

Evaluation of channels

Submitted to study group

Using aMethod proposed by Healey and Moore

Charles Moore **Avago Technologies**

March 8, 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)

3m and 5m cable channel Data

Provided by Mark Bugg, Molex

case	pulse gain	dibit gain	available Signal	implementation noise	ILD noise	Re-reflection Tx	Re-reflection Rx	Re-reflection Tx-Rx	total channel noise	NEXT 0	NEXT 1	NEXT 2	NEXT 3	FEXT A	FEXT B	FEXT C	PSXT	total noise	S/N	margin
Molex3m P1 RX0	357.017m	296.761m	79.057mV	5.230mV	3.057mV	2.925mV	3.290mV	2.030mV	5.731mV	0.693mV	0.973mV	0.578mV	0.785mV	1.466mV	3.010mV	0.674mV	3.747mV	8.616mV	9.176	7.222mV
Molex3m P1 RX1	351.357m	292.650m	77.962mV	5.193mV	2.980mV	2.938mV	2.762mV	1.988mV	5.394mV	0.874mV	0.774mV	0.867mV	0.875mV	1.456mV	1.126mV	2.946mV	3.866mV	8.427mV	9.252	7.205mV
Molex3m P1 RX2	345.259m	279.147m	74.365mV	5.072mV	2.766mV	2.660mV	3.134mV	1.981mV	5.336mV	0.484mV	0.551mV	0.776mV	1.022mV	2.924mV	0.876mV	1.230mV	3.608mV	8.198mV	9.071	6.680mV
Molex3m P1 RX3	349.630m	280.643m	74.763mV	5.086mV	3.098mV	2.587mV	2.804mV	2.015mV	5.311mV	0.446mV	0.395mV	0.967mV	0.707mV	0.790mV	3.275mV	1.254mV	3.836mV	8.294mV	9.014	6.652mV
Molex3m P2 RX0	343.931m	296.947m	79.107mV	5.231mV	3.064mV	2.950mV	3.239mV	2.033mV	5.720mV	0.707mV	0.865mV	0.615mV	0.682mV	0.771mV	3.944mV	0.695mV	4.327mV	8.877mV	8.911	6.910mV
Molex3m P2 RX1	328.781m	240.187m	63.986mV	4.705mV	3.398mV	2.492mV	2.369mV	1.944mV	5.210mV	0.809mV	0.982mV	0.753mV	0.581mV	1.691mV	1.156mV	0.566mV	2.653mV	7.505mV	8.526	5.146mV
Molex3m P2 RX2	347.670m	286.203m	76.245mV	5.136mV	3.557mV	2.752mV	2.944mV	1.965mV	5.723mV	0.758mV	0.935mV	1.007mV	1.847mV	3.062mV	0.905mV	1.431mV	4.257mV	8.789mV	8.675	6.349mV
Molex3m P2 RX3	337.279m	266.592m	71.020mV	4.957mV	2.198mV	2.580mV	2.563mV	1.949mV	4.675mV	0.820mV	0.808mV	1.124mV	0.711mV	0.959mV	3.153mV	1.499mV	4.025mV	7.914mV	8.974	6.275mV
Molex5m P1 RX0	226.638m	168.567m	44.906mV	3.941mV	2.477mV	1.740mV	1.681mV	1.253mV	3.682mV	0.608mV	1.105mV	0.669mV	0.927mV	0.935mV	2.379mV	0.396mV	3.097mV	6.220mV	7.22	1.447mV
Molex5m P1 RX1	211.959m	146.277m	38.968mV	3.672mV	2.697mV	1.525mV	1.364mV	1.229mV	8.059mV	0.748mV	1.073mV	0.698mV	0.808mV	0.950mV	0.795mV	2.139mV	2.993mV	9.348mV	4.169	-7.528mV
Molex5m P1 RX2	225.886m	169.276m	45.095mV	3.950mV	2.516mV	1.754mV	1.693mV	1.245mV	3.718mV	0.627mV	1.050mV	0.832mV	1.501mV	1.688mV	0.496mV	0.773mV	2.852mV	6.128mV	7.358	1.889mV
Molex5m P1 RX3	227.288m	164.892m	43.927mV	3.898mV	2.119mV	1.560mV	1.437mV	1.269mV	3.255mV	0.666mV	0.563mV	1.112mV	0.694mV	0.431mV	1.843mV	0.783mV	2.583mV	5.698mV	7.709	2.561mV
Molex5m P2 RX0	237.481m	182.771m	48.690mV	4.104mV	1.736mV	1.666mV	1.955mV	1.284mV	3.356mV	0.866mV	1.000mV	0.489mV	0.826mV	1.190mV	1.701mV	0.486mV	2.687mV	5.943mV	8.192	3.553mV
Molex5m P2 RX1	228.405m	170.953m	45.542mV	3.969mV	2.337mV	1.571mV	1.700mV	1.256mV	3.521mV	0.896mV	0.791mV	0.511mV	0.553mV	0.999mV	0.736mV	1.554mV	2.439mV	5.840mV	7.798	2.800mV
Molex5m P2 RX2	226.578m	164.237m	43.753mV	3.891mV	2.174mV	1.409mV	1.820mV	1.250mV	3.404mV	0.605mV	0.786mV	0.650mV	1.001mV	1.869mV	0.621mV	1.085mV	2.732mV	5.847mV	7.483	2.128mV
Molex5m P2 RX3	231.957m	174.481m	46.482mV	4.010mV	1.916mV	1.497mV	1.775mV	1.276mV	3.270mV	0.608mV	0.566mV	0.975mV	0.599mV	0.452mV	1.860mV	0.870mV	2.534mV	5.761mV	8.068	3.240mV

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

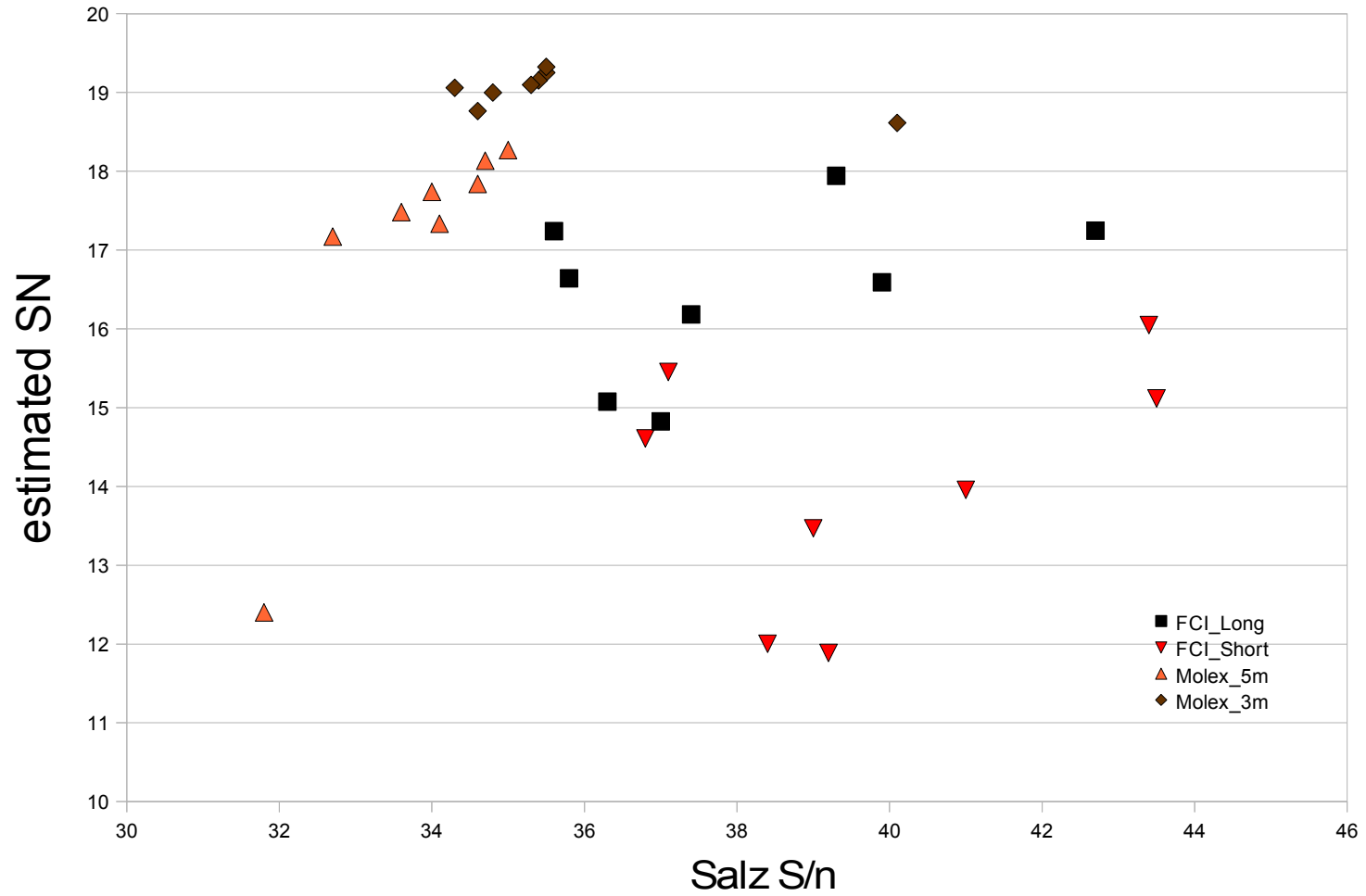
margin column, if positive, additional noise which can be added and still meet BER<1·10⁻¹²

Backplane channel Data

Provided by Vittal Balasubramanian FCI

case	pulse gain	dibit gain	available Signal	implemen tation noise	ILD noise	Re- reflection Tx	Re- reflection Rx	Re- reflection Tx-Rx	total channel noise	FEXT A	FEXT B	FEXT C	NEXT 0	NEXT 1	NEXT 2	NEXT 3	PSXT	total noise	S/N	margin
FCL_CC_Long_Link_Pair_1_1_to_Pair_3	314.124m	260.748m	69.463mV	4.902mV	5.738mV	4.031mV	4.031mV	1.915mV	8.313mV	0.542mV	2.089mV	0.803mV	1.068mV	1.984mV	0.581mV	0.857mV	3.384mV	10.226mV	6.79	-2.645mV
FCL_CC_Long_Link_Pair_1_2_to_Pair_4	308.984m	255.279m	68.006mV	4.850mV	5.805mV	4.223mV	4.223mV	1.897mV	8.542mV	0.542mV	0.121mV	1.330mV	0.726mV	0.389mV	0.400mV	1.409mV	2.214mV	10.069mV	6.75	-2.803mV
FCL_CC_Long_Link_Pair_1_4_to_Pair_6	317.609m	264.194m	70.381mV	4.934mV	4.494mV	3.993mV	3.993mV	1.932mV	7.471mV	2.089mV	0.121mV	0.288mV	1.380mV	1.376mV	2.142mV	0.721mV	3.656mV	9.671mV	7.28	2.577mV
FCL_CC_Long_Link_Pair_1_5_to_Pair_7	303.600m	247.443m	65.919mV	4.775mV	8.063mV	4.705mV	4.705mV	1.903mV	10.626mV	0.803mV	1.330mV	0.288mV	0.714mV	0.498mV	0.546mV	1.935mV	2.701mV	11.959mV	5.51	-7.425mV
FCL_CC_Long_Link_Pair_1_to_Pair_9	314.995m	259.367m	69.095mV	4.889mV	5.219mV	3.847mV	3.847mV	1.949mV	7.787mV	0.614mV	0.879mV	0.481mV	1.068mV	0.726mV	1.380mV	0.714mV	2.337mV	9.487mV	7.28	2.558mV
FCL_CC_Long_Link_Pair_2_to_Pair_10	305.179m	249.477m	66.461mV	4.795mV	7.441mV	4.808mV	4.808mV	1.923mV	10.261mV	0.614mV	1.534mV	0.162mV	1.984mV	0.389mV	1.376mV	0.498mV	2.997mV	11.716mV	5.67	-6.924mV
FCL_CC_Long_Link_Pair_5_to_Pair_13	313.278m	259.527m	69.138mV	4.891mV	6.591mV	4.205mV	4.205mV	1.948mV	9.089mV	0.879mV	1.534mV	0.270mV	0.581mV	0.400mV	2.142mV	0.546mV	2.930mV	10.729mV	6.44	-4.293mV
FCL_CC_Long_Link_Pair_8_to_Pair_16	315.884m	259.679m	69.178mV	4.892mV	3.923mV	3.648mV	3.648mV	1.903mV	6.755mV	0.481mV	0.162mV	0.270mV	0.857mV	1.409mV	0.721mV	1.935mV	2.704mV	8.768mV	7.89	4.462mV
FCL_CC_Short_Link_Pair_1_1_to_Pair_3	715.205m	670.946m	178.740mV	7.863mV	21.929mV	14.269mV	14.269mV	9.181mV	31.183mV	2.236mV	6.769mV	2.387mV	1.921mV	2.796mV	1.025mV	1.619mV	8.467mV	33.255mV	5.38	-21.442mV
FCL_CC_Short_Link_Pair_1_2_to_Pair_4	699.904m	653.814m	174.176mV	7.762mV	23.485mV	15.944mV	15.944mV	8.477mV	33.642mV	2.236mV	0.628mV	3.767mV	1.538mV	0.652mV	0.689mV	2.231mV	5.275mV	34.927mV	4.99	-24.624mV
FCL_CC_Short_Link_Pair_1_4_to_Pair_6	724.223m	680.134m	181.188mV	7.917mV	16.838mV	14.697mV	14.697mV	9.425mV	28.362mV	6.769mV	0.628mV	1.017mV	2.513mV	2.313mV	2.848mV	1.027mV	8.251mV	30.580mV	5.93	-16.469mV
FCL_CC_Short_Link_Pair_1_5_to_Pair_7	678.791m	627.484m	167.162mV	7.605mV	32.261mV	17.530mV	17.530mV	8.063mV	41.477mV	2.387mV	3.767mV	1.017mV	1.425mV	0.857mV	0.839mV	2.670mV	5.614mV	42.541mV	3.93	-35.279mV
FCL_CC_Short_Link_Pair_1_to_Pair_9	709.388m	663.499m	176.756mV	7.820mV	19.258mV	14.366mV	14.366mV	8.905mV	29.375mV	2.410mV	3.703mV	1.904mV	1.921mV	1.538mV	2.513mV	1.425mV	6.128mV	31.010mV	5.7	-18.159mV
FCL_CC_Short_Link_Pair_2_to_Pair_10	683.881m	634.038m	168.906mV	7.644mV	31.486mV	17.855mV	17.855mV	8.243mV	41.193mV	2.410mV	4.858mV	0.701mV	2.796mV	0.652mV	2.313mV	0.857mV	6.650mV	42.421mV	3.98	-34.965mV
FCL_CC_Short_Link_Pair_5_to_Pair_13	710.976m	666.745m	177.621mV	7.839mV	26.155mV	16.508mV	16.508mV	8.914mV	36.174mV	3.703mV	4.858mV	1.211mV	1.025mV	0.689mV	2.848mV	0.839mV	7.008mV	37.671mV	4.72	-27.948mV
FCL_CC_Short_Link_Pair_8_to_Pair_16	711.088m	661.846m	176.316mV	7.810mV	15.457mV	13.590mV	13.590mV	9.030mV	26.265mV	1.904mV	0.701mV	1.211mV	1.619mV	2.231mV	1.027mV	2.670mV	4.623mV	27.789mV	6.35	-11.980mV

estimated total SNR vs Salz SNR



Observations:

- The 5m cables from Molex appear to work, but the margins are thin and most likely, on board traces will need to be longer.
- One 5m channel fails badly. I am told that it is a known cable quality issue. Hopefully, it will be resolved before the spec is finished.
- Once again we see that short backplanes are not necessarily any easier than long ones. All of the backplane channels which “passed” are “long links”.
- For all the channels evaluated, in channel effects, ILD noise and re-reflections, were worse than crosstalk.
- We should be looking for channels which are near the boundary between “passing” and “failing”. The channels evaluated so far meet that, with some “passing”, with little margin, some “failing” by a little, and only a few “failing” badly and none passing with much margin.