

Evaluation of Various channels

Using a Method proposed by Healey and Moore

Charles Moore **Avago Technologies**

May 16, 2011

- This evaluation uses the method and values called out in another presentation at this meeting
- This evaluation has 2 goals:
 - Illustrate use of the evaluation method and the information it provides
 - Provide useful information toward setting taskforce objectives
- I intend to run this evaluation, or a refinement of it, if one is agreed upon, on all channels provided to the study group and taskforce, and make the results available.

Simulation parameters used as recommended in healey_01_0111
“Suggested practices of reporting simulation results”:

Bit rate	26 Gb/s
Modulation	PAM2
Signaling rate	26 Gbaud
Number of symbols simulated	N/A
Target symbol error ratio	$1 \cdot 10^{-12}$
Tx Test pattern	NA
Tx output voltage, peak-to-peak	0.8 V (NEXT is 1.2 V)
Tx Deterministic jitter, peak-to-peak	NA
Tx Deterministic jitter distribution	NA
Tx Random Jitter, RMS	NA
Rx Random noise, RMS	Included in implementation noise
Rx Deterministic jitter, peak-to-peak	NA
Rx Random Jitter, RMS	NA
Rx Low-frequency gain	1.0
Tx, Rx Device package	No loss, indefinite phase
Tx, Rx Single ended resistance	66 Ω (gives magnitude but not phase of device reflection coefficient)
Tx, Rx Single ended capacitance	200 fF (gives magnitude but not phase of device reflection coefficient)

Backplane channel Data

Provided by Megha Shanbhag TEConnectivity

case	pulse gain	dibit gain	available Signal	implementation noise	ILD noise	Re- reflection Tx	Re- reflection Rx	Re- refelction Tx-Rx	total channle noise	NEXT 0	NEXT 1	NEXT 2	NEXT3	FEXT A	FEXT B	FEXT C	PSXT	total noise	S/N	margin
TE_board_Meg6_686mm_measured	294.033m	228.035m	60.748mV	4.584mV	3.093mV	3.104mV	2.963mV	1.849mV	5.604mV	3.655mV	0.765mV	1.403mV	1.213mV	0.941mV	0.248mV	1.597mV	4.569mV	8.561mV	7.10	1.156mV
TE_board_Measured_110511	295.057m	229.250m	61.072mV	4.596mV	3.088mV	3.286mV	3.014mV	1.856mV	5.733mV	0.351mV	2.060mV	0.524mV	1.000mV	0.658mV	0.158mV	1.214mV	2.752mV	7.847mV	7.78	3.723mV
TE_board_Meg6_1087mm_simulated	198.943m	147.584m	39.316mV	3.688mV	1.490mV	1.368mV	1.368mV	1.252mV	2.744mV	0.909mV	0.387mV	0.383mV	0.892mV	0.702mV	0.285mV	0.690mV	1.723mV	4.909mV	8.01	2.676mV
TE_board_Meg6_757mm_simulated	300.334m	245.984m	65.530mV	4.761mV	1.952mV	2.051mV	2.051mV	1.780mV	3.924mV	0.929mV	0.399mV	0.396mV	0.912mV	1.178mV	0.504mV	1.155mV	2.233mV	6.561mV	9.99	6.618mV
TE_board_Nelco6_1087_simulated	108.132m	54.359m	14.481mV	2.238mV	1.454mV	0.956mV	0.956mV	0.998mV	2.222mV	0.683mV	0.282mV	0.281mV	0.671mV	0.308mV	0.117mV	0.304mV	1.130mV	3.350mV	4.32	-2.643mV
TE_board_Nelco6_757mm_simulated	170.190m	109.666m	29.215mV	3.179mV	2.290mV	1.527mV	1.527mV	1.359mV	3.428mV	0.690mV	0.287mV	0.286mV	0.679mV	0.577mV	0.229mV	0.570mV	1.346mV	4.865mV	6.01	-2.532mV

Color code

“passes” margin is > 0

“passes with 3 dB margin” margin > total noise

“fails near pass” margin < 0 but S/N>5.02

“fails badly” margin < 0 and S/N<5.02

margin column, if positive, additional noise which can be added and still meet $BER < 1 \cdot 10^{-12}$

Cable channel Data

From Mark Bugg Molex

case	pulse gain	dibit gain	available Signal	implementati on noise	ILD noise Tx	Re-reflection Tx	Re-reflection Rx	Re-refelcton Tx-Rx	total channle noise	NEXT 0	NEXT 1	NEXT 2	NEXT3	FEXT A	FEXT B	FEXT C	PSXT	total noise	S/N	margin	Salz
Molex 5m P1 RX1	228.721m	181.642m	48.389mV	4.091mV	1.478mV	1.400mV	1.451mV	1.200mV	2.773mV	0.670mV	0.858mV	0.694mV	0.791mV	0.983mV	1.011mV	0.225mV	2.081mV	5.363mV	9.02	4.312mV	37.5
Molex 5m P1 RX2	229.827m	182.675m	48.665mV	4.103mV	1.220mV	1.529mV	1.261mV	1.207mV	2.622mV	0.712mV	0.571mV	0.436mV	0.422mV	0.981mV	0.218mV	0.965mV	1.773mV	5.182mV	9.39	4.587mV	38.4
Molex 5m P1 RX3	230.127m	183.306m	48.833mV	4.110mV	1.604mV	1.565mV	1.504mV	1.224mV	2.964mV	0.447mV	0.443mV	0.552mV	0.756mV	0.892mV	0.279mV	0.961mV	1.752mV	5.362mV	9.11	4.413mV	38.2
Molex 5m P1 RX4	232.008m	183.770m	48.956mV	4.115mV	1.267mV	1.386mV	1.368mV	1.227mV	2.628mV	0.492mV	0.414mV	0.716mV	0.605mV	0.171mV	0.937mV	0.911mV	1.741mV	5.184mV	9.44	4.648mV	38.6
Molex 5m P2 RX1	233.430m	185.640m	49.454mV	4.136mV	1.578mV	1.199mV	1.590mV	1.245mV	2.829mV	0.780mV	0.937mV	0.493mV	0.411mV	0.801mV	0.923mV	0.183mV	1.851mV	5.342mV	9.26	4.574mV	39.8
Molex 5m P2 RX2	231.253m	183.468m	48.876mV	4.112mV	1.413mV	1.664mV	1.495mV	1.234mV	2.919mV	0.839mV	0.744mV	0.471mV	0.363mV	0.685mV	0.230mV	0.955mV	1.745mV	5.336mV	9.16	4.454mV	39.5
Molex 5m P2 RX3	228.174m	181.159m	48.261mV	4.086mV	1.388mV	1.338mV	1.262mV	1.205mV	2.600mV	0.390mV	0.405mV	0.552mV	0.635mV	0.885mV	0.257mV	1.075mV	1.741mV	5.146mV	9.38	4.541mV	37.9
Molex 5m P2 RX4	232.706m	184.489m	49.148mV	4.123mV	1.280mV	1.416mV	1.528mV	1.243mV	2.743mV	0.536mV	0.413mV	0.784mV	0.551mV	0.170mV	0.973mV	0.975mV	1.817mV	5.275mV	9.32	4.585mV	38.0
Molex 4m 26AWG P1 RX1	283.042m	229.732m	61.201mV	4.601mV	1.968mV	1.801mV	2.007mV	1.500mV	3.660mV	0.878mV	0.812mV	0.593mV	0.448mV	0.704mV	0.751mV	0.261mV	1.764mV	6.138mV	9.97	6.170mV	42.0
Molex 4m 26AWG P1 RX2	281.935m	231.961m	61.794mV	4.624mV	1.655mV	1.732mV	2.139mV	1.475mV	3.534mV	0.704mV	0.638mV	0.499mV	0.346mV	0.868mV	0.324mV	0.823mV	1.676mV	6.056mV	10.20	6.368mV	41.9
Molex 4m 26AWG P1 RX3	281.308m	230.279m	61.346mV	4.607mV	1.802mV	1.896mV	1.816mV	1.494mV	3.517mV	0.400mV	0.384mV	0.580mV	0.606mV	0.830mV	0.279mV	0.787mV	1.548mV	5.999mV	10.23	6.334mV	42.5
Molex 4m 26AWG P1 RX4	284.023m	233.302m	62.152mV	4.637mV	1.521mV	1.789mV	2.461mV	1.506mV	3.720mV	0.596mV	0.396mV	0.711mV	0.554mV	0.327mV	0.879mV	0.693mV	1.638mV	6.166mV	10.08	6.332mV	42.3
Molex 4m 26AWG P2 RX1	280.128m	229.746m	61.204mV	4.601mV	1.872mV	1.743mV	2.042mV	1.479mV	3.591mV	0.629mV	0.827mV	0.617mV	0.570mV	0.952mV	1.337mV	0.243mV	2.131mV	6.214mV	9.85	6.095mV	38.8
Molex 4m 26AWG P2 RX2	280.009m	229.114m	61.036mV	4.595mV	1.385mV	1.856mV	1.771mV	1.478mV	3.269mV	0.680mV	0.573mV	0.464mV	0.444mV	0.924mV	0.329mV	1.204mV	1.902mV	5.951mV	10.26	6.319mV	39.4
Molex 4m 26AWG P2 RX3	281.402m	230.362m	61.369mV	4.608mV	1.694mV	2.047mV	1.710mV	1.501mV	3.499mV	0.451mV	0.428mV	0.641mV	0.685mV	1.469mV	0.245mV	0.899mV	2.072mV	6.145mV	9.99	6.197mV	38.4
Molex 4m 26AWG P2 RX4	279.304m	228.473m	60.865mV	4.589mV	1.907mV	1.739mV	2.036mV	1.467mV	3.599mV	0.465mV	0.394mV	0.729mV	0.618mV	0.271mV	1.004mV	0.931mV	1.799mV	6.103mV	9.97	6.138mV	40.5
Molex 3m 30AWG P1 RX1	288.924m	238.517m	63.541mV	4.688mV	1.884mV	1.888mV	1.941mV	1.519mV	3.632mV	0.671mV	0.931mV	0.533mV	0.540mV	0.490mV	1.427mV	0.409mV	2.083mV	6.286mV	10.11	6.492mV	39.9
Molex 3m 30AWG P1 RX2	268.109m	229.337m	61.095mV	4.597mV	1.441mV	2.048mV	2.102mV	1.487mV	3.591mV	0.695mV	0.587mV	0.495mV	0.409mV	0.434mV	0.332mV	0.637mV	1.394mV	5.998mV	10.19	6.286mV	45.7
Molex 3m 30AWG P1 RX3	286.719m	229.545m	61.151mV	4.599mV	1.646mV	2.014mV	2.049mV	1.511mV	3.639mV	0.417mV	0.577mV	0.661mV	0.722mV	1.529mV	0.341mV	1.037mV	2.235mV	6.276mV	9.74	6.019mV	38.0
Molex 3m 30AWG P1 RX4	276.617m	222.888m	59.377mV	4.532mV	1.290mV	1.903mV	2.022mV	1.475mV	3.398mV	0.645mV	0.603mV	0.843mV	0.628mV	0.332mV	0.328mV	0.851mV	1.682mV	5.909mV	10.05	6.032mV	42.4
Molex 3m 30AWG P2 RX1	287.489m	234.828m	62.558mV	4.652mV	1.860mV	2.020mV	1.923mV	1.499mV	3.672mV	1.053mV	1.031mV	0.762mV	1.807mV	0.940mV	1.557mV	0.499mV	3.094mV	6.686mV	9.36	5.869mV	36.4
Molex 3m 30AWG P2 RX2	289.027m	234.044m	62.349mV	4.644mV	1.289mV	1.956mV	1.763mV	1.526mV	3.305mV	0.841mV	0.655mV	0.577mV	0.753mV	1.019mV	0.449mV	1.934mV	2.649mV	6.286mV	9.92	6.254mV	36.9
Molex 3m 30AWG P2 RX3	285.742m	235.674m	62.784mV	4.660mV	1.942mV	2.164mV	1.934mV	1.495mV	3.799mV	0.486mV	0.592mV	0.757mV	1.126mV	1.753mV	0.473mV	1.100mV	2.633mV	6.564mV	9.57	6.053mV	36.7
Molex 3m 30AWG P2 RX4	266.120m	201.624m	53.713mV	4.311mV	1.978mV	1.710mV	1.731mV	1.472mV	3.464mV	0.653mV	0.487mV	1.002mV	0.881mV	0.490mV	1.818mV	1.053mV	2.664mV	6.138mV	8.75	4.546mV	35.6

Cable information

Provided by Chris DiMinico MC Communications

Intended as an example of 40GBASE_CR4

Not for use at higher data rates

case	pulse gain	dibit gain	available Signal	ILD noise	Re-reflection Tx	Re- reflection Rx	Re- refelction Tx-Rx	total channel noise	NEXT 0	NEXT 1	NEXT 2	NEXT3	FEXT A	FEXT B	FEXT C	PSXT	total noise	S/N	margin	Salz
QSFP-1m-IL/Rx1-TX1.s4p	381.073m	274.064m	73.011mV	5.026mV	4.084mV	3.684mV	2.602mV	9.117mV	1.372mV	1.108mV	0.878mV	0.878mV	2.854mV	2.387mV	0.991mV	4.485mV	11.336mV	6.44	-4.549mV	31.05
QSFP-1m-IL/TX1-Rx1.s4p	383.017m	277.842m	74.017mV	5.060mV	4.199mV	4.219mV	2.605mV	9.610mV	1.341mV	0.897mV	0.878mV	1.177mV	3.067mV	2.110mV	0.854mV	4.383mV	11.712mV	6.32	-5.135mV	31.06
QSFP-1m-IL/Rx2-TX2.s4p	379.435m	275.544m	73.405mV	5.039mV	4.190mV	4.382mV	2.584mV	10.421mV	1.092mV	0.768mV	0.878mV	0.789mV	4.166mV	0.593mV	2.334mV	5.136mV	12.664mV	5.8	-7.169mV	29.87
QSFP-1m-IL/TX2-Rx2.s4p	383.923m	278.504m	74.193mV	5.066mV	4.324mV	3.667mV	2.608mV	8.953mV	1.139mV	0.878mV	1.040mV	0.808mV	3.686mV	0.765mV	2.025mV	4.671mV	11.298mV	6.57	-4.041mV	30.84
QSFP-1m-IL/Rx3-TX3.s4p	382.457m	276.913m	73.770mV	5.052mV	4.461mV	4.002mV	2.598mV	9.861mV	0.876mV	0.878mV	1.389mV	1.914mV	2.680mV	0.618mV	3.169mV	4.971mV	12.144mV	6.08	-6.117mV	30.1
QSFP-1m-IL/TX3-Rx3.s4p	382.493m	278.048m	74.072mV	5.062mV	4.244mV	4.039mV	2.603mV	10.010mV	0.878mV	0.860mV	1.006mV	1.746mV	1.905mV	0.651mV	3.328mV	4.540mV	12.101mV	6.12	-5.957mV	31.06
QSFP-1m-IL/Rx4-TX4.s4p	379.037m	273.930m	72.975mV	5.024mV	4.736mV	4.736mV	2.582mV	9.933mV	0.878mV	0.817mV	1.950mV	1.083mV	1.148mV	2.348mV	4.049mV	5.473mV	12.404mV	5.88	-6.794mV	29.52
QSFP-1m-IL/TX4-Rx4.s4p	380.285m	273.132m	72.762mV	5.017mV	4.262mV	3.221mV	2.590mV	9.777mV	1.147mV	0.890mV	1.641mV	0.843mV	0.746mV	2.390mV	3.767mV	5.096mV	11.684mV	6.23	-5.425mV	29.66
QSFP-3m-IL/Rx1-Tx1.s4p	207.070m	127.371m	33.932mV	3.426mV	1.850mV	1.761mV	1.229mV	4.849mV	0.797mV	0.585mV	0.543mV	0.597mV	1.380mV	0.694mV	0.342mV	2.033mV	6.276mV	5.41	-4.012mV	30.22
QSFP-3m-IL/Tx1-Rx1.s4p	206.843m	127.265m	33.903mV	3.425mV	1.990mV	1.916mV	1.229mV	4.849mV	1.414mV	0.767mV	0.745mV	0.939mV	1.534mV	0.702mV	0.359mV	2.646mV	6.687mV	5.07	-4.634mV	28.71
QSFP-3m-IL/Rx2-Tx2.s4p	206.640m	126.743m	33.764mV	3.418mV	1.735mV	2.111mV	1.229mV	4.741mV	0.750mV	0.607mV	0.743mV	0.592mV	1.417mV	0.381mV	1.168mV	2.314mV	6.287mV	5.37	-4.058mV	29.29
QSFP-3m-IL/Tx2-Rx2.s4p	203.863m	124.489m	33.164mV	3.387mV	1.870mV	1.916mV	1.224mV	4.750mV	0.750mV	1.007mV	1.238mV	0.991mV	1.559mV	0.376mV	0.966mV	2.753mV	6.451mV	5.14	-4.401mV	28.03
QSFP-3m-IL/Rx3-Tx3.s4p	206.999m	125.963m	33.556mV	3.407mV	1.927mV	1.598mV	1.237mV	4.947mV	0.750mV	0.822mV	0.791mV	1.489mV	0.625mV	0.392mV	1.260mV	2.477mV	6.497mV	5.17	-4.409mV	29.8
QSFP-3m-IL/Tx3-Rx3.s4p	206.307m	127.038m	33.843mV	3.422mV	1.701mV	1.936mV	1.228mV	4.778mV	0.782mV	0.878mV	0.859mV	0.998mV	0.622mV	0.381mV	1.305mV	2.287mV	6.306mV	5.37	-4.074mV	30.28
QSFP-3m-IL/Rx4-Tx4.s4p	207.006m	126.552m	33.713mV	3.415mV	1.870mV	1.928mV	1.236mV	5.030mV	0.713mV	0.585mV	1.271mV	1.094mV	0.314mV	1.045mV	1.299mV	2.555mV	6.595mV	5.11	-4.529mV	28.83
QSFP-3m-IL/Tx4-Rx4.s4p	207.347m	126.762m	33.769mV	3.418mV	1.697mV	1.421mV	1.230mV	4.620mV	1.058mV	0.775mV	0.878mV	0.806mV	0.380mV	0.905mV	1.592mV	2.951mV	6.460mV	5.23	-4.321mV	27.91
QSFP-5m-IL/Rx1-Tx1.s4p	190.346m	102.978m	27.433mV	3.081mV	1.971mV	1.682mV	1.176mV	50.041mV	1.500mV	0.736mV	1.134mV	0.878mV	0.977mV	0.801mV	0.405mV	2.769mV	50.212mV	0.55	-50.060mV	25.99
QSFP-5m-IL/Tx1-Rx1.s4p	189.074m	98.602m	26.267mV	3.081mV	1.484mV	1.850mV	1.190mV	10.264mV	1.026mV	1.225mV	0.738mV	1.225mV	0.915mV	0.633mV	0.300mV	2.441mV	10.973mV	2.39	-10.317mV	27.62
QSFP-5m-IL/Rx2-Tx2.s4p	189.594m	102.098m	27.199mV	3.081mV	1.397mV	1.879mV	1.173mV	11.515mV	0.909mV	0.588mV	0.879mV	0.859mV	0.977mV	0.370mV	0.966mV	2.205mV	12.119mV	2.24	-11.485mV	26.49

Observations:

- The cables from Molex all appear to work, some with $>3\text{dB}$ margin, but these results are incomplete as they do not include realistic host boards. I believe that Molex is working at correcting this omission.
-