C_comp and Buffer Scaling Observations

Bob Ross

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GROUP

Agenda

- Enhanced IBIS Version 2.1 model subset
- 2-tap pre-emphasis example and impedance interaction
  - Driver Schedule
  - Combining Buffers
- Ideal buffer test case
  - Problems
  - C_fixture solution for peaking
- Conclusions/recommendations

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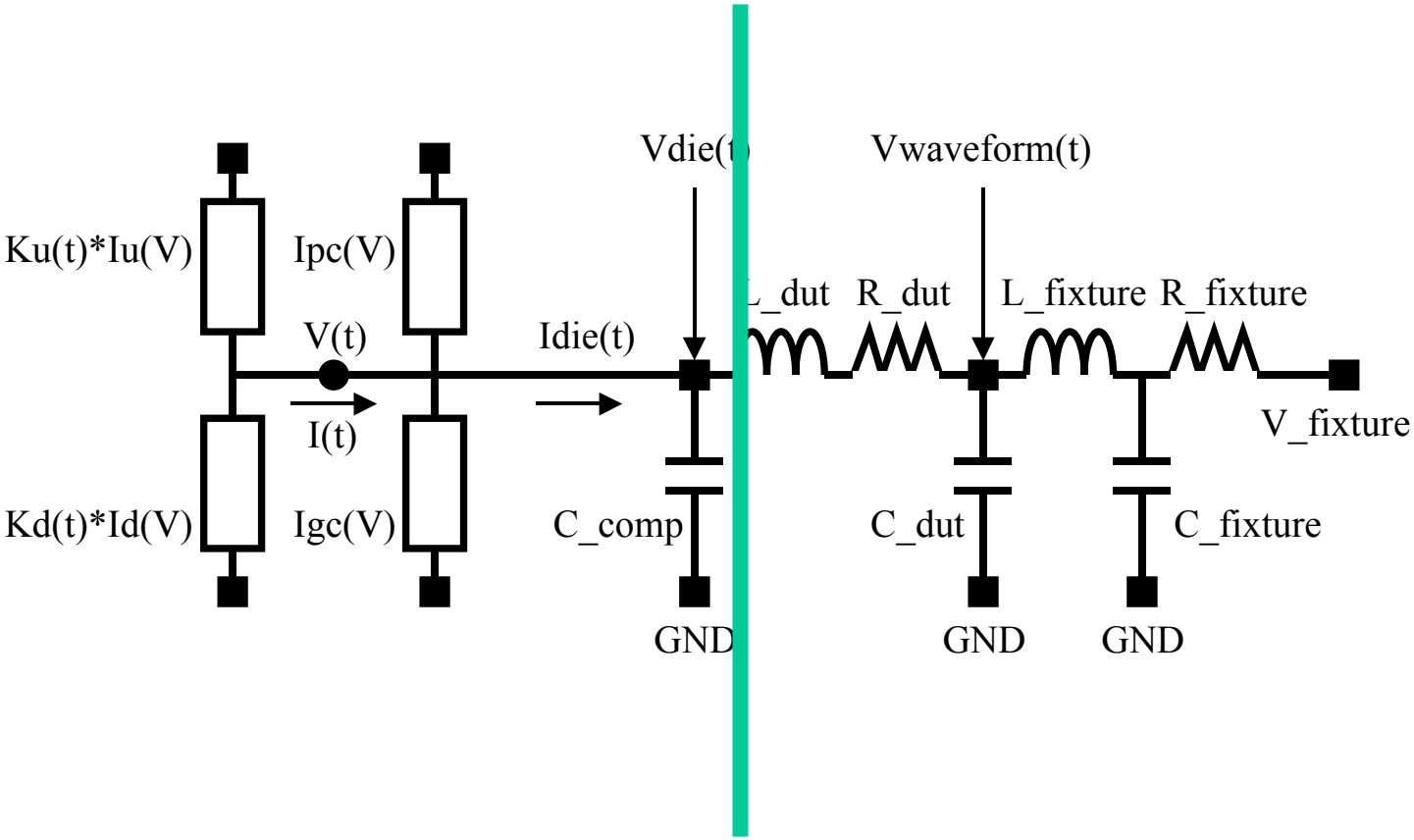
Full IBIS Version 2.1 Buffer (C_comp is part of buffer)



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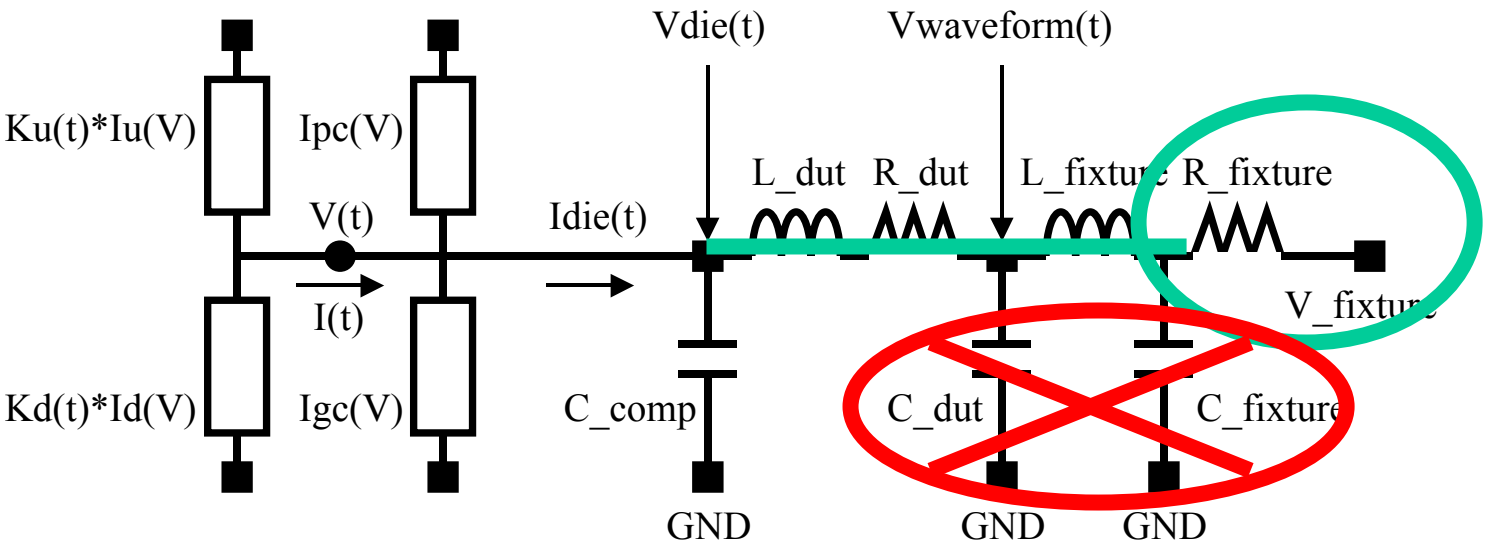
Typical Industrial Subset of IBIS Version 2.1



R_fixture, V_fixture and C_comp

Used for K-table extraction algorithm to develop internal driver model

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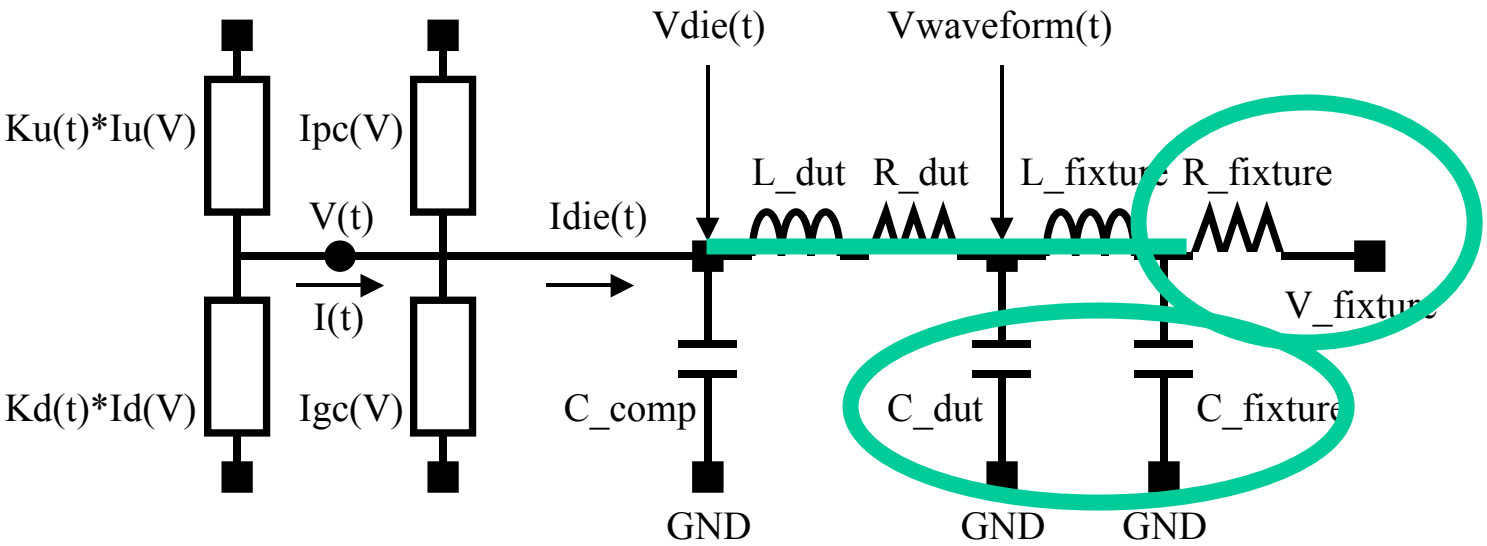
Proposed Enhanced Subset of IBIS Version 2.1



C_comp* = C_comp + C_dut + C_fixture

K-table Extraction algorithm UNCHANGED

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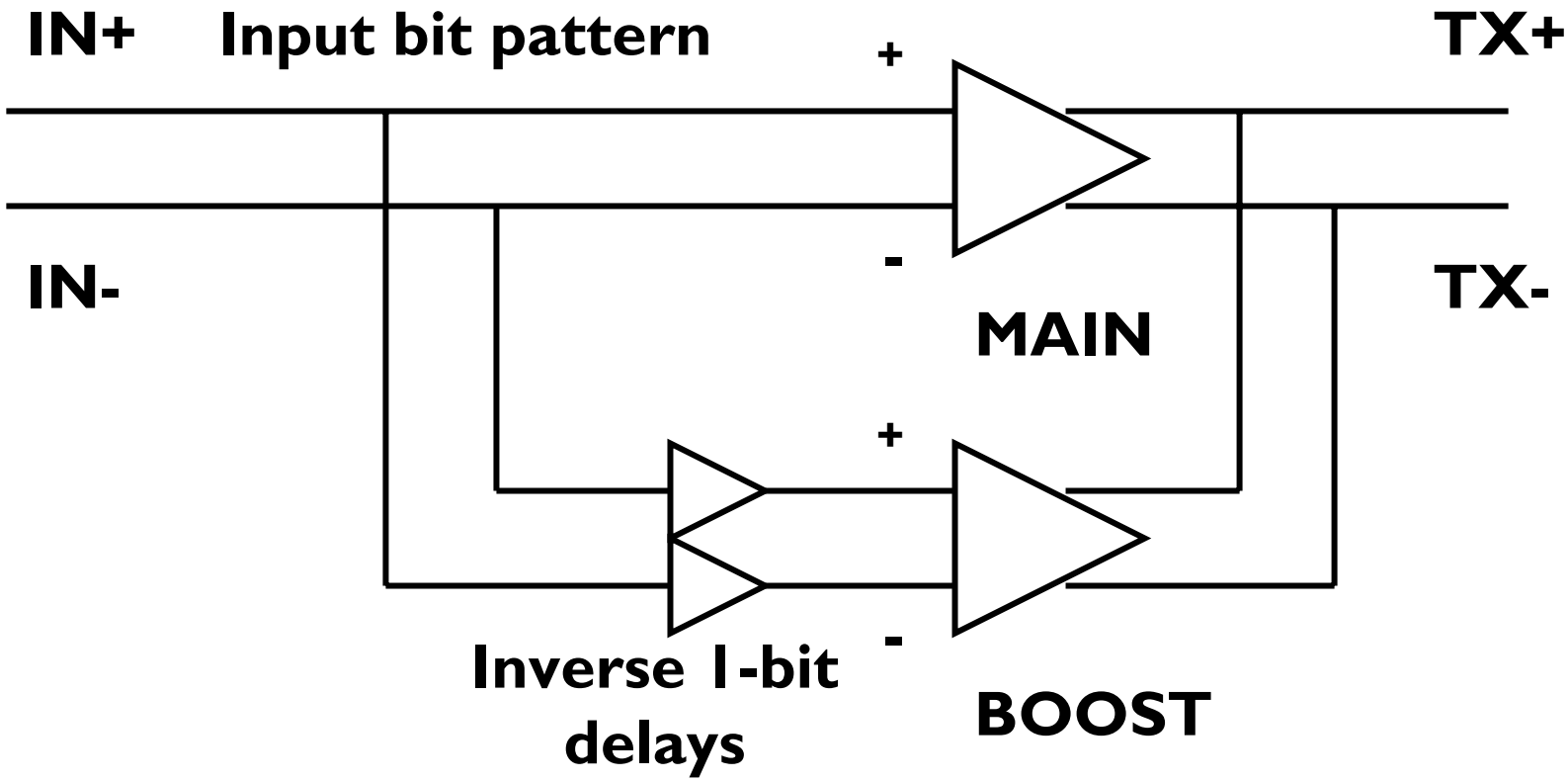
2 – Tap Pre-emphasis, Differential Control and [Driver Schedule]



[Driver Schedule]

Model_name	Rise_on_dly	Rise_off_dly	Fall_on_dly	Fall_off_dly
MAIN	0	NA	0	NA
BOOST	NA	0.47059ns	NA	0.47059ns

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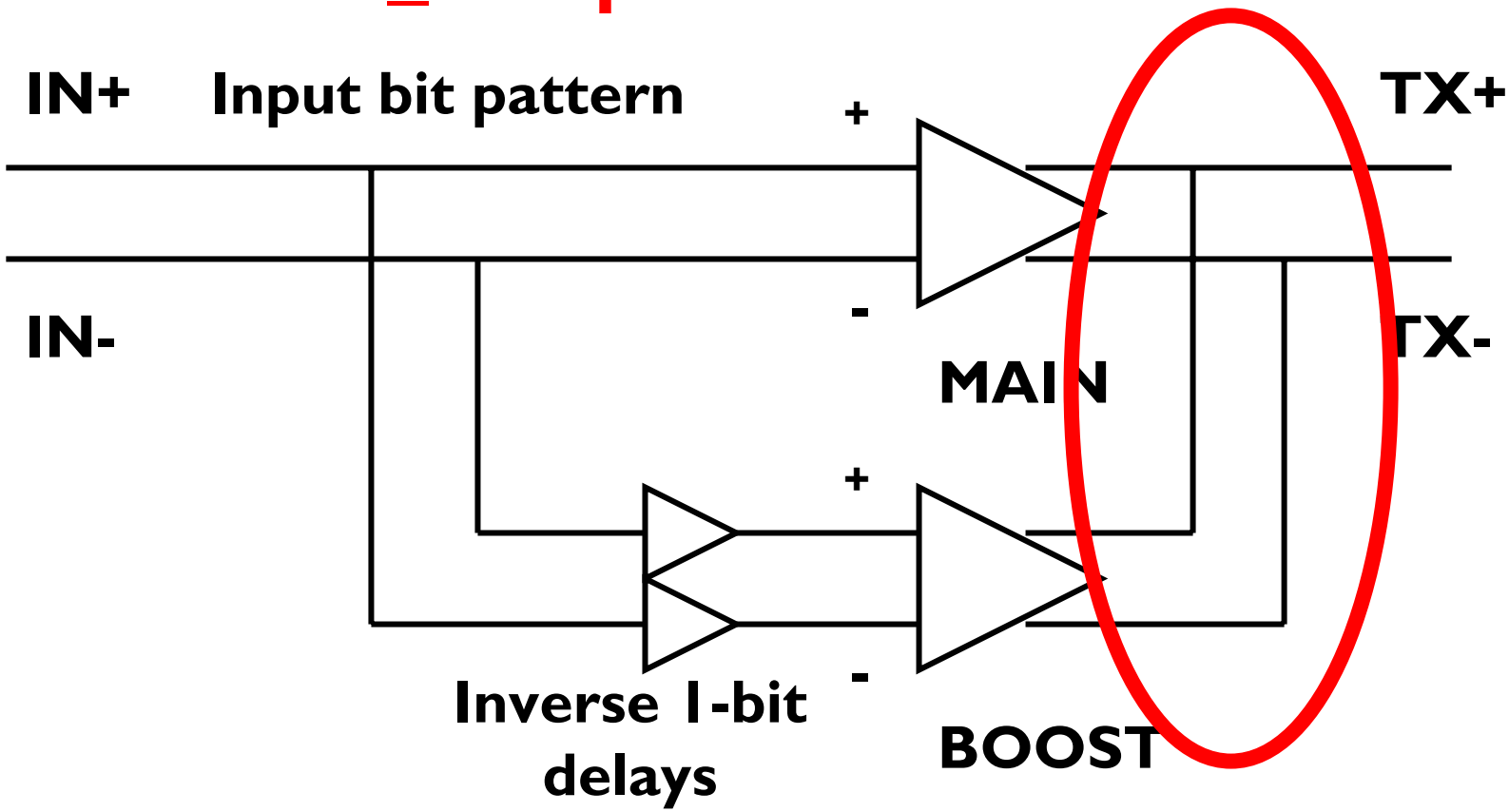
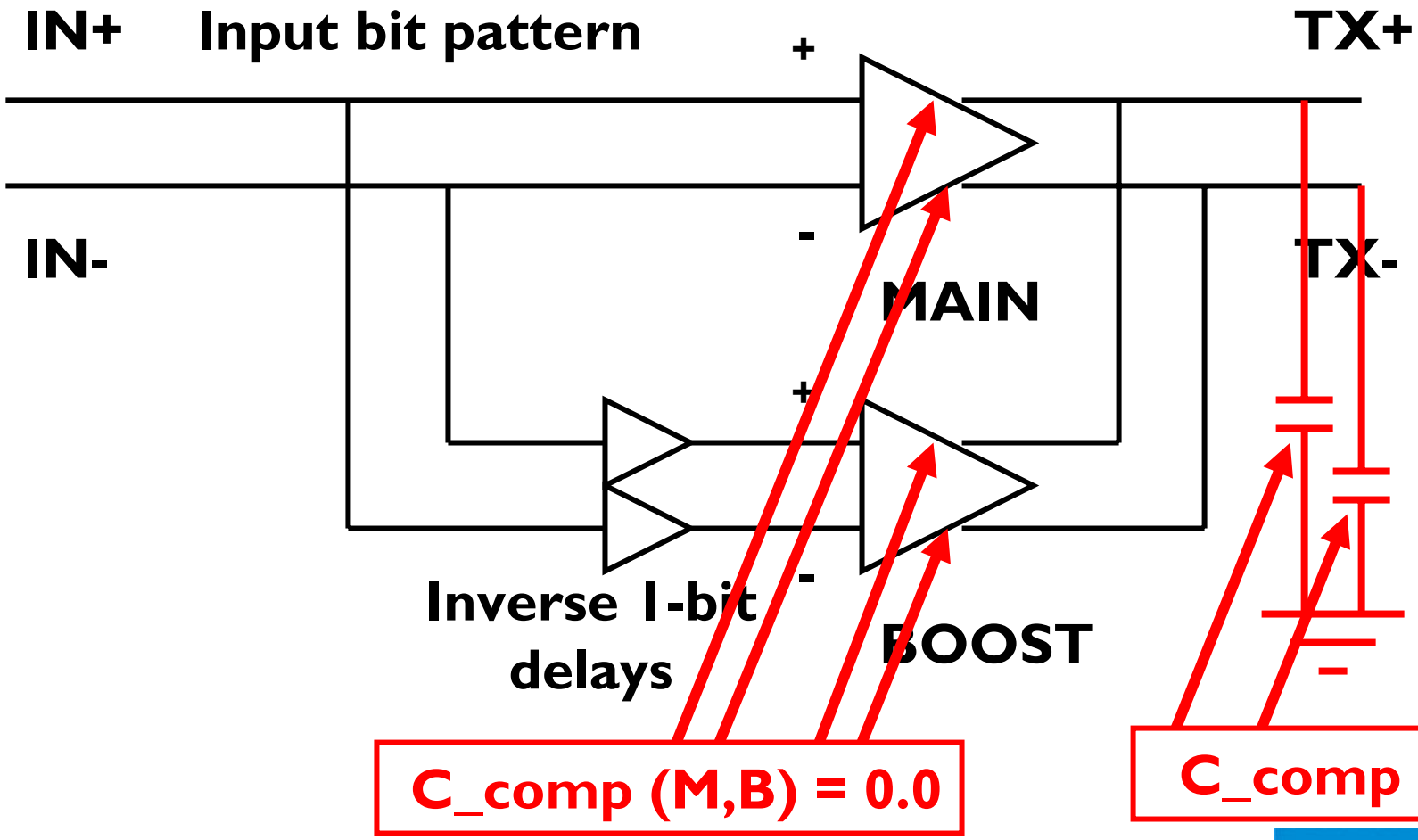
Output Impedance and C_comp Interaction??




```
[Driver Schedule]
| Model_name Rise_on_dly Rise_off_dly Fall_on_dly Fall_off_dly
MAIN         0           NA           0           NA
BOOST        NA          0.47059ns    NA          0.47059ns
```

IBIS Solution - C_comp as Load with [Driver Schedule]



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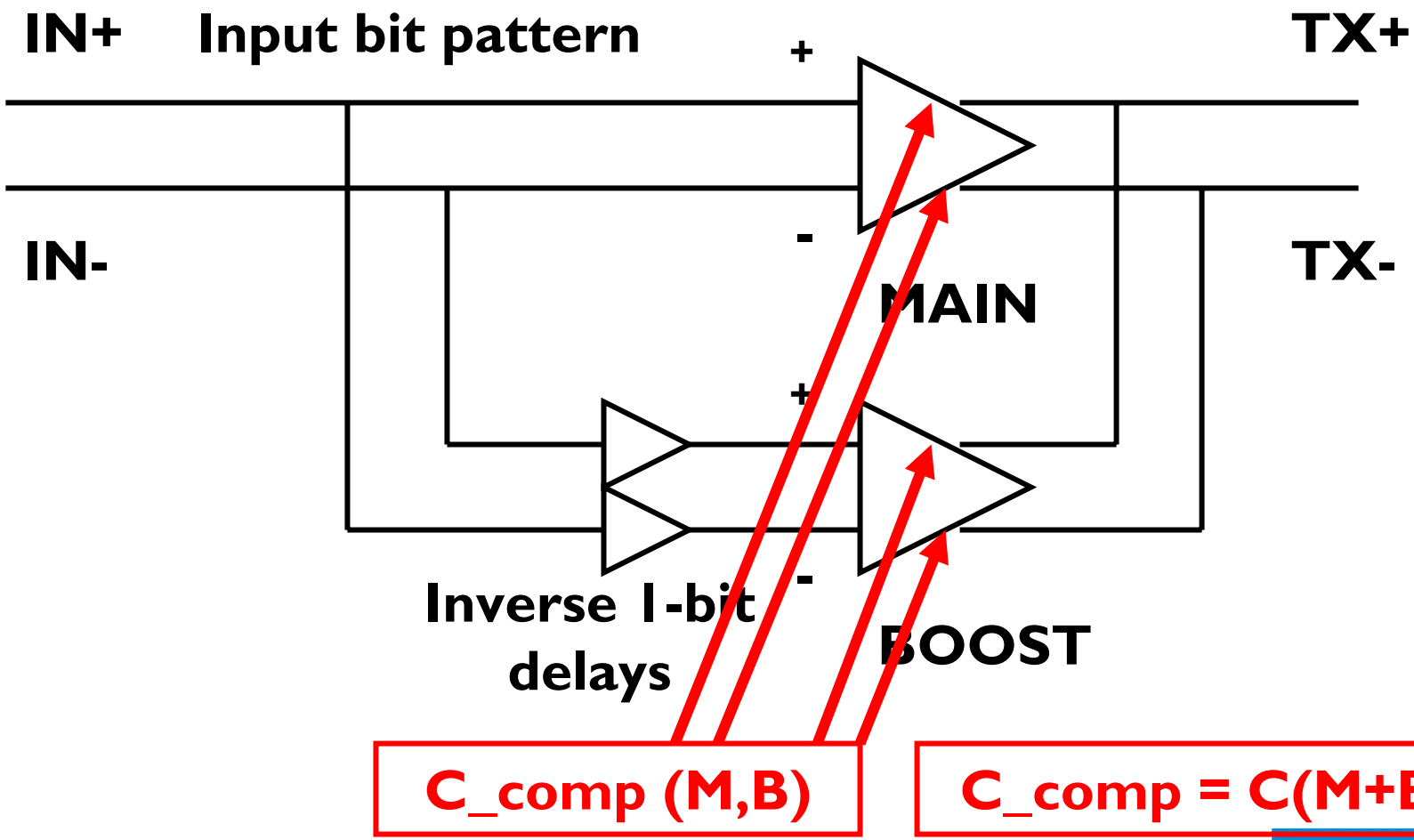
Macro Model – Buffer Scaling Solution



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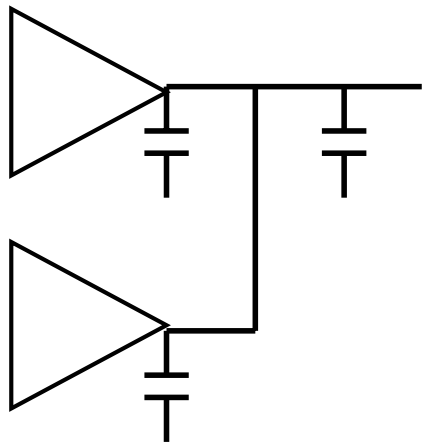
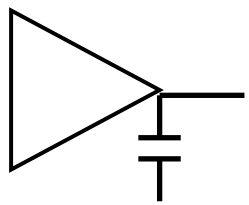
Both Approaches Have Limits - Shown by Ideal Buffer Test Case

- Summation
  - 100 ps ideal ramp
  - 25 Ω ideal buffer (in connected mode)
  - C_comp = 3.0 pF
  - Vdd = 1.5 V
- Each one-half scaled
    - 100 ps ideal ramp
    - 50 Ω ideal buffer
- 50 Ω R_fixture
- 50 Ω load





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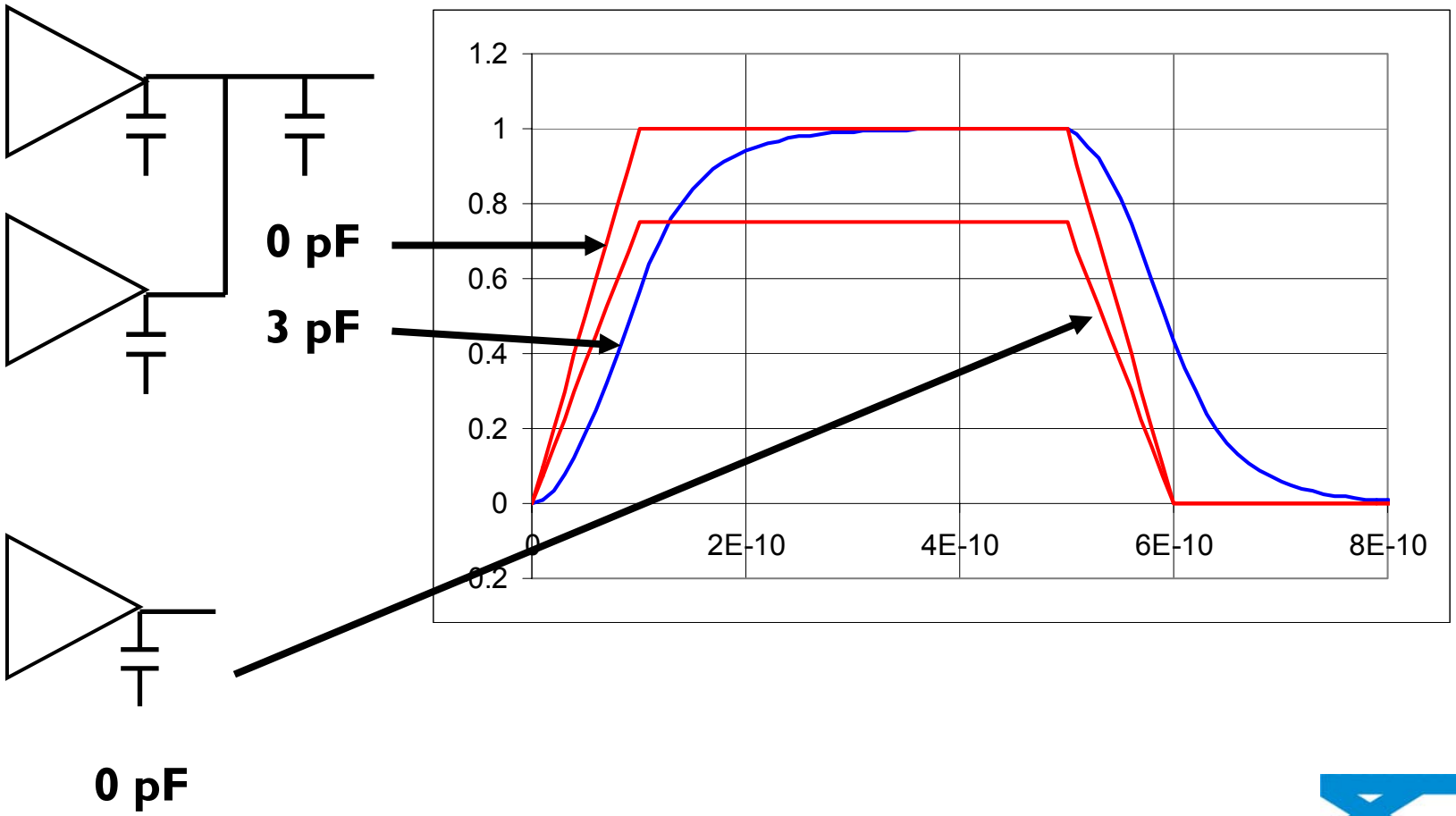
IBIS [Driver Schedule] Setup with/without C_comp = 3 pF



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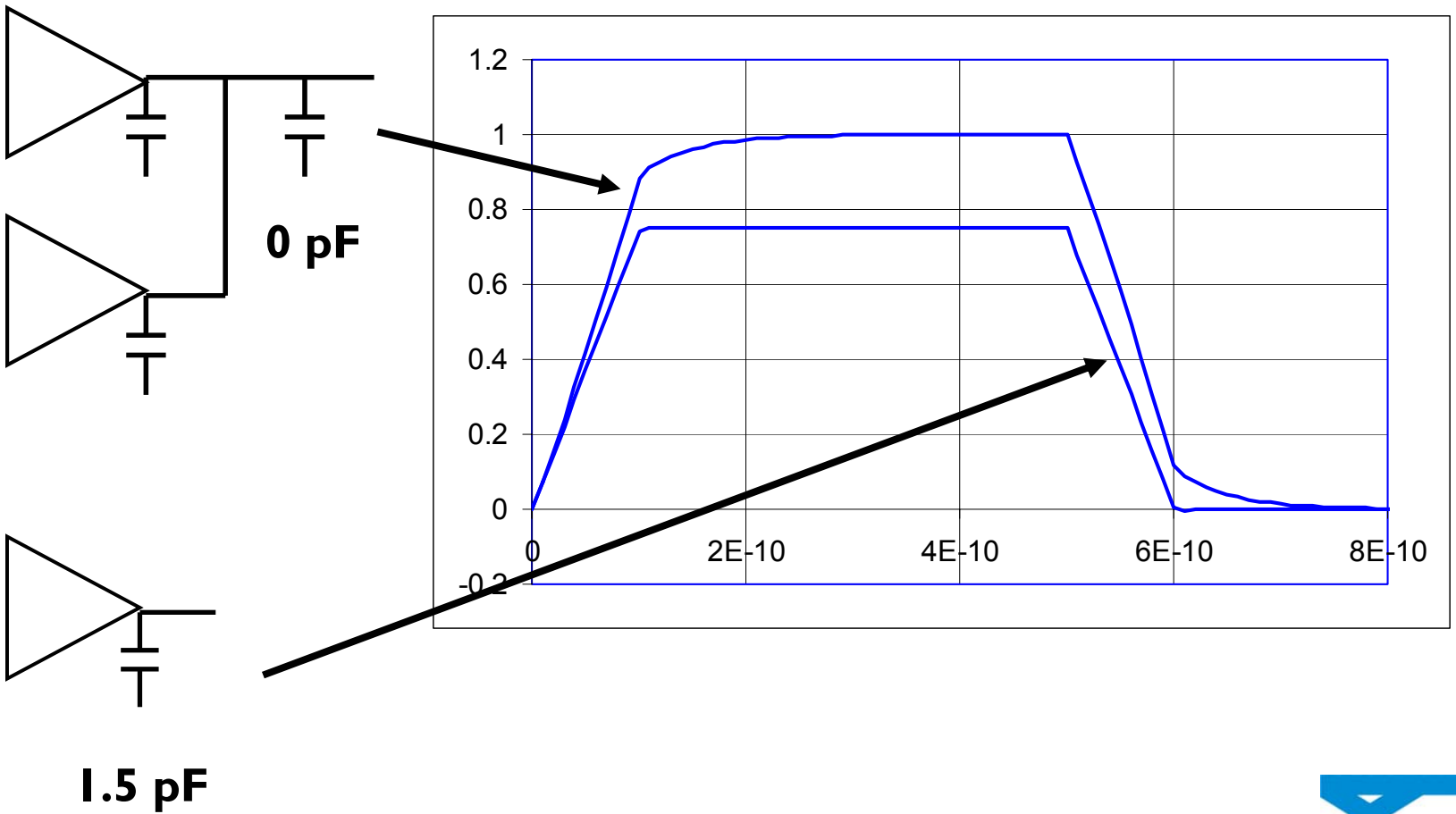
Connected One-half Scaled Buffers



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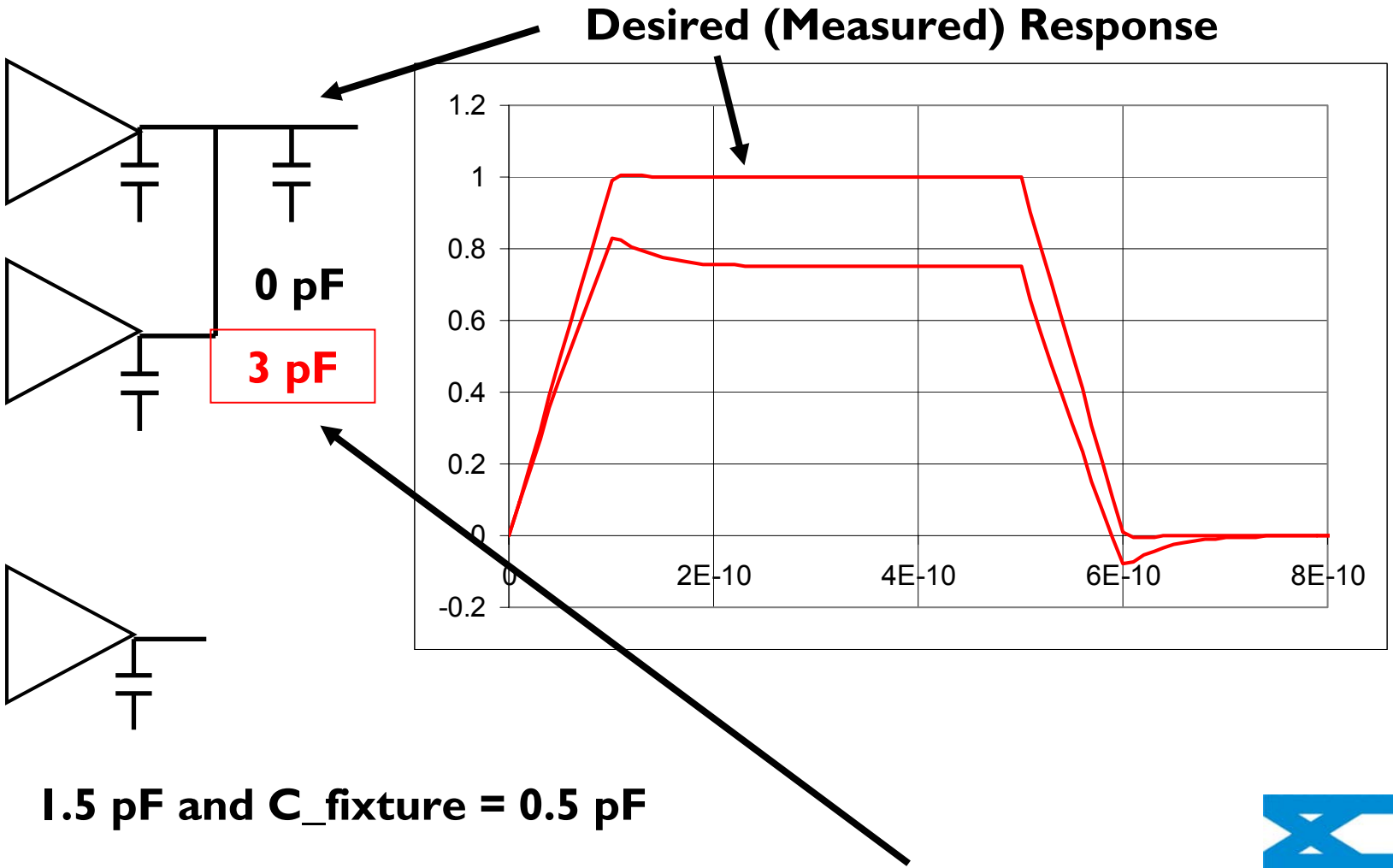
C_fixture Peaking Works in All Cases with Original Scaled Waveforms



1.5 pF and C_fixture = 0.5 pF

or 0 pF and C_fixture = 2.0 pF for [Driver Schedule] setup

Conclusions/Recommendations

- Implement "enhanced" IBIS Version 2.1 subset with C_fixture and C_dut processing
  - No algorithm change
- Use a C_fixture tweak for 2-tap pre-emphasis simulation ([Driver Schedule], language, macro-model, etc.) with "scaled" buffers
  - Independent tweaks for rising, falling edges possible
  - Experimentally adjust C_fixture with real non-linear, non-ideal buffers
- Watch out for impedance interactions!!