Package impedance and termination effect on COM

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Introduction

- This presentation explores the impact of varying package impedance (Zc) and R_d termination on COM for the 400GAUI-8 (Clause 120D) chip to chip specification.

- COM uses a particular package trace impedance and die impedance for its calculations.

- Yasuo Hidaka in 802.3cd (e.g.) hidaka_3cd_01a_0317 has shown that for a large number of backplane channels the COM varies significantly (on the order of +/-0.5dB) depending on the choice of package trace impedance and die impedance within a 10% manufacturing tolerance and that no one choice of impedances gives the worst case.

Methodology

- Three variations from the IEEE P802.3bs/D3.1 COM parameters are evaluated to cover manufacturing tolerances and potential different target impedance values.
- All COM parameters, other than those shown in tables, are the same as in IEEE P802.3bs/D3.1 spec.
- Av was adjusted so that the steady state voltage Vf is kept equal to 0.4V for all the combinations.
- The first eight channels evaluated are found at http://grouper.ieee.org/groups/802/3/bs/public/channel/index.shtml . The additional two channels have smaller capacitive discontinuities and higher impedance (but not higher than 110 ohms).

COM comparison to D3.1 ORIGINAL

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	D3.1 ORGINAL	D3.1 CAVM mod1	D3.1 CAVM mod2	D3.1 CAVM mod3	Delta mod1 to original	Delta mod2 to original	Delta mod3 to original
package_Zc (ohms)	90	100	110	95			
Av/Ane (V)	0.45	0.418	0.394	0.416			
Cd (nF)	1.80E-04	1.80E-04	1.80E-04	1.80E-04		Largest negative difference	
Rd (ohms)	[55 55]	[50 50]	[45 45]	[50 50]		Largest positive difference	
Channels							
mellitz_3bs_02_0714	3.54	3.51	3.27	3.6	-0.03	-0.27	0.06
mellitz_3bs_03_0714	4.02	4.17	3.81	4.2	0.15	-0.21	0.18
mellitz_3bs_04_0714	4.13	4.08	3.53	4.24	-0.05	-0.6	0.11
mellitz_3bs_05_0714	3.13	3.35	2.96	3.19	0.22	-0.17	0.06
mellitz_3bs_06_0714	2.7	2.65	2.47	2.71	-0.05	-0.23	0.01
mellitz_3bs_07_0714	4.11	4.07	3.68	4.21	-0.04	-0.43	0.1
mellitz_3bs_08_0714	4.02	3.92	3.52	4.13	-0.1	-0.5	0.11
shanbhag_01_0914	4.93	4.98	4.61	5.08	0.05	-0.32	0.15
Cavium_20dB_HghZ /w reduced xtlk	2.7	3.28	2.92	3.17	0.58	0.22	0.47
Cavium_20dB_HghZ_Nom_HighZ /w reduced xtlk	2.96	3.46	3.11	3.36	0.5	0.15	0.4

COM comparison to Mod3 (OIF adopted)

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	D3.1 ORGINAL	D3.1 CAVM mod1	D3.1 CAVM mod2	D3.1 CAVM mod3	Delta original to mod3	Delta mod1 to mod3	Delta mod2 to mod3
package_Zc (ohms)	90	100	110	95			
Av/Ane (V)	0.45	0.418	0.394	0.416			
Cd (nF)	1.80E-04	1.80E-04	1.80E-04	1.80E-04		Largest negative difference	
Rd (ohms)	[55 55]	[50 50]	[45 45]	[50 50]		Largest positive difference	
Channels							
mellitz_3bs_02_0714	3.54	3.51	3.27	3.6	-0.06	-0.09	-0.33
mellitz_3bs_03_0714	4.02	4.17	3.81	4.2	-0.18	-0.03	-0.39
mellitz_3bs_04_0714	4.13	4.08	3.53	4.24	-0.11	-0.16	-0.71
mellitz_3bs_05_0714	3.13	3.35	2.96	3.19	-0.06	0.16	-0.23
mellitz_3bs_06_0714	2.7	2.65	2.47	2.71	-0.01	-0.06	-0.24
mellitz_3bs_07_0714	4.11	4.07	3.68	4.21	-0.1	-0.14	-0.53
mellitz_3bs_08_0714	4.02	3.92	3.52	4.13	-0.11	-0.21	-0.61
shanbhag_01_0914	4.93	4.98	4.61	5.08	-0.15	-0.1	-0.47
Cavium_20dB_HghZ /w reduced xtlk	2.7	3.28	2.92	3.17	-0.47	0.11	-0.25
Cavium_20dB_HghZ_Nom_HighZ /w reduced xtlk	2.96	3.46	3.11	3.36	-0.4	0.1	-0.25

Conclusions and proposals.

- **With realistic Tx package/die impedances the COM can be significantly worse (0.6dB) than with the values presently used in COM. This creates a "hole" in the specification that should be filled. Raising the COM requirement for the channel to 0.5dB above the COM used for the interference tolerance test will close the majority of the "hole".**

- **Changing to Zc=95 ohms Rd=50 ohms (nominal values) improves COM over Zc=100 ohms and Zc=90 ohms for the majority of channels and reduces the variability somewhat.**

Proposal

- **In order to close the “hole” in the specification increase the COM for measuring the channel to 3.5dB.**

- **Change to Zc=95 ohms Rd=50 ohms (nominal values) to make the results less dependent on the impedance of the channels.**

Backup

Introduction to backup

- Having a package trace impedance of 80 ohms was thought to be possible in the extreme case if a low impedance like 90 ohms were chosen as the target. However additional analysis, not presented here, found that with Zc=80 ohms and Rd=55 ohms the package will not pass SNR_{isi} and therefore the effect on COM is not relevant. For interest the COM results with this combination are presented on the next slides. They show poor results for COM as well.

COM comparison to D3.1 ORIGINAL – Mod4 added

	D3.1 ORGINAL	D3.1 CAVM mod1	D3.1 CAVM mod2	D3.1 CAVM mod3	D3.1 CAVM mod4	Delta mod1 to original	Delta mod2 to origina	Delta mod3 to origina	Delta mod4 to origina
package_Zc (ohms)	90	100	110	95	80				
Av/Ane (V)	0.45	0.418	0.394	0.416	0.441				
Cd (nF)	1.80E-04	1.80E-04	1.80E-04	1.80E-04	1.80E-04		Largest negative difference		
Rd (ohms)	[55 55]	[50 50]	[45 45]	[50 50]	[55 55]		Largest positive difference		
Channels									
mellitz_3bs_02_0714	3.54	3.51	3.27	3.6	2.63	-0.03	-0.27	0.06	-0.91
mellitz_3bs_03_0714	4.02	4.17	3.81	4.2	3.1	0.15	-0.21	0.18	-0.92
mellitz_3bs_04_0714	4.13	4.08	3.53	4.24	3.53	-0.05	-0.6	0.11	-0.6
mellitz_3bs_05_0714	3.13	3.35	2.96	3.19	2.43	0.22	-0.17	0.06	-0.7
mellitz_3bs_06_0714	2.7	2.65	2.47	2.71	2.25	-0.05	-0.23	0.01	-0.45
mellitz_3bs_07_0714	4.11	4.07	3.68	4.21	3.31	-0.04	-0.43	0.1	-0.8
mellitz_3bs_08_0714	4.02	3.92	3.52	4.13	3.29	-0.1	-0.5	0.11	-0.73
shanbhag_01_0914	4.93	4.98	4.61	5.08	4	0.05	-0.32	0.15	-0.93
Cavium_20dB_HghZ /w reduced xtlk	2.7	3.28	2.92	3.17	1.57	0.58	0.22	0.47	-1.13
Cavium_20dB_HghZ_Nom_HighZ /w reduced xtlk	2.96	3.46	3.11	3.36	1.94	0.5	0.15	0.4	-1.02

COM comparison to Mod3 (OIF adopted) - Mod4 added

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	D3.1 ORGINAL	D3.1 CAVM mod1	D3.1 CAVM mod2	D3.1 CAVM mod3	D3.1 CAVM mod4	Delta original to mod3	Delta mod1 to mod3	Delta mod2 to mod3	Delta mod4 to mod3
package_Zc (ohms)	90	100	110	95	80				
Av/Ane (V)	0.45	0.418	0.394	0.416	0.441				
Cd (nF)	1.80E-04	1.80E-04	1.80E-04	1.80E-04	1.80E-04		Largest negative difference		
Rd (ohms)	[55 55]	[50 50]	[45 45]	[50 50]	[55 55]		Largest positive difference		
Channels									
mellitz_3bs_02_0714	3.54	3.51	3.27	3.6	2.63	-0.06	-0.09	-0.33	-0.97
mellitz_3bs_03_0714	4.02	4.17	3.81	4.2	3.1	-0.18	-0.03	-0.39	-1.1
mellitz_3bs_04_0714	4.13	4.08	3.53	4.24	3.53	-0.11	-0.16	-0.71	-0.71
mellitz_3bs_05_0714	3.13	3.35	2.96	3.19	2.43	-0.06	0.16	-0.23	-0.76
mellitz_3bs_06_0714	2.7	2.65	2.47	2.71	2.25	-0.01	-0.06	-0.24	-0.46
mellitz_3bs_07_0714	4.11	4.07	3.68	4.21	3.31	-0.1	-0.14	-0.53	-0.9
mellitz_3bs_08_0714	4.02	3.92	3.52	4.13	3.29	-0.11	-0.21	-0.61	-0.84
shanbhag_01_0914	4.93	4.98	4.61	5.08	4	-0.15	-0.1	-0.47	-1.08
Cavium_20dB_HghZ /w reduced xtlk	2.7	3.28	2.92	3.17	1.57	-0.47	0.11	-0.25	-1.6
Cavium_20dB_HghZ_Nom_HighZ /w reduced xtlk	2.96	3.46	3.11	3.36	1.94	-0.4	0.1	-0.25	-1.42