



Package to Board Linkage capacitance - C_p

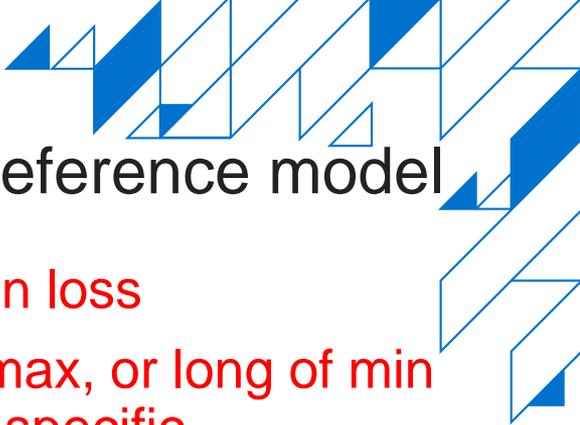
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IEEE802.3CK ad-hoc telephonic meeting

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Agenda

1. Package imperfections and inclusion in the reference model
2. Package to board linkage “Ball area” capacitance
3. Cp TDR Results
4. Summary



Package imperfections and inclusion in the reference model

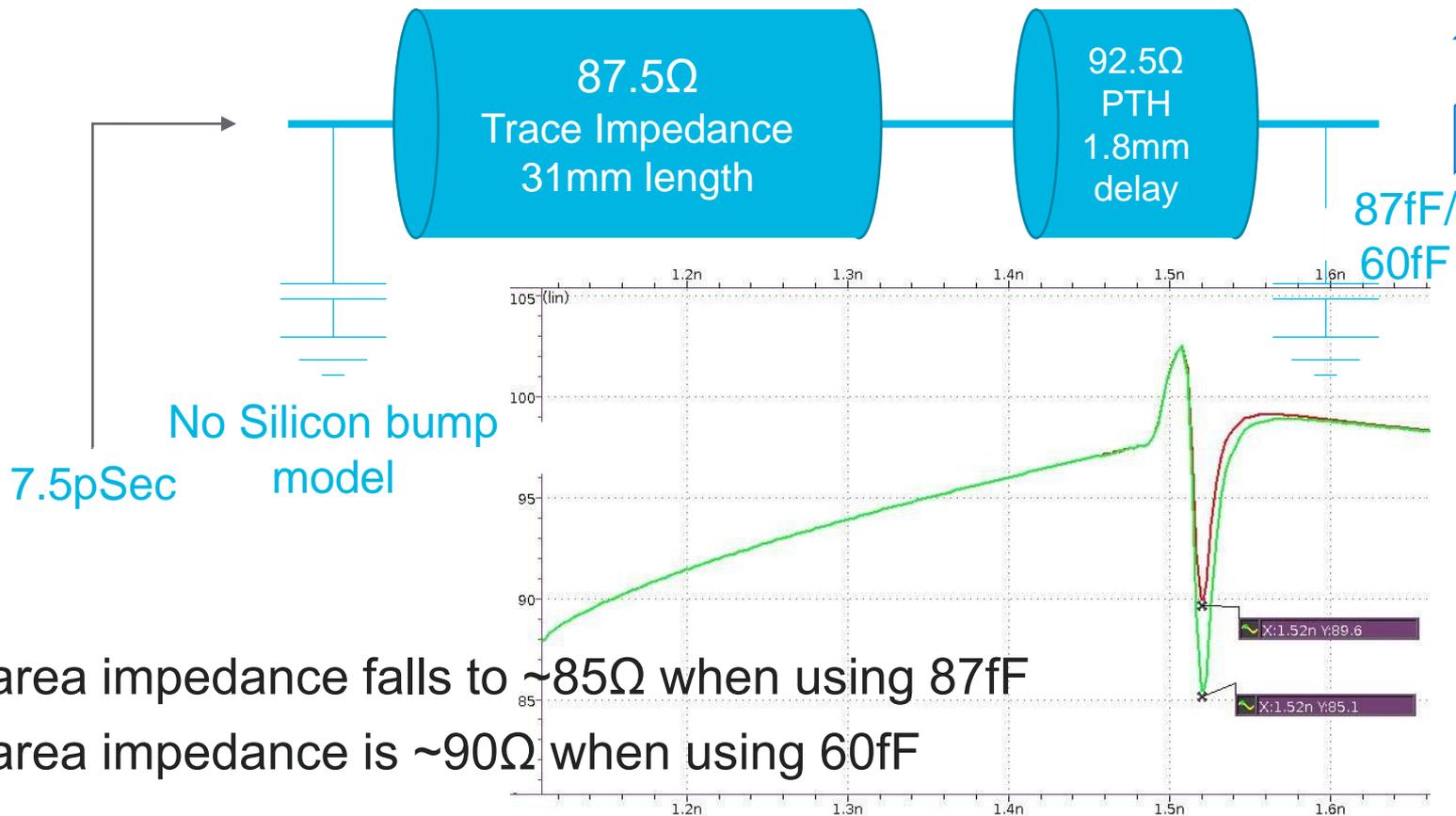
- Loss – Included, may fall short of max, or long of min loss
- Length – Two reference lengths – may fall short of max, or long of min length, may not introduce worst re-reflections given specific interconnects
- Bump area discontinuity – model included to represent silicon “T-Coil” and bump discontinuity
- Trace + PTH impedances – Models are included to represent impedances of the trace and the PTH with delay relative length – Manufacturing tolerances are not represented and package vias were optimized to bring best COM result, one PTH location close to the ball
- Package cross lane Far-end/Near-end Crosstalk – Not included
- Ball-area discontinuity – Next Slide



Package to board linkage “Ball area” capacitance

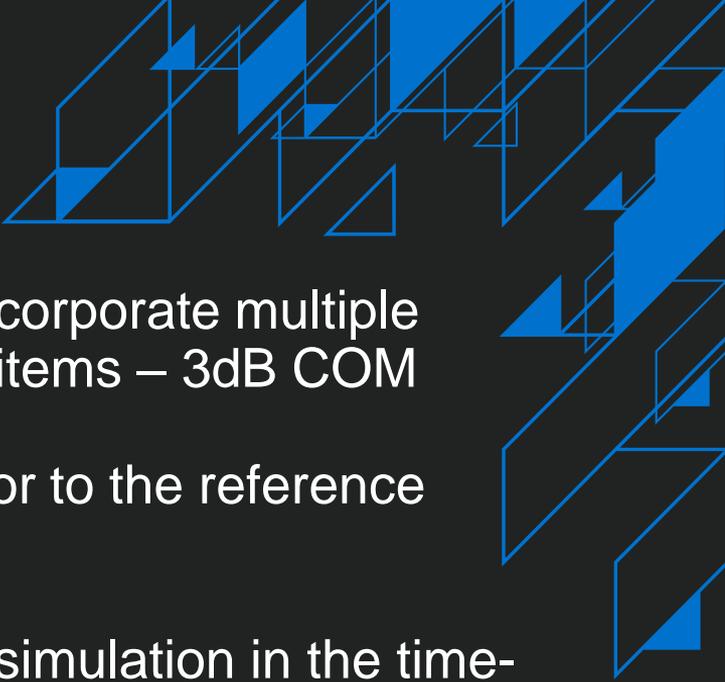
- Device package including 100Gbps lanes vary in size and type
 - Various types and sizes can have different ball-area characteristic impedance discontinuity.
 - Implementation requirements vary, mechanical requirements vary, manufacturing tolerance vary
- Package to board linkage capacitance is used to emulate reference package ball area discontinuity and is called C_p
 - A more complicated model was avoided thanks to ball-area dimensions relative to wavelength. For better accuracy can increase complexity – no need
 - Correlation to extractions (No board pad – coax port on ball) was provided in https://www.ieee802.org/3/ck/public/19_01/benartsi_3ck_01_0119.pdf
- The usage of C_p is in the time domain in COM and TP0v simulations
 - Discontinuity in time domain is best estimated by time domain reflectometry

Cp TDR using COM rise-time (7.5psec)



- Ball area impedance falls to $\sim 85\Omega$ when using 87fF
- Ball area impedance is $\sim 90\Omega$ when using 60fF

Summary



- The reference package model does not incorporate multiple manufacturing related and design related items – 3dB COM
- Loss and reflections are a major contributor to the reference package model imperfections
- The reference package model is used for simulation in the time-domain, thus one should look at its effect in time domain reflectometry
- It was demonstrated that 87fF introduce a reasonable discontinuity – not best case, for sure not worst case

Thank you!

