Two PKG types approach – Radix Optimized type supporting data

Adee Ran - Cisco
David Katz – Marvell Technology
Liav Ben-Artsi – Marvell Technology
Rich Mellitz – Samtec

November 2023 - Hawaii

Agenda

In lusted_3dj_04_2309 a method of two package target optimization cases were presented and widely accepted as a path forward

This presentation will provide the required background data for “Radix optimized” package B case

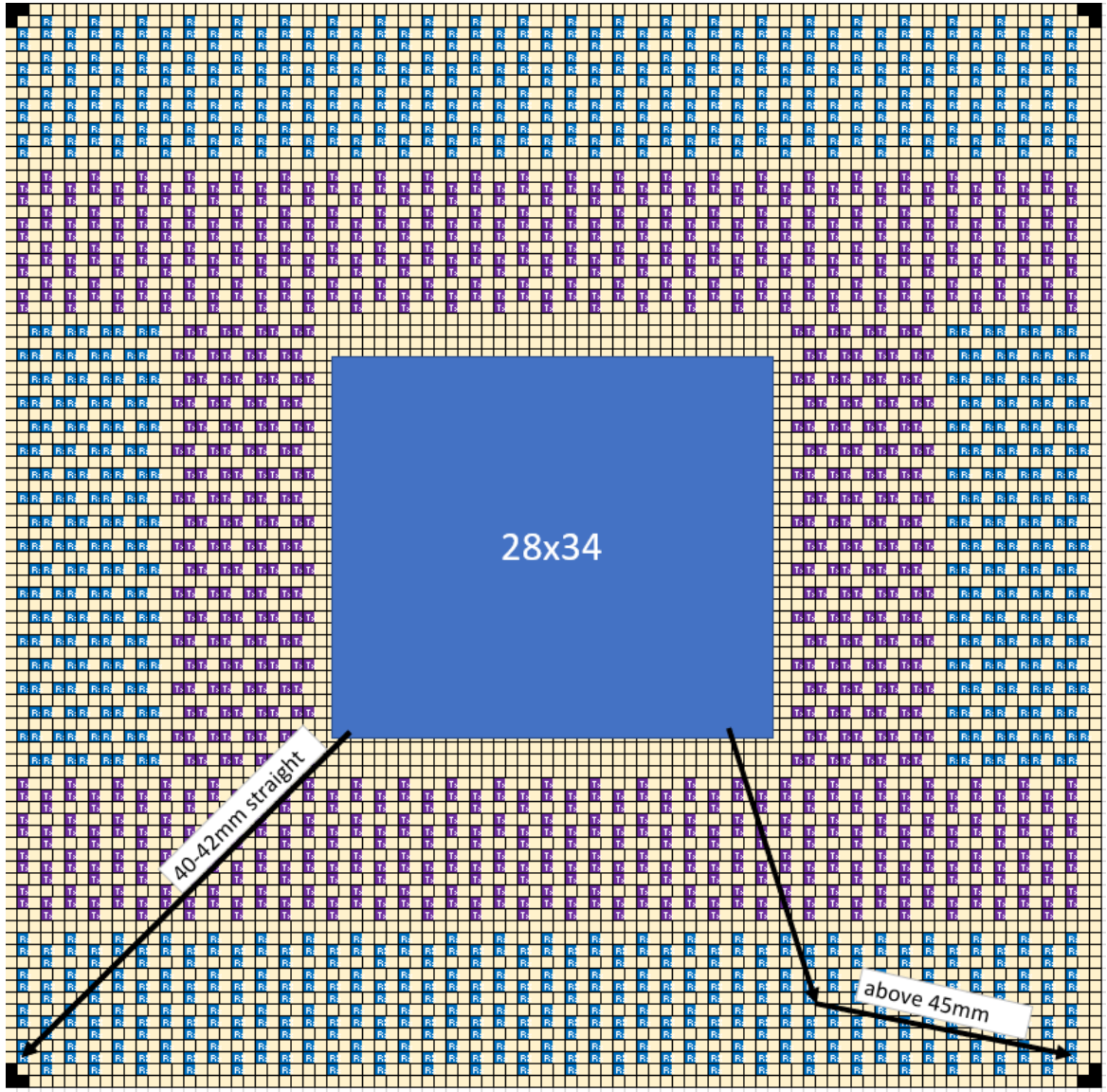
- ❑ Recap on base assumptions to construct PKG B COM model
- ❑ Suggestion for Case B package model
- ❑ Next steps

Assumption 1: Trace length: High Radix Population of 512 Tx Lanes & 512 Rx Lanes

PRESENTED IN:
BENARTSI_3DF_01A_2211

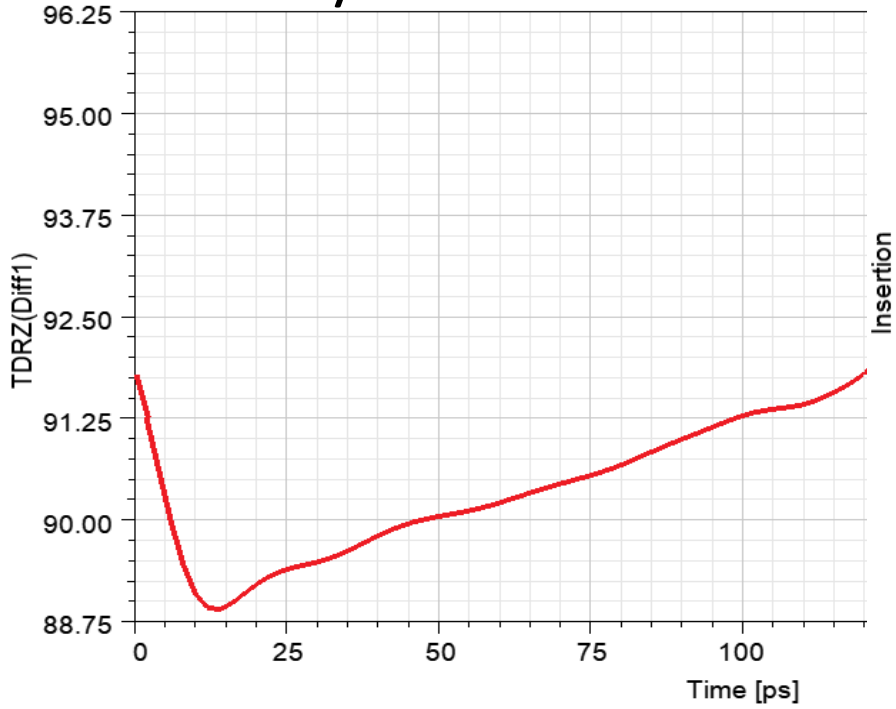
92X92 BALL-OUT MATRIX

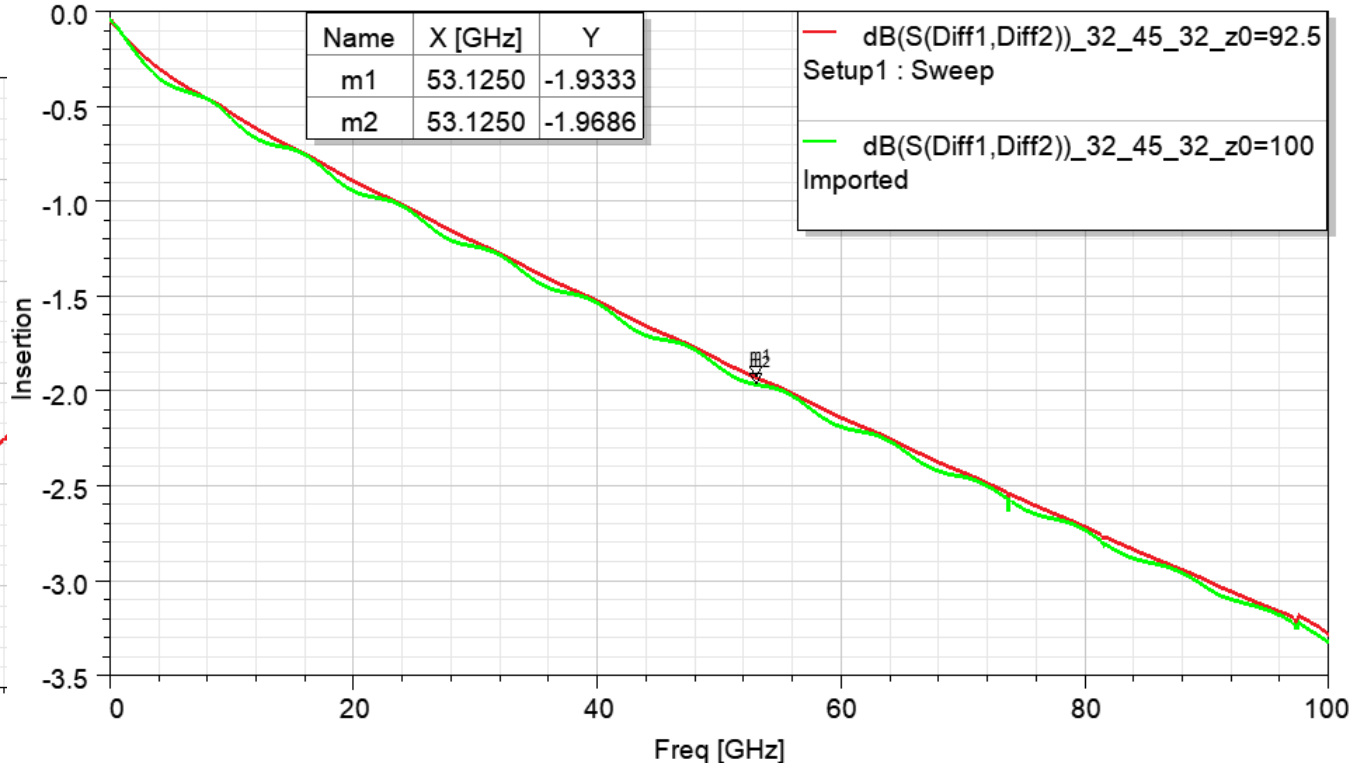
- No overhead was taken for CMOS, PCIe, or any addition signals
- Routing of Tx, or Rx lanes can easily be 40-45mm long, or even longer in congestion cases
- **Outcome: Use 45mm for PKG-B case**



Assumption 2: Trace Geometry and material properties

- To lower loss: Used 45µ dielectric height above and below trace
- No “skip layer” topology
- 32µ trace width; 45µ separation ➔~89Ω characteristic impedance
- Trace loss/mm ≈0.195dB





Assumption 3: Package Geometry

- Intermediately used an 8-2-8 with 800µ core thickness and 1mm pitch
- A stack up of as many as 9 build-ups may be needed
- A core thickness of 1200µ or more will probably be needed for a radix optimized package co-planarity
- A package core transfer of ~1200µ was already optimized (not integrated yet into the end to end model) ≈ 0.5dB at 53.125GHz; To be integrated into updated PKG model alongside buildup vias
- Overall package TDR shows ~92.5Ω impedance

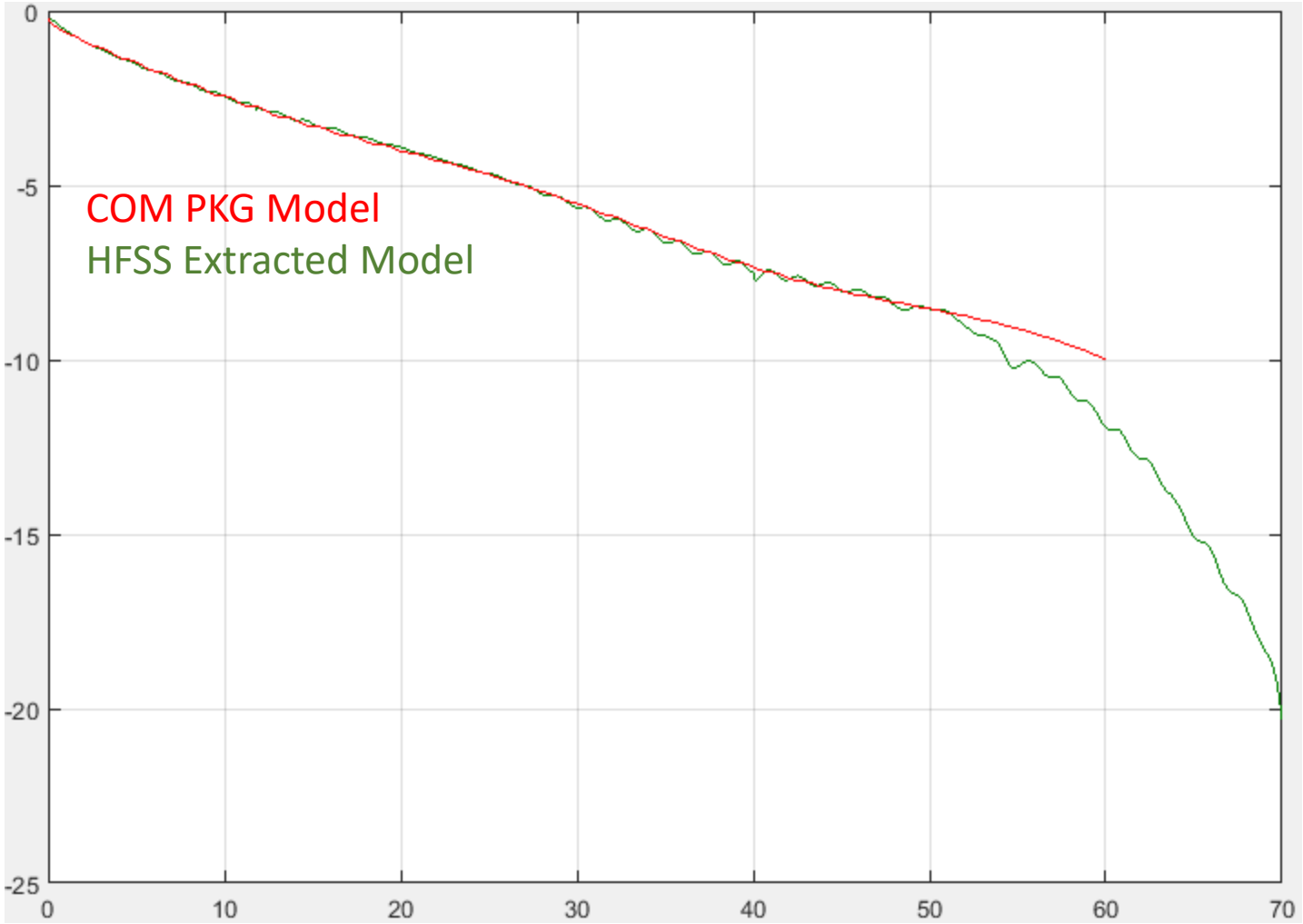
Outcome: Package Extraction

- Intermediate Extraction shows ~9.35dB loss at 53.125GHz
- Return loss is better than -13dB at 53.125
- Fitted parameters are brought forth on the next slide

Suggested Package Type B Parameters

Table 93A–3 parameters			
Parameter	Setting	Units	Information
package_tl_gamma0_a1_a2	[5e-4 6.5e-4 3e-4]		
package_tl_tau	0.006141	ns/mm	
package_Z_c	[92 92 ; 70 70; 80 80; 100 100]	Ohm	
z_p select	[1 2 3 4]		[test cases to run]
z_p (TX)	[8 24 30 45 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases]
z_p (NEXT)	[7 23 29 44 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases]
z_p (FEXT)	[8 24 30 45 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases]
z_p (RX)	[7 23 29 44 ; 1 1 1 1; 1 1 1 1 ; 0.5 0.5 0.5 0.5]	mm	[test cases]
C_p	[0.4e-4 0.4e-4]	nF	[TX RX]

Frequency Domain Comparison



Next steps

- Suggest to use the current parameters as a good enough representation of package type B – Radix optimized
- Integrate the 1200µ core section into the bump to ball model – Estimated adjusted overall loss to be around 9.5dB – Real close to current package
- Use the newly extracted model to minorly refit the parameters and provide during one of the coming adhocs

Thank You!