-8 C2C

Raj Hegde & Magesh Valliappan, Broadcom
IEEE 802.3bs 400Gb/s Task Force
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CONTRIBUTORS AND SUPPORTERS

- **Contributors:**

  - Vivek Venkatraman, Broadcom

- **Supporters:**

  - Yasuo Hidaka, Fujitsu Laboratories of America

  - Tomoyuki Arai, Socionext

  - Pirooz Tooyserkani, Cisco

  - Marco Mazzini, Cisco

- **DFEs are known to multiply errors in the feedback loop**
  - A single random error at the DFE input can lead to an error-burst at the output
  - Probability of k consecutive errors is a function of the first tap value:
    - Tap value of 1: 0.75^k, Tap value of 0.7: 0.72^k, Tap value of 0.6: 0.62^k

- **Differential Precoding limits burst error impact**

- **Defined in 100GBase-KP4 (94.2.2.6)**
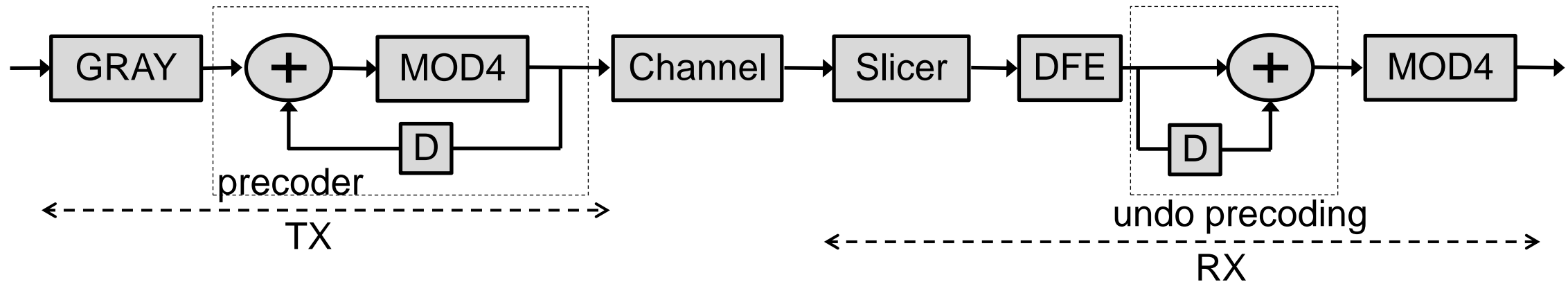
- **Reduces 1-tap DFE burst error runs into 2 errors per event**
  - One error at the entry and one error at the exit
  - More details and worked out example in parthasarathy_01_0911

For electrical sub-links in Multi-Part links with a penalty of ~0.1dB in the optical sub-link

|	FLR = 6.2e-11	
	DER0	**BER**
Random (No DFE)	1.60E-04	8.02E-05
a=0.5	5.19E-05	5.19E-05
a=0.75	3.67E-07	7.34E-07
a=0.75 precoded	2.66E-05	2.66E-05

- **When DFE tap value is high, BER is dominated by burst errors**

- **Precoder allows substantial BER target relaxation by breaking up long error bursts**

- Almost 2 orders of magnitude improvement for DFE tap value ~ 0.7 to 1.0

- DER0 is the Detector Error Ratio as defined in COM

DFE RANGE FOR CDAUI8 LINKS

- **Simulation Setup**

  - Channel : Case_000004 from mellitz_3bs_01_0714, insertion Loss is ~19dB at 13.3GHz

  - Large ASIC package model, loss is ~25dB including packages on both sides

  - Fractionally spaced Feed-Forward Equalizer (FS-FFE) with large number of taps

  - Decision feedback equalizer with constraints on tap amplitudes

- **Result : Higher performing DFE tap weights are in the range of 0.5 to 0.75**

- **The "optimal" solution for a product depends on implementation considerations also**

TX PRECODER BENEFITS
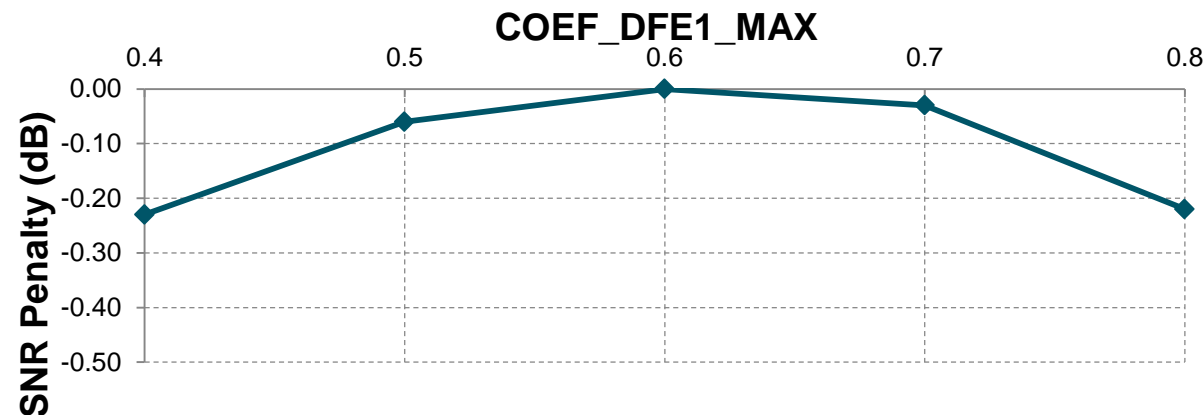
- **Allows more flexible EQ choices and power/performance tradeoffs for RX**

- **Bypass-able option improves interoperability between designs optimized for different criteria**

- **FEC code word interleaving to handle other sources of correlated errors like**

  - Shared Power supply noise

  - Random phase noise from a common VCO

  - EMI and impulse noise events

- **Provides lane-level mitigation against lane-level DFE generated burst errors**

  - Lane-level protection allows extension to other PAM4 AUI configurations where interleaving multiple FEC codewords may not be feasible

CONCLUSIONS

- **Recommend that CDAUI8 C2C TX PMA include a bypass-able TX differential precoder**

  - Defined in 100GBase-KP4 (94.2.2.6)

- **Implementation is inexpensive & low risk – small digital logic**

- **Does not require new programming pathways**

  - Adds 1 control bit to the same interface as CDAUI8 c2c's TXFIR

- **No impact to an RX that doesn't need it**