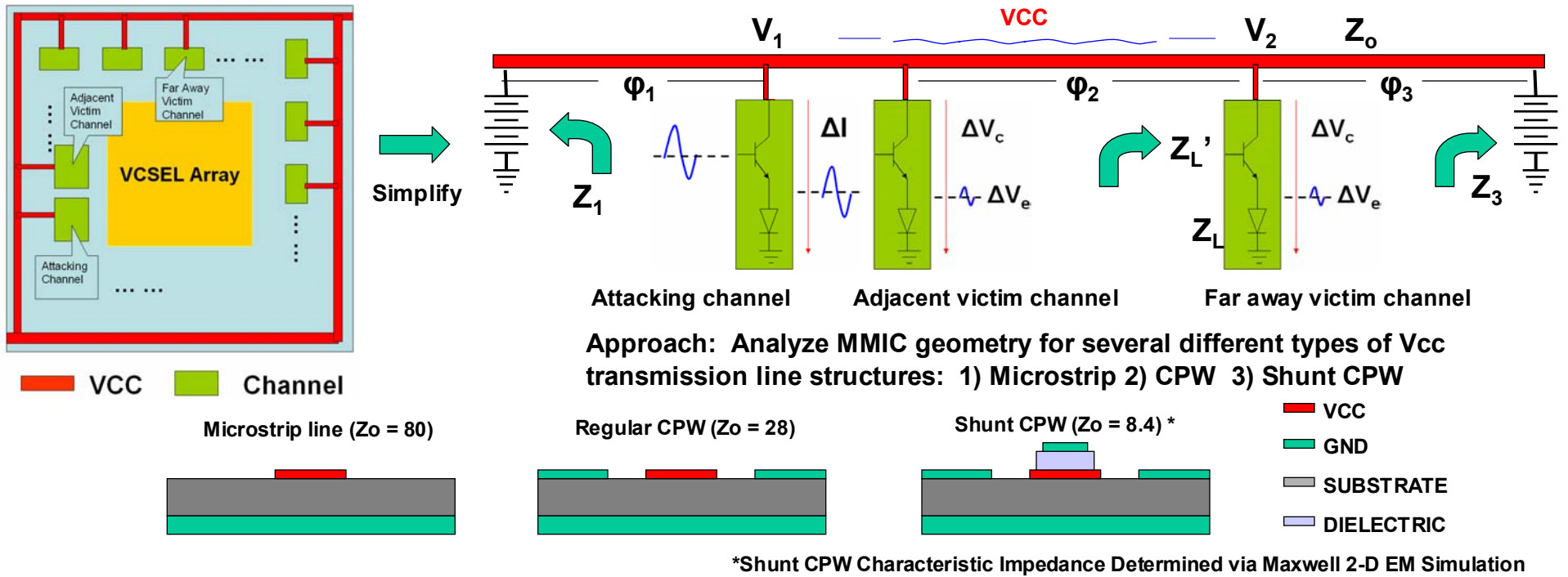


# Crosstalk Reduction in Single-Ended VCSEL Drivers

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**BACKGROUND:** Crosstalk is critical for high-density arrays of vertical surface emitting lasers (VCSELs). High density dictates single-ended (as opposed to balanced) driver circuits which impacts channel to channel crosstalk performance.

1. Crosstalk can occur in a single-ended driver design due to Vcc fluctuation caused by imbalanced current loads. The geometry and AC impedance of the Vcc line affects the crosstalk level!

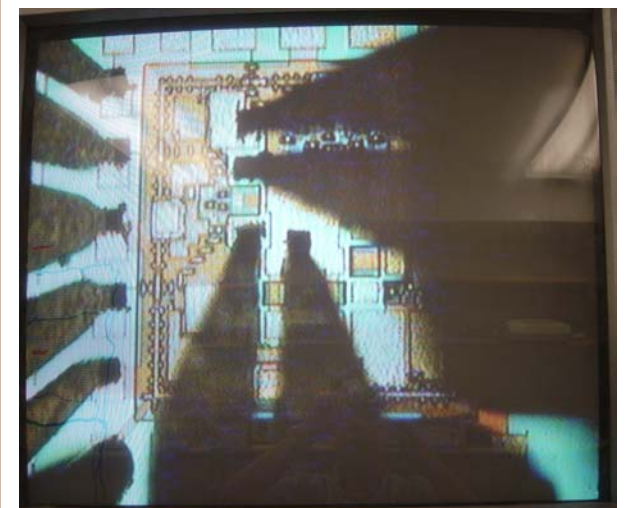


## 2. Generalized Analysis – Transmission Line analysis

$$\begin{aligned} \therefore Z_3 &= jZ_o \tan(\phi_3) \quad \text{and} \quad Z_1 = jZ_o \tan(\phi_1) \\ \therefore Z'_L &= Z_L // Z_3 \quad \Rightarrow \quad Z_i = Z_o \frac{Z'_L + jZ_o \tan(\phi_2)}{Z_o + jZ'_L \tan(\phi_2)} \\ \Rightarrow Z_{total} &= \frac{Z_i \times Z_1}{Z_i + Z_1} \quad \Rightarrow \quad V_1 = \Delta I \times Z_{total} \\ \therefore V(d) &= A(e^{j\beta d} + \Gamma e^{-j\beta d}) \quad \text{where} \quad \Gamma = \frac{Z'_L - Z_o}{Z'_L + Z_o} \\ \therefore A &= V_1 / (e^{j\phi_1} + \Gamma e^{-j\phi_1}) \quad \Rightarrow \quad V_2 = A(1 + \Gamma) \end{aligned}$$

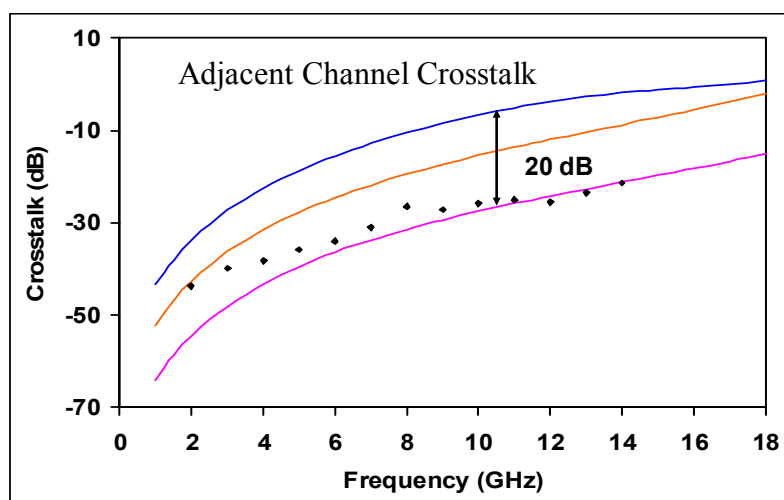
The analysis shows that a lower impedance transmission line significantly reduces crosstalk.

## 3. RF Wafer Probes used to take crosstalk measurements

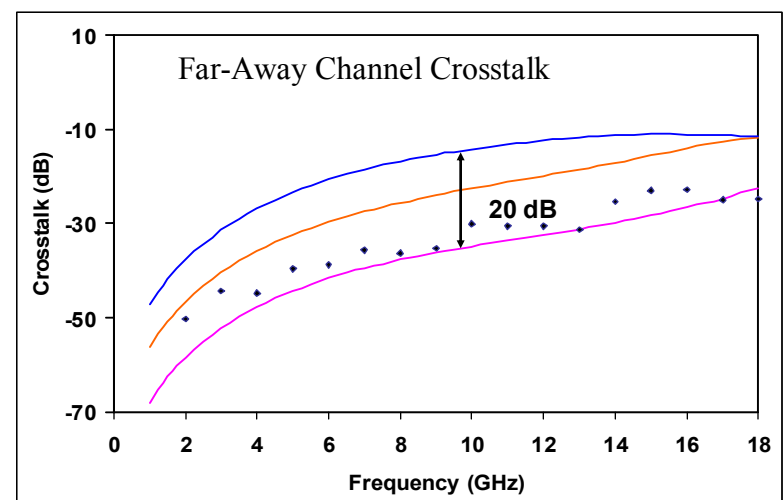


## 4. Simulated and Measured Crosstalk Results

Circuit-level simulations done in Agilent Advance Design System



Crosstalk of adjacent channel through VCC  
(—) Microstrip line, (—) regular CPW, (—) shunt CPW  
(♦) Measured data on 3x3 driver chip



Crosstalk of far away channel through VCC  
(—) Microstrip line, (—) regular CPW, (—) shunt CPW  
(♦) Measured data on 3x3 driver chip

**Conclusion:** VCC line using shunt CPW structure effectively reduces crosstalk by 20 dB in single-ended driver channels