NRZ vs PAM-4 Re-Timer Power Comparison for 56Gb/s C2M and C2EO Electrical Channels

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Agenda

- C2M Re-Timer Power Estimates
- C2EO Re-Timer Power Estimates
- Summary

Re-Timer Assumptions

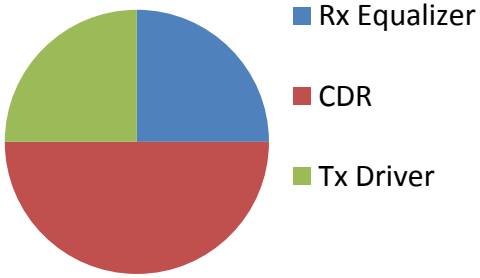
- **PAM-4 C2M and C2EO receivers are based on an individual per lane reference-less CDR**
  - **compatible with reference-less and clock-forwarded interfaces**

- **NRZ C2M and C2EO receivers also based on a per lane reference-less CDR**

C2M Module Transceiver Power Comparison

- **NRZ vs PAM-4 module re-timer power**
  - **for same modulation format at input and output**

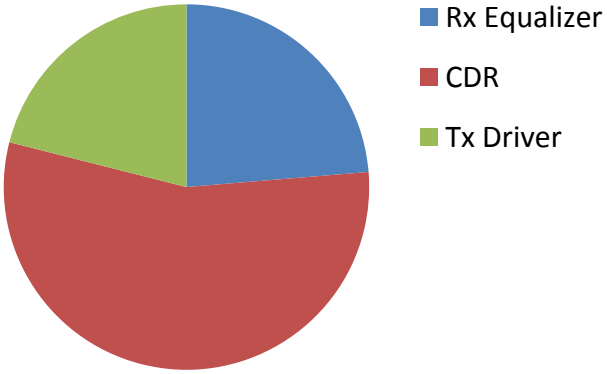
28G NRZ Module Re-Timer



P = 105mW
$Eff_{28G\ NRZ}$ = 3.8pJ/bit

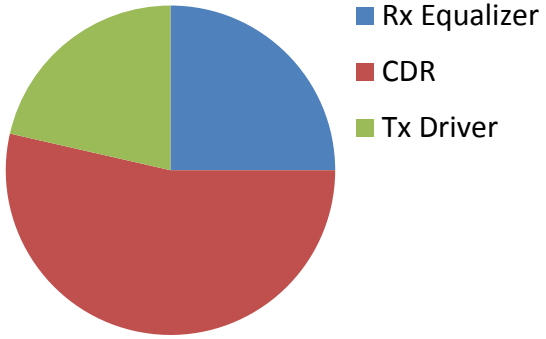
(based on proven and available silicon)

56G NRZ Module Re-Timer



P = 200mW
$Eff_{56G\ NRZ}$ = 3.6pJ/bit

56G PAM-4 Module Re-Timer

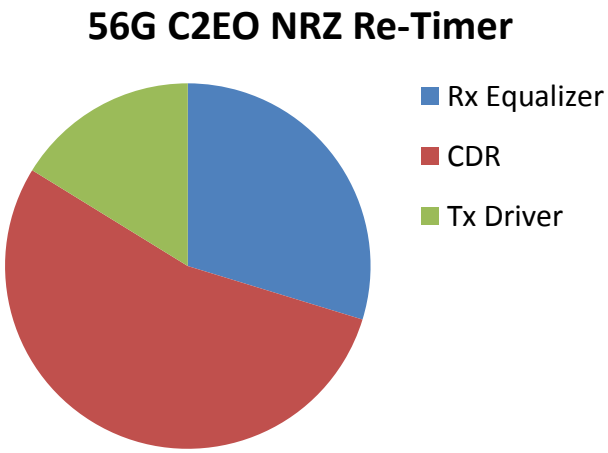


P = 160mW
$Eff_{56G\ PAM4}$ = 2.9pJ/bit

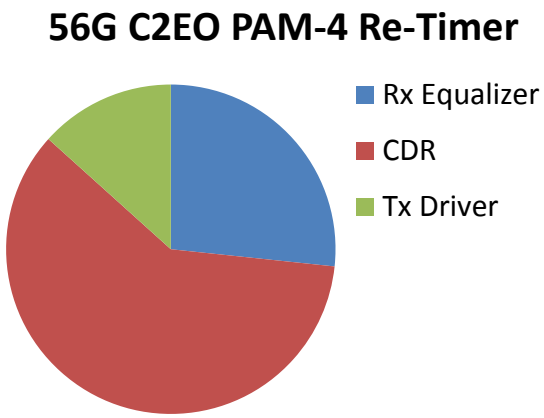
- **56G PAM-4 C2M re-timer power is 80% that of NRZ**

C2EO Re-Timer Power Comparison

- **NRZ vs PAM-4 module re-timer power**
  - **for same modulation format at input and output**



P = 185mW
$Eff_{56G\ NRZ}$ = 3.3pJ/bit



P = 150mW
$Eff_{56G\ PAM4}$ = 2.7pJ/bit

- **56G PAM-4 C2EO re-timer power is 81% that of NRZ**

Summary

Interface	NRZ efficiency	PAM-4 efficiency
56Gb/s C2EO	3.3 pJ/bit	2.7 pJ/bit
56Gb/s C2M	3.6 pJ/bit	2.9 pJ/bit

- **PAM-4 re-timers will enable low power C2M and C2EO solutions**