Improved ATCA Channel Equalization Analysis with Package Impacts

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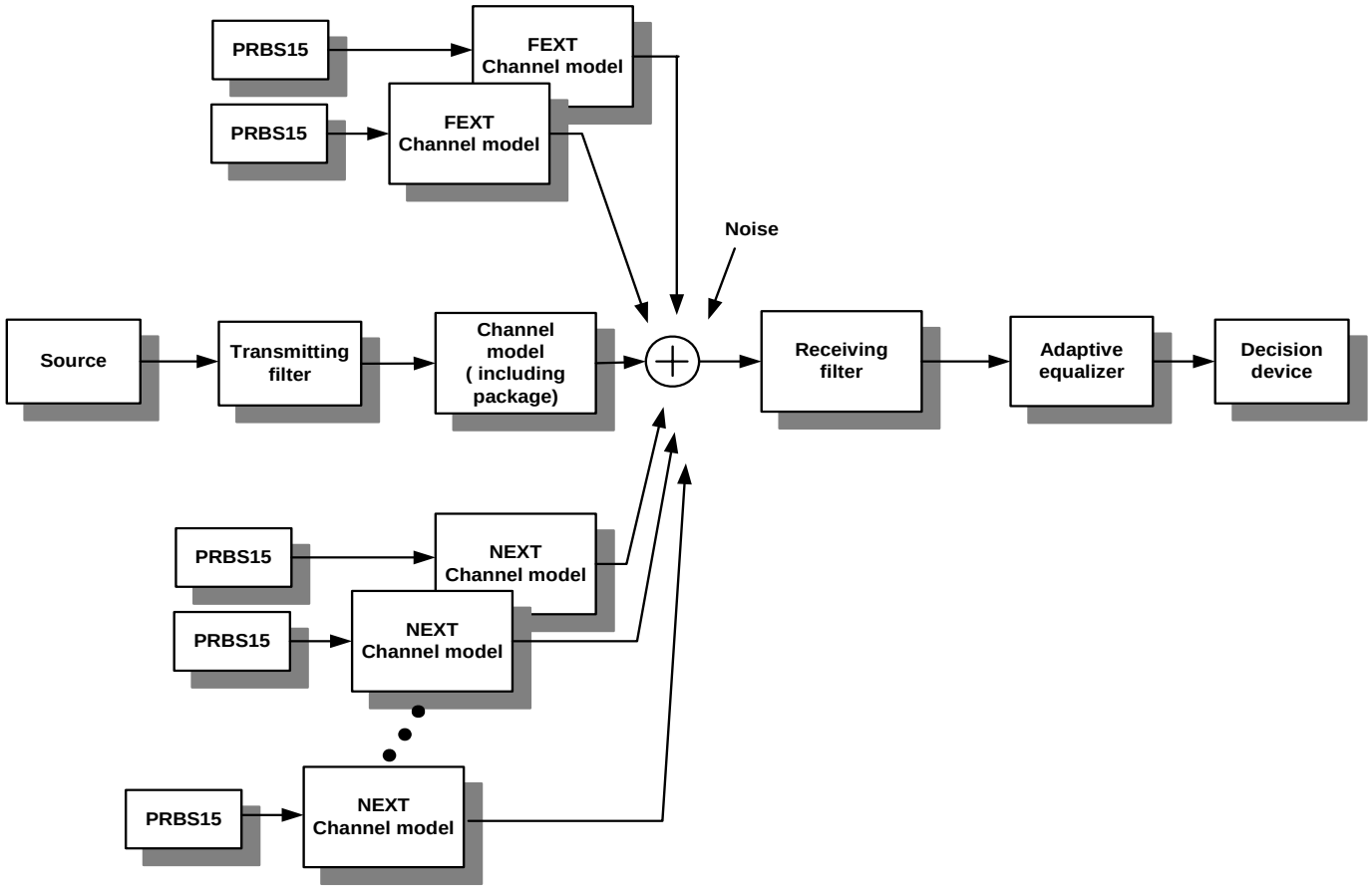
- **Objective:**

  Investigate different package impacts on the equalization performance on improved Intel ATCA channel models.

Simulation configuration

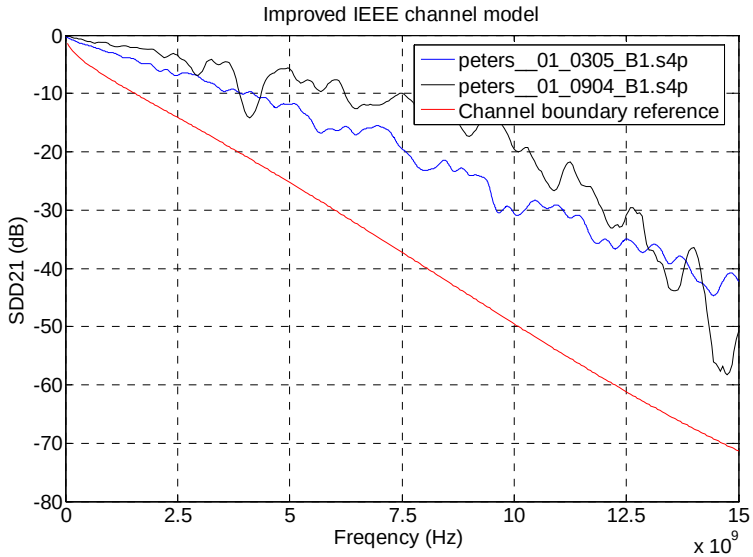
Simulator setup	NRZ FFE3 / DFE5
Tx amplitude	800 mVpp
Jitter	0
DCD	0
Random noise	1.46mVrms
Crosstalk	NEXT / FEXT (The crosstalk data for the improved channels are not available at the time of simulation. Use original crosstalk data as a reference that may not be realistic for the improved channels)
Data pattern	PRBS15
Coupling	DC coupling
Package	Different package models
Data rate	10.3 Gbps
Simulation time	32K bits

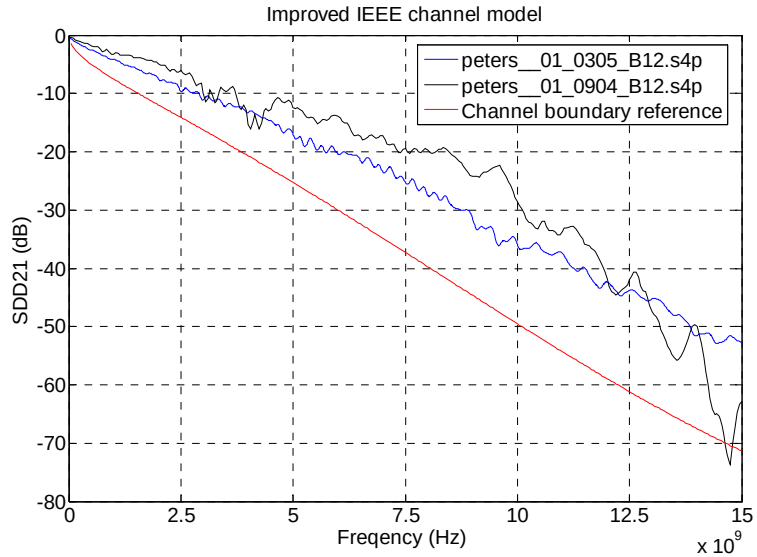
Simulation methodology

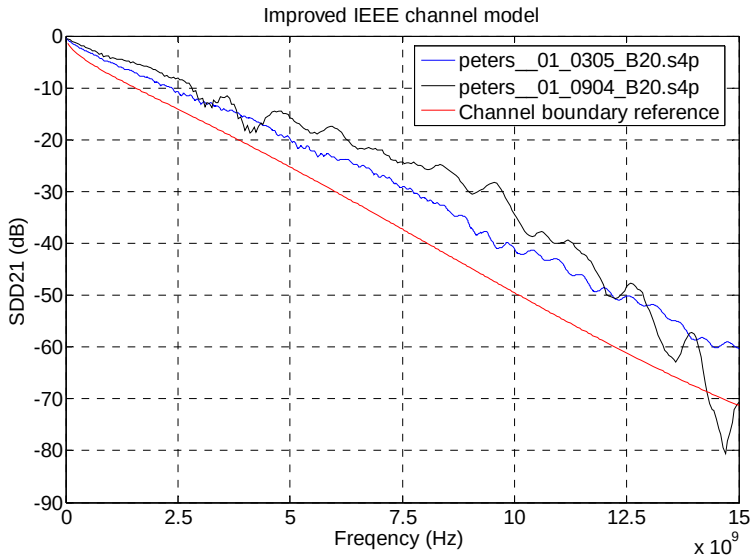


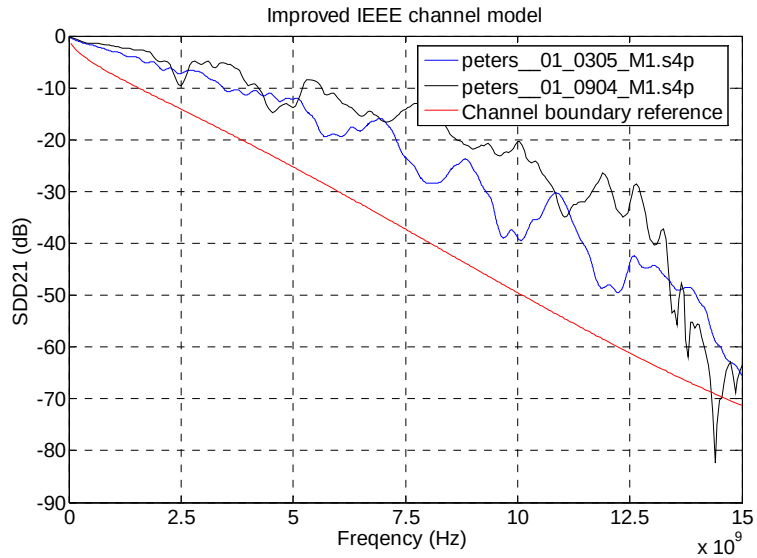
Simulation flow

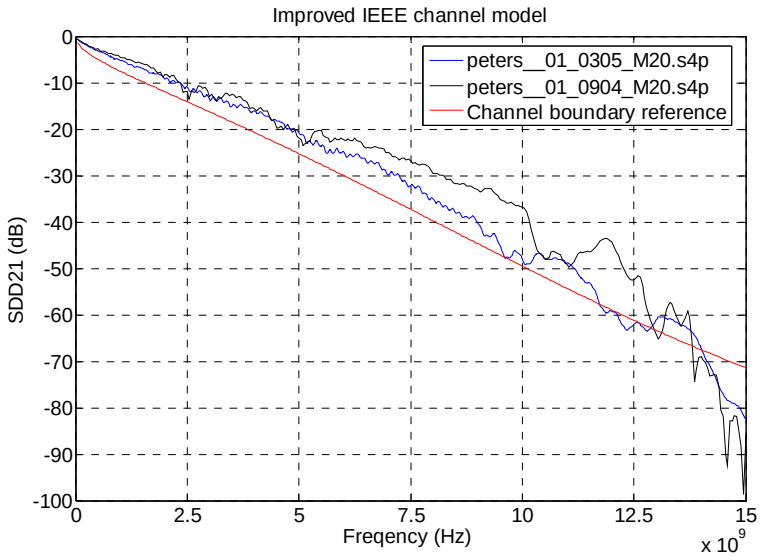
Improved Intel ATCA channel models

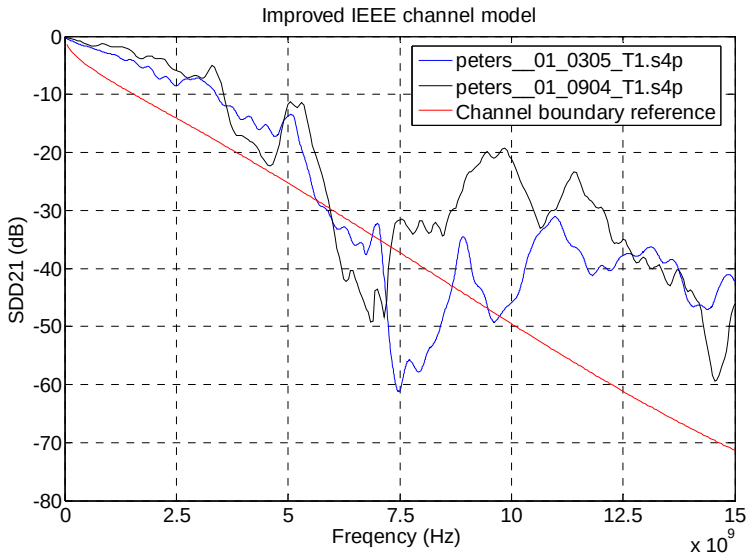


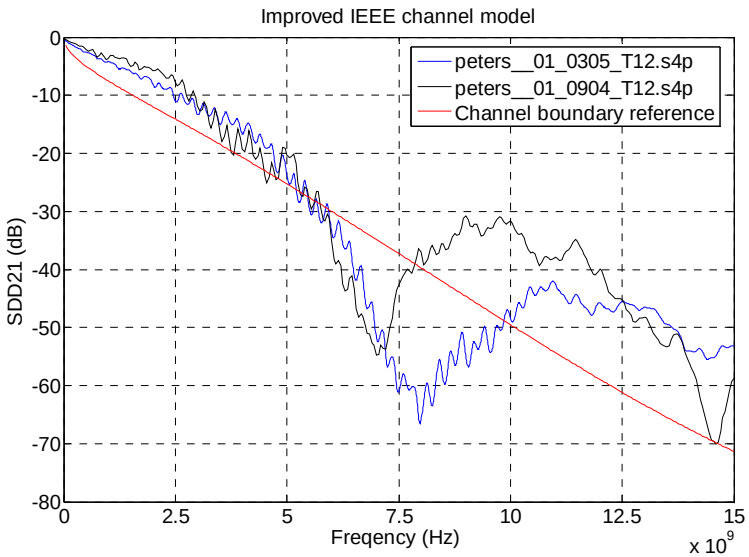







Improved IEEE channel model
peters__01_0305_M20.s4p
peters__01_0904_M20.s4p
Channel boundary reference
SDD21 (dB)
Freqency (Hz)
x 10^9


Improved IEEE channel model
peters__01_0305_T1.s4p
peters__01_0904_T1.s4p
Channel boundary reference
SDD21 (dB)
Freqency (Hz)
x 10^9


Improved IEEE channel model
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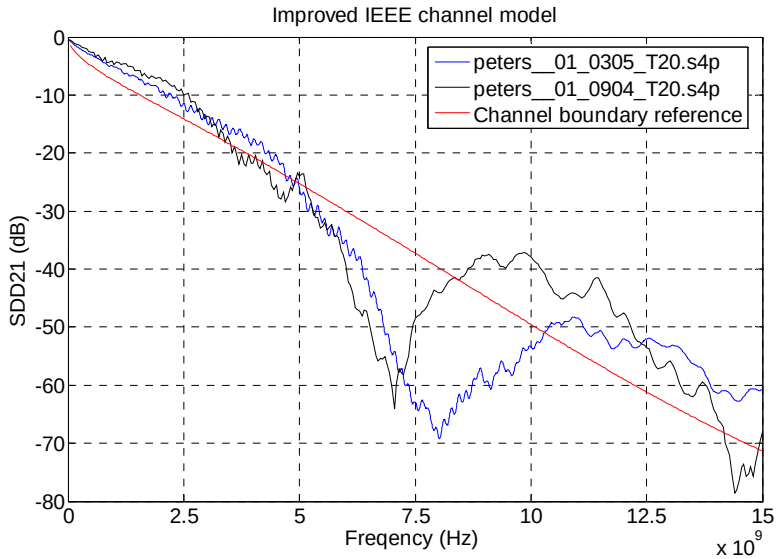
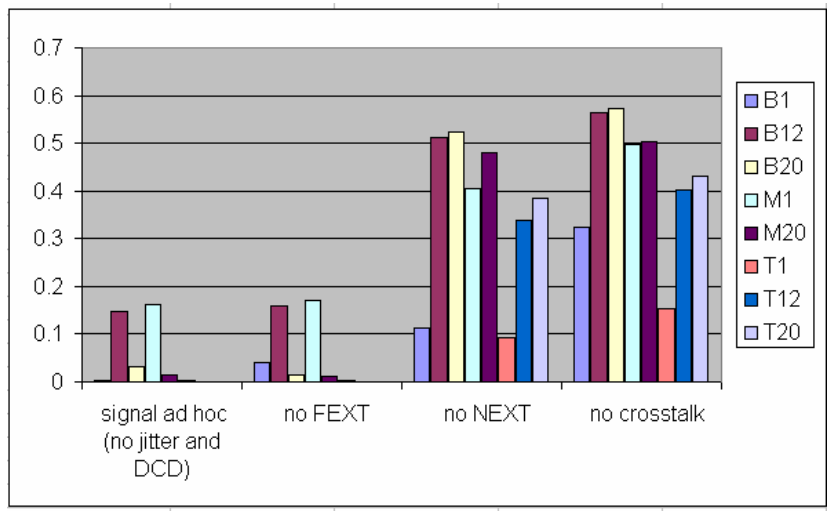
peters__01_0904_T12.s4p
Channel boundary reference
SDD21 (dB)
Freqency (Hz)
x 10^9

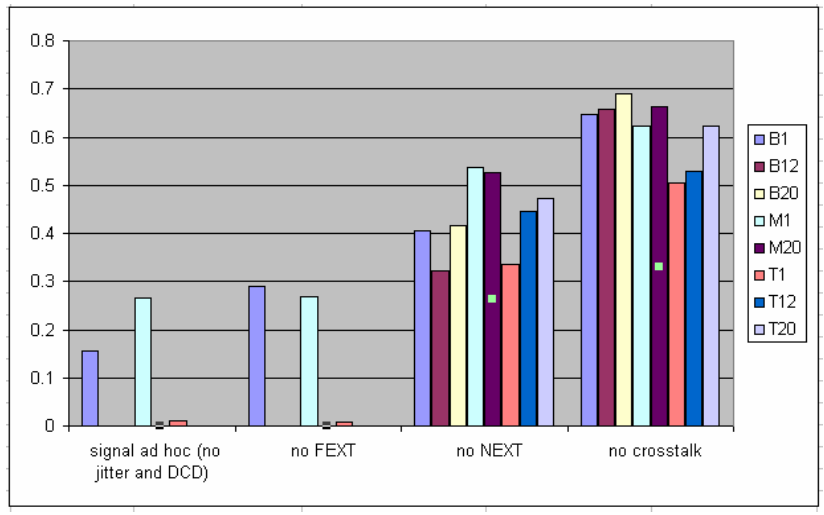

Improved IEEE channel model
peters__01_0305_T20.s4p
peters__01_0904_T20.s4p
Channel boundary reference
SDD21 (dB)
Freqency (Hz)
x 10^9

Simulation results and comparisons

Original Intel ATCA channel wth IEEE802.3ap cap like package				
Forward taps=3 , Backward taps = 5 Voltage margin (Vp-p)				
Channels	signal ad hoc (no jitter and DCD)	no FEXT	no NEXT	no crosstalk
B1	0.002437858	0.040770752	0.111962055	0.322872067
B12	0.147298044	0.159616062	0.511552105	0.563473321
B20	0.030672882	0.015492615	0.523410049	0.572115584
M1	0.162533705	0.170375666	0.405957297	0.497284422
M20	0.014341242	0.012728122	0.480904238	0.50470782
T1	0.001876329	0.002514368	0.093370208	0.153879017
T12	0.000242406	0.000105148	0.337026054	0.403135515
T20	8.98128E-05	0.000240446	0.385505952	0.430508349



Improved Intel ATCA channel wth IEEE802.3ap cap like package				
Forward taps=3 , Backward taps = 5 Voltage margin (Vp-p)				
Channels	signal ad hoc (no jitter and DCD)	no FEXT	no NEXT	no crosstalk
B1	0.154956	0.291099	0.404969	0.648303
B12	0.000271	0.000091	0.321077	0.658175
B20	0.000126	0.000184	0.415347	0.689224
M1	0.264902	0.269226	0.53707	0.621743
M20	0.001017	0.000478	0.527296	0.664154
T1	0.010938	0.008597	0.335778	0.505179
T12	0.000717	0.00044	0.445178	0.527594
T20	0.000143	0.000229	0.473143	0.623224



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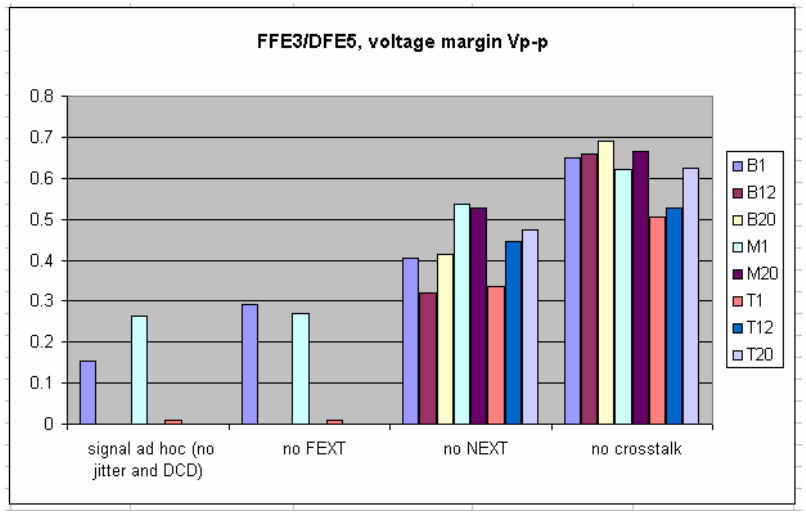
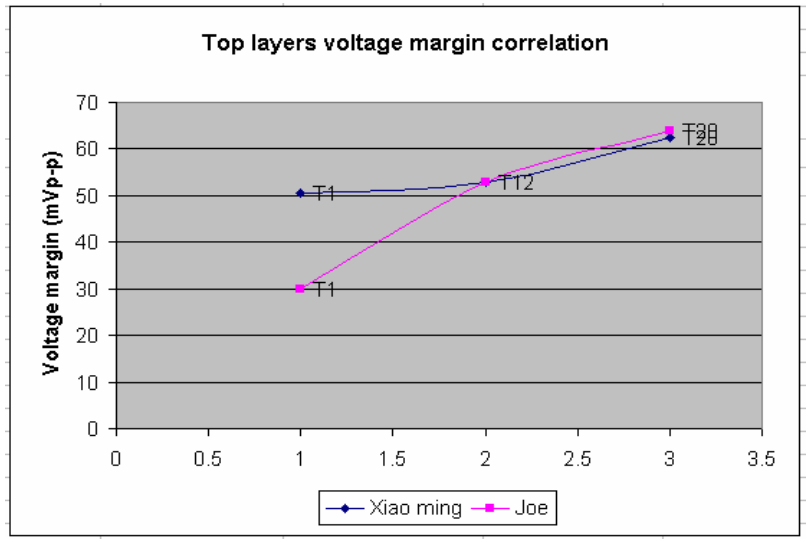
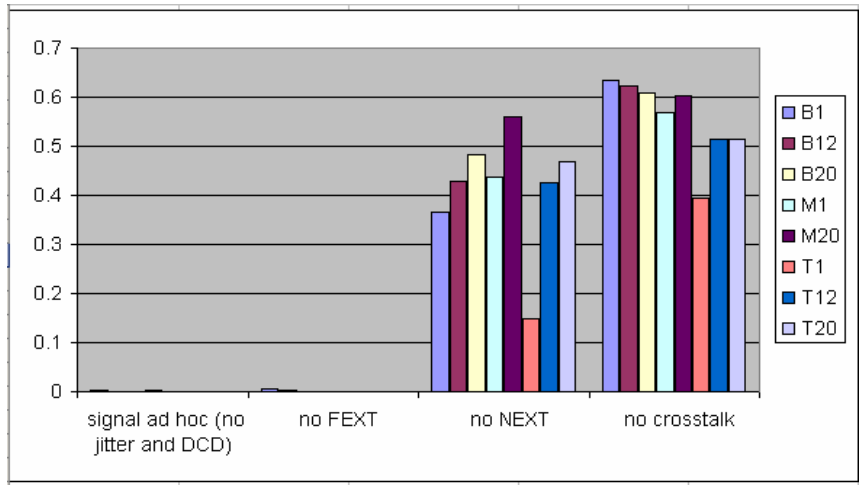


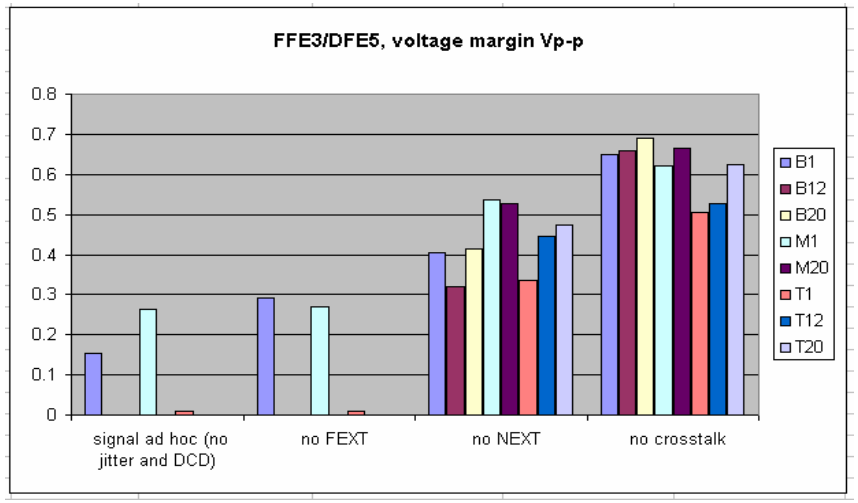
Improved Intel ATCA top layers voltage margins comparisons (no crosstalk and DCD)		
Voltage margin (mVp-p)	Xiao ming's results (scaled)	Joe's results*
T1	50.5179	30
T12	52.7594	53
T20	62.3224	64
* Results from seemann_01_0305, IEEE802.3ap		



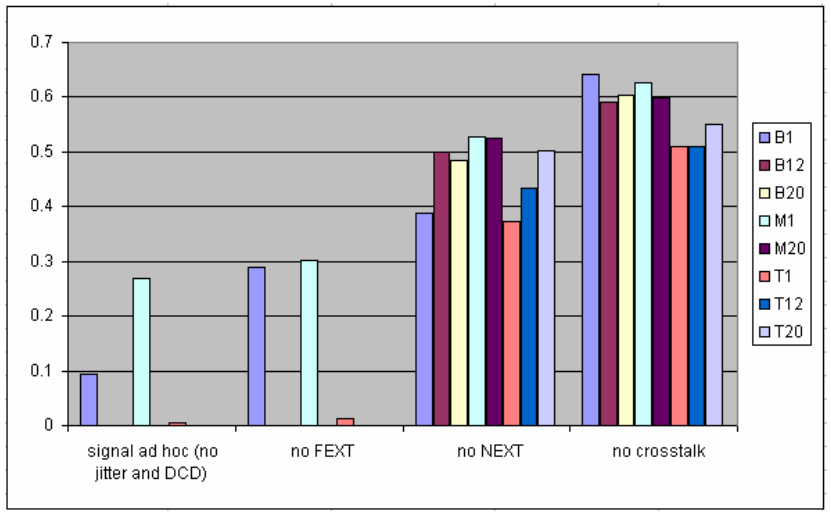
Improved Intel ATCA channel without package				
Forward taps=3 , Backward taps = 5 Voltage margin (Vp-p)				
Channels	signal ad hoc (no jitter and DCD)	no FEXT	no NEXT	no crosstalk
B1	0.002237282	0.006527938	0.364987051	0.634242096
B12	0.000218075	0.001453889	0.427584681	0.623484405
B20	9.88542E-05	0.000186805	0.483994931	0.608457388
M1	0.003279104	0.000620731	0.438284519	0.569965005
M20	0.000199789	0.00010131	0.559720327	0.602915121
T1	0.000484879	0.000604839	0.147447204	0.393286471
T12	0.000452239	0.000368816	0.425445211	0.51322477
T20	0.000262709	0.000113313	0.468414542	0.513759816



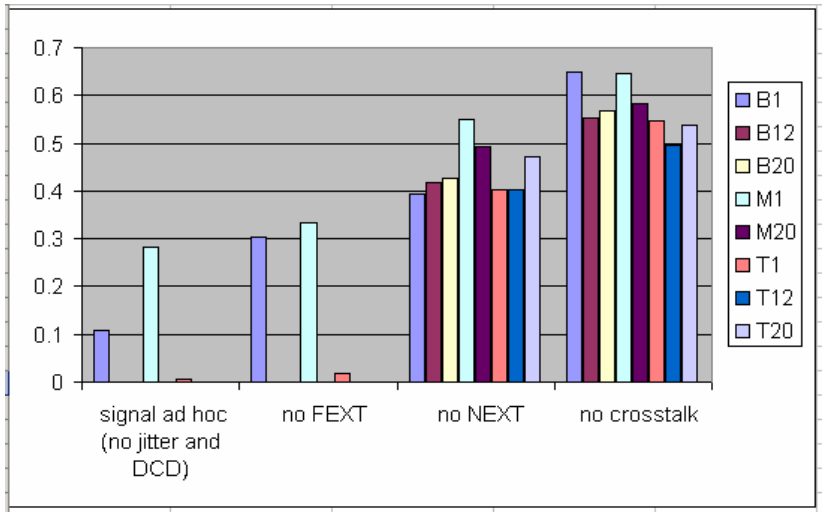
Improved Intel ATCA channel wth IEEE802.3ap cap like package				
Forward taps=3 , Backward taps = 5 Voltage margin (Vp-p)				
Channels	signal ad hoc (no jitter and DCD)	no FEXT	no NEXT	no crosstalk
B1	0.154956	0.291099	0.404969	0.648303
B12	0.000271	0.000091	0.321077	0.658175
B20	0.000126	0.000184	0.415347	0.689224
M1	0.264902	0.269226	0.53707	0.621743
M20	0.001017	0.000478	0.527296	0.664154
T1	0.010938	0.008597	0.335778	0.505179
T12	0.000717	0.00044	0.445178	0.527594
T20	0.000143	0.000229	0.473143	0.623224



Improved Intel ATCA channel with Intel package 1				
Forward taps=3 , Backward taps = 5 Voltage margin (Vp-p)				
Channels	signal ad hoc (no jitter and DCD)	no FEXT	no NEXT	no crosstalk
B1	0.093714782	0.289744122	0.386946709	0.641579572
B12	0.000340123	0.000138907	0.499443151	0.590154239
B20	9.88768E-05	0.000108856	0.484009094	0.602432611
M1	0.267898204	0.301659269	0.528731146	0.625628793
M20	7.8436E-05	0.000744538	0.525838503	0.59818076
T1	0.005090634	0.013627613	0.372458297	0.509465103
T12	0.00011787	8.68734E-05	0.43274773	0.510202535
T20	0.000125126	5.55806E-05	0.502081662	0.551055188



Improved Intel ATCA channel with Intel package 2				
Forward taps=3 , Backward taps = 5 Voltage margin (Vp-p)				
Channels	signal ad hoc (no jitter and DCD)	no FEXT	no NEXT	no crosstalk
B1	0.109316673	0.304560693	0.394205339	0.648434334
B12	0.000414327	0.000199376	0.418740544	0.553569008
B20	0.000124935	3.3513E-05	0.427421279	0.569250509
M1	0.282027238	0.333470368	0.548383272	0.64583052
M20	6.8692E-05	0.00026118	0.49187631	0.582285437
T1	0.00460084	0.017961015	0.402718219	0.547234972
T12	0.000178009	0.000377983	0.401659229	0.495657382
T20	7.27737E-05	3.50885E-05	0.470403995	0.536706876



Conclusions

- The simulation data show that the improved Intel ATCA channel models provide better eye voltage margins than the original channels for the same package model being used.
- Different packages affects the equalization performance.
- The ATCA channel-aware package design will help to improve overall equalization performance of some channels