Two PKG types approach – Radix Optimized type supporting data

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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

- 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 \(\Rightarrow \approx 89\Omega\) characteristic impedance
- Trace loss/mm \(\approx 0.195\text{dB}\)

IEEE P802.3df 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/s Ethernet Task Force
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>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
<th>Units</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>package_tl_gamma0_a1_a2</td>
<td>[5e-4  6.5e-4 3e-4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>package_tl_tau</td>
<td>0.006141</td>
<td>ns/mm</td>
<td></td>
</tr>
<tr>
<td>package_Z_c</td>
<td>[92 92 ; 70 70; 80 80; 100 100]</td>
<td>Ohm</td>
<td></td>
</tr>
<tr>
<td>z_p select</td>
<td>[ 1 2 3 4]</td>
<td></td>
<td>[test cases to run]</td>
</tr>
<tr>
<td>z_p (TX)</td>
<td>[ 8 24 30 45 ; 1 1 11; 1 1 1 1 ; 0.5 0.5 0.5 0.5 ]</td>
<td>mm</td>
<td>[test cases]</td>
</tr>
<tr>
<td>z_p (NEXT)</td>
<td>[ 7 23 29 44 ; 1 1 11; 1 1 1 1 ; 0.5 0.5 0.5 0.5 ]</td>
<td>mm</td>
<td>[test cases]</td>
</tr>
<tr>
<td>z_p (FEXT)</td>
<td>[8 24 30 45 ; 1 1 11; 1 1 1 1 ; 0.5 0.5 0.5 0.5 ]</td>
<td>mm</td>
<td>[test cases]</td>
</tr>
<tr>
<td>z_p (RX)</td>
<td>[7 23 29 44 ; 1 1 11; 1 1 1 1 ; 0.5 0.5 0.5 0.5 ]</td>
<td>mm</td>
<td>[test cases]</td>
</tr>
<tr>
<td>C_p</td>
<td>[0.4e-4  0.4e-4]</td>
<td>nF</td>
<td>[TX RX]</td>
</tr>
</tbody>
</table>
Frequency Domain Comparison

IEEE P802.3dj 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/s Ethernet Task Force
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!