# Comments On De-Embedding

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# What Is De-Embedding?

- Removes the effects of a known part of a measurement system

- Many oscilloscopes specified at the front panel inputs
  - At very high speeds cables and fixtures degrade the signal

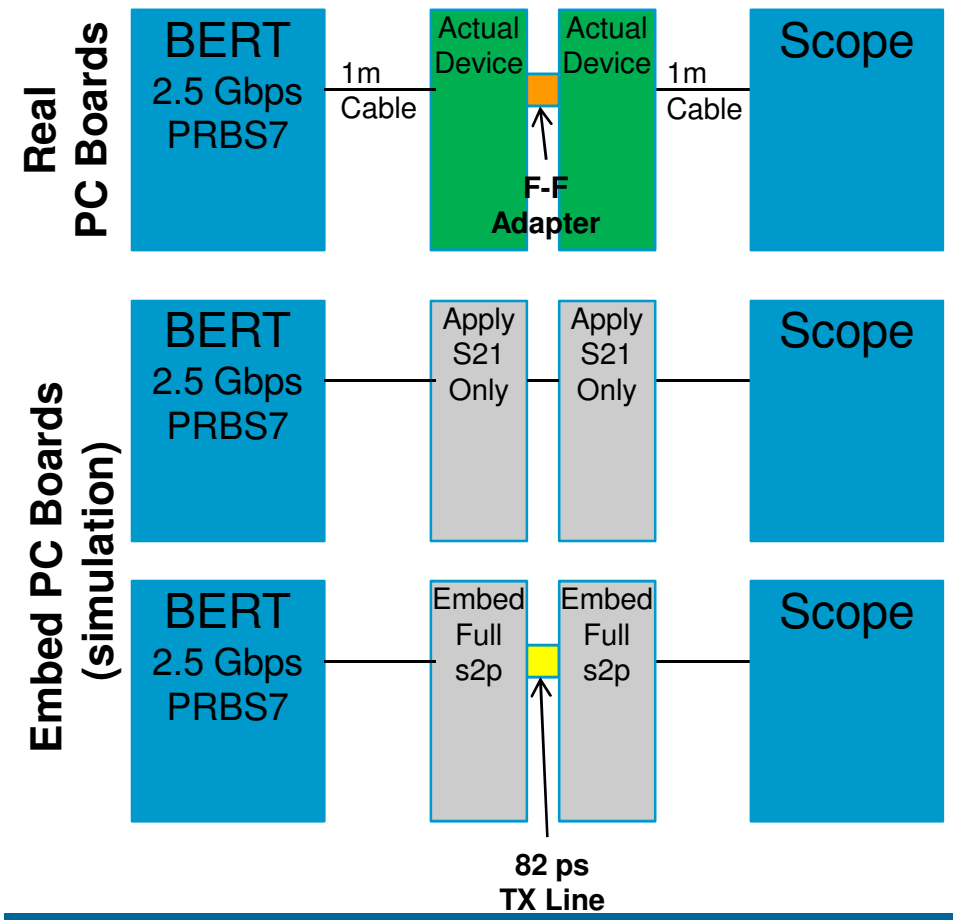
- De-embedding is an attempt to reverse the degradation
  - Improves measurement accuracy
  - Gives margins back to system design

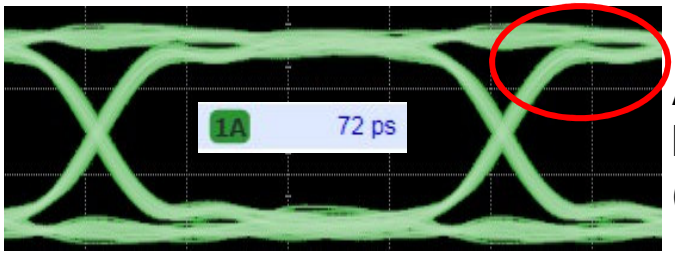
# Mathematical Process

- Imposes certain restrictions on the test signal (for example, PRBS2^15-1)
- Usually requires the S-parameters of the subsystem to be de-embedded
- De-embedding fully-populated S-parameters more difficult
  - but also more accurate if reflections contribute to jitter and noise
- Effectiveness depends on the type and accuracy of the model for the parts to be removed
  - Smaller effects easier to be compensated than big ones

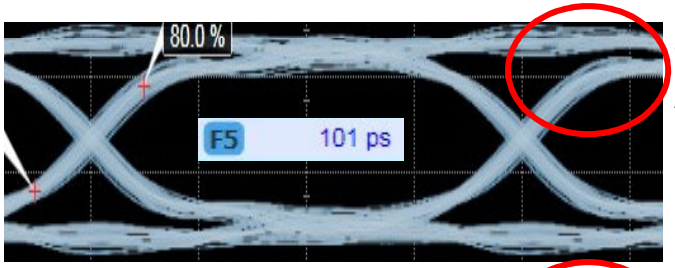
# Measurement Example

| Measurement | | Current | |
|---|---|---|---|
| Rise Time | F5 | 101 ps | S21 only |
| Rise Time | F3 | 71 ps | Full .s2p |
| Rise Time | 1A | 72 ps | Actual Signal |

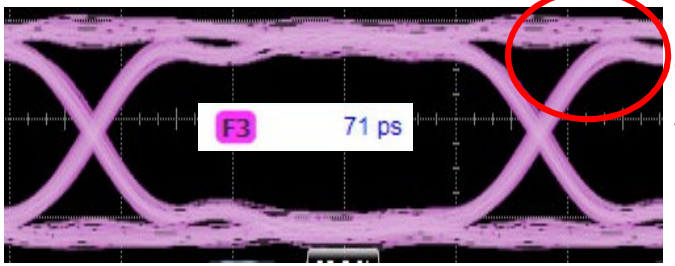



**Actual** Measurement (direct)




**Simulation -** Apply S21 Only




**Simulation -** Apply Full .s2p

# Recommendations

- Make efforts to de-embed HCTB, MCTB for 32G FC
  - Less margin for jitter & noise needed for measurement
  - Use margin for system design

- Characterize properties of HCTB, MCTB, and cables
- Publish generic S-parameters for normative de-embedding
  - Requires worst-case board tolerances tight enough to avoid individual S-parameter files