Informative Back Plane Channel: Ad-hoc Recommendations

Abstract: This presentation covers the conference calls and work of the channel ad-hoc group between the March 2004 meeting and the May 2004 meeting, as well as recommendations for a starting point on how the 802.3ap working group should define an informative channel model.

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10G Back Plane Ethernet 802.3ap

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Outline

- 8 April 2004 Conference Call Highlights

- 22 April 2004 Conference Call Highlights

- 26 April 2004 Direction Perspective

- 5 May 2004 Conference Call Highlights

- 21 May 2004 Conference Call Highlights

- Informative Channel Six Mask Set Recommendations

- Further Work

- Outline of Work to Complete Before July 2004 Plenary

8 April 2004 Conference Call Highlights

- Consensus to follow CX-4 were possible.

- Consensus on the following Simulation Parameters:

  - AC Coupling, a few people opposed to removing DC options.

  - 100Mhz to 20GHz frequency range based on 3rd harmonic of 8b10b.

  - 12.5Gps worst case signal rate to handle 8b10b contingencies.

  - Board Impedance 100ohm +/-10%.

- Consensus to use 2-Port Differential Measurements. Discussed techniques for 2-Port Single- ended to 2-Port Differential for those people that have two port physical systems.

- Consensus to evaluate the channel in terms of SDD21 and not S21.

- Consensus on Channel Simulation Model TP1 – TP4 with ac coupling included at the receiver on the right side of TP4.

- No disagreement was raised for Joel Goergen to create and release a set of cards based on our starting channel point defined at the May Interim that would allow interested parties to compare findings with other members in a controlled and calibrated manor. Basically, a reference point.

- Concerns raised on the VNA setup (IF BW, sampling, and launch power), as well as calibration for two port single-ended measurements.

22 April 2004 Conference Call Highlights

- Consensus verified on the Simulation Channel Model TP1 – TP4.

- Consensus on the following Additional Simulation Parameters:

  - Assume RX/TX terminations are ideal for now.

- Consensus to use an equation based SDD21 mask as informative in the channel model definition.

- Statistical Eye Method was discussed as a normative channel description, but most participants were uncomfortable specifying something like this before all the parameters of the code method, TX parameters, and RX parameters are known.

- Consensus was reached that it was the right direction to provide an equation based mask set for an informative model, while using a comprehensive equation based model as normative.

- An issue was raised regarding UL not being an international standards body. Until the research is complete, consensus was to continue with our current enhanced FR-4 definition.

26 April 2004 Direction Perspective

- This call was open to all members, but was not a conference call. My notes on the meeting were sent to the chair. The intent of the call was to discuss the direction we should take on the informative channel.

- The call focused on a channel definition that could be defined in the following manor:

  - Simple Compliance Method (Mask Approach)

  - S-Parameter Approach

  - Pulse Response Approach

- At the end of the call, it was clear a six mask approach as an informative channel model was the best way.

  - SDD21 Magnitude

  - SDD11 Magnitude

  - SDD22 Magnitude

  - Group Delay

  - NEXT Multi-Aggressor with open ends terminated

  - FEXT Multi-Aggressor with open ends terminated

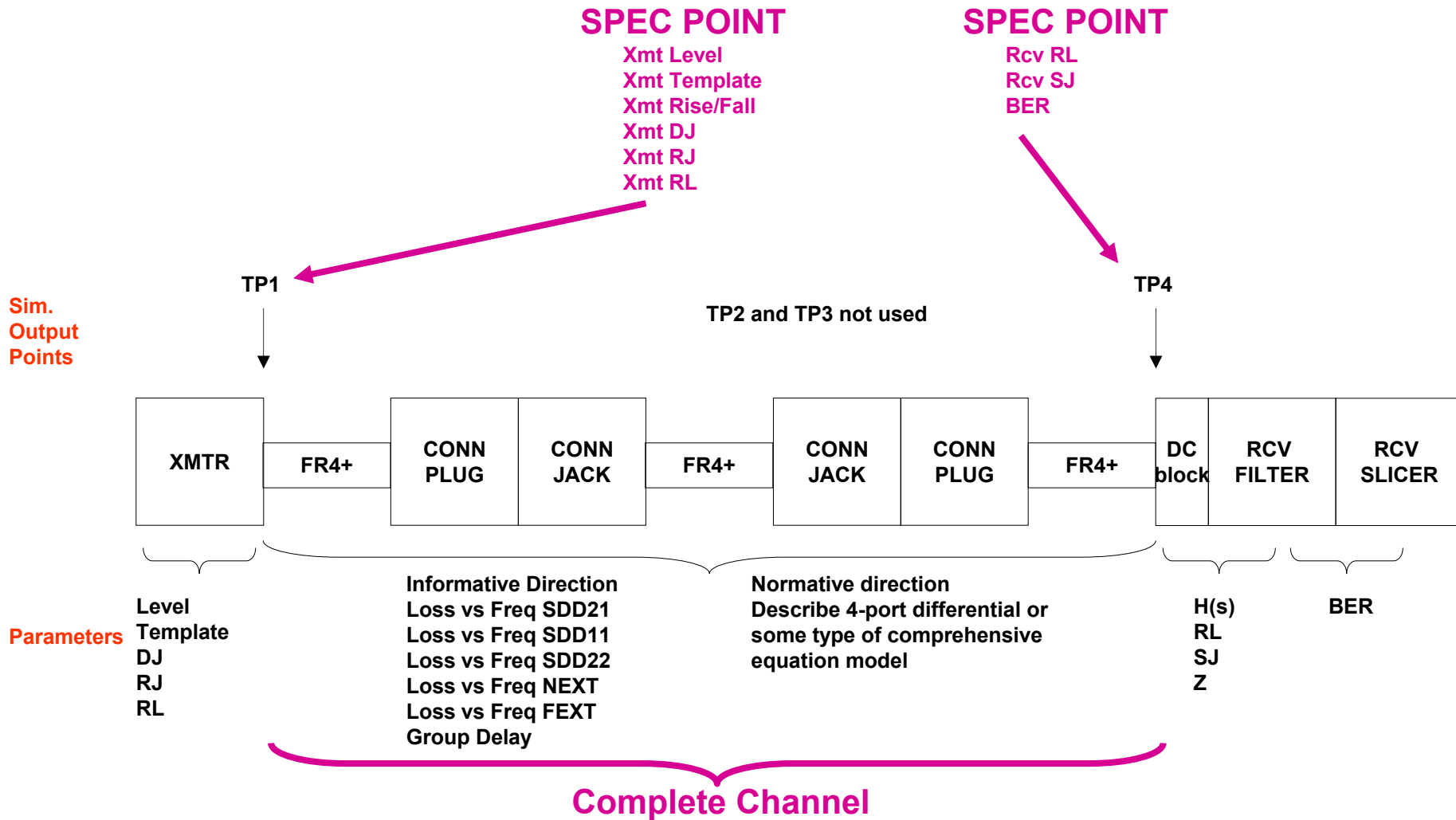**10G Back Plane Ethernet 802.3ap**

5 May 2004 Conference Call Highlights

- Graeme Boyd presented a paper on 2-Port Single-ended conversion to 2-Port Differential. Consensus was reached on this method with agreement that the conversion is dependent on loosely-coupled transmission lines, as well as termination precision.

- Consensus was reached to define the following informative masks:

  - SDD21 Magnitude

  - SDD11 Magnitude

  - SDD22 Magnitude

  - NEXT Multi-Aggressor with open ends terminated, similarly defined in CX-4, but not those exact constants. Jeff Cain contributed slides to show this.

  - FEXT Multi-Aggressor with open ends terminated, similarly defined in CX-4, but not those exact constants. Jeff Cain contributed slides to show this.

- Consensus to have one more call to define mask values and agree on a Group Delay concept.

21 May 2004 Conference Call Highlights

- John D'Ambrosia gave a presentation on SDD21 Magnitude values, discussed future work to understand how the channel is effected by packaging, and presented data regarding the effects of temperature and humidity to the SDD21 Magnitude.

- Consensus to devote an entire call to address packaging effects on the channel.

- Brian Seeman will present thoughts on combining NEXT and FEXT into a total aggregate effect at a future conference call.

- Consensus to use Joel Goergen's equation and constants contribution to the ad-hoc for the SDD21 Magnitude Mask.

- Consensus to use CX-4 Return Loss Equations defined in 54.7.3 as SDD11 and SDD22 Magnitude Masks.

    - There was considerable confusion with both SDD11 and SDD22 return loss defined in 54.6.3.5 from the transmitter and receiver point of view with the SDD11 and SDD22 defined in 54.7.3 from the channel point of view.

    - I believe most of us were thinking of the channel.

    - Zhi Wong's contribution on this matter referred to the silicon. His presentation points out the defined CX-4 equation crosses the 0dB line at 5Ghz. This will need to be addressed if these equations are used for a baseline from the silicon point of view.

- Consensus to use CX-4 NEXT Equations defined in 54.7.4 extrapolated to 20Ghz and lowered by 10dB as NEXT Magnitude Mask, based on contributions from Jeff Cain and Joel Goergen.

- Consensus to use CX-4 FEXT Equations defined in 54.7.5 extrapolated to 20Ghz and lowered by 10dB as FEXT Magnitude Mask, based on contributions from Jeff Cain and Joel Goergen.

- Consensus to use Jeff Cain's group delay contribution, but change the curve y-axis label to 'Group Delay Variation' and normalize it about zero as the Group Delay Mask.
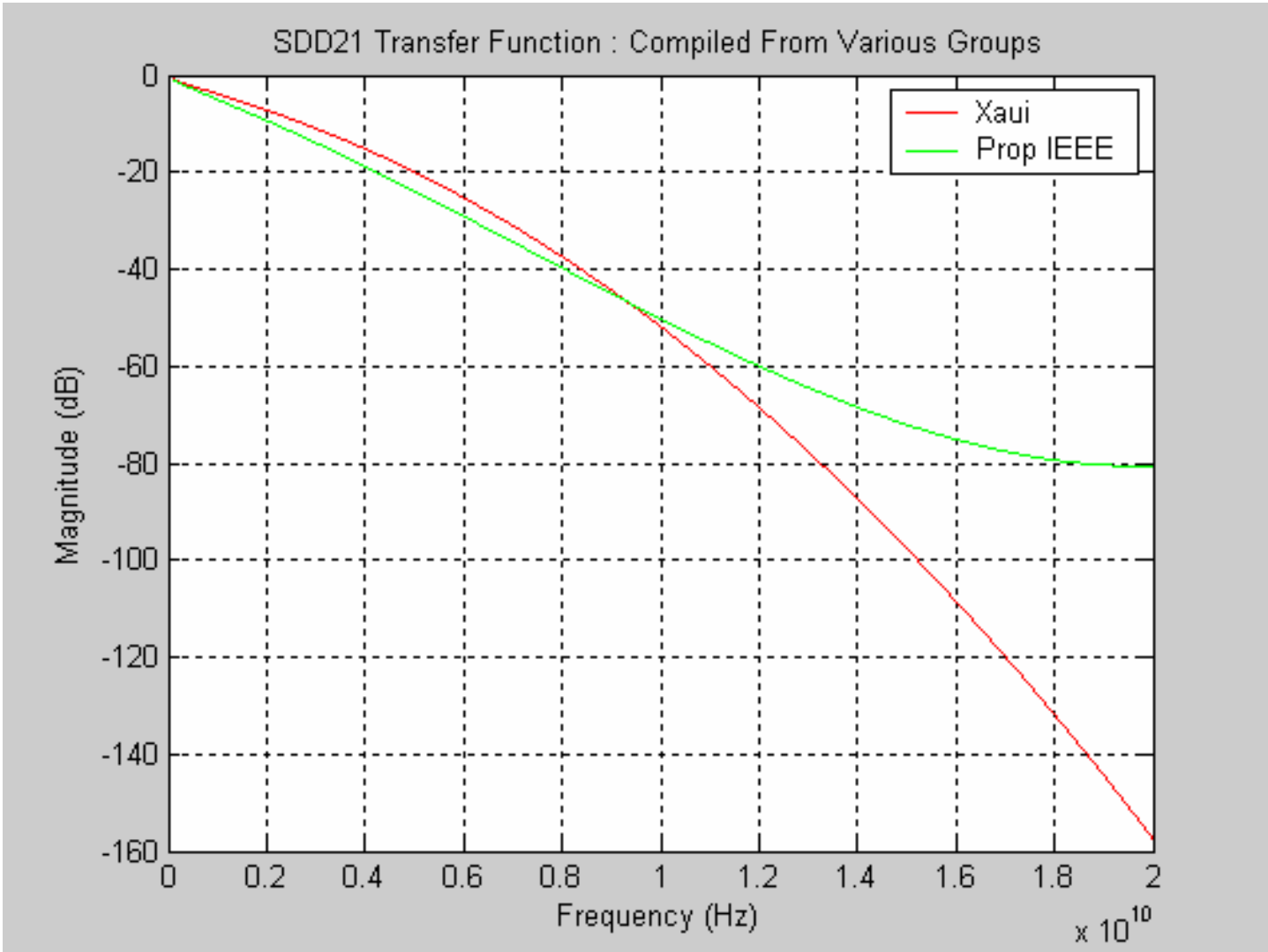
Proposed Model for Simulation

SPEC POINT
Xmt Level
Xmt Template
Xmt Rise/Fall
Xmt DJ
Xmt RJ
Xmt RL

SPEC POINT
Rcv RL
Rcv SJ
BER

Sim.
Output
Points

TP1

TP4

TP2 and TP3 not used

XMTR	FR4+	CONN PLUG	CONN JACK	FR4+	CONN JACK	CONN PLUG	FR4+	DC block	RCV FILTER	RCV SLICER

Informative Direction
Loss vs Freq SDD21
Loss vs Freq SDD11
Loss vs Freq SDD22
Loss vs Freq NEXT
Loss vs Freq FEXT
Group Delay

Normative direction
Describe 4-port differential or
some type of comprehensive
equation model

Level
Template
DJ
RJ
RL

H(s)
RL
SJ
Z

BER

Parameters

Complete Channel

SDD21 Channel Equation

- b1 = 6.5E-06

- b2 = 3.3E-10

- b3 = 3.2E-20

- b4 = 1.38E-30

- SDD21 = -20*log10(e)*(b1*sqrt(f) + b2*f + b3*f^2 - b4*f^3)

SDD21 Channel Magnitude Mask

SDD21 Transfer Function : Compiled From Various Groups

SDD11 and SDD22 Channel Equations

- ReturnLoss(f) ≥ 22.35 – 17.19xlog(f/100), f in Mhz

  - For 100Mhz ≤ f < 400Mhz
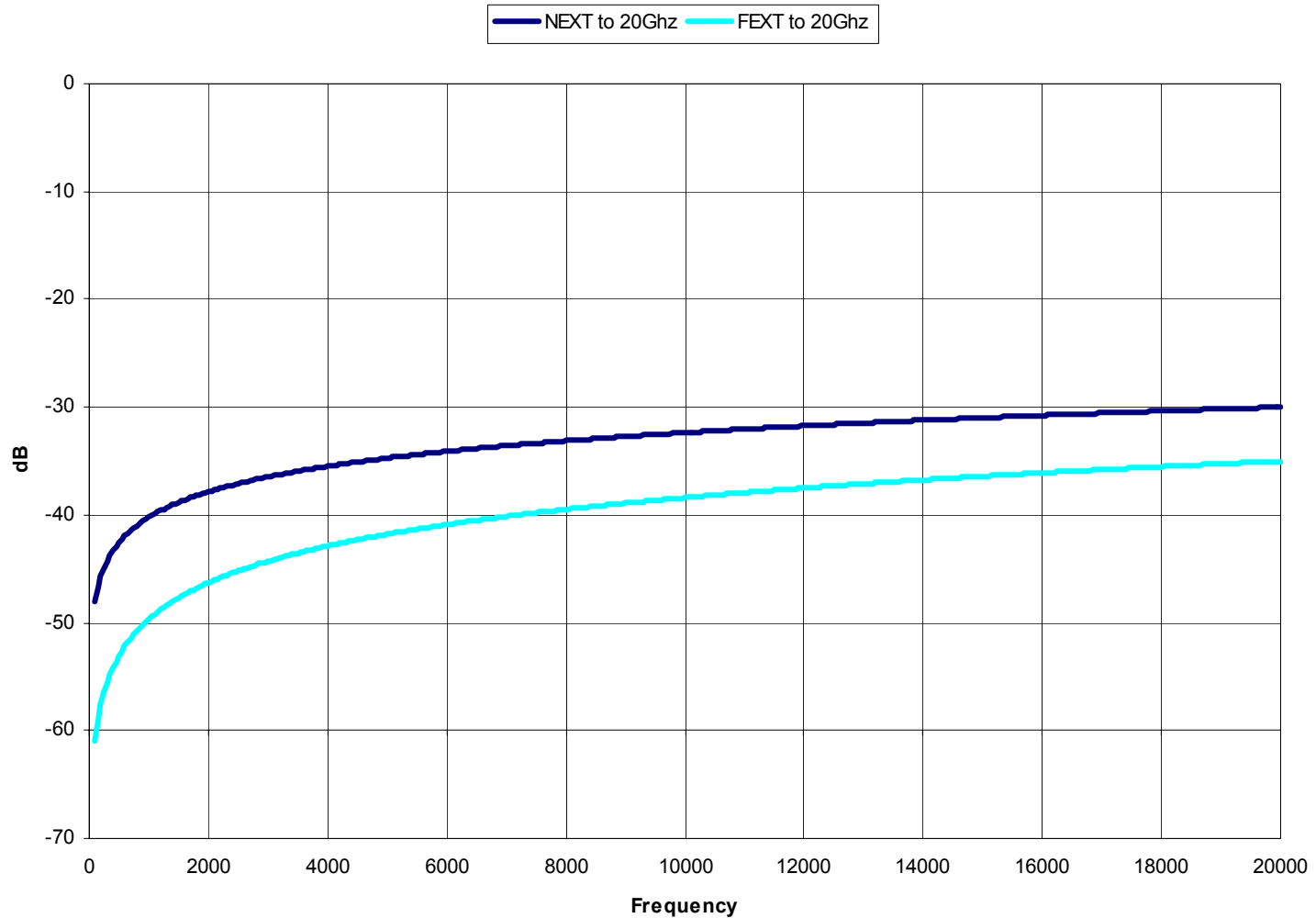
- ReturnLoss(f) ≥ 12

  - For 400Mhz ≤ f ≤ 20000Mhz

SDD11 and SDD22 Channel Magnitude Mask
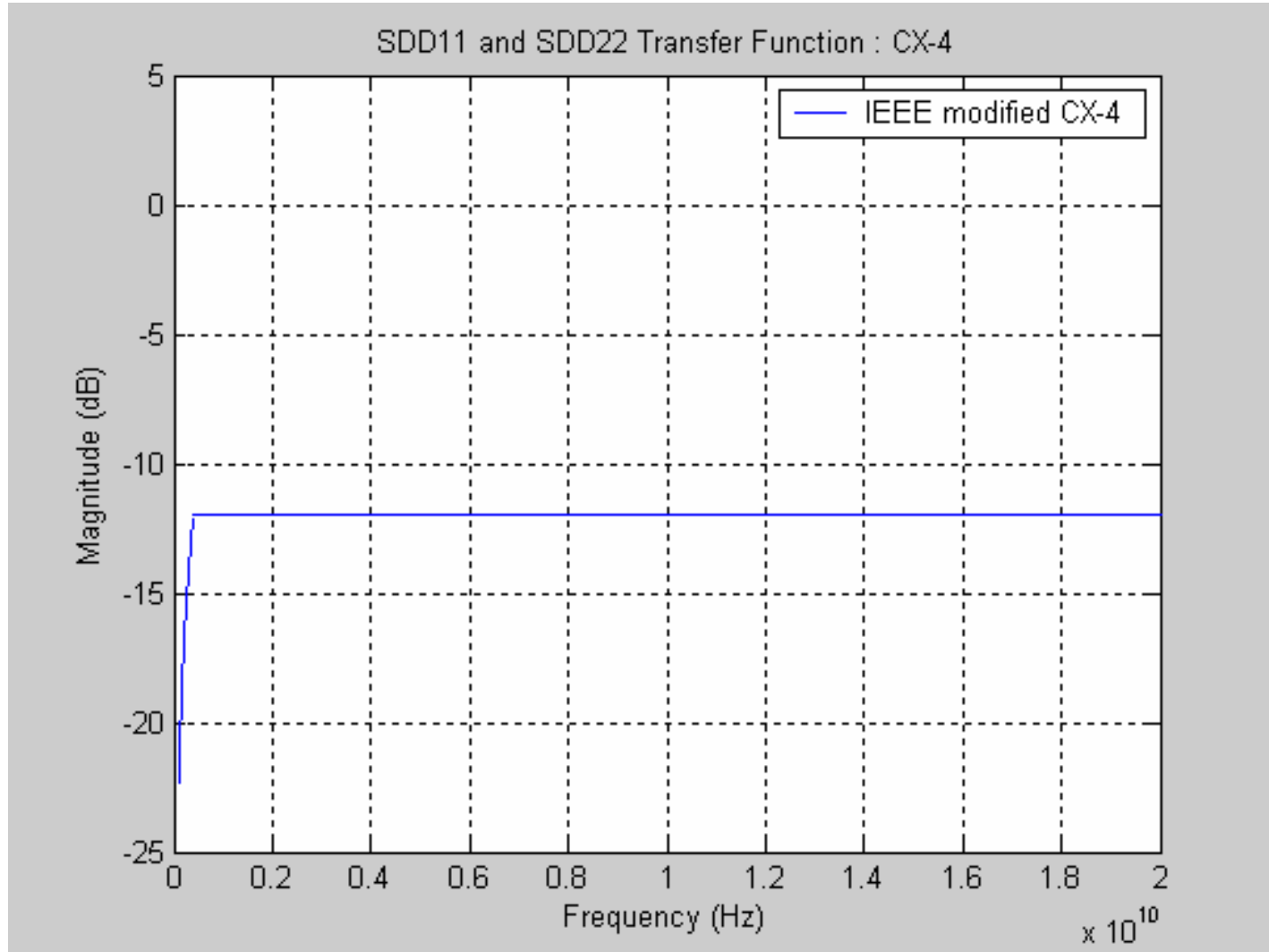
NEXT/FEXT Channel Equation

- NEXT to 20Ghz = 30-7.85*LOG(f/20000); f in MHz
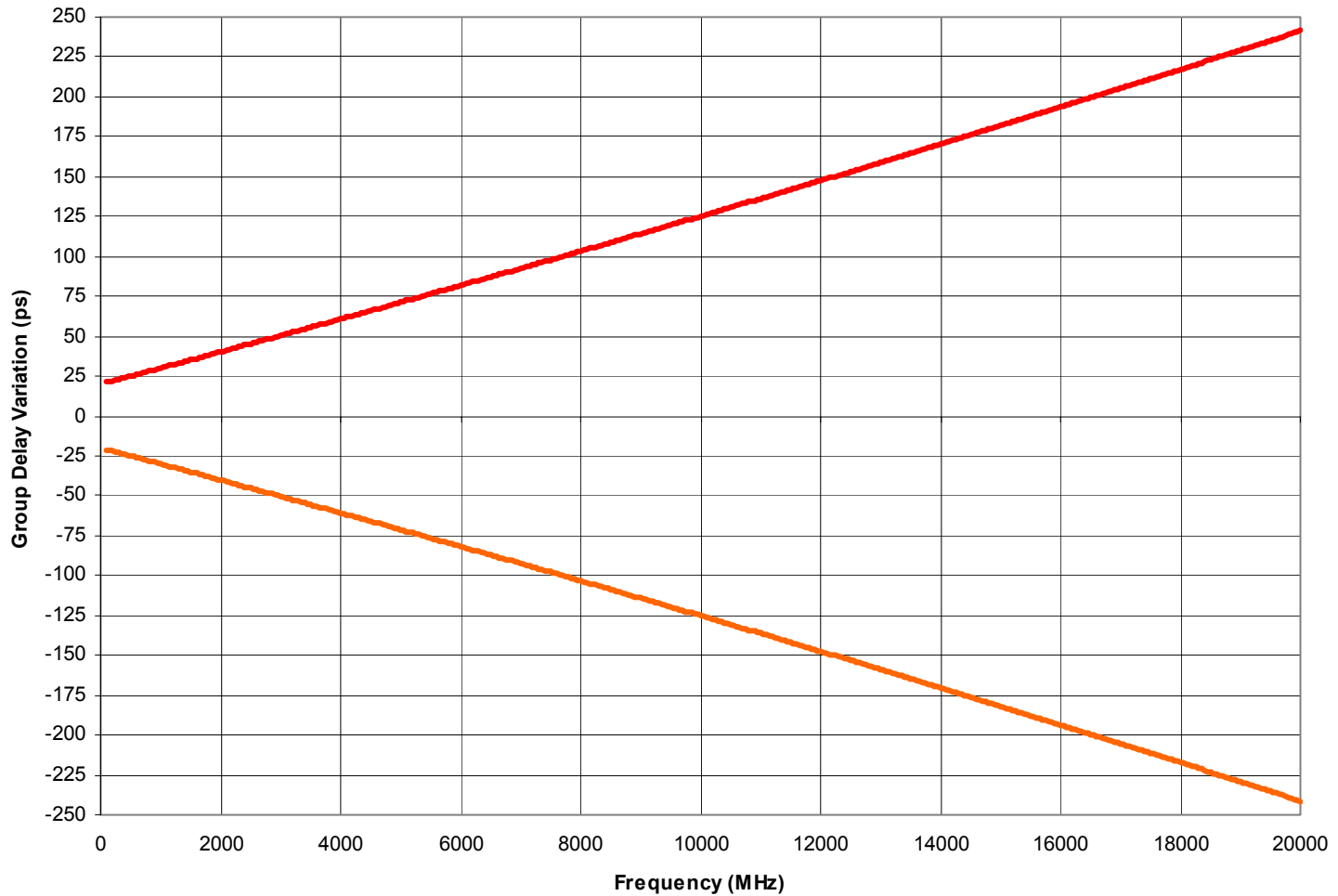
- FEXT to 20Ghz = 35-11.27*LOG(f/20000); f in MHz

NEXT/FEXT Channel Magnitude Mask

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Group Delay Equation

- Top Slope = 1000*(EXP(f/100000) - 0.98); in ps

- Bottom Slope = -1000*(EXP(-f/100000) -0.98); in ps

  - Bottom Slope based on 1000*(EXP(-f/100000) -1.02) and modified as above for symmetry.

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Group Delay Mask

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Further Work

- Verify known channels meeting 'Improved FR-4' material guidelines to SDD21, SDD11, and SDD22 proposed masks.

- Verify NEXT and FEXT masks. CX-4 shows FEXT with a higher limit then NEXT. We need to address why that was originally done.

- Verify Group Delay mask concept and gather data to support it.

- Devote at least one call to the effects temperature and humidity have on 'Improved FR-4' and the proposed six masks.

- Devote at least one call to the effects packaging will have on the proposed six masks.

- Develop and distribute a test and measurement board that meets close to the worst case of each mask, as well as the best cases possible. The intent is to establish confidence in presented data across presenters and various measurement equipment / techniques.

Outline of Work to Complete Before Next Plenary

- To be determined ….