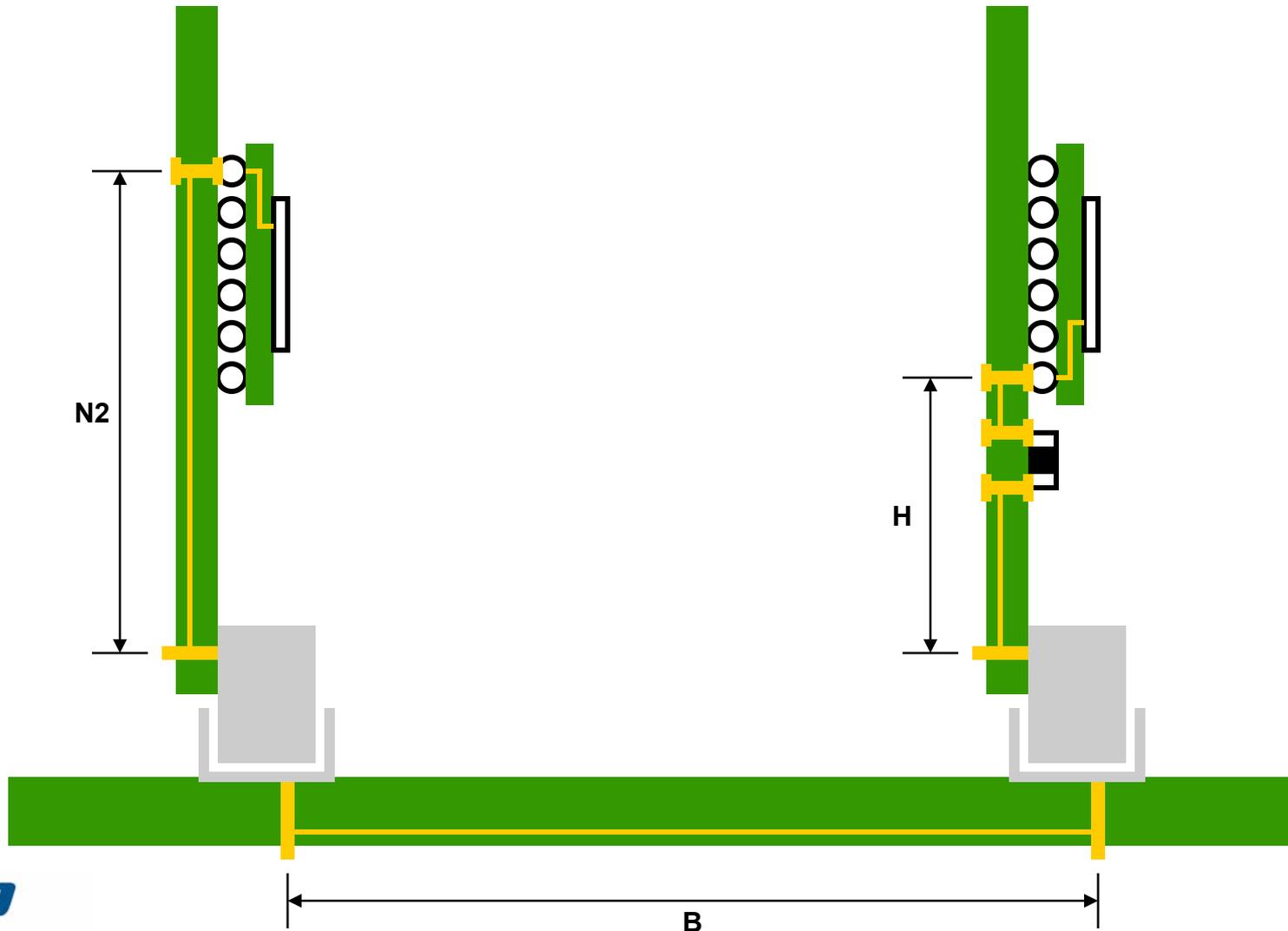


Channels for Consideration by the Signaling Ad Hoc

John D'Ambrosia Tyco Electronics
Adam Healey, Agere Systems

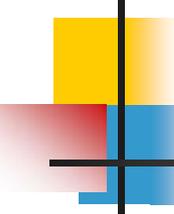
IEEE P802.3ap Signaling Ad Hoc
September 17, 2004

Two-Connector Topology



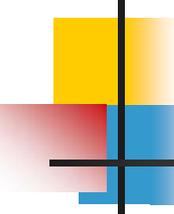
Topology Data

Description	N1	N2	B	H	Total	No. Connectors	AC / DC Coupling	Source
	(mm)	(mm)	(mm)	(mm)	(mm)			
Blade Server								
Proposed Worst-Case	76	102	533	127	838	3	AC	<i>koenen_01_0504.pdf</i>
ATCA								
Full Mesh (max)	0	127	533	127	787	2	AC	<i>(note 1)</i>
Switch / Router								
2 to 3 chassis/rack (min)	0	152	51	305	508	2	AC	<i>goergen_01_0304.pdf</i> <i>(note 2)</i>
2 to 3 chassis/rack (max)	0	152	559	305	1016			
5 to 8 chassis/rack (min)	0	127	51	229	406			
5 to 8 chassis/rack (max)	0	127	432	229	787			
					700	2	AC or DC	<i>mandich_01_0704.pdf</i>
					1000		AC	
ATCA Example (Star)								
min(B)	0	102	28	102	231	2	AC	<i>peters_01_0504.pdf</i>
max(B)	0	102	244	102	447			
<p>Note 1: From PICMG 3.0 R1.0 AdvancedTCA Specification, December 30, 2002 (8.4.2.1 and 8.2.4.3).</p> <p>Note 2: Based on LC-2/SF-2. For minimum values, fabric position is assumed to be in the middle of the line cards. For maximum values, fabric position is assumed to be at the top of the line cards.</p>								



Topology Observations

- Worst-case backplane trace length (B) is about 21" (533mm).
 - Applies to full-mesh and star applications where the hub cards are positioned at the top or bottom of the node cards.
 - This distance may be reduced by centering the hub cards.
 - Example: Tyco Electronics Dual-Star ATCA Backplane, B(max) = 9.8" (248mm).
- Wide range of variability in the expected trace length on node and hub cards.
 - N2 = 3" (76mm) to 6" (152mm)
 - H = 3" to 12" (305mm)
 - Median trace length is 6" (152mm).
 - Additional mezzanine connector and N1 = 3" for blade servers.
- AC-coupling is required by multiple applications.



Recommended Channels of Interest

- Objective: 1m of “improved FR-4”
 - 10” Line Card > 20” Backplane > 10” Line Card
- ATCA Full Mesh
 - 6” Line Card > 20” Backplane > 6” Line Card
- ATCA Dual-Star
 - 6” Line Card > 10” Backplane (with and without stub) > 6” Line Card
- Adjacent Slots
 - 6” Line Card > 1” Backplane (with stub) > 6” Line Card
- Variations of above scenarios based on different grades of “improved FR-4”

Summary of Proposed Test Cases

Test Case	Line Card		Backplane			Total Length	Comments
	Length	Material	Length	Material	Stub		
1	10" (254mm)	Nelco 4000 13SI	20" (508mm)	Nelco 4000 13SI	Bottom (or counter-boring)	40" (1016mm)	Channel Model <i>Tyco - Data to be available within 2 to 3 weeks</i>
2	10" (254mm)	Nelco 4000 13	20" (508mm)	Nelco 4000 13SI	Bottom (or counter-boring)	40" (1016mm)	Margin Test Case <i>Tyco - Data is available.</i>
3	10" (254mm)	Nelco 4000 6	20" (508mm)	Nelco 4000 13SI	Bottom (or counter-boring)	40" (1016mm)	Margin Test Case <i>Tyco - Data is available.</i>
4	6" (152mm)	Nelco 4000 13	20" (508mm)	Nelco 4000 13SI	Bottom (or counter-boring)	32" (812mm)	ATCA Full Mesh <i>Tyco - Data is available.</i>
5	6" (152mm)	Nelco 4000 13	10" (254mm)	Nelco 4000 13	Bottom (or counter-boring)	22" (558mm)	ATCA Dual Star <i>Tyco - Data is available.</i>
6	6" (152mm)	Nelco 4000 13	10" (254mm)	Nelco 4000 13	Top Layer (with stub)	22" (558mm)	ATCA Dual Star <i>Tyco - Data is available.</i>
7	6" (152mm)	Nelco 4000 13SI	1" (25mm)	Nelco 4000 13SI	Near Top-Layer (with stub)	13" (330mm)	Adjacent Slot <i>Tyco - Data is available.</i>

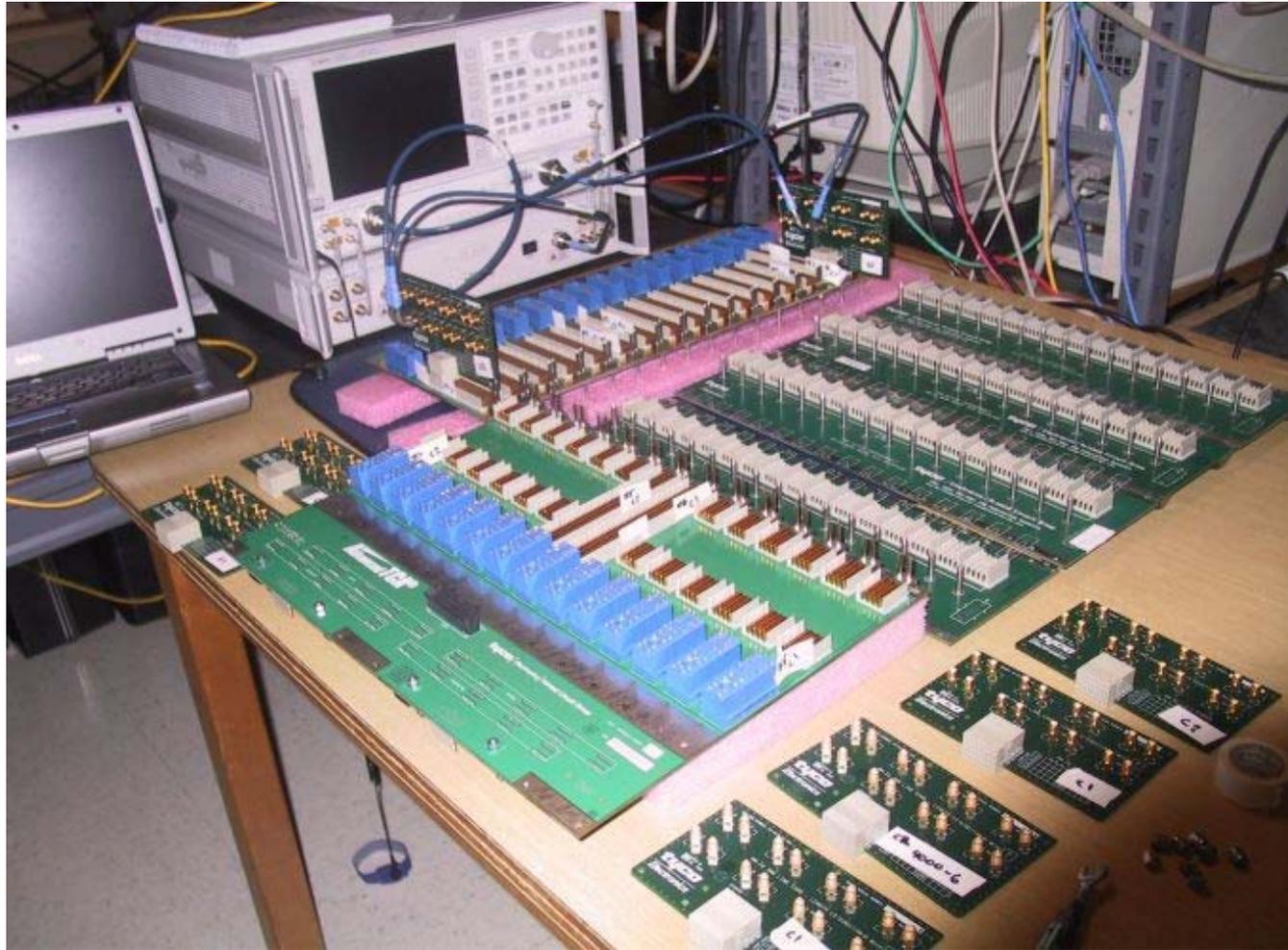
NOTE: Data for all test cases includes dominant, adjacent NEXT and FEXT aggressors.

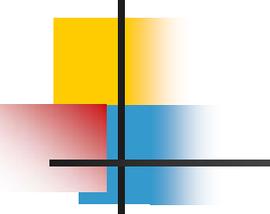
Testing

- All measurements taken by UNH
 - Agilent 8720ES with N4418A test set ---
 - Also known as the Agilent N1951A 20GHz Physical Layer Test System (S/N US0020201)
 - Cals are SOLT (short open load thru) to 26GHz cal set into 50ohm loads at the end of SMA cables.
 - No de-embedding of the line cards was attempted/included at all.
 - Equipment Settings done in accordance with Ad Hoc Guidelines where possible
 - IF BW – 300 Hz
 - Launch Power - -5 dBm
 - Averaging – was not supported with equipment / software, being investigated
 - Time constraints limited use of smaller IF BW, but some data was gathered and will be reported on
 - Testing Cases2 – 7 – week of 8/30/04
 - Testing Case1 – week of 9/13/04

- Thanks to Bob Noseworthy and Jeff Lapak, and everyone else there!

Test Setup @ UNH-IOL





Z-PACK HM-Zd Test Platforms

- ***Platform #1 – Kaparel ATCA Full Mesh Backplane***
 - Nelco 4000-13SI
 - 1” to 20” traces
 - Uses QuadRoute Technique
 - 0.125” thickness, 100 Ω Differential
 - 8 Signal layers throughout board
 - Validating use of “Improved FR-4”
- ***Platform #2 – Tyco ATCA Dual Star Backplane***
 - Nelco 4000-13
 - 1” to 10” traces
 - Uses QuadRoute Technique
 - 0.125” thickness, 100 Ω Differential
 - 4 Signal Layer throughout board
 - Validating use of “Improved FR-4”
- ***SMA Line Cards – All Platforms***
 - Nelco 4000-13, 4000-13SI
 - 6”, and 10” trace
 - 6 mil trace width, 100 Ω Differential
 - 0.092” thickness
 - 4 Signal layers throughout board
 - All boards for each material from same panel
 - “Improved FR-4” used

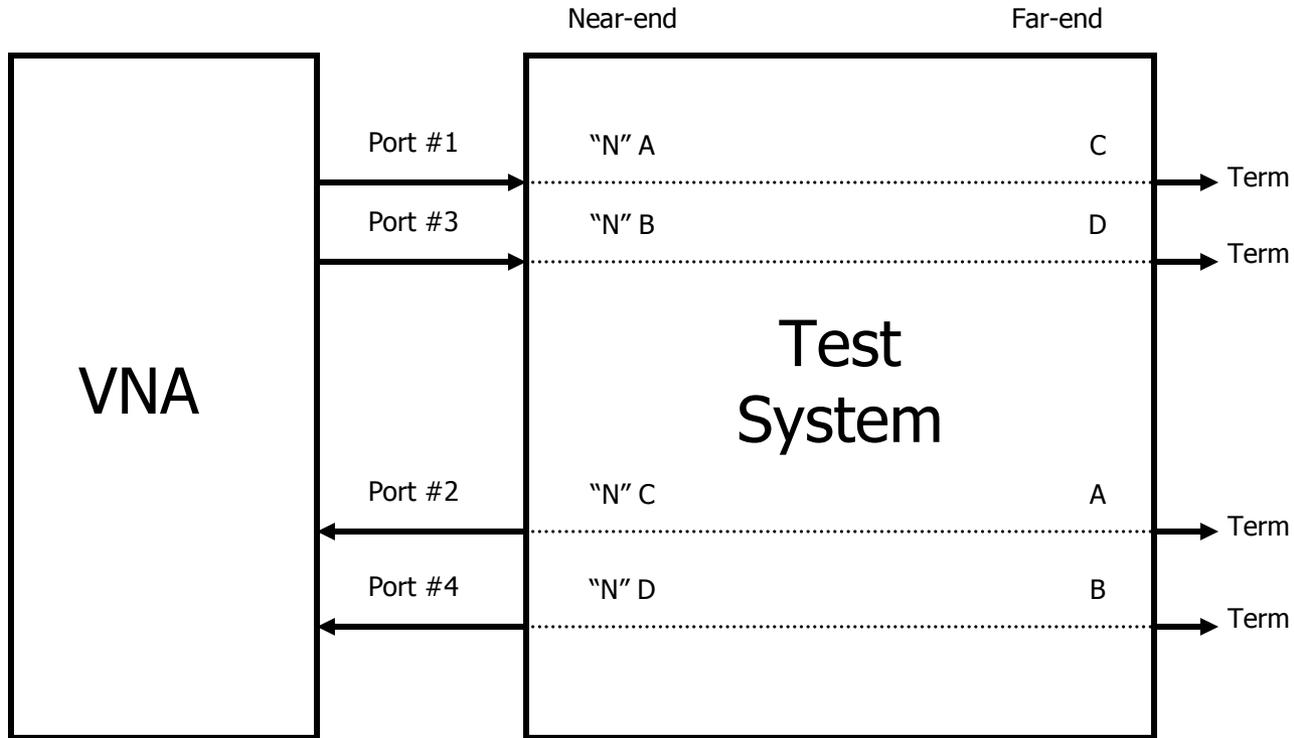
ATCA Pinout

	Pair A/B		GND	Pair C/D		GND	Pair E/F		GND	Pair G/H		GND
N-1	Tx+	Tx-	GND	Rx+	Rx-	GND	Tx+	Tx-	GND	Rx+	Rx-	GND
N	Tx+	Tx-	GND	Rx+	Rx-	GND	Tx+	Tx-	GND	Rx+	Rx-	GND
N+1	Tx+	Tx-	GND	Rx+	Rx-	GND	Tx+	Tx-	GND	Rx+	Rx-	GND

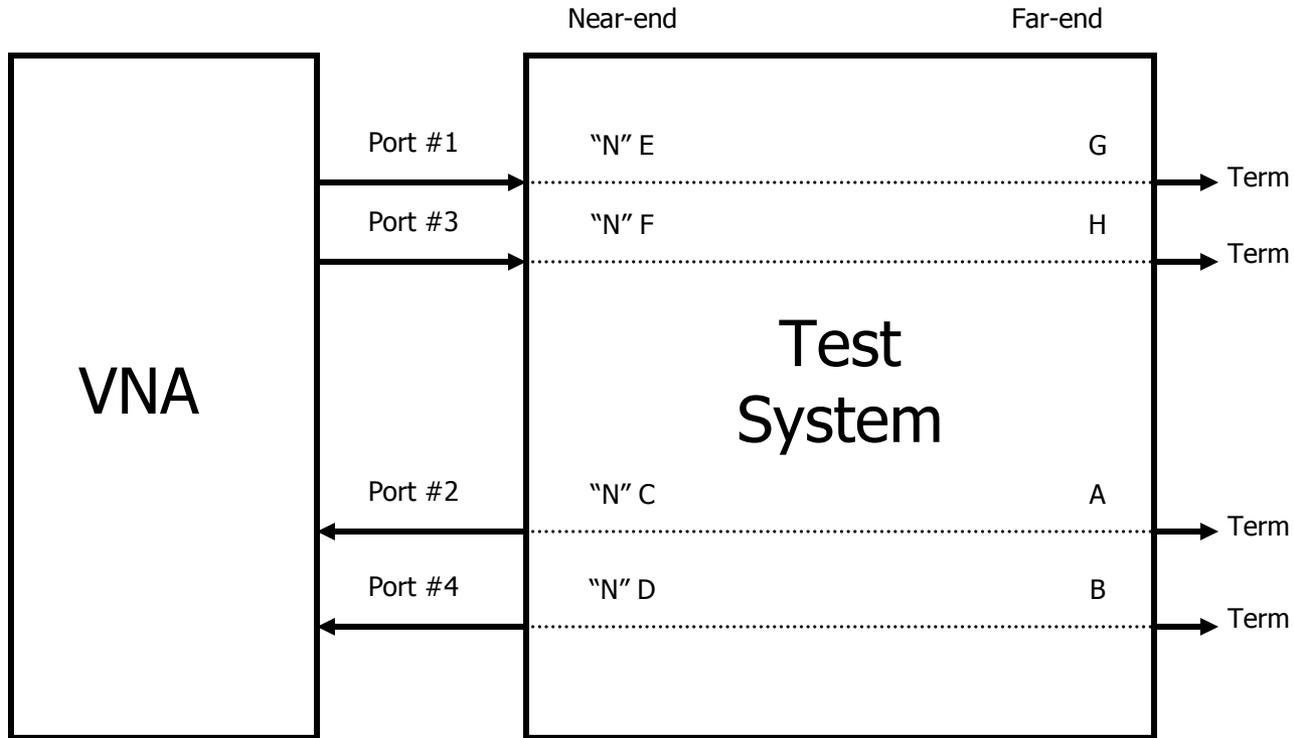
"N1"
"N2"

- Pair C/D chosen due to number of surrounding aggressors
- Direct adjacent aggressors are dominant
- Aggressors similar system length to victim
- NEXT Aggressors
 - Can not assume similar performance between
 - Pair A/B > Pair C/D ("N1")
 - Pair E/F > Pair C/D ("N2")
- FEXT Aggressors
 - Can assume similar performance between
 - "N-1" Pair C/D > "N" Pair C/D ("F")
 - "N+1" Pair C/D > "N" Pair C/D ("F")
- Line cards designed for different backplane pinout. Total system skew within pair not optimized between line cards / backplane. Investigating impact.
- For Test Case #6, "N2" does not exist. Pair E/F is a N/C on the line card.

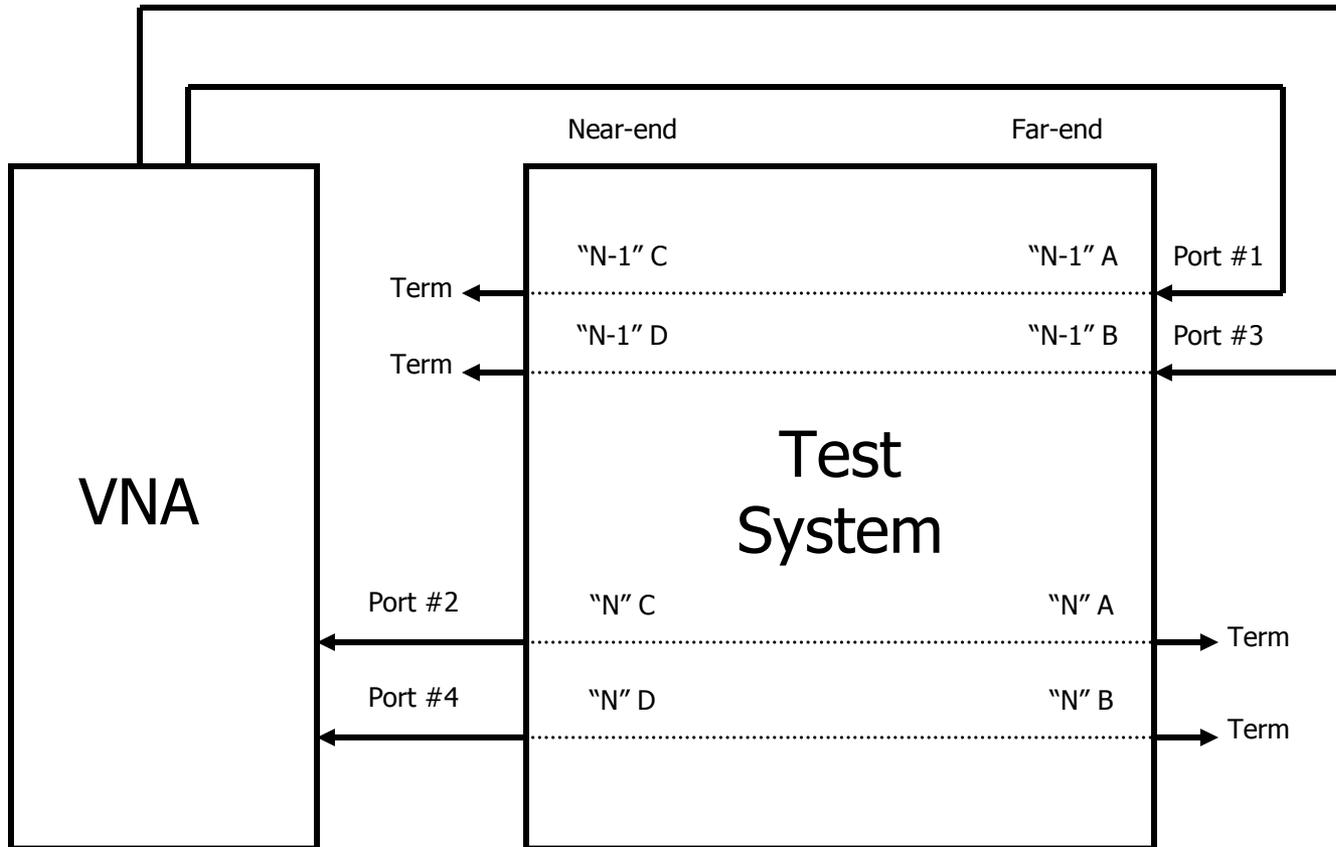
Crosstalk NEXT Aggressor "N1"



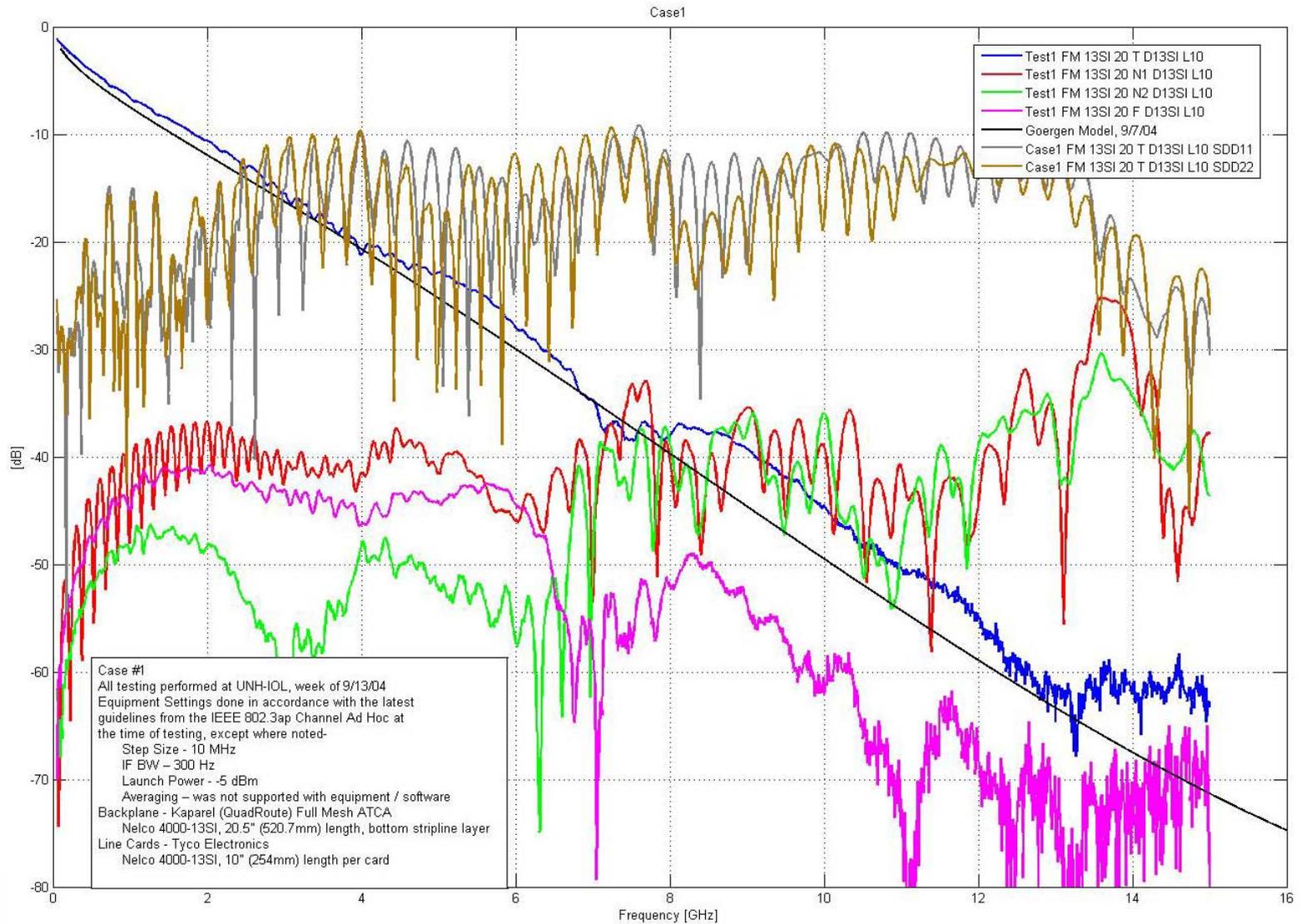
Crosstalk NEXT Aggressor "N2"



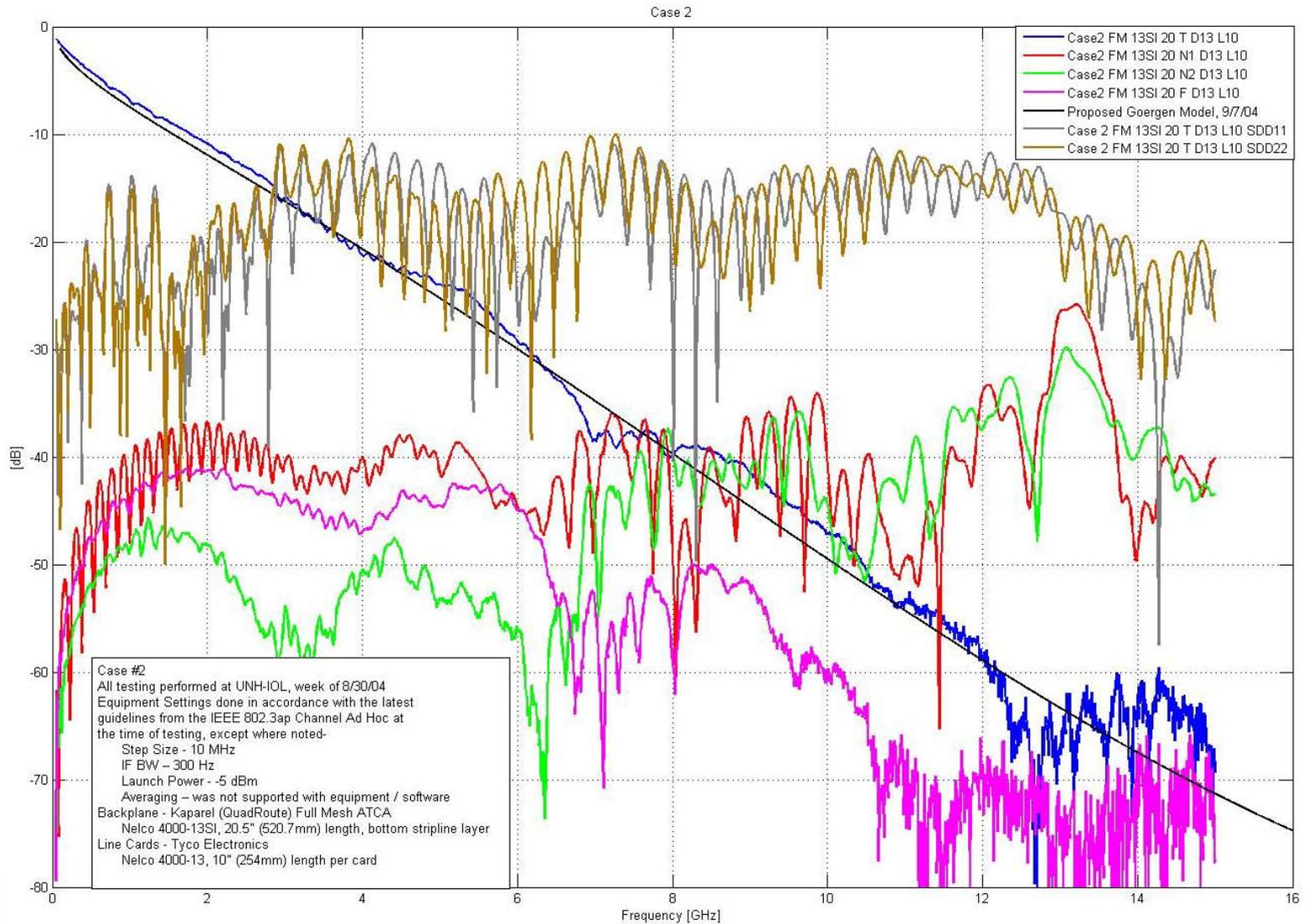
Crosstalk FEXT Aggressor



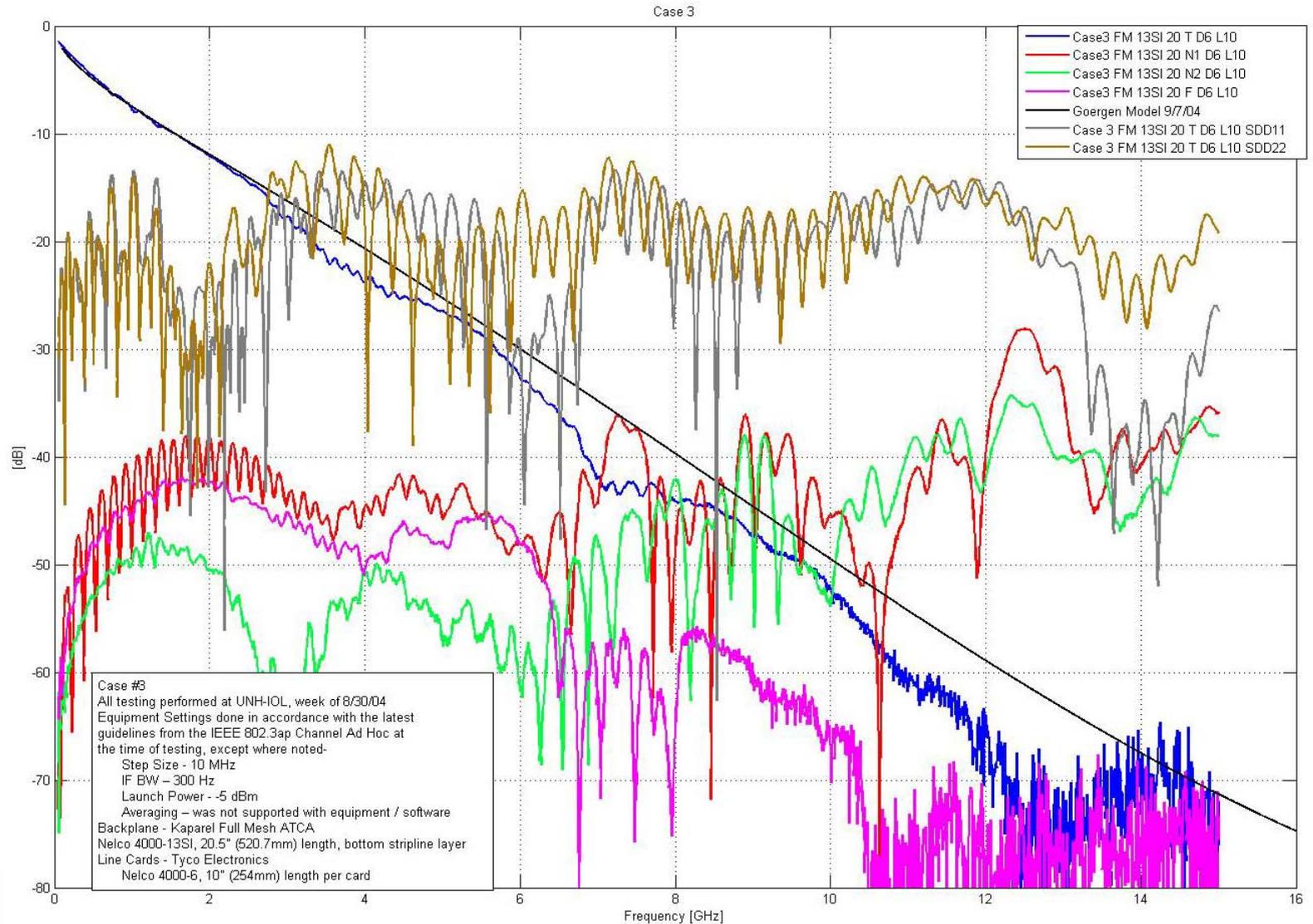
Case #1



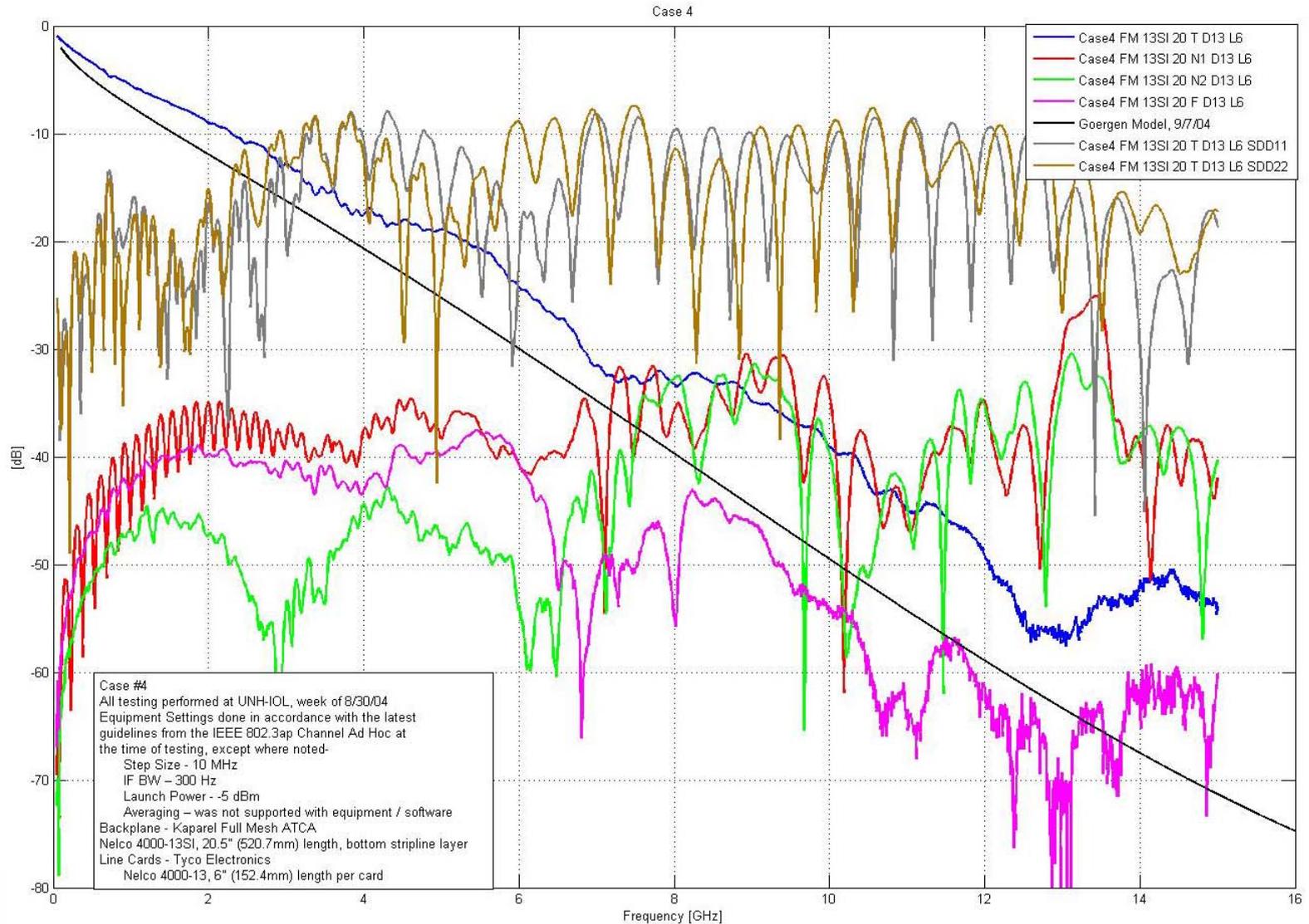
Case #2



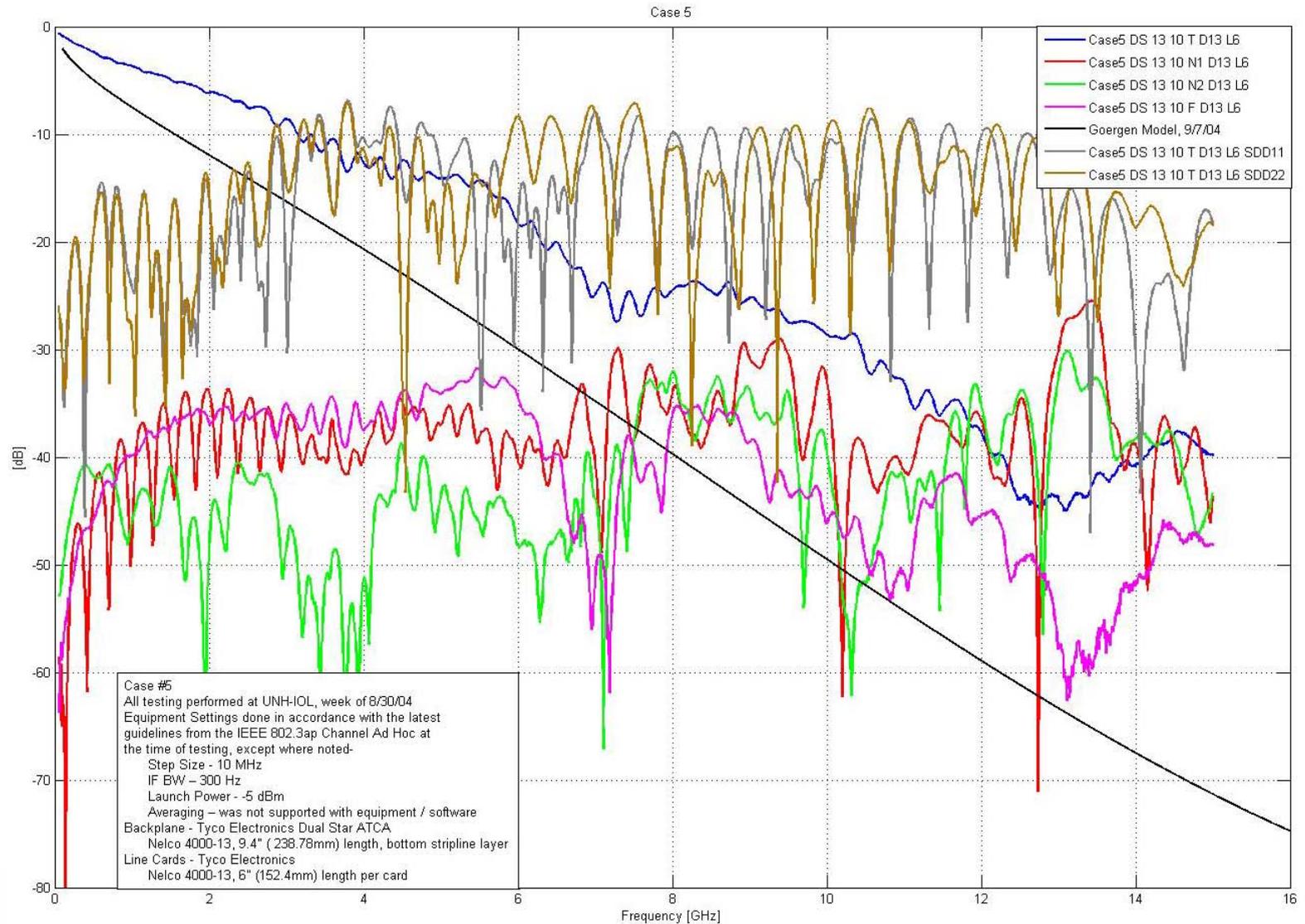
Case #3



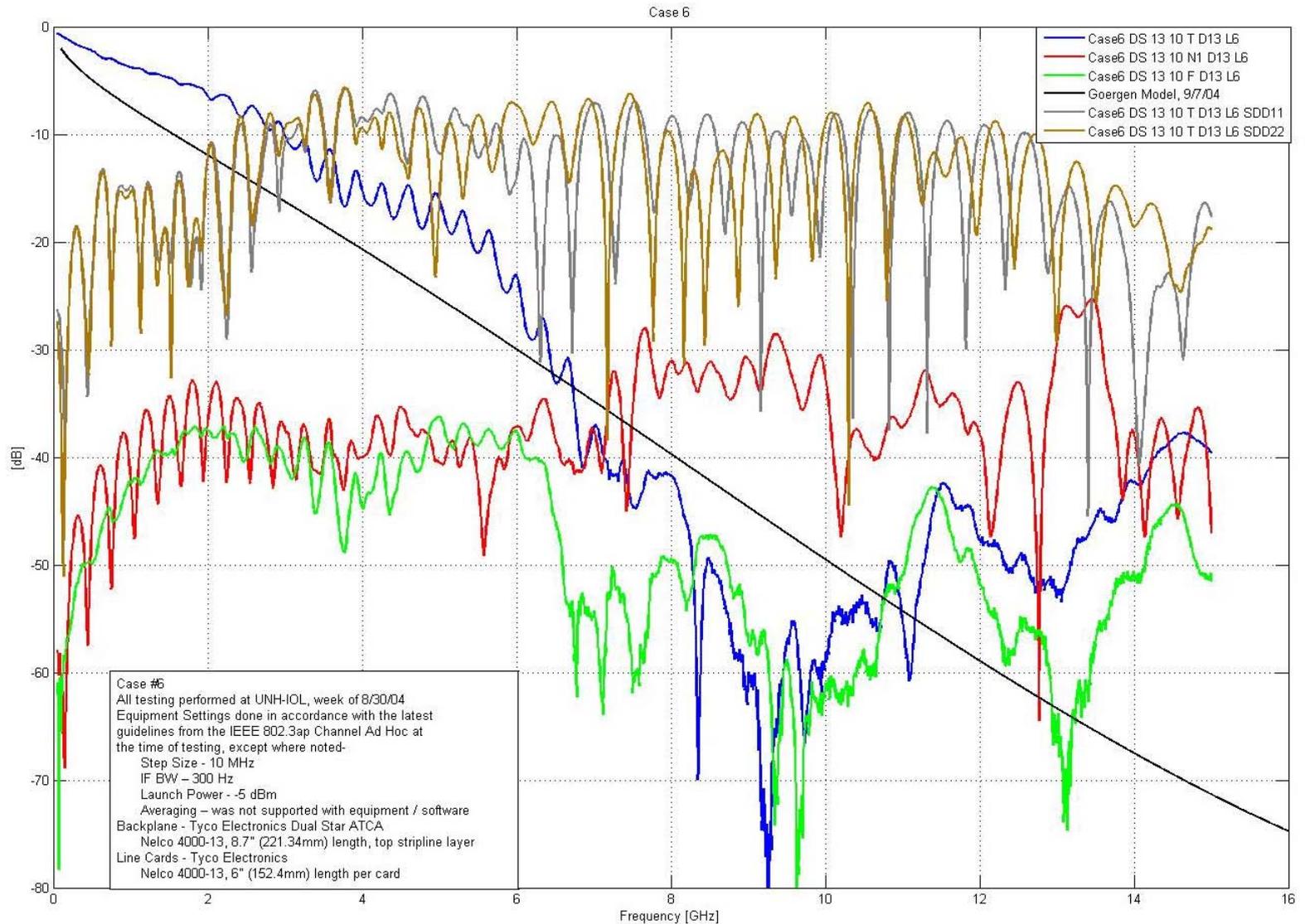
Case #4



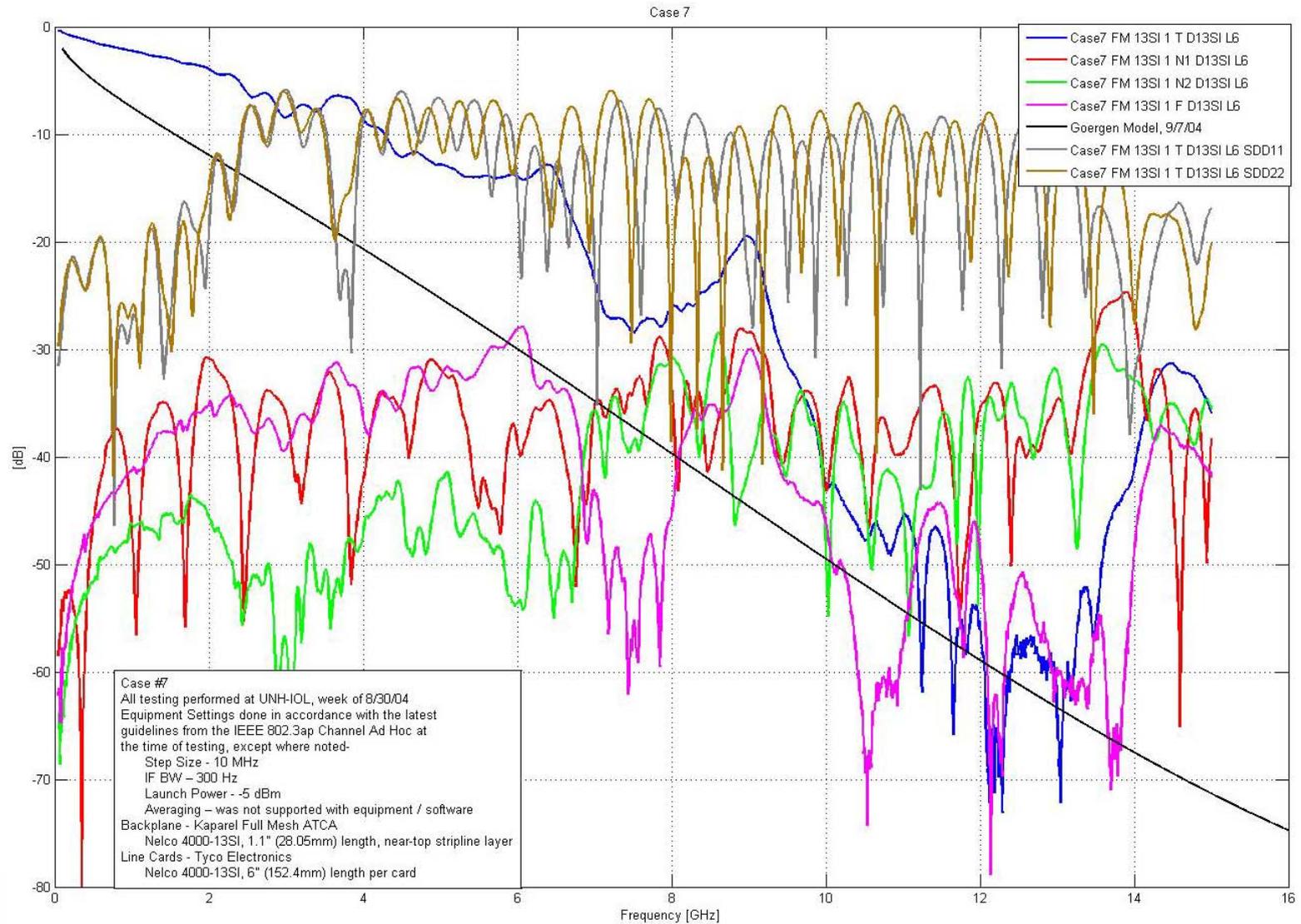
Case #5

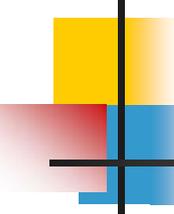


Case #6



Case #7





Additional Considerations

- Performance is implementation specific -
 - Forward channel
 - Return Loss
 - Crosstalk
- Stub Effects
 - Include even if they violate the channel model?
- Crosstalk
 - Different pin-outs.
- Return Loss
 - Good launch required to see difference.
 - Driven by line card layer connection with further peaking caused by backplane layer connection.
- Manufacturing and environmental variance